

The Gender-Energy Nexus in Eastern and Southern Africa

Editors

P.B. Mihyo and T.E. Mukuna



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Acronyms

AfDB	African Development Bank
AFREPREN	African Energy Policy Research Network
AIDS	Acquired Immune-Deficiency Syndrome
AMCEN	African Ministerial Conference on the Environment
AMEs	average marginal effects
CLDs	Causal Loop Diagrams
CLOUT	Centre for Livelihoods Opportunities Unlimited
CO ₂	carbon dioxide
COMESA	Common Market for Eastern and Southern Africa
CSA	Central Statistical Agency (Ethiopia)
CSOs	Civil Society Organisations
DFID	(UK) Department for International Development
DRC	Democratic Republic of Congo
ENERGIA	International Network on Gender and Sustainable Energy
FAO	Food and Agriculture Organisation of the United Nations
FDRE	Federal Democratic Republic of Ethiopia
GAD	Gender and development
GDP	Gross domestic product
GENEZ	Gender and Energy Network of Zimbabwe
GHG	Greenhouse gas
GNI	Gross national income
GNU	Government of national unity, Zimbabwe
GoK	Government of Kenya
GoZ	Government of Zimbabwe
GTP	Growth and Transformation Plan
GW	Gigawatt
HIV	Human Immune-Deficiency Virus
IEA	International Energy Agency
IGAD	Inter- Government Authority on Development
IMF	International Monetary Fund
IPCC	Inter-Governmental Panel on Climate Change
LHRC	Legal and Human Rights Centre
LPG	liquid petroleum (propane) gas
MAEs	marginal effects at the sample mean
MDGs	Millenium Development Goals
MEM	Ministry of Energy and Mines (Tanzania)
MEPD	Ministry of Energy and Power Development

MEPIP	Ministry of Economic Planning and Investment Promotion
MIGESADO	Swahili acronym for, Biogas Projects in Dodoma
MNL	multinomial logistic
MoFED	Ministry of Finance and Economic Development, Ethiopia
MW	Megawatt (unit of electric energy)
NBPE	National Biogas Programme for Ethiopia
NEMA	National Environment Management Authority
NFA	National Forestry Authority
NGOs	Non-governmental organisations
NOCZIM	National Oil Company of Zimbabwe
NORAD	Norwegian Agency for Development Cooperation
OSSREA	Organisation for Social Science Research in Eastern and Southern Africa
PPP	public-private partnership
PRSP	poverty reduction strategy paper
PV	Photovoltaic
R&D	Research and Development
RE	renewable energy
REA	Rural Energy Agency of Tanzania
SADC	Southern Africa Development Community
SD	Sustainable development
SDGs	Sustainable Development Goals
SHHS	the Sudan Household Health Survey
SIRDC	Scientific and Industrial Research and Development Centre
SNPPR	Southern Nations, nationalities and Peoples Region of Ethiopia
SPSS	Statistical Package for the Social Sciences
SREP	Scaling-Up Renewable Energy Program
SSA	Sub-Saharan Africa
STERP	Short-Term Emergency Recovery Programme
TANESCO	Tanzania Electric Supply Company
UNDP	United Nations Development Programme
UNIDO	United Nations Industrial Development Organisation
URT	United Republic of Tanzania
WEC	World Energy Council
WHO	World Health Organisation
WID	Women in Development
ZERC	Zimbabwe Electrical Regulation Commission

About Authors

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INTRODUCTION

Paschal B. Mihyo

As global awareness about the impact of climate change on the environment and livelihoods increased, it became clear that the issue of energy was being discussed in terms of how climate change was impacting on hydroelectric sources of energy. Renewable energy sources began featuring highly on the research and policy agendas of international, regional and national institutions. The efforts to develop new alternative sources of energy have been spectacular as shown in some of the chapters in this book. But most of the efforts and results have failed to capture the voices and needs of women, thereby leading to a worry that the link between gender and energy is not being properly captured.

The first chapter on *the Gender–Energy Nexus in Sub-Saharan Africa: The Case of Zimbabwe* by Charles Mutasa gives an overview of energy policies of Zimbabwe. The chapter underlines five major points. First, if the design of these policies is not based on appropriate gender demand and supply analysis, it may fail to address the major energy needs of women which are different from those of men. Secondly, that women’s participation in the design and implementation of energy projects increases the possibility of integrating gender issues in the projects as demonstrated by a small hydroelectric project in Zimbabwe, which the author analyses pointing out lessons that can be learnt from it.

Third that contrary to what many planners think, women’s energy needs are not only limited to cooking but should be viewed from a wider perspective in terms of their productive and emancipatory needs. Fourth, it is argued in the chapter that rural electrification has a big potential for enabling women to attend local meetings, listen to radio and watch television, consequently becoming more informed, and eventually empowered. Thus, as active citizens and with improved access to energy, rural women become income earners as they are pulled into the monetary economy and acquire a new status in society, as they become capable of leading community projects. The author emphasises that their voices must be heard and heeded to by men. Fifth, notwithstanding the increasing availability of new modern technologies, certain traditions still make it difficult for rural women to be freed from gender-based energy burdens and be at par with their male counterparts.

The second chapter on ‘*Gender Nexus in Ethiopia: An Analytical Review*’ by Alemu Tolemariam and Dejene Mamo analyses the gender, energy and education policies of Ethiopia all of which are very focused and clear on how to bridge the gender gap in access to energy and other opportunities. The authors note that in spite of this, the energy policy is very generic and current policy measures on energy appear to be gender-neutral. In policy debates and discussions, gender issue are left to lower ranking female staff

from the various stakeholder institutions, which indicates the lower priority and importance assigned to this area and prevents consideration and implementation of the gender mainstreaming policy. They argue that any analysis of the implementation of the extent to which gender is mainstreamed in policy is made difficult because there is a general lack of gender-disaggregated data at the relevant ministries and this makes it difficult to know about their operations, or even the activities and programmes they implement.

The authors also point out the major weaknesses of the gender and other policies which make it difficult to mainstream gender. They include: lack of clear guidelines on what is to be done to eliminate gender disparities; lack of clarity about the explicit structural and systemic constraints to attaining gender equality and equity in energy access; failure to tackle the property rights system, income disparities between men and women and household decision-making power which adversely and disproportionately impacts on women regarding access to and control over productive economic resources including energy; and strict adherence to least cost criteria to energy supply while ignoring the fact that socio-cultural dynamics can only exacerbate the incidence of energy poverty already experienced by women.

In the third chapter, Henry Michael Kigodi and Japhace Poncian write on *'The Energy-Gender Nexus in Tanzania: Assessing Rural Electrification in the Context of Gender Mainstreaming among Women'*. The chapter focuses on strategies undertaken by the Rural Energy Agency (REA) to electrify rural Tanzania, in the context of gender mainstreaming in energy projects, as well as its viability in resolving gender-energy challenges experienced by rural women. The authors argue that although from policy documents it seems government takes gender issues seriously, most policy implementers on the ground were unaware of the issues of gender or how to mainstream them into the rural electrification plans and processes. According to the authors, this implies that there is more gender mainstreaming on paper than in policy practice. Secondly they argue that patriarchal practices that marginalise rural women are still entrenched in rural Tanzania to the extent that rural electrification may only end-up lighting rural Tanzania but may not contribute to fundamental changes required in altering complex and multiple energy challenges that women face. Third they found out that high costs of energy and limited energy choices have not been addressed and will remain major issues that challenge rural electrification. They conclude that without involving women in planning and implementation of rural electrification programmes, gender issues will remain unresolved.

The fourth chapter entitled *'Towards a Gender Transformation? A Critique of Gender Mainstreaming in Energy Policy in Kenya'* by Moses Adama Osiro critically examines Kenya's energy policies. He argues that in Kenya, access to and ownership of resources is mediated by gender relations, and the sexual division of labour between men and women within households

predominantly assigns to women the bulk of household energy services provision. He argues that women are the main collectors, producers and users of household energy and much of the energy that women use is not fuel energy but metabolic energy applied to everyday tasks, such as firewood and water collection, and carrying crops to storage facilities at harvest time, which in most cases could be substituted by mechanical or electrical energy. He calls for a broader framework which recognises that far from being just a women's problem (as the cooking problem has been seen in the past), the gender-energy nexus should be seen as a societal problem, which needs to be dealt with taking into account the social relations between men and women, and the expectations and roles of both men and women, as regards energy. This, according to the author, calls for a better understanding of the differences in the ways men and women use energy in various cultures and locations in order to be able to promote greater gender equity and the empowerment of women, as well as enhance the effectiveness of energy projects, poverty programmes, and overall sustainable development activities.

The author argues further that gender issues are missing from all the major policies touching on energy in Kenya because the focus is on the commercialisation of energy resources and the major emphasis is on mainstream sources of electric power. This approach leaves very little room for the needs of the traditional sectors to be addressed by energy policies, programmes and projects. The author doubts the extent to which rural electrification in Kenya will address the needs of the poor communities. According to him, the rural electrification programme is driven by the urge to "modernise" the traditional rural sector as it targets provision of basic infrastructure targeting market centres, public secondary schools, youth polytechnics, health centres, and water systems. He acknowledges the importance of these programmes and their potential to address gender issues; but he asserts that 'the speed with which these programmes are to be rolled out obviates the messy participatory approach that would be necessary to undertake comprehensive gender analyses and develop concomitant monitoring and implementation frameworks to ensure gender equitable outcomes'.

Chapter five on '*Community Perspectives in the Demand, Availability and Accessibility of Energy Resources: A Case Study of Sinceni on Deforestation*', by Londiwe Dumsile Hlophe and Musa M. A. Dube explores the causes and effects of deforestation in Swaziland and measures taken by communities to control it. They assert that in Swaziland, approximately 80 per cent of the population lives on public or national land (communal land), and depends on wood fuel for cooking and heating. In the rural areas of the country, communities collect food, firewood, medicinal plants, and construction materials directly from the forest. In a Swazi household, women and children are responsible for collecting firewood. The magnitude to which a household relies on and utilises forest resources is dependent on the household's demographic and economic

characteristics, and other factors such as markets, prices and technology. The authors argue that the high rate of unemployment in Swaziland has led to an increase in the business of selling firewood and that rapid demographic change, constant droughts, livestock and agricultural expansion, cultural practices and lack of proper regulatory systems combine to impact negatively on the rate of deforestation in the country and rapid rates of deforestation are worsening energy poverty.

Chapter six by Anna Wawa on the '*Gender Equity and Household Decision-making in Alternative Energy Technology Adoption: The Case of Access to Biogas in Central Tanzania*' assesses the extent to which household decision-making factors affect technology choices and adoption of new technologies in Central Tanzania. The author asserts that since 1975, Tanzania has been at the forefront in promoting the use of alternative renewable energy sources, such as biogas, in order to reduce excessive dependence on wood fuel at the household level. She asserts that the Tanzania Domestic Biogas Programme was launched to support the development of domestic biogas in order to increase access to energy in rural areas to support services in agriculture, health, sanitation, gender, and environment and the hope is that biogas will uplift the dignity of women and improve their health, lessening their workload by saving time consumed for firewood collection. She notes, however, that women's rights to access energy are constrained by intra-household decision-making, women's social position and low value attached to women's labour. Unequal gender relations limit women's ability to participate and voice their energy needs in decision-making at all levels of the energy system. She concludes that this factor has reduced the impact of biogas on gender roles in Tanzania's society and that due to domestic level decision-making, which is controlled by men, biogas technology has so far not been adopted by a larger part of the population.

Chapter seven by Yahia Omar Adama on '*Cooking Fuel in Sudan: Utilisation Patterns, Health Hazards and Clean Fuel Adoption*' examines the dependence of the majority of the people in Sudan on biomass for cooking and heating and policy initiatives by government to reduce that dependency. The author asserts that most households in Sudan depend on biomass as the main source of energy and income-generation and the bulk of forest utilisation for biomass occurs in the dry and semi-dry areas, which have more than one-quarter of the country's forests and as a result deforestation has emerged as a policy issue. The author indicates that about 84 per cent of biomass fuel is consumed by the household sector in Sudan with firewood as the main source of energy for rural households and charcoal being used more by urban residents and the burning of firewood and crop residues using traditional inefficient stoves releases heavy smoke with toxic pollutants. This exposes women and children to health hazards and that is why the Sudan government invests in clean energy, such as electrification, gasoline, liquid petroleum gas, and fuel-efficient stoves programmes. The author gives account of other policy interventions in the

household's energy sector aimed at combating desertification and deforestation through influencing demand transition from woody biomass towards modern fuel options. The author notes, however, that such transition, aimed at reducing the pressure on forest resources, is conditioned by the adoption rate with little attention paid to demand characteristics of rural communities and fails to note that changes in the availability of energy due to policy interventions have different impacts on different gender groups. To substantiate this, the author points out that the adoption of modern fuels, such as LPG and electricity, which are clean, efficient and convenient is constrained by fuel costs and also by relatively high start-up costs of connection, availability of cooking utensils, stability of the supply source, and level of access which affect the capability of the majority of women to get access to these alternatives. The author concludes that if gender issues are taken into account when developing energy policies and household traits, including initial endowment, this may affect the adoption of modern fuels. The chapter ends with a call for a holistic approach in the design and implementation of energy policies.

Chapter eight by Betelhem Ephrem titled, '*Changing Challenges to Opportunity in Household Energy Demand: Women 'Tiftif' Makers*' is a case study of women '*tiftif*' makers in a selected sub-city of Addis Ababa. *Tiftif* is a flat pancake-like, local household energy source, made with a mixture of miniature charcoal, clay soil and water. It is an innovative source of energy that has been developed by women in Addis Ababa and other parts of Ethiopia which reduces excessive dependence on biomass; reduces the burden of women who every day search for and carry heavy loads of firewood and reduces carbon emissions. The author attempts to explore the implications of this innovation on women's access to and control over household energy in urban settings, which plays a crucial role in determining the economic and health status, living conditions and position of women in a society. The study also analyses the challenges women encounter due to the absence of easily accessible and affordable energy sources. The study focuses on women's issues, from their own perspectives, gives due recognition to women's coping mechanisms and problem-solving ability in the energy sector and provides significant evidence on policy gaps regarding national energy demand and distribution in relation to women's access to and control over household energy resources.

Chapter nine by Truphena Mukuna on '*Gender-Sensitive Clean Energy Technologies for Sustainable Development Amongst Pastoralist Maasai in Kenya*' introduces the policies and interventions adopted by state and non-state actors in supporting the development of alternative energy technologies in Kenya and their impact on gender needs of the Maasai women in pastoralist communities in Kenya. The author explains the energy and gender crisis, analyses gender roles in the energy perspective, conventional energy sources, climate change, renewable energy and sustainable development, the status of renewable energy in Kenya, the

effects of biomass use, and innovative gender-sensitive clean energy technologies that have been introduced. She argues that access to energy is a critical enabler for economic and social development and promotion of renewable energy technologies as it has the potential for reducing the cost of energy, providing communities with affordable energy, promoting productivity and helping in creating employment by empowering enterprises for both the rural and urban poor.

Mukuna further argues that renewable energy systems based on hydropower, modern clean biomass, geothermal, wind or solar energy can diversify energy supply, reduce energy imports and provide significant local and global environmental gains. And because of the gendered nature of energy poverty, access to modern, sustainable energy can also significantly enhance the empowerment of women by reducing their time and labour burdens, improving their health, and providing them with opportunities for enterprise and capacity enhancement. The author assesses the Kenya National Energy Policy and acknowledges its recognition of the importance of adoption of clean energy technologies for sustainable development; but, she argues that among the pastoralist Maasai in Kajiado and Narok Counties in Kenya, women have taken to charcoal burning and selling as an alternative source of livelihood to adapt to climate change and they also use the same biomass in their poorly ventilated houses to cook which exposes them to pollution and respiratory tract infections. According to the author, in spite of a large variety of renewable energy options that are environmentally friendly such as ‘jiko kisasa’, a Kenya brand of low fuel cooking stove, briquettes, rocket stoves, solar cookers and light gauge pots, these women lack capital to access these technologies or for initial installation of solar, wind pumps or electricity and the Kenya National Energy policy is silent about the plight of women who bear the brunt of energy poverty.

Chapter ten by Paschal Mihyo is about bridging the gap in gender-based energy needs in Kenya, Tanzania and Uganda. It identifies the differentiated energy needs of men and women at household and community levels, in meeting production and reproduction needs and responsibilities and their transformational and strategic needs. The author asserts that the needs of these gender groups are totally different but policies of the three countries do not make a clear distinction of each group’s needs. He examines the policies of the three countries and asserts that although some of them are more robust on gender issues than others, all are equally gender-blind, they pay more attention to grid-based energy sources and fossil energy and do not have adequate statistics on biomass consumption in terms of specific demand and supply patterns. They also allocate minuscule budgets to the development of biomass especially fuel wood although over 80 per cent of the people in these countries depend on firewood and charcoal.

The author notes that although the policies of these countries are clear on what needs to be done, they are less so on who should do what and under what arrangements; each of the policies expresses concern about climate change but in the strategies and guidelines there is no mention of what should be done to mitigate its impact on energy sources; each has a robust programme on renewable energy but it leaves most of the initiatives to social entrepreneurs, NGOs and donor-funded projects to extend access to alternative energy sources in remote areas where most of the poor, the majority of whom are female, live. Although municipal waste is ample in the urban areas of the three countries, contributing to health hazards, it is not harvested for use in generating energy on a large scale; there is a general scarcity of data on renewable sources of energy especially those used by the poor in the three countries; and in each of the three countries, regulatory systems are still very lengthy, rigid and bureaucratic, leading to some investors avoiding investing in renewable energy.

The author, while appreciating investments and initiatives of the three governments in trying to bridge the gender gap in the access to energy in rural and urban areas, argues that for these efforts to have an impact, there is need to develop energy programmes that will address and reduce problems women face in their social development, especially those relating to health, safety and security; their advancement needs such as education, political participation, organising and networking and training in entrepreneurship, policy development and management, and also interventions that increase their capabilities to develop, design, produce, install and manage these new alternative energy technologies.

CHAPTER ONE

The Gender-Energy Nexus in Zimbabwe

Charles Mutasa

Abstract

This chapter provides a brief background and current status of the gender-energy nexus, as it pertains to Zimbabwe, looking at the past, present and prospective policy priorities, projects and programmes. It begins by reviewing the various theories or frameworks that attempt to explain the challenges associated with women's access to and utilisation of different sources of energy. The chapter then discusses the relevance of gender theories in explaining linkages among gender, energy and development. Key to this is the analysis of how the new energy providers/stakeholders in Zimbabwe have factored in issues of gender equality, in their endeavour to revolutionise the energy sector. The chapter also looks at efforts both by government and non-governmental organisations to link energy and gender issues against a backdrop of a global village that is striving to achieve Sustainable Development Goals, including the attainment of the Millennium Development Goals. A rural micro-hydro electric project, which Practical Action and other non-governmental organisations in Zimbabwe are promoting as a pilot case project to illustrate how gender issues can be mainstreamed in energy planning and project implementation, is analyzed. Lessons and observations, which can be used elsewhere in Africa, are drawn from the case study. An important conclusion of the chapter is that although frantic efforts are being made to promote equal access and opportunities for women in energy supply and policy-making processes in Zimbabwe, a lot more can be done with more political goodwill and commitment, from both energy planners and political leaders. The use of participatory approaches and multi-stakeholder approaches is highly recommended for energy policymaking and project implementation.

Keywords: Gender mainstreaming, Gender equality, Energy planning, Development, Gender-energy nexus.

1. Introduction

Gender issues have come to the forefront in many development sectors, including agriculture, forestry and water, but the energy sector in Sub-Saharan Africa (SSA), including Zimbabwe, has been slow to acknowledge the link between and among gender, energy and development. Energy poverty remains widespread and gender inequality exists at every level of the energy sector. Limited access to energy has a disproportionate effect on women in general, and especially disadvantages them economically. The gender problems of energy in Zimbabwe are as complex and varied as in the continent itself. A lot of energy demand and supply analysis is required to address the gender shortfalls.

Although energy is a key factor in economic and social development, only less than 10 per cent of the rural population (mostly women) in SSA have access to modern energy services, with just over 20 per cent of the population connected to electric power supply (African Development Bank [AfDB] 2008). There has been little investment in alternative and renewable energy sources from the private sector, public sector and donor agencies. The ministries responsible for energy and power development have limited technical and research capacity to develop effective policy responses that can mainstream gender and adequately cover rural areas in the energy sector. As a result, energy provision across Africa remains one of the principal development challenges.

Despite the existence of new modern technologies, certain traditions still make it difficult for rural women to be freed from gender-based energy burdens. Limited access to energy is a problem that has meant women have to spend large amounts of time and physical effort to supply fuel for their households and productive needs, using their own labour to carry heavy loads over increasingly long distances, at great risk to their health and safety. As the World Bank (2010) observes, most African women dwelling in urban slum areas and rural areas still suffer or die from indoor air pollution from burning coal, wood and other traditional biomass fuels. Smoke from traditional cooking and heating methods contains dangerous amounts of toxic substances, and continues to increase cases of morbidity and mortality that contribute to respiratory diseases, cancer and eye problems. For instance, a study by Mills (2010) cites headaches, coughing and burning eyes as the main health problems associated with the use of wood fuel. Thus, because of its links with development, the energy sector requires a critical analysis of its gender aspects, within a wider market context. The lack of energy services is directly correlated with gender gaps and the major elements of poverty, including inadequate healthcare, low education levels and limited employment opportunities.

As the United Nations Development Programme [UNDP] (2011) notes, few women in Africa have access to electricity from national grid; even fewer have electrical appliances for grinding, cooking, food processing, fetching water, running small businesses such as mills, and food sales. They are forced to spend significant amounts of their time and energy on subsistence activities; and this is a barrier to gender development as it reduces the time available to them to contribute to other aspects of livelihood strategies. There are very few independent producers of electricity, just a handful of wind-powered schemes and small hydro-schemes, but the scale is insignificant, given the challenge. Millions of women cook with firewood, with about 70 per cent of households in both semi-urban and urban areas using firewood as a primary cooking fuel (Government of Zimbabwe [GOZ] 2010). Greater attention and analysis of these needs and concerns could help governments to promote overall development goals, such as poverty alleviation, employment, health, and education, through improved energy policies.

The need to balance the gender and energy aspects of sustainability cannot be over-emphasised, as these are also manifested in the World Energy Council

(WEC) goals of energy accessibility, availability and acceptability (WEC 2005). Gender-energy links are as essential as water and food for the survival and well-being of humankind. At the most basic level, energy provides cooked food, boiled water and warmth. Adequate energy supplies are vital for efficient functioning of all sectors of the economy. As UNDP (2011) argues, energy development with a gender lens is a prime mover for socioeconomic growth and development. It is one of the most essential inputs for sustaining people's livelihoods.

In SSA, gender mainstreaming is still relatively rare in energy activities and institutions. Energy sector policies and investments still need to focus on expanding women's business activities, through use of more energy-efficient processes and equipment. There is an urgent need for women to access new information technology, which enables them to use efficient types of fuels and equipment, and in turn allows them to increase their profitability, productivity and entrepreneurship. This chapter, using Zimbabwe as a case study, argues that issues of women's access to renewable energy should not be divorced from the important gender arguments for social equity and human rights. Women are already active energy change agents, at both household and community levels. What they need is to be financially resourced and availed space in energy policymaking and planning.

The major objective of this chapter, therefore, is to initiate both policy dialogue and action among development practitioners working in the energy and gender spheres. It explores the usefulness of having energy specialists and planners integrate their work with gender analysts. It argues that women are essential contributors to the social and economic wellbeing of their families, as well as the general energy and economic development; but currently their work is less valued than men's. The nature, extent and impact of women's work can remain invisible if there is no awareness of the need to mainstream gender issues into energy policy development and planning. For sustainable development and effective energy planning, it is important to know how women rank their priorities, what their aspirations are and what they think about their empowerment status. The chapter concludes by recommending actions, policies, programmes and projects that can be pursued to improve the mainstreaming of gender issues in the energy sector in Zimbabwe.

1.1. Methodology

A thorough review of the relevant literature was undertaken. This included searching peer-reviewed and grey literature in recognised electronic databases and websites, thus building on available reviews in the field of gender and energy development. Sources of the literature included, but were not limited to, publications, documents and media articles produced by NGOs working in the energy sector and government institutions such as the Ministry of Energy and Power Development, the Rural Electrification Agency (REA), the Zimbabwe Electrical Regulation Commission (ZERC), and the Institute of Environmental Sciences. An interview guide was developed to guide discussions with 34 key informants from these institutions. The informants included key representatives of the government energy sector; representatives of the Zimbabwe Electrical Supply

Authority and the National Oil Company of Zimbabwe; energy experts in the university; agents of solar and gas companies in Harare; and NGOs working in the sector as well as those from the Consumer Council. The interviews were conducted through face-to-face interaction as well as telephone conversations.

A field visit to Mutare rural was undertaken in order to conduct interviews and focus group discussions at Chipendeke micro-hydropower project. Chipendeke is a pilot gender-energy project by Gender and Energy Network of Zimbabwe (GENEZ), a local NGO network.¹ At Chipendeke, key informant interviews were conducted with selected community leaders, councillors and representatives of community-based organisations, to solicit their views on the relevance and impact of the micro-hydropower project in their community. Four focus group discussions² were also held with community members, one with a group of 12 youths running a self-help project, the second with nine women who are basically housewives in the community, the third with seven women running a cooperative irrigation project, and the last with eight men running small-scale irrigation projects in the area due to the availability of the hydropower project. The information collected at the Chipendeke site was also compared with information derived from four focus groups held with men and women (combined) in Masvingo rural (11), Bindura rural (7), Zvimba rural (11), and Epworth (9). The idea was to compare and contrast economic activities and livelihood options of those privileged to have the micro-hydroelectric project and those struggling to access energy sources in rural communities. A focus group discussion in each of these places allowed the researcher to solicit ordinary men and women's views on gender and energy issues in Zimbabwe.

The data collected was analyzed using narrative and content analyses. The study triangulated the different methods in order to explore the gender-energy nexus in Zimbabwe, focusing particularly on rural communities and their access to both alternative and renewable energy sources. Review of relevant literature from all stakeholders, interviews, focus group discussions, and case study research designs was therefore employed.

1.2. Organisation of the Chapter

The chapter begins with an introductory statement on the subject of the gender-energy nexus, followed by an outline of the methodology used to undertake the study. It then proceeds to present and critically discuss the relevance of the theoretical framework and approaches that have been developed in recent years, trying to explain the gender-energy nexus within the development discourse. The third section gives an overview of the Zimbabwe gender-energy dynamics before focusing on the Chipendeke micro-hydropower pilot project, which the International Network on Gender and Sustainable Energy (ENERGIA) and a local NGO partner, Practical Action, are pursuing, aiming at mainstreaming gender issues into the energy sector, from a rural setting. The chapter ends by drawing observations and lessons from the Zimbabwean case study. It then concludes by giving action points that could assist in furthering the gender-energy nexus in development practice, in form of recommendations.

2. Theoretical Framework

Greater understanding of the differential roles of men and women in certain cultures, in different locales, and at different income levels, can help enhance the effectiveness of energy projects and development programmes as a whole, particularly in rural areas. Recent energy and gender frameworks offer some important insights, in particular, insights into the linkages between the domestic economy and the market economy. Of particular concern in the frameworks is the discussion about the physical, mental and health burdens on women, men and children, caused by the current status of energy service in rural and peri-urban areas. A number of gender theoretical perspectives and approaches in the energy sector are being put forward to try and explain the gender-energy nexus. Initially, women came into consideration in the energy sector only in their reproductive roles, as users and producers of fuel for cooking, and the effects of energy scarcity on their ability to fulfil these roles, hence on their families' and their own health and nutrition. This initial analysis of women and energy issues has proved inadequate and not readily adaptable to energy planning, hence the development of new theories, frameworks and approaches.

The new unfolding perspectives and approaches on the gender-energy nexus focus on the fundamental questions of how the empowerment of women to make choices about energy as well as how responsive the energy sector is to provide affordable modern energy equipment that addresses women's needs. Various views are given on how energy in livelihood strategies can improve the position of women by either creating opportunities or relieving the constraint of energy scarcity. Issues concerning the impacts of energy and the potential/feasibility of improving the situation of women, in terms of sustainability, are identified and critically analyzed. However, with globalisation and more advocacy work on gender equality, a number of scholars have been factoring the aspect of gender into existing theories, in a bid to explain the dynamics within the energy sector.

Feminist political ecology theory brings into a single framework a feminist perspective combined with analysis of ecological, economic and political power relations (Clancy and Skutsch 2003). The feminist political ecology theoretical framework directly addresses women's aspirations by hearing women's voices on how to improve the situation, what they find important and for what reason. This can be done by capturing women's voices by means of surveys, opinion polls or voting. For example, one can ask women the reasons for shifting to clean fuels and get responses such as "It is convenient to turn on/off", "It is time-saving", "I like it since it leads to cleaner household", and "We cannot afford it, it is very expensive". This theory also argues that the environment (which includes energy) in developing countries is a survival and not a quality of life issue as perceived by the developed world. It links environment with livelihoods and the conditions necessary to meet basic subsistence needs, especially those related to basic human survival, health and safety. In this regard, the theory's analysis of gender in the energy sector tends to primarily focus on the situation in the developing countries, and not the industrial countries. Some focus on industrial countries

tends to emphasise that women's research agenda should differ from that of men by being more skewed towards renewable energy and social aspects of energy.

One other theory that is being used in explaining the gender-energy nexus is the Stakeholder theory. The Stakeholder theory was developed from political science and business management research in the last two decades and it is now being used to explain gender dynamics in the energy sector (Brugha and Varvasovszky 2000). With Freeman's (1984) pioneer work, the stakeholder theory has now been applied in both the literature and practice of management, public policy planning and public administration. The modern stakeholder theory has three directions, including descriptive/empirical, normative and instrumental rationales (Donaldson and Preston 1995). The stakeholder theory roots are in the political and policy sciences and in management theory, where it has evolved into a systematic tool with clearly defined steps and applications for scanning the current and future organisational environment. Stakeholder analysis can be used to generate knowledge about the relevant actors so as to understand their behaviour, intentions, interrelations, agendas, interests, and the influence or resources they have brought, or could bring, to bear on decision-making processes.

Descriptive studies document how organisations manage or interact with stakeholders; normative stakeholder theory prescribes how organisations ought to treat their stakeholders; and instrumental stakeholder theory focuses on how organisations pursue their interests through managing relationships with stakeholders (Freeman 1999). For the gender-energy nexus, the stakeholder theory becomes important in that women's input and participation in energy policymaking is important for successful development. The exclusion of women's input and participation in energy planning implies that gender considerations are left out as these key stakeholders are excluded and marginalised. The exclusion of women in energy planning means that the neglected issues and concerns of women about certain energy technologies are bound to deter sustainable development as they will fail to liberate women from household chores that limit their public participation and contribution. The idea is that women's challenges and problems are better articulated and presented by women themselves.

Brugha and Varvasovszky (2000) suggest that energy planners should employ the stakeholder theory to assist policy analysis and formulation; to conduct strategic planning and evaluate threats and opportunities for change; to facilitate consensus-building, public participation and stakeholder collaboration in a planning process; or to facilitate efficiency, effectiveness and equity in planning and decision-making. Effective energy planning, which may lead to community capacity-building in the long-run, requires the public, especially women, to be involved in the decision-making process and mutually commit to collective decisions on community development. In this regard, public participation in the energy sector provides a safeguard against ill-informed decisions, educates the public and decision-makers alike on each other's concerns, builds public confidence and understanding, and provides new and valuable information to planners and policymakers.

One framework used in exploring and explaining the gender-energy nexus in development work is the gender analysis framework (Skutsch 2008). This framework looks at gender differences, typically differences in terms of responsibilities, time, budgets and decision-making power. The gender analysis framework identifies, specifically, how public policy affects women and men differently, and seeks to demonstrate that policy and implementation cannot be gender-neutral. Hence, the framework argues that an engendered energy policy would recognise that women and men have different energy needs. Women make decisions relating to domestic energy uses (for example, in food preparation and heating water); therefore, the burden of energy shortages, price increases and cost-recovery plans tends to fall disproportionately on women. The framework draws upon sex-disaggregated data and analyses the causes and consequences of gender differences and inequalities. Gender analysis enables an understanding of the existing gender situation, before and after intervention. It enables planners and other stakeholders to assess the impact of an intervention on both male and female members of households and communities.

Skutsch and Schulte (1997) identified three types of commonly used gender analysis methods. The first involves using gender analysis as a filter, through which all project plans should pass before approval. In this way, even if projects are not deliberately designed with gender as a primary concern, an acceptable degree of equity is assured because all projects have to pass a “gender test”. The second gender analysis method involves building gender into the project cycle so that gender issues are considered at each stage. This is a more thorough approach, with different planning tools or analytic frameworks used at different stages. The result will be that gender considerations are taken into account from the very beginning of the process, starting with problem identification and project formulation, and not merely used to filter out “poor” plans. The third and last method involves incorporating gender into planning procedures such as the Logical Framework, or computer-based energy models that, for instance, predict supply and demand. In theory, there is no reason why gender issues should not be incorporated in these frameworks, whether they are used at the beginning of the planning process to identify potential interventions, or at the end to evaluate them. Table 1, adapted from Skutsch (2005) shows some of the alternatives and interventions that can be taken in advancing gender and energy. The challenge of incorporating gender issues into energy policy and project design is complex, however, and so far, few energy programmes have used the tools that have been developed for gender analysis. This may be because the tools and methodologies used in other development sectors are not readily adaptable to energy planning. Empowerment of women may not always be a realistic goal, for instance, in energy projects and programmes focused on extending the electricity grid, though in fact, women may benefit from the result (Skutsch 2005) (see Table 1).

Organisations such as Network on Gender and Sustainable Energy (ENERGIA)³ have criticised the gender analysis framework as too shallow and irrelevant to the energy sector (ENERGIA 2011). A number of reasons have been given by ENERGIA and others for dismissing the framework (Skutsch 2008; African Energy Policy Research Network—AFREPREN 2011; Clancy and Skutsch

2003). Firstly, the gender analysis framework gives no direct guidance on how to determine desired gender development directions, which need to be explicit, not only for reaching objectives, but also because more clarity is needed in the energy sector where the case for gender mainstreaming is less readily accepted. Secondly, the framework is not explicit on what kinds of energy would increase women's welfare, increase their productivity and help empower them.

Table 1. Gender goals and examples of possible energy interventions

Gender goal	Meaning	Implies	Example of energy intervention
Welfare of women	• Reduction of women's workload and ill health.	• Practical needs are met, especially reproductive activities.	• Improved stoves, power for grinding and husking, powered domestic water supply and electric lighting.
Production activities of women	• Women able to participate in economic activities/increased productivity or efficiency.	• Productive needs are met, but gender roles not necessarily changed.	• Supply of energy (electric, mechanical power or heat) for women's small businesses in the home and outside, coupled with credit schemes and technical training.
Empowerment, equality, equity for women	• Open new roles for women outside traditional roles. • Women earn and control income in the economic sphere.	• Strategic interests need to be addressed, e.g. • New roles, activities and freedom for women. • Opening new opportunities for women.	• Inclusion of women in management and training of energy programmes and projects. • Sensitise men to create space for women to participate. • Enable women's access to media, leading to increased awareness of political and social rights.

SOURCE: Skutsch (2005).

Basically, there is need for the framework to give precise guidance to energy planners on how to design policies, programmes or projects that ensure that women have some say over the outcomes. For this reason, ENERGIA and other organisations working on energy issues use tools such as gender checklists, stakeholder analysis, gender and energy matrix, rapid social assessments, and

gender organisational assessment of energy sector partners, among others, to mainstream gender in the energy sector. ENERGIA, the International is committed to promoting gender mainstreaming in energy and climate policies, programmes, projects, institutions, and investments. It provides guidance to governments and institutions interested in incorporating greater gender balance into their energy activities and investments. This work integrates an emphasis on human rights and empowerment of women, with a practical focus on increasing the effectiveness of energy access, and climate change mitigation programmes and investments.

Another framework used to explain the gender-energy nexus is the MDGs and sustainable development framework (Havet 2003; DFID 2002). This framework sees energy as an input to other development priorities. Expanded access to energy is an essential prerequisite to meeting all the MDGs. Even the UNDP has begun to advocate for the adoption of a new global target for energy as a prerequisite to fulfilling other international development targets of the MDGs. With access to energy, several MDGs can be achieved. Due to the concentration of poverty in rural areas of developing countries, and the disproportionate effect it has on women's low social and economic status, improving the situation of women farmers through better energy services will promote both MDG 1 (reducing poverty and hunger) and MDG 3 (promoting gender equality and empowering women). The framework argues that reducing poverty and hunger through small-scale businesses run by women, who are empowered by the availability of alternative means of energy, is the way to go. Women's burden to provide water and food for their families is reduced when there is improved access to energy services.

According to Goldblatt (2005), energy improvements are relevant to MDG 2 (achieving universal primary education) as less time is spent on firewood collection and food preparation; it means more girls in school. Girls, who are in many respects held back more than boys are in terms of primary education as they have to help their mothers to collect fuel for household needs, are set free to pursue their education through gender-sensitive energy services. Women's empowerment becomes more of a reality when they are set free from extreme household labour through better household energy services. This increases their educational and employment opportunities, allowing them to participate fully in community activities.

Health-wise, cleaner fuels reduce respiratory diseases; purified water reduces water-borne diseases; energy can enhance power lighting, and electricity allows the refrigeration of medicine and vaccines as well as powering water pumps for health centres. Maternal and child health (MDGs 4 and 5) improves with cleaner cooking stoves and absence of indoor air pollution. Currently, cooking with firewood contributes to about two million deaths each year, around the globe, with approximately 400,000 in Africa, and about 30 per cent of these deaths occurring to children under the age of five years (Lei 2011). It is, again, through realising the gender-energy nexus that the world will be able to save the remaining forests as is essential for sustainability of the environment, as outlined

in MDG 7. Thus, the discussions on post-2015 MDGs agenda should be able to bring together the development goals and the sustainable development goals coming out of Rio +20.

In this chapter, the two theoretical perspectives, the gender analysis framework, and the MDGs and sustainable development framework are treated as complementary, mutually inclusive, and reinforcing each other, in explaining the gender-energy nexus in Zimbabwe. Basically, the linkage between energy and gender originates from two major viewpoints, energy security and environmental impacts of energy production and consumption. Gender is a main determinant that defines access, ways of utilisation, opportunities and control over all energy resources.

3. The Zimbabwe Background

Originally colonised by the British in 1890, Southern Rhodesia (now Zimbabwe) became a colonial government in 1923. The primary tactic of British colonialists was widespread land appropriation, forcing peasantry into employment in mines and on farms, for poverty wages. Racial discrimination, gender inequality and ill-treatment of the black people by the white minority dominated the colonial era. This led to political conflict between the ruling white minority and the black majority in the country. After neighbouring Zambia and Malawi became independent of Britain in 1964, Southern Rhodesian Prime Minister, Ian Smith, vowed that there would never be African majority rule in Southern Rhodesia and announced unilateral declaration of independence from Britain in 1965. After a protracted liberation war in the 1970s, both Ian Smith and the African nationalists agreed to end the war through the Lancaster House talks of 1979. Thus, the British government formally granted independence to Zimbabwe on April 18, 1980 (MEPIP⁵ 2011).

Post-independence development needs, including those of the energy sector in the 1980s, were characterised by the government's desire to redress colonial imbalances and inequity issues. In general, between independence and the mid-1990s, Zimbabwe developed one of the strongest economies and expanded its energy sector. The government was able to secure loans from the World Bank and construct a viable energy infrastructure. However, as the International Monetary Fund [IMF] (2011) notes, between 1996 and 2009, Zimbabwe's gross domestic product (GDP) declined by 37 per cent and gross national income (GNI) per person fell by 54 per cent. By 2008, the country experienced hyperinflation, with unemployment at 85 per cent, as factory closures became a common feature. Water shortages and frequent power cuts resulted in a horrendous cholera outbreak that claimed the lives of many, especially vulnerable women and children. The hyperinflation caused dramatic reductions in the value of funds allocated to energy development. Budgets lost their meaning as prices increased daily, reducing the purchasing powers of institutions. Every sector, including energy, had its budgets drastically reduced (World Bank 2010).

Zimbabwe's economic revival began in 2009, after the formation of a government of national unity (GNU) and the adoption of a multi-currency system. At the time,

AfDB (2011) estimated that Zimbabwe's infrastructure rehabilitation required US\$ 14.2 billion. The rehabilitation was necessitated by a deterioration caused by years of neglect due to hyperinflation and international sanctions slammed on the government of Mr. Mugabe for alleged human rights abuses. Besides neglect, some of the energy structures have been mismanaged and affected by climate changes. The Ministry of Economic Planning and Investment Promotion (MEPIP) (2011) Medium Term Plan 2011–2015, claims that the Hwange power station technology is now outdated and unable to cope with national energy demands. Zimbabwe's economic recovery programme included the introduction of a Short-Term Emergency Recovery Programme (STERP) in March 2009, which sought to achieve macroeconomic stability and economic liberalisation. Since the introduction of STERP, the country has registered an economic growth rate, ranging between 6 and 8 per cent, after a decade of recession (IMF 2011). STERP is credited with halting the inflation surge which had a devastating effect on the economy and infrastructure, particularly the energy sector. Since STERP, the country has maintained a single digit inflation of below 5 per cent.

3.1. The Energy Sector in Zimbabwe

Zimbabwe's energy sector has been on the decline for the last decade due to vandalism of some of its infrastructure, heavy external debt, and lack of maintenance and investment. The decline, characterised by constant power outages, has resulted in the sector failing to meet both domestic and business energy needs. A National Energy Policy, launched in September 2012, is expected to revive the country's energy sector. The 2012 Zimbabwe National Energy Policy provides measures and strategies to address bottlenecks that have disrupted the exploitation, transmission and utilisation of energy in Zimbabwe (GOZ 2012a). Among other things, the new policy seeks to create green jobs, promote the use of renewable energies as well as mainstream gender into energy development. Enshrined in the policy are the principles of applicability, acceptability, affordability, accountability, and availability in the development of the sector. The government of Zimbabwe, through its Ministry of Energy and Power Development, has for the past five years been calling for joint venture investments or public-private partnership to resuscitate the sector. The Ministry has the overall responsibility for energy issues in Zimbabwe. The terms of reference of the ministry include policy formulation, performance monitoring and regulation of the energy sector, as well as research, development and promotion of new and renewable sources of energy.

The Ministry supervises and oversees the performance of energy parastatals, holdings of the Zimbabwe Electricity Supply Authority (ZESA) and the National Oil Company of Zimbabwe, among others. Other autonomous support institutions include the Scientific and Industrial Research and Development Centre (SIRDC), which carries out research and analysis in natural resource management, including renewable energy and energy conservation issues. The Forestry Commission is active in the area of woody biomass as their mandate covers all state forests, which are a major source of wood fuel. Active NGOs in renewable energy technology promotion include Zimbabwe Energy Research Organisation,

Southern Centre for Energy and Environment, Intermediate Technology Development Group,⁶ and Southern Alliance for Indigenous Resources.⁷

Energy planning in Zimbabwe seems to only concentrate on meeting the policy priority of alleviating energy-related negative environmental impacts, without an entire focus on energy demands, especially those that are gender-sensitive. This has led to many failures and disappointments, for both planners and beneficiaries (Mabuza, Brent and Mapako 2007). Some of the problems of the energy sector in Zimbabwe include the lack of consistent energy policy and uneconomic prices of energy, which have resulted in very limited investment in the sector. The inadequacy of investors in the sector has led to limited technology transfer or poor access to modern/commercial energy, especially for the rural population, which has in turn stifled economic development, contributing to social hardships in the rural areas. Energy development is generally mostly held back by lack of capital, skills, capacity, and the absence of a practical regulatory framework.

Energy consumption in Zimbabwe has grown at an average rate of about 3.5 per cent per annum, since 1990. The major energy sources in Zimbabwe are petroleum fuels, wood fuel, electricity and coal. Other alternatives such as solar, wind and gas⁸ are just gathering momentum and generally lack investors. The potential for renewable energy, especially for solar power and solar water heaters, is enormous, but has not been sufficiently exploited. As SIRDC (2010) notes, wood fuel meets about 53 per cent of national energy demands, followed by coal at 20 per cent, liquid fuels at 14 per cent, and electricity at 13 per cent. Access to electricity nationally is about 40 per cent but is mostly urban-based, with only 19 per cent covering rural areas.⁹ Electricity generation is mostly hydropower, with a bit of complementarity from thermal sources. The current electricity generation is approximately 63 per cent of the installed capacity (GOZ 2012a). The country's electricity generation capacity has remained almost constant in the past 10 years against an increasing demand necessitated by a growing population and rapid urbanisation. It may be challenging for the country to develop wind energy because of generally poor wind speeds while there is scope for development of biogas energies such as that from agricultural wastes, sugarcane and animal dung. However, the biggest opportunity for the country lies in exploiting solar power. This will help mitigate prevailing power shortages and reduce emission of global warming causing gases.

Much of the household energy in Zimbabwe is derived from biomass in the form of wood fuel, charcoal, crop residues, and dung, although electricity, coal and fossil fuels tend to be quite prominent and monopolise the energy sector, given their commercial use in industry, agriculture, and tertiary services. With hydroelectricity shortfalls, nearly all households in both urban and rural areas use biomass, and dependence on this in rural areas is overwhelming. The challenge that the country is facing with overdependence on biomass, in the face of a growing population, is environmental concerns linked to deforestation, climate change and the need to switch to renewable energies in a gender-sensitive manner. About 64 per cent of rural households are dependent on biomass for their

cooking, heating and lighting (MEPIP 2011). There is a large gap in unfulfilled domestic electricity connections.

The generation, transmission and distribution of electricity are handled by the ZESA. Internal supply of electricity by ZESA has not been adequate to cover the entire country and about 40 per cent of energy has been imported from the neighbouring countries of Mozambique, South Africa, Zambia, and the Democratic Republic of Congo (DRC). The country produces 1,400 megawatts a day from its electric and thermal power stations in Kariba, Hwange, Bulawayo, Manyati, and Harare versus the required 2,200 megawatts required daily (Zvauya and Kadirire 2011). Zimbabweans have had to contend with load shedding over the past decade as the power utility struggles to meet high demand. The shortage affected economic revival efforts, especially at a time when the economy was in recovery mode, in the past three years. As Chagutah (2010) observes, most investments in electrical grids and fuel distribution systems have tended to focus on urban and industrial development, often leaving rural areas and peri-urban settlements literally in the dark. Only 5.8 per cent of the rural population has access to modern fuels for cooking and heating, compared to 78.8 per cent in urban areas. Government efforts to boost electricity coverage have seen a growth in national coverage from 20 per cent to 42 per cent, between 1990 and 2001. Due to women's traditional responsibility for fuel supplies in rural areas, the burden of unpaid work related to energy scarcity falls more heavily on women than men. Despite the promise of the Medium Term Plan to improve energy supplies and ensure full participation of women in all sectors of the economy, women remain marginalised and are outside the policymaking machinery of the energy sector.

Zimbabwe's energy sector, besides its failure to mainstream gender issues in planning and policy formulation, faces a number of challenges. There is a huge electricity generation shortfall, which compels the country to import from her neighbours in the region, a region which has a general shortage of energy sources (ZESA 2011). Given the country's standoff with Western donors and low foreign currency reserves, the importation of energy remains a challenge. The same challenge applies to the importation of petroleum fuels. In the last decade, Hwange's coal production and distribution has been problematic given the rail and road transportation challenges experienced by the country due to hyperinflation. A heavy reliance on public enterprises to run the energy sector for years has crippled the capacity of the country to diversify and offer alternative energy sources.

3.2. The Gender-Energy Nexus in Zimbabwe

The existence of gender disparities in Zimbabwe's energy sector makes it reasonable to conclude that the present structures and processes are not functioning in such a way to take care of the concerns and needs of women. In line with this, one can argue that the gender composition of staff and gender relations within energy sector institutions may be more important in the structural exclusion of gender issues for the energy sector. The energy sector is male-

dominated. For instance, the Energy Directorate and Public Enterprises under the Ministry of Energy, is run mostly by men, who, by virtue of their scientific or technical qualifications, have risen through the ranks to be in top management. Women mostly shun the sector and often pursue social sciences for life careers, hence are less likely to join or lead the sector. Although the government has, for the past three post-independence decades, tried to promote women through affirmative action, most women still do not find joy in pursuing careers within the energy sector (GOZ 2010). The few numbers of women in the energy sector, to a great extent, makes it difficult to achieve gender-sensitivity within the sector.

Interviews with government officials¹⁰ indicate that although the country has a national gender policy, what is missing in the energy sector is the voice of gender advocates and women's organisations. Very few women's organisations have the time, funding or mandate to deal with energy issues. The rhetoric on the need to incorporate gender issues into energy projects, right from the design stage, more often than not, ends up as workshop talk instead of reality. The use of participatory and stakeholder approaches involving women is conspicuously missing in Zimbabwe. As AFREPREN (2011) notes, energy planning in Zimbabwe will remain gender-blind until it becomes multidisciplinary and demand-driven. In addition to this, energy data produced and circulated by the national statistics bureau and analysis by many researchers often fails to disintegrate energy data, by gender. Thus, women's organisations need to work with the government and rollout gender mainstreaming trainings within the energy sector.

At community and household level, a central concern in the energy sector is that women rarely have control over energy resources and technology, even if they have access or usufruct rights to the same.¹¹ In Zimbabwean culture, the wife "belongs" to her husband, alongside all household assets, including energy. Hence, women have to fetch firewood and water, while men are responsible for making decisions when these energy sources become commercialised (SIRDC 2010). Men's better access to capital has often been cited as a reason why they frequently take over energy activities when these move from the domestic to the monetary economy, as in wood fuel trade versus collection. Yet, women's involvement in energy issues starts from the burdensome gathering process, right to the utilisation process at the other end.

Chagutah (2012) argues that women and girls in Zimbabwe remain excluded from energy planning and decision-making processes as it is presumed to be men's domain. Such attitudes in Zimbabwe are demonstrated by the absence of a gender policy framework covering the environment and natural resource management. Women's energy needs are directly related to their workload and their time. For instance, most women in Zimbabwe spend much time in fetching firewood and water, given the lack of cheap, accessible and affordable energy sources. More labour and longer hours are spent managing household energy systems instead of engaging in other viable economic community activities. Figure 1 shows that the best way to break out of energy poverty, for most women in Zimbabwe, would be to improve energy services, which in turn free time for

women and girls to engage in other productive community activities. Women have to go through a transformation process, if they are to access various alternative and renewable energy sources, which would help empower them to participate fully in development activities. They would have the possibility of doing more work, outside their household chores, as well as getting better education, skills and expertise, if the energy supply chain improves. With traditional energy, the gender problems would still deter women from effectively participating in development activities.

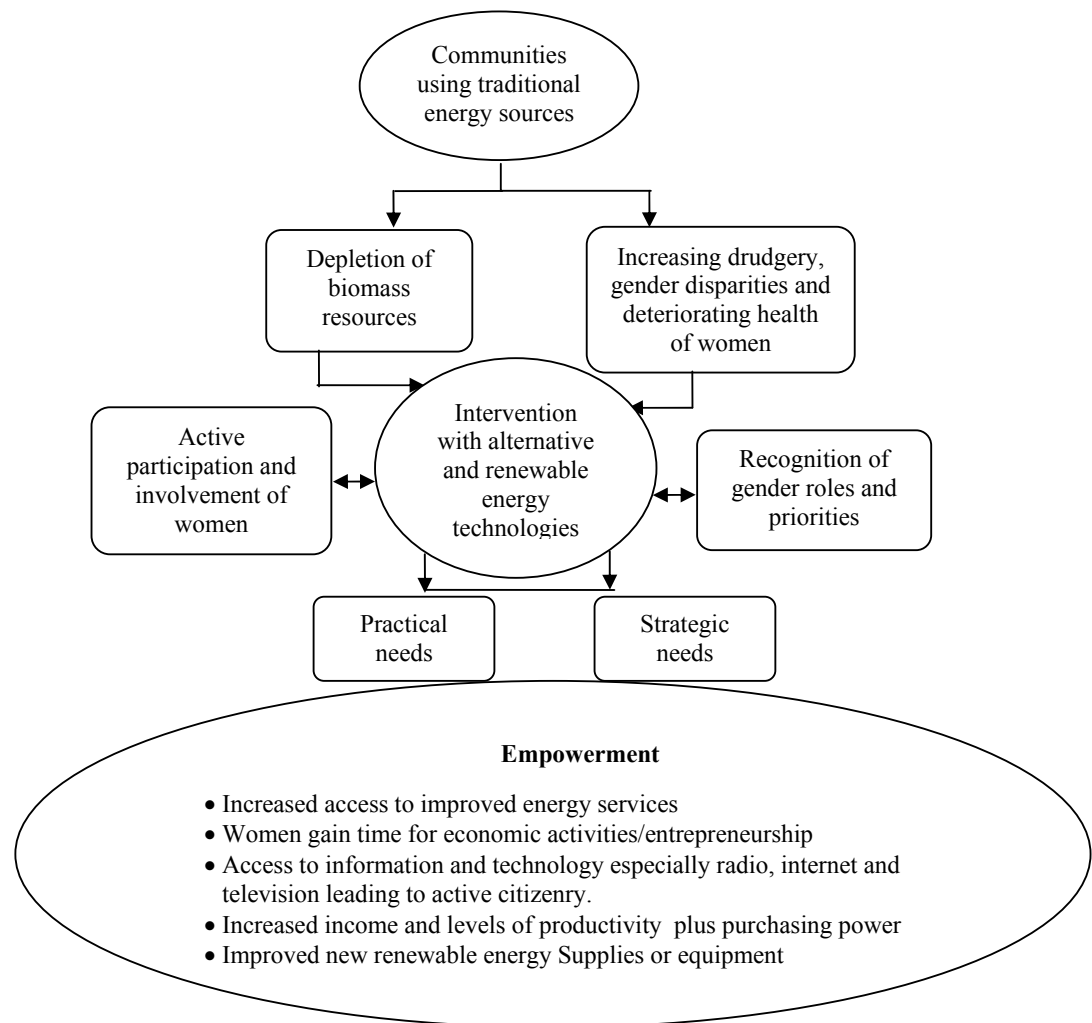


Figure 1. A Virtuous Circle to Break Out of Energy Poverty and Gender Inequality

SOURCE: Adapted from the Institute for Development Studies [IDS] 2003).

Rural energy is one of the central areas where women's roles and responsibilities should not be underestimated since they are directly involved in consumption and management of energy resources. Human rights activists consider rural electrification as a way of promoting the socioeconomic rights of women as this enables them to attend local meetings, listen to radio and watch television, consequently becoming more informed, and eventually empowered and active citizens (Fanchi 2005). With improved access to energy, rural women become income earners as they are pulled into the monetary economy and acquire a new status in society, as they become capable of leading community projects and demand that their voices be heard and heeded to by men. As Shakya (2011) notes, most rural Zimbabwean women, who have been empowered through alternative or renewable energy sources, have become influential within their communities. Given its economic development pace, Zimbabwe's Medium Term Plan 2011–2015, estimates that the country will have about 4 per cent annual increase of electricity demand (MEPIP 2011). In order to meet this demand, a number of rural energy projects that are meant to resuscitate the energy sector have been planned. These projects include boosting of hydroelectricity generation as well as using solar and gas energy. Table 2 shows the potential 120 megawatts micro-hydroelectricity projects lined up by the government, to boost rural energy generation in Zimbabwe. NGOs have also been involved in energy generation projects, particularly for indigent populations in rural areas. An in-depth case study of Chipendeke micro-hydro scheme power station is given and analyzed in the next section, linking rural energy and gender issues. The Chipendeke micro-hydro scheme, by NGOs working under the umbrella of Practical Action, helps to demonstrate what can be done to take care of gender issues in energy projects. Practical Action Southern Africa houses a network called Gender and Energy Network for Zimbabwe (GENEZ). GENEZ is affiliated to ENERGIA International, an international network that seeks to advocate for policy reforms and promote awareness and training on mainstreaming gender in energy projects. GENEZ membership includes individuals, institutions and government ministries interested in bridging the gap between men and women in issues of energy.

Table 2. Potential mini-hydro sites

District	Site	Capacity	Annual Energy (Production GWh)
Mwenezi	Manyuchi	1.4	5.5
Masvingo	Mutirikwi	5.0	40.0
Mutasa	Osborne	3.0	23.6
Bikita	Siya	0.9	5.6
Mutasa	Duru	2.3	6.0
Nyanga	Gairezi	30.0	7.9
Nyanga	Tsanga	3.3	8.8

SOURCE: Government of Zimbabwe [GOZ] (2012b).

The ENERGIA idea is to stimulate action aimed at assimilating gender into the energy access agenda in developing countries. ENERGIA Africa Network

consists of 17 national focal points (ENERGIA 2011; UNDP and ENERGIA 2004). In Southern Africa, these cover Zimbabwe, Malawi and Mozambique. GENEZ is chaired by representatives from the Ministry of Women's Affairs, Gender and Community Development, and the Ministry of Energy and Power Development. Other committee members include a representative of Practical Action Southern Africa, who coordinates the network. Practical Action Southern Africa has partnered with the Ministry of Energy and Power Development to come up with the 2012 National Energy Policy for Zimbabwe, which embraces the fundamentals of the gender-energy nexus. ENERGIA, through participatory engagements with marginalised groups, especially women, seeks to remove the policy, technical and institutional barriers that limit the development and use of renewable energy sources to meet the energy needs of poor, off-grid communities. Rural uptake of renewable energies in Zimbabwe, just like in many parts of Africa, remains low (IEA 2011). This lack of access to modern energy technologies continues to militate against socioeconomic development as women remain confined to household chores in an environment in which they can do much more, in terms of contributing to economic development.

3.4. The Chipendeke Micro-hydropower Project

ENERGIA is working with GENEZ to pilot 15 gender energy micro-hydro projects in the region covering Zimbabwe, Malawi and Mozambique. Chipendeke, in Mutare, Zimbabwe, is one of the six projects that ENERGIA and GENEZ are piloting in the country. The Chipendeke micro-hydropower project represents one of the easier and cheaper ways of using technology to avail electric power from falling water, in a rural community. The Chipendeke project is run by a local management team, which includes women. The micro-hydropower project has benefited more than 200 households, taking into consideration the gender needs of the community. The project produces 25 kilowatts of electrical energy, used to light 400 homes, eliminating the need to use candles, paraffin and batteries for lighting, heating and cooking. The community, especially women and children, have been empowered through access to communication and information mechanisms, especially televisions and radios. The remoteness of the village is no longer an issue, with modern energy technology now in their households.

A study of the Chipendeke micro-hydro energy project reveals the stages through which a gender-energy project can be realised. Table 3 shows the gender action plan used by GENEZ and partners to ensure that the energy project was gender-sensitive.

Table 3. Gender action plan for the Chipendeke project

Gender goal	Indicators	Means of verification
Improve welfare through improving access to: • Home lighting during cooking. • Refrigeration and ironing. • Public/health information. • Radio and television. • Electricity for agriculture and food processing.	• At least a 30% increase to lighting during cooking hours. • A 50% increase in access for women to public/health information on radio and television. • 50% reduction time spent by women on agro-processing.	• Household interviews. • Interviews with grinding mill operators, women in target areas. • Household surveys.
Welfare: improved healthcare facilities.	• A 50% increase in the number of deliveries at the local clinic. • 25% Increase in the storage of medicines at the local clinic.	• Clinic admission records. • Interviews with clinic staff.
Empowerment and equity.	• 50% of businesses owned by women at the business centre.	• A short survey on the number of businesses owned by men and women at the service centre.

SOURCE: ENERGIA (2011).

The first form of action taken to mainstream gender into the micro-hydro energy project involved undertaking both technical feasibility studies as well as conducting socioeconomic studies, which ensured that the energy and daily needs for both men and women were met, from the onset. From the baseline survey, a gender action plan to mainstream gender into the project planning, implementation, monitoring, and evaluation was developed, with the project team, local micro-hydro project committee and women's groups, so as to build understanding for and acceptance of the gender mainstreaming activities.

In the Gender Action Plan, a number of gender goals were identified, which included improving the welfare of women by enabling higher access to lighting, especially at home; improved health facilities through lighting and powered refrigeration at local clinics; ensuring that women were part of the management of the project; and improving opportunities for women to increase their productivity and income-generation. These goals and intentions of the project are the same as those identified in Table 1.

Women in this community not only have been empowered in matters related to the project, but also have taken-up important positions in the community and run

business enterprises. Women's access to energy at Chipendeke has offered a number of significant life-changing opportunities in areas such as health, education, sanitation, and farming. Most women farmers in Chipendeke now harvest bigger garden produce and run irrigation schemes, which would not have been possible without the project. Large horticulture products are now being refrigerated before they are sent to the market. An interview with Mrs. Mawoyo, one of the irrigation farmers in the area, indicates that what she used to spend on paraffin for lighting is now being channelled towards children's education and other family essentials, as a result of the micro-hydro project.¹²

Storing up large amount of fuel wood is no longer a symbol of being a good daughter-in-law here. The micro-hydropower project has relieved women in this community from the hassles of fetching firewood and failing to participate in income-generating activities due energy supply challenges. It is our miracle and liberator. (Mrs. Mawoyo, Chipendeke resident).

Focus group discussions with women in Chipendeke also revealed that the hydropower project not only empowered women but also reduced the national cost of distribution and transmission of electric power to rural women.

The provision of electricity through the micro-hydro project has enabled the clinic to attend to emergencies and child birth at night, thus lowering infant mortality. Other health concerns raised were that in the absence of electricity, the use of firewood for cooking, and candles and paraffin for lighting, was causing sore eyes. Households indicated that much, almost 80 per cent, of the firewood collection was done by women and children, and seldom by men. Thus, the provision of electricity through the micro-hydro electricity project reduced the drudgery for women and children. Further to this, the survey findings of this project indicate that there is a clear economic, social and environmental case for scaling-up renewable energy access for some of the poorest communities in Zimbabwe, and Africa as a whole (Shakya 2011). If MDGs are to be met with equity, there is need to focus on the communities that have the least access to energy and ensure that this energy access is truly sustainable — environmentally, socially and economically right, as well as gender-sensitive.

Prior to the setting up of the micro-hydropower project in Chipendeke, biomass collection to meet a household's energy needs was a burden (physically and metaphorically) on women and girls. This could entail spending several hours a day collecting firewood loads of up to 20 kilogrammes or more. The responsibility for household energy provision affected women's health disproportionately to men's. For example, higher levels of lung and eye diseases due to longer hours of exposure to smoke and particulates in smoky kitchens, was experienced by women, in comparison to men. Firewood collection also reduced the time women had available to contribute to other aspects of livelihood strategies, and girls were frequently kept away from school, to assist their mothers.

3.5. Observations from Zimbabwe's Experience

Documenting the process of gender mainstreaming in the form of case studies contributes to the success of gender mainstreaming in the energy programme/project/institution, and the potential for its replication, more widely. At the national and international levels, evidence or best practices of gender impact and change in energy projects, can be used for advocacy and lobbying to influence energy policies and political processes elsewhere.

Zimbabwe, like most of its Southern Africa Development Community (SADC) neighbours, does not need more policy documents on energy and gender mainstreaming. What is needed is the implementation, driven by political goodwill and commitment. Markets need a legal framework to flourish, and this legal framework needs to be gender-sensitive. A gender-sensitive framework in the energy sector only comes about when policymakers go out to consult the poor urban and rural women and men on their basic energy-gender needs (AFREPREN 2011). Women have carried the microfinance transformation of poverty into sustainable livelihoods. They can also carry the energy-gender transformation, if they are given the chance and supported. There is need to open up the energy market in a democratic and gender-sensitive manner, for big and small investors, and to create business conditions that allow male and female investors to shoulder minimal risk.

Energy and women are linked in many diverse ways, particularly through the nature of the (predominantly biomass) energy resource base, the characteristics of the household and community economy, the features of energy policies, and the position of women in families and communities. Energy can be a vital entry point for improving the position of women in households and societies. According to Bryceson and McCall (1997), the main components of a woman's day, linked to energy services, comprise:

- (a) primary production, including agriculture and raw material extraction;
- (b) value-added production, encompassing post-harvest operations and food processing;
- (c) domestic maintenance — cleaning and repairing of the residence and its surroundings, and preparation and distribution of consumption goods for the family and household members;
- (d) child-bearing, childcare and education; and
- (e) transport from agricultural fields and raw material sites to places of domestic consumption, and for marketing.

Another basic observation is that the dimensions of the gender-energy nexus and the livelihoods analysis have been poorly understood, hence, their significance underestimated. It is also worth noting here that gender analytical tools and frameworks that are in standard use in the agriculture, health and water sectors (the Harvard Matrix, Gender Analysis Matrix) are hardly used in energy planning. To some extent, existing gender tools can be adapted to the energy

sector, to bring to light hidden aspects of the gender-energy nexus, but there is a clear need to develop tools specific to the energy sector, to ensure that all aspects are analyzed.

The use of biomass has a number of repercussions for poor people. The fuel quality is low, and when burnt, it gives off quantities of smoke and particulates that are recognised as having negative effects on health (World Bank 2010). The many hours spent daily in collecting fuel means that this time cannot be used for other livelihood and self-advancement activities. The supply of biomass resides in the informal sector, which contributes to its “invisibility” in formal statistics. The fact that biomass in rural areas is collected at zero monetary cost, mainly by women and children, hence falls outside national energy accounts, renders the issue invisible — no data, no visibility; no visibility, no interest, and so policies and strategies fail to address the issue comprehensively.

3.6. Lessons Learnt

A number of lessons can be derived from studying the gender-energy nexus. It is clear that although a special focus on women’s energy needs in development policies can help to promote other goals relating to poverty eradication, health, employment and education, the importance of bringing a gender perspective to energy planning, analysis and project design, is still not widely understood or accepted. Gender equality is often viewed predominantly as a political issue, unrelated to technical concerns about energy production and supply. Energy planners and policymakers still do not consider women at all. As an assumed non-existent entity, women’s concerns are treated as “added on” factors or as not directly relevant to energy issues.

The other lesson is that biomass supply is usually beyond the influence and control of energy sector professionals (Ki-moon 2011). The lack of visibility, plus divided ministerial responsibility, leads to minimal interest and investment at the national and donor levels. Coherent policy is desperately needed, not least of which is to achieve sustainable biomass fuel supply. It was also noted that alternatives to biomass have not achieved widespread use, especially through commercial channels. The failure of alternatives may have to do with their failure to take on board both gender and traditional considerations, as seen with the case of wood stoves and solar energy for cooking. The evidence for the contribution energy can make to meeting women’s strategic needs is only beginning to emerge; for instance, electricity creates safer streets at night, enabling women to attend meetings, participate in education classes, gain a feeling of self-worth, and link to the outside world through access to electronic media.

It is amazing to learn that energy planners have usually equated women’s interest in energy with cooking, to the exclusion of other needs, particularly needs related to productive activities and emancipatory goals (Sustainable Energy for All Practitioners Network 2012). In addition, since the main focus of energy planning has been on fossil fuels, to the exclusion of biomass fuels, even women’s practical needs have hardly been addressed. What can be learnt from this is that as part of their coping strategies, women have responded to wood fuel shortages

by adopting management strategies to conserve fuel. They shorten cooking periods, explore less fuel-intensive cooking and food processing methods, cook fewer meals, serve cold leftovers, change the types of food eaten, and purchase other fuels. Women are important managers of natural resources and also producers of biomass fuels.

The burden of biomass fuel use is a major aspect of most poor women's lives. It absorbs large amounts of time in heavy work and can have negative effects on health. Although this problem has been recognised, for 30 years very little has been done about it (World Bank 2010). Over-reliance on fossil fuels or biomass resources also results in destruction of the environment, which will have cumulative negative effects on the food, water, and land required by people for living. As a major source of emission, primary energy use of fossil fuels has resulted in tremendous exhaust gases, which caused serious damage to the global environment.

The current focus in energy policies and planning, as noted above, is very much on increasing the efficiency in the electricity sector. The implications of this focus, for women, have not been well thought-out. Although electricity has many benefits, it does not help to address the major energy problem that most women in rural areas face, in terms of their practical needs — their daily cooking requirements. Cooking with electricity is not cheap; either the energy itself or the stove is expensive, if not both.

There is limited penetration by renewable energy technologies, due to lack of clear energy policies and strategies, high upfront costs for the promotion of the technologies, and a generally poor appreciation and demonstration of benefits. With the economic doldrums engulfing the nation, the government is unable to invest in new technologies.

4. Conclusions

A basic conclusion of this chapter is that women are particularly badly served by the energy forms they are using. Energy is one of the most essential inputs for sustaining people's livelihoods. At the most basic level, energy provides cooked food, boiled water and warmth. It has long been established that women are disproportionately burdened, in comparison to men. Due to lack of modern energy carriers, women resort to the use of traditional fuels such as wood fuel, which poses detrimental effects on health because of cooking over smoky fires. In instances where modern energy carriers have been provided, these have failed to improve the livelihoods of women because participatory approaches have not been used to include them in the design and implementation of energy projects. Consequently, energy technologies have failed to lessen women's physical drudgery; yet well-thought strategies would enable them to attend community meetings, participate in education classes, gain a feeling of self-worth, and link to the outside world, through access to television.

It is important, therefore, that all energy projects consider the differential role of men and women, in relation to energy systems. A change in energy production

paradigms is necessary, and women should be at the forefront of this energy revolution. The energy production technologies space present opportunities, and equally present enormous challenges, for women in Zimbabwe. They should be champions of this new energy production paradigm that promotes the utilisation of clean energy sources. There is need to deliberately address the gender question and empower women to be their own liberators, from both economic and social bondage.

5. Recommendations

The following steps could be taken to improve the gender-energy nexus in Zimbabwe and similar setups elsewhere:

- (i) Gender analysis and mainstreaming still needs to be fostered in the energy sector, especially among energy planners and practitioners.
- (ii) Emphasis needs to be placed on the education of women and spreading awareness. Women have to be empowered to make choices about energy. Capacity-building is needed to promote the use of efficient energy appliances and their availability. Enabling choice is linked to issues of sustainable livelihoods and poverty alleviation, including access to income-generating activities.
- (iii) Further research is needed on gender-energy areas, especially comparative studies of women's strategic energy needs.
- (iv) A more holistic approach to the analysis of the impacts of biomass collection and use on women's health, including the physical effects of carrying such heavy loads, is needed.
- (v) There is need for those promoting alternative energy sources to carefully study the gender and traditional dynamics of their products and obtain local buy-in before wasting a lot of time and investments in what is not relevant to the targeted beneficiaries, especially women and girls. To this end, participation, ownership and coordination of energy work is necessary.
- (vi) There is need for the government to deliberately set-up a fund that assists women in energy-related activities, to access the much-needed capital that would enable them to market and manage new energy products, such as solar panels, wind and micro-hydropower generators, in villages.
- (vii) Women's engagement is essential for the successful design, marketing and adoption of new energy technologies and climate-responsive innovations. The UN Secretary-General has particularly emphasised the impact of energy poverty on women's employment, stating that women spend many hours, each day, on routine daily subsistence activities, such as pounding grain, fetching water and gathering firewood, and they have little or no time for earning an income (Ban Ki-moon 2011).

- (viii) There is need for a multi-sectoral approach in the promotion and adoption of gender-sensitive energy planning, auditing, gender-based needs assessments, monitoring, and evaluation.

Notes

1. Gender and Energy Network of Zimbabwe, a network of individuals and organisations seeking to promote awareness and training on mainstreaming gender in energy projects.
2. To deal with the religious grouping mentality of men dominating women and to allow women to freely express their energy needs and interests, the discussions were held with the groups separately.
3. ENERGIA International Network on Gender and Sustainable Energy was launched in 1995 as a network of committed individuals and organisations working on gender mainstreaming in energy policy and practice. Its common goal is to create equal opportunity and access to relevant energy resources for the poor. ENERGIA-Africa is the key player in gender and energy in the region.
4. This covers assistance offered, which includes helping with the developing of gender action plans for projects and institutions/departments, with specific focus on gender issues, goals, and capacities.
5. Ministry of Economic Planning and Investment Promotion.
6. An international organisation with offices in Africa (Zimbabwe, Kenya and Sudan) seeking to enrich poor communities with modern technologies as a way of ensuring that there is equity and IT industry benefits for indigent populations.
7. A regional Civil Society Organisation (CSO) network headquartered in Harare, which assists rural communities with livelihood options and natural resource management, including energy issues.
8. Government has plans to re-introduce biogas, which is currently being used on a small-scale. Biogas is a non-renewable energy that uses waste as a form of fuel. The renewable energy is mainly used for cooking and lighting.
9. See David Tinarwo (2011), Design of Village Power and Micro-Grids for Rural Areas in Zimbabwe and Potential for Renewable Energy Technologies in Zimbabwe. Paper presented at Zimbabwe's First International Energy and Power Conference and Exhibition, September 27-29, 2011.
10. The Ministry of Finance's Deputy Director (Recurrent Expenditure, Budgeting), Mrs. Manyanya and Mr. Nyaguse, the Director of Policy Planning and Coordination in the Ministry of Economic Planning and Investment Promotion.
11. See Johnson Siamachira, "Clean Energy Comes to Chipendeke", *The Herald*, Saturday May 28, 2011.
12. In local rural homes, families spend at least one-third of their income on paraffin for lighting, and diesel for the milling of grain.

References

- African Development Bank (AfDB). 2008. *Clean energy investments framework for Africa. Role of the African Development Bank Group*. Tunis: AfDB.
- . 2011. *Infrastructure and growth in Zimbabwe: An action plan for sustained strong economic growth. Summary report*. Tunis: AfDB.
- AFREPREN. 2011. *Renewable energy/energy efficiency policy study report*. Nairobi: AFREPREN/FWD.
- Ban Ki-moon. 2011. 'Sustainable energy for all': *A vision statement by Ban Ki-moon, Secretary-General of the United Nations*. New York: UN publications.
- Bryceson, D. F. and McCall, M. K. 1997. Lightening the load on rural women: How appropriate is the technology directed towards Africa? *Gender, Technology and Development*, 1(1): 23-45.
- Brugha, R. and Varvasovszky, Z. 2000. 'Stakeholder analysis: A Review'. *Health Policy and Planning*, 15(3): 239–246.
- Chagutah, T. 2010. *Climate change vulnerability and preparedness in Southern Africa. Zimbabwe Country Report*. Cape Town: Heinrich Boell Stiftung.
- Clancy, J. and Skutsch, M. 2003. *The gender-energy-poverty nexus: Finding the energy to address gender concerns in development*. London: UK Department for International Development Project.
- Department for International Development (DFID) 2002. *Energy for the poor: Underpinning the millennium development goals*. London: DFID.
- Donaldson, T. and Preston, L. E. 1995. The stakeholder theory of the corporation: Concepts, evidence, and implications. *Academy of Management Review*, 20 no. 1: 65–91.
- ENERGIA. 2011. *Mainstreaming gender in energy projects: A practical handbook*. Harare: ENERGIA.
- Fanchi, J. R. 2005. *Energy in the 21st century*. Singapore: World Scientific Publishing Co.
- Freeman, R. E. 1984. *Strategic management: A stakeholder approach*. Boston: Pitman.
- . 1999. Divergent stakeholder theory. *Academy of Management Review*, 24(2): 233–236.
- Goldblatt, D. L. 2005. *Sustainable energy consumption and society: Personal, technological or social change?* Dordrecht: Springer.
- Government of Zimbabwe (GOZ). 2010. *Zimbabwe millennium development goals progress report 2010. A report by Government of Zimbabwe to the United Nations*. Harare: GOZ.
- . 2012a. *National energy policy*. Harare: Ministry of Energy and Power Development.

- . 2012b. *The future we want. A report by Government of Zimbabwe to the United Nations Conference on Sustainable Development, Rio +20*. Harare: GOZ.
- Havet, I. 2003. Linking women and energy at the local level to global goals and targets. *Energy for Sustainable Development*, 7 (3): 75–79.
- Institute of Development Studies (IDS). 2003. A review of the evidence and case studies. ASTAE EnPoGen Project. Washington, D.C: World Bank.
- International Monetary Fund (IMF). 2011. *Zimbabwe article IV consultation report*. Washington: IMF.
- International Energy Agency (IEA) 2000. *World energy outlook 2004*. Paris: IEA.
- . 2004. *World Energy Outlook 2004*. Paris: IEA.
- . 2011. *World energy outlook 2011 special report- energy for all*. Paris: IEA.
- Kebede, B. and Dube, I. 2004. 'Part 1: Introduction'. *In: Energy services for the urban poor in Africa: Issues and policy implications*, edited by B. Kebede and I. Dube. London: Zed Books.
- Lei, B. 2011. 'Integrating planning theory with energy planning in developing rural areas: A critical assessment of the energy intervention programmes in rural Hainan, China'. Ph.D. thesis, University of Waterloo, Ontario, Canada.
- Mabuza, L. O., Brent, A. C. and Mapako, M. 2007. The transfer of energy technologies in a developing country context: Towards improved practice from past successes and failures. *Proceedings of World Academy of Science, Engineering and Technology*, 22: 237–241.
- Ministry of Economic Planning and Investment Promotion (MEPIP). 2011. *Zimbabwe medium term plan 2011–2015*. Harare: MEPIP.
- Mills, G. 2010. *Why Africa is poor and what Africans can do about it*. Pretoria: Penguin Books.
- Scientific and Industrial Research and Development Centre (SIRDC). 2010. Position paper on the status of renewable energy in Zimbabwe. Harare: SIRDC.
- Shakya, I. 2011. Regional micro-hydro power project: ENERGIA Africa gender mainstreaming in energy projects online coaching final report. Harare: Practical Action.
- Skutsch, M. 2005. 'Gender analysis for energy projects and programmes'. *Energy for Sustainable Development*, 9(1): 37–52.
- . 2008. The gender issue in energy project planning: Welfare, empowerment or efficiency? *Energy Policy*, 26(12): 945–955.
- Skutsch, M. and Schulte, N. G. 1997. Hitching for the gender and energy problem onto schemes for co-management of local level resources. *In: Gender and land use: Diversity in environmental practices*. Amsterdam: Penguin Books.
- Sustainable Energy for All. 2012. Energy access practitioner network: Towards achieving universal energy access by 2030. UN Foundation.

-
- United Nations Development Programme (UNDP). 2011. *Human development report. Sustainability and equity: A future for all*. New York: Palgrave Macmillan Publishers Ltd.
- UNDP and ENERGIA. 2004. *Gender and energy for sustainable development: A toolkit and resource guide*. New York: UNDP.
- World Energy Council (WEC). 1999. *The challenge of rural energy poverty in developing countries*. London: WEC.
- . 2005. *Regional energy integration*. London: WEC.
- World Bank. 2010. *Global health report*. Washington, D.C: World Bank.
- Zimbabwe Electricity Supply Authority (ZESA). 2011. Annual report. Harare: ZESA.
- Zvauya, C. and Kadirire, H. 2011. Disband ZESA. *Daily News*, Saturday July 9, 2011.

CHAPTER TWO

Gender-Energy Nexus in Ethiopia: An Analytical Review

Alemu Tolemariam and Dejene Mamo

Abstract

Gender differentials in energy poverty have been a concern of policymaking processes in Ethiopia as in many developing economies. However, the fact that the incidence of energy poverty weighs more on women and young girls than on their male counterparts is still a serious concern despite observable improvements recorded in recent years pursuant to the various government and stakeholder interventions. This chapter attempts to assess the main causes of gender energy poverty, existing conditions and the various stakeholder interventions, and discusses their role in unravelling of the gender energy poverty gap based on an integrated analytical review of policy documents and relevant empirical literature. The study established that women bear the incidence of energy poverty mainly because of their socially ascribed roles related to non-paid reproductive and community activities and the poor development of modern energy infrastructure. The study also established that various policies and strategies, relevant to the improvement of both the demand and the supply sides of the energy market, have been introduced and implemented by the government and stakeholders to reduce the incidence of energy poverty. The demand side policies involve mainstreaming of gender into energy policies and programmes, whereas the supply side is concerned with achieving gender parity in the energy sector through the development of clean and renewable energy services. The chapter recommends the reinforcement of concerted efforts by the government and donors in pursuing strategies of expanding access to improved energy technology while engendering the national energy policy.

Keywords: Energy poverty, gender gap, gender mainstreaming, energy policy, Ethiopia.

1. Introduction

1.1. The Study Context

Ethiopia is a landlocked country with a total area of 1.1 million square kilometres, located in the north-eastern part of Sub-Saharan Africa (SSA). The country shares frontiers with Eritrea (912 kilometres) to the north and northeast, Djibouti (349 kilometres) to the east, Somalia (1,600 kilometres) to the east and southeast, Kenya (861 kilometres) to the south, and the Sudan (1,606 kilometres)

to the west. Ethiopia's topographical diversity encompasses high and rugged mountains, flat-topped plateaus and deep gorges with rivers and rolling plains. Altitudes range from 110 metres below sea level in the Danakil Depression in the northeast to over 4,600 metres above sea level in the Simien Mountains in the north. The country is the second-most populous in SSA, with a population of 84,734,262 (World Bank 2011). The population living in rural areas is 82.983 per cent, with females comprising 50.231 per cent of the population. Ethiopian women, like their counterparts in other developing economies, face the hurdle of energy poverty as a result of their socially-ascribed roles related to reproductive and community-based activities. Energy is essential for basic household chores, including lighting, cooking and heating, and because women and girls are primarily responsible for most of the household work, access to energy could result in significant positive changes in their quality of life, especially in health, education, and attendance and participation in income-generating activities. Although it has been proved that energy is an essential factor in economic and social development, limited access to sustainable and modern energy services is a problem that has disproportionately affected women, especially in rural areas.

According to the United Nations Development Programme (UNDP 2011), about 1.4 billion people around the world (one out of five) lack access to electricity and about 2.7 billion people (40 per cent of the world's population) depend on wood and charcoal as a primary source of energy. This implies that poor women around the world face energy-related obstacles, including the time required to collect woodfuel, scarcity of woodfuel in their vicinity, and health problems associated with burning and collecting woodfuel. Various studies and reports have documented the adverse health consequences on women and young girls associated with burning of biofuel and charcoal. The World Health Organisation (WHO 2011) reported that 2 million people, mainly women and children, die annually because of indoor pollutants that emanate from biomass combustion. A study by Parikh (2012) on Himachal Pradesh in India confirmed that girls below the age of five years and females in the 30–60 years age-group (who are usually the main cooks in a family) are at higher risks of being affected by indoor pollutants than their male counterparts of the same age-group.

The scenario in SSA in general and Ethiopia in particular seems even worse. According to UNDP (2012), only 32 per cent of people in SSA have access to electricity and 25 countries are in a state of power crisis. The International Energy Agency (IEA 2011) revealed that 3 billion people, largely in SSA and southern Asia, rely on traditional fuels such as wood, dung and agricultural residue for cooking, agro-processing and heating. Due to limited access to electricity, dependence on biomass energy is very high in SSA economies — 93 per cent in Ethiopia while the figure is in the range of 93–95 per cent for the Democratic Republic of Congo (DRC), Burundi, Tanzania, and Uganda (World Bank 2011).

The continued depletion of existing biomass resources further burdens women in Ethiopia as they are responsible for collection of fuel for household consumption, and are exposed to greater health and safety risks. Along with their mothers, young children are exposed to large amounts of smoke and particulates from indoor fires and suffer from a number of respiratory diseases. Limited access to energy services is directly correlated with the major elements of poverty, coupled with inadequate healthcare, low education levels and limited employment opportunities.

Gender issues have come to the forefront in many development sectors, including agriculture, forestry and water, but the literature in the energy sector has been slow to recognise the links between gender equality, energy and development. Insufficient access to modern energy sources and existing patterns of energy use, processing and collection affect women and men differently. Because of their socially-determined gender roles, women and girls assume a higher proportion of the burden of unavailable energy services and inefficient energy use. Thus, greater attention to the needs and concerns of women in these areas could help governments to promote overall development goals such as eradication of poverty, achievement of the MDGs for employment, health, and education through improved energy policies.

Given this backdrop, therefore, it is essential to study the gender-energy nexus and how the energy development policy has been aligned to gender mainstreaming in the Ethiopian context. The current chapter contributes to the existing body of literature through a detailed analytical investigation of gender mainstreaming in energy sector development, with special emphasis on how energy development interventions and programmes could be implemented so as to provide access to modern energy services and technologies in a gender equitable manner.

1.2. The Problem Statement

Abundant literature on the gender-energy nexus in the developing world indicates a gender differential in energy demand services. Ethiopia is no exception; and the fact that energy utilisation varies between female and their male counterparts is recognised by the National Women's Policy. In Ethiopia, gender inequalities prevail in the design and implementation of many development programmes, projects and activities. Many of these inequalities emanate from socially-ascribed gender roles in the community. Women are more involved in home-based chores (fetching water, firewood collection and taking care of children) and community activities, which are usually less profitable and regarded as "doing nothing". On the other hand, males are involved in more lucrative productive activities that fetch better income. The problem is exacerbated by access to and control over key economic resources by the two groups. While men have more access to and control over resources, such as land, credit and livestock, women are disadvantaged, both economically and socially.

Differential access to and control over key resources, including energy resources, has also impacted men and women differently. The sole energy source for rural Ethiopian communities is biomass. Electricity and motorised energy services are very limited or non-existent. However, various studies indicate that using biomass for cooking, heating and lighting purposes negatively affects women and children, particularly their health, through indoor air pollution. Moreover, the dependence solely on biomass as an energy source also results in high carbon emissions due to depletion of existing forest resources.

Cognisant of these facts, Ethiopia has documented a climate resilient green economy strategy in which the net carbon emission is projected to be zero by 2025 (FDRE 2011). The strategy involves diversifying the country's energy resources to other clean and renewable energy sources (solar, wind and geothermal) in addition to strengthening the already existing hydropower energy sources.

In order to realise the envisaged strategies, different actors have renewed their commitment. Thus, this chapter undertakes an analytical review of the facts and available evidence concerning the gender-energy nexus in Ethiopia, in light of the following research questions:

- What is the gender differential in energy services demand and access to various energy sources?
- What are the adverse consequences on women and children due to limited availability of alternative energy sources?
- How are the new and existing alternative energy sources presented to and accessed by the local population, with regard to gender?
- What are the challenges and opportunities for development actors related to the introduction of clean energy sources and enhancing energy access and utilisation?
- How have international targets, such as the MDGs, impacted the energy sector in Ethiopia, especially regarding access to clean and affordable energy sources and technologies?
- Which are the identified gender roles in the development and implementation of energy policies, projects and strategies?
- What is the extent and degree of mainstreaming gender into energy policies and strategies?

1.3. Study Objectives

The main objective of this study is to analyze gender-energy linkages in Ethiopia. More specifically, the study aims to:

- document past trends which have contributed to the inequitable present state of affairs in the gender- energy nexus in Ethiopia.

- analyze gender roles in the development and implementation of development policies, including energy policies, projects and strategies.
- identify the nature and type of government organisations, and non-governmental organisations, interventions in addressing issues of gender-based access to energy, and elaborate successes, failures and experiences gained.
- explain the gender empowerment and mainstreaming strategies pursued in energy sector development as an intervention policy of the government.
- analyze the gender-energy nexus policy gaps, and propose appropriate strategic interventions.

1.4. Study Methodology

This chapter adopted an integrated analytical approach involving the analysis of primary and secondary information. The study relied on primary information acquired through interviews with Director of the Rural Electrification Agency, the Gender Office of the Ministry of Water and Energy, as well as secondary information collected through review of relevant literature, government policy documents, and other publications and reports produced by international agencies such as the United Nation Development Programme, International Energy Agency, World Health Organisation, United Nations Economic Commission for Africa, and World Bank. Annual reports from the Central Statistical Agency (CSA) of Ethiopia, the Ministry of Water and Energy, and the National Bank of Ethiopia were also reviewed.

1.5. Organisation of the Chapter

This chapter is structured into six parts. The first part is the introductory section, which attempts to put into proper context the global, regional and national gender-energy-poverty challenge, and the place of women in the energy sector scenario. It also highlights the energy sector development policies that have been formulated and pursued by the Government of Ethiopia, and examines the gender equity consequences of the execution of these policies. Part two presents the review of literature on the nature, causes and consequences of gender energy poverty. The review culminates with a documentation of the schematic design of the conceptual framework developed by the researchers, based on the analysis of evidence in the literature review. The third section of the paper presents documentation of the analysis of past trends which have contributed to the present state of affairs in gender inequality, in Ethiopia. It gives a clear picture of the degree to which national policies of Ethiopia are engendered, with particular emphasis on the energy sector policy. Part four deals with a diagnosis of the nature of the energy supply and demand situation in the country. It also illuminates on the potential sources of renewable energy in

Ethiopia, with focus on the extent of exploitation of these potentials. Part five analyses the gender implication of access to modern energy technology, at household level. It elaborates on national programmes to enhance access to improved energy technology along with the level of outreach performance, in the context of Ethiopian economy. The last section concludes the discussion and explores policy implications on engendering the energy sector and its institutional framework, to achieve gender equality within the energy sector in Ethiopia.

2. Literature Review and Conceptual Framework

The use of “women” or “gender” has been controversial starting from the 1960 feminist movement in the United States of America (Wamukonya 2002). Initially, equity and social concerns were determined as “women’s” issues and not gender-related; but the work of Ester Boserup in the 1970s, articulated in the publication *Women’s Role in Economic Development*, drew attention to the economic disparities between women and men, and the lack of integration of women in development programmes in developing countries. This resulted in proposals that changed the paradigm from “women in development” to “gender and development”. Henceforth, gender is defined as the socially-constructed roles and socially-acquired behaviours and expectations associated with the relationship between men and women (World Bank 2001).

Previous studies (Barnett 2000; Clancy and Skutsch 2003; Nyoni 1993; Tucker 1999; Wilson and Green 2000) have explored the gender-energy-poverty nexus. For instance, Clancy and Skutsch (2003) argue that out of the approximately 1.3 billion people living in poverty, it is estimated that 70 per cent are women, and, in most cultures, women and men have differing roles and responsibilities, according to socially-defined division of labour, based on gender. This gender asymmetry is reflected in various social and economic dimensions. In terms of reproductive activities, women generally have primary responsibility for the care and feeding of children and families, as well as healthcare and education. In many developing countries, it is the women who perform most of the work related to subsistence agriculture, plus gathering and managing fuel and water.

Martine and Villarreal (1997) indicated that traditional practices by extension officers render energy-related problems irrelevant in developing countries. This leads to the question of whether a gendered loom can address the real problematic issues for women. Parikh (1995) justifies gender-related energy policies in developing countries on the basis that they are made necessary by the low income in these countries. However, challenges within the gender-energy-poverty nexus concern the ideas of access and control over resources, including energy, which directly contributes for the gender differential in earning and utilising income generated from these resources.

Historically, the gender-energy approach of the developing economies is justified on the basis that women use energy differently from men, and that providing energy to women will improve their livelihoods. Some have also argued that energy is a basic good (Clancy 1999), implying that women are entitled to it as much as to health and education. This “basic good” view is contentious. The World Energy Council [WEC] (1999) and United Nations Development Programme [UNDP]/ESCAP (1990) recognise that energy is not a basic good although it is a useful input for satisfying basic needs. As the world transits into a globalised existence and the role of government vis-à-vis the private sector shifts, with increased emphasis on the responsibility of the latter to meet the demand for energy, the focus on women and energy has been progressive in addressing the challenges of sustainable development. Skutsch (2001) argues that as a result of the contextualisation of energy problems as having a women’s dimension, solutions have generally been crafted against this background, so that the general framework has focused on advocating and implementing a women-targeted approach, both at the end-user and decision-making levels; advocating for increased access to electricity for women; and more recently, using decentralised electrification technologies as well as setting up micro-financing schemes to provide credit to women for energy and other needs.

Access to modern energy is essential in countering the energy poverty of women. The IEA defines energy access as “a household having *reliable* and *affordable* access to clean cooking facilities, a first connection to electricity and then an increasing level of electricity consumption over time to reach the regional average” (IEA 2011, 473). The IEA definition emphasises the *economic* context of affordability, the *security* element of reliability, and focuses on access to electricity and cook stoves, with a long-term objective of increasing the level of energy consumption to some regional standard. Therefore, access to electricity and cook stoves is emphasised (*ibid.*).

Policies and approaches for gender empowerment have been pursued as one of the essential factors to promote economic growth and development at the international as well as national levels over the past two decades. Two important events that brought “mainstreaming of gender issues” to the forefront in the energy debate were the 1992 Rio Summit and the 1995 Beijing Conference. The 1992 United Nations Conference on Environment and Development drew attention to the linkage between environment and economic development. It also led to international recognition of the fact that extension of the benefits of development to all people, men and women, is fundamental to the fulfilment of the social equity objectives of sustainable development (UNDP 2003).

In 1995, the Fourth World Conference on Women, held in Beijing, emphasised the need to promote greater overall development opportunities for women. With regard to energy, the Beijing Platform for Action called

on governments to support the development of equal access for women to sustainable and affordable energy technologies, including renewable energy efficiency technologies, through participatory needs assessment, energy planning and policy formulation at local and national levels. The term “gender mainstreaming” came into widespread use with the adoption of the Beijing Platform for Action, in 1995. In 2000, the Millennium Development Goals (MDGs) also included a specific goal on gender equality and women’s empowerment. In 2002, the World Summit on Sustainable Development (WSSD) further reinforced this and called upon nations to eliminate all forms of discrimination against women. Gender mainstreaming in the energy sector requires concrete strategies with significant participation of stakeholders from the government, NGOs and community-based organisations. Dutta (2003) suggests the following framework (Figure 1) for successful mainstreaming of gender issues into energy policies and programmes.

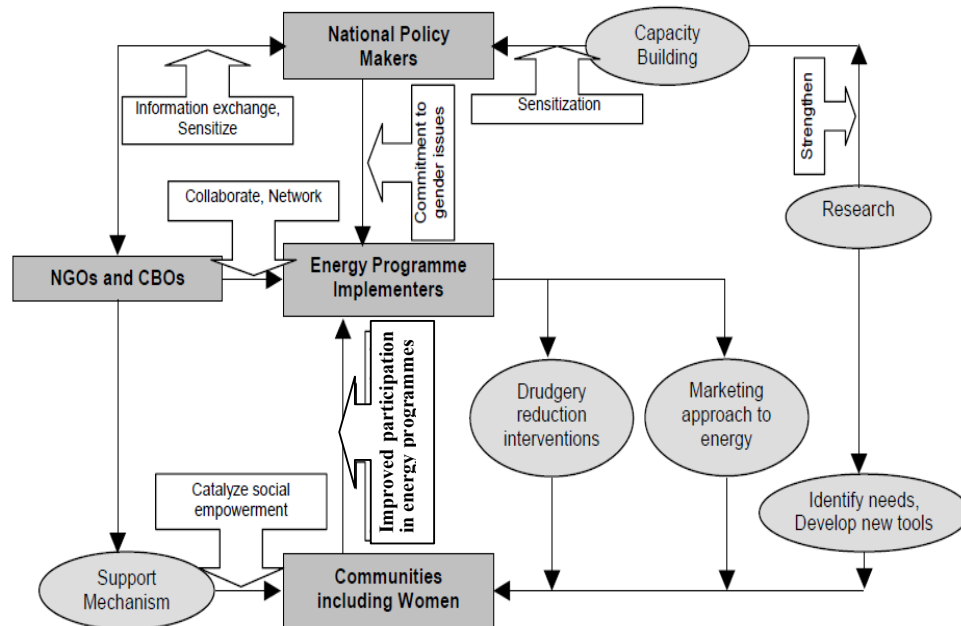


Figure1. Framework for Mainstreaming Gender into Energy Sector Policies and Programmes

SOURCE: Adapted from Dutta (2003, 43).

Based on the reviews and discussions in the preceding section, authors developed the conceptual framework of this chapter, schematised in Figure 2.

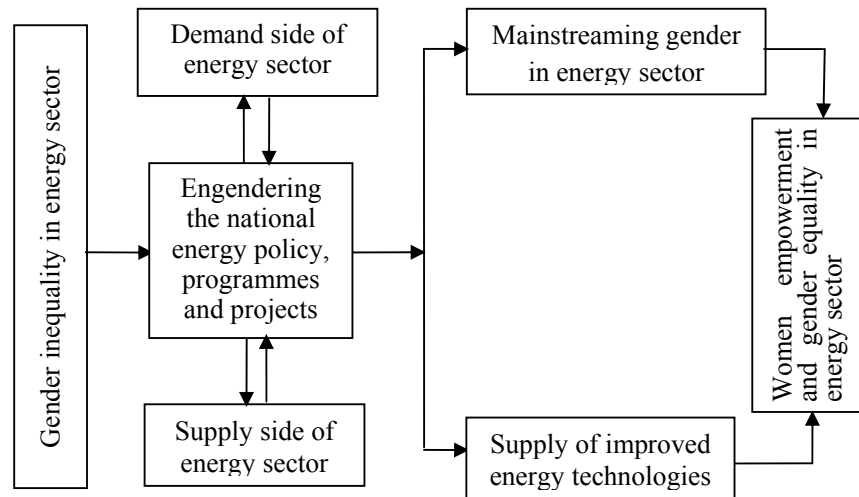


Figure 2. Schematic Design of the Conceptual Framework

SOURCE: Authors' views based on literature review

3. Gender Analysis of National Energy Policy of Ethiopia

The majority of Ethiopian women, like their Sub-Saharan African (SSA) counterparts, hold a low status in society. This has been manifested in lack of equal access to education, training and gainful employment opportunities, and their low involvement in policy formulation and decision-making processes. However, women play a fundamental role in the community by taking care of all social activities. In spite of this, they do not enjoy the fruits of their labour and they endure political, economical, social, and cultural marginalisation. Although women constitute more than 50 per cent of the population and contribute their share in community and household activities, they have not benefited from their labour in parity with their male counterparts. Available evidence reveals that the involvement of women in qualified jobs and related fields is very low. The Labour Force Survey (CSA 2005) indicates that the majority of employed females (68.5 per cent) were unpaid family workers while 54.8 per cent of males were self-employed. This implies that the majority of women perform tiresome, low-paid and even unpaid jobs. The 2007 census on employment also shows that women represent only 33.48 per cent of total government employees and more than 90 per cent of them are engaged in low-grade jobs.

3.1. The Millennium Development Goals Contextualised to Ethiopia

Ethiopia has been committed to the achievement of the MDGs, by 2015. The MDGs consolidate previous international agreements and protocols on women's rights, empowerment and equality into a single set of goals and targets to be achieved. MDG-3 (Table 1) shows that gender equality is both a goal in itself and a condition for achieving the other goals. If the energy

sector provided equitable services to the people in accordance to their needs, it would be possible to contribute significantly to reaching many of the MDGs. However, since energy is a crosscutting issue and is not expressly mentioned in the eight goals, it is easy for the sector to gloss over them and not feel directly responsible for the attainment of the goals. It is, therefore, important for the sector to itemise the issues that concern it and how it will contribute to the attainment of these goals. The contribution of energy to MDGs, and thereby to gender equality, in the Ethiopian context, is elaborated in Table 1.

Table1. Gender and energy linked to the Millennium Development Goals

MDG-1: Eradicate extreme poverty and hunger	Since more women than men are living in poverty (59.24 per cent of economically inactive population according to the 2007 National Census), ensuring that women's energy needs are met will reduce women's burdens in providing food and water for their families, and improve their ability to earn income.
MDG-2: Achieve universal primary education	Girls are more likely than boys to be kept away from school because they are needed to help their mothers with the burdens of gathering fuel and water, and performing domestic and agricultural chores, or because there is not enough money to send them to school. Proper energy services reduce such burdens significantly
MDG-3: Promote gender equality and empower women	Because 68.5 per cent of employed females are unpaid family workers, better access to energy services frees women from extreme household drudgery, increases their educational and employment possibilities, and allows them to participate more fully in community and political affairs.
MDGs-4, 5 and 6: Reduce child and maternal mortality and combat infectious diseases	As 95 per cent of the energy need is satisfied with traditional biomass, cleaner cooking fuels and improved stoves reduce respiratory illnesses that affect women and children. Pumped water from clean sources, and/or energy for purifying water reduces the spread of water-borne diseases associated with child mortality. Energy services allow health clinics to have lights, water pumps, medical refrigeration for drugs and vaccines, medical instruments, fans and sterilisers.
MDG-7: Ensure environmental sustainability	Women, especially in rural areas, impact on the sustainability of land and natural resources in their traditional roles as managers of wood and biomass fuel supplies and related environmental resources.
MDG-8: Develop global partnerships	There is a growing interest to take advantage of emerging global mechanisms, such as the Green and Sustainable Development Mechanism, among others, to realise win-win outcomes, translating to national and global benefits. Gender perspectives within such arrangements are however not clear so far.

SOURCE: Adapted from DFID-UK (2002).

3.2. National Policy Frameworks

To fix the centuries-long gender disparities, the Government of Ethiopia constitutionally recognises gender concerns and has formulated several laws and policies to promote gender equality. In particular, Article 35 of the Constitution of the Federal Democratic Republic of Ethiopia clearly stipulates the political, economic and social rights of females as equal to males (FDRE 1994c). The government has also been promoting mainstreaming of gender in all its development policies and strategies, to address gender inequality. National policy frameworks, including the National Energy Policy, are guided by constitutional provisions. The energy sector in Ethiopia, which is guided by the National Energy Policy (Federal Democratic Republic of Ethiopia [FDRE] 1994a, revised 2009) has been developed in the context of the overall national policy framework. The national policy framework includes Vision 2025 Climate Resilient Green Economy, the MDGs and their domestication to the Ethiopian contexts and the National Gender Policy. Other key policies closely linked to the National Energy Policy also include the National Environmental Policy, National Educational Policy, National Agricultural Policy, and National Policy on Science and Technology. The linkage lies in the fact that all these policies are interconnected and overlap in terms of their objectives, activities and scope. Accountability, good governance as well as mainstreaming of crosscutting issues, such as gender, HIV/AIDS and environment are also common prerequisites in all these policies.

The Government of Ethiopia has articulated a national vision termed as Vision 2025, in which the country aspires to be a middle income nation by 2025 (MoFED 2010). The specific goal for energy in Vision 2025 is that there would be universal access to clean, reliable and affordable energy, at the lowest total economic, financial, social and environmental cost, consistent with national development goals, by 2025 whilst its gender goal is that there would be gender equity and equality in the socioeconomic development process by 2025 (FDRE 2011). These goals are very broad and do not specifically address the issue of gender equity in energy. It is important, therefore, that gender equity in the energy sector be unpacked and defined in order to design specific programmes to meet these goals. Despite the long-term frame in which the vision will be implemented, its realisation will be determined by the actions and measures that the government, cooperating partners, private sector, civil society, NGOs, and individuals will take through short, medium, and long-term plans. The vision, therefore, serves as a guide to all development efforts and the energy sector is no exception. The vision began to be translated into tangible action with the growth and transformation plan (Phase I, 2010–2015). By the end of this phase, at least 80 per cent of households will be expected to benefit from modern energy services.

3.3. National Women's Policy

The National Women's Policy was formulated and adopted in 2004 in order to address gender inequality (FDRE 2004). National institutional machineries were established at federal, regional and *woreda* (district) levels, to implement the policy. The Women's Affairs Office was re-established as a full-fledged ministry in October 2005, with the duties and responsibilities of ensuring participation and empowerment of women in political, economical, social, and cultural matters. However, evidence shows that the participation of women in political and policy decision-making is still far from achieving equity. Females occupy only 27.79 per cent of the legislative and hold only a limited number of ambassadorial and ministerial portfolios in the executive branch of government (Tables 2 and 3). Participation of women in political decision-making processes facilitates the degree of engendering energy sector policies, programmes and projects. Hence, women's participation and representation matters for the reason that access to energy for women is influenced by the extent of mainstreaming gender in the energy sector.

Table 2. Women's representation in Federal Parliament

	2000 to 2005		2005 to 2010		2010 to 2015	
	Male	Female	Male	Female	Male	Female
House of People's Representatives	502	42	413	117	395	152
House of the Federation	110	7	91	21	96	16

SOURCE: House of People's Representatives (2012).

Table 3. Women's representation in the Executive Branch

	2000 to 2005		2005 to 2010		2010 to 2015	
	Male	Female	Male	Female	Male	Female
Ministers	16	1	20	2	20	2
Deputy minister/State ministers	12	4	30	5	42	6
Ambassadors	16	4	35	3	N/A	N/A

SOURCE: Federal Civil Service Agency (2012)

The National Women's Policy of Ethiopia indicated some key policy guidelines and objectives with regard to equality of women in their political, economic and social roles. There is no energy-sector-specific policy guideline in the National Women's Policy, unlike the case in SSA economies, such as Kenya, Zambia and Tanzania, where the gender policy specifies the energy sector policy objectives. The following are the specific women's issues supported by this policy (FDRE 1994b):

- Ensuring the full development and advancement of women and guaranteeing them the enjoyment of their democratic and human rights so that they can participate in the economic, social and political life of their country, on equal basis with men.

- Modifying or abolishing existing laws, regulations, customs, and practices, which aggravate discrimination against women and facilitating conditions conducive to the participation of women in the decision-making process at all levels.
- Creating a situation whereby society's discriminatory attitude towards women and women's complacency about it are eliminated through an elevated awareness.
- Making sure that women participate in the formulation of government policies, laws regulations, programmes, plans, and projects that directly or indirectly benefit and concern women as well as in the implementation thereof.
- Encouraging research work on ways and means of lightening the workload of women as well as increasing their income and compiling the results thereof for use by others, too.
- Coordination of all government programmes that concern women and following-up their implementation to make sure that they are free of duplication and do not involve unnecessary costs.
- Incorporating women's affairs into the government structure and entrusting a government body with it as well as establishing branches thereof in all ministries and governmental organisations.
- Making sure that government policies, laws, regulations, plans, and other activities are based on participation of women in implementation of development programmes thereof, on an equal basis with men and guaranteeing equal benefit to them.

These policy intentions are articulated with the presumption that gender is a crosscutting issue and it is obvious that these aspirations cannot be realised by a single government agency or ministry, but concerted efforts from all key stakeholders are required. The government, through the Ministry of Women and Youth Affairs and the National Women's Policy, has gone further to provide the public sector with guidelines for mainstreaming gender in the public sector. Energy sector gender mainstreaming is aimed at ensuring that women and men have access to and control over energy sources equitably, and that information related to the energy sector is disseminated to women, men and children.

However, there is no mechanism in place for monitoring whether the ministries are mainstreaming gender or not, and issues of inequalities between men and women are not specified; nor have indicators been developed. Based on the broad guidelines of the National Women's Policy, it is the responsibility of each ministry, in this case the Ministry of Water and Energy, to develop targets, indicators, and activities in accordance with their resources and mandate. The Ministry of Women and Youth Affairs works with the gender-focal persons responsible for coordinating the activities in each ministry.

3.4. National Policy on Education and Training

The National Policy on Education and Training was adopted in 1994 (FDRE 1994b) with its major goals as follows:

- Develop the physical and mental potential and the problem-solving capacity of individuals by expanding education, and in particular, by providing basic education for all.
- Bring-up citizens who can take care of and utilise resources wisely, who are trained in various skills, by raising the private and social benefits of education.
- Bring-up citizens who respect human rights, stand for the wellbeing of people, as well as for equality, justice and peace, endowed with democratic culture and discipline.
- Bring-up citizens who differentiate harmful practices from useful ones, who seek and stand for truth, appreciate aesthetics, and show positive attitude towards the development and dissemination of science and technology in society.
- Cultivate the cognitive, creative, productive, and appreciative potential of citizens by appropriately relating education to environment and societal needs.

In relation to gender, the policy recognises the centrality of women's contribution to national development and has therefore articulated the need to integrate gender into all education interventions and gear education towards reorienting society's attitude and values pertaining to the role and contribution of women in development. Current statistics show that the enrolment of girls at primary schools, like in most SSA economies, has significantly improved although their participation in secondary and higher education institutions signifies that more effort should be exerted to bring gender parity in education and training (Table 4). The narrowing of educational opportunities for girls becomes even more prominent at tertiary level.

Table 4. Summary of recent education sector development data

Indicators	2006/07	2007/08	2008/09	2009/10	2010/11
Improvement of education service					
Universities	21	22	22	22	26
Student intake capacity of higher education institutions	43,764	56,421	NA	NA	95,000
Participation of women in higher education institutions (%)	26	24	22.2	27	27
Primary enrolment (in millions)	14.0	15.3	15.6	15.8	16.7
Secondary enrolment (in thousands)	1,399	1,501	1,588	1,696	1,760
TVET enrolment	191,151	229,252	308,501	353,420	371,347
Girls' primary enrolment (%)	45.9	46.5	47.3	47.4	47.3
Grades (1–4) gross enrolment ratio (%)	117.1	127.8	122.6	118.8	124
Girls' gross enrolment ratio	111.2	122.8	118.4	114.3	119.1
Boys' gross enrolment ratio (%)	122.9	133	126.7	123.2	128.8
Grades (5–8) gross enrolment ratio (%)	61.1	60.2	63.1	65.5	66.1
Girls' gross enrolment ratio (%)	53.7	55.5	60.5	63.5	64.8
Boys' gross enrolment ratio (%)	68.3	64.8	65.6	67.4	67.4
Girls' gross primary enrolment ratio (%)	85.1	90.5	90.7	101.6	93.2
Boys' gross primary enrolment ratio (%)	98	100.5	97.6	108.4	99.5
Gross primary enrolment ratio (%) (urban, rural)	91.7	95.6	94.4	93.4	96.4

SOURCE: National Bank of Ethiopia (2010/2011).

3.5. The National Energy Policy within Gender Perspective

The National Energy Policy of Ethiopia (FDRE 1994a, revised 2008) is a guideline to be implemented and used by various stakeholders in meeting development objectives which aim at improving the lives of Ethiopians in the energy sector, through improved energy availability, supply and use. According to the National Energy Policy, the ministry responsible for

energy in the country is the Ministry of Water and Energy, which has the overall responsibility of implementing the policy. It plays a coordinating role in the whole energy sector and takes the lead in developing new public sector or government-led energy related programmes, projects and activities. It further states that other ministries and statutory bodies should ensure that they execute policy provisions within the context and confines of their legal mandates (FDRE 1994a).

In practice, the Ministry of Water and Energy has been working with various stakeholders such as other government ministries, the Rural Electrification Authority, energy utilities, private institutions involved in the development of energy resources, the Environmental Protection Authority of Ethiopia, the Ministry of Forest and Natural Resources, donor organisations as well as gender and energy networks in various platforms. It is advantageous that the policy outlines who the lead player is in the sector, and therefore, it is important that the Ministry of Water and Energy takes the lead in gender mainstreaming activities in the sector. However, the policy is very generic and current policy measures on energy appear to be gender-neutral. The Ministry of Water and Energy works with various stakeholders in various sub-sectors of the energy sector. Relations with the stakeholders in these sub-sectors are high-level and of high priority to the country economically and politically. However, the lack of gender integration in their discussions is noticeable. The topic of gender is left to lower ranking female staff from the various stakeholder institutions, which indicates the lower priority and importance assigned to this area and prevents consideration and implementation of the gender mainstreaming policy.

According to the National Women's Policy, it is the responsibility of the Ministry of Water and Energy to prioritise gender in the energy sector and lead in the implementation of all the areas identified in the National Energy Policy. But the energy agenda, including the gender aspects, remains a very centralised and urban-based programme. Most of the stakeholders, particularly the Ministry of Water and Energy, have no structures or presence in the provinces or districts. This makes it difficult for the Ministry of Water and Energy to be influenced by, or even informed of, the situation of ordinary citizens as far as their energy needs are concerned. This is a major reason for the lack of integration of the main energy stakeholders in gender issues and concerns of the communities they are meant to serve.

As is the case in other SSA economies, it is difficult to analyze gender issues in the functioning of the Ministry of Water and Energy of Ethiopia as there is a general lack of gender disaggregated data of their operations, or even the activities and programmes they implement. It is important that the Ministry of Water and Energy focuses on this cause and guides other stakeholders to do the same because, according to the National Energy Policy, they are the leaders and coordinators of the policy, which outlines

the need for gender mainstreaming in the sector. The limited success of gender mainstreaming in the energy policy, programmes and activities is attributable to the fact that the energy policy appears gender-neutral with more emphasis on economic necessity of energy resource development, its price affordability and utilisation (World Bank 2010). The following summary explains this situation briefly:

- The gender perspectives are not articulated in the policy document. This means that it would be unlikely that gender issues would be considered relevant when planning small-scale rural and urban energy projects.
- There is no mention of what is to be done to eliminate gender disparities, with respect to each policy measure of the energy policy.
- The analysis of the vision statement of the energy policy, which is “to promote equitable access to quality energy services at least cost while protecting the environment”, revealed that it would be unlikely to achieve equitable access, so long as the historical gender biases are not explicitly addressed at policy level.
- The property rights system, income disparities between men and women and household decision-making power, adversely and disproportionately impact on women regarding access to and control over productive economic resources including energy.
- Strict adherence to least cost criteria to energy supply while ignoring the socio-cultural dynamics can only exacerbate the incidence of energy poverty already experienced by women.

4. Gender Implications of Energy Supply and Demand

4.1. The Potential Sources of Energy in Ethiopia

The fact that the incidence of energy poverty falls on women more than men has been explained in the previous sections. Expansion of access to energy from different sources could at least remedy the situation. Ethiopia, similar to other SSA countries, is endowed with different potential sources of energy, most of which are renewable. Such sources include solar energy, hydropower, wind power, biomass energy resources, and geothermal energy (Tables 5 and 6).

New renewable energies, such as wind, solar and modern biomass, are valuable alternatives to supplying the rural population with energy, to reduce the incidence of women’s energy poverty. For instance, wind power and geothermal energy are becoming increasingly competitive in Africa, in general, and Ethiopia recently commenced investment in these sectors in different parts of the country. Solar energy is gradually being applied to water heating (solar water heaters), water pumping, cooking, and food drying, besides the various photovoltaic (PV) applications. The

contribution of new renewable energy options in the future is expected to increase the primary energy mix for Ethiopia.

Table 5. Energy resources of Ethiopia

Resource	Units	Exploitable potential	Currently exploited
Wood biomass	Million tonnes	74 per year	60 per year
Crop residue	Million tonnes	38 per year	4.9 per year
Animal dung	Million tonnes	29.8 per year	7.8 per year
Solar radiation	KWh/m ² /day	5.2 to 6.5 per day	About 5 MW
Wind power	m/s	3.5 to 9	80 MW
Hydropower	MW	45,000	2000
Geothermal	MW _e	5000	7.3
Bio-ethanol	Million litres	300 to 2000 per year	8 per year
Natural gas	Billion m ³	110	-
Coal	Million tonnes	300	-

SOURCE: Adapted from Japan International Cooperation Agency (2012).

Table 6. Installed power capacity of Ethiopia, by source

Energy Source	Installed capacity (MW)
Hydropower energy	1842.6
Geothermal energy	7.3
Small-scale hydropower and diesels	158.8
Solar radiation energy	5.00
Wind energy	80
Total power generation	2093.70

SOURCE: Ministry of Water and Energy (2011/2012).

4.2. Access to Energy and Electrification Status in Ethiopia

Table 7 indicates that biomass accounts for a predominant share of total energy supply (92.6 per cent), followed by imported petroleum energy (5.4 per cent). Even though hydroelectric power expansion is quite significant, its share of total energy supply pales in comparison and it is still lower than the share of imported energy. The household sector is, by far, the largest energy consuming sector (89 per cent) (using mainly biomass for cooking), followed by the transportation sector (using almost exclusively imported fuels except recent efforts to integrate biofuels into the mix). The industrial and services sectors demand a much lower level of the energy share.

Therefore, from an energy security perspective, what happens to sustainable management of the biomass in the country, the trend in dependence on imported fuel, and progress in the electricity sector, are areas to watch closely. Woody biomass represents the principal form of cooking and lighting fuel in the country's rural areas, and an increasing fraction of the population is being confronted with the difficult choice between eating its food poorly cooked and travelling long distances to collect fuel for cooking. The scarcity of woodfuel has led to an increased utilisation of dung and agri-residues for cooking, which could otherwise have been used to enhance the nutrient status and texture of the soil, and contribute positively to agricultural production.

A similar pattern of reliance on biomass is noticeable in SSA economies, with 74 per cent average dependence on biomass, although the country-specific biomass dependency rate varies — 67 per cent in Nigeria, 94 per cent in Democratic Republic of Congo (DRC), 94 per cent in Tanzania, 83 per cent in Kenya, and about 93 per cent in Ethiopia (UNECA 2012). Available evidence suggests that rapid decline in forest bio-stock and growth in demand in Ethiopia, coupled with the largely unsustainable harvest are sources of serious concern for biomass-dependent household energy security, in terms of availability of sufficient supply and affordability of wood and charcoal, particularly in urban areas. The pace of transition to alternative indigenous green energy sources (such as electricity), integration of improved and efficient cook stoves as a mitigation technology, sustainable forest harvest, and overall energy portfolio transition will remain structural challenges for Ethiopia.

Given that one of the household roles for females in Ethiopia is cooking, the implication of this evidence is that women face the stumbling blocks of energy production from biomass and the adverse consequences of its uses, in terms of their health and participation in income-generating activities as they spend much of their time collecting woodfuel and travelling long distance in search of the same. A stable supply of adequate and renewable energy is important not only for industrialisation but also for gender equality. Access to modern and renewable energy reduces the energy poverty of women, specifically in rural areas, and that of the urban poor (Dutta 2003).

Moreover, a growing concern for continuing dependence on biomass for energy, with limited transition to modern energy sources, poses the challenge of unsustainability of the biomass energy source. For instance, the demand for wood in eastern Africa in general and Ethiopia in particular, is increasing, with a declining resource base. This complicates the solution to the energy problem, requiring a fast move to energy transition while sustainably managing the biomass resources of the country. Energy accessibility is crucial for social development. At the micro-level, the existing heavy reliance on biomass and limited transition to modern energy sources has social costs, including indoor pollution and the opportunity cost

of retrieving firewood. Based on the World Health Organisation (WHO) data, the IEA (2011) estimates that globally, some 1.3 million lives are lost due to health complications related to inhalation of smoke from biomass burning. This impact largely affects women and children.

Table 7. Energy consumption in Ethiopia

Consumption	Source of energy measured in tera* joules						%
	Biomass			Electricity		Petroleum	
	Woodfuel	Crop residue	Animal dung			Total	
Urban hh**	40,825	2824	3263	1832	4161	52905	7.1
Rural hh	509,881	49186	50629	-	3171	612867	82.1
Agriculture	-	-	-	-	1497	1497	0.9
Transport	-	-	-	-	26743	26743	6.1
Industry	17,213	1409	1396	1864	4573	26455	0.5
Services	22,219	1031	1046	1145	331	25772	3.5
Total	570,138	54540	56334	4841	40476	746239	
%	78.1	7	7.5	2	5.4		100

SOURCE: Ministry of Water and Energy (2011/2012)

Notes: * Tera 10¹² or 1 billion; **hh =Stands for household

Access to modern energy in Ethiopia has been considerably improving in recent years, rising from 16 per cent in 2005 to 41 per cent in 2012 (Ministry of Water and Energy 2012), while the average access rate for SSA is 32 per cent (IEA 2012). This is largely attributable to efforts of the Ethiopian Electric Power Corporation and the Government of Ethiopia at large in constructing new power plants and expanding the national grid with a record that surpassed the SSA average, but yet, it still leaves about 49.5 million people without access.

The analysis of electricity access rates in some of the SSA economies makes Ethiopia's access performance a relatively commendable achievement. Access rate is 1 per cent in the South Sudan (leaving 9.3 million people without access), 9 per cent in Uganda (leaving more than 28 million people without access though recent reports place access at 12 per cent), 11 per cent in DRC (leaving nearly 59 million people without access), 13.9 per cent in Tanzania (leaving nearly 38 million people without access), and 16.1 per cent in Kenya (leaving more than 33 million people without access). However, the access rate figures do not reflect the proportion who are actually using electricity because it is calculated by the population living in the electrified area (which means the area reached by the national grid), but many of the poor do not have money to meet the cost of distribution lines from the national grid to their houses; hence, they are

left without electricity. This means that the real access rate of the population that is actually using electricity is lower than the officially reported access rates.

Access to diversified and clean energy forms contributes enormously to practical, productive and strategic needs of women as it relates to gender-energy-poverty reduction (Table 8). Skutsch (1998) emphasised that energy should be seen not just as an efficiency or welfare element in development; it should also be seen as an indirect means for enhancing gender equity, as well.

Table 8. Possibilities for improving the position of women through energy

Energy form	Women's needs		
	Practical interests	Productive interests	Strategic interests
Electricity	• pumping water: ◦ reducing need to haul and carry. ◦ mills for grinding. ◦ lighting improves working conditions at home.	• increase possibility of activities during evening hours. • Provide refrigeration for food production and sale. • power for specialised enterprises (hairdressing and internet cafes).	• make streets safer: ◦ allowing participation in other activities (evening classes and women's group meetings). ◦ open horizons through radio, TV and internet.
Improved biomass (supply and conversion technology)	• improved health through better stoves. • less time and effort in gathering and • carrying firewood.	• more time for productive activities. • lower cost of process heat for income-generating activities.	• control of natural forests in community forestry management frameworks.
Mechanical	• milling and grinding. • transport and pottering of water and crops.	• increases variety of enterprises.	• transport: • allowing access to commercial and social/political opportunities.

SOURCE: Department for International Development (2002b).

5. Gender and Improved Energy Technology

The vast majority of Ethiopians have no access to modern energy sources. They cook on three-stone fires, using biomass from trees and forests, and light their houses with smoky kerosene lamps. Health posts and health centres in their neighbourhoods lack the equipment to perform reliable diagnosis and their children cannot do their homework in the evenings. The Ethiopian government and external donor funding institutions, including civil societies, have been investing in expansion of improved energy technologies. The technologies and services predominantly promoted include photovoltaic energy, micro-hydropower, distribution of energy-efficient cooking stoves, and enhancement of access to biogas for household use. These endeavours are meant to improve access to clean energy sources and reduce the burden on women and children of collecting firewood for lighting and cooking. Following are some sources of clean energy that are being promoted by the Ethiopian government and other development actors.

5.1. Photovoltaic (PV) Solar Electricity Applications

The first PV systems were installed in Ethiopia in the mid-1980s. These systems were installed for rural home lighting and school lighting. The largest of these was a 10.5 kWp system installed in 1985, in central Ethiopia, which served 300 rural households through a micro-grid in the village. This system was later upgraded to 30 kWp in 1989, to provide power for the village water pump and grain mill. It is estimated that a total of some 5.3 MWp of PV is now in use in Ethiopia (Ministry of Water and Energy 2012). The main area of application for PV is off-grid telecom systems (particularly for mobile and landline network stations), which account for 87 per cent of total installations. Photovoltaic systems are also used in social institutions, including health stations, schools and for water pumping. Some 30,000 residential customers are also served with PV in rural areas, easing energy poverty for women (see Table 9).

Table 9. Photovoltaic installed capacities in Ethiopia

Service provider	PV installed capacities measured in kWp by sector					Total
	Telecom	Schools	Health sector	Water	Home and business	
Public	4.600	101	170	-	40	4.911
Private	-	-	-	-	48	48
NGOs	-	28	191	30	56	305

SOURCE: Adapted from Ethio Resource Group (2012).

The outlook for the solar electricity sector in Ethiopia projects a rapid increase in installation of off-grid applications, and later, for grid-connected

applications. Off-grid applications will be dominant in the short-term but grid-connected PV may become important in the medium and long-term. Short-term plans that have direct relevance for the PV sector include plans to disseminate more than 3 million PV home systems and increase mobile ownership to 40 million. Off-grid telecom applications now account for 87 per cent of the total installed PV capacity in Ethiopia. Strong growth is foreseen in the coming ten years for this segment due to the drive for universal access to mobile connectivity (the plan is for 90 per cent mobile network coverage and 40 million mobile users, by 2015). This will result in doubling of installed PV capacity by 2015, then again doubling by 2020. This will be public sector-driven demand and is highly likely to be realised.

5.2. Modern Cooking Stoves

Modern cooking stoves refer to fuel-efficient wood or charcoal-burning stoves, or stoves using new energy sources such as LPG, electricity and solar energy. It is well-documented that indoor air pollution from burning wood, animal dung and other biofuels is a major cause of acute respiratory infections, which constitute the most notable cause of death for young children in developing countries (Murray and Lopez 1996). Through its effect on respiratory health, indoor air pollution is estimated to cause between 1.6 and 2 million deaths per year in developing countries (Smith 1999). Most of the deaths occur in poor households, and approximately 1 million of the afflicted are children (Smith 1999; Smith 2000). Environmental issues, such as natural resource degradation, are exacerbated with the use of traditional cooking stoves, which range from three-stone open fires to substantial brick-and mortar models and cook stoves with chimneys. In light of this, the promotion of modern stoves is essential to deter these challenges, of which women are the main casualties.

The Ethiopian government, supported by development agencies, has been promoting the development and distribution of fuel-efficient modern cook stoves to households (FDRE 2011). The Ethiopian cook stove market has been able to disseminate 4.4 million modern stoves up to 2011 (Miranda 2011), which made about 27 per cent of the total population acquire modern stoves. The access to modern fuels for cooking ranges widely in SSA, from less than 3 per cent of the population in Uganda, Mozambique and Tanzania, to 96 per cent in Mauritius and 83 per cent in South Africa. The Government of Ethiopia envisioned the production and dissemination of 9.4 million modern cooking stoves, with the focus on *injera* stoves within the growth and transformation plan (GTP Phase-1) (MoFED 2010). By 2015, every household in Ethiopia is anticipated to have access to modern cooking stoves, of which women shall be the main beneficiaries. Modern and fuel-efficient cooking stoves made locally, such as *mirit*, reduce the drudgery linked to fuel collection and cleaning but time poverty is limited to collection. At the moment in time where many family decisions are taken, women are then removed from the decision-making arena. However, fuel-efficient stoves that allow cooking in a smoke-free

kitchen might contribute to strengthening women's position in the household. Improved health for women and children is a driving force behind many stove programmes. From a gender equity perspective, access to reliable, modern energy services is required, not only for cooking, but also for entrepreneurial, agricultural and industrial development.

5.3. Biogas Energy Development

Biogas as an alternative to the use of biomass for energy was introduced in Ethiopia in 1979. Since then, approximately 1,000 biogas plants have been constructed up to 2008, of which 50 per cent were reported to be in regular use (Ministry of Water and Energy 2011). Due to the renewed interest in biogas and the success of biogas programmes in other developing economies, notably Asian economies, a national biogas program was introduced in Ethiopia pursuant to a feasibility study which proved the potential for the dissemination of domestic biogas in Ethiopia.

The National Biogas Programme for Ethiopia establishes biogas digester plants that provide smallholders with alternative, renewable, clean, and safe energy (biogas) for cooking and lighting, as well as organic fertiliser (bioslurry) to improve their crop yields and sanitation. The project has already brought combined economic, social and environmental benefits to smallholders from 5,011 newly installed biogas digester plants, by the end of 2012. Similarly, biogas energy technology dissemination has been observable in many of the SSA economies, and helping to avert the risks that women face in biomass energy use as a result of their primary household role of cooking. The number of biogas digester installations across Africa is increasing, largely in the domestic energy sector for cooking and lighting, due to national domestic biogas programmes in Rwanda, Tanzania, Kenya, Uganda, Cameroon, Benin, and Burkina Faso, each with national targets of over 10,000 domestic systems to be installed, from 2009 until 2013 (Edwards, Ejigu and Araya 2011).

The National Biogas Programme for Ethiopia is being implemented in the four main crop growing regions of the country, namely the Regional States of Amhara; Oromiya; Southern Nations, Nationalities and Peoples; and Tigray. In the Tigray region, for instance, the project covers many communities and includes women who are from the poorest segment of the community (Edwards, Ejigu and Araya 2011). Results indicate that the use of bioslurry as organic fertiliser has indeed increased crop yields, outperforming chemical fertilisers. The project was designed by the Ethiopian government, in collaboration with the Netherlands Development Organisation, and is coordinated by the Ministry of Water and Energy. To ensure a distinct difference between regulatory responsibilities and operational management, a National Biogas Programme Coordination Office and Regional Biogas Programme Coordination Office were established under the overall responsibility of the Ethiopian Rural Energy Development Centre and Ministry of Water and Energy. The National and Regional coordination offices established a partnership for the day-to-day

management of the project. Training, promotion and extension services are provided in collaboration with national and regional government institutions, which includes promotional services by NGOs and provision of micro-credit for biogas by microfinance institutions, while the private sector is responsible for the actual construction of biogas plants.

5.4. Mini Off-grid Hydropower Development

Up to 90 per cent of the electrical energy produced in the country comes from hydropower plants. The reasons for this are found in the climatic and geographic conditions of the country. Ethiopia has a comparatively mild and rainy climate, and the presence of the Blue Nile is a major contributor to the country's water resources. With an estimated 159,300 GWh/year of unexploited potential, hydropower is the most economically viable energy resource for Ethiopia but only 5 per cent of the available potential is utilised. The government has now made considerable commitment to accelerate the development of hydropower resources with the view of increasing output to 40 GW (or about a quarter of the total potential available), for the period 2015–2020. Hydropower plants in Ethiopia are large and getting even larger. Projects under construction now include two hydropower plants with capacities of 1,800 MW and 6,000 MW, namely Gigil Gibe III and the Grand Renaissance Dam, respectively (Ministry of Water and Energy 2012).

The major hydropower plants are connected to the national grid, which is limited to serving urban, and more recently, semi-urban rural towns of the nation. As is the case in other SSA economies, extending the grid to every remote household is not feasible for technical and financial reasons as the rural settlement pattern in Ethiopia is scattered. In rural areas of Ethiopia, women have been significantly challenged due to energy poverty. Women are the main producers and users of energy in rural areas. To address this challenge, one viable option is the development of off-grid mini-hydropower plants as Ethiopia is endowed with water resources. Currently, there are fewer than 50 micro-hydropower plants in Ethiopia, with combined generating capacity of below 10MW. Like in many African economies, small hydropower potential is underdeveloped and underutilised in Ethiopia. The SSA share is only 0.5 per cent of the globally installed small hydropower capacity of 98GW. It is the most untapped potential in Africa with only a few hundred small hydropower plants in operation, mainly in eastern and southern Africa, Nigeria, and Ghana (WEC 2007). For instance, the German International Cooperation (2005) forecast shows that Nigeria has a potential for 277 new sites, generating more than 734 MW, versus 7 installed, and there is potential for 700 new sites in Madagascar, and 600 in Ethiopia.

6. Conclusions and Policy Implications

The national policy framework of Ethiopia is in support of gender mainstreaming in energy sector policies, programmes and strategies.

However, what is clearly emerging is that there is limited knowledge on the linkage between gender, energy and poverty, at policy level. There are broad general comments on gender in the various policies but without concrete strategies for mainstreaming gender. The national energy policy of Ethiopia appears to be generic, with no specific policy objective related to gender equality in the energy sector although the National Women's Policy clearly stipulates the responsibility of every government agency in Ethiopia to mainstream gender in its policies, programmes and projects (2004b). Analysis of the national policies reveals that although the National Women's Policy, the MDGs, the Growth and Transformation Plan (GTP), and the Climate Resilient Green Economy Strategy provide a supportive environment for mainstreaming gender in energy sector development, gender is not highly prioritised in this sector. This is a result of inadequate capacity on how to deal with gender issues or even how to go about mainstreaming gender in policies and programmes.

However, the energy development policy of Ethiopia, which focuses on renewable energy sector development, has been contributing tremendously, and shall definitely continue to contribute, to the reduction of women's energy poverty in Ethiopia. To make the energy sector development gender sensitive, it is important to understand the differing energy needs of men and women as well as their varying social roles. This implies that mainstreaming of gender concerns in energy policies is also required, given that men and women have different roles, needs and perceptions of energy. Women are often disproportionately affected by energy poverty compared to their male counterparts due to their household roles in production and consumption of energy. Careful attention to these differing interests is essential for understanding energy markets and consumer needs, for reducing the negative impacts of existing energy consumption patterns, and for achieving distribution of energy services in a gender equitable manner. For effective gender mainstreaming in the energy sector, concerted and coordinated effort has to be exerted by policymakers, research institutions, communities, and other development partners, such as NGOs. This demands commitment to gender concerns about energy poverty from these stakeholders so that they can properly collaborate to alleviate the challenges. Energy development interventions need to substantially involve the end users or women who face the hurdles of energy poverty. While targeting access expansion and capacity-building in the short-run, the long-term objective of energy interventions should be the development of commercially-viable and sustainable energy services. These require concrete strategies for gender mainstreaming in the energy sector.

Mainstreaming gender in energy policies and programmes is necessary but insufficient for achieving gender equity in Ethiopia's energy sector because of two reasons. Firstly, women assume the primary responsibility in household and reproductive chores because energy production and consumption is their main role. Secondly, the majority of women rely on biomass energy, which produces hazardous gas in addition to the

inefficiency in use due to lack of modern cooking technology. In recognition of this fact, the Ethiopian government has been implementing programmes to improve access to modern energy technologies, particularly in rural areas. However, it has neither created sufficient access nor changed the pattern of current energy consumption significantly, so far. This implies that there is need to pursue improved energy technology access expansion strategies. That is to say, government and donors investment into improved energy technology infrastructure development has to maintain its momentum and private sector involvement in this sector has to be encouraged. Given that access to modern energy technologies is so critical, not only for national economic development but also for the achievement of gender equality, focusing more attention on women and energy linkages, increasing women's contribution to improved energy provision approaches and ensuring that women benefit from these approaches will enhance the overall welfare of the society. For instance, modern stoves reduce drudgery linked to fuel collection and combustion. Similarly, fuel-efficient stoves that allow cooking in a smoke-free kitchen might contribute to strengthening women's position in the household as well as improved health for women and children.

Achievement of gender parity in the energy sector also requires the development of clean and renewable energy services. The Ethiopian government has been committed to pursuing green growth strategies, with focus on renewable energy development. The programme introduced to scale-up investment in renewable energy has to be reinforced to alleviate energy poverty amongst women in Ethiopia. This is because targeting energy poverty amongst women has a multiplier effect as modern energy services shall enhance the education and health of women and children, while directly reducing women's drudgery related to energy poverty.

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References

- Barnett, A. 2000. 'Energy and the fight against poverty'. Paper presented at Economic Research Seminars, Institute of Social Studies, The Hague, Netherlands. June.
- Central Statistical Agency (CSA). 2005. '*National Labour Force Survey*'. A.A., Ethiopia.
- Clancy, J. 1999. 'Policies, projects and the market empowering women? Some initial reactions to developments in the energy sector'. Paper presented at

- ENERGLIA* Workshop on Improving Women's Access to the Market: Policies, Projects, or Market. University of Twente, The Netherlands, November.
- Clancy, J. and Skutsch, M. 2003. 'The gender-energy-poverty nexus. Finding the energy to address gender concerns in development'. DFID Project CNTR998521.
- Department for International Development (DFID). 2002. *Energy for the poor: Underpinning the Millennium Development Goals*. London: DFID.
- Dutta, S. 2003. Programme development in the area of improved labour saving options for mountain women. *MEI (Energy) Internal Working Paper, No. 2002/4*, ICIMOD.
- Edwards, S., Ejigu, F. and Araya, H. 2011. 'Biogas plant for smallholder farmers in Ethiopia'. Showcased by Award-Winning Team for Sustainable Development, ISIS Report 07/12/11, Institute of Sustainable Development, Addis Ababa, Ethiopia.
- Ethio Resource Group. 2012. *Solar energy vision for Ethiopia: Opportunities for creating a photovoltaic industry in Ethiopia*. Addis Ababa.
- Federal Democratic Republic of Ethiopia (FDRE). 1994a. *National energy policy*. Addis Ababa, Ethiopia: FDRE.
- . 1994b. *National policy on education and training*. Addis Ababa, Ethiopia: FDRE.
- . 1994c. *The Constitution of the Federal Democratic Republic of Ethiopia* (unofficial English translation from the Amharic original). Addis Ababa, Ethiopia: FDRE.
- . 2004. *National women's policy*. Addis Ababa, Ethiopia: FDRE.
- . 2011. *Green economy strategy: Ethiopia's climate-resilient green economy*. Addis Ababa, Ethiopia: FDRE.
- GTZ-TERA. 2005. *Wind energy site selection report for Ethiopia*. Eschborn, Germany.
- . 2009. *Biogas energy potential assessment report for Ethiopia*. Eschborn, Germany.
- IEA. 2012. International Energy Agency *World Energy Outlook Fact Sheet*. Energy in sub-Saharan Africa today.
- International Energy Agency (IEA). 2011. *World Energy Outlook 2011*. Paris, France: IEA.
- Japan International Cooperation Agency (JICA). 2012. *Energy Policy of Ethiopia*. Addis Ababa, Ethiopia: JICA.
- Martine, G. and Villarreal, M. 1997. *Gender and sustainability: Reassessing linkages and issues*. Rome: Food and Agricultural Organization of the United Nations.

- Ministry of Finance and Economic Development (MoFED). 2010. *Growth and transformation plan (GTP) 2010/11–2014/15*. Volume 1. Addis Ababa, Ethiopia: MoFED.
- Ministry of Water and Energy (MWE). 2011. *Scaling-up investment in alternative renewable energy in Ethiopia*. Addis Ababa: MWE.
- . 2012. *Annual report 2011/2012*. Addis Ababa: MWE.
- Miranda, R. C. 2011. *RHEEIP field assessment report*. Addis Ababa: Global Alliance for Clean Cook stoves.
- Murray, C. J. L., Lopez, A. D. 1996. *The global burden of disease*. MA: Harvard University Press.
- National Bank of Ethiopia (NBE). 2011. *Annual report*. Addis Ababa, Ethiopia: NBE.
- Nyoni, S. 1993. Women and energy: Lessons from the Zimbabwe experience. *Working DFID Project CNTR998521 Gender-Energy-Poverty Nexus Paper* 22. Zimbabwe Environment Research Organization (ZERO), Harare, Zimbabwe.
- Parikh, K. J. 1995. Gender issues in energy policy. *Energy Policy*, 23(9): 745–754.
- . 2012. Hardships and health impacts on women due to traditional cooking fuels: A case study of Himachal Pradesh, India. *Energy Policy*, 39(12): 7587–7594.
- Skutsch, M. M. 1998. The gender issue in energy project planning: Welfare, empowerment or efficiency? *Energy Policy*, 26: 945–955.
- Skutsch, M.M. 2001. ‘Strengthening the institutional capacity of the south in renewable energy technologies’. *In*: Pontenagel, I. and S. Peter (Eds.), *Promoting global transfer activities for renewable energy: Papers and documents of the International Impulse Conference for the Creation of an International Agency for Renewable Energy 2001, Berlin*. Eurosolar [etc.], Bonn [etc.], pp. 61–64.
- Smith, K. R. 1999. Indoor air pollution. *Pollution Management in Focus. Discussion Note No. 4*, August. Washington, D.C: World Bank.
- . 2000. ‘National burden of disease in India from indoor air pollution’. *Proceedings of the National Academy of Sciences*, 97(24): 13286–13293.
- Tucker, M. 1999. Can solar cooking save forests? *Ecological Economics*, 31: 77–89.
- United Nations. 2010. *Millennium Development Goals Report 2010*. New York: UN.
- United Nations Development Programme (UNDP). 2011. *Energy for a sustainable future: The Secretary-General’s Advisory Group on Energy and Climate Change Summary Report and Recommendations*. New York: UNDP.
- . 2012. *Millennium Development Report 2011*. New York: UNDP.

- United Nations Development Programme (UNDP-ESCAP). 1990. Linking rural electrification with rural development in Asia. Regional Energy Development Programme RAS/86/136.
- . 2003. *Gender and energy: How is gender relevant to sustainable energy policies, in sustainable energy strategies? Materials for decision-makers*. New York: UNDP.
- United Nations Economic Commission for Africa (UNECA). 2012. *Tracking progress on macroeconomic and social development in the Eastern Africa Region: Sustaining economic growth and development in turbulent times*. Addis Ababa: UNECA.
- Wamukonya, N. 2002. 'A critical look at gender and energy mainstreaming in Africa'. Draft paper presented at Gender Perspectives in Sustainable Development side event organized by UNDESA/DAW and WEDO at Prep Com III, April 2002.
- Wilson, M. and Green, J. M. 2000. 'The feasibility of introducing solar ovens to rural women in Maphephethe'. *Tydskrif vir Gesinsekologie en Verbruikerswetenskappe*, 28: 54–61.
- World Bank. 2001. 'Engendering development'. *World Bank Policy Research Report*. New York: Oxford University Press.
- . 2010. *Modernizing energy services for the poor: A World Bank investment review. Fiscal 2000–08*. Washington, D.C: World Bank.
- . 2011. *World development report 2011: Conflict, security and development*. Washington, D.C: World Bank.
- . 2011. *World Development Report: word development indicators*. Washington, D.C.: World Bank.
- World Energy Council (WEC). 1999. *The challenge of rural poverty in developing countries*. London: World Energy Council/Food and Agriculture Organization of the United Nations.
- . 2007. *The World Energy Council, Survey of Energy Resources*.
- World Health Organization (WHO). 2011. *Risk factors for chronic respiratory diseases*. Retrieved August 15, 2014, from <http://www.who.int/gard/publications/Risk%20factors.pdf>.

CHAPTER THREE

The Gender-Energy Nexus in Tanzania: Assessing Rural Electrification in the Context of Gender Mainstreaming among Women

Henry Michael Kigodi and Japhace Poncian

Abstract

This chapter presents empirical evidence from a study conducted in two rural districts of Tanzania. The aim was to assess government rural energy strategies devised by the Rural Energy Agency to electrify rural Tanzania, in the context of gender mainstreaming in energy projects, as well as its viability in resolving gender-energy challenges experienced by rural women. A total of 22 semi-structured interviews were conducted with rural women and Tanzania Electric Supply Company officials in Kilolo and Shinyanga rural districts, over a period of two weeks. Findings indicated that although the government takes gender issues seriously, much more remains to be done as most of the study informants had little knowledge on what rural electrification is; an indication that gender may just have been mainstreamed in energy policies, plans and strategies, on paper, merely by a mention of the words “gender” and “gender mainstreaming”. Additionally, the study found out that patriarchal practices that marginalise rural women are still entrenched in rural Tanzania, to the extent that rural electrification may only end-up lighting rural Tanzania instead of altering complex and multiple energy challenges that women face. High costs of energy and limited energy choices were also mentioned as the main issues that challenge rural electrification. From the findings, it is recommended that the government ought to go down to rural women, to learn about their expectations and challenges; build awareness among rural women on the use of different energy sources; diversify energy sources; and implement energy policies, plans and strategies effectively, to resolve gender-energy challenges.

Keywords: Gender-energy, gender mainstreaming, energy strategies, rural energy, energy poverty

1. Introduction

Modern energy services are considered a vital input in the development process. It is widely acknowledged that access to affordable and modern energy services is a key to development and poverty reduction, in the developing world. Without this, developing countries are likely to be trapped in a vicious circle of poverty, social instability and underdevelopment (Mohn 2013). Unfortunately, however, not all people have access to modern energy services. Statistics indicate that more than 20

per cent of the world's population has no access to electricity. About 2.4 billion people use traditional biomass for cooking and heating, and 99 per cent of those who live without energy are found in the developing world (Mohn 2013). The situation is even worse in Sub-Saharan Africa (SSA), where four out of five families lack access to electricity (Practical Action, n.d). Due to this energy poverty, people still cook on an open fire, thus running the risk of endangering their lives due to exposure to fumes, which kill more than 1.4 million people each year (*ibid.*). Further, it is argued that an African uses only one-eleventh, one-sixth, and one-half of the energy used by a North American, a European, and a Latin American, respectively, thus making Africa the lowest consumer of energy (Davidson *et al.* 2007).

When one factors in the question of gender, the situation becomes more critical. It is obvious that men and women have different energy needs, and are disproportionately affected by lack of access to modern energy services. By virtue of their social roles in African societies, women are usually the victims of lack of modern energy services. In many of the rural African societies, women bear the responsibility of meeting household energy needs by collecting, preparing and using woodfuel (Maduka and Fayomi 2004; James 1999). This becomes an additional burden on their already overburdened lives. Thus, it is not surprising that many of the 1.4 million deaths a year caused due to exposure to woodfuel fumes are women and children (Practical Action, n.d). In Tanzania, the situation is not any better, regarding access to modern energy services.

The United Republic of Tanzania (URT) is a political union of two semi-autonomous countries, which was formed in 1964, from the former Tanganyika and Zanzibar (made-up of Unguja and Pemba Islands). It is the largest of the five East African countries (Tanzania, Uganda, Kenya, Rwanda, and Burundi). Tanzania has a total area of 945,000 square kilometres (www.tanzania.go.tz/home/pages/219) and a population of almost 45 million, with an annual growth rate of 2.7 per cent, in the last ten years (URT 2013). Women constitute 51 per cent of the total population (*ibid.*). Like any other SSA country, Tanzania faces several socioeconomic and political challenges, such as poverty, gender inequality, promotion of democracy, and human rights observance. Access to reliable and affordable energy sources remains a big challenge in Tanzania, given the fact that the country has been suffering from intermittent power supply and rationing for a fairly long duration. As a country, Tanzania is facing energy challenges resulting from technical and economic constraints, and has not developed adequate linkages between energy and gender, for sustainable development (Kassenga 2008; Oparaocha 2004). In terms of access to electricity, only 23 per cent of the population has access to modern electricity connection. In rural areas, only 7 per cent of the population has access to electricity (Muhongo 2013). Per capita energy consumption is one of the lowest in SSA, currently standing at less than 100 kilowatt-hours (Mathew n.d). The use of biomass (firewood and charcoal) accounts for more than 90 per cent of energy supply (Ministry of Energy and Minerals [MEM] 2013a). The

remaining 10 per cent comes from commercial energy sources, such as petroleum, electricity, coal, and solar energy (*ibid.*).

A quick look at these challenges shows that they affect women and men disproportionately. In light of this, the gender-energy nexus has attracted debate among different scholars, stakeholders and civil society organisations, in terms of access, control and affordability of energy to women, in Tanzania. This is so because women are more disadvantaged than men in circumstances of accessing, decisions and control over energy sources (Maduka and Fayomi 2004). According to Sosovele (2010), opportunities are more limited for women than men, in the context of policy challenges, where there is absence of holistic and comprehensive energy policies to address gender equality. Maduka and Fayomi (2004), and Sosovele (2010) further argue that when making decisions and interventions in energy policies, women's abilities are more restricted than men's, and there are weak institutional and legal frameworks to respond to women's energy needs.

Given these gender-energy challenges, the government has been trying its best to mainstream gender in the design and implementation of energy projects and strategies. Moreover, the government, through the MEM has committed itself to increasing the proportion of people connected to electricity, from the current 23 per cent to at least 30 per cent, by the end of 2014/2015 (Muhongo 2013). The national energy policy of 2003 also captures the centrality of gender in all energy programmes and projects, as a means of liberating women from the bondage of challenges resulting from unreliable energy sources (URT 2003). Further, the MEM Strategic Plan 2011/12–2015/16 stresses the need for "... ensuring adequate supply of energy to increase social and economic welfare" (URT 2012, 12). All these efforts indicate how the government is committed to making gender an integral part of all energy development strategies, plans, policies, and projects. In addition, the government has formulated the Rural Energy Agency (REA) to coordinate and distribute electricity in rural areas. Its major aim is to improve access to modern energy services in rural areas as a means of improving rural livelihoods and reducing poverty. This is because, according to energy policy, "Energy consumption in rural areas accounts for about 85 per cent of total national energy consumption" (URT 2003, 6). Although REA has partnered with the World Bank to mainstream gender in the organisational structure, design, implementation, and monitoring and evaluation of energy projects, (URT 2013), it does not explicitly state how and to what extent it considers gender issues in its energy distribution. It appears that the main preoccupation of the agency is to increase the number of people in rural areas having access to energy. Moreover, the question of whether or not rural electrification is gender-sensitive and can help to reduce women's health risks associated with unreliable energy sources remains less researched.

Most studies on rural electrification have focused on the potential benefits of the project to the rural population, their livelihoods as well as to national development. There is virtually nothing on the extent to which rural electrification integrates gender-specific needs in the design, formulation and implementation of energy policy and projects. Thus, it remains unknown whether new energy projects in the form of rural electrification in Tanzania will rescue women, and, if so, how. The present study aims at addressing this knowledge gap. It was the objective of this study to explore the extent to which rural electrification resolves the gender-energy nexus challenge among rural women in Tanzania. This study was specifically intended to answer the following questions:

- Can rural electrification projects resolve health risks and the killings of alleged witches in rural areas as a result of unreliable energy sources?
- To what extent does the state mainstream gender during formulation of energy policies, implementation and energy distribution, to provide adequate energy services?
- How do women perceive new energy projects?
- What challenges face rural electrification projects as far as gender is concerned?
- What should be done to make the provision of energy services effective and reliable to the majority of rural women in Tanzania?

This is a qualitative study based on the use of semi-structured interviews and surveys conducted for a period of two weeks in rural areas, in two districts of Tanzania, namely Kilolo and Shinyanga. Since Kilolo has extensive forest activities and woodfuel is the main energy source, the study sought to establish if rural electrification can reduce dependence on woodfuel and reduce health risks. The selection of Shinyanga was based on traditional ways of life and beliefs such as the killing of alleged witches whose eyes are reddened by over-use of cow dung as a form of energy. The study sought to establish whether rural electrification can rescue women in these areas from killings and other health risks. In these areas, women gather firewood and cow dung for cooking in households because of limited energy choices. Therefore, the study aimed to establish, from these areas, how rural electrification took on board women's needs as a process of fundamental change in the existing structures, which subordinate women in access to and control over energy sources.

Once the two study areas were identified, interview guides were prepared in Swahili. This was after an extensive survey had been conducted in both areas. Interview questions were set for three groups: women beneficiaries of rural electrification strategy, non-beneficiaries and officials from Tanzania Electric Supply Company (TANESCO). After identifying beneficiaries and non-beneficiaries of rural electrification, a sample of 20 informants was randomly selected. Of these, 10 were from Kilolo district

and 10 from Shinyanga rural district. Two TANESCO officials were also interviewed, one from each district. The study sought to obtain insightful comments from all groups on whether they understood the question of gender mainstreaming in the energy sector, and challenges faced by rural women in accessing reliable energy sources. While conducting interviews, observations were made on the energy sources used and on the patriarchal practices. Full anonymity of the informants was observed and assured, from the beginning to the end. The major methodological challenge experienced while collecting information from informants was that some of the women interviewed were not free to speak out, because, in some traditions, there are bounding norms, whereby women have to listen or consult their husbands before they can speak out. For instance, in Shinyanga rural, some informants spoke in Sukuma¹ language and their husbands had to translate for a researcher to understand the answers. This marks the long-lived and unchanging nature of gender relations. To reduce the impact of this on the quality and reliability of information, permission had to be sought from the husbands to allow their wives to speak out. The researchers also ensured that information disclosed by the informants was treated confidentially.

The remainder of the chapter is organised as follows: section two covers the conceptual and theoretical issues on gender and energy in Tanzania; section three presents, analyses and discusses results; lastly, a conclusion is presented as a reflection on women's concerns over rural electrification and how rural electrification fits in the framework of gender and development (GAD) as far as gender mainstreaming is concerned.

2. Conceptual and Theoretical Issues on Gender and Energy in Tanzania

Access to modern energy services in Africa remains one of the major challenges to inclusive and sustainable development. For instance, the majority of people living in SSA lack sustainable energy and access to modern energy services, and the problem is even worse in rural areas (Sawe 2005). Most societies in Africa are facing unstable and insecure energy sources, which have posed a threat to economic development and to people's lives. In Tanzania, as pointed out earlier, only 23 per cent of the population has access to electricity, and only 7 per cent of rural areas are electrified (Muhongo 2013). To realise sustainable energy supply, Tanzania has passed through different stages since independence in 1961, to arrive at the current REA strategy. Initiatives such as Improved Woodfuel Stoves and Private Tree Nurseries Promotion Project; Africa Rural Energy Enterprise Development Project; Sustainable Energy Policy and Research Knowledge Network; and establishing of REA and Rural Energy Fund, have been in place (Sawe *et al.* 2004). Efforts at ensuring access to modern energy services date back to the pre-independence period. For the first time, electricity was introduced in 1908, under the German colonial regime, and in 1931, was transformed by establishing two electric companies, namely the Dar es Salaam and District Electric Supply Company and TANESCO

(Msyani 2013). Soon after independence in 1961, the government acquired shares from both companies, and in 1975, the two companies were merged to form a state-owned company officially known as Tanzania Electric Supply Company (TANESCO) (*ibid.*). Since then, several measures have been taken to ensure the government supplies modern energy to its rural dwellers. One of these initiatives is the establishment of REA in 2007, to coordinate and oversee rural energy projects. Despite this notable initiative, rural Tanzania, like many other rural areas in SSA, still suffers from lack of modern energy services. At the household level, lack of modern energy services affects women more than men. This is because, as discussed earlier, women are the main procurers, producers and users of energy. Moreover, considering the triple roles that women play in most African societies, it is evident that lack of modern energy services places more burdens on their shoulders than is the case for men. In these societies, traditional energy sources, such as charcoal, firewood, cow dung and cereal residues, still dominate and women are in most cases responsible for ensuring their availability. Kauzeni, Sawe and Sechambo (2001) argue that most of the initiatives developed have suffered from lack of national priority, inadequate information and lack of requisite institutions and skills in the energy sector.

When it comes to development and women's empowerment, it clearly emerges that gender and energy cannot be separated. Gender and energy are related in that there is always, at least in the poor developing countries where access to reliable and affordable energy sources is still a challenge, a disparity between men and women over the use and consequences of unreliable energy sources. Thus, women are disproportionately affected by unreliable energy sources because they are the ones at the centre of production, reproduction and community roles, all of which are energy-intensive. Like in many other African countries, Tanzania's energy sector is facing a major challenge of provision of modern energy services to its population, to facilitate economic development and poverty reduction (Wamukonya 2002). As noted earlier, the challenge is even more critical in rural areas, where more than 80 per cent of the country's poor live (Aikaeli 2010). In these areas, unreliable energy sources pose a burden to the already overburdened woman, who has to always be on the move looking for woodfuel, cow dung or cereal residues for cooking and other household activities, at the expense of her health, life and even meaningful participation in non-household activities that are relevant for the country's development.

When one considers all this, it becomes obvious that women are at the receiving end of unreliable energy sources. The following account (Songela 2006, 19) captures this properly:

The responsibility for household energy use affects women's health disproportionately to men's (for example, higher levels of lung and eye diseases due to longer hours of exposure to smoke and particulates in

smoky kitchens experienced by women, compared to men). Woodfuel collection also reduces the time women have available for contributing to other aspects of livelihood strategies, and girls are frequently kept away from school to assist their mothers. Women are also responsible for a number of other survival tasks needed to sustain the household such as water collection, transport, food processing and cooking. Many of these tasks are demanding in terms of both human energy and time; the preparation of many staple root crops and grains takes upwards of an hour of vigorous pounding.

This account captures one of the main issues that have been affecting women in rural Tanzania as a result of the use of unhealthy energy in their daily domestic activities. These are but some of the multitude of challenges that women face as a result of unreliable and unsustainable energy sources.

This study is framed in the GAD approach. The GAD approach emerged in the 1980s, in response to the weaknesses of the Women in Development (WID) approach. While WID emphasised on women as if gender was all about women, GAD expands the concept of gender as a social construct, involving relations between men and women. The critiques raised by GAD over WID revolve around the fact that WID excluded men by focusing only on women, forgetting that men were the main initiators of women's marginalisation and subordination. GAD specifically works on three principles: focuses on practical and strategic levels to bring about change in gender relations; involving men and women to change gender relations; and taking a broader and historical view of gender relations (World Vision Australia n.d). According to Tasli (2007), and Bradshaw, Castellino, and Diop (2013), the GAD approach emphasises gender mainstreaming so as to integrate women's concerns into the design, implementation and evaluation of all socioeconomic and political policies, projects and programmes. It approaches gender relations in the totality of the complex environment of socioeconomic and political structures. This study assesses rural electrification in Tanzania in the context of gender mainstreaming. To understand the extent to which rural electrification integrates gender-energy specific needs into its design and implementation, the GAD approach seems to be well-suited. This is because rural electrification is both a development and gender issue that needs to be approached from the perspective of gender and development. Any study of rural electrification must consider the socioeconomic and political issues that determine by who and how energy decisions are made at the household level. There is no suitable approach to understand this other than GAD. Looking at socially determined gender roles, it appears that women play triple roles in most families, if not all — reproductive, productive and community roles. While most women are facing this triple burden, unreliable supply of energy may add onto the burdens they are already experiencing. In relation to rural electrification in Tanzania, the GAD approach is chosen to enable the analysis of gender-energy nexus challenges, to see if the strategy can help in reducing the burden to women.

3. Results, Analysis and Discussion

3.1. Rural Electrification, Health-related Risks and the Killings of Alleged Witches

Results indicate that rural women have been facing a myriad of health and life risks as a result of unreliable energy sources. Years of exposure to unreliable energy sources have positioned women in a much more precarious health and life situation. Thus, modern energy services designed for electrifying rural areas come at a time when they are greatly needed. The quibble remains whether they can resolve these health and life risks and challenges that women have endured over time. As for rural Tanzania, the great majority of informants expressed strong personal feelings over health problems they are facing as a consequence of unreliable energy sources. Walking long distances to find firewood, family influences, especially from their husbands, were factors affecting their daily lives. Some mentioned family conflicts emanating because of mistrust:

You know, we walk a long distance to fetch firewood. You gather enough to sustain you and your family, maybe for a week, again another week, you do the same. We carry large bundles of firewood on our heads; when you reach home, the whole body is exhausted and you have severe headache and chest pain. At the same time, you have to prepare food, and engage with other family activities. So, I think rural electrification may help us reduce some burdens somehow, although the cost may be a problem, but at least you can say, let me use electricity for once. (Mama John, Interview, November 5, 2013, Shinyanga).

This informant illuminates on the fact that it is still not clear whether rural electrification may help reduce the burden of unreliable energy sources to women. The main concern raised here is the cost of electricity and its affordability to the rural poor. All informants from Kilolo and Shinyanga were of this view, that even if all rural households are electrified, the possibility that this may help in reducing energy challenges is unlikely because of higher costs. According to Uisso and Mwiha (2005), the poor spend more than 35 per cent of their household income on energy, while the rich spend about 14.45 per cent. These statistical differences clearly mark rural areas as victims of the situation, as opposed to urban areas, because the majority of the poor are found in rural areas. Although the government has clearly stated that electrifying rural areas is a means to rural modernisation and transformation (MEM 2013b), it appears that a situational analysis to examine the economic capability of the rural population was not adequately done. The government has cut down costs of energy installation for rural households to US\$111, to enable many to have access to modern energy services (Muhongo 2013); but the basis on which this was done is not plainly stated. This means that electrifying rural areas, where most of the poor live, may not be a solution to energy challenges that face women.

Energy challenges change with changing seasons. It was noted that energy challenges are more critical during the rainy seasons when access to reliable energy becomes difficult. Some opportunists use this period to maximise profit from the great demand shown by other people; therefore, this adds burdens onto the already overburdened woman, as Shinyanga noted:

Unreliable energy affects us severely during planting seasons; the prices are high, and because we don't have other sources of energy we are forced to work hard. Psychologically, this causes problems for us. Children are crying, our husbands are asking where the food is. So, as a woman you have to use all means² to make sure your family gets food on time. As you see, I have a little kid here, she doesn't understand if there is no firewood. (Siwema, Interview, November 7, 2013, Shinyanga).

This response clearly indicates that patriarchal relations still dominate in most rural households.

Regarding health risks posed by unreliable energy, some informants expressed their psychological sufferings as they think that the challenges of unreliable energy make them very tired and look much older than their actual age. In fact, some of them looked like they were in their mid-forties yet they were actually in their thirties. This was observed even as we interviewed these women. For instance, while one of our informants was actually aged 35 years, she looked more like she was 40 – 45 years. She openly expressed how bad she felt over her early aging. This is understandable, given the fact that aging is usually associated with a decline in performance and attractiveness (White 1988). Although there may be various reasons for early aging, it is obvious that the psychological sufferings that women experience as a result of unreliable energy sources make them constantly unhappy, something which may lead to other health risks. This goes beyond the triple role burden argument that most scholars have advanced; it is a new burden added onto the triple roles that a woman plays in the household.

As far as resolving the challenges posed by unreliable energy sources, many informants were pessimistic on whether rural electrification can do so. A common running argument was that the costs of electricity are too high for the majority of rural women to afford. Many believed that installing and using electricity for cooking and other domestic activities would require one to have reliable financial resources to meet the costs. This resonates well with an argument that off-grid energy projects in Africa face the challenge of low average income, of the targeted consumers (the rural population in this case) (Adomakoh 2012). This means that without addressing income challenges, rural electrification is unlikely to alter the energy-related gender injustices that rural women have endured for so long. Moreover, it is true that the costs of distributing electricity to rural areas are enormous (Wamukonya 2002; Kassenga 2008; Sosovele 2010), so much so that it would be very difficult for the majority of the rural population to

afford electricity, given their poverty. In spite of the fact that many respondents cited high energy costs, the actual costs involved in using modern energy, such as electricity for cooking, were beyond their knowledge. Their reasoning was based on the observation that if many beneficiaries of electricity do not use it for cooking, then it must be expensive. The problem here seems to be lack of knowledge and information about the use of electricity and other modern energy sources such as solar energy.

As will be discussed in the next sub-section, there is a serious lack of citizen participation in the design and implementation of energy policies. Although there seems to be a knowledge gap, experience from a study conducted in South Africa shows that households connected to electricity hardly used it for cooking, mainly because it is considered expensive (Green and Zwebi 2004). This is not any different in Tanzania. Designing ways in which rural electrification can be made accessible and affordable to more rural people calls for concerted efforts by the government and other development stakeholders. Reducing the costs of installation and utilisation may be a desirable short-term strategy but it cannot be sustainable because it is very difficult to reduce costs to the satisfaction of many while at the same time ensuring the sustainability of rural electrification projects. Rural electrification needs to be done alongside economic empowerment of the rural population, especially women, so that with time, they can be economically independent and afford the costs of electrification. This can be done through improving rural transport and communication infrastructure, promoting economic diversification away from agriculture, and ensuring that markets for rural products are readily available. Providing financial services to rural women through their entrepreneurial groups and supporting mobile financial services in rural areas are some ways of empowering women financially, to offset the challenges of energy costs.

In relation to the opinions expressed by many informants in rural Shinyanga, regarding energy challenges and how they affect their daily lives, it was noted that the use of firewood, charcoal, maize stalks, and cattle dung compounds superstitious beliefs in rural Shinyanga, thus putting women in danger. Consider the following excerpt:

But sometimes when we don't have charcoal we use cattle dung and this is a problem because it produces a lot of smoke, more than firewood. As you were hearing in the past days, all women with red eyes were labelled as witches and were killed. So, if we don't have reliable energy, it is a problem for us. For instance, these days we don't go to the bush where we used to gather firewood from because the village government has prohibited us. So, imagine, what are we going to do? My family needs food, and especially my husband³ when he comes home, he expects me to have cooked; what am I going to use? Really, there are so many intimidations we are getting. (Anitha, Interview, November 7, 2013, Shinyanga).

In relation to the GAD perspective which guided the study, the above responses from interviewees indicate that gender relations have not changed for the better. Unreliable energy sources encourage men to continue subordinating their wives and this makes women more vulnerable to numerous health and life risks. In both Kilolo and Shinyanga, it appears that the responsibility of fetching firewood remains in the hands of women. Unfortunately, in Shinyanga, lack of reliable energy sources adds a burden to women — being accused of witchcraft just because their eyes have been reddened by years of cooking in unventilated kitchens, using smoky firewood and cow dung (Minja 2011). Statistics from Legal and Human Rights Centre show that, on average, more than 500 people are killed every year over witchcraft allegations (Minja 2011). It is further reported that more than 3,000 people were killed in a period of six years, from 2005 to 2011 (Huffington Post 2012). In Shinyanga alone, 242 people were killed because of local beliefs in witchcraft, between January 2010 and January 2011 alone (*ibid.*). This is indeed a serious threat to women and their lives. Certainly, something needs to be done to save the lives of these women. Knowledge and awareness creation should be streamlined in government and civil society organisations' plans and strategies for rural development. This must be a permanent strategy because it would take some time before such beliefs are completely eliminated. Diversification of energy sources can be another way to save lives. This would lower the costs of energy and offer rural women more energy choices. However, all this needs to be done alongside economic empowerment of rural women so as to set them free from the bondage of poverty.

3.2. Gender Mainstreaming in Energy Policies and Energy Projects in Rural Tanzania

Gender mainstreaming in all development projects and plans is considered an appropriate approach for ensuring gender equality, by making both women's and men's concerns and experiences integral to the design, implementation, and monitoring and evaluation of all development policies (UN WOMEN 2013). It follows, therefore, that the success of any energy project, plan, strategy, or policy, depends mainly on how it integrates women's and men's concerns and aspirations. As for rural electrification in Tanzania, evidence suggests that energy projects are not adequately gendered as opposed to the government's claims of mainstreaming gender in all development plans/strategies. Results from the field study reveal that energy-specific needs of women have not been satisfactorily tackled. It was expressed by many interviewees that the state has not done enough to allow rural women's participation, and if it does, this was more common in urban areas, as Aisha indicates:

Do they even care about us? I did not see any leader coming to ask about my views on the issue.... They do not involve us. We just see TANESCO [Tanzania Electric Supply Company] installing electricity in rural areas,

we don't know by who and how decisions were made. (Aisha, Interview, November 11, 2013, Kilolo).

This shows how rural women have not been involved in the design and implementation of rural electrification. The results are in tandem with what the NORAD report (2012) concludes, which is, gender issues have not been systematically developed or institutionalised despite some positive gender-relevant actions. It follows, therefore, that gender mainstreaming in the designing and implementation of rural electrification was not adequately done, at least in the rural areas. This is why all the informants reported to either not having heard anything about rural electrification or had heard about it from a friend or through media reports. Gender-specific energy needs of women in rural areas were, therefore, not accorded significant consideration in the planning and execution of the project. If they were, then the process was not inclusive. Although men were not interviewed to determine how well-informed they are, study findings indicate that rural women are not aware of how and why the government has invested in rural electrification, and what this means to them. Of course, experience shows that men are more well-informed compared to women. For instance, a study conducted in Zanzibar on media sector mapping revealed that men are more informed than women on issues of good governance and governance policies (Tanzania Media Women's Association 2013). The following response from an informant responding to the question on how she got to know about rural electrification sums it all:

... first of all I hear such things from you, here today. I have never heard anything about rural electrification or energy policy, and if there is something like that, then we in rural areas are excluded. There is limited opportunity to participate. The leaders are not allowing us to participate enough to express what we need and say what the energy sector should look like. (Modesta, Interview, November 12, 2013, Shinyanga).

Looking at REA also reveals that gendered energy needs were not prioritised when designing and executing rural electrification. The REA is responsible for rural electrification. Its core vision is to transform rural livelihoods through provision of modern energy services, and its mission is to promote and facilitate availability and accessibility of modern energy services in rural mainland Tanzania (REA 2012). To fulfil these REA has the following mandates:

- Promote, stimulate, facilitate and improve modern energy access for productive uses in rural areas, in order to stimulate rural economic and social development.
- Promote rational and efficient production and use of energy, and facilitate identification and development of improved energy projects and activities in rural areas.
- Finance eligible rural energy projects through the Rural Energy Fund.

- Prepare and review application procedures, guidelines, selection criteria, standards, and terms and conditions for grants allocation.
- Build capacity and provide technical assistance to project developers and rural communities.
- Facilitate preparation of bid documents for rural energy projects.

A critical look at all this reveals that what they are mostly interested in is to increase the number of people accessing energy in rural Tanzania, and not addressing gendered energy needs. Although increasing access to modern energy services cannot be underestimated, this alone cannot address energy challenges that rural women face. This is because increasing access to modern energy services is not adequate to address the root causes of gender injustices, related to energy. This is confirmed by one of the TANESCO officials who had the following to say about rural electrification:

With rural electrification, what we want to achieve is to increase the number of rural households accessing modern energy services. The government is committed to achieve a target of increasing people's access to electricity to 30 per cent, by the year 2014/2015, and rural electrification is one strategy to achieve the target. (James, TANESCO official, Kilolo, November 17, 2013).

Responses from women informants also show that there is a participation gap as all women interviewed claim not to have participated in the programme, in any way. While GAD emphasises involving men and women to change gender relations (World Vision Australia n.d), the practice of rural electrification points to the contrary. Some informants attribute this to patriarchy and limited women's participation and presence in politics and decision-making organs:

There are not enough women representatives in decision-making organs. Much of what women need remains unknown to decision-makers. Parliamentarians are partisan when debating issues in parliament, which limits making our gender-energy needs addressed in many energy policies and projects. (Sefivawo, Interview, November 15, 2013, Kilolo).

A somewhat similar argument is raised by a TANESCO official, who thinks that REA has done little to empower women in energy:

It is true that REA has played a great role in supplying electricity to rural areas, but because of resource constraints and high energy needs, it appears that the government has put less effort into empowering women. However, we are thinking about gender in most of our energy programmes" (Mhango, TANESCO official, Shinyanga, November 11, 2013).

In reference to the quotations above, it is evident that rural electrification has not adequately integrated rural women's concerns and needs into the design and implementation of the project. The consequence of this is a

continuation of a general trend of limited women's participation in various social, political and economic issues in Tanzania. This is the situation in both Kilolo and rural Shinyanga, where the study was conducted. Looking at a broader and historical view of gender relations in Tanzania, customary laws that have been giving men more power and control over resources and decision-making processes (Losindilo, Mussa and Akarro 2010) still dominate. Instead of rural electrification addressing this anomaly, it has just marginalised women in its design and implementation approach.

3.3. Women's Perceptions on Rural Electrification Project

Electrifying rural areas was an idea which all interviewees subscribed to. Many saw it as an opportunity for rural development and transformation. Having access to electricity was thought to be a means to women's empowerment and economic freedom. It was expressed by the informants that having reliable energy would give them an opportunity to engage in other economic activities that would guarantee their freedom and liberate them from the bondage of patriarchy. Shoma's statements affirm this:

You know, as women, we have so many small business projects which sustain our living, and if there are no reliable energy sources it affects production. It takes time and higher costs to find alternative energy sources. At the end of the day, even the small projects we have end up declining. (Shoma, Interview, November 9, 2013, Shinyanga).

Other benefits associated with rural electrification include improvement of social services, such as health and education, because electricity acts as a pulling factor in attracting and retaining workers. So, instead of people declining offers to work in rural areas, electricity may ultimately attract them to live and work there. Furthermore, the presence of electricity in rural areas is believed to create employment opportunities for rural youth (in areas such as mobile phones recharging and hair cutting), thus reducing the problem of rural-urban migration. Jane has the following to say in this connection.

I see it (rural electrification) as an opportunity for rural transformation, especially in creating economic opportunities for the rural population. For a long time, young people have been running from rural areas to towns, partly because of availability of electricity in towns. So, rural electrification may help solve this problem. It has the potential of helping us develop and get markets for our products. The project may also attract people from towns to come and invest in rural areas. (Jane, Interview, November 15, 2013, Kilolo).

What the informants expressed about rural electrification is in line with arguments raised by Ahlborg and Hammar (2011), who are of the opinion that access to and use of electricity is of benefit to people in both developed and developing countries, more so to the rural areas. They also opine, "... while electricity may not bring development on its own, it is a highly

desired commodity and a prerequisite to rural development, in long term perspective” (*ibid.* 2,493). Moreover, it is argued:

[a]ccess to modern energy services, particularly electricity, is not only a prerequisite for agreeable living standards, but it is also an indispensable input for productive, economic and improved social services. The positive impacts of electricity for the poor in rural areas are basic activities such as pumping water for drinking and irrigation purposes, lighting for extending working and studying hours, and powering small-scale rural industries. (Sawe 2008, 1).

Therefore, as the above analysis indicates, rural electrification brings a multi-sectoral impact in rural areas. Sectors in which rural electrification has a great impact include education, health, financial transactions such as mobile money transfer, barber shops, and cereal milling shops. In all these sectors, rural electrification can potentially reduce energy costs, create employment opportunities, and ultimately, reduce rural poverty. It, therefore, plays the role of a catalyst for social, economic and productive improvement. It is undeniable that the presence of electricity in rural areas creates opportunities which may help to reduce the marginalisation and subordination of women. Although rural electrification is not a panacea to the various challenges women face, we argue that it is vital for their gradual empowerment and reduction of the burdens they face in their daily lives. Interviews cited above confirm this.

In spite of the fact that many informants were of the view that rural electrification is very significant, it was noted that the government has not done its best to offer various energy choices to the rural population. From observations in the field sites, it was noted that most of the rural houses were surrounded by bundles of firewood and heaps of cow dung. An absence of electricity connectivity was noted, and even where electricity was available, it was mainly hydro-based electricity. Other energy sources such as solar and cooking gas were generally absent in the areas visited. This indicates that energy diversification in rural Tanzania is still underdeveloped. Some informants expressed views that, if the government introduces other new sources at reasonable prices, the majority of women could use them as an alternative to hydro-electricity, which seems to be expensive. All the informants insisted that limited energy choices make rural electrification unable to resolve energy challenges faced by women, mainly because electricity is too expensive for them. Asked whether rural electrification can resolve energy challenges facing women in rural Tanzania, one of the informants was straightforward in her response:

Tohoo.⁴ It cannot resolve energy challenges because costs will be high. The government has failed to involve us women to realise our energy demands. If the costs are lowered to enable us poor women to use electricity for cooking and for other usages, then, it can somehow resolve the challenges. (Sofia, Interview, November 9, 2013, Shinyanga).

Observations in the field were in line with the expressions of informants. Many of the households visited, in both Kilolo and Shinyanga (18 of 20 households), had electricity installed or used gas or other energy sources for various activities. Even the two that were connected to hydro-electricity did not use electricity for cooking. Many households were surrounded by bundles of firewood, cow dung, maize stalks, cereal residues, and a few of them, charcoal. Hence, it is evident that limited energy choices continue to pose serious energy challenges to women. Rural electrification may offer some remedy, but, if energy diversification is not done, the project is bound to fail to alter women's energy challenges because costs will be too high for many. As pointed out earlier, this affordability challenge needs to be addressed if rural electrification is to bear fruits to women. Engaging women in income-generating activities, such as arts and crafts, petty trade and poultry, as well as creating an enabling environment for investment in rural areas, would surely curb energy cost challenges.

3.4. Rural Electrification and Gender: The Challenges

The study revealed that several challenges abound with the implementation of rural electrification. From the perspective of informants, most of the challenges relate to participation and decision-making. Interviewees claimed that women are regarded as takers of what has been decided by men. This appears to exclude very important energy stakeholders, as noted below:

The government has failed to involve women in decision-making while energy sector touches women directly. The problem is because of patriarchal practices. Women are placed as decision takers and men as doers. I am a good follower of media; I have not come across news telling about women's participation in policy and decision-making on energy sector. The state forgets that women are controllers of everything, in many households. (Shoma, Interview, November 9, 2013, Shinyanga).

From the above quotation, it is clear that the rural electrification strategy to empower women through distribution and supply of reliable energy encounters several challenges. These include structural challenges embodied in socio-cultural practices that marginalise women in decision-making and access to resources, limited knowledge, high energy costs, and policy laxity. According to Uisso and Mwihava (2005), Damhaug (2009) and Sosovele (2010), energy challenges range from policy to participation, at different levels. Limited integration of women's energy needs may be hampered by unidentified leadership positions which could help to pinpoint women's energy needs. Given that woodfuel accounts for about 90 per cent of the energy used nationally (Uisso and Mwihava 2005), the challenge remains how to improve access to a variety of reliable sources of energy. It is further argued by Lyimo (2007, 4) that:

[e]ven with rural electrification, the impact on income-generating activities among users would remain low. Even if electricity was to be

supplied on a 24-hour basis, it is unlikely that there would be a change in usage levels; the predominate [sic] reason being that the rural poor do not have the tools and knowledge necessary for effective use”.

Therefore, it is apparent that challenges arising from knowledge scarcity, to usage of rural electrification, may hamper women’s emancipation in the energy sector. Although the energy policy clearly states that women will greatly be involved in any issue concerning energy so as to empower them and help resolve the challenges of energy they face (URT 2003), interviews with rural women indicate that this has not been the case. Many of the informants said they either had not heard anything about rural electrification or they had heard about it from friends. This means that translating policy statements into practice has largely been a challenge, with regard to the energy sector.

Another important issue that came out of the informants was concern over the supposedly high energy costs that rural women cannot afford. All the 20 key informants mentioned this as the single most important challenge to their access and use of reliable energy sources. Some went to the extent of saying it may be possible to install electricity in their homes but not to use it for cooking. Asked whether rural electrification can resolve energy challenges, one informant had this to say:

Yeah, of course if it is lighting, then it can. But for cooking, we still face the same challenges. Who can afford cooking using electricity, if buying charcoal and fuel wood is itself not always possible? (Mwajuma, Interview, November 14, 2013, Kilolo).

Rural people’s concerns over high energy costs are not born out of ignorance. According to the MEM budget speech, the cost of installing electricity to rural households is US\$ 111 (Muhongo 2013), which is equivalent to 177,000 Tanzanian shillings.⁵ Although this may be regarded as less costly, the fact that about 40 per cent of the rural population lives below the national basic needs poverty line (URT 2011), and 80 per cent of the country’s poor live in rural areas (World Bank 2013), gives credence to concerns expressed by informants. If statistics speak for themselves, then this is an indication that electrifying rural areas is not something that can easily resolve gender-energy challenges, unless the government is prepared and committed to diversifying energy sources for the rural poor, and seriously work on strategies for rural poverty reduction. As noted above, rural electrification is a very commendable strategy for rural development and transformation, but, as far as gender is concerned, there is still a long way to go with the current poverty levels.

3.5. Rural Women and Future Energy Aspirations

Access to reliable and affordable energy sources is thought to be the best strategy for empowering women and resolving the gender-energy challenges they face in their daily lives. Many informants aspire to have reliable energy sources. Most of the informants expressed concerns about

women's participation in new systems of energy, apart from rural electrification. Thus, the main issue is not only having access to reliable and affordable energy sources but also taking into consideration gender-specific energy needs, and involving rural women in all energy issues and processes. It was expressed by many that electrifying rural areas is not enough to reduce energy complexities and more needs to be done:

It is time now for the government to get directives from us (we women). The government does not value women; they are not getting opinions from rural areas on what we need. Mass education is needed about other sources of energy like cooking gas, and reduced prices to enable us access cheaper energy. Women's participation should start at grassroots level, and if there are seminars regarding energy policymaking, these should focus on rural women, and not in urban areas. (Shoma, Interview, November 9, 2013, Shinyanga).

This resentment requires the government and energy stakeholders to think critically about how they can integrate gender issues and needs into the design and implementation of energy projects. It brings out a very critical question regarding whether or not the government talks to rural women to learn of their challenges and needs, before coming-up with policies and energy projects for electrifying rural areas. Currently, REA is working with the World Bank to integrate gender issues into the design, implementation, and monitoring and evaluation of energy projects (URT 2013). REA is training its staff to implement identified gender issues in energy projects. It is also strengthening its gender-specific focal unit (*ibid.*). These efforts are commendable but they are, by no means, enough to address gender-energy challenges in rural areas. As the above informant opines, the success of REA's efforts will depend on how much the Agency involves rural women to learn of their needs, aspirations and perceptions, and how it integrates these into the energy projects. It is important to note that empowering women in rural areas is not only about bringing them electricity or thinking on their behalf about what is good for them, it is also about giving them freedom to decide on what they want. As the following informant notes, training and awareness campaigns are very important for the success of any energy project in rural areas.

I urge the government to conduct seminars for many women so that they understand other sources of energy, instead of sticking only on one source of energy. For instance, many women still believe gas is very dangerous for cooking. Also on my own knowledge, I believe any well-off person has freedom to use any type of energy; *it has nothing to do with gender* [emphasis authors']. So, I think it is time for the government to involve women to know other sources of energy, it will help women. Otherwise, we will remain to be women forever⁶ and men, controllers. (Hamisa, Interview, November 9, 2013, Shinyanga).

The informant aspires to learn and be informed of energy issues as a means of helping women resolve the energy challenges they are facing. She

understands that energy is vital for the emancipation of women; but, more needs to be done on educating women about the various sources of energy. Although the capacity to afford financial costs of energy is the major constraint for rural electrification in tackling gender-energy injustices, it is observed that educating women about energy issues is desirable. Further, the informant challenges the government to tackle the problem of patriarchy in society, as a step to making access to and use of reliable energy sources, of meaningful impact on women's energy needs. More important is the fact that some of the informants still lack knowledge about gender issues and their connection with energy. For example, the above informant desires to see the oppression and marginalisation of women in society ending, and women taking leading roles in decision-making; but, she has limited knowledge on gender and energy. This is what makes training and awareness raising on issues of gender and energy very relevant for the success of rural energy projects. Emancipating women from the strips of energy poverty requires making them aware of their situation and learning from them about their needs, so that designed energy projects would be of benefit to them.

4. Conclusion

Facilitating access to affordable and reliable energy sources in rural Tanzania remains one of the best ways to rural transformation and development. Current efforts by the government of Tanzania, through the MEM and REA, to electrify rural Tanzania are commendable. This chapter demonstrates, without doubt, that from the perspective of fieldwork informants and available literature, rural electrification is vital for rural transformation and development. The study indicates that rural electrification is a gateway to various socioeconomic transformations in rural Tanzania. Aspects, such as employment opportunity creation, rural-urban migration mitigation, promotion of social services by attracting potential servants to rural areas, attracting investors in rural areas, and lighting rural Tanzania are associated with rural electrification, as expressed by many of the informants.

It is also noted that gender-energy challenges remain unyielding in Tanzania. While rural electrification is commendable and encouraged, the study reveals that resolving energy challenges facing rural women in Tanzania requires more than just electrifying rural areas. For rural electrification to have any meaningful impact on the gender-energy challenges, gender-specific energy needs require to be identified and mainstreamed in the design and implementation of rural electrification projects. Although REA has worked with the World Bank to mainstream gender in energy programme design (URT 2013), evidence from the field confirms that women's energy needs have not been properly and adequately integrated into the design and implementation of rural electrification projects. The majority of the informants are not well-informed about rural electrification. This means that rural women have not

been consulted, to learn about their energy needs and challenges.. Of course, there is still room for improvement, given the fact that rural electrification is just taking-off in Tanzania. The Rural Electrification Agency would therefore have to talk to rural women, among other energy stakeholders, to learn of their challenges and needs, so that they can be integrated into the various energy projects. The best approach here is to put women at the forefront of rural energy plans and ensure that they participate in the design, formulation, implementation, and monitoring and evaluation of energy projects, to achieve desirable outcomes. Doing so will ensure that rural energy projects are community-owned and an outcome of women's needs, and not what the government thinks it is best to do.

Furthermore, study findings indicate that for rural electrification to resolve energy challenges, especially those related to cooking using woodfuel, cow dung, and other unsustainable sources, costs for installation and use of electricity for cooking must be brought down. Despite the fact that the government has brought down costs for electricity installation in rural areas, many still believe that it is too expensive for the rural poor to afford cooking using electricity. This argument is compounded by the fact that many of the informants were not well-informed on the use of and real costs involved in cooking using electricity. This suggests to the government the need to design awareness programmes for the rural people. It is not enough to increase the number of households accessing electricity to 30 per cent, by 2015; this should go hand-in-hand with awareness creation among the rural people. Higher electricity charges and costs should also challenge the government and energy stakeholders to think about how to bring this down. This is compounded by the fact that rural people do not have enough reliable energy choices. All the informants explicitly stated that the government has not given them enough energy choices to enable them resolve gender-energy challenges. The government and other energy sector stakeholders should work on this. One way of doing this is to diversify energy sources for rural areas instead of depending mainly on hydropower, which is unreliable, given the current challenges imposed by climate change and variability. Other potential energy sources would be solar power, natural gas, biogas, and cost-effective and environmentally-friendly wood stoves. This can best be done if the government continues to nurture public-private partnerships, by creating conditions that attract more private investors to the rural energy sector. It is the authors' contention that the diversification of energy sources will provide the rural population with adequate energy choices, given the alternatives presented to them, thus bringing down costs. Ultimately, women who are overburdened by cooking energy can reduce the time, expenditure, health risks, and accidents associated with collection of firewood in the forest and cooking using woodfuel (Ngoo 2004).

From the findings of the study based on the GAD perspective, it appears that rural electrification has failed to mainstream gender in the design and implementation of rural energy projects. Although gender mainstreaming cannot resolve energy cost challenges, it is vital in making women's concerns and needs known and integrated into energy projects. By making them known, the government will have to respond to them and design rural energy projects, alongside other strategies to resolve the challenge of costs. Whereas GAD emphasises working with men and women to iron-out different gender issues in development projects, rural electrification has not adequately worked with women to identify their energy needs and challenges. Moreover, patriarchal practices, which have for so long marginalised and oppressed women in rural Tanzania, are still prevalent. This indicates that rural electrification may not have approached the challenge of energy in rural areas from a holistic and historical approach, which is a challenge to the government to reflect on its rural energy strategies and plans, so as to improve on future energy projects. As for the current energy projects, it is evident that they have not successfully integrated women's gender-specific energy needs. As per study findings, REA has mainly focused on the quantitative side of rural electrification, with little emphasis on addressing the gendered aspects of rural energy. This should be a lesson for REA, to seriously make gender-energy needs of women central to the design and implementation of future energy projects. In view of the above conclusions, the following are recommended, in order to make rural electrification gender-sensitive and responsive to rural development and transformation:

- Consulting with and involving rural people, especially women, to learn of their energy needs, challenges and expectations, and mainstream these in all energy policies, plans, strategies, and projects. The government should not, in any way, try to think on behalf of rural women and men about what is good for them. Energy projects and plans should be informed by the needs and expectations of women and other energy consumers.
- Awareness building among rural women and men about the use of different sources of energy, costs involved and likely benefits of sustainable and modern energy sources vis-à-vis traditional energy sources.
- The government should focus more on rural women's participation in energy policymaking and implementation. Increasing the number of women in the energy sector and in decision-making bodies is commendable but not enough to ensure that women's energy concerns are addressed.
- Moving from papers to implementation is very important to realise the good things contained in policy statements about gender-energy issues.

Notes

1. Sukuma is a vernacular language spoken by one of the tribes found in the western part of Tanzania. The country has more than 126 ethnic tribes.
2. The informant expressed herself by saying that sometimes they end up with debts, whereby they have to borrow money from friends without the knowledge and consent of their husbands. What matters to her is to see that the family gets food, and this has sometimes caused women to be in conflicts as their husbands have no idea where the money is from.
3. To the Sukuma tribe, taking care of their husbands should be women's priority number one, and is the essence of marriage. Looking at this statement, it is clear that the Sukuma women still face these bad traditional practices.
4. A Sukuma word that means "no". The informant mentioned this when asked about whether electricity could resolve energy challenges, stressing and showing doubt on the rural electrification strategy.
5. 1 US\$ = TZ shillings 1,592 as of October 25, 2013. <http://bot.go.tz/>. Currency exchange rates do fluctuate, therefore, it is subject to change.
6. This could be interpreted to mean that if the current state of affairs remains the same, women will continue to be marginalised. The statement also indicates that the informant is dreaming about a world where women are not just takers of decisions but also decision-makers and drivers of their own lives.

References

- Adomakoh, K. 2012. 'Meeting the rural electrification challenge'. Paper presented at the 3rd International Off-Grid Lighting Conference and Trade Fair, Dakar, Senegal, November 15-23. Retrieved December 12, 2013, from http://www.lightingafrica.org/2012conference/index.php?option=com_content&view=article&id=139&Itemid=333.
- Ahlborg, H. and Hammar, L. 2011. 'Drivers and barriers to rural electrification in Tanzania and Mozambique— grid extension, off-grid and renewable energy sources'. *World Renewable Energy Congress*, Linköping, Sweden, May 8–13. *Policy Issues (PI)*, 2493–2500. Retrieved October 20, 2013, from http://www.ep.liu.se/ecp/057/vol10/028/ecp57vol10_028.pdf.
- Aikaali, J. 2010. *Determinants of rural income in Tanzania: An empirical approach*. Research Report 10/4. Retrieved November 7, 2013, from http://www.repoa.or.tz/documents/rr10_4.pdf.
- Bradshaw, S., Castellino, J. and Diop, B. 2013. 'Women's role in economic development: Overcoming the constraints'. Background paper for the High-Level Panel of Eminent Persons on the Post-2015 Development Agenda. Retrieved September 16, 2013, from http://www.post2015hlp.org/wp-content/uploads/2013/06/Bradshaw-Castellino-Diop_Womens-Role-in-Economic-Development-Overcoming-the-Constraints.pdf.
- Davidson, O., Chenene, M., Kituyi, E., Nkomo, J., Turner, C. and Sebitosi, B. 2007. *Sustainable energy in Sub-Saharan Africa*. Seychelles: International Council for Science. Retrieved December 30, 2013, from

- http://www.icsu.org/africa/publications/reports-and-reviews/icsu-roa-science-plan-on-sustainable-energy/Doc%20SP02.1_ICSU%20ROA%20Science%20Plan%20-%20Sustainable%20Energy.pdf.
- Damhaug, M. 2009. 'Gender equality in the energy sector: Case of Tanzania'. *Regional Seminar on Women's Empowerment and Gender Equality*, May 13–14, Maputo. Retrieved October 23, 2013, from http://www.google.co.tz/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&ved=0CCgQFjAA&url=http%3A%2F%2Fwww.norad.no%2Fen%2Fthematic-areas%2Fenergy%2Foil-for-development%2Fnews-archive%2F_attachment%2F128974%3F_download%3Dtrue%26_ts%3D1225fc34689&ei=sJFnUq3_HYSc0QXO94HIBg&usq=AFQjCNE6o6KePj7GMxf4pbZR4fhqyDyQ&bvm=bv.55123115,d.Yms.
- Green, M. A. and Zwebe, D. 2004. 'From solar home systems to grid electricity: A women's view'. *ADB FINESSE Africa Newsletter 1.6*, October 7–9.
- Huffington Post. 2012. 3,000 lynched in Tanzania for "witchcraft" in past six years. Retrieved November 7, 2013, from http://www.huffingtonpost.com/2012/05/29/tanzania-witchcraft-3000-lynchings-witches_n_1553448.html.
- James, B. 1999. Case report: Energy at the margins of power: Gender and policy in the energy sector. *Agenda*, 18–47.
- Kassenga, G. R. 2008. The status and constraints of solar photovoltaic energy development in Tanzania. *Energy Sources, Part B: Economics, Planning, and Policy*, 3(4): 420–432.
- Kauzeni, A. S., Sawe, E. N. and Shechambo, F. C. 2001. Assessing rural needs and solutions in northeast Tanzania. *UTAFITI (New Series) Special Issue*, 4: 89–104.
- Losindilo, E., Mussa, A. S. and Akarro, R. J. 2010. Some factors that hinder women participation in social, political and economic activities in Tanzania. *Arts and Social Sciences Journal*, 4: 1–10.
- Lyimo, B. M. 2007. Improving energy resilience in Tanzania. *Sustainable Energy Watch*. Dar es Salaam: HELIO International.
- Maduka, O. and Fayomi, G. 2004. Gender and renewable energy in Africa. *ADB FINESSE Africa Newsletter, 1.6*, October, 2–4.
- Mathew, G. [n.d.]. Rural energy agency initiatives in mainstreaming gender in the delivery of modern energy services to rural areas. Retrieved December 30, 2013, from http://siteresources.worldbank.org/EXTGENDER/Resources/workshop-032211-Day-1-Grace_Mathew.pdf.
- Ministry of Energy and Mines (MEM). 2013a. The energy sector overview. Retrieved September 13, 2013, from <http://www.mem.go.tz/AboutUs/MEMOverview/TheEnergySector/tabid/121/language/en-US/Default.aspx>.
- . 2013b. Concept note for the establishment of REA and REF. Retrieved December 27, 2013, from <http://www.rea.go.tz/Resources/eLibrary.aspx>.
- Minja, T. 2011. 'Violence against older women in Tanzania'. Paper prepared for panel discussion: Violence and abuse against older persons. Second Working Session of the Open-ended Working Group on Ageing, August 1–4, 2011, NY.

- Mohn, T. 2013. 'It takes a village: Rural electrification in East Africa'. *IEEE Power and Energy Magazine*, July/August, 46–51.
- Msyani, C. M. 2013. 'Current status of energy sector in Tanzania: Executive exchange on developing an ancillary service market'. February 25th to March 2nd, Washington, D.C.
- Retrieved November 4, 2013, from <http://www.usea.org/sites/default/files/event/Tanzania%20Power%20Sector.pdf>.
- Muhongo, S. M. 2013. Hotuba ya waziri wa nishati na madini Mhe. Prof. Sospeter Mwijarubi Muhongo (Mb) akiwasilisha bungeni makadirio ya mapato na matumizi kwa mwaka 2013/2014. Retrieved September 9, 2013, from <http://www.mem.go.tz/Resources/eLibrary/tabid/93/language/en-US/Default.aspx>.
- Ngoo, G. 2004. Energy and gender: A brief case of TaTEDO experiences. *ADB FINESSE Africa Newsletter 1.6*, October 10–11.
- NORAD. 2012. Gender review. *NORAD Report 9*. Dar es Salaam: Royal Norwegian Embassy. Retrieved October 19, 2013, from http://www.google.co.tz/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CCoQFjAA&url=http%3A%2F%2Fwww.norad.no%2Fno%2Fresultater%2Fpublikasjoner%2Fnoradsrapportserie%2Fpublikasjon%2F_attachment%2F399137%3F_download%3Dtrue6s%3D13c48834c3b&ei=xVRiUvDhHoGG4ASerYHoCA&usg=AFQjCNHjEyev4CfqLyTmL77GPZ6kcPTs-Q&bvm=bv.54934254,d.bGE.
- Oparaocha, S. 2004. Changing the face of gender and energy: The role of ENERGIA as an international network. *ADB FINESSE Africa Newsletter 1.6*, October 5–6.
- Practical Action. [n.d]. Energy and Sub-Saharan Africa. Retrieved December 30, 2013, from <http://practicalaction.org/energy-and-sub-saharan-africa>.
- Rural Energy Agency (REA). 2012. About us. Retrieved October 19, 2013, from <http://www.rea.go.tz/AboutUs/AboutREA.aspx>.
- Sawe, E. N. 2005. 'Developing sustainable rural energy strategies at district level (issues and options). Partners for Africa - Policy Dialogue Conference, June 22–25. Retrieved November 4, 2013, from <http://www.partners4africa.org/docs/S1-5-Sawe-PfA-Tanzania-0506.pdf>.
- . 2008. Decentralized rural electrification through liquid biofuel powered multifunctional platforms (MFPs): Some lessons and experience from TaTEDO pilot project. *Sustainable Energy and Development Forum*, 6: 1–6.
- Sawe, E. Kimambo, C. Kipondya, W. and Hello, J. 2004. Sustainable energy and development forum: Participatory approaching for implementing sustainable energy development activities in Tanzania. *Newsletter of the traditional Energy and Development and Environmental Organization (TaTEDO) Issue 1*. <http://www.youfly.co.tz/tatedo/files/publications/SEDF%20Newsletters/sedf1.pdf>, Accessed on 04/11/2013.]
- Songela, F. 2006. Gender and energy and their link to the MDGs. *Sustainable Energy and Development Forum*, 4: 16–21.
- Sosovele, H. 2010. Policy challenges related to biofuel development in Tanzania. *Africa Spectrum*, 45(1): 117–129.

- Tanzania Media Women's Association. 2013. Media sector mapping Zanzibar: Key findings. Retrieved December 28, 2013, from <http://www.sfcg.org/programmes/tanzania/Media%20Sector%20Mapping%20Zanzibar%20Key%20Findings%2030%20April%202013.pdf>.
- Tasli, K. 2007. A conceptual framework for gender and development studies: From welfare to empowerment. OFSE FORUM 32. Retrieved September 16, 2013, from <http://www.oefse.at/Downloads/publikationen/foren/Forum32.pdf>.
- Uisso, J. and Mwihava, N. 2005. Tanzania national energy policy: Focus on renewable energy and poverty reduction. Paper presented at Partners for Africa Policy Dialogue Conference, June 22-24 June, Dar es Salaam.
- UN WOMEN. 2013. Gender mainstreaming. Retrieved November 12, 2013, from <http://www.unwomen.org/en/how-we-work/un-system-coordination/gender-mainstreaming>.
- United Republic of Tanzania (URT). 2003. *The national energy policy*. Ministry of Energy and Minerals. Retrieved October 23, 2013, from <http://tatedo.org/cms/images/publications/reports/energypolicy.pdf>.
- . 2003. *The national energy policy*. Retrieved October 27, 2013, from <http://www.mem.go.tz/Resources/eLibrary/tabid/93/language/en-US/Default.aspx>.
- . 2011. *Tanzania: Country report on the millennium development goals 2010*. Retrieved October 27, 2013, from <http://www.povertymonitoring.go.tz/WhatisNew/MDG%20Report%202010.pdf>.
- . 2012. *Ministry of Energy and Minerals: Strategic Plan 2011/12-2015/16*. Dar es Salaam. Retrieved November 8, 2013, from <http://www.mem.go.tz/Resources/eLibrary/tabid/93/language/en-US/Default.aspx>.
- . 2013. *Scaling-up renewable energy programme (SREP): Investment Plan for Tanzania*. Retrieved October 30, 2013, from http://www.mem.go.tz/Portals/0/EasyDNNNewsDocuments/1033/0039_08052013-SREP_Tanzania%20IP_Final_Draft.pdf.
- . 2013. *2012 population and housing census: Population distribution by administrative areas*. Dar es Salaam. Retrieved September 9, 2013, from http://www.nbs.go.tz/sensa/PDF/Census%20General%20Report%20-%2029%20March%202013_Combined_Final%20for%20Printing.pdf.
- Wamukonya, N. 2002. *A critical look at gender and energy mainstreaming in Africa*. Draft paper distributed at the Gender Perspectives in Sustainable Development side event organized by UNDESA/DAW and WEDO at Prep Com III. Retrieved October 19, 2013, from <http://www.un.org/womenwatch/daw/forum-sustdev/Njeri-paper.pdf>.
- White, L. K. 1988. Gender differences in awareness of aging among married adults, ages 20 to 60. *The Sociological Quarterly*, 29 (4): 487–502.
- World Bank. 2013. *Tanzania overview*. Washington, D.C: World Bank.
- World Vision Australia. [n.d]. Gender and development (GAD) approach: Learning from the past, hope for the future. Retrieved September 16, 2013, from http://www.worldvision.com.au/Libraries/3_3_1_Health_PDF_reports/Learning_from_the_Past_Hope_for_the_Future_-_Part_5.pdf.

CHAPTER FOUR

Towards a Gender Transformative Agenda? A Critique of Gender Mainstreaming in Energy Policy in Kenya

Moses Adama Osiro

Abstract

Energy is a critical input into the economic and social advancement of any society, and is especially pertinent in efforts to alleviate poverty, and spur economic and social development. Notwithstanding this, access to energy in resources is not only constrained by physical shortages but by the unequal power relations between women and men. Nevertheless, the predominantly gender-neutral approach to energy policies in many countries has meant that policymakers often fail to recognise and address the implications of such gender inequalities, with the result that such policies discriminate against women. The Government of Kenya has adopted a number of policy frameworks to mainstream gender in all its development programmes, including energy provision. This chapter critically examines Kenya's energy policy documents, through a content analysis of various government publications pertinent to energy and concludes that the current policy framework as articulated in the National Energy Policy document is largely gender-neutral, which falls short of engendering the energy sector to such an extent that would promote gender-equitable access to energy services in Kenya.

Keywords: Gender inequalities, gender mainstreaming, energy poverty, gender-neutral, gender-equitable.

1. Introduction

Kenya's long-term development blueprint, known as Vision 2030, identifies energy as one of the infrastructure enablers of its social and economic pillars (Government of Kenya [GoK] 2012). Sustainable, affordable and reliable energy for all citizens is recognised as a key factor in the realisation of Vision 2030. However, as is the case in many parts of the world, overall socioeconomic development is limited by lack of widespread availability of modern energy services such as lighting, cooking and heating, refrigeration, pumping, transportation, and communications (Khennas 2012). In Kenya, the challenges of energy supply include low access to modern energy services, high cost of energy, irregular supply, and high cost of energy investments (Mwakubo *et al.* 2007). It is estimated that 77 per cent of the population in Kenya does not have electricity connections. Over 85 per cent of the population relies on traditional fuels

such as wood, charcoal, dung, and agricultural residues for cooking and heating. Many of the urban and rural poor are not reached by grid-based electrical power nor is there adequate distribution of gas or other cooking and heating fuels. Firewood remains the predominant fuel for cooking. Nationally, 68.3 per cent of all households use firewood as their main source of cooking fuel. Over 80 per cent of the households in rural areas rely on firewood for cooking, compared to 10 per cent of urban households. Charcoal is the second-most widely used cooking fuel, used by 13.3 per cent of households. Kerosene is ranked the third predominant cooking fuel but is the most common type of fuel for cooking among 44.6 per cent of urban dwellers (GoK 2011).

Lack of adequate access to affordable energy constitutes one of the non-income dimensions of the concept of poverty, alongside others such as health, education and living conditions (Sovakool 2012). The UNDP defines energy poverty as the “inability to cook with modern cooking fuels and the lack of a bare minimum of electric lighting to read or for other household and productive activities at sunset” (Gaye 2007, 4). The Asian Development Bank, on the other hand, implying a capability-based conception, defines it as “the absence of sufficient choice in accessing adequate, affordable, reliable, high quality, safe, and environmentally benign energy services to support economic and human development” (Masud, Sharan and Lohani 2007, 47).

The foregoing scenario of energy use in Kenya, characterised by lack of access to electricity and overreliance on traditional biomass fuels such as wood, charcoal, and/or dung for cooking, suggests that a significant segment of the population is experiencing energy poverty, albeit stratified along the rural-urban divide (Karekezi, Kimani and Onguru 2008). Nevertheless, the incidence of energy poverty is not only differentiated spatially and by income levels, but is also gendered. It is becoming widely acknowledged that energy, like agriculture, health and education, is not gender-neutral. Skutsch (1998) points out that the kind and quantity of energy available and its price have different effects on men and women because of the sexual division of labour, according to which energy is utilised for different activities and ends. Women are particularly affected by lack of accessible and affordable energy services due to their traditional roles, household responsibilities, and low social and political status. In Kenya, access to and ownership of resources is mediated by gender relations, and the gendered division of labour between men and women within households predominantly assigns to women the bulk of household energy services provision. Women are the main collectors, producers and users of household energy. Moreover, much of the energy that women use is not fuel energy but metabolic energy applied to everyday tasks, such as firewood and water collection, and carrying crops to storage facilities at harvest time, which in most cases could be substituted by mechanical or electrical energy. It has, for instance, been shown that women in Kenya

spend 6–8 hours collecting firewood, and carry 20–30 kilogrammes to their homes (Munien and Ahmed 2012). In view of this, the African Development Bank (2007) observes that the real rural energy crisis is rural women's time, with women working longer days than men in providing human energy for household survival activities, non-monetised work which is largely invisible in national accounts and labour force statistics. Moreover, many income-generating activities of women, predominantly in the informal sector, are fuel-intensive, and the viability of these activities is affected by energy prices and availability. Energy scarcity thus impinges on the provision of other basic services such as water, health and education. Owing to the fact that women do most of the cooking, they and their young children are exposed to large amounts of smoke and particulates from indoor fires and suffer from a number of respiratory diseases. The associations between indoor air pollution and acute lower respiratory infections have been borne out by a number of empirical studies. For instance, a study in rural Kenya found that the amount of pollution a child is exposed to correlates to the risk of developing pneumonia (Ekouevi and Tuntivate 2011).

This situation provides the impetus for explicitly focusing on the gender-energy nexus. The thrust of this focus is that far from being just a women's problem (as the cooking problem has been seen in the past), this nexus is a societal problem, which needs to be dealt with taking into account the social relations between men and women, and the expectations and roles of both men and women, as regards energy. Arguably, access to energy in eastern and southern Africa is not only constrained by physical shortages but by the unequal power relations between women and men (Karekezi and Wangeci 2005). Nevertheless, policymakers have often failed to recognise and address the implications of such gender inequalities, with the result that supposedly gender-neutral energy policies discriminate against women (Clancy and Feenstra 2004). Better understanding of the differences in the ways men and women use energy in various cultures and locations can be instrumental in promoting greater gender equity and the empowerment of women, as well as enhancing the effectiveness of energy projects, poverty programmes, and overall sustainable development activities. While gender issues have come to the forefront in many development sectors, including agriculture, forestry and water, the energy sector has been slow to acknowledge the links between gender equality, energy and development.

1.1. Problem Statement

While gender issues have come to the forefront in many development sectors including agriculture, forestry, and water, the energy sector has been slow to acknowledge the links between gender equality, energy and development. Up to recently, the development plans for the energy sector in Kenya focused on large-scale, capital-intensive technology projects designed to provide energy for growth in the formal sectors of the economy— cash crops and mechanised production— which are primarily

controlled by men. Almost totally excluded from this definition are small-scale, management-intensive activities carried out primarily by women, using their own muscle power or local natural resources, for both family subsistence and small-scale income activities, usually in the informal sector. There is, however, a growing awareness that energy as an input in development generates consequences for men and women which are mediated by existing gender relations, whether this is explicitly acknowledged or not. Better understanding of differences in the ways men and women use energy can be instrumental in promoting greater gender equity and the empowerment of women, as well as enhancing the effectiveness of energy projects, poverty programmes and overall sustainable development activities. This has given impetus for inclusion of gender issues in energy planning. Mainstreaming gender in the energy sector is, therefore, imperative for addressing pertinent gender concerns, which have implications for the wellbeing of both men and women. Arguably, access to energy is not only constrained by physical shortages but by the unequal power relations between women and men. Nevertheless, the extent and manner in which gender issues are integrated into energy policies delimits the prospects of energy as an input in development processes, contributing to transforming extant gender relations and alleviating the gendered nature of energy poverty. It is against this background that this chapter critically interrogates gender mainstreaming in energy policies in Kenya.

1.2. Purpose of the Study

To critically examine the manner in which gender concerns have been integrated within the energy policy framework in Kenya over time, and how these enable or constrain the harnessing of gender-energy nexus for improving the wellbeing of men and women.

1.3. Study Questions

1. The key questions that this study sought to answer are:
2. In what ways are energy policies in Kenya gender-aware, gender-blind or gender-neutral?
3. How has the gender-energy nexus been constructed in gender mainstreaming efforts, in energy policy discourse?
4. Are energy policies geared to meeting welfare objectives or women's empowerment?
5. What institutional measures have been implemented to concretise and sustain gender mainstreaming in the energy sector in Kenya?

1.4. Methodology

The study commenced with a review and content analysis of secondary sources of data, mainly government policy documents (Sessional Papers and corresponding legislation, both energy sector specific, and those

pertinent to other overlapping sectors such as agriculture) as well as cross-cutting themes, especially on gender and poverty reduction. Other sources of secondary data included research publications by governmental and non-governmental organisations (NGOs) as well as networks addressing themselves to the gender-energy-poverty nexus. Primary data was collected through key informant interviews in order to triangulate and clarify information obtained from the secondary data.

2. Conceptual Literature

2.1. The Capability Approach to Gender and Development

The capability approach to gender and development (GAD), as it crystallises feminist interfaces with development theory, is used here to facilitate a critical engagement with gender relations as social and power relations, which is underscored to be the fundamental issue in the gender-energy debate. Gender and development adopts a two-pronged approach to the study of women and development, investigating women's material conditions and class position, as well as the patriarchal structures and ideas that define and maintain women's subordination (Parpart, Connelly and Barribeau 2000). The focus is on relationships between women and men, not on women alone, as they mediate access to and control of energy resources, and concomitant productive opportunities.

To appreciate the particular ways in which energy can be a medium of transforming gender relations and empowering women, it is useful to examine the practical ways in which energy expands the options of men and women. Notably, development requires more than the creation of opportunities for people to earn sustainable livelihoods; it also requires the creation of a conducive environment for men and women to seize those opportunities (Alba 2000). The capability approach provides a lens through which the options potentiated for women can be examined. Sen (1999, 87), credited with advancing the capability approach in poverty discourse, has argued that "in analyzing social justice, there is a strong case for judging individual advantage in terms of the capabilities that a person has, that is, the substantive freedoms he or she enjoys to lead the kind of life he or she has reason to value". He employs the twin concepts of functionings and capabilities to articulate his argument. A person's functionings reflect the collection of "beings" and "doings" she or he actually achieves, such as being literate, educated, well-fed, or belonging to a social network (*ibid.* 1; 74–76). A person's capabilities, on the other hand, represent "the alternative combinations of functionings that are feasible for her to achieve" (*ibid.*, 75). It reflects the person's real opportunities or positive freedom of choice between possible lifestyles.

Thus, goods and income are not important in themselves; but in what their characteristics enable people to be or do—the capabilities that individuals can generate from them (Robeyns 2005). Nevertheless, the extent to which an individual can generate capabilities depends on the simultaneous

mediation of social (social norms, traditions and institutions), personal (mental and physical vulnerabilities) and environmental conversion factors (*ibid.*). In view of this, Alkire (2008) concludes that fundamental to the capability approach is a normative proposition— social arrangements should be primarily evaluated according to the extent of freedom people have to promote or achieve functionings they value. Similarly, Robeyns (2005, 94) describes the capability approach as “a broad normative framework for the evaluation and assessment of individual wellbeing and social arrangements, the design of policies, and proposals about social change in society” and that the distinguishing characteristic of the approach is “its focus on what people are effectively able to do and to be”. Thus, the benchmark for assessing the outcomes of efforts to realise social progress, development or poverty reduction goals becomes the expansion of freedoms.

With respect to energy, the functionings that can be achieved, particularly by women, are severely constrained by existing gender relations, which not only restrict access to certain forms of energy but also the various uses that women can put them to. Thus, the gendered nature of access and use of energy is essentially a question of social justice. Applied to analyzing energy policies, the framework is useful in assessing the prospects which efforts to integrate gender into energy policies have for transforming gender relations in such a way that expands the options for both men and women. In particular, it provides a lens through which to look beyond the generic goal of enhanced availability of energy, to examine specific ways in which energy policies seek to ease barriers in access to energy posed by gender relations, in other words, in what ways do energy policies seek to enhance the “functionings” of men and women. It means interrogating the empowerment goals of energy policy beyond the welfare and efficiency objectives that dominate energy policies in many countries. This framework is employed to examine the thrust of the energy policies, to find out to what extent they explicitly seek to empower women through enhanced access to energy as an instrument for expanding their capabilities.

2.2. Gender Mainstreaming Approaches in the Context of Energy Policy

The idea of gender mainstreaming became popularised during the United Nations Fourth World Conference on Women, in 1995. The Beijing Platform for Action, the outcome of the conference, envisioned the promotion of women’s empowerment and equality between women and men through, among other measures, the establishment of “national machineries” to ensure the mainstreaming of gender perspectives in all spheres of society (United Nations 2001, 26).

Gender mainstreaming is the process of integrating a gender equality perspective into the development process, by assessing the implications for women and men, of any planned action at all stages and levels. In addition, explicit plans of action have to be formulated to address such gender issues,

requisite resources and expertise provisioned for realising pertinent strategies and accountability systems instituted to assure desired ends. The powerful appeal of the notion of gender mainstreaming lies, according to Woodford-Berger (2007, 124) “in the spirit, politics and promise of its early intentions: to imbue all systems, structures and institutionalized cultures with awareness of gender-based biases and injustices, and to remove them”. In principle, if not necessarily in practice, it entails the reworking of structures of decision-making and institutional cultures such that gender becomes a central rather than a peripheral issue (Chant and Gutmann 2002; Razavi 1997).

A common distinction made in the literature between gender mainstreaming approaches categorises them as either “agenda-setting” or “integrationist”. Generally, the integrationist approach seeks to introduce a gender perspective into existing policy while an agenda-setting approach seeks to challenge and transform policy paradigms in the process of engendering policy. More specifically, the former introduces a gender perspective “without challenging the existing policy paradigm, instead selling gender mainstreaming as a way of more effectively achieving existing policy goals” (Walby 2005, 4). The downside of this approach is that, relatively, its impact is likely to be less substantial. Agenda-setting, on the other hand, implies “the transformation and reorientation of existing policy paradigms, changing decision-making processes, prioritising gender equality objectives and rethinking policy ends. In this approach, it is the mainstream that changes” (*ibid.*).

Jahan (1995) contrasts the two approaches to gender mainstreaming as well as their implications, specifically focusing on the energy sector. The integrationist approach essentially addresses itself to women’s practical gender interests by focusing on “technological fixes”, such as low-grade solar energy systems, biogas, wind energy, and biomass, and does not tackle the real energy concerns of users and managers of energy at the household level (mainly women). The agenda-setting approach, in contrast, aims to introduce women’s concerns related to their social position into mainstream development agendas, so as to transform the agenda for change, thus fostering gender equality. This approach to energy policy might entail the empowerment of women to participate in energy decision-making, and help them to increase the productivity and value of their labour through access to credit, training and income-generating opportunities, without isolating men in these efforts. It recognises that women have to be empowered economically, socially and politically in order to be able to make choices about energy use. Hence, the focus of energy policies should be upon, not only the provision of energy as an end, but the expansion of accessible, affordable and reliable options for particularly poor energy users (Makhabane 2002). It holds the promise of realising concrete outcomes in women’s empowerment by seeking to transform the extant dominant development paradigms, gender relations and government institutional architecture. Arguably, this is more likely to be realised

through transformational interventions geared to meet women's strategic gender interests, an orientation embedded within the agenda-setting approach to gender mainstreaming.

Nevertheless, the empowerment prospects of mainstreaming gender in energy policy are not unequivocal. Clancy *et al.* (2007, 245) argue that "the implementation of energy policy is unlikely to empower women directly, however well it is conceived and however gender-sensitively it is framed". They observe that while energy policy and planning generally aim at increasing the availability and reducing the cost of energy and appropriate conversion technologies, access to one specific resource, though necessary, will never be sufficient to empower women on its own. In any case, the reasons for women's subordinate position in society are complex and multi-dimensional, and involve much more than the simplistic notion of lack of one type of resource, in this case energy. To achieve empowerment through energy interventions, gender relations must be altered to be more favourable to women; energy interventions designed to promote production (such as the provision of electricity) should be implemented in such a way as to increase economic opportunities for women in particular; women must be included in organisation committees and management training; and men should be sensitised to create space for women to participate (Skutsch 1998). In order to assess the degree to which a project or policy is explicitly oriented towards transforming gender relations, a useful heuristic is a typology of policies developed by Naila Kabeer (March, Smyth, and Mukhopadhyay 1999). These are broadly classified into gender-blind and gender-aware policies.

Gender-blind policies recognise no distinction between the sexes. Gender-blindness is thus the tendency to ignore socially determined gender roles, responsibilities, and capabilities of men and women, implicitly assuming that the interests and needs of men and women coincide. Although such policies may appear to be unbiased, they are based on assumptions which result in a bias in favour of extant gender relations (Khamati-Njenga and Clancy 2002; Parikh 1995). This is because, they are often based on information derived from men's activities but which are generalised for women as well (Cecelski 1995; UNDP 2004). Gender-aware policies recognise the differential agency of men and women in development processes and activities, as mediated by gender relations, which lead to differences in interest and priorities between men and women. These are further categorised into gender-neutral, gender-specific and gender-redistributive policies. Gender-neutral policies apply knowledge of gender differences in a given social context to overcome biases in development interventions but are not aimed specifically at either men or women, and are assumed to affect both sexes equally. Even though they are gender-neutral by design, their impact, may in fact be gendered since they tend to leave existing distribution of resources and responsibilities unchanged. Gender-specific policies use knowledge of gender differences in a given context to address the practical gender needs of men and women. Under

these policies, specific programmes are implemented that address the needs and interests of women, at the same time as they address those of men. Gender-redistributive policies are geared towards meeting strategic gender interests — to transform the existing gender relations so as to realise a more balanced relationship between men and women.

In spite of its merits, Subramanian (2007, 113–114) outlines key criticisms that have been directed at the manner in which gender mainstreaming has been translated at national government levels. One concerns the mono-cultural nature of mainstreaming strategies, according to which “most mainstreaming ‘machinery’ looks the same irrespective of the country” despite the complexity of gender relations and the contextual variations in the processes and outcomes related to gender inequalities. Moreover, most are located at the national level, rarely reaching sub-state levels where development change may be more manageable, and may more closely reflect the needs and priorities of particular sub-groups. In consequence, Goetz and Sandler (2007, 168) observe that because mainstreaming efforts often concentrate attention on “top-loading” and investing in those women at higher rungs in the social ladder, presuming that the ensuing privileges and benefits would be shared with those women who are most in need, it has largely been impotent. Mukhopadhyay (2007) adds that gender mainstreaming without institutional accountability is merely a technical exercise without political outcomes, thus leaves the prevailing and unequal power relations intact. It is therefore not enough for an agency to acknowledge the importance of and embrace the goal of gender equality in development work, and even to be equipped with the plethora of frameworks, tools and checklists available for integrating gender into their activities.

The foregoing conceptual framework is applied to analyzing the manner in which gender is mainstreamed in energy policies in Kenya, in answering questions on whether the policies are gender-neutral or gender-aware, as well as whether they seek to transform existing gender relations through strategic programmes to enhance access to energy.

3. Energy Policy, Legal and Regulatory Frameworks

The Government of Kenya has implemented a number of policies to address energy issues in support of its development challenges. These include formulation of a national energy policy and improvements in the energy planning process, among others. Energy policy in Kenya has developed over time, through Sessional papers, government regulations and pertinent legislation, with the electricity and petroleum sub-sectors getting the most attention. Providing an elaborate account of this trajectory, Mwakubo *et al.* (2007) explain that energy sector policies successively addressed themselves to specific aspects of these two major sub-sectors. For example, they point out that Sessional Paper No. 10 of 1965 dwelt on the Electric Power Act (Cap 314) that was used to regulate the sector. Then,

in 1984, the government formulated the National Energy Policy and Investment Plan, which focused on the importance of energy availability, effective use of energy, generation of the resource, potential of domestic energy sources and increasing capacity of electricity generation. It also provided guidelines for the woodfuel sector, encouraging domestic substitution and promotion of alternative sources of energy, human power development, effective coordination, and energy distribution network. However, they observe that these guidelines were silent on environmental aspects of energy-related activities and deficient on consumer interest and involvement in energy activities, issues that have a bearing on gender concerns in energy access and use.

Further, in the 1984/88 Development Plan, the focus of energy remained on the supply of petroleum, electricity and woodfuel. It was thus silent on other sources of energy which again could have dividends for poverty reduction, and by extension, a nexus with gender impacts, such as solar, wind, ethanol and other biomass resources. This was followed by *Sessional Paper No. 1 of 1986 on Economic Management for Renewed Growth*, which did not focus much on the power sector; rather, it called for the establishment of the Department of Price and Monopoly Control within the Ministry of Finance to monitor action in restraint of trade and to enforce pricing in various sectors, including petroleum. In the 1989–1993 plan period, there was a shift of focus towards development and exploration of renewable energy resources such as solar, wind, biogas and woodfuel, and towards the use of efficient kilns and cook stoves. In the 1994–1999 development phase, the concern for sustainable use of energy resources was raised, although nothing tangible was implemented. The next significant legislative development came in 1997 in the form of the Electric Power Act, which was enacted to replace Cap 314 in order to bring on board new developments and to make it more responsive to private sector participation in the provision of electricity (*ibid.*).

In the past, laws governing energy development and distribution were scattered across different acts of parliament: the Electric Power Act, the Petroleum Act, the Forests Act, the Water Act, the Environmental Management and Coordination Act, and the Physical Planning Act. Other legislations that are relevant to the operations of the energy sector are Licensing Act, Standards Act, Trade Licensing Act, Local Government Act, Weights and Measures Act, and Monopolies Act. These have since been consolidated into the Energy Act of 2006, which was enacted in December 2006, subsequent to Sessional Paper No. 4 of 2004. The act seeks to “amend and consolidate the law relating to energy, to provide for the establishment, powers and functions of the Energy Regulatory Commission and the Rural Electrification Authority, and for connected purposes” (GoK 2006, 6). Thus, the Energy Act of 2006 intends to address the current disparities in sub-sector regulations, and bring regulation and enforcement of energy sector activities under one body, the Energy Regulatory Commission (2006).

A comprehensive energy policy came into being with the publication of Sessional Paper No. 4 of 2004, on energy, a product of consultations between the Ministry of Energy and stakeholders in the sector. The broad objective of the policy was to ensure adequate, quality, cost-effective, and affordable supply of energy to meet development needs, while protecting and conserving the environment. The specific objectives of the energy policy were to improve access to affordable energy services; promote utilisation of energy as a tool to accelerate economic empowerment for urban and rural development; ensure provision of sustainable quality energy services for development; provide an enabling environment for the provision of energy services; promote development of indigenous energy resources; and promote security of supply, energy efficiency and conservation as well as prudent environmental, health and safety practices.

The reasons for the absence of gender mainstreaming in these policy and regulatory frameworks can be gleaned from the more recent urgency, priority and vigour with which energy provision is being pursued in Kenya's overall development strategy, as outlined in Kenya's long term economic blueprint, Vision 2030. The primary focus of these policy initiatives is essentially on commercial energy. Sessional Paper on Vision 2030 (GoK 2012) identifies energy as *the foundation* of vision 2030. It states that energy "is one of the infrastructural enablers of the economic, social and political pillars of the Kenya Vision 2030" and "the level and intensity of *commercial energy use* in a country is a key indicator of the degree of economic growth and development" [emphasis added] (GoK 2012, 17). Access to energy is, thus, an imperative for rapid and sustained economic growth and poverty reduction. However, it proceeds to place a premium on commercial energy in Kenya (dominated by petroleum and electricity) as *the prime movers* (emphasis added) of the modern sector of the economy, while woodfuel provides energy needs of the traditional sector, including rural communities and the urban poor. This bifurcation reflects where the priority attention is, and in which gender issues are, at least on the surface, invisible. It further mentions that "electricity remains the most sought-after energy source by Kenya society and access to electricity is normally associated with rising or high quality of life" (GoK 2012, 18). However, the gendered nature of this access is muted. Given that the majority of (poor) women in rural areas are the key actors in energy provision, it is clear that the thrust of the energy policy is on pursuing goals that may not immediately attend to their so-called "traditional sector". Implicitly, this inbuilt bias rationalises peripheralising issues pertinent to women's energy needs altogether.

In the quest to "modernise" the traditional rural sector, the government has continued to finance extension of electricity supply in rural areas as part of the basic infrastructure to stimulate economic growth and employment creation. The current policy provides for the extension of electricity to market centres, public secondary schools, youth polytechnics, health centres, and water systems. A Rural Electrification Authority (REA)

charged with the mandate of implementing the Rural Electrification Programme came into operation in July 2007. This is expected to increase the speed of implementation of several projects that are lined up for implementation throughout the country. While there is a great opportunity to address gender issues in this programme, the approach adopted in its implementation assumes a gender-neutrality, to the extent that communities are presumed to have prior consensus on what the priorities are for both men and women. The speed with which these programmes are to be rolled out obviates the messy participatory approach that would be necessary to undertake comprehensive gender analyses and develop concomitant monitoring and implementation frameworks to ensure gender equitable outcomes.

3.1. Macro-Policy Environment for Gender Mainstreaming

The rationale for gender mainstreaming in sectoral policies, programmes and projects in Kenya is clearly articulated in key macro-policy documents. Firstly, The National Policy on Gender and Development arose from the government's realisation that without a coherent and comprehensive overall framework for guiding the different sectors and agencies involved in development, tremendous resources may continue to be lost unless the thrust of mainstream development directly addresses gender concerns. The overall objective of the gender policy is "to facilitate the mainstreaming of the needs and concerns of women, men, girls, and boys in all sectors of development initiatives, and driven by the focus by all population groups to participate in and benefit equally from the development process" (GoK 2000, 4). The policy recognises that traditional development theories have not facilitated the participation of women in strategic areas and positions of power and influence because they are based on traditional assumptions of the roles and responsibilities of women and men. It further recognises that it is the right of men, women, boys, and girls to participate in and benefit from development and other initiatives. It is acknowledged in the policy that women's experience of poverty "may be different and more acute than that of men because of gender-based forms of exclusion, which lead to their unequal access to economic opportunities" and that the basic objective of any type of development is "to enlarge people's choices by facilitating equal access to opportunities, for all men and women in society, and ensuring that such opportunities and empowerment of people are sustained so that they are able to participate in and benefit from the development process". To realise this goal, the critical issues to address in this case include shelter, water, energy, and the environment. Nevertheless, there is scarce explicit mention of energy as an input into gender transformation efforts envisaged in the policy. Instead, energy issues are subsumed under the category of policy concerns entitled "poverty and sustainable livelihoods", in which it is specifically recommended that the gender policy "promote the development of energy-saving *jikos* that are accessible and affordable to all the families, especially women, and support research into alternative sources of energy" (GoK 2000, 14). It is in this particular frame

that the gender-energy nexus is articulated in the policy. This rendition of gender in energy offers a very limited canvas upon which the fundamentally political problem of transforming skewed gender relations as an integral part of development endeavours can be pursued. Essentially, it constructs the energy problem as a domestic problem, taking for granted rather than problematising the existing gendered division of labour and its concomitant constraints on socioeconomic empowerment of men and women. Further, it pigeonholes the needs and interests of women within the household sector, thereby ignoring their roles which extend into other activities beyond the household, such as agriculture and food processing, as well as in microenterprises. Couched in these terms, it effectively makes energy a “women’s problem”, insofar as the demands for energy by women for productive rather than household reproductive uses are hardly given substantive attention.

Secondly, the National Commission on Gender and Development was set up by an Act of Parliament in the year 2003. It is mandated to coordinate, implement and facilitate gender mainstreaming in national development and to advise the government on gender concerns. The commission’s core mandate is to undertake lobbying and advocacy, monitoring and evaluation, and oversee legal reforms on issues affecting women and girls. Specific tasks of the Commission include:

- a) to participate in the development of national development policy formulation;
- b) to liaise with relevant line ministries and exercise general supervision over implementation of the national policy on gender and development;
- c) to formulate proposals and advise on the establishment and strengthening of institutional mechanisms that promote gender equity and equality, particularly with regard to access to and benefit from education, healthcare, nutrition, shelter, employment, and control of economic and natural resources.
- d) to initiate legal reforms on issues affecting women and gender equality, in collaboration with the Attorney-General.

Sessional Paper No. 2 of 2006 (GoK 2006) provided institutional mechanisms to ensure effective realisation of gender mainstreaming. These included the Ministry of Gender, Sports, Culture and Social Services; Department of Gender and Social Services; National Commission on Gender and Development; Office of the Secretary for Gender; gender officers in ministries, parastatals and institutions of higher learning; district gender and social development officers; and government officers at the divisional level. These government institutions and officers are required to work very closely with Civil Society Organisations (CSOs), communities and other development partners. Sessional Paper No. 2 of 2006 also

proposed the establishment of gender divisions in all ministries. These are expected to:

- a) provide training and capacity building to staff;
- b) develop concrete approaches, methods and tools for mainstreaming gender;
- c) develop indicators for gender mainstreaming on processes, outcomes and impacts of programmes;
- d) build new constituencies to deepen and sustain gender mainstreaming.
- e) establish performance appraisal systems at the individual and departmental levels.

They are ultimately expected to initiate plans and strategies for their ministries, to command and allocate resources to enhance their ministries' execution of the national development blueprints and strategies, such as the National Development Plan, the Economic Recovery Strategy and the Millennium Development Goals (MDGs) as well as the Beijing Platform for Action. Since budgets are still not allocated for the planned divisions, there is little hope that ministries can be persuaded to establish their own gender divisions. Notably, in 2007, the Head of the Public Service Commission issued a directive that line ministries need to appoint gender officers, who are dedicated to the job and should be at a higher level in the public service, and stipulates that appointed persons need to be trained. To date, however, there is no such officer in the Ministry of Energy. Instead, there exists a gender committee which oversees the mainstreaming of gender issues in the ministry albeit in collaboration with the Ministry of Gender and Social Services. This clearly reflects the extent to which gender issues are not located at the "mainstream" of core line ministry mandates but are added to them, contingent on convenience and pragmatism.

In order to support gender mainstreaming efforts, it is imperative that gender-responsive budgeting and a concomitant monitoring and evaluation framework be institutionalised. Through the Ministry of Gender, Children and Social Development, the government has already finalised a monitoring and evaluation framework for tracking the coordination and harmonisation of gender mainstreaming efforts. Nevertheless, it is apparent that the inertia of gender-neutral planning in the Ministry of Energy, according to which the foremost priority is given to the petroleum and electricity sub-sectors owing to their critical role in driving the long-term economic development agenda, and poverty alleviation, presumably for both men and women, constitutes a major obstacle to institutionalising such frameworks. Gender issues, though acknowledged in principle, only gain traction incrementally. In the same vein, gender-responsive budgeting is an important strategy for mainstreaming gender in any policy arena, and is most effective where it is informed by an engendered policy framework because the desired gender-responsive outcomes and objectives are laid out

and the kinds of activities needed to achieve these outcomes are identified. Only then is there a basis for making investment choices necessary to promote gender equality and equity. The absence of such an approach to planning is reflected in critical deficiencies in attention to gender in the monitoring and evaluation framework. Given the overall gender-neutral thrust of the sector, specific budgetary allocations for monitoring progress in gender mainstreaming, with requisite capacity and standardised reporting frameworks, are virtually absent.

The poverty reduction strategy paper (PRSP) is another policy framework that recognised the need for engendering all socioeconomic, political and investment activities, including energy, in the same way that this is equally underscored in Vision 2030 development blueprint (GoK 2001). Although gender imbalance is acknowledged in the PRSP document, there is no detailed cognisance of gender dimensions in the proposed policies, or anticipation of gender implications of the outcomes, in reference to the different poverty dimensions which indicate that women are relatively more disadvantaged than men in virtually all dimensions of poverty. This is partly due to lack of a comprehensive disaggregated database when the policy was formulated. Moreover, men and women are largely treated as a homogeneous group in the PRSP such that their differences in access to and control of productive assets and opportunities are ignored. This gender-blindness means that in terms of policy priorities, women's interest are marginalised and their disadvantages would be exacerbated rather than diminished. Moreover, the PRSP is not explicit on how to address the fundamental gender problem of lack of control over property in land, which pivots most of the exclusion of women from benefiting from opportunities in the agricultural sector.

The 9th National Development Plan, 2002–2009 (GoK 2002), also emphasised that the inclusion of women in development processes is a prerequisite for attaining sustainable development, and set out to engender all development programmes in order to realise this end.

It is evident that an enabling macro-policy environment for mainstreaming gender into sectoral policies, programmes and projects is in place, including the energy sector. However, the link between macro-policy and sectoral policies remains weak and there is selective adaptation of macro-policy issues to influence sectoral planning, thereby implying an incremental fashion of engendering energy policy (Mbuti *et al.* 2007).

3.2. Content Analysis of Kenya's Energy Policy

3.2.1. Gender Components of the Overall Policy Objectives

According to Sessional Paper No. 4 of 2004, the mission of the energy sector is to facilitate provision of clean, sustainable, affordable, reliable, and secure energy services for national development (GoK 2004). Nevertheless, the third draft of the energy policy specifies that the mission of the energy policy is “to facilitate provision of clean, sustainable,

affordable, reliable and secure energy services at least cost while protecting the environment” (GoK 2012, 13). The revision effectively foregrounds the environmental as well as efficiency concerns in energy provision, which have significant implications as far as the gender question is concerned. The attention given to environmental protection in the production and use of energy resources has important gender implications. Owing to socioeconomic constraints, women’s access to energy resources has been restricted to supply options which are inefficient and environmentally-unfriendly. This development, therefore, gives impetus for policy measures that would scale-up access to efficient and environmentally-benign energy supply and end-use technologies that would greatly improve the quality and quantity of energy available to women (Mbuti *et al.* 2007).

The least cost consideration implies a bias towards those energy supply options which are economically viable, which might effectively circumvent demand from those whose settlement patterns (primarily in rural areas, and unplanned settlements in urban areas, and who constitute the bulk of the poor) render supply cost ineffective. Again, this may adversely affect women who are also the majority among poor segments of the population. More positively, the policy recognises that “the principal taxation policy pursued by the Government of Kenya (GoK) in the energy sector is based on the need to create a sustainable balance between fiscal revenue generation and ensuring accessibility of energy by the low income segments of the population at reasonable prices” (GoK 2012, 19). How this balance is achieved is, however, not clear. This has implications for women too, considering the social position of women vis-à-vis state interests. The government also uses taxation as a “prudent” policy instrument “to discourage wasteful consumption of energy”, and by extension, to encourage its efficient utilisation in a cost-effective manner. While this is a valid concern, mention is specifically made of an incentive given to domestic users who are exempted from Value Added Tax where total consumption is below 200 kilowatt hours per month. This implicitly suggests an intention to regulate domestic consumption behaviour, in a sense suggesting the inferior status of this category, vis-à-vis industrial consumers. In the same vein, emphasising macroeconomic concerns, the policy observes that “the cost of energy has significant impacts on economic activities, *particularly* those that are energy-intensive such as cement, steel, pulp, and paper production. In a liberalized market such as Kenya’s, energy prices are a significant determinant of competitiveness of locally manufactured goods relative to imports. In this regard, *high energy prices impact negatively on domestic wealth creation, balance of payments and employment creation* since consumers opt for cheaper imports”(ibid. 20). It is clear from this statement that the priority concerns when it comes to energy pricing would be focused on the “productive” sectors, which obscures the contribution of domestic energy use to economic progress. The cost to domestic use, which is highly gendered, is muted.

The overall objective of the energy policy is “to ensure affordable, sustainable and reliable supply to meet national and county development needs, while protecting and conserving the environment” (GoK 2012, 20). While there is no explicit attention to gender issues in the overall objectives of the energy policy, or even direct mention of the term “gender” among the specific objectives of the policy, these can be gleaned from some of the statements in the policy document. For example, the broad contours of gender concerns are apparent in objectives (b) and (f), which are highlighted below:

- (b) Improve access to quality, reliable and affordable energy services—“affordable” is important because access to energy services is a function of the ability to pay. Consequently, pricing of energy services in a manner that disregards the socioeconomic characteristics of target users is likely to marginalise economically susceptible constituencies such as women.
- (f) Ensure that prudent environmental, social, health and safety considerations are factored in energy sector developments.

The other objectives specify concerns with national and county economic empowerment, ensuring energy supply security, diversification, efficiency and conservation, research and development, standardisation, international cooperation, and promotion of market competition.

3.2.2. Positioning of Gender in Policy Framework: Gender as “A Cross-cutting Issue”

The term “gender” explicitly enters into the energy policy document as one of the cross-cutting issues in the policy alongside the legal and regulatory framework, research and human resource development, integrated energy planning, policy implementation, monitoring and evaluation and data. It identifies the major gender concerns for the energy sector as including (GoK 2012, 133):

1. gender imbalances in various positions in institutions;
2. inadequate implementation of policy on gender mainstreaming; and
3. inadequate public awareness on the adverse health effects of use of woodfuel and kerosene on women and children.

The first challenge recognises that gender imbalances in professional positions in institutions in the energy sector, both private and public sectors, could be partly responsible for the gender-neutral orientation in the sector, in general. The recognition of male dominance in the various institutions in the sector is an important step towards redressing gender neutrality in energy programmes and decision-making processes. The majority of policymakers are men, and this male-dominated structure results in the generalisation of the experiences and needs of men to the entire population, thereby ignoring the difference in the interests and needs between men and women, and the marginalisation of issues affecting

women in the sector. In response to this challenge, the declared strategy is, “The Government shall take measures to implement the one-third gender principle in the energy sector institutions as provided for under Article 27(8) of the constitution” (GoK 2012, 133). It is difficult to envisage how this would be achieved when the human resource development strategy is silent on bridging the gender gap in employment within the sector. Without a clear formula for training more women staff in the ministry to take up senior decision-making positions, merely realising the one-third gender threshold may not transform the thinking within the sector appreciably.

The second gender issue identified in the sector is an acknowledgment that mainstreaming of gender in the sector falls below expectations. There is also a declared intent to mainstream gender, not only in policy formulation and energy planning, but also in energy production and use, which promises a more comprehensive platform upon which gender issues can be ventilated in the future. The document is, however, silent on why this challenge exists and what specific measures would be undertaken to redress it. It simply proposes to “mainstream gender issues in policy formulation and in energy planning, production and use” (*ibid.*). This is quite a broad and ambiguous statement, which in fact highlights the danger of positioning gender as a cross-cutting issue. On the one hand, it suggests that it should be integrated throughout all the sectoral activities, while on the other hand, assuming that this will happen everywhere may effectively diffuse it such that it lacks effective institutional anchor based on specific structures of accountability. Even though there are gender and energy desk officers in the ministry, their mandate is not very clear, and, given their institutional location, they obviously lack the political clout to champion the gender agenda at higher rungs of policymaking.

Part of the reason why implementation of gender mainstreaming is unsatisfactory is the inadequacy of sex-disaggregated data. This partly explains why current policy statements are shy of taking the empowerment approach, since conducting a meaningful gender analysis would not be possible without such data in the first place. Thus, in the absence of sufficient gender-disaggregated data that would guide technology generation efforts and help monitor progress towards engendering energy, the possibility of gender transformation through energy remains a mirage. Moreover, there has been hitherto little demand for such data in energy planning processes, which have largely been gender-neutral. Gender-neutral planning prevails partly because planning has been focused simply on the provision of energy sources and the appropriate conversion technologies, rather than on energy services as a basis for projects and programmes. This entails supplying predetermined technological packages, or energy sources, particularly electricity provision, without interrogating what alternatives would be best suited for the different needs of men and women at the community level. The energy services approach means planners have to be much more aware of the social and economic circumstances of the target group (demand-led, participatory approach),

which suggests a direct nexus with gender relations. It has always been assumed that communities exist as entities and that any energy project that is implemented meets the needs of the targeted community. Current energy planning and budgeting still assumes the attitude that all projects are intended for the communities and all members are expected to benefit equally.

The third challenge problematises the use of woodfuel and kerosene, even though it is acknowledged that these are the forms of energy widely used among the majority of households. The problem underscored here is the limited awareness among the “public” about the adverse health effects of using these kinds of fuels. The word “public” here appears to be gender-neutral but implicitly suggests a reference to the presumptive household heads, who are the men and who are expected to exercise decision-making power within households. Otherwise, it would have been less ambiguous and more gender-aware to specifically recognise the role of women in decisions about household fuel consumption and explicitly target them accordingly. Again, it is not satisfactory to limit the gaze at the problem to merely public awareness. Beyond awareness lies the real challenge of offering options to users, which cannot be achieved without deliberate efforts to undertake, in a participatory manner, the development of technologies that are affordable, and which especially empower the women to engage in economically productive ventures that would enable them transition from harmful fuels. In response to the third challenge, the policy states (GoK 2012, 133):

In order to address the challenges faced by women and children in the use of woodfuel and kerosene, Government shall:

- (b) Undertake public education and awareness creation on the cultural structures and practices hindering the access by women to alternative sources of energy.
- (c) Undertake public health education on the efficient use of bioenergy and promote the use of fuel efficient bioenergy appliances.
- (d) Enhance regional, gender and environmental considerations in energy planning and development.

From the foregoing, it is apparent that the underlying rationale for integrating gender concerns is basically welfare-oriented. The document specifies that policies and strategies that are to be pursued in addressing gender concerns are merely meant to “address challenges faced by women and children in the use of woodfuel and kerosene”, which is essentially an attempt to address *women and energy* issues rather than *gender* issues. In fact, at household level, the promotion of improved efficiency end-use devices, such as improved stoves, has been extensively pursued in Kenya. Penetration of improved charcoal stoves is estimated at over 60 per cent of the rural households (AFREPREN 2006, cited in Muchiri 2008, 11). For over two decades now, one of the most visible and gender-aware energy

policy measures in Kenya has centred around implementation of stove programmes that are meant to reduce the time spent by women in looking for cooking energy as well as reduce indoor air pollution among women and children, in addition to other benefits. Thus, the policy construes the energy problems pertinent to woodfuel as a women's problem, a perspective that entrenches rather than seeks to challenge the existing gender relations. Again, these challenges are narrowly limited to those relating to the use of woodfuel and kerosene (thereby excluding electricity, which is male-dominated of course) rather than *access to and control of resources* necessary for expanding access to woodfuel and kerosene. Moreover, where there would be an opportunity to pursue the gender transformational path to energy policy, as suggested by strategy (b), the government seeks to educate the public on the ways in which cultural practices obstruct women's access to *alternative sources* of energy, not equitable access to and control of resources on which woodfuel generation depends. It is clear that this thrust also overlooks the importance of the stake that women have in alternative sources of energy and suggests that they have little stake in fuel-switching or transiting, for instance, to fossil fuel use. Neither is the understanding of the empowerment potential of energy itself canvassed in these statements. In this way, the element of gender as power relations is conveniently elided out of purview and hence, there are limited prospects for women's empowerment that would be expected from this approach.

Empowering women would require transforming women's lives by promoting greater self-reliance based on increased skills, income, social status, and decision-making power, and enabling women to take control of their own transformation process, a complex challenge that would never be achieved through public education alone. Gender transformation cannot be achieved simply by gender sensitisation campaigns but instead must entail a comprehensive multi-sectoral approach that addresses the challenge from the root cause. In fact, strategy (c) cannot be meaningfully realised without women's empowerment such that they can have access to the proposed options of efficient use of bioenergy and related appliances domestically. Thus, the focus of the policy, as stated, is merely on meeting a narrow range of women's practical gender interests rather than strategic gender interests. Again, there is no recognition of the role of women as active participants in the generation of energy innovations, appreciating their innovative capacities, or knowledge or suggestions of measures to support their innovative capacities. Rather, the impression created is of women as merely passive recipients of new technologies.

Nevertheless, more recently, the Draft Kenya Investment Plan for the Scaling-Up Renewable Energy Program (SREP) (GoK 2011, 13) explicitly foregrounds gender issues in its approach. Its gender awareness is evident in its acknowledgment that access to affordable energy in Kenya is gendered, with the following implications for poor households, and for women in particular:

- (a) Women and children disproportionately suffer from health problems related to gathering and using traditional fuel, and cooking in poorly ventilated indoor conditions. These include respiratory infections, cancer, and eye diseases.
- (b) High opportunity costs related to time spent gathering fuel and water limit their ability to engage in educational and income-generating activities, resulting in dramatically different literacy rates and school enrolment levels between men and women.
- (c) Lack of electricity in rural areas is an added hindrance to women's access to useful media information, such as markets for their produce, health information and civic education.

It also points out that there are disparities in energy use between female-headed and male-headed households, according to which about 15 per cent of male-headed households compared to 11 per cent of female-headed households use electricity for lighting, but a larger proportion of female-headed households (81 per cent) use kerosene lamps or other unspecified sources as compared to male-headed households (78 per cent). Also more female-headed households than male-headed ones rely on woodfuel.

Clearly, it is the document that explicitly alludes to the gender transformative utility of energy, through its potential for women's empowerment, by underscoring the question of expanded options for women as a result of access to energy resources. This is indeed a remarkable departure from all previous policy documentation, and it attributes this to efforts to incorporate the findings of a gender audit report in the ministry (Mbuthi *et al.* 2007), which concluded, among other issues, that:

In spite of an increasing awareness of gender at the policy and operational levels, mainstreaming gender perspectives into programmes and activities is yet to be fully embraced by policymakers.

A genuinely gender-sensitive energy policy instead must be driven by clear plans, budgets and implementation activities whose targets are clearly measurable.

Thus, instead of gender issues being driven from within the Ministry of Energy, it is external actors that have played a major role in their emerging salience. Supported by the International Network on Gender and Sustainable Energy (ENERGIA), the gender audit process brought together actors in the energy system— including civil society organisations and government representatives— to analyze critical gender gaps in existing national energy policy formulation and implementation. The gender audit brought more visibility to gender and energy issues among a wider audience, thereby generating a number of spin-offs, such as integration of gender issues into specific energy plans (such as the Kenya Rural Electrification Plan). While appreciable, these remain integrationist efforts

to mainstream gender issues in energy, rather than the more radical and comprehensive agenda-setting approach.

4. Conclusion

The complexity of the challenge of addressing the marginalisation of women in development essentially requires a multipronged approach in which the subordinate position of women is attacked from multiple dimensions, in such a manner that enhances the opportunity, capability, security, and empowerment of women through a transformation of the institutions that exclude them from full participation in societal processes. While there exists, in principle, a comprehensive policy framework for mainstreaming gender in development concerns in Kenya, this framework is, however, characterised by policy statements that are, in a number of respects, incoherent in terms of how they construct the sources of gender inequality and how they propose to address it. This applies particularly to the macropolicy frameworks, such as the poverty reduction strategy paper and the national gender policy, which exhibit a logical gap between the diagnosis and prescription.

There is an emergent recognition of gender issues in the energy sector, even though the energy policy document still subsumes gender issues in gender-neutral language and gives attention to the macro-level concerns geared towards the productive sector energy supply, while giving less attention to household concerns, in a disaggregated manner. This gender-neutral approach effectively forecloses opportunities for transforming the gendered nature of access to energy in Kenya, insofar as it focuses on energy and women, thereby leaving the prevailing gender relations unchanged. The fundamental challenge is ultimately to strengthen the position of women in society. This means strengthening the position of women relative to that of men, not just formally, but through laws which provide for equality in inheritance, in access to education and in very concrete ways in daily life. An empowerment approach to gender in energy implies transforming social relations so that women can fulfil strategic gender interests through energy inputs. It is thus a political agenda which may not be realisable if simply couched in technical apolitical discourse. Nor can it be achieved by modest interventions, which aim to minimise the drudgery and a host of related social, health, and economic problems but which do not structurally expand their options. Thus, the welfare approach dominates in most of the policy documents, finding it less controversial to address practical gender needs of women and men, which do not upset the existing gender balance of power.

Gender mainstreaming remains a work in progress in Kenya's energy sector, with ongoing capacity building efforts among staff in the Ministry as well as other institutional mechanisms for giving visibility to the gender-energy nexus, albeit at a slow pace. This implies that a comprehensive appraisal of gender mainstreaming to unveil the underlying dynamics (especially the political economy of mainstreaming gender in energy

sector) will be an important research theme in the future as the process matures temporally.

References

- African Development Bank. 2007. *Kenya country gender profile*. Human Development Department.
- Alba, A. 2000. 'Foreword'. *In: Theoretical perspectives on gender and development*, edited by Parpart Jane, Patricia Connelly and Eudine Barriteau, v–vii 2000. Ottawa: IDRC.
- Alkire, S. 2008. Using the capability approach: Prospective and evaluative analyses. *In: The capability approach: Concepts, measures and applications*, edited by C. Flavio, M. Qizilbash and S. Alkire, 26-49. Cambridge: Cambridge University Press.
- . 2005. Why the capability approach? *Journal of Human Development and Capabilities*, 6(1): 115–135.
- Cecelski, E. W. 1995. From Rio to Beijing: Engendering the energy debate. *Energy Policy*, 23(6): 561–575.
- Chant, S. and Gutmann, M. C. 2002. "Men-streaming" gender? Questions for gender and development policy in the twenty-first century. *Progress in Development Studies*, 2(4): 269–282.
- Clancy, J., Ummar, F., Shakya, I. and Kelkar, G. 2007. Appropriate gender-analysis tools for unpacking the gender-energy-poverty nexus. *Gender and Development*, 15(2): 241–257.
- Clancy, J. and Feenstra, M. 2006. 'How to engender energy policy'. A technical briefing paper prepared for ENERGIA. Leusden, The Netherlands.
- Ekouevi, K. and Tuntivate, V. 2011. 'Household energy access for cooking and heating: Lessons learned and the way forward'. *Energy and Mining Sector Board Discussion Paper*, No . 2 3. Washington D.C.: The International Bank for Reconstruction and Development/The World Bank.
- Energy Regulatory Commission (ERC). 2006. *The energy act 2006*. Nairobi: ERC.
- Gaye, A. 2007. Access to energy and human development. *Human Development Report 2007/2008*. Occasional Paper 2007. NY: United Nations Development Program Human Development Report Office.
- Goetz, A. and Sandler, J. 2007. Swapping gender: From cross-cutting obscurity to sectoral security? *In: Feminism in development: Contradictions, contestations and challenges*, edited by A. Cornwall, E. Harrison and A. Whitehead, 161–176. London: Zed Books.
- Government of Kenya (GoK). 2000. *National gender and development policy*. Nairobi: Ministry of Gender, Sports, Culture and Social Services.

- . 2001. *Poverty reduction strategy paper for the period 2001–2004. Volume I and II*. Nairobi: Government Printer.
- . 2002. *National development plan, 2002–2008. Effective management for sustainable economic growth and poverty reduction*. Nairobi: Government Printer.
- . 2004. *Sessional Paper No. 4 of 2004 on energy*. Nairobi: Government Printer.
- . 2006. *Sessional Paper No. 2., on gender equality and development*. Nairobi: Government Printer.
- . 2011. ‘Scaling-up renewable energy program (SREP) investment plan for Kenya (IPK)’. Draft. Nairobi: Energy Regulatory Commission.
- . 2012. *National energy policy*. Third draft. Nairobi: Government Printer.
- Jahan, R. 1995. *The elusive agenda: Mainstreaming women in development*. London: Zed Books.
- Karekezi, S., Kimani, J. and Onguru, O. 2008. Energy access among the urban poor in Kenya. *Energy for Sustainable Development*, 12 no. 4: 38–48.
- Karekezi, S. and Wangeci, J. 2005. The role of gender research in influencing power sector policy in eastern and southern Africa. *Energia News*, 8 no. 2.
- Khamati-Njenga, B. and Clancy, J. 2002. ‘Concepts and issues in gender and energy’. Paper prepared for ENERGIA. Leusden, The Netherlands.
- Khennas, S. 2012. Understanding the political economy and key drivers of energy access in addressing national energy access priorities and policies: African perspective. *Energy Policy*, 47 (1): 21–26.
- Makhabane, T. 2002. Promoting the role of women in sustainable energy development in Africa: Networking and capacity-building. *In: Gender, development and climate change*, edited by R. Masika, 84–91. Oxford: Oxfam.
- March, C., Smyth, I. and Mukhopadhyay, M. 1999. *A guide to gender-analysis frameworks*. Oxford: Oxfam.
- Masud, J., Sharan, D. and Lohani, B. N. 2007. *Energy for all: Addressing the energy, environment, and poverty nexus in Asia*. Manila: Asian Development Bank.
- Mbuthi, P., Odongo, F., Machera, M. and Imitira, J. 2007. Gender audit of energy policy and programmes in Kenya. A collaborative activity between the Ministry of Energy, Practical Action East Africa, ENERGIA, and East African Energy Technology Development Network. June.
- Muchiri Lydia. 2008. *Gender and equity in bioenergy access and delivery in Kenya*. Nairobi: Practical Action East Africa. <http://energia.org/wp-content/uploads/2015/06/65-Gender-and-equity-in-bioenergy-access-and-delivery-in-Kenya.pdf>.

- Mukhopadhyaya, M. 2007. Mainstreaming gender or “streaming” gender away? *In: Feminisms in development: Contradictions, contestations and challenges*, edited by A. Cornwall, E. Harrison and A. Whitehead, 135–149. London: Zed Books.
- Munien, S. and Ahmed, F. 2012. A gendered perspective on energy poverty: Advancing the development goals in developing countries. *Agenda*, 26(1): 112–123.
- Mwakubo, S., Ikiara, M., Mutua, J. and Aligula, E. 2007. Strategies for securing energy supply in Kenya. *KIPPRA Discussion Paper, No. 74*, September. Nairobi: Kenya Institute of Public Policy Analysis and Research.
- Parpart, J., Connelly, P. and Barriteau, E. 2000. *Theoretical perspectives on gender and development*. Ottawa: IDRC.
- Parikh, J. 1995. Gender issues in energy policy. *Energy Policy*, 23(9): 745–754.
- Razavi, S. 1997. Fitting gender into development institutions. *World Development*, 25(7): 1111–1125.
- Robeyns, I. 2005. The capability approach: A theoretical survey. *Journal of Human Development and Capabilities*, 6(1): 93–117.
- Sen, A. 1999. *Development as freedom*. Oxford: Oxford University Press.
- Sen, G. 2008. Poverty as a gendered experience: The policy implications. *Poverty in Focus*, 13 (January): 6–7.
- Skutsch, M. M. 1998. The gender issue in energy project planning: Welfare, empowerment or efficiency? *Energy Policy*, 26(12): 945–955.
- 2004. ‘Tooling up for gender in energy. Technical briefing paper prepared for ENERGIA’. Leusden, The Netherlands.
- Sovakool, B. K. 2012. The political economy of energy poverty: A review of key challenges. *Energy for Sustainable Development*, 16: 272–282.
- Subramanian, R. 2007. Making sense of gender in shifting institutional contexts: Some reflections on gender mainstreaming. *In: Feminisms in development: Contradictions, contestations and challenges*, edited by A. Cornwall, E. Harrison and A. Whitehead, 112–121. London: Zed Books.
- United Nations Development Programme (UNDP). 2004. *Gender and energy: A toolkit and a resource guide*. New York: UNDP.
- Walby, S. 2005. Gender mainstreaming: Productive tensions in theory and practice. *Social Politics: International Studies in Gender, State and Society*, 12(3): 321–343.
- Woodford-Berger, P. 2007. Gender mainstreaming: What is it (about) and should we continue doing it? *In: Feminisms in development: Contradictions, contestations and challenges*, edited by A. Cornwall, E. Harrison and A. Whitehead, 122–134. London: Zed Books.

CHAPTER FIVE

Community Perspectives on the Demand, Availability and Accessibility of Energy Resources in Swaziland: A Case Study of Sinceni on Deforestation

Londiwe Dumsile Hlophe and Musa M.A.Dube

Abstract

There has been an increasing demand for renewable energy resources and communities have failed to replenish these resources, thus leading to negative impacts on communities that rely on these resources for a living. This chapter seeks to identify the views of the community, with regard to deforestation in Swaziland. It explores the causes, and effects on the community, as well as exploring what the community is currently doing to control the situation. Data was collected through the use of a valid questionnaire from 199 respondents. The study revealed that the area is deforested and firewood is the main source of fuel. The main causes of deforestation are human and livestock population growth. The situation is posing negative effects to the society, especially women, and will worsen if not attended to urgently. The researchers recommend that forest management systems should integrate perspectives and practices from the community.

Keywords: Deforestation, population growth, energy resources, forests, firewood.

1. Introduction

1.1. Background

Swaziland is a developing country located in the Sub-Saharan region, in the southern part of Africa. The country covers an area of 17,364 square kilometres and lies between latitudes 26° S and 27° S and longitudes 31° E and 33° E. It is bordered by the Republic of South Africa on the north, west, and southern sides, and Mozambique on the east side. The country has a total population of 1.231 million (CIA World Factbook 2013a). About 75 per cent of the total population lives in rural areas. Swaziland had an estimated unemployment rate of 40 per cent in 2013, which represents a deterioration from 28.2 per cent recorded in 2007 (CIA 2013b). Unemployment in the country has a strong rural dimension in that those residing in rural areas are much more likely to be unemployed than those living in urban areas. In 2010, the unemployment rate in rural areas was 37.1 per cent compared to 16.7 per cent in urban areas (WHO 2011). Two-thirds (63 per cent) of the population live in chronic poverty and one-quarter depends on food relief (World Bank 2007; Manyatsi and Hlophe

2010). This, therefore, means that people in the rural areas are struggling to meet their day-to-day needs. According to Nathan and Kelkar (1997), people living in poverty rely on wood as their source of fuel, thus deforestation is inevitable in the rural areas of Swaziland.

Furthermore, forestry and other related processing industries in the country contribute significantly to the country's economy, through export. A quarter of the country is classified as primary forest, which comprises planted forests; yet, only 32 per cent of the country is covered by forests. This, therefore, indicates that deforestation in the country is predictable as there is not much forest cover; yet wood is in high demand in the country, both for commercial and non-commercial purposes (Nyoka 2003).

1.2. Case for Action

According to Manyatsi and Hlophe (2010), about two billion people worldwide use firewood and charcoal as their main source of energy for cooking and heating their homes. In Africa only, 60 million of the rural population and 40 million of the urban population are dependent on the forest (Mayaux *et al.* 2013). In Swaziland, approximately 80 per cent of the population lives on public or national land (communal land) and depends on woodfuel for cooking and heating. In the rural areas of the country, communities collect food, firewood, medicinal plants, and construction materials directly from the forest. In a Swazi household, women and children are responsible for collecting firewood (Manyatsi and Hlophe 2010). The magnitude to which a household relies on and utilises forest resources is dependent on the household's demographic and economic characteristics, and other factors such as markets, prices and technology (Nathan and Kelkar 1997).

The high rate of unemployment in Swaziland has led to an increase in the business of selling firewood. This is evident through piles of firewood by the roadside, which are more noticeable in the Lowveld of the country. The high demand for firewood in rural areas has resulted in trees increasingly being felled in forests in order to get firewood for sale and earn income, thus encouraging deforestation (Manyatsi and Hlophe 2010). In addition, the country is facing challenges of deforestation and degradation as a result of agriculture and livestock expansion, and population growth (Nyoka 2003).

These challenges, if not addressed, will have a negative impact on the country in meeting the Millennium Development Goals (MDGs) and, therefore, should be investigated. Additionally, the challenges have a bearing on the health and social status of the population. This chapter seeks to identify and describe the impact of deforestation on women and children as they are normally left to bear the consequences. The views will provide deeper insight to the government in understanding the complexity of the problem and, thus in turn, assist in formulating policies and legislation that

will address the topic of deforestation, using the perspectives of the communities involved in Swaziland.

1.3. Objectives

The specific objectives of the study were to:

- identify the causes of deforestation in Sinceni;
- determine the impact of deforestation on women and children; and
- describe the coping strategies currently used by communities in order to manage deforestation.

1.4. Methodology

1.4.1. Selection of Study Area



Figure 1. The Study Area

SOURCE: Theodora Maps.

Sinceni is situated in the Lubombo region, which is the Lowveld of Swaziland, where agriculture is widely practised. Lubombo is found in the east of the country (see map above) and has a sub-tropical climate. The population in Sinceni is dependent on agriculture, and more recently, selling of wood and wood products for a living. According to Mr. Simelane, a local authority representative, Sinceni covers an area of about 218,750 square metres and consists of a population of about 3,200 people (including adults and children), with 400 homesteads and five villages (Sinceni, personal communication, October 10, 2013). Therefore, the area was selected due to the recently adopted behaviour of selling wood and wood products, to generate income. This was evident in piles of firewood, traditional platters and wooden spoons along the dusty roads in the area, during an informal tour by the authors.

1.4.2. Sample Size

A total sample of 199 respondents was randomly selected from the total target population of 400 households. One person was purposively selected from each household (the oldest person). Table of sample size selection (Krejcie and Morgan 1970) was used to determine the sample size.

1.4.3. Data Collection

A self-administered questionnaire was used to collect data. Enumerators were trained and sent out to collect data using an interview schedule. This data collecting tool was validated by experts in forestry and onsite pretesting was conducted in the study area. Consent to collect data was requested from the local authority leaders, and respondents were asked too, for ethical reasons. This interview schedule was used to collect information on the sources of fuel; uses of forests; condition of the forests; observed signs of deforestation; impacts of deforestation and coping strategies employed by the communities; and the constraints faced by the community in controlling deforestation.

1.4.4. Data Analysis

Data was analyzed using the Statistical Package for the Social Sciences (SPSS Version 20) to compute means, standard deviations and variance. The findings were presented using graphs and tables.

2. Literature Review

Deforestation is described by Angelsen and Kaimowitz (1999) as the complete long-term removal of tree cover. Rademaekers *et al.* (2010) further describe deforestation as the conversion of forest lands to alternative uses, with negative or zero presence of trees.

Forests, as mentioned earlier, are of vital significance in the wellbeing of society and life, in general. According to Angelsen and Kaimowitz (1999) and Mayaux *et al.* (2013), tropical rainforests are considered the richest and most treasured ecosystem on the earth's land surface. However, this richness is being lost annually due to deforestation. For instance, in the 1980s, approximately 15.4 million hectares of tropical rainforests were lost each year. Between 1990 and 1995, the annual loss was projected at 12.7 million hectares. Mbatu (2010) stipulates that between 1980 and 1990, an estimated 137.3 million hectares of tropical rainforests were cleared.

These rates of deforestation have been increasing unremittingly in Latin America, Southeast Asia and Sub-Saharan African countries, up until 2005, when deforestation began to decline. The increase was especially evident between the late 1970s and early 1990s. During this period, the main drivers of deforestation were capitalised planters, agri-businesses, logging firms, and cattle ranchers. This represented a shift from prior causes, which were mainly state-sponsored new land settlement schemes (Rudel 2013). Of importance to note is that these drivers were normally government

initiatives, which usually do not represent the community's views or at times leave out some specific gender perspectives.

Having explored the condition of forests, it raises concerns on the impacts of deforestation on the society, and more especially, on women and children. This is because women are the household cooks and managers. As stated by Nathan and Kelkar (1997), not only do they use wood for cooking but also for other activities such as space heating, smoking food to dry and preserve it, and repelling insects. In addition, Manyatsi and Hlophe (2010) revealed that selling of wood is a major contribution to household income in Swaziland. Therefore, the cutting of trees, resulting in deforestation, poses negative effects on women and children, who are normally responsible for collecting firewood. These negative effects can be manifested physically, emotionally and financially. For instance, Manyatsi and Hlophe (2010) revealed that women are forced to travel longer distances, and that exerts both physical and emotional strain on women. An option normally exercised by communities involves using oxen or tractors to haul the firewood closer to the household but this can also be a financial drain to the already poor community (Manyatsi and Hlophe 2010).

2.1. Causes of Deforestation

The authors recognise the many factors associated with deforestation. However, in this study, the focus was on community perspectives, specifically on the demand, availability and accessibility of energy resources, forests being the main source of the energy resource. As mentioned earlier, the community is dependent on the forest for a number of uses. These include woodfuel, medicinal plants, livestock grazing, and wood for construction. Community perspectives will help in narrowing down the impacts of deforestation.

In order to study the impact of deforestation on gender, it is important to recognise the causes, which may shed light on the culprits of deforestation. This, in turn, will help in incorporating the views of the community, specifically women, in finding ways to alleviate the impact of deforestation. As mentioned by Nathan and Kelkar (1997), women's perspectives are usually left out when implementing models to control deforestation.

There are two causes of deforestation as is evident in the literature — proximate causes and underlying causes. Proximate causes are the direct causes and form the observable drive for forest decline. They operate at a local level, namely individual, household or community level. On the other hand, underlying causes are outside the control of communities or local level. This means that they are regional or global events with complex relationships between organisations. Therefore, they have a higher causal order that determines the degree of the actual direct pressure on forests (Lambin, Geist and Lepers 2003; Mbatu 2010; Rademaekers *et al.* 2010; Laurance *et al.* 2002).

2.1.1. Proximate Causes

Infrastructure Extension: This includes transport, market, settlements, private companies, and public services such as water lines, electricity grids and sanitation. Studies indicate that with infrastructure extension, the rate of deforestation is increased. For instance, studies conducted in Belize, Cameroon, Costa Rico, Mexico, Honduras, and Philippines indicate a strong positive relation between roads expansion and deforestation. This means that improving or extending a community's infrastructure increases the rate of deforestation (Angelsen and Kaimowitz 1999). However, the role of women in household management and firewood availability is normally left out as it is observed that infrastructure extension is dominated by males and government initiatives.

Agricultural Expansion: Agricultural expansion involves permanent cultivation, shifting cultivation, cattle ranching, and colonisation, which entails transmigration and resettlement. According to Lambin, Geist and Lepers (2003), in developing countries there has been an increasing demand for food yet the amount of suitable land available for crops is very limited and so are forests. In these countries, a large quantity of the cultivable land is often under rainforests or is found in marginal areas. This has led to removal of rainforests in order to meet the food demand. It also necessitates the use of fertilisers and irrigation of crops to increase food production, which assists in converting non-arable land to crop production land. In the process of meeting the increasing demand for food, forests are cleared, thus resulting in deforestation and unavailability of firewood. Lambin, Geist and Lepers (2003) further state that between 1992 and 1999, pastures increased significantly, by 4.8 per cent, even in non-tropical countries. For instance, in eastern Africa, there was a startling increase in head of cattle (872,000 cattle per year), thus an increase in the demand for pastoral land, which meant conversion of natural forests to pasture lands. This conversion entails removal of forests, which in turn means that women and children are left out, more especially in an African setting whereby livestock size is associated with a man's worth and food is associated with the ability of a man to feed and take care of his household. However, the role of women in preparing the food and serving their families is overlooked, thus women's perspectives are left out yet they bear the consequences.

Wood Extraction: This includes wood extraction for commercial purposes, woodfuel, pole wood, and charcoal. A study by Angelsen and Kaimowitz (1999) revealed that higher prices for timber stimulate deforestation by making logging more lucrative. Increasing the value of timber also increases the disposable benefits of clearing land, thus encouraging deforestation. This shows that with the demand for wood, there is an increase in deforestation. For instance, a study conducted by Nathan and Kelkar (1997) indicates that deforestation, through wood extraction, is based on the demand, cost and availability of wood, and of other wood

alternatives. However, Nathan and Kelkar (1997) further confirmed that the effect of wood extraction on women is being undermined, yet it has a huge bearing on development, even though at times women and children are the main culprits.

2.1.2. Underlying Causes

Demographic Factors: These include natural increase, population density, population distribution, immigration, and lifecycle changes (Rademaekers *et al.* 2010). Population growth, for instance, as noted earlier, has a positive correlation with deforestation. As the population grows, so do the demands for resources such as land, food, woodfuel, timber, and other forest products. Population growth has an influence on the channels of deforestation. For instance, an increase in population induces technological progress, which may reduce or increase pressure on the forest. In many cases, population growth is related to infrastructure availability, soil quality, distance to markets, and off-farm employment opportunities. These factors increase migration opportunities and, in turn, accelerate deforestation as a means of securing the land (Angelsen and Kaimowitz 1999).

According to Lambin *et al.* (2003), lifecycle features or changes are associated with household labour availability, which is linked to migration, urbanisation and the breakdown of extended families into several nuclear families. For instance, a study conducted in West African Sudan-Sahel zone indicates that over a period of 25 years, as a result of an increase in nuclear households and the transfer of livestock wealth from herding families to merchants, agriculturalists and government officials, there has been an increase in crop production, reduced labour availability among pastoral households, lower energy and skills applied to livestock husbandry, and reduced livestock mobility, which increased the risk of land degradation resulting from the removal of forest cover.

Lambin *et al.* (2003) further illustrate that woodfuel demand by households in Africa differs between nuclear family units and larger consuming units (extended families). Larger consuming units are classified as more energy-efficient. Nuclear families, therefore, cause more forest degradation. This is because extended families would require one batch of firewood to cook, yet with further breakdown of the household, more batches are required, which could be avoided. This negative impact is usually borne by women and children, who are responsible for collecting firewood, yet their perspectives are normally left out.

Income Level and Economic Growth: This includes market growth and commercialisation, economic structure, urbanisation, and industrialisation (Rademaekers *et al.* 2010). According to Angelsen and Kaimowitz (1999), ideally, higher national income and economic growth can be anticipated to lessen the pressure on forests by improving off-farm employment opportunities. However, this accelerates deforestation through stimulating

demand for agricultural and forest products, and improving access to virgin forests and markets. As much as some high-income countries have laws fostering the protection of forests, there is still a positive relationship between economic growth and deforestation. Angelsen and Kaimowitz (1999) also allude that studies conducted in developing countries associate higher national per capita income with greater deforestation. This reveals that as the country is climbing the economic development ladder, the aftermaths are undermined, thus the minorities (including women and children) are left to bear the impact of activities associated with development.

Technological Progress: Technological progress in agriculture may also have an impact on deforestation. For instance, technological changes that increase yields without altering labour or capital requirements increase the rate of deforestation. However, if not so, a decrease in deforestation is expected as per a study conducted in Philippines on maize production, whereby technology increased aggregate supply and lowered prices (Lambin *et al.* 2003). However, Angelsen and Kaimowitz (1999) assert that technological progress leads to more deforestation. This is because as more forests are cleared, more trees are lost, resulting in loss of firewood and other forest products.

Policy and Institutional Factors: According to Rudel (2013) and Angelsen and Kaimowitz (1999), policies to improve the terms of trade for agriculture tend to increase earnings for farmers, and thereafter, intensify deforestation. Furthermore, increases in agricultural and timber prices generate more deforestation when labour supply is comparatively variable. Higher rural wages also increase the demand for agricultural and forest products. Therefore, policies designed to increase agricultural and forest product exports are likely to increase deforestation. Similarly, pro-agricultural policies can be anticipated to have robust deforestation effects in the context of globalised agricultural markets and trade liberalisation.

Furthermore, Rademaekers *et al.* (2010) state that in addition to the above, communities' rights to ownership also have a bearing on deforestation. As stated by Angelsen and Kaimowitz (1999), communities clear forest to increase land and property ownership rights. The motivation behind this is threefold:

- (a) To ensure land ownership in order to maximise agricultural potential in the future, communities will secure the piece of land before others do so. This is because of anticipated benefits in the future as a result of technological progress and new roads.
- (b) The price of the land in the future, should the owner sell it, regardless of the agricultural potential.
- (c) To avoid competition. Communities may be having conflicts over land, hence as a means of securing one's land, they will clear forests and fence their piece of land. However, the availability of the forest produce

in the future is often underestimated, yet has a negative bearing on the individual owner and community at large.

Cultural Factors: These include public attitudes, values and beliefs when it comes to forest clearing. It could be an inherited practice from forefathers passed on to generations. It could also be individual or household behaviour such as unconcern about forests. All these have a negative effect on forests, increasing deforestation (Rademaekers *et al.* 2010). Nonetheless, these factors are not up-to-date with current trends. For instance, forests are cleared and some important attributes are not considered, such as the use of forests currently and in the future. These uses entail the availability of forests for their produce, such as firewood, to be used by women.

Nonetheless, rising deforestation of tropical rainforests has major consequences, which include effects on climate and diversity (presented mainly through reduced timber supplies), siltation, flooding, and soil degradation. These consequences further affect economic activity and threaten the livelihoods and cultural integrity of people or communities that are dependent on forests, including those using forests as a source of fuel (Angelsen and Kaimowitz 1999).

3. Findings and Discussion

The findings of the study and discussion regarding the condition of forests in Sinceni, the community perspectives on the demand, availability and accessibility of forests, and the applied management practices or strategies towards deforestation are presented in this section. These findings are presented in accordance with the objectives of the study, as a way of capturing the study topic “community perspectives regarding the demand, availability and accessibility of energy resources with regard to deforestation in the study area, Sinceni”.

3.1. Findings

3.1.1. Demographic

A total of 117 (60 per cent) of the respondents were female and 79 (40 per cent) were male. The average age of the respondents was 49 and the average household size was 7.5. A total of 52 per cent of the houses were headed by the father, 10 per cent were headed by a child and 40 per cent were headed by the mother, with the remaining headed by a family relative such as an aunt or uncle. A higher percentage (30 per cent) of the respondents had received secondary education; 24 per cent had received primary education and 21 per cent had received high school education. Eighteen (18) per cent had no formal education whilst only 5 per cent had tertiary education.

3.1.2. Sources of Fuel

Over half of the households (55 per cent) used firewood as the main source of fuel, followed by those using both firewood and electricity (38 per cent). The others (1 per cent) used both firewood and gas (handigas) as a source of fuel (see Table 1).

Table 1. Sources of fuel

Energy source	N	Percentage (%)
Firewood	109	55
Firewood and electricity	76	38
Electricity	8	4
Gas	4	2
Others	2	1
Total	199	100.0

SOURCE: Computed from fieldwork data.

3.1.3. Causes of Deforestation

3.1.3.1. Uses of the Forest: Out of the 109 households that depended on firewood as a source of fuel, 87 (80 per cent) believed that the forest is mainly used for firewood whilst 21 indicated that it was mainly used for building materials. This was followed by those using both firewood and electricity as source of fuel, whereby 62 stated that the forest was mainly used for firewood and 10 indicated that it was used for getting building materials (Table 2).

Table 2. Main uses of forests by household source of fuel

Source of fuel	Main uses of forests				Total
	Firewood	Building	Medicine/Herbs	Other (specify)	
Firewood	87	21	0	1	109
Firewood and electricity	62	10	2	2	76
Electricity	6	1	1	0	8
Gas	3	1	0	0	4
Others (specify)	2	0	0	0	2
Total	160	33	3	3	199

SOURCE: Computed from fieldwork data.

3.1.3.2. Description of Deforestation: Deforestation was defined by the respondents differently. For instance, 68 per cent of the respondents defined deforestation as the cutting down of trees, while 22 per cent defined it as the burning of trees or forests. Definitions are illustrated in Table 3.

Table 3. Definition of deforestation

Statement	N	Percentage (%)
Cutting of trees or forests	132	68
Burning of trees or forests	42	22
Cutting or burning of trees or forests	9	5
Decrease in number of trees	8	4
Availability of trees or forests	1	0.5
Soil erosion	1	0.5
Total	193	100

SOURCE: Computed from fieldwork data.

3.1.3.3. Condition of Sinceni, in Terms of Deforestation: A total of 115 (58 per cent) respondents stated that the area is currently deforested, while 27 per cent of these indicated that the area is now very significantly deforested as compared to 10 years back. Thirty six (36) per cent of the respondents stated that the area was not deforested. However, 11 per cent of these believed that when compared to 10 years ago, they would say the area is very significantly deforested as lots of trees have been removed. This is further illustrated in Table 4.

Table 4. Current level of deforestation compared to 10 years back

Level of deforestation	condition of deforestation compared to 10 years back				Total
	No significant deforestation	Moderate deforestation	Very significant deforestation	Cannot judge	
Deforested	9	58	31	17	115
Not deforested	21	19	8	23	71
Don't know	1	0	2	10	13
Total	31	77	41	50	199

SOURCE: Computed from fieldwork data.

Table 5 illustrates the level of deforestation by the source of fuel. Amongst the 109 households dependent on the firewood as source of fuel, 61 per cent believed the area was deforested while 33 per cent stated that the area was not deforested. A total of 42 (57 per cent) of those who used both firewood and electricity as a source of fuel stated that the area is deforested, while only 37 per cent indicated that the area was not deforested.

Table 5. Level of deforestation by source of fuel

Source of fuel	Level of deforestation			Total
	Deforested	Not deforested	Don't know	
Firewood	67	36	6	109
Firewood and electricity	42	28	6	76
Electricity	5	3	0	8
Gas	1	2	1	4
Others (specify)	0	2	0	2
Total	115	71	13	199

SOURCE: Computed from fieldwork data.

3.1.3.4. Signs of Deforestation: Figure 2 illustrates the observed signs of deforestation in the area. Over half (53 per cent) of the respondents stated that removal of the fertile top soil (soil erosion), loss of shrubs and trees were the most evident signs of deforestation in the area. A total of 34 per cent indicated that there was diminished plant cover, while 33 per cent stated that there were changes in soil surface condition, notably compaction through trampling by livestock.

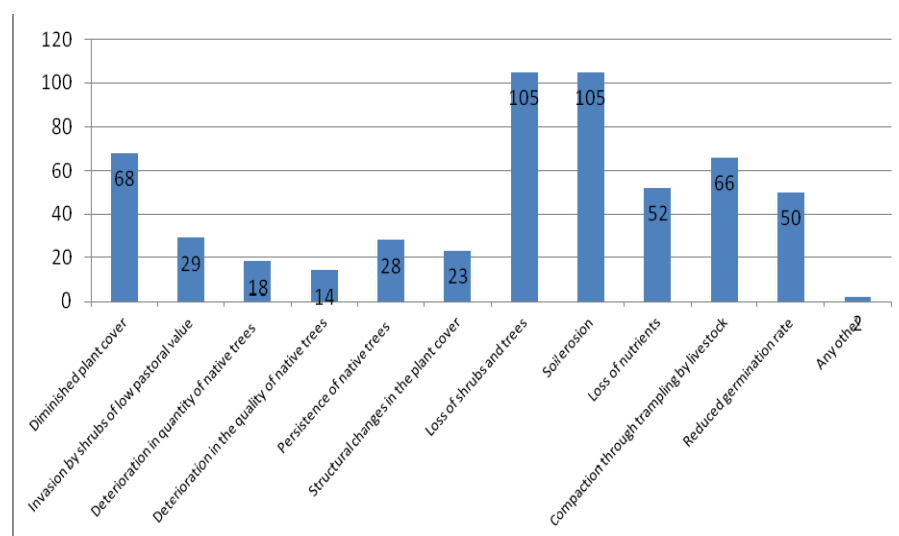


Figure 1. Signs of Deforestation in Sinceni

SOURCE: Adapted from fieldwork data

3.1.3.5. Main Causes of Deforestation: About 59 per cent of the respondents convinced that increase in population size was the main cause of deforestation. Thirty six (36) per cent of all the respondents indicated that increase in livestock size was a leading cause of deforestation,

followed by poor rainfall (30 per cent). Infrastructure extension was said to be another cause of deforestation, indicated by only 5 per cent of all the respondents (Table 6).

Table 6. Causes of deforestation

Causes of deforestation	N	Per cent
Increase in population size	117	59
Increase in livestock size	72	36
Poor rainfall	60	30
Climate change	40	20
Economic improvement	38	19
Poor policies	36	18
Infrastructure extension	10	5
Others	8	4

SOURCE: Computed from fieldwork data.

3.1.3.6. Factors that Contribute to Deforestation: As indicated in Table 7, 62 of the respondents believed that drought was the highest contributing factor in Rank 1, followed by human population growth (55 respondents), then livestock production increment (32 respondents). Amongst the least contributing factors (Rank 6). None of the respondents believed that livestock production increment was the least contributing factor. Only two respondents stated that drought was the least contributing factor, while three respondents stated that human population growth was the least contributing factor.

Table 7. Factors contributing to deforestation, ranked

Contributing factors	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6
Drought	62	37	37	23	10	2
Human population growth	55	33	43	20	12	3
Livestock production increment	32	55	40	21	15	0
Little attention from government	13	11	12	46	60	12
Traditional management	12	17	27	42	54	5
Others	6	9	3	3	1	4

SOURCE: Computed from fieldwork data.

Livestock production increase was said to have a role in accelerating deforestation through a number of ways. These include overgrazing (117 respondents), trampling of the soil causing soil erosion (50 respondents), eating vegetation (5 respondents), and overcrowding (17 respondents). On

the other hand, drought was also stated to be a contributing factor to deforestation through poor rainfall causing trees to dry-up (153 respondents) and poor rainfall prohibiting people from cultivating their fields, causing them to turn to felling trees to sell as firewood or poles, for income (32 respondents).

The increase in population size has a direct link to deforestation in that people cut trees and convert forests to homesteads and farmlands as the demand for living space rises. In addition, trees are felled as the infrastructure is being extended, paving the way for electricity expansion, water, telephone tracks, and construction of roads.

The respondents believed that traditional management strategies have a relationship with deforestation. They explained that in order to mark lands and ensure security of land, households were allocated land, resulting in felling of trees. Secondly, respondents added that the system only focused on preservation of a few plant species while others were overlooked. Thirdly, the system is dependent on traditional remedies, whereby trees are cut down for roots, leaves or bark, required to make traditional drugs.

Finally, little attention from the government was also said to contribute to deforestation as trees are felled by the government for development purposes. The respondents also added that the government has not enforced laws and regulations against cutting of trees and there are no government officials in the area to monitor the preservation of environment. In addition, the respondents stated that government was failing to meet the needs of the people, thus people resorted to clearing forests to sell forest products for income, thus accelerating the rate of deforestation.

3.1.3.7. The Main Perpetrators of Deforestation: All the respondents (199) believed that human beings and livestock were the main perpetrators of deforestation. Human beings were further classified according to the main activities they perform, which in turn has a contributory effect on deforestation. These activities included handicrafts, building, traditional remedies, and business.

3.1.4. The Impact of Deforestation

3.1.4.1. The Forecast of Deforestation: Thirty five (35) per cent of the females indicated that the condition of the forest will deteriorate gradually in the coming 15 years, compared to 48 per cent of the males who shared the same belief. These were followed by 22 per cent of females and 18 per cent of males, who believed deterioration would occur quickly (Table 8).

Table 8. Forecast of forest condition in the coming 15 years, by sex of respondent

Sex of respondent	Forecast of forest condition in coming 15 years					Total
	Will not change	Will deteriorate very quickly	Will deteriorate very gradually	Very difficult to forecast	Don't know	
Female	20	25	40	13	17	115
Male	8	14	38	10	9	79
Total	28	39	78	23	26	194

SOURCE: Computed from fieldwork data.

3.1.4.2. Effects of Deforestation: When respondents were asked about the effects of deforestation on society in the next five years, they believed that there would be more soil erosion, loss of natural forests, decrease in number of trees, growth of invasive tree species, lack of firewood, and compromised air quality. Amongst the current effects that families are experiencing as a result of deforestation, respondents expressed that soil erosion was evident, and some families were already struggling to get wood, and had to travel long distances in search of firewood, strong building wood (poles) and wood for handicrafts. They also indicated that some of the indigenous tree species were already extinct and invasive species, such as *Chromolina odorata* (*sandanezwe*) had developed in some forests.

When asked about the effects of deforestation on children in the future, respondents raised their concerns about the inability of their children to identify wild fruits (will not know them), lack of knowledge of natural trees and wild animals. This means that children would either learn about these at school or would have to pay for wild fruits, animals and plants. In addition, as forests would be destroyed and extinct, respondents felt that children would miss out on the traditional life currently experienced by the community such as hunting, worms gathering and looking after livestock.

Effects of deforestation on women included shortage of firewood, grass for making chicken nests and roofing (thatch grass). Women would have to travel long distances to get firewood and would lose market as they would not be able to meet the demand for firewood, nest and thatching grass due to the long distances; there would be loss of culture as women would no longer be able to perform women's chores, such as gathering firewood; and women would suffer from diseases associated with travelling long distances and carrying heavy loads, brought about by inaccessibility of firewood in the vicinity of their homes or neighbourhoods.

As a result of deforestation, in the near future, the respondents believed that men would struggle to get wood for building their homes, kraals, fencing, and handicrafts, such as the traditional meat platter, spoons and forks.

When probed on the effects of deforestation in the future if it were to remain unattended, 133 respondents stated that the area would be bare (loss of vegetation), resulting in soil erosion; 23 respondents stated that livestock would be lost due to lack of vegetation; and 2 respondents believed that the climate would change due to loss of vegetation, and the air quality would be compromised.

3.1.5. Coping Strategies by the Community

3.1.5.1. Improving Forestation: As shown in Table 9, 72 per cent of the respondents believed that reduction of livestock population would improve forestation, followed by stopping indiscriminate bush clearing (13 per cent).

Table 9. Responses on what can be done to improve forestation

Item	N	%
Reduction of livestock population	142	72
Stop indiscriminate bush clearing	26	13
Reduce bush clearing	17	9
Development of market infrastructure	12	6
Total	197	100

SOURCE: Computed from fieldwork data.

3.1.5.2. Strategies to Control Deforestation: A Likert scale was used to measure the level of agreement by the respondents on strategies that could be employed to control deforestation. The level of agreement was measured as follows:

0=don't know, 1=strongly disagree, 2=disagree, 3=slightly disagree, 4=slightly agree, 5=agree, 6=strongly agree

Table 10 illustrates how the respondents rated the strategies. For instance, when asked if shifting grazing and planting trees could control deforestation, the mean level of agreement was 4.5, with a standard deviation of 1.8 and 1.7 respectively, for both strategies, which means that respondents agreed with these strategies. The use of cotton was the least known strategy in the area, given that the level of agreement was 0.9, with a standard deviation of 1.6.

Table 10. Strategies that could be used to control deforestation

Strategies	N	Mean	Std. Deviation
Shifting grazing	198	4.5	1.8
Planting	190	4.5	1.7
Shifting farming	198	4.1	1.9
Rotational grazing	184	3.9	2.0
Crop residues stocking	186	2.8	2.2
Movement of animals	194	2.8	2.0
Use of cotton	133	0.9	1.6
Seeding	173	3.7	1.9
Land resting	180	3.7	2.0
Traditional rotational grazing management strategies	172	3.7	4.5
Lack of information on dangers of deforestation	178	3.3	5.3
Reforestation	164	3.3	5.4
Fertiliser application	181	3.0	1.9
Destocking	180	3.0	2.3
Shelter belt planting	154	2.5	2.3
Scarification	126	1.6	2.1

SOURCE: Computed from Fieldwork Data.

3.1.5.3. *Control of Deforestation*: Figure 3 indicates the strategies currently employed by respondents to control deforestation.

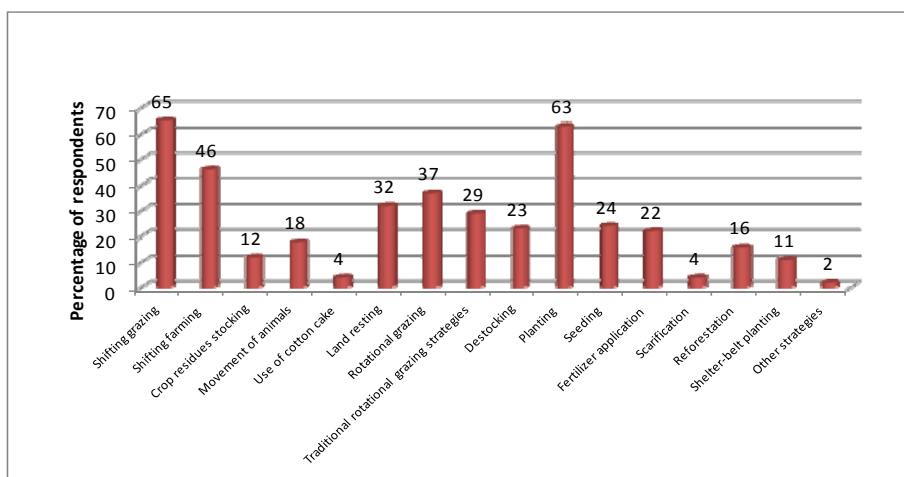


Figure 2. Current strategies used to control deforestation

SOURCE: Adapted from fieldwork data.

Sixty five (65) per cent of the respondents stated that they currently practise shifting grazing as a means of controlling deforestation, followed by 63 per cent who practised planting aloes and other shrubs. The least practised methods were the use of cotton cake and scarification, with only 4 per cent of the respondents giving a positive response.

3.1.5.4. Constraints to Controlling Deforestation: In their bid to control deforestation, respondents reported being faced with a number of constraints, including poverty, which was reported as the most common constraint (77 per cent), followed by overpopulation (49 respondents). The least faced constraint was indigenous knowledge, which encouraged the cutting of trees (15 per cent) (see Table 11).

Table 11. Constraints faced when controlling deforestation

Item	N	%
Poverty	154	77
Overpopulation	98	49
Human activities	72	36
Conflict and migration	54	27
Frequent droughts	41	21
Lack of local knowledge on livestock management strategies	41	21
Land degradation	36	18
Shortage of funds	36	18
Lack of technical and scientific knowledge	34	17
Indigenous knowledge	30	15
Lack of awareness of technical methods	29	15

SOURCE: Computed from fieldwork data.

3.1.5.5. Role Played by Others in Controlling Deforestation: Respondents were asked about the role played by other institutions and agents in the community, to control deforestation. These were the government, Yonge Nawe (an organisation working on the promotion of preservation of the environment), youth clubs, and other institutions. More than half (53 per cent) of the respondents stated that the government was not doing anything in the area to prevent or control deforestation. Forty one (41) per cent stated that the government was helpful in a number of ways, such as educating the nation on deforestation over the national radio in a weekly program, while some indicated that they had some officials who were helpful in passing the message to the community.

Fifty nine (59) per cent of the respondents indicated that they had heard of Yonge Nawe and the institution had helped them, through educating them on tree planting, providing them with plants, and educating them on preserving the soil and nature. However, 40 per cent indicated that the

institution had not done anything for the community. Sixty five (65) per cent of the respondents stated that there were no youth clubs in the area, while 31 per cent indicated that they had heard about youth clubs and these were helpful in educating the community on nature, conservation as well as controlling and preventing soil erosion. A total of 93 per cent of the respondents stated that there were no other organisations nor institutions helping with deforestation, while 7 per cent stated that there was an organisation named Swaziland Agricultural and Development Enterprise, which was helpful in providing plants and educating them on reforestation.

3.2. Discussion

The importance of forests cannot be over-emphasised, as has been mentioned in a number of studies, including Angelsen and Kaimowitz (1999), in which forests are said to be the richest source ecosystem and vital for society's wellbeing. However, this prominence is being undermined by the cutting or burning of trees, resulting in long-term removal of tree cover. Human beings are not spared either, as they are clearing forests for a number of reasons (Rademaekers *et al.* 2010).

This study was aimed at evaluating the condition of forests in Sinceni (Nceka) and exploring community perspectives on the impact of deforestation on the society, and most importantly, on women and children. Men are not left out as they are also directly involved in the removal of forests in the community. The coping strategies employed by communities to control and prevent deforestation were also explored.

It emerged that the area is deforested and this was mainly expressed by those dependent on the forest for firewood. In addition, when compared to several years back, a huge change is apparent and the area is currently significantly deforested. As a result of this deforestation, women are struggling for firewood and other forest products, and will continue to do so. Children will also suffer, for instance, in not knowing some tree species, wild fruits and animals. On the other hand, men are struggling to obtain wood for building and handicrafts, a trend that will continue. However, the community is employing some strategies to control the situation, even though they are currently faced with a number of constraints in solving the problem.

The findings of the study revealed that a large proportion of the community is dependent on the forest as a source of fuel (55 per cent) and the forest is mainly used for firewood (80 per cent) and building materials (17 per cent). The clearest signs of deforestation in the area were mainly loss of shrubs and trees, diminished plant cover and compaction on the ground, through trampling by livestock. These conditions have had a detrimental effect on human beings as they are the main perpetrators of deforestation, and the community believes that through increase in population as well as increase in livestock size, the level of deforestation has been accelerated. These are both the underlying and proximate causes of deforestation as explained in a

number of studies (Lambin *et al.* 2003; Mbatu 2010; Rademaekers *et al.* 2010).

As explained by Angelsen and Kaimowitz (1999), deforestation has negative and sometimes un-reversible effects on both society and life. In Sinceni, the community is already facing some negative effects due to the current situation. This includes loss of biodiversity, community wellbeing and culture. Currently, families are suffering due to soil erosion and shortage of strong wood for building. The most disturbing news, however, is that the community is convinced that the situation is not going to reverse but will continue gradually, and the area will be deforested in coming years. This means that the community is still going to suffer as a result of deforestation, and most importantly, those dependent on the forest for a living. Women will not be spared as they will struggle for firewood and wood for handicrafts, thus meeting their needs and supporting their families is bound to become even more difficult. Children will also suffer as they will not know some of the natural trees, wild fruits and animals presently in existence, and will have to travel longer distances to fetch firewood. As explained by Nathan and Kelkar (1997), women will be mostly affected as they are home “managers”. This means that they will bear most of the consequences, and this, besides the long distances travelled to collect firewood, includes the time lost to the forest, which could be used to perform other activities. Expected health effects on women will be associated with carrying heavy loads of firewood on their heads, over long distances, and making several trips to the forest for the firewood. These health effects include backaches, injuries and falls, which will increase in incidence and prevalence due to the above mentioned factors. Should this not be the case, they will be forced to buy firewood, though it emerged from the study that due to drought, households no longer plough their fields but sell firewood as a source of income. These findings were also confirmed by Manyatsi and Hlophe (2010) in their study, whereby selling of firewood was found to be a source of income and means of livelihood in Swaziland rural communities.

Nonetheless, community members are not ignorant of the condition. Hence, they are employing a number of strategies to control deforestation. These include shifting grazing, planting trees, rotational grazing, and shifting farming. However, the community’s efforts are being threatened by a number of constraints, such as poverty, overpopulation, human activities, and land degradation. One could expect some additional assistance from other institutions and organisations but this is not the case as more than half (53 per cent) of the community members testified that the government is doing nothing to help the situation. According to studies conducted, external assistance is crucial in controlling deforestation. This external assistance could be regional, national or international and includes policies, rules and regulations focusing on monitoring the valuable forest ecosystem (Rademaekers *et al.* 2010; Rudel 2013; Angelsen and Kaimowitz 1999).

Limitations of the Study

Initially, the study methodology involved a qualitative approach. However, permission to assemble focus group discussions was granted very late, making it impossible for the researchers to conduct as this could have led to not meeting the deadline of submission of the study findings. Hence, the study ended up as entirely quantitative, thus missing out themes that could have been derived through applying a qualitative approach. Therefore, if the study had progressed as per the initial plan, more comprehensive information would have been synthesised into the current findings, thus yielding much more inclusive findings.

4. Conclusion and Recommendations

4.1. Conclusion

The study concluded that Sinceni is currently deforested and forests have mainly been used for firewood, which is the main source of fuel in the area. The community perceives that population growth and drought have significantly contributed to deforestation in the area. However, in order to cope with deforestation, the community has employed a number of forest management strategies, including shifting grazing. Nonetheless, forests are still under threat due to a number of constraints such as poverty and overpopulation. This has led to detrimental effects on members of the community, especially women, such as struggling for firewood and wood for building. If not addressed, this could result in a much more critical outcome such as compromised air quality. In addition, deforestation could act as an impediment to development as it will impact negatively on the health status of the country, thus affecting economic growth. It is likely that there would be an increase in the mortality and morbidity rate, especially of women and children. This will also have a negative effect on the country's effort in meeting the MDGs, especially Target 7, aimed at ensuring environmental sustainability.

4.2. Recommendations

Based on the findings of the study, it is recommended that forest management systems should integrate community perceptions and practices. Thus, the indigenous knowledge of the villagers, such as rotational grazing, in conjunction with technical and scientific knowledge, should be used to develop methods of resource management, whereby it is in the people's interest to manage pastures and biological resources. This should be included in policies, programmes, projects, strategies, and activities by the agricultural ministry and environmental conservation groups such as Yonge Nawe, whose aim is to reduce deforestation. While these could be national policies and programmes, there should be site-specific management systems that represent what the communities feel and know better, since they know what is happening on the ground. Problems may seem the same but in essence they differ in impact, in different

communities. One cannot implement a management system for the whole country since each and every community has its own perceptions of the problem. Communities have their own perception of deforestation and it is these perceptions that influence their actions towards forests and coping strategies adopted. Communities should be taught about issues such as livestock production increment and traditional management systems, which through the study, it was observed that most respondents do not view these factors as main contributing factors to deforestation but push the blame to other factors such as drought. More importantly, everybody in the community, especially women, should be involved when making decisions that will affect them in the future. For instance, if their views were to be incorporated when converting forests, this could help preserve forests, thus saving them from the day-to-day struggle of carrying firewood over long distances, thus posing negative effects on them.

It is also important to encourage the communities to embrace outside help in managing natural resources. They need to integrate their knowledge with the assistance offered by other stakeholders, thus realise their capacity to monitor and respond to challenges of deforestation and change, more effectively.

References

- Angelsen, A. and Kaimowitz, D. 1999. Rethinking the causes of deforestation: Lessons from economic models. *The World Bank Research Observer*, 14(1): 73–98.
- CIA World Factbook. 2013. *Swaziland demographic profile*. Retrieved September 30, 2013, from http://www.indexmundi.com/swaziland/demographics_profile.html.
- . 2013. *Swaziland economy profile*. Retrieved September 30, 2013, from http://www.indexmundi.com/swaziland/economy_profile.html. **Error! Hyperlink reference not valid.**
- Krejcie, R. V. and Morgan, D. W. 1970. Determining sample size for research activities. *Educational and Psychological Measurement*, 30: 607–610.
- Lambin, E. F., Geist, H. J. and Lepers, E. 2003. Dynamics of land-use and land-cover change in tropical regions. *Annual Review of Environment and Resources*, 28: 205–241.
- Laurance, W. F., Albernaz, A. K. M., Schroth, G., Fearnside, P. M., Bergen, S., Venticinque, E. M. and Da Costa, C. 2002. Predictors of deforestation in the Brazilian Amazon. *Journal of Biogeography*, 29(5 and 6): 737–748.
- Manyatsi, A. M. and Hlophe, E. T. 2010. Contribution of sale of firewood towards rural livelihood in Swaziland and its environmental sustainability. *Current Research Journal of Social Sciences*, 2(4): 226–232.
- Mayaux, P., Pekel, J. F., Desclée, B., Donnay, F., Lupi, A., Achard, F., Clerici, M., Bodart, C., Brink, A., Nasi, R. and Belward, A. 2013. State and evolution

- of the African rainforests between 1990 and 2010. *Philosophical Transactions of the Royal Society B.*, 368(1625).
- Mbatu, R. 2010. Deforestation in the Buea-Limbe and Bertoua regions in southern Cameroon (1984–2000): Modernization, world systems, and neo-Malthusian outlook. *GeoJournal.*, 75(5): 443–458.
- Nathan, D. and Kelkar, G. 1997. Wood energy: The role of women's unvalued labor. *Gender Technology and Development*, 1(2): 205–224.
- Nyoka, B. I. 2003. State of forestry and tree genetic resources in dry zone Southern Africa Development Community countries. Food and Agriculture Organization of United Nations, Forestry Department. Retrieved August 18, 2014, from <http://www.fao.org/docrep/005/ac850e/ac850e00.htm>.
- Rademaekers, K., Eichler, L., Berg, J., Obersteiner, M. and Havlik, P. 2010. Study on the evolution of some deforestation drivers and their potential impacts on the costs of an avoiding deforestation scheme. Final report. European Commission Directorate-General for Environment. Rotterdam, The Netherlands.
- Rudel, T. K. 2013. The national determinants of deforestation in Sub-Saharan Africa. *Philosophical Transactions of the Royal Society*, 368(1625).
- World Health Organization (WHO). 2011. *Introduction to country context: Swaziland*. Retrieved September 5, 2013, from http://www.aho.afro.who.int/profiles_information/index.php/Swaziland:Introduction_to_Country_Context.
- World Bank. 2007. *Swaziland*. Retrieved September 5, 2013, from: <http://data.worldbank.org/country/swaziland>.

CHAPTER SIX

Gender Equity and Household Decision-Making in Alternative Energy Technologies Adoption: A Case of Access to Biogas Technology in Central Tanzania

Anna Wawa

Abstract

Tanzania, as is typical of most Third World countries, is facing energy poverty. One of the challenges facing the Tanzanian government is the failure to reach rural households, since it is only 2 per cent of the population that has access to modern energy services. Currently, only 12 per cent of Tanzania's population is connected to the national electricity grid. However, the coverage of the grid continues to be concentrated in urban areas, with rural coverage of only 2.5 per cent. Ninety (90) per cent of Tanzania's energy consumption is met by biomass, primarily woodfuel. The dominance of woodfuel use in Tanzania has led to its scarcity, manifested by devastation of natural vegetation and an increasing distance between woodfuel collection points. Women in particular, due to their roles and close interaction with the environment, are major victims of domestic energy problems. Several Non-Governmental Organisations in the country have introduced biogas technology as an alternative source of domestic energy, aimed at reducing workloads for women in firewood collection, thus reducing deforestation. Despite its potential, biogas technology in the country has not been adopted to the expected level; hence, its aims have not been sufficiently achieved. The main objective of this study is to examine how far biogas projects in Tanzania have addressed gender equity, through accessing local populations. Specifically, the study aimed at assessing the involvement of men and women in biogas activities and its influence in adoption of biogas technology. The study is based on primary data collected through interviews with households, government and NGO officials dealing with biogas dissemination. Study findings revealed that women are obliged to ensure fuel availability in the household and engage in most of the activities related to the operations of biogas plants. Unfortunately, however, women are less involved in decision-making concerning biogas and lack knowledge on biogas due to illiteracy and little exposure to information systems. This has denied women the expected benefits from biogas technology, hence leading to non-sustainability of the technology. The study recommends the empowerment of women, where project developers have to facilitate women's access to information and education, thus enhancing their knowledge and skills. Additionally, decision-making and equal sharing of responsibilities by men and women is critical for women's wellbeing. Women need alternative energy sources that are less labour demanding, more convenient, healthier, and safer, to address their critical need for energy.

Keywords: Gender equity, biogas technology, alternative energy, accessibility.

1. Introduction

1.1. Background to the Study

Tanzania, like other Third World countries, is challenged by energy poverty. The country is experiencing inadequate and unreliable access to modern energy for the majority of its citizens. Ninety (90) per cent of Tanzania's energy consumption is met by biomass, primarily woodfuel. Besides, woodfuel accounts for over 80 per cent of energy consumption in rural areas, where the majority (80 per cent) of Tanzania's population lives. Woodfuel use by households constitutes the largest share of the total energy consumption (Rural Energy Agency [REA] 2007). The dominance of woodfuel use in Tanzania has led to its scarcity, manifested by devastation of natural vegetation and the increasing distance between points where woodfuel is collected for basic survival activities such as cooking (Kambele 2003). Women, in particular due to their roles and close interaction with the environment, are major victims of the energy poverty in Tanzania.

According to the United Republic of Tanzania [URT] (2003), one of the challenges facing the Tanzanian government is failure to reach its rural households with energy requirements, since only 2.5 per cent of the rural population has access to modern energy services. Even for the population with access to electricity, about 80 per cent has very low purchasing power, hence has opted mainly for woodfuel as a cheaper and easily accessible energy source. Furthermore, in electrified areas, the energy supply is not reliable and is unaffordable for the greater part of the population. This was confirmed by the minister, Ministry of Energy and Minerals, as interviewed by Corporate Tanzania (2010), who declared that the current energy supply in Tanzania is unreliable due to frequent interruptions of power supply and over-dependence on the mono-source of hydro-based power. Little access to commercial energy has led to the government promoting the use of alternative energy sources to meet energy needs, through its rural energy policy.

Millennium Development Goals (MDGs) reflect poverty and its linkage with gender inequality. Poor women are particularly vulnerable to energy poverty as they are primary energy procurers and managers. Furthermore, Danielsen (2012) argues that women in developing countries experience energy poverty differently and more severely than men. This is associated with the gender division of labour and different roles played by men and women in the society. An analysis done in Tanzania by Budlender (2008) shows that women are more involved in firewood collection than men, where women's participation rate is 38.9 per cent, while for men it is only 17.1 per cent. Location-wise, women in rural areas are more involved in woodfuel collection, reflected by a participation rate of 50.4 per cent, compared to 9.5 per cent for women in urban areas. Similarly, Mikkelsen (2012) comments that without access to modern energy, gender inequality

and poverty are accentuated as women and girls are often overburdened with the tasks of firewood and water collection. Their burdens are further exacerbated by environmental degradation such as deforestation. Hence, women's health and opportunities in the social, economic and political spheres are hindered.

In Africa, Tanzania has been amongst the forefront countries in promoting the use of alternative renewable energy sources, such as biogas, in order to reduce excessive dependence on woodfuel at the household level (Schmitz 2007). According to the Tanzania Domestic Biogas Programme, domestic biogas provides benefits in the fields of rural energy supply, agriculture, health, sanitation, gender, and environment. Nes and Nhete (2007) further add that biogas uplifts the dignity of women and improves their health, lessening their workload by saving time consumed for firewood collection. Consequently, savings are increased by eliminating expenditure on other energy sources. In this regard, Cecelski (2004) asserts that women would have special interest in conserving and managing energy, and women's interests would be identical with those of energy programmes due to their responsibilities and dependence on biomass. However, women's rights to access energy are constrained by intra-household decision-making, women's social position and low value attached to women's labour. Unequal gender relations limit women's ability to participate and voice their energy needs in decision-making, at all levels of the energy system (Mikkel 2012). Women need alternative energy sources that are less labour demanding, more convenient and safer to their health, to address their critical need for energy. Tanzania has been disseminating biogas technology as an alternative renewable energy source to reduce excessive dependence on woodfuel. The history of biogas technology in Tanzania dates back to 1975 but so far it has not been adopted by a larger part of the population.

1.2. Statement of the Problem

Biogas technology use in Tanzania is relatively mature compared to in other African countries (Schmitz 2007). An analysis undertaken by Nhete and Kellner (2007) reveals that the exact number of biogas plants installed in Africa is unknown but most units are installed in Tanzania. Unfortunately, an estimated 60 per cent of the installed biogas plants in Tanzania failed to remain operational in spite of the efforts made to introduce alternative energy programmes and the apparent advantages of the technology such as lessening women's workload. In most cases, women, who are viewed as major beneficiaries of alternative energy programmes, have shown a low level of response towards biogas energy technologies. As noted by Cecelski (2004), women are assumed to be a homogenous and largely passive benefits-receiving group, and the different implications of the wider use of alternative energy technologies for women and men have hardly been examined. This study, therefore, aims to fill this gap by examining how far biogas projects in Tanzania have addressed

gender equity in presenting biogas technology to local populations. Specifically, the study aims at assessing the involvement of men and women in biogas activities, and the influence of gender in the adoption of biogas technology.

The following research questions were formulated to guide the study:

- Are the alternative energy technologies, such as biogas, accessible to local populations?
- In which ways are men and women involved in biogas technology activities?
- Is gender equity a key factor influencing biogas uptake in Tanzania?

1.3. Methodology

This study was carried out in two districts, namely Kongwa and Bahi in Dodoma Region, central Tanzania. The selection of the study areas was based on the fact that Dodoma Region is a semi-arid area with all the signs of wood fuel scarcity, hence a need for alternative energy sources. In addition, the districts selected have the potential for the operation of biogas plants as demonstrated by factors such as favourable temperatures, livestock keeping and agricultural residuals, which provide feedstocks for the operation of biogas plants. Additionally, there have been biogas projects run by the non-governmental organisation (NGO) known as MIGESADO (a Swahili acronym which means, Biogas Projects in Dodoma) that have been disseminating biogas technology since 1994.

The research design used in this study is a cross-sectional survey which allows collection of data on different groups of respondents, at one point at a time. Households were the target population of the study as they are potential adopters of biogas technology. It is from this target population that a grand total of 320 households were randomly selected to represent the entire population in the study area. Both primary and secondary data was collected and used to achieve the objectives of the study. Primary data was collected using structured and semi-structured interviews, checklists for focus group discussions and field observations. In contrast, secondary data was collected from various sources, including reports from government officials, both at district and national levels, and from NGOs, libraries, institutions, and web sites, which were then used to complement information obtained from the respondents. The use of a combination of methods in data collection was due to the diversity of information required by the researcher to achieve the objectives of the study.

Data collected through interviews was coded and entered into the Statistical Package for Social Sciences (SPSS), for both descriptive and quantitative techniques, which was used to analyze the data. A substantial part of the analysis was based on descriptive statistics such as frequencies, cross-tabulations and correlation coefficients.

1.4. Organisation of the Chapter

This chapter is organised into four sections. Section one presents the background information, statement of the problem, objectives of the study, and the research methodology. Section two presents a theoretical literature review related to the study and constructs under discussion. Findings and discussions are presented in section three, which also analyzes relationships between variables. Finally, section four presents conclusions and recommendations for further studies.

2. Theoretical Literature Review

The history of biogas utilisation shows independent developments in various developing and industrialised countries. Anecdotal evidence indicates that biogas was used for heating bath water in Assyria during the 10th century B.C., and in Persia during the 16th century B.C. In India, the first digestion plant was built at a leper colony in Bombay, in 1859, while in England, anaerobic digestion began in 1895 (Biogas Works 1999). Historical experiences in Germany, China and India clearly demonstrate how biogas development responds to favourable frame conditions. In Germany, for instance, biogas dissemination gained momentum through the need for alternative energy sources in a war-torn economy (ISAT and GTZ [n.d.]). According to ISAT, the German Technical Cooperation (GTZ), following its launching in 1980, chose biogas technology as a focal point of its activities. This resulted in a cross-sectoral scheme that has accompanied and supported the development and dissemination of biogas technology in Latin America, Asia and Africa. A number of biogas dissemination programmes involving GTZ were launched in Bolivia, Colombia, Nicaragua, the Caribbean, Tanzania, Kenya, Burundi, Morocco, and Thailand.

Biogas technology was introduced in Tanzania, in 1975, but was very demanding and expensive, costing up to US\$ 2000 (CONDRIT Ltda 1995). According to this source, it did not have a big impact until the introduction of the low-cost plastic biodigester (costing US\$ 70), which was introduced in March 1993. Rajeswaran (1983) describes the rationale behind the promotion of biogas technology, particularly in rural areas of Tanzania. He comments that Tanzania with an agrarian tradition is ideally suited to using agricultural residues for the production of feeds, fertiliser and fuel as a result of biogas technology implementation. In central Tanzania, the dissemination of biogas technology started in 1994, after the establishment of an NGO called MIGESADO. The organisation was initiated in response to serious deforestation in Dodoma Region, caused by the demand for firewood, both in rural and urban areas, which resulted in a heavy workload for rural women in fetching firewood and water, and high prices for urban charcoal users.

MIGESADO is involved in constructing and marketing biogas plants, and providing subsidies for the same. It is also involved in training masons,

both males and females. However, the biogas plants thus far installed have been found to have a number of drawbacks, including inadequate capacity for cooking and low durability (Kimambo 2002). Lotte, Malene and Helle (2004) in their evaluation of small-scale biogas digesters in Morogoro Region revealed the reasons for the relatively high number of non-functioning biodigesters, which are related to the actual management and maintenance of the biodigesters, organisational design of the biogas project and financial sustainability of the project.

Literature indicates that biogas technology has been adopted in Tanzania but not at the expected level, despite its potential. Few studies have explored factors for the low adoption of biogas technology (Kambele 2004; Schmitz 2007; Ng'wandu, Shila and Heegde 2009). The factors identified include high installation costs, lack of training, inadequate marketing, poor coordination amongst stakeholders, and low public awareness. The available studies have not touched much on gender relations, particularly women's involvement in biogas programmes, which is believed to have significant influence in sustainability of biogas technology. This is due to the fact that women are major actors in biogas plant operations and if they have access to information and are fully involved in biogas programmes, it would have a positive impact on sustainability of biogas technology. This study, therefore, seeks to fill this knowledge gap and add onto the existing knowledge on factors that influence people to adopt or not adopt alternative energy technologies, hence address energy poverty.

2.1. Theoretical Framework for Technology Adoption

Technology adoption is a process through which an individual or organisation decides to fully use an innovation in their daily business (Rogers 1995). The Diffusion of Innovation Theory, developed by Rogers (1995), was adapted for this study. It is the most widely recognised technology adoption framework. The theory suggests three categories of determinants of technology adoption, which include characteristics of an innovation, individual categories and communication channels. The characteristics of an innovation which may influence its adoption include relative technology advantages such as ease of use, cost-saving, efficiency, and convenience. Rogers' theory further considers the categories of adopters as determinants of technology adoption. Rogers (1995) and Feder, Just and Ziberman (1985) classify members of a social system into five adopter categories. These are innovators, early adopters, early majority, late majority, and laggards. These categories follow a standard deviation-curve. Very few innovators adopt the innovation in the beginning (2.5 per cent); early adopters account for 13.5 per cent a short time later, the early majority comprises 34 per cent; the late majority accounts for 34 per cent, after some time, and finally the laggards account for 16 per cent.

- Innovators are venturesome individuals in social systems who are very eager to try new ideas. They are also capable of coping with a high degree of uncertainty and play an important role in importing new

ideas. Innovators are regarded as the first to adopt a new idea (Rogers 1995; Feder, Just and Ziberman 1985).

- Early adopters are more integrated into the social system than innovators. Members of this category are said to speed up the diffusion process and are the ones from whom potential adopters seek advice and information about the innovation, since they find it necessary to make a judicious innovation decision. According to Rogers (1995), this category decreases the uncertainty about a new idea by adopting it and then conveying a subjective evaluation of the innovation to a nearby peer by means of interpersonal networks.
- The early majority category of adopters comprises members who adopt the new idea just before the average members of the social system, but after the early adopters. This category links the very early adopters and the relatively late adopters in the diffusion process. The innovation decision period of early majority is relatively longer than that of the innovators and early adopters (Feder, Just and Ziberman 1985).
- The late majority are the members of the social system who adopt innovations relatively late. Members of this category adopt the innovation after the majority of people in the society have adopted. The adoption by this category comes as a result of economic necessity and peer group pressure (Rogers 1995).
- Laggards are the last group in a social system to adopt innovations. According to Rogers (1995), these people possess no opinion on leadership and are most localised in outlook. They often make decisions in terms of what has been done by previous generations and interact primarily with others who also have certain traditional values. It can be argued, therefore, that laggards tend to be suspicious of innovations and change agents.

The Diffusion of Innovation Theory further predicts that media as well as interpersonal contacts provide information, and influence opinion and judgment. The information flows through networks. Technology adoption theories, though widely applied in the understanding of factors influencing technology adoption, have their limitations. Abukhzam and Lee (2010) in their analysis of adoption frameworks concluded that despite widespread interest in understanding factors affecting users' attitude towards technology adoption, limited attention has been paid to describing the factors that affect workforce attitude towards the adoption of a new technology. The Diffusion of Innovation Theory, for instance, has been criticised in terms of its deficiencies in explaining the effect of adopters' demography on innovation adoption (Abukhzam and Lee 2010). Rogers (1995) ignores the impact of demographic differences among adopters, such as age, income, gender, and education, yet according to Abukhzam and Lee (2010), these factors have been found to have a significant influence on users' attitude towards the adoption of technological

innovation. Simon (2006), while considering these limitations in addition to demographic characteristics, also incorporates facilitating factors such as institutional support services and effectiveness of actors, as factors influencing awareness and attitude towards technology adoption.

Figure 1 illustrates the conceptual framework for the adoption of biogas technology based on Diffusion of Innovation Theory.

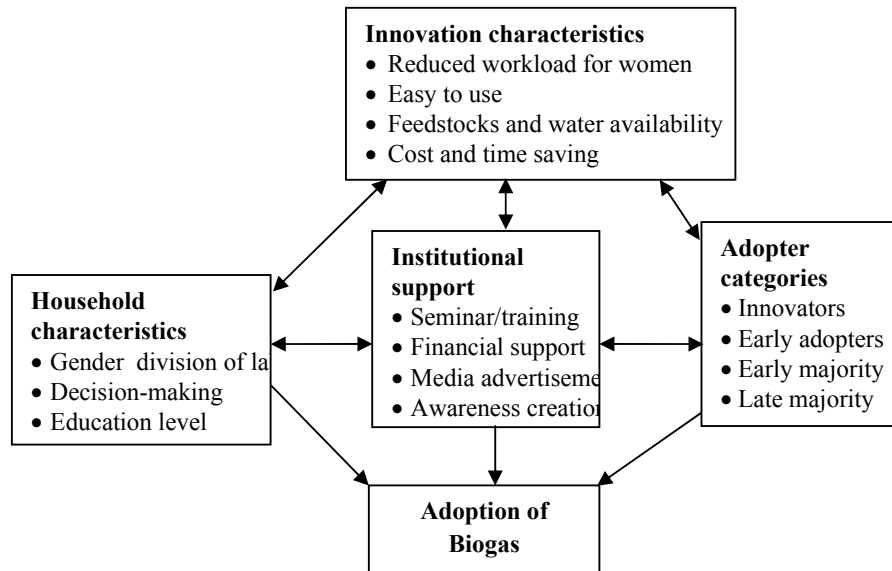


Figure 1. Conceptual Framework for Adoption of Biogas Technology

SOURCE: Adapted from Rogers (1995).

Institutional support services tend to influence other factors responsible for adoption of a technology. Government, in particular, is assumed to influence the adoption of biogas technology through its policies, extension services, awareness creation campaigns, and financial support. Government's responsible ministries and NGOs are the sources of information and other technical support services, which also determine the uptake of the technology. Other major determinants of technology adoption include household characteristics such as gender roles, education level, resource ownership, and decision-making systems, since biogas technology involves labour, financial investment and land for biogas plant installation. The framework further shows the influence of innovation characteristics in adoption of the biogas technology. The potential benefits should be easily visible. In the case of biogas technology, these benefits include reduced workload for women as they are saved from searching for firewood and become more involved in other productive work. The technology should be simple, reliable and compatible with the local culture. The availability of feedstocks and water are vital for the functioning of biogas plants. Other determinants of technology adoption, as per the adoption theory, include

the categories of adopters. Not all individuals in a society adopt the technology at the same time (Rogers 1995). Given other factors favouring the adoption, the potential adopters would still adopt the technology differently.

2.2. Gender and Energy

This study assumes that gender being a social factor, influences the adoption of biogas technology. Gender, according to Clancy *et al.* (2011), is a system of socially defined roles, privileges, attributes, and relationships between women and men. Gender roles are often determined and prescribed by strongly held cultural and religious traditions. These roles are not universal but vary in degree, from society to society. Gender roles are not determined by nature but by the social environment in which a person is raised. In most cases, tasks and responsibilities are allocated on the basis of what a particular society considers appropriate for women and men. In general, women tend to have a greater range of tasks than men. These differences have implications on the capacity to participate in activities such as meetings, and in taking-up opportunities which arise as additional tasks (Clancy *et al.* 2011).

Gender relations can positively or negatively influence adoption of a technology, depending on gender responsibilities and ownership of resources (Simon 2006). Gender responsibilities can take the form of performing different tasks in energy supply and management systems, and differences in resource ownership such as livestock, houses and land. In the rural areas of less developed countries, men and women play very distinct and definite roles in domestic energy management. Women have traditionally shouldered the responsibility of managing the domestic energy requirements for their families. As a rule, the tasks of cooking are carried out by women. These have been perceived by many African societies as women's tasks. It is only when wood is collected for sale, or where social constraints restrict women from leaving their homes, that men participate (Dutta 1997).

Fontana and Natali (2008) further comment that public investment policy has an important role to play in redressing gender inequalities and reducing poverty by promoting initiatives that reduce time spent by women in the above-mentioned tasks. In India, for instance, over the last two decades, many efforts have been made by the government to ameliorate the problems in the rural energy sector. These efforts have mainly been in the form of national programmes for promoting renewable energy technologies such as biogas, improved energy-saving cooking stoves and solar cookers (Dutta 1997). Evaluation of these programmes, according to Dutta (*op. cit.*), has shown a wide variation in functionality rates and long-term acceptability of the technologies. Lack of involvement of women at all stages of the project cycles has been identified as one of the major causes of limited sustainability of projects. A number of factors form barriers to

the effective participation of women in rural energy dissemination programmes. These factors, according to Dutta (1997), include the traditional decision-making roles in the society; level of economic independence; educational constraints leading to lack of access to information, skills and technical expertise; and ideological barriers among extension workers.

Traditionally, women tend to have limited decision-making power about household purchases, including technologies. Chungu, Kimambo and Bali (2001), in their study on the processing plants and the individual sugarcane growers in Tanzania, observed that the ownership patterns follow patriarchal lines. The head of the household (husband/father) owned the family property, namely land, production tools and domestic animals. This, according to Chungu, has been taken as an indication that ownership and management of the technology is male-dominated. The above case study suggests that for a capital-intensive technology, such as biogas, it is automatically a man who will decide on its adoption or non-adoption. In most cases, men who are decision-makers in the household might not see the advantage of less time spent by women in firewood collection, and they might be reluctant to adopt biogas installation, since firewood is often and wrongly considered by the society as something free of charge, mainly collected by women and children.

Women are most familiar with household fuel supply problems as well as the need and preferences of the immediate environment and energy systems. However, since extension officers interact primarily with men, this source of indigenous knowledge remains untapped, hence technologies and innovations which were targeted for women are based on the perceptions and preferences of men. It is, therefore, not surprising that women are reluctant to adopt useful technologies such as biogas. This is supported by Karlsson (2003), who asserts that women are the primary users of energy. It is, therefore, important that they are involved in decisions on energy issues, specifically in designing and implementing projects to meet their needs. He identifies lack of education and technical training as an important constraint on women's participation in energy decision-making processes and in activities involving energy systems. Women already have valuable knowledge about local conditions and resources, additional education about energy technologies, which would increase their ability to contribute to energy solutions and to adopt new, cleaner fuels and equipment. Women, who have learned new skills and obtained improved access to energy for households and income-generating activities, can create new resources for investing in better conditions for themselves, their families and their communities.

Unfortunately, however, as Cecelski (2000) reveals, gender differentials in poverty are seldom discussed in renewable energy policies even though they influence the potential for women's involvement. The question of land ownership, labour and benefits, time-use and other family responsibilities,

differential access to credit and information, skills and training, from gender perspectives, have not generally been seen as relevant to the dissemination and commercialisation of renewable energy technologies. Clancy *et al.* (2011) further add that the differences between women and men pose challenges for ensuring equity in access to and benefit from energy technologies.

3. Findings and Discussion

3.1. Energy Situation in Central Tanzania

The primary energy source for domestic use in central Tanzania, particularly Dodoma Region, is woodfuel in the form of firewood or charcoal. Findings presented in Table 1 indicate that 69.7 per cent of the respondents in the study area experienced shortage of woodfuel. In addition, the problem of woodfuel is indicated by 22 per cent of the respondents, who asserted that woodfuel was no longer available in their area.

Table 1. Availability of primary energy in central Tanzania

Availability of woodfuel	Kongwa, N=161	Bahi, N=159	Total, N=320
Easily available	1.2 (2)	15.7 (25)	8.4 (27)
Not easily available	62.7 (101)	76.7 (122)	69.7 (223)
Not available	36.0 (58)	7.5 (12)	21.9 (70)
Total	100.0 (161)	100.0 (159)	100.0 (320)

SOURCE: Compiled from fieldwork data.

Note: Bold figures represent the percentage while figures in brackets represent the number of respondents involved.

As a result of woodfuel scarcity in the study area, people have opted to use wastes such as crop residuals, rice husks, sawdust, wood shavers, and oil seed cakes as alternatives to firewood. During a field visit to some villages, the researcher met women and girls carrying bundles of crop residuals from the farms, to be used for cooking. However, these wastes are seasonal and unreliable, and cooking power from these residuals, as per users' explanation, is minimal. The shortage of woodfuel implies that people will have to look for alternative energy sources, which are more efficient for domestic use.

Other indicators of woodfuel scarcity in central Tanzania include the increasing distances to firewood sources and time spent in firewood collection. Findings of this study indicate that 58 per cent of the respondents have been spending more than five hours per trip in firewood collection (Figure 2).

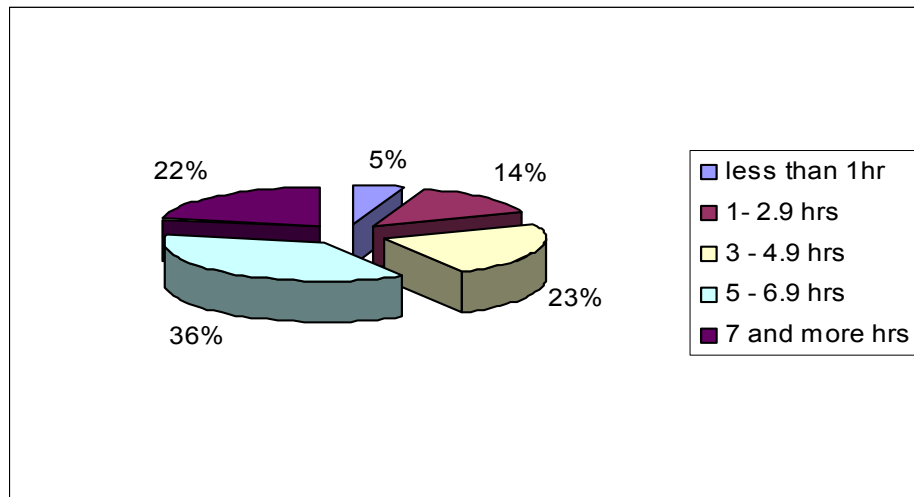


Figure 2. Time Consumed by Firewood Collection

SOURCE: Compiled from fieldwork data.

Firewood collection, as per literature, is a task mainly done by women and children. This implies that women spend most of their daytime hours in firewood collection, which affects their efficiency in engaging in other more productive activities.

On the other hand, firewood collection is also laborious and consumes human energy, when accompanied by cooking in a smoky environment. This is because both activities result in negative health outcomes on women and children. Among the aims of the MIGESADO project was the need to lessen women's workload and improve their health, with the ultimate goal of influencing the decision of households to adopt biogas technology. However, is the aim of introducing biogas technology perceived equally by the beneficiaries and the decision-makers in the household?

3.2. The Extent of Biogas Adoption in Dodoma Region

Data collected from the MIGESADO project shows that a total of 798 biogas plants had been constructed in Dodoma Region, from 1994 to 2009. Bahi district had a total of 50 biogas plants whereas Kongwa district had a total of 127 plants constructed, by the year 2009 (Table 2). This includes all the districts of Dodoma Region as well as Chiwe village representing villages selected for the study. Chiwe village was found to have the highest number of biogas plants constructed as compared to other villages in the study area. The number of biogas plants in other study villages ranged from 1 to 12 per village. The adoption percentages were calculated by dividing the total number of biogas plants constructed by the number of households.

Table 2. Extent of biogas adoption in Dodoma Region

Region/District	Number of households by 2009	Number of biogas plants constructed up to 2009	% adoption
Dodoma Region	376,630	798	0.21
Kongwa	50,877	127	0.25
Bahi	51,068	50	0.09
Dodoma Urban	74,914	398	0.50
Chamwino	53,215	143	0.27
Mpwapwa	56,563	32	0.06
Kondoa	89,893	50	0.06
Chiwe village	6145	17	0.28

SOURCE: MIGESADO (2009).

Data presented in Table 2 show that Bahi district shows the lowest adoption (0.09 per cent), compared to Kongwa district (0.25 per cent). This implies that biogas technology has penetrated more in Kongwa district than in Bahi, which may be due to differences in the severity of woodfuel shortages between the two districts as revealed in Table 1. Kongwa experiences more shortage, hence having a greater need for alternative energy than Bahi.

Table 2 also gives a general expression of the adoption of biogas technology in central Tanzania, which supports the existing literature indicating that biogas technology in Tanzania has not been adopted to the expected levels, in consideration of its potentiality and maturity in the country. The extent of adoption in Table 2 can also reflect adopters' categories as revealed by Rogers (1995). The persistent low adoption rate of biogas falls under the early adopters' category, with the majority being laggards. Furthermore, it is doubtful if this adoption is natural as it was facilitated by the subsidy approach used by the MIGESADO project in introducing biogas technology. Installation costs were subsidised by the biogas project, whereby the subsidies were rated in four categories relating to the income level of the beneficiary, ranging from 15 per cent to 58 per cent of total biogas plant construction costs (MIGESADO 2009). The low-income earners received a higher percentage of the subsidy than high-income earners. This arrangement encouraged low-income earners to adopt the technology. Nonetheless, the adoption is still low, which implies that without the subsidy the adoption could be even lower.

3.3. Peoples' Awareness of Biogas Technology

As shown in Figure 3, 82 per cent of the respondents acknowledged that they had at least heard about biogas technology. This implies that people were aware of the existence of the technology, which might have been due to the existence of a biogas project (MIGESADO) in the area, for about

sixteen years preceding the study period. However, awareness of the existence of biogas technology in the area does not necessarily mean that people are knowledgeable of the technology itself. People need to get detailed information about the technology, how it functions, its advantages, and its financial aspects, in order to decide whether to adopt or not.

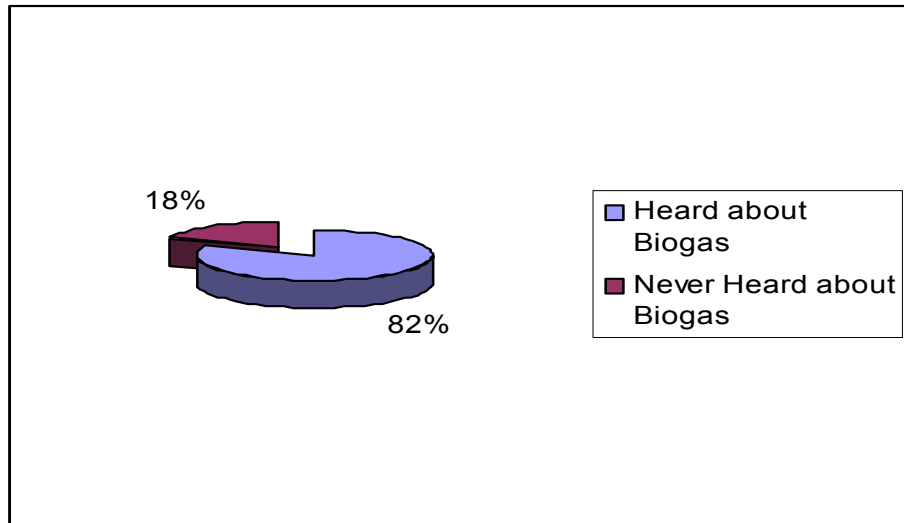


Figure 3. Access to Biogas Technology Information

SOURCE: Compiled from fieldwork data.

To assess the level of information acquired on biogas technology, respondents were asked to indicate if they had attended awareness creation activities such as workshops, training sessions, meetings, campaigns, and demonstrations on biogas matters. Results indicate that 72.4 per cent of non-adopters of biogas technology had never attended any of the activities, compared to 19.7 per cent of adopters. In total, about 60 per cent of all respondents had never attended any awareness creation activity. This implies that the majority of people in the study area have just heard about biogas technology but have no detailed information on the technology (Table 3).

Table 3. Respondents who attended biogas awareness creation activities

Activity	Non-adopters	Adopters	Total
Seminars/workshops on biogas technology	1.7 (4)	34.2 (26)	9.5 (30)
Village meetings with biogas project officials	19.2 (46)	32.9 (25)	22.5 (71)
Visited by biogas project staff at home	5.9 (14)	7.9 (6)	6.3 (20)
Demonstration on biogas operations	0.8 (2)	5.3 (4)	1.9 (6)
Never attended any of the activities	72.4 (173)	19.7 (15)	59.7 (188)
Total	100.0 (239)	100.0 (76)	100.0 (315)

SOURCE: Compiled from fieldwork data.

Note: Bold figures represent the percentage while figures in brackets represent the number of respondents involved.

These results tally with Kambele (2003), who observed that in Arumeru district, people did not have sufficient information on biogas technology but had just heard about it. Therefore, lack of detailed information could have an effect on information dissemination to potential adopters and on the operations of biogas plants, resulting in poor performance of the plants, which in turn disappoints both adopters and potential adopters of the technology.

Awareness alone is not enough to influence the adoption of innovation. According to adoption theories, awareness is just the first stage of the adoption process, and it has to be followed by accumulation of knowledge, which in turn induces the perception of people on the technology (Rogers 1995). The accumulation of knowledge is a result of continuous efforts of acquiring information concerning the introduced innovation. Responding to household interviews on knowledge of biogas technology, 48.4 per cent (Bahi district) and 44.7 per cent (Kongwa district) of respondents claimed to have little knowledge, while 45.3 per cent of Bahi respondents and 41.6 per cent of Kongwa respondents claimed to have no knowledge at all (Table 4). This finding is supported by key informants from the MIGESADO project, who admitted that the project focused more on construction of biogas plants. However, little was done on educating people about the technology. After construction of biogas plants, the adopters were left with a written brochure, intended to guide the user on biogas plant operations. However, during household interviews, very few respondents were able to produce their brochures, and the majority no longer had them. They were either lost or destroyed, hence respondents lacked technical backup to sustain the innovation. This implies that users, mainly women

who operate the biogas plants, had no reference guide and in cases where biogas plants failed, they ended up abandoning the plants.

Table 4. Respondents' knowledge on biogas technology

Knowledge level	Bahi	Kongwa	Total
No knowledge at all	48.4 (77)	44.7 (72)	46.6 (149)
Little knowledge	45.3 (72)	41.6 (67)	43.4 (139)
Moderate knowledge	5.0 (8)	11.8 (19)	8.4 (27)
Much knowledge	1.3 (2)	1.9 (3)	1.6 (5)
Total	100.0 (159)	100.0 (161)	100.0 (320)

SOURCE: Compiled from fieldwork data.

Note: Bold figures represent the percentage while figures in brackets represent the number of respondents involved.

Knowledge of a given technology influences the attitude towards it and can be manifested by people's willingness to invest or not to invest in it. Respondents were asked about their willingness to invest in biogas technology, if supported. In response to this question, only 25 per cent of the respondents showed a willingness to invest in biogas technology while the majority (75 per cent) showed interest in investing in other activities, such as small businesses, agriculture and education, which were perceived to be more profitable compared to biogas technology (Figure 4).

This implies that people were not yet convinced that biogas technology could be as profitable as other businesses. This might have been the case as people still perceived the available primary energy source, mainly woodfuel, as cheaper and easier to obtain compared to biogas, in terms of labour requirement and preferences of family members involved. Women, for instance, would prefer biogas technology to relieve them from the laborious task of firewood collection. On the other hand, men traditionally not being responsible for firewood collection, might not see the great need in investing in biogas, hence opt to invest in other activities perceived to be more beneficial. Attitude, as asserted by Abukhzam and Lee (2010), is a crucial element in implementation of the technology, and it can be a powerful activator or act as a barrier in adoption of a technology.

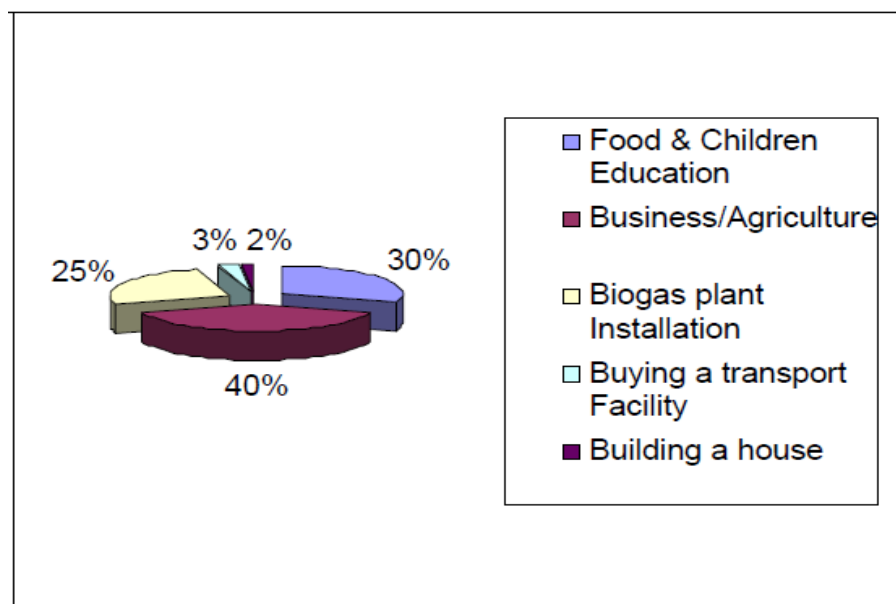


Figure 4. Respondents' Willingness to Invest in Priority Areas

SOURCE: Compiled from fieldwork data.

Another attitudinal response from discussions above is perception differences in the uses of biogas technology between men and women. Men perceived biogas technology as a modern energy source to supply power for electrical appliances such as lamps, pressing irons, and refrigerators, which could be used for storing drinks when running small businesses. Women, on the other hand, perceived biogas technology as alternative energy for cooking likely to relieve them from firewood collection. Women can only adopt technologies perceived to have greater benefits. They usually compare benefits from the available technology with the newly introduced technology and select the one with more perceived benefits. These differences in perception have an implication on decision-making about adoption of biogas technology.

3.3. Access to Information and Support Services for Uptake of Biogas Technology

Access to information and other support services has a greater influence in uptake of an innovation. During household interviews, the accessibility to these factors (Table 5) was measured by the respondents' expression of their knowledge towards biogas technology. Those who knew nothing about biogas technology were considered to have no access to information. Those who had just heard about biogas but had no details of it were considered to have little access. Respondents with moderate access were

those who could explain about the technology, at least what it is and how it functions. This group constitutes of mainly users of the technology who could give little information about biogas technology. Those who could give detailed information about biogas technology, and could explain about obstacles and how to overcome these as well as some technical aspects, were considered to have big access.

Access to the above-mentioned factors has a great impact on peoples' knowledge, which in turn influences their attitude towards adoption of the technology. Access to the factors above can further be distinguished and has different impacts on household members, particularly men and women, due to different roles and gender relations as elaborated in Section 3.4. Biogas technology, being capital-intensive, needs institutional support services for information dissemination as well as material and financial support. This support can be provided through extension services, rural energy programmes and financial institutions. This has a direct link to government policies and their implementation strategies to support efforts directed towards the development of alternative energy technologies such as biogas. However, as revealed by Sawe (2009), the Tanzanian energy policy is missing a statement that directly promotes biogas technology as an alternative energy source, hence no clear strategies are in place to develop the biogas sector. Nevertheless, new hope can be cherished due to the recent efforts to establish the National Biogas Programme. This follows the introduction of Biogas for Better Life Africa Initiative, a programme which aims at coordinating and promoting biogas activities in the country.

Table 5. Respondents' access to support services for biogas technology adoption

Factors	Non-adopter N=241	Adopters N=79	Total N=320
Access to knowledge			
No access	61.0(147)	2.5(2)	45.6(149)
Little access	37.8(91)	60.8(48)	43.4(139)
Moderate access	0.8(2)	31.6(25)	8.4(27)
Big access	0.4(1)	5.1(4)	2.6(5)
Total	100.0(241)	100.0(79)	100.0(320)
Access to credits and or subsidies			
No access	67.6(163)	3.8(51.9)	51.9(166)
Little access	29.5(71)	51.9(41)	35.0(112)
Moderate access	2.5(6)	39.2(31)	11.6(37)
Big access	0.4(1)	5.1(4)	1.6(5)
Total	100.0(241)	100.0(79)	100.0(320)
Access to district council encouragements			
No access	75.9(183)	69.6(55)	74.4(238)
Little access	24.1(58)	30.4(24)	25.6(82)
Moderate access	0.0(0)	0.0(0)	0.0(0)
Big access	0.0(0)	0.0(0)	0.0(0)
Total	100.0(241)	100.0(79)	100.0(320)
Access to demonstrations			
No access	87.1(210)	0.0(0)	65.6(210)
Little access	11.2(27)	72.2(57)	26.3(84)
Moderate access	1.2(3)	21.5(17)	6.3(20)
Big access	0.4(1)	6.3(5)	1.9(6)
Total	100.0(241)	100.0(79)	100.0(320)
Access to advertisements			
No access	60.6(146)	16.5(13)	49.7(159)
Little access	37.3(90)	68.4(54)	45.0(144)
Moderate access	2.1(5)	12.7(10)	4.7(15)
Big access	0.0(0)	2.5(2)	0.6(2)
Total	100.0(241)	100.0(79)	100.0(320)

SOURCE: Compiled from fieldwork data.

3.4. Involvement of Men and Women in Biogas Activities

Table 6 indicates the responsibilities and involvement of men and women in biogas activities at the household level, which is assumed to influence adoption or non-adoption of the technology. As the data presented in the table show, 75 per cent of the respondents indicated that women were the ones responsible for ensuring availability of domestic energy in the household, compared to 15 per cent who indicated that men could also ensure availability of domestic energy. However, 62 per cent of the respondents in the study indicated that decision-making concerning biogas adoption was done by men, compared to 15 per cent who said it was done by women. These results tally with other studies (Dutta 1997; Ngwandu, Shila and Heegde 2009; Schmitz 2007), which indicated that traditionally, the male dominates in decision-making in households as well as in ownership of resources. This implies that if a man, who is a decision-maker and controller of household resources, is not convinced or not willing to adopt biogas technology, he will decide not to adopt it. The results further imply that women being responsible of ensuring availability of energy for domestic use would prefer biogas technology as an alternative energy but its adoption is determined by a man, who is not directly affected by energy problems like a woman.

Table 6. Gender-based involvement and responsibilities in biogas at household level

Activity/responsibility	Bahi N=159	Kongwa N=161	Total N=320
Who ensures availability of energy?			
Husband	7.5(12)	23.0(37)	15.3(49)
Wife	83.0(132)	66.5(107)	74.7(239)
Husband and wife	9.4(15)	10.6(17)	10.0(32)
Total	100.0(159)	100.0(161)	100.0(320)
Who owns the biogas plant?			
Husband	63.3(19)	61.2(30)	62.0(49)
Wife	10.0(3)	16.3(8)	13.9(11)
Husband and wife	26.7(8)	22.4(110)	24.1(19)
Total	100.0(30)	100.0(49)	100.0(79)
Who decided on biogas adoption?			
Husband	60.0(18)	63.3(31)	62.0(49)
Wife	13.3(4)	16.3(8)	15.2(12)
Husband and wife	26.7(8)	20.4(10)	22.8(18)
Total	100.0(30)	100.0(49)	100.0(79)

SOURCE: Compiled from fieldwork data.

The findings revealed that women were obliged to ensure fuel availability in the household through firewood collection. This was enforced by women's role of cooking and family care, in general. Similarly, for the households which had adopted biogas technology, women were bound to do most of the activities related to biogas plant operations.

Furthermore, women being the users and expected beneficiaries of biogas technology, they are the ones who carry out most of the activities related to biogas plant operations. The daily activities for operating the biogas plant, as mentioned by a MIGESADO informant, include collecting feedstocks and water, filling the plant, cleaning the mixing pit, agitating the contents in the digester, checking the gas pressure and gas-holder contents, and checking the appearance and odour of the digested slurry. Weekly or monthly activities include removing the digested slurry; cleaning and inspecting gas appliances; checking the gas valves, fittings and appliances for leaks; and inspecting the water traps. Collecting feedstocks and fetching water for feeding the biogas plant, mostly performed by women and girls, involves labour and time, depending on availability and distance from source.

These activities, to some extent, were perceived by women to be as laborious as woodfuel collection, hence making no difference in their daily routines. Unfortunately, women were less involved in decision-making concerning biogas, did not own biogas plants and also lacked knowledge on biogas due to illiteracy and little exposure to information systems. All these reasons made women reluctant to understand biogas issues and therefore did not experience the expected benefits from biogas technology, thus leading to non-sustainability of the technology. This is contrary to the MIGESADO project, which aimed at making biogas technology beneficial to women, say, by relieving women of firewood collection, an exercise which is tiresome and time-consuming as it affects both women's health and their efficiency in other productive work.

It was further revealed by women during focus group discussions that men were mostly the ones who attended village meetings and seminars during the dissemination of biogas technology in the area. This is due to the fact that women are occupied with household chores. This finding is supported by Clancy *et al.* (2011) who observed that the greater range of women's tasks and responsibilities have implications on their capacity to participate in activities such as meetings and take-up opportunities. During household interviews for this study, it was further observed that women who were expected to be more conversant with explaining biogas operations as they were the ones who performed most of the activities, surprisingly, however, were not confident to do so. Instead, the explanations were given by men. In the absence of men, women would ask their school-going children to give explanations to the researcher about biogas plant operations. This indicated that women were inadequately trained on biogas issues, a fact that has contributed to their having little or no knowledge, hence lack of

confidence and interest in biogas technology. Women's multiple roles and household tasks tend to limit them in acquiring such beneficial knowledge. This suggests the need for alternative ways of reaching women in order to make them acquire knowledge on biogas technology and also points to the need to relieve them of household chores for sustainability of biogas technology.

Men who had adopted the technology further reported some cases in biogas operations whereby women and children were reluctant or showed no interest. This might be due to either lack of involvement of women from the early stages of adoption of the technology, or lack of knowledge or interest resulting from unrealised benefits of the technology. Lack of interest on the part of women, the main actors in biogas plant operations, has a negative implication on sustainability of biogas technology, which ultimately results in continued use of wood-based sources, hence continued depletion of environmental resources. From focus group discussion, women respondents expressed the reasons for continued use of woodfuel as the main source of energy for domestic use. The major reason was attributed to inadequate cooking power due to little gas production and its inability to last long. The size of cookers was also reported by respondents as too small to support large cooking utensils for large families. This finding tallies with Cecelski's (2000) observation that women are assumed to be a homogenous group, and largely passive beneficiaries of biogas, while in actual fact, they are not. Little consideration is paid to women's interests, time and labour involved in biogas plant operations. The differences between women and men, as Clancy *et al.* (2011) observed, pose challenges for ensuring equity in access to and benefit from alternative energy technologies.

Except for decision-making and ownership of biogas plants, all other activities related to biogas plant operations that require both energy and time were carried out by women rather than by men (Table 7). These activities include collecting animal dung, fetching water for biogas plants, and cleaning and feeding the biogas plant.

Table 7. Gender involvement in biogas-related activities at household level

Activity/responsibility	Bahi N=159	Kongwa N=161	Total N=320
Who collects feedstocks for biogas plant?			
Husband	20.0(6)	24.5(12)	22.8(18)
Wife	53.3(10)	55.1(27)	54.4(43)
Husband and wife	26.7(8)	20.4(10)	22.8(18)
Total	100.0(30)	100.0(49)	100.0(79)
Who fetches water for biogas plant?			
Husband	16.7(5)	14.3(7)	15.2(12)
Wife	60.0(18)	67.3(33)	64.6(5)
Husband and wife	23.3(7)	18.4(9)	20.3(16)
Total	100.0(30)	100.0(49)	100.0(79)
Who cleans and feeds the biogas plant?			
Husband	13.3(4)	18.4(9)	16.5(13)
Wife	53.3(16)	51.0(25)	51.9(41)
Husband and wife	33.3(10)	30.6(15)	31(25)
Total	100.0(30)	100.0(49)	100.0(79)
Who carries bio-slurry to the farm?			
Husband	50.0(15)	46.9(23)	48.1(38)
Wife	20.0(6)	16.3(8)	17.7(14)
Husband and wife	30.0(9)	36.7(18)	34.2(27)
Total	100.0(30)	100.0(49)	100.0(79)

SOURCE: Compiled from fieldwork data.

This implies that women, who are bound to ensuring availability of energy for domestic use, are also responsible for operating biogas plants, a technology which was hoped to relieve them from the task of firewood collection. However, during focus group discussions, it was revealed by women that where distances to water sources are longer, biogas operation activities are as laborious and time-consuming as firewood collection. Such situations negatively affect the decision to adopt the technology. However, according to available literature, biogas technology does not only offer energy for cooking; it also has other advantages such as waste management, power for lighting, and slurry production, which serves as a

fertiliser and as an agent in reducing greenhouse gases as mentioned in the background information of this study. These additional benefits seem not to have been clearly emphasised by project developers as their major focus was on energy issues. It should be noted that biogas technology cuts across several disciplines such as agriculture, health and education. To explore its benefits comprehensively requires inter-sectoral cooperation. This calls for more education, especially to women who are the major actors, on the multi-benefit nature of biogas technology, which differentiates it from other alternative energy technologies.

The above observations, namely the combined effect of decision-making systems, ownership of household resources, knowledge of biogas technology, and activities related to biogas plant operations, have negatively influenced women's attitude towards biogas technology, including their participation in biogas plant operations. This resulted in unattended biogas plants, which in turn contributed to non-functioning biogas plants, hence impeding sustainability of biogas technology. This finding tallies with that of Dutta (1997), who found that little involvement of women in renewable energy programmes in India was the major barrier to acceptability of technologies.

Another observation concerning gender and biogas adoption was that; men who had adopted biogas technology were willing to involve themselves in cooking the work which in many African cultures is normally perceived as women's. One man had this to say.

With biogas cooker, I can get into the kitchen and cook because there is no more smoke or soot.

This implies that adoption of biogas technology creates a friendly kitchen environment which motivates men's participation in house chores which in turn would relieve women from kitchen works and give them time to involve themselves in more productive works. On the other hand, this man's expression can be interpreted to mean the current cooking practices of using three stone fireplaces, accompanied by smoky environment, exposes women's health to risks than are men. This confirms what is realized in Millennium Development Goals that poor women are vulnerable to respiratory infections as they have high levels of exposure to indoor and outdoor air pollution.

Men also expressed their concern on the need for alternative energy, even though their priority was different from that of women. It was revealed during focus group discussions that men particularly in rural areas need alternative sources of power for purposes like lighting, for small businesses, for radio and television and recharging their mobile phones. This difference of priority between men and women may have implication on adoption of biogas technology in relation to decision making system. Men who are decision makers might not opt for biogas technology if there were other alternatives for their purpose. This is supported by Clancy *et al*,

(2011) who observed that benefits from energy services are different between men and women and that energy services affect men and women differently because their activities differ. If gender equity is a goal of any energy intervention, it is important to ask who is experiencing what and therefore identify adjustments.

4. Conclusions and Recommendations

The current energy situation in Tanzania necessitates the need for alternative energy sources. The majority of Tanzanians (90 per cent) have no access to modern energy but depend on biomass as a major source of domestic energy. Overdependence on woodfuel use is associated with continuous loss of forest resources and increased distances to firewood sources, which in turn overburdens women, who are the major victims of domestic energy poverty. Biogas technology has been operational in Tanzania for a considerable period of time but has not yet been adapted to expected levels. The findings of this study reveal that despite the need for alternative energy sources, the potentiality of biogas technology and favourable conditions has been low in central Tanzania, ranging from 0.09 to 0.5 per cent. This rate reflects that the technology has been adopted by few innovators. Several factors have been linked to the low adoption of biogas technology. However, this study mainly focused on gender relations and their influence on accessibility and adoption of biogas as an alternative energy technology.

From the findings of the study, the majority of respondents had little or no knowledge of biogas technology, implying that the greater proportion of the rural population has no access to information and other support services regarding alternative energy technologies. Even biogas users claimed to have little knowledge on operations of biogas plants as well as on emerging obstacles and how to overcome them. Lack of knowledge or little access to knowledge may have negatively affected people's attitude towards biogas technology as was manifested by their unwillingness to invest in the technology. From the findings, only 25 per cent of the respondents showed a willingness to invest in biogas technology, while the remaining 75 per cent expressed interest in investing in other activities.

The findings also revealed gender stereotyping in access to information and knowledge, resource ownership and decision-making on alternative energy technologies such as biogas. Women were obliged to ensure fuel availability in the household, through firewood collection. Similarly, for the households which had adopted biogas technology, women were bound to perform most of the duties related to biogas plant operations. This was enforced by women's roles of cooking and family care, in general. Biogas-related activities, to some extent, were perceived by women to be as laborious as woodfuel collection, hence making no significant difference in their daily routines. Unfortunately, women were less involved in decision-making concerning biogas, did not own biogas plants and also lacked

knowledge on biogas due to illiteracy and little exposure to information systems. Men, on the other hand, were the decision-makers and attended seminars and training sessions on biogas, though they are not fully engaged in biogas operations as women.

Furthermore, women's tasks and responsibilities have limited their participation in energy programmes, hence they are not fully informed about biogas operations despite their obligations to attend to the biogas plants. All these reasons — non-involvement of women in decision-making, little access to information on bio-gas, and being overburdened by domestic chores — have negatively affected women's capabilities and attitude towards biogas technology, resulting in low interest and reluctance to adopt the technology. This, in turn, has deprived women of the opportunity to experience the expected benefits from biogas technology, something which eventually leads to non-sustainability of the technology. Unrealised benefits and unmet needs of women, particularly regarding design and size of cookers, resulted in abandonment of biogas plants, hence non-sustainability of the technology and continued use of woodfuel. As Clancy *et al.* (2011) argue, if gender equity is a goal for energy interventions, it is important to ask who is experiencing what, and why this is so, then make appropriate adjustments.

Findings further revealed differences in preferences between men and women on alternative energy technologies, with women focusing more on energy for cooking, while men appeared to be more interested in using energy for lighting and small business. This implies that if a man finds other cheaper alternatives to meet his needs, he will not decide to invest in biogas technology. This shows that gender equity has a significant influence on adoption of alternative energy technologies.

Based on study findings, it is recommended that energy intervention programmes and responsible government departments apply effective and gender-sensitive promotion approaches and continuous education to the community in disseminating and implementing energy projects. There is a need to implement awareness creation programmes designed to encourage and attract the target population to adopt biogas technology. For effective awareness creation, materials should be written in an understandable language, which for the Tanzania context is Kiswahili, as it is widely used throughout the country, including rural areas.

There is a need for a change of mindset in the community, particularly on decision-making processes and household division of labour, which overburdens women and deprives them of opportunities to express their needs. Decision-making and equal sharing of responsibilities by men and women is critical for the wellbeing of women and children. At household level, participation of all family members is highly recommended to avoid the perception held by women that biogas operations are as laborious as firewood collection. Project developers should emphasise on training of women due to the fact that women have valuable knowledge which needs

to be tapped and incorporated in the design of cookers, which will be more appropriate to their local environment. Experiences from other countries, such as India and Kenya, have shown that the involvement of women in all stages of technology development has contributed to high adoption and sustainability of energy projects. Furthermore, women are responsible for the operation of biogas plants, hence need to be acquainted with full knowledge for sustainability of the technology. Well-informed and well-trained women will encourage active participation and boost the confidence of women on alternative technologies. The use of women groups could be an easy and convenient way of disseminating information on alternative energy technologies. Though traditionally not decision-makers, women have convincing power and if well-informed and convinced of alternative energy technologies and their benefits, can influence their husbands to adopt these technologies. Gender equity is a key point and significant factor in addressing energy poverty. Access to information and other support services by local populations, particularly women, is vital for sustainability of alternative energy technologies.

References

- Abukhzam, M. and Lee, A. 2010. Workforce attitude on technology adoption and diffusion. *The Built and Human Environment Review*, 3: 60 –71.
- Biogas Works. 1999. Introduction to anaerobic digestion. Retrieved April 25, 2007, from <http://www.biogasworks.com>.
- Budlender, D. 2008. *The political and social economy of care: Contesting gender and class inequalities*. Tanzania Report 2. Geneva: The United Nations Research Institute for Social Development. Retrieved October 6, 2009, from <http://www.un.org/women>.
- Cecelski, E. 2000. 'The role of women in sustainable energy development. Subcontractor report'. Colorado: National Renewable Energy Laboratory.
- . 2004. 'Energy, environment and development. Re-thinking gender and energy: Old and new directions'. *Energia/EASE Discussion Paper*. Retrieved September 20, 2013, from www.energia.org/fileadmin/files/media.
- Chungu, A. S., Kimambo, C. Z. M. and Bali, T. A. L. 2008. 'Assessment of village-level sugar processing technology in Tanzania'. *Research Report No. 014 for REPOA*. Dar es Salaam: Mkuki na Nyota Publishers.
- Clancy, J., Winther, T., Matinga, M. and Oparaocha, S. 2011. *Gender equity in access to and benefits from modern energy and improved energy technologies. World Development Report, Background Paper*. ETC/Energia. Retrieved September 12, 2013, from www.norad.no/en.
- Corporate Tanzania. 2010. *Energy and solid minerals: The business trade and investment guide 2010/2011*. Dar es Salaam: Corporate Guides International Ltd.

- CONDRIT Ltda, 1995. 'Improvement and promotion of tubular biogas digester. Report to Coordination Farming Systems Program'. Dar es Salaam.
- Danielsen, K. 2012. 'Gender equality: Women's right and access to energy service. Inspiration paper in the run-up to Rio+20'. Denmark: Ministry of Foreign Affairs. Retrieved October 18, 2013, from <http://fromeu2012.dk/en/meeting>.
- Dutta, S. 1997. International network on gender and sustainable energy. *Energia News*, Issue 4. Retrieved November 11, 2009, from <http://www.google.co.tz>.
- Feder, G., Just, R. and Ziberman, D. 1985. Adoption of agricultural innovations in developing countries. A survey. *Economic Development and Cultural Change*, 33 no. 2: 255–298.
- Fontana, M. and Natali, L. 2008. Gendered patterns of time use in Tanzania. Public investment in infrastructure can help. Paper prepared for the IFPRI Project on Evaluating the Long-Term Impact of Gender-Focused Policy Interventions. Retrieved June 15, 2010, from <http://www.ids.ac.uk>.
- ISAT and GTZ. n.d. Biogas basics. *Biogas Digest*, 1. Retrieved October 4, 2007, from <http://www.gtz.de>
- Kambele, Z. 2003. 'Factors affecting the adoption of biogas technology as an alternative source of energy in rural Tanzania: A case study of Arumeru district, Arusha Region'. Ph.D. dissertation, University of Dar Es Salaam, Tanzania.
- Karlsson, G. 2003. Technical training for women regarding energy technologies. *UNDP Briefing Paper*. Retrieved October 15, 2009, from <http://www.sustainable-solutions.com/docs>.
- Kimambo, C. Z. M. 2002. *Appropriate technologies for renewable energy development in Tanzania*. Altoona: Rathaus Hamburg.
- Lotte, C., Malene, L. and Helle, K. N. 2004. Evaluation of small-scale biogas digesters in Turiani, Nronga and Amani, Tanzania. Integrated farming in human development. Proceedings of a workshop. University of Aarhus, Denmark. Retrieved March 5, 2007, from <http://www.husdyr.kvl.dk>.
- MIGESADO. 2009. 'Dodoma biogas and alternative energy project. Annual reports'. Dodoma, Tanzania.
- Mikkel, O. 2012. Gender equality, women's right and access to modern energy services. EU Sustainable Energy for All Summit, April 16, 2012. Discussion Paper No. 1. Retrieved October 18, 2013, from http://ec.europa.eu/europeaid/what/energy/sustainable/documents/discussion_paper_1_en.pdf.
- Nes, W. J. and Nhete, T. D. 2007. Biogas for a better life: An African initiative. *Renewable Energy World Magazine*, 10 no. 4. Retrieved July 10, 2009, from <http://practicalaction.org/journal>.

- Nhete T. D. and Kellner, C. 2007. Biogas for better life in Africa. An African initiative, a synopsis of lessons from past and present programmes to disseminate biogas technology in Africa. Retrieved September 4, 2010, from [http://www.snvworld.org/en/Documents/20070913%20Article%20on%20the%20Biogas%20Africa%20Initiative%20in%20Renewable%20Energy%20World%20\(1\).pdf](http://www.snvworld.org/en/Documents/20070913%20Article%20on%20the%20Biogas%20Africa%20Initiative%20in%20Renewable%20Energy%20World%20(1).pdf).
- Ng'wandu, E., Shila, L. C. and Heegde, F. E. W. 2009. *Tanzania domestic biogas programme: Programme implementation document*. The Hague: SNV.
- Rajeswaran, K. 1983. 'Simple energy technology biogas utilization in Tanzania'. *Service paper No. 83/4*. Paper presented at IRA Seminar, May 24, 1983, University of Dar es Salaam, Tanzania.
- Rural Energy Agency (REA). 2008. Annual report for the financial year ended June 30, 2008, Dar es Salaam.
- Rogers, E. M. 1995. *Diffusion of innovation*. 4th Edition. New York: The Free Press.
- Sawe, E. N. 2009. Sustainable charcoal production for poverty reduction in Tanzania. Paper on Bioenergy for Sustainable Development in Africa. Brussels, Belgium. Retrieved October 19, 2010, from <http://www.tatedo.org>.
- Simon, M. M. S. 2006. 'Adoption of rotational woodlot technology in semi-arid areas of Tanzania: The case of Tabora region.' Ph.D. thesis, Sokoine University of Agriculture, Morogoro, Tanzania.
- Schmitz, T. 2007. Feasibility study for a national domestic biogas programme in Tanzania. Eschborn: GTZ.
- United Republic of Tanzania (URT) 2003. *National energy policy*. Ministry of Energy and Minerals, Dar es Salaam, Tanzania.

CHAPTER SEVEN

Cooking Fuel in Sudan: Utilisation Patterns, Health Hazards and Cleaner Fuel Adoption

Yahia Omar Adam

Abstract

The study objectives were to: (i) investigate to what extent the utilisation patterns of cooking fuels vary by fuel type, economic status, family size, and location (urban/rural); (ii) identify health hazards involved; and (iii) recognise the main factors that influence cleaner fuel adoption by households. Cross-tabulation and multinomial logistic regression methods were used to draw data from the Sudan Household Health Survey of 2006. The results revealed that traditional biomass dominates the fuel portfolio by 72.4 per cent. The health risks among women and children appeared as associated externalities. The study results also indicated that assets poverty was the main factor that hindered adoption of cleaner fuels by households. Fuel choices were also determined by other factors such as demographic characteristics of the household, and status and location of dwelling unit. The study recommends that other factors, besides income, need to be investigated in order to effectively manage available energy resources as well as coordinate efforts of policy institutions.

Keywords: Gender-energy nexus, biomass fuel, health hazards, clean fuel, Sudan

1. Introduction

The energy balance of developing countries is dominated by biomass, particularly traditional solid biomass (firewood, charcoal and residuals). It is estimated that 2.5 billion people in developing countries, especially in rural areas, still utilise traditional biomass for cooking and heating (World Energy Outlook 2006). In many countries, traditional biomass accounts for 90 per cent of the household's energy needs. Concurrently, the number of biomass users is expected to exceed 2.5 billion people, by 2015 (International Energy Agency [IEA] 2007). With increasing population and urbanisation, household energy use and carbon dioxide (CO₂) emissions have been an important issue globally, more so for the developing countries. The dependence on biomass as a source of fuel and income for households has profound and long-lasting negative impacts on forests. The utilisation of crop residuals for fuel indicates that they are not available as fertilisers; hence, this contributes to land degradation and low agricultural productivity. Furthermore, the adoption of biomass for cooking and heating increasingly constitutes a major health hazard for women in many

developing countries due to indoor pollution. These health hazards arise from the fact that women do most of the cooking (WHO 2002; IEA 2007).

Most households in Sudan, as is the case in other developing countries, depend on biomass as the main source of energy and income-generation. Nevertheless, the bulk of forest utilisation for biomass occurs in the dry and semi-dry areas, which have more than one-quarter of the country's forests (World Food and Agriculture Organisation [FAO] 2006). Therefore, deforestation has emerged as a policy issue in Sudan. Recently, it has been indicated that 84 per cent of biomass fuel is consumed by the household sector in Sudan (FAO 2005), where the pattern of consumption varies by location. For instance, firewood is the main source of energy for rural households whereas charcoal is more frequently used by urban residents. The burning of firewood and crop residuals using traditional inefficient stoves releases heavy smoke with toxic pollutants. Women and children are exposed to these health hazards, mainly in rural areas. Due to these hazards, the Sudan government invests in clean energy, such as electrification, gasoline and liquid petroleum gas, and fuel-efficient stoves programmes.

The literature on the energy sector in Sudan is limited. The main themes explored relate to the investigation of macro-energy balance (Pearce, Edward and Anil 1990; Yousif 1995; National Forest Inventory for the Sudan 1996; National Forests Corporation/Food and Agricultural Organisation [FAO] (1994). Other studies have focused on the development and efficient utilisation of alternative energy potentials (Omer 2001, 2003, 2007). The possible health hazards associated with the utilisation of firewood have also been highlighted by some scholars (Hood, Ahmed and Sidi 2004; Malla *et al.* 2011; Pope *et al.* 2010; Bruce *et al.* 2006; Grieshop, Marshall and Kandlikar 2011). Additionally, policy interventions in the household's energy sector broadly depend on combating desertification and deforestation through influencing demand transition from woody biomass towards modern fuel options. However, such transition, aimed at reducing the pressure on forest resources, is conditioned by the adoption rate with little attention paid to demand characteristics of rural communities, especially women. Changes in the availability of energy due to policy interventions have different impacts on gender. Generally, the adoption of modern fuels, such as liquid propane gas (LPG) and electricity, which are clean, efficient and convenient, is not only constrained by fuel costs but also by relatively high start-up costs of connection, availability of cooking utensils, stability of the supply source, and level of access. Therefore, gender requires to be taken into account when developing energy policies. Additionally, household traits, including initial endowment, may also affect the adoption of modern fuels. Thus, understanding of usage patterns, health hazards, and factors influencing the household's fuel decisions is crucial for designing public policies aimed at stimulating the adoption of clean, sustainable cooking fuel energy.

The research drew data from the Sudan Household Health Survey (SHHS) conducted in 2006, to provide a descriptive analysis of the households' fuel preferences (Central Bureau of Statistics 2006). The SHHS total sample size was 25,000 households in the 25 states of Sudan. Finally, 24,553 households were found occupied, of which 24,046 households were successfully interviewed with 146,723 listed individual members. Overall, the survey contained the most recent and detailed information on key socioeconomic and demographic variables, covering a wide range of topics. In particular, the instrument used by the SHHS consisted of five sets of questionnaires: (i) household questionnaire; (ii) women's questionnaire administered to all women aged 15–49 years in each household; (iii) under 5 years of age questionnaire, administered to mothers or caretakers of all children under 5 years of age living in the household; (v) community questionnaire; and (vi) food security questionnaire. The study variables were drawn selectively from these sets of questionnaires. The energy section of the survey contained 12 options on the primary cooking fuel used by the household. These were electricity, liquid propane gas, natural gas, biogas, kerosene, cool lignite, charcoal, wood, straw/shrubs/grass (henceforth straws), animal dung, agricultural crop residuals, and other fuel. The initial inspection of these fuel options revealed that liquid propane gas and natural gas can be aggregated into LPG as the latter variable contains less information to merit investigation as a separate option. The same applies to cool lignite and charcoal, which were aggregated into charcoal. The quality of dwelling was identified from data by the type of roofing. It was assumed that the dwellers of a house roofed by durable material such as metal, cement, fibre, concrete, shingles or brick avoid roof strain by adopting cleaner fuels. High ranking in the asset index (belonging to a relatively rich income quintile versus the poorest reference quintile) may also encourage use of clean fuel. This variable is used to provide a test for the energy ladder hypothesis.

Graphical and cross-tabulation analyses were applied to provide an overview of the households' fuel preferences contained in the SHHS. The graphical analysis was used to describe the patterns of unconditional correlation between a given fuel adoption rate and selected households' characteristics, namely permanent income, location (urban/rural) as well as household size. Cross-tabulation was applied to explore the extent of exposure to the risks of indoor pollution among users of smokier fuels and non-users. The cooking habitat of the households and the reported cases of suspected pneumonia among children below five years of age were used as indicators of the risks of indoor pollution. The multinomial logistic modelling method was used to investigate the main factors influencing the choice of primary cooking fuel by the household.

The wealth index or permanent income index was recomputed for the households by applying the principal component analysis method to available information on 24 assets. These asset indicators were grouped

into: (i) 13 indicators on the household ownership of consumer durables (motorbike, bicycle, television, watch, radio, mobile, fixed telephone, computer, refrigerator, cooking utensils, cart, and car/truck); (ii) 6 indicators on the characteristics of household dwelling and landownership (2 about dwelling type, 2 about toilet facility, 1 about the number of rooms and 1 about landownership); (iii) 2 indicators on migration and employment status (employed and non-migrant); (v) 1 indicator on food security (the number of meals served per day); and (vi) 2 indicators on community assets (connection to water pipelines and connection to the internet).

The weights of the first component were used to obtain a measure for permanent income, assuming that the asset index captures the underlying long-term income, through information on household assets. The asset variables were coded 1/0 while the number of rooms and meals were numerically coded. The population of the households was divided into five quintiles, ranging from the poorest to the richest, according to their ranking on the permanent income scale. As the study data was limited to the estimation of a household fuel demand system based on macroeconomic behaviour, multinomial logistic regression was applied instead to investigate the main predictors of fuel choices. Though less attached to economic theory, this method has advantages in terms of estimation and data fitting. The theory of random utility provides the conceptual framework for the econometric modelling of the choice behaviour from a set of exclusive alternatives (McFadden 1981). The multinomial logistic model is estimated with eight fuel options — LPG, biogas, kerosene, charcoal, firewood, straws, dung, and crop residuals. The dependent variable is the given fuel choice and LPG is the reference category. The estimated binomial logit equation for electricity to initialise the multinomial logistic (MNL) failed to converge. Thus, it is aggregated with LPG as both belong to the group of modern cleaner fuels (henceforth referred to as LPG).

This chapter is organised into four sections. Following the introductory section, section two outlines the conceptual framework of the study. Section 3 presents the study findings and discussion. Finally, section 4 presents conclusions and recommendations.

2. Conceptual Framework

Household fuel choice and demand have been often conceptualised in terms of the energy ladder model, whereby more diversified choices and demands for fuel sources are predicted in terms of the nature of the appliances used and the purpose, as income increases. The model purports to explain both fuel choice and switching in relation to income growth (Foley 1995; Heltberg 2005; Mekonnen and Köhlin 2008). It perceives that with low income, biomass tends to dominate. As income rises, and due to the pressure of deforestation and urbanisation, households tend to adopt

“intermediate” fuels such as kerosene, charcoal and coal. In the third stage, households switch to cleaner and more efficient fuels, such as LPG and electricity, as their income is sufficient (Leach 1992). However, the linear relationship between income and energy demand and preferences, as upholds in the ladder hypothesis, have been criticised as being simplistic because factors other than income could equally elucidate fuel choice and demand. For instance, a pure demand effect is associated with increasing income, which will result in substitution due to convenience and changing uses over time. Supply factors will also play a role as scarce fuels have higher prices and are less available. Additionally, households may not switch completely from one fuel to another as income increases, but instead use a combination of modern and traditional fuels, and stack fuels for specific purposes (Barnes and Qian 1992; Davis 1998). While this is acknowledged in the literature, Heltberg (2005) notes that the relative merit of fuel-switching versus fuel-stacking is not yet known. He also argues that the motivation for fuel-stacking is less obvious. Nonetheless, specialised uses for certain fuels due to tasks, cooking technology and taste may provide an explanation for fuel-stacking, and to the extent that fuel-stacking is the norm, policies promoting cleaner fuels may not displace the traditional ones, hence may generate fewer benefits than hypothesised.

The literature on fuel choice shows that many factors, other than income, could affect a household’s fuel adoption decisions. Chief among these are the household size, gender composition, location, cooking habitat, age, education, availability of alternative fuels, and accessibility, including cooking utensils as well as the degree of development of fuel markets and wage labour market. Many studies draw on the household economic theory in order to fully accommodate these factors, especially in situations where fuel production and consumption are interlinked or markets are imperfect or missing. According to this framework, households maximise utility, with consumption of final goods, leisure and fuel attributes as arguments, subject to consumption function constraints in cooking and other activities as well as time and income. Modern fuels are often financed from current cash budget while biomass may involve household labour for collection; hence the time and income constraints implicitly captured these opportunity costs (Amacher, Hyde and Joshee 1993; Heltberg, Arndt and Sekhar 2000; Gebreegziabher *et al.* 2010).

Gender analysis in energy has largely treated women as a homogeneous group, in terms of access to assets and other resources (Jyoti 1995). There has been a particular focus on poor rural women in much of the energy analysis. Survey information has sometimes provided some interesting glimpses of differences in energy consumption patterns by women, usually in terms of income or other attributes, rather than labour or social relationships. For instance, Barnes and Sen (2004) in a large sample survey in rural India found that women households consume more electricity than men, regardless of level of literacy or income. Additionally, in India,

illiterate women using biofuels were found by Parikh, Haimanti and Shyam (2003) to have a higher rate of respiratory diseases than those with primary education. In Ethiopia, women at lower income levels were found to adopt fuel-saving practices (such as soaking legumes) that went against traditional norms, while higher-income women limited themselves to practices, such as using the fire consecutively for different practices, that were considered part of the traditional concept of the ideal woman (Cecelski 2004).

3. Findings

Based on the SHHS question on fuel options, a number of observations were drawn. Firstly, solid fuel, which includes wood, charcoal, crop residuals, straws, dung, and crop residuals, is the primary source of cooking energy in Sudan, as reflected by 72.4 per cent of the responses. This figure is only marginally less than the 74 per cent responses reported by the household sector in 1995 (Ministry of Environment and Physical Development 2003). This indicates a mere 1.6 per cent decline in the use rate of solid fuel, over more than a decade. For all the respondents, woodfuel contributed by 53.7 per cent to total household energy use, followed by charcoal, which contributed by 15.6 per cent. The patterns of woodfuel utilisation varied from 98.6 per cent in the less urbanised and forest rich states to 3.5 per cent and 8.1 per cent, respectively, in the relatively urbanised Khartoum and Gazera states. In contrast, charcoal use is concentrated in the more urbanised states, with Sinnar and Gadarif showing high rates of use (about 37 per cent each). Both states are adjacent to the big charcoal production areas in Sudan. Similar patterns of woodfuel and charcoal utilisation are found in studies by Arnold *et al.* (2003). Secondly, the utilisation of non-biomass and relatively cleaner cooking fuel alternatives, namely LPG, biogas, kerosene and electricity combined, accounted for only 6.7 per cent of cooking energy consumption in Sudan, in 2006. The pattern of demand for these fuels remains highly concentrated in two states, Khartoum and Sinnar, which jointly consumed about 50 per cent of these fuels in the same year.

Finally, the option of “other fuel” generated relatively large responses, representing 19.7 per cent of the total responses. Since the list of fuel options in the survey questionnaire was rather exhaustive, it seemed that the category of “other” represents situations of fuel-stacking, whereby the respondent was unable to decide on a primary fuel. This appears plausible because positive responses to this option concentrated in three states, Khartoum, Gazera and River Nile, which are more urbanised with a relatively developed market for cooking fuels. Nonetheless, this option is dropped along with a missing category, leaving 19,716 valid observations for the subsequent analysis. Existing switching policies need to acknowledge the continued dependence on biomass as well as the possibility of the existence of considerable fuel-stacking. This implies that other complementing policy is needed in order to improve the efficiency of

utilisation of dominant fuel sources. Although the use rate of woodfuel declines as income increases, it remains relatively high for the rich; and it averages at 67 per cent for all income quintiles and about 44 per cent among the richest income quintile.

Additionally, both charcoal and LPG steadily increased with the level of income for all income quintiles, averaging about 20 per cent and 7 per cent, respectively. However, none of these fuels overtake firewood, even for the rich quintile. The average adoption rate of charcoal, wood and LPG in urban locations is 41.40 per cent, 39.30 per cent and 15.10 per cent, respectively, while the corresponding rate for rural users is 12.10 per cent, 78 per cent and 4.70 per cent, respectively. The response of woodfuel to income growth was less uniform for urban users compared to rural users. Woodfuel use peaks as the dominant fuel for the middle income quintile and sharply declines afterwards. Charcoal tends to uptake woodfuel, starting at an income level beyond the middle income quintile, and it dominated urban fuel usage thereafter. The LPG usage rate is notably increasing as from the second income quintile, but remains relatively low except for the rich where it clearly uptakes woodfuel for this quintile.

Figure 1 shows that the utilisation of woodfuel decline with income growth, yet woodfuel remains the main cooking energy source for the rural population. No other fuel displaced the given options per income quintile, implying that fuel-switching is likely to be less responsive to income among rural dwellers. The abundance of wood sources in Sudan and the relatively low collection cost seem to explain the dominance of woodfuel. Charcoal is the leading fuel among urban dwellers, particularly for the high income quintiles. The uptake of LPG is rather limited for all cooking fuel users, suggesting that policies for fuel-switching also need to address factors relating to the aggregate supply side of the LPG in addition to end user-price subsidy. The adoption rates per income quintile of the major fuels (woodfuel, charcoal and LPG) against household size were depicted in Figure 1. Although the household size is not directly linked to fuel choice, it appears that the mean size is higher for wood users followed by charcoal and LPG. This implies that the availability of household labour generally encourages the utilisation of biomass, especially woodfuel. Figure 1 also shows that the mean household size per income quintile varies considerably for a given fuel option. Part (a) of the figure suggests that the poorest quintiles belong to large size households and tend to adopt woodfuel more frequently compared to the richest quintiles at the upper end of the income scale. Parts (b) and (c) show the reverse patterns for charcoal and LPG. That is to say, the richest fourth and fifth income quintiles trend to use LPG and charcoal more frequently in comparison to other income quintiles belonging to large size households at the lower end of the income scale. These observations imply that, household size matters for fuel choice in Sudan. However, whether the household size raises the adoption probabilities for all fuels, or only for particular fuels, needs formal testing.

Part (a) also suggests that woodfuel is relatively prevalent among the richest quintiles in the fourth and fifth income quintiles. Similar observations are found in other literature and a number of explanations have been offered to account for this. For example, Bardann *et al.* (2010) found that the absence of the supply of cleaner fuel was a crucial determinant of adoption of solid fuels in Nepal. In addition, woodfuel may be encouraged due to the taste or texture it gives to food or due to the preference for certain traditional cooking techniques (Heltberg 2003).

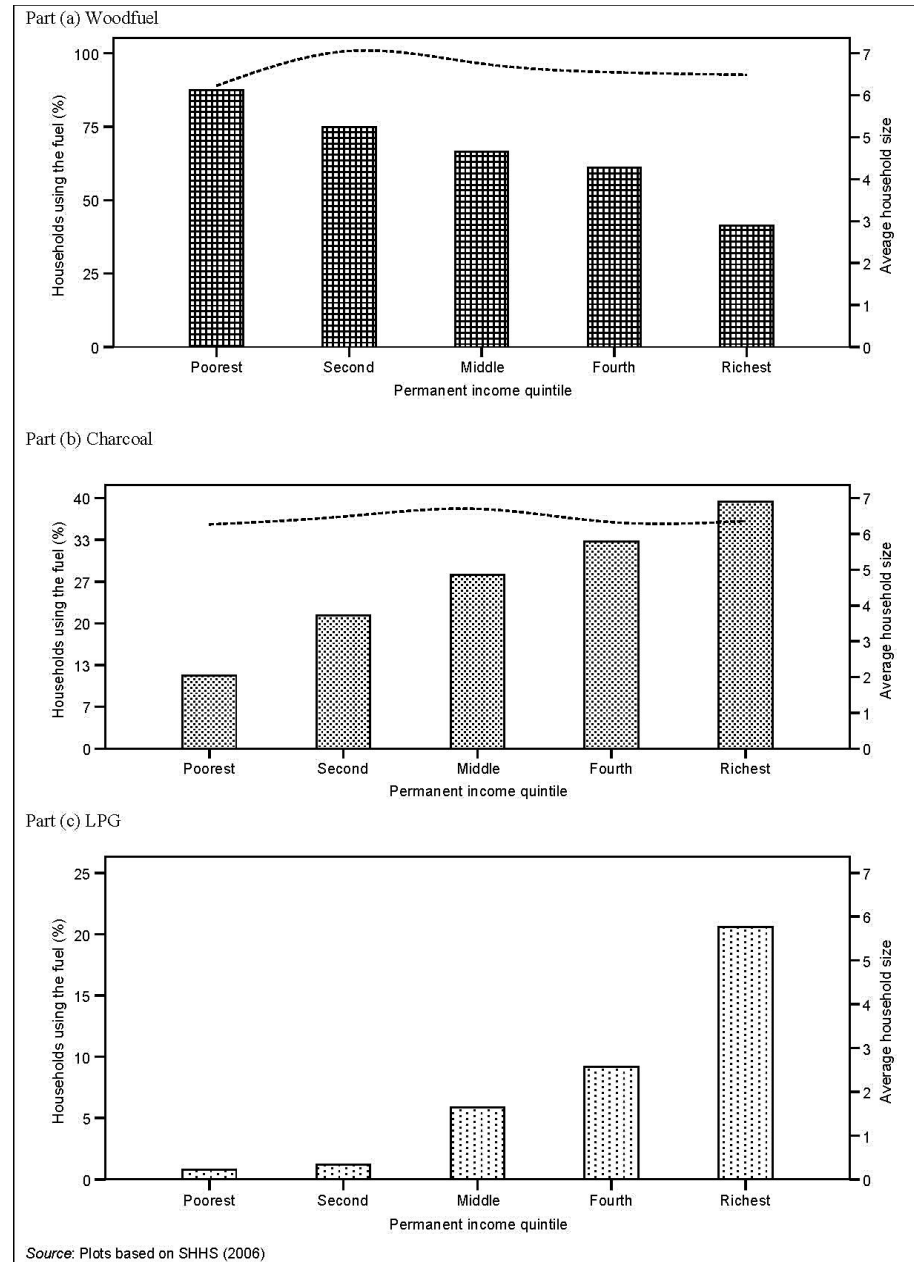


Figure 1: Utilisation of Major Fuels: Woodfuel, Charcoal and LPG

SOURCE: Adapted from the Sudan Household Health Survey by CBS (2006).

The adoption of biomass for home use is as old as humankind, but over time it has become a source of health concerns due to the increasing awareness about its risks, especially indoor pollution. More recently, a report by WHO (2002) indicates that indoor air pollution is responsible for 2.7 per cent of the global burden of diseases. The IEA (2007) estimates that, annually, 1.6 million women and children die from exposure to indoor pollution. There is limited information on the level of indoor pollution from biomass use in Sudan. However, the SHHS by CBS (2006) data on cooking fuels utilisation and the household cooking habitat can give an indication on the extent of indoor pollution. In general, dwellers of a household, where cooking with biomass takes place more frequently in all-purpose rooms, are most exposed to the risks of indoor pollution, depending on the duration of cooking and quality of ventilation. Cooking in a separate room, such as a designated kitchen, represents an intermediate level of risk. A variable binning the smokier fuels (firewood, straws, crop residuals, and dung) is constructed and cross-tabulated with the predominant cooking habitats, namely cooking in an all-purpose room, in a separate room and in the open (outdoors). Table 1 shows the results.

Table 1. Smokier fuels usage and cooking habitat

Cooking habitat					
Smokier fuel adoption	(1)	(2)	(3)	(4)	(5)
National					
Use smokier fuel	14.8	27.6	24.1	66.5	19.96
Not use smokier fuel	2.5	24.6	6.4	33.5	10.10
Total	17.3	52.2	30.5	100.0	30.06
Urban					
Use smokier fuel	8.8	15.4	12.5	36.7	3.33
Not use smokier fuel	4.4	47.9	11.0	63.3	5.72
Total	13.4	63.3	23.5	100.0	9.05
Rural					
Use smokier fuel	17.4	32.8	29.1	79.3	16.63
Not use smokier fuel	1.7	14.6	4.4	20.7	4.33
Total	19.1	47.4	33.5	100.0	20.96

SOURCE: Calculations based on the Sudan Household Health Survey (2006).

Note: Column headings are as follows: (1) All-purpose room %; (2) Separate room %; (3) Outdoor %; (4) Total %; (5) Population in millions.

As appears in Table 1, about two-thirds of the population countrywide utilises smokier fuels for cooking. More than 17 per cent of these people live in households that cook in all-purpose rooms. The level of risk associated with exposure to emissions of carbons and other particulate matter is very high for this group of people. Additionally, 27.6 per cent of

those who cook in separate rooms are exposed to these risks, depending on the duration of cooking, quality of ventilation and number of attending household members. Generally, women do most of the cooking in Sudan as a matter of culture; hence, they are more likely to inhale more smoke than men. Children tend to be indoors with their mothers and are more likely to develop diseases resulting from a given level of exposure, especially among low-income quintiles.

Table 1 shows that the patterns of utilisation of smokier fuels and cooking arrangement vary considerably by household location. The proportion of rural households adopting smokier fuels is very high compared to urban households (79.3 per cent versus 36.7 per cent). Cooking in the kitchen and outdoors is more frequent among rural households than urban ones; the combined percentages are 61.9 per cent and 27.9 per cent, respectively. This may partly compensate for risks of exposure. However, the proportion of those who cook in all-purpose rooms remains very high in the rural areas, compared to urban areas (17.4 per cent and 8.8 per cent, respectively). Similar patterns of use of smokier fuels by cooking arrangement for urban and rural dwellers are found in other comparator countries. See for instance, Heltberg (2005) for Guatemala, Heltberg (2003) for a group of developing countries and Jack (2004) for Peru.

The SHHS collected information about child-suspected pneumonia (acute respiratory infection) during the last two weeks before the survey. The prevalence rate of suspected pneumonia was 12 per cent among the age group below five years of age, who accounted for about six million of the national population. Table 2 presents the distribution of children suspected to have pneumonia, by cooking habitat and location of households. Countrywide, the incidence of suspected pneumonia infection is very high among users of smokier fuels (68.1 per cent), compared to 31.9 per cent among non-users. Rural children appear to suffer most from exposure to smokier fuels. The incidence of suspected pneumonia among users of smokier fuels relative to non-users in the rural and urban areas is 75.7 per cent and 50.9 per cent, respectively (Table 2). In addition, the incidence of suspected pneumonia seems to be associated more with cooking in all-purpose rooms and in a kitchen, as an intermediate stage, which combined, accounted for 46.7 per cent and 33.6 per cent of the reported child cases among users of smokier fuels in the rural and urban areas, respectively (Table 2).

The distribution of children cases by income quintiles, based on the constructed asset index, is shown in Table 3. Overall, the number of children reported with acute respiratory infection appears to correlate marginally with the economic status of the household, as it declined by only 1.6 per cent for the richest compared to the poorest income quintile, with spike in the middle. Similar results are noted in the SHHS, despite the differences in the asset set used for the construction of asset index and the sampled households. The report also noted that under-reporting of child

cases tends to be higher among the poorest households. The percentage of mother/caretaker awareness of the danger signs of pneumonia is found to be higher among mothers in rich household (22.1 per cent) than in poor households (15.2 per cent).

Table 2. Suspected pneumonia among children by smokier fuels usage, cooking habitat

Cooking habitat	(1)	(2)	(3)	(4)	(5)
Smokier fuel adoption					
National					
Use smokier fuel	13.8	28.9	25.4	68.1	400.02
Not use smokier fuel	3.5	18.8	9.6	31.9	187.40
Total	17.3	47.7	35.0	100.0	587.42
Urban					
Use smokier fuel	10.9	22.7	17.3	50.9	91.76
Not use smokier fuel	5.7	32.9	10.5	49.1	88.59
Total	16.5	55.6	27.8	100.0	108.36
Rural					
Use smokier fuel	15.1	31.6	29.0	75.7	308.25
Not use smokier fuel	2.5	12.6	9.2	23.3	98.81
Total	17.6	44.2	38.2	100.0	407.06

SOURCE: Calculations based on the Sudan Household Health Survey, 2006.

Note: Column headings are as follows: (1) All-purpose room %; (2) Separate room %; (3) Outdoor %; (4) Total %; (5) Number of children in thousands.

Notwithstanding these results, the patterns of the prevalence rate of child-suspected pneumonia vary considerably for the different income quintiles, by cooking arrangement. The infection rate is very high among households using smokier fuels in the poorest quintile (82.4 per cent and it drops with income rise to 56.4 per cent for users of smokier fuels among the richest). In addition, child infection concentrates among the poorest cooking with smokier fuels in all-purpose rooms. The reported cases account for 41.4 per cent of the total for this quintile and decline by more than two-thirds for similar users in the second quintile. A high per cent of households without separate kitchens (95.2 per cent) belongs to the poorest income quintile (Table 3). This can be partially explained by the asset index, which tends to place people with fewer rooms into this group.

Table 3. Suspected pneumonia among children by smokier fuels usage, cooking habitat

Cooking habitat					
Smokier fuel adoption by income	(1)	(2)	(3)	(4)	(5)
Poorest income quintile					
Use smokier fuel	41.4	8.3	37.2	82.4	94.81
Not use smokier fuel	11.8	1.0	4.8	17.6	20.16
Total	53.2	4.8	42.0	100.0	114.97
Second income quintile					
Use smokier fuel	11.9	31.1	30.4	73.49	92.10
Not use smokier fuel	6.4	14.8	7.2	26.6	33.28
Total	16.5	45.9	37.6	100.0	125.38
Middle income quintile					
Use smokier fuel	10.7	41.3	18.9	70.9	97.53
Not use smokier fuel	1.1	20.7	7.3	29.1	40.23
Total	11.8	62.0	26.2	100.0	137.76
Fourth income quintile					
Use smokier fuel	0.8	35.8	28.0	64.6	76.33
Not use smokier fuel	0.6	22.2	12.6	35.4	41.75
Total	1.4	58.0	40.6	100.0	118.08
Richest income quintile					
Use smokier fuel	0.1	38.2	18.1	56.4	59.21
Not use smokier fuel	-	28.9	14.7	43.6	45.84
Total	0.1	67.1	32.8	100.0	105.05

SOURCE: Calculations based on the Sudan Household Health Survey by CBS (2006).

Note: Column headings are as follows: (1) All-purpose room %; (2) Separate room %; (3) Outdoor %; (4) Total %; (5) Number of children in thousands.

The subsequent multinomial logistic regression results and their analysis describe the main determinants that could have influenced the household's decision to adopt a particular cooking fuel. Table 4 explores the household's main socioeconomic characteristics that are likely to affect fuel choice and the nature of their construction as well as their descriptive statistics. Most of the variables are often included in cooking fuel adoption and demand literature in developing countries. For instance, Hosier and Dowd (1987) and Farsi, Massimo and Shonali (2007) reported that the level of education of the household head (beyond primary level) encourages diversification out of smokier fuels due to improved awareness of associated risks and the relatively higher opportunity cost of fuel collection

among the educated households. Likewise, diversification is more likely for those dwelling in a relatively modern house, ranking high in the assist index, residing in urban area, and owning cooking utensils (Heltberg 2003, 2005; Mekonnen and Köhlin 2008).

Data presented in Table 5 reveal that more than 70 per cent of the estimated coefficients are statistically significant. However, before discussing these results, it is important to test for the robustness of the estimated model. A variety of specification tests in the context of the MNL had been proposed in the literature. The Hausman and McFadden (1984) specification test is the most common; it aims to detect departure from the independent and identically distributed (IID) errors assumption or the independence of the irrelevant alternative (IIA). Other tests include Cramer and Ridder's (1991) test for pooling alternatives in the MNL model as well as testing the validity of imposing linear and fixed restrictions on the coefficients associated with the explanatory variables. The IIA and pooling tests are primarily used in this study to examine the parsimony of the estimated model, whether the data underlying the estimation supports the specified model. The IIA property of the MNL model essentially implies that if a subset of the choice set is truly irrelevant, omitting it from the model will not change parameter estimates systematically. However, if the remaining odds are not truly independent of these alternatives, then the parameter estimates obtained when these choices are included will be inconsistent (Greene 2005). The IIA hypothesis is often imposed on choice behaviour as a minimum requirement for rationality (Ray 1973).

Table 4 contains the results of applying the Hausman and McFadden IIA test. As seen, some test statistics are negative. Hausman and McFadden (1984, 1226) noted, "We have occasionally found the test statistic to be negative", and concluded that this is strong evidence against rejecting the null hypothesis 1. Overall, two tests reject the hypothesis that the IIA holds, implying that the assumption of zero error covariance is violated and that the choice set may contain closer substitutes. In many applications, IIA assumption of the MNL is found to be too restrictive. Much of the literature in this area is concerned with alleviating this assumption. In particular, the nested logit model, the generalised extreme value, the multinomial, and the mixed logit are proposed as alternative models (Greene 2005). In addition, Kennedy (2003) provided a discussion of these basic ways for dealing with IIA. However, each of these modelling strategies has assumptions of its own, which appear difficult to meet with data available for this study. Another strand of literature questioned the power of IIA tests. For instance, Long and Freese (2001) indicate the fact that the results of the Hausman and Small-Hsiao IIA tests may provide little guidance on violation of the IIA condition. Even in a well specified model, IIA tests often reject the assumption when the alternatives seem distinct (Cheng and Long 2007). Perhaps, the best way to proceed is to follow McFadden's (1973, 113) advice that the IIA implies that the MNL model should be used in cases "... where the alternatives can plausibly be assumed to be distinct and weighed

independently in the eyes of the decision maker". However, as noted by Long and Freese (2001), identifying a model with distinct outcomes that are not substitutes seems reasonable; however, the advice is unfortunately ambiguous. Perhaps the ambiguity relates to the question of identifying the distinct outcomes on a priori basis. Furthermore, in some cases, researchers may be interested in examining the impact of introducing a new alternative, which often affects close substitutes.

Notwithstanding the preceding, the results of the IIA are taken to imply the existence of closer substitutes in the model. Cramer and Ridder's (1991) pooling test is used to identify the alternatives that could be further aggregated to establish a parsimonious model. The results of the pooling test are reported in Table 5. As it appears, the tests reject pooling of alternatives in the model. Clearly, compromises are inevitable for achieving model parsimony. Some of the marginal fuels could be merged in view of their very low share in total fuel portfolio and their relatively small scores in the pooling tests. Accordingly, a five-option model could be formulated by further merging biogas and kerosene with LPG, and aggregating dung and crop residuals together. These new categories are referred to, henceforth respectively, as liquid fuels, and dung and residuals. The results of estimating model (II) with the main fuel options are shown in Table 5. The IIA and pooling tests reveals that model (II) is reasonably specified (see Table 5). It should be noted that the IIA tests confirmed the robustness of the standard errors for certain misspecification of the distribution of the residuals of the utilities of different options, but not for heteroskedasticity. Hence, the reported standard errors are adjusted for unknown latent heterogeneity based on the "cluster-corrected" robust covariance matrix (Greene 2007). It should also be noted that such adjustment is warranted for a reasonably specified model.

The overall fit of model (II), in terms of the adjusted McFadden pseudo R-squared, is almost identical to the general model (I). R-squared in the respective models is 0.3014 and 0.3016, implying that about 30 per cent of the log-likelihood is explained by the model. It should be noted that such a low R^2 is typically observed in cross-sectional data with a large number of observations (Gujarati 2008). However, the value of t-statistic, which tests the null hypothesis that all the parameters of the given model have no effect, is highly significant, implying that R^2 is statistically significant and the given model is well-specified. Although the coefficients of models (I) and (II) are not linearly related, they are based on the same sample and explanatory variables, which furnish a base for their comparison. While R^2 is the same for both models, the other information criteria (AIC, SBC and HQC) indicate that the log likelihood is more efficiently estimated for model (II), where all these criteria declined by about one percentage point.

Thus, the following discussion focuses on the second model and only marginally refers to the general model, as far as this is relevant. Tables 4 and 5 present both models, respectively, the marginal effects at the sample

mean (MAEs) and the average marginal effects (AMEs) computed from each observation's marginal effect, with respect to an exogenous variable averaged over the entire estimation sample. Current practice favours the latter approach. However, the computation of the associated asymptotic standard errors is difficult; hence the standard errors of the former approach can be used instead (Greene 2007). Most of the estimation results are broadly in line with the prior expectations. As seen in both tables, the level of education of the head of household significantly affects the probabilities of fuel adoption predicted by model (II). Specifically, a movement from a household, whose head is without primary education, to a household whose head completed primary education, would on average increase the probability of adoption of modern fuels and charcoal by 0.06 per cent and 0.14 per cent, respectively, and it decreases the choice probabilities of firewood, straws and residuals by 0.19 per cent, 0.004 per cent and 0.01 per cent, respectively. Post-primary education relative to primary and lower levels involves even higher adoption probabilities of modern fuels and charcoal, while it reduces the likelihood of using firewood, straws and residuals. Since education is a crucial component of human capital and is expected to positively correlate with income, both the pattern and magnitude of the predicted fuel choice probabilities at various education levels appears to lend support to the energy ladder hypothesis. That is to say, as the level of education of the decision-maker in the household increases, the household generally moves up the energy ladder, from smokier fuels towards cleaner alternatives. The relatively higher predicted probabilities of charcoal in both models imply that it is an important intermediate fuel followed by liquid fuels up the energy ladder, in the Sudanese context. All the predicted average marginal effects for the various education levels are statistically significant when evaluated at their corresponding marginal effects at sample mean.

The demographic variables of the household included in the model are also important determinants of the choice of fuel sources. First, a one per cent increase in the size of the household tends, on average, to increase the probability of choosing firewood, straws as well as dung and crop residuals by 0.009 per cent, 0.02 per cent and 0.007 per cent, respectively; while it reduces the probability of adopting modern fuels and charcoal by 0.03 per cent and 0.006 per cent, respectively. All these average marginal effects are statistically significant at less than 1 per cent. Second, the AME of the age of head reveals that modern fuels are more likely to be adopted by younger heads; however, the MAE of age indicates that this may also be the case for charcoal. The corresponding AME and MAE for dung and crop residual options in models (I) and (II) are both negative but statistically insignificant. Third, female headship of the household seems to reduce the likelihood of adopting modern fuels (charcoal and firewood) and would increase the likelihood of choosing the marginal fuels (straws and dung/crop residuals). A change from male-headed to female-headed household would increase the probability of adopting straws and dung/crop

residuals by 0.01 per cent for both fuels and the associated AMEs statistically significant, whereas the other AMEs are negative but not significant. Fourth, a 1 per cent rise in the ratio of adult female in the household significantly reduces the probability of choosing modern fuels and charcoal by 0.07 per cent and 0.002 per cent, respectively, and increases the probability of adopting firewood by 0.08 per cent. The effect of female proportion is negative in the case of straws and positive for dung and crop residuals but statistically insignificant. Generally these results indicate that both the female headship of household and the relatively high ratio of adult female there are closely associated with poverty.

Overall, an increase in the number of adult females in the household appears to correlate with the use of smokier fuels. As noted earlier, this may be due to the tradition of *dukhan*, which could develop loyalty with smokier fuels. More importantly, it may be the case that an increase in the number of women in the household reduces the opportunity cost, particularly for firewood collection, from the open forests and commons. As seen in Tables 5, wood endowment is an important determinant of firewood use. In particular, a relocation of household from a poorly wood-endowed location to a better-endowed location increases the adoption probability of firewood by about 0.2 per cent; whereas, it reduces the choice probabilities of modern fuels as well as charcoal, straws and dung/crop residuals by 0.11 per cent, 0.07 per cent, 0.01 per cent, and 0.005 per cent, respectively.

The characteristics of the house itself also matter for the household's fuel adoption strategy. The AMEs indicate that a change from a house without modern roof to one with modern roofing significantly increases the probability of choosing modern fuels and charcoal, by 0.08 per cent and 0.002 per cent, respectively, and it reduces the probability of adopting firewood by 0.08 per cent, whereas the AMEs for straws and dung/crop residuals are not significant. Additionally, availability of cooking utensils has a similar effect; observing a household having cooking utensils relative to one without is predicted to increase the probability of adopting modern fuels by 0.02 per cent and charcoal by about 0.01 per cent, while it decreases the choice probability of firewood, straws and dung/crop residuals by 0.01 per cent, 0.02 per cent and 0.01 per cent, respectively. The estimated effects are significant at less than one per cent, implying that the start-up cost is critical for adopting modern fuels.

In addition, the effect of the existence of a kitchen is predicted to raise the probability of adopting modern fuels by 0.02 per cent and reduce the probability of using straws and dung/crop residuals by 0.03 per cent and 0.01 per cent, respectively. Although the effect of the existence of a kitchen is not significant for woodfuel and charcoal, the positively estimated average probabilities for these options imply that the existence of a kitchen provides storage space for these bulkier fuels, hence encourages their use. The AMEs associated with cooking outdoors imply that a change from

household whose habitat features kitchens or who cook in all-purpose rooms would reduce the probabilities of choosing modern fuels and charcoal by about 0.02 per cent and 0.01 per cent, respectively, and raises the choice probabilities of firewood and dung/crop residuals by 0.02 per cent. This may be due to the fact that cooking outdoors is problematic during rainy and stormy days, hence is not suitable for permanently installed cooking utensils. Additionally, the residence of a household in an urban relative to rural location, tends to increase the probabilities of using modern fuels and charcoal by 0.03 per cent and 0.17 per cent, respectively, and involves a decline in the probabilities of using wood and straws by 0.19 per cent and 0.01 per cent, respectively. However, it has no significant effect on adopting dung/crop residuals.

The frequency of cooking per day is estimated to have a significant effect in the case of firewood and charcoal — 1 per cent increase in the frequency of servicing meals is predicted to increase the adoption probability of wood by 0.04 per cent and reduce that of charcoal by 0.07 per cent. The predicted significant negative choice probability for charcoal suggests that the increase in the frequency of meals may induce economies of scale in cooking for charcoal users, hence reduces the frequency of cooking per meal.

The estimated significant effects belonging to a given income group suggest that both the middle and richest income quintiles, relative to the poorest, tend to adopt modern fuels. The associated average marginal effects are 0.01 per cent and 0.02 per cent, which are respectively significant at 5 per cent and 1 per cent levels; whereas, the other estimated effects are not significant. In addition, the income variable appears as an important factor in using charcoal and firewood. The average predicted probabilities imply that households in the second, middle, fourth, and richest income quintiles, relative to the poorest, tend to adopt charcoal and diversify away from firewood. While these probabilities are significant and positive for the control income quintiles, opting for charcoal, and significantly negative for those choosing firewood, the order of magnitudes varies. Notwithstanding this, firewood seems to be the main cooking energy source for the poorest income quintile. The effect of income is broadly insignificant for straws and dung/crop residuals except for the richest users of the latter option. A change from the poorest to the richest income quintile suggests a rise in the choice probability of dung/crop residual by 0.01 per cent, which is significant at 5 per cent level. This finding is at odds with the energy ladder hypothesis, which is broadly corroborated by the other results. However, it may be the case that, dung and crop residuals are collected from “own animal/herds” and “own farm”, where the supply of these fuels increases with the level of household wealth; in terms of herd and land, especially given that both AMEs are positive (see Table 4).

Overall, the adoption of modern fuels (LPG, electricity, kerosene and biogas) is significantly related to the standard of living of the household—the relatively rich households with formally educated heads, having fewer members, residing in a modern dwelling equipped with kitchen and cooking utensils, and located in urban areas. These covariates also predicted charcoal as an important intermediate fuel in urban areas. More especially, relocation of a household from rural to urban area is shown to raise charcoal adoption probability by 0.17 per cent and reduce firewood choice by 0.19 per cent. This suggests that the urban areas provide important market for charcoal, which may continue to grow in the future. Firewood appears to be the universal cooking fuel in Sudan, especially among the relatively asset-poor households residing in forest-rich locations, with more members and higher ratio of women. The availability of a kitchen, which is an indicator of the dwelling status, hence the household's standard of living, is predicted to be positively associated with the probability of firewood adoption, but the estimated effect is statistically insignificant. The visual impression of Figure 1 part (a), though not confirmed by the model's results, suggests that the relatively rich people in the fourth and fifth income quintiles still adopt firewood as a prime cooking fuel. This wood-puzzle may be due to a number of factors. For instance, a relatively high proportion of the rich may live in forest-endowed regions. In addition, there may be a predilection for cooking with firewood due to the taste and texture it gives to food or due to a preference for certain traditional techniques (Heltberg 2003). The results also indicate that marginal fuels, namely straws, dung and crop residuals, continue to play an important role in the aggregate fuel portfolio in Sudan.

Table 4. Marginal effects models (I) and (II)

	(1)								(2)			
	LPG	Biogas	Kerosene	Charcoal	Firewood	Straws	Animal dung	Crop residuals	LPG	Charcoal	Firewood	Straws
y	0.0330*** (0.0069)	-0.0038 (0.0040)	0.0074*** (0.0020)	-0.0350 (0.0430)	0.2443*** (0.0468)	-0.2013*** (0.0131)	-0.0247*** (0.0080)	-0.0186*** (0.0058)	0.0770*** (0.0107)	-0.0457 (0.0426)	0.2113*** (0.0473)	-0.2013*** (0.0131)
	0.0236*** (0.0020)	0.0005 (0.0008)	0.0019*** (0.0005)	0.2289*** (0.0074)	-0.2455*** (0.0082)	-0.0030* (0.0019)	-0.0033* (0.0017)	-0.0031** (0.0013)	0.0378*** (0.0025)	0.2248*** (0.0073)	-0.2515*** (0.0083)	-0.0031*** (0.0019)
	0.0278*** (0.0024)	0.0021** (0.0009)	0.0023*** (0.0006)	0.2927*** (0.0096)	-0.3072** (0.0112)	-0.0077** (0.0031)	0.0003 (0.0020)	-0.0105*** (0.0035)	0.0456*** (0.0030)	0.2870*** (0.0095)	-0.3176*** (0.0112)	-0.0077*** (0.0031)
	-0.0069*** (0.0013)	-0.0032*** (0.0009)	-0.0010** (0.0004)	-0.0281*** (0.0098)	0.0209** (0.0106)	0.0126*** (0.0023)	0.0022 (0.0019)	0.0033** (0.0013)	- (0.0021)	-0.0285*** (0.0097)	0.0224** (0.0108)	0.0126*** (0.0023)
	-0.0179*** (0.0019)	-0.0020** (0.0009)	0.0034*** (0.0007)	-0.0441*** (0.0099)	0.0325*** (0.0106)	0.0373*** (0.0025)	-0.0010 (0.0018)	-0.0016 (0.0012)	- (0.0027)	-0.0412*** (0.0098)	0.0399*** (0.0108)	0.0373*** (0.0025)
head	-0.0012 (0.0010)	0.0025*** (0.0008)	-0.0001 (0.0003)	-0.0029 (0.0077)	-0.0129 (0.0083)	0.0059*** (0.0017)	0.0058*** (0.0019)	0.0027** (0.0011)	-0.0002 (0.0017)	-0.0015 (0.0076)	-0.0139 (0.0084)	0.0059*** (0.0017)
adult	-0.0168*** (0.0038)	-0.0025 (0.0028)	-0.0019* (0.0011)	-0.0578** (0.0269)	0.0801*** (0.0289)	-0.0097 (0.0062)	0.0072 (0.0047)	0.0016 (0.0033)	- (0.0062)	-0.0555** (0.0266)	0.0858*** (0.0293)	-0.0097 (0.0062)
of)	0.0175*** (0.0017)	0.0053*** (0.0010)	0.0021*** (0.0005)	0.0601*** (0.0100)	-0.0835*** (0.0113)	0.0012 (0.0032)	0.0022 (0.0021)	-0.0051** (0.0025)	0.03166** (0.0024)	0.0580*** (0.0100)	-0.0887*** (0.0115)	0.0012 (0.0032)
of	0.0042***	0.0046***	0.0004	0.0242***	-0.0180**	-0.0094***	-0.0051***	-0.0009	0.0097***	0.0259***	-0.0196**	0.0094***

	(1)								(2)			
	LPG	Biogas	Kerosene	Charcoal	Firewood	Straws	Animal dung	Crop residuals	LPG	Charcoal	Firewood	Straws
nsils	(0.0013)	(0.0013)	(0.0004)	(0.0083)	(0.0088)	(0.0015)	(0.0012)	(0.0009)	(0.0022)	(0.0082)	(0.0090)	(0.0015)
a	0.0036	0.0022**	0.0005	0.0184	0.0007	-0.0180***	-0.0006	-0.0067***	0.0070**	0.0194	0.0022	-0.0180*
m	(0.0023)	(0.0010)	(0.0005)	(0.0124)	(0.0133)	(0.0024)	(0.0023)	(0.0016)	(0.0035)	(0.0123)	(0.0134)	(0.0024)
	-0.0030	-0.0025**	-0.0005	-0.0242**	0.0235*	-0.0005	0.0061***	0.0012	-0.0076**	-0.0247**	0.0261**	-0.0005
	(0.0024)	(0.0010)	(0.0005)	(0.0118)	(0.0124)	(0.0017)	(0.0020)	(0.0010)	(0.0035)	(0.0117)	(0.0125)	(0.0017)
ay	0.0017	0.0018	-0.0003	-0.0761***	0.0716***	0.0046	-0.0056*	0.0023	0.0027	-0.0739***	0.0687***	0.0046
	(0.0028)	(0.0016)	(0.0006)	(0.0183)	(0.0196)	(0.0036)	(0.0030)	(0.0022)	(0.0045)	(0.0182)	(0.0199)	(0.0036)
el	0.0004	-0.0010	0.0185***	0.1000***	-0.0971***	-0.0019	0.0006	-0.0028**	0.0033	0.0987***	-0.0963***	-0.0019
	(0.0031)	(0.0010)	(0.0007)	(0.0129)	(0.0136)	(0.0021)	(0.0019)	(0.0013)	(0.0041)	(0.0128)	(0.0138)	(0.0021)
ntile	0.0092***	-0.0022**	0.0115*	0.0587***	-0.0675***	0.0010	-0.0003	-0.00001	0.0085**	0.0568***	-0.0660***	0.0010
	(0.0027)	(0.0011)	(0.0007)	(0.0137)	(0.0145)	(0.0023)	(0.0021)	(0.0013)	(0.0039)	(0.0136)	(0.0146)	(0.0023)
ntile	0.0106***	-0.0075***	0.0022	0.0773***	-0.0832***	0.0011	0.0026	-0.0011	0.0064	0.0724***	-0.0812***	0.0011
	(0.0028)	(0.0016)	(0.0007)	(0.0148)	(0.0157)	(0.0027)	(0.0023)	(0.0016)	(0.0041)	(0.0147)	(0.0159)	(0.0027)
ntile	0.0016***	-0.0108***	-0.0008	0.1252***	-0.1404***	0.0023	0.0045	0.0037**	0.0142***	0.1167***	-0.1419***	0.0023
	(0.0030)	(0.0019)	(0.0008)	(0.0163)	(0.0175)	(0.0035)	(0.0028)	(0.0019)	(0.0043)	(0.0161)	(0.0177)	(0.0035)
ntile	-0.0340***	-0.0036***	-0.0019	-0.1800***	0.2329***	-0.0063***	-0.0058***	0.00001	-	-0.1752***	0.2404***	-0.0063*
	(0.0023)	(0.0008)	(0.0004)	(0.0066)	(0.0074)	(0.0014)	(0.0012)	(0.0008)	0.0534***	(0.0065)	(0.0071)	(0.0014)
									(0.0027)			

(1)								(2)			
LPG	Biogas	Kerosene	Charcoal	Firewood	Straws	Animal dung	Crop residuals	LPG	Charcoal	Firewood	Straws
0.0158***	0.0012*	0.0019***	-0.1800***	-0.2675***	-0.0056***	0.00001	0.0008	0.0268***	0.2492***	-0.2716***	-0.0056*
(0.0015)	(0.0006)	(0.0004)	(0.0066)	(0.0074)	(0.0018)	(0.0014)	(0.0009)	(0.0020)	(0.0067)	(0.0075)	(0.0018)
19716	19716	19716	19716	19716	19716	19716	19716	19716	19716	19716	19716

Column headings are as follows: (1) Model I: marginal effects (MAEs) I; (2) Model II: marginal effects model (MAEs) II.

SOURCE: Calculation based on Table 4 and sample population.

Table 5. Average marginal effects models (I) and (II)

Variables	(1)								(2)				
	LPG	Biogas	Kerosene	Charcoal	Firewood	Straws	Animal dung	Crop residuals	LPG	Charcoal	Firewood	Straws	Dung/crop residuals
Constant	0.1408	-0.0087	0.0296	-0.0972	0.3238	-0.3382	-0.0234	-0.0267	0.2182	-0.1300	0.2902	-0.3392	-0.0391
Primary education level	0.0620	-0.0012	0.0037	0.1322	-0.1847	-0.0036	-0.0040	-0.0044	0.0628	0.1352	-0.1860	-0.0037	-0.0082
Post-primary education level	0.0695	0.0013	0.0043	0.1748	-0.2233	-0.0106	-0.0003	-0.0157	0.0730	0.1768	-0.2313	-0.0110	-0.0076
Household age	-0.0234	-0.0055	-0.0032	-0.0057	0.0095	0.0210	0.0023	0.0050	-0.0319	-0.0056	0.0093	0.0210	0.0072
Household head age	-0.0655	-0.0026	-0.0123	0.0095	0.0122	0.0627	-0.0010	-0.0030	-0.0810	0.0096	0.0128	0.0628	-0.0041
Household head gender	-0.0050	0.0048	-0.0004	-0.0016	-0.0177	0.0098	0.0059	0.0042	-0.0005	-0.0020	-0.0173	0.0098	0.0099
Number of adult females	-0.0598	-0.0035	-0.0059	-0.0030	0.0787	-0.0169	0.0079	0.0025	-0.0715	-0.0018	0.0798	-0.0168	0.0104
Type of dwelling (modern roof)	0.0616	0.0088	0.0067	0.0023	-0.0758	0.0026	0.0019	-0.0081	0.0752	0.0022	-0.0773	0.0025	-0.0026
Availability of cooking utensils	0.0130	0.0084	0.0011	0.0090	-0.0094	-0.0156	-0.0052	-0.0013	0.0218	0.0088	-0.0084	-0.0156	-0.0067
Cooking in separate room	-0.0080	-0.0044	-0.0017	-0.0117	0.0189	-0.0011	0.0063	0.0017	-0.0164	-0.0099	0.0202	-0.0011	0.0071
Cooking outdoors	0.0115	0.0040	0.0017	0.0074	0.0161	-0.0301	-0.0004	-0.0102	0.0157	0.0084	0.0165	-0.0300	-0.0106
Frequency of meals per day	0.0192	0.0037	-0.0008	-0.0686	0.0416	0.0072	-0.0058	0.0035	0.0200	-0.0669	0.0421	0.0073	-0.0024
Permanent income level													
The second income quintile	-0.0157	-0.0024	0.0071	0.0806	-0.0635	-0.0025	0.0005	-0.0041	-0.0082	0.0791	-0.0646	-0.0025	-0.0038
The middle income quintile	0.0288	-0.0049	0.0036	0.0257	-0.0547	0.0020	-0.0005	0.0000	0.0130	0.0355	-0.0502	0.0021	-0.0004
The third income quintile	0.0336	-0.0149	-0.0006	0.0413	-0.0625	0.0022	0.0024	-0.0015	0.0047	0.0517	-0.0599	0.0022	0.0013
The richest income quintile	0.0507	-0.0215	-0.0057	0.0705	-0.1087	0.0046	0.0042	0.0059	0.0178	0.0772	-0.1086	0.0045	0.0091
Forest endowment	-0.1131	-0.0044	-0.0030	-0.0625	0.1997	-0.0115	-0.0050	-0.0002	-0.1131	-0.0685	0.1985	-0.0116	-0.0053
Residence in urban area	0.0248	0.0003	0.0040	0.1715	-0.1941	-0.0079	-0.0004	0.0018	0.0290	0.1719	-0.1945	-0.0079	0.0014
Number of observation	19716	19716	19716	19716	19716	19716	19716	19716	19716	19716	19716	19716	19716

Column headings are as follows: (1) Model I: marginal effects (MAEs) I; (2) Model II: marginal effects model (MAEs) II.

SOURCE: Calculation based on Table 4 and sample population.

4. Conclusion and Recommendations

4.1. Conclusions

The results of the descriptive analysis show that firewood and charcoal are universal cooking fuels in Sudan and are likely to dominate the fuel portfolio, even in the long run. Although the utilisation rate of firewood declines as income increases, it remains relatively high for the rich; and it averages at about 67 per cent for all income quintiles and about 44 per cent among the richest income quintile. Firewood largely dominates the rural cooking energy portfolio, followed by straws, LPG, kerosene, biogas, and electricity. The urban fuel portfolio is typically dominated by charcoal, as a primary fuel, followed by LPG, with limited use of biogas, kerosene and electricity. Crop residuals, animal dung and straws are often used by the urban and rural poor. The combined use rate of fuels, other than biomass and LPG, averages 5 per cent at the national level.

Two-thirds of the population countrywide is found to use smokier fuels for cooking, namely firewood, straws, dung, and crop residuals. More than 17 per cent of the population lives in households that cook with smokier fuels, in all-purpose rooms. The proportion of users to non-users of smokier fuels is very high among rural dwellers compared to urban dwellers, 79.3 per cent versus 36.7 per cent, respectively. It has been established that the risks associated with exposure to smokier fuels are very high among women, and children under five years of age, who usually remain indoors with their mothers. The incidence of child-suspected pneumonia infection is more than double among users of smokier fuels, compared to non-users, 68.1 per cent versus 31.9 per cent, respectively. Rural children appear to suffer most, with the incidence of infection placed at 75.7 per cent among users of smokier fuels relative to non-users, while the corresponding ratio for urban children is 50.9 per cent.

The socioeconomic characteristics of households are found to be important factors influencing probabilities of fuel adoption. Broadly, the analysis confirms that, households are moving-up the energy ladder and their fuel choices are determined by level of permanent income proxies by the asset-index. In addition, formal education of the household head as well as residence in modern dwellings equipped with kitchen and cooking utensils, which are also indicators of wealth status, tend to encourage adoption of modern fuels. Larger households with a higher share of women as well as female-headed households, and residence around forest-areas, significantly induce firewood use, including other smokier fuels. Although it is difficult to determine the effect of fuel prices and labour costs from the study data, the correlation of large size household and the high share of adult females, with the probability of adoption of smokier fuels, including firewood, imply that households' demand and supply of these fuels are broadly non-separable. Thus, it seems that LPG and charcoal are more commercialised with relatively developed urban-based markets, compared to firewood, dung and crop residuals markets, which are relatively thin and

concentrated. Notwithstanding this, reforms of these markets, especially the firewood market, could benefit a large number of the poor, who are still engaged as buyers and sellers of wood. In spite of the fact that the lighting source is not clearly indicated in the data, the use of electricity as cooking fuel is found to be extremely limited. The extent to which households substitute or complement fuel uses is difficult to ascertain from the present data; however, fuel-stacking could be a very common issue that requires further investigation.

4.2. Recommendations

The analysis broadly confirms that in line with the energy ladder, income is an important factor inducing households' transition to clean energy. Nonetheless, factors other than income are equally found to be important in influencing the probabilities of fuels adoption. Better education of the household head tends to reduce the adoption of firewood, dung and crop residuals. Thus, while a policy geared towards raising income is important, further interventions to improve education could also enhance the transition to modern fuels. Enhanced electrification programmes can serve as a catalyst for switching to modern fuels. The ongoing subsidy in the household fuel sector focuses on end-user price without consideration of possible LPG supply constraints. Improved LPG distribution networks, through promotion of entrepreneurship in cylinder distribution, refilling and maintenance shops, would stabilise the supply of LPG. Such programmes would also create positive externalities by engaging numerous small-scale entrepreneurs in the household energy sector.

The health hazards of biomass need to be taken seriously. In this context, the fuel switch policy could provide a medium- to long-term solution. However, promotion of improved stoves could reduce the health risks among women and children. In particular, the results indicated that the availability of cooking utensils should not be taken for granted. The pilot project of *Kanoon Alsseroor*, a locally made improved biomass stove, could be supported for large-scale dissemination, at low cost. In addition, the successful pilot programs of Intermediate Technology Development Group and CHF International in Sudan focusing on reducing the start-up costs of upgrading to modern fuels could be adapted and linked to the recently introduced micro-financing, to improve accessibility, particularly for households with small children.

Although the MNL modelling provides a parsimonious representation of fuel choice probabilities for Sudan, the results are by no means final and could be improved in many ways. Firstly, the standard household economic model could be applied to a richer data set that includes information on prices of fuels and costs to a more realistic analysis of the demand for energy. Such modelling strategy is more relevant, especially where market information is incomplete as in the case of self-collected firewood (dung, straws and crop residuals). Secondly, the extent of fuel-stacking needs to be further explored, especially given that it affects fuel-switching policies.

Thirdly, analysis of market penetration and the employment impact of forest products industry, including charcoal, is crucial for crafting broad-based incentives for forest conservation. Fourthly, although the study controls for unknown heterogeneity, a disaggregated analysis, for instance at the state level, may indicate significant differences in fuel preferences, which would be of interest to public policy.

References

- Amacher, G., Hyde, W. and Joshee, B. 1993. Joint production and consumption in traditional households: Fuel-wood and crop residues in two districts of Nepal. *Journal of Development Studies*, 30(1): 206–225.
- Arnold, M., Köhlin, G., Persson, R. and Shepherd, M. 2003. 'Fuelwood revisited: What has changed in the last decade?' *CIFOR Occasional Paper*, No. 39: 8–15.
- Bardann, P.J., Balad, S.D., Mookher, D. and Sarkar, R. 2010. The environmental impact of poverty: Evidence from firewood collection in rural Nepal. *Economic Development and Cultural Change*, 59(1): 23–61.
- Barnes, D. F. and Qian, L. 1992. Urban interfuel substitution, energy use and equity in developing countries. *In: International issues in energy policy, development and economics*, edited by J. P. Dorian and F. Fesharaki. Boulder, CO: Westview Press.
- Barnes, D. F. and Sen, M. 2004. The impact of electrification on women's life in rural India. *Energia News*, 7(1): 13–14.
- Bruce, N., Rehfuess, E. Mehta, S., Hutton, G. and Smith, K. 2006. Indoor air pollution. *In: Disease control priorities in developing countries*, edited by D. T. Jamison, J. G. Breman and A. R. Measham. Washington, D. C: World Bank.
- Cecelski, E. 2004. Re-thinking gender and energy: Old and new directions. *Energy, Environment and Development*. ENERGIA/EASE Discussion Paper, 65–68.
- Central Bureau of Statistics/Ministry of Health/ Southern Sudan Commission of Census, Statistics and Evaluation. 2006. *Sudan household health survey report (SHHSR)*. Khartoum-Sudan.
- Cheng, S. and Long, J. S. 2007. Testing for IIA in the multinomial logit model. *Sociological Methods Research*, 35(4): 583–600.
- Cramer, J. S., and Ridder, G. 1991. Pooling states in the multinomial logit model. *Journal of Econometrics*, 47(2–3): 267–272.
- Davis, M. 1998. Rural household energy consumption: The effect of access to electricity—Evidence from South Africa. *Energy Policy*, 26(3): 207–217.
- Farsi, M., Massimo, F. and Shonali, P. 2007. Fuel choices in urban Indian households. *Environment and Development Economics*, 12(6): 757–774.

- Foley, G. 1995. 'Photovoltaic applications in rural areas of the developing world'. *World Bank Technical Paper*, No. 304. Washington, D.C.: World Bank.
- Food and Agricultural Organization of United Nation (FAO). 2005. Global forest resources assessment: Progress towards sustainable forest management. *FAO Forestry Paper*, 147. Rome, Italy.
- Gebregeziabher, Z., Mekonnen, A. Kassie, M. and Köhlin, J. 2010. 'Household tree planting in Tigray, northern Ethiopia: Tree species, purpose and determinants'. *Environment for Development Discussion Paper Series* Efd DP 10-01: 5–7.
- Greene, W. 2005. *Econometric analysis*. NY: New York University.
- . 2007. *LIMDEP 9 User's guide*. Student version. NY: Econometric Software, Inc.
- Grieshop, A. P., Marshall, J. D. and Kandlikar, M. 2011. Health and climate benefits of cookstove replacement options. *Energy Policy*, 39(12): 7530–7542.
- Gujarati, D. N. 2008. *Basic econometrics*. 4th edition, McGraw-Hill Higher Education.
- Hausman, J. and McFadden, D. L. 1984. Specification tests for the multinomial logit model. *Econometrica*, 52(5): 1219–1240.
- Heltberg, R. Arndt, T. C., and Sekhar, N. U. 2000. Fuelwood consumption and forest degradation: A household model for domestic energy substitution in rural India. *Land Economics*, 76(2): 213–232.
- Heltberg, R. 2003. Household fuel and energy use in developing countries: A multicountry study. Washington, D.C: World Bank. Retrieved April 11, 2012, from http://www.esmap.org/esmap/sites/esmap.org/files/Report_FuelUseMulticou ntryStudy_05.pdf.
- . 2005. Factors determining household fuel choice in Guatemala. *Environmental and Development Economics*, 10: 337–361.
- Hood, A. H., Ahmed, A. O. and Sidi A. A. 2004. Dissemination of smoke reduction interventions in Sudan. Case Study for Workshop and Networking Event, September 12–17, Barcelona, Spain.
- Hosier, R. H. and Dowd, J. 1987. Household fuel choice in Zimbabwe: An empirical test of the energy ladder hypothesis. *Resources and Energy*, 9(4): 347–361.
- International Energy Agency (IEA). 2007. *World energy outlook*. Paris, France.
- Jack, D. 2004. Income, household energy and health. Harvard University, USA. Retrieved March 27, 2012, from http://www.hks.harvard.edu/m-rcbg/repsof-ypf-ksg_fellows/Papers/Jack/dwj_repsol.pdf.
- Jyoti, P. K. 1995. Gender issues in energy policy. *Energy Policy*, 23(9): 745– 54.
- Kennedy, P. 2003. *A guide to econometrics*. 5th edition . M.A.: MIT Press.

- Leach, G. 1992. The energy transition. *Energy Policy*, 20(2): 116–123.
- Long, J. S., and Freese, J. 2001. *Regression models for categorical dependent variables using stata*. TX: Stat Press.
- Madala, G. S. 1983. *Limited-dependent and qualitative variables in econometrics*. Cambridge: Cambridge University Press.
- Malla, M. B., Bruce, N., Bates, E. and Rehfuess, E. 2011. Applying global cost-benefit analysis methods to indoor air pollution mitigation interventions in Nepal, Kenya and Sudan: Insights and challenges. *Energy Policy*, 39(12): 7518–7529.
- McFadden, D. L. 1973. Conditional logit analysis of qualitative choice behaviour. In *Frontiers in econometrics*, edited by P. Zarembka, 105–142. NY: Academic Press.
- . 1981. Structure discrete probability models derived from theories of choice. In: *Structural analysis of discrete data with econometric applications*, edited by C. F. Manski and D. L. McFadden, 198–272. MA: Massachusetts Institute of Technology.
- Mekonnen, A. and Köhlin, G. 2008. Determinants of household fuel choice in major cities of Ethiopia. *Environment for Development Discussion Paper Series*, EFD DP 08–18.
- Ministry of Environment and Physical Development/Higher Council for Environment and Natural Resources. 2003. *Sudan's first national communication (SFNC)*. Khartoum, Sudan.
- National Forests Corporation (NFC)/Food and Agricultural Organization (FAO). 1994. *Forestry products demand survey*. NFC and FAO.
- National Forest Inventory for the Sudan. 1996. FAO/GCP/SUD/047/NET. National Forests Corporation (NFC), Ministry of Environment and Tourism, Khartoum-Sudan.
- Omer, A. M. 2001. Wind energy in Sudan: Water pumping in rural areas. *Refocus*, 2 (8): 34–37.
- . 2003. Energy in Sudan. *International Journal of Global Energy Issues*, 19(4): 289–309.
- . 2007. Wind energy in Sudan for water pumping in rural areas. *International Energy Journal*, 8 (4): 275–284.
- Parikh, J., Haimanti, B. and Shyam, K. 2003. Cooking with biofuels: Risk factors affecting health impact on rural women. *Economic and Political Weekly*, 38(26): 2681–2692.
- Pearce, D., Edward, B. and Anil, M. 1990. *Sustainable development: Economics and environment in the Third World*. UK: Edward Elgar Publishing Limited.
- Pope, D. P., Mishra, V., Thompson, L., Siddiqui, A. R., Rehfuess, E. A., Weber, M. and Bruce, N. G. 2010. Risk of low birth weight and stillbirth associated

with indoor air pollution from solid fuel use in developing countries.
Epidemiologic Reviews, 32(1): 70–81.

Ray, P. 1973. Independence of irrelevant alternative. *Econometrica*, 41(5): 987–991.

World Energy Outlook. 2006. *Energy for cooking in developing countries*.
OECD/IEA. Paris, France.

World Health Organization (WHO). 2002. *The world health report 2002: Reducing risks, promoting healthy life*. Geneva, Switzerland.

Yosif, H. M. 1995. Population, biomass and the environment in central Sudan.
International Journal of Sustainable Development and World Ecology, 2(1): 54–69.

CHAPTER EIGHT

Turning Challenges into Opportunities in Household Energy Demand: Women *Tiftif* Makers in Yeka Sub-city, Addis Ababa

Betelhem Ephrem

Abstract

Socioeconomic factors that are related to the utilisation of household energy, such as division of labour in the household and women's low economic status, make women more vulnerable than men. By employing snowball sampling, the present study recruited ten women who reside in Yeka sub-city, Addis Ababa, and who use *tiftif* as alternative household energy. Major themes emerged from their response to a semi-structured in-depth interview that mainly relied on open-ended questions. Hence, the women are coping with challenges in demand, access and consumption of modern energy, by utilising *tiftif*, which is an alternative local household energy. Poverty and financial insecurity are driving factors for the women to venture into *tiftif*-making. The women make *tiftif* for both household energy consumption and for the market. Despite the natural and human-made, as well as physical, social and economic challenges these women face, they persevere to sustain their energy demand and livelihoods.

Keywords: *Tiftif*, energy, household, women, Addis Ababa

1. Introduction

In poverty and development discourse, energy is identified by many scholars as a major manifestation and exacerbator of poverty (Reddy 2000). Energy poverty, according to Reddy, is the absence of sufficient choices in accessing adequate, affordable, reliable, high quality, safe, and environmentally benign energy services, to support economic and human development. Other scholars consider the per capita consumption of energy as the measure of quality of life and economic prosperity of a given country (Rai 2004). Energy is an important input in any country's economic and social development, both in public as well as private spheres, thus lack of energy is one factor that accounts for the underdevelopment of countries in the developing world (Messeret 2011; Rai 2004).

Access to energy is among the key elements for the economic and social development of Ethiopia. A survey conducted by the Ministry of Water and Energy of Ethiopia (2012) shows that traditional fuels/biomass fuels such as woodfuel, crop residues, charcoal and animal dung are the predominant energy sources, constituting 92 per cent of total energy consumption of the country in 2010. On the other hand, modern fuels contributed 8 per cent of total energy consumption in 2010, of which 7 per cent was from hydrocarbon products (light products 2.53 per cent and heavy products 4.34

per cent) and 1.04 per cent from electricity. Regarding household energy consumption, 98.67 per cent is biomass, while electricity and petroleum products together accounted for 1.33 per cent. Jargstorf (2004) predicts that the country's dependence on biomass fuel remains one of the highest in Africa, compared to the averages for Sub-Saharan Africa (SSA), and Africa, in general, which is 90 per cent and 60 per cent, respectively.

According to the Ministry of Finance and Economic Development [MoFED] (2006), about 71 per cent of households at the national level use kerosene for lighting, followed by firewood (16 per cent) and electricity (13 per cent). About 75 per cent of urban residents use electricity while rural residents predominantly use kerosene (80 per cent) and firewood (18.5 per cent). On the contrary, it is only 0.4 per cent of the rural population that is reported to be using a private electricity connection for lighting, while another 0.8 per cent has access to a shared connection.

More specifically, in rural areas of Ethiopia, 85 per cent of the population depends on woodfuel as their primary fuel for cooking. Next to woodfuel, rural people are dependent on crop residues (12.65 per cent), kerosene (0.21 per cent), electricity (0.05 per cent) and LPG (0.07 per cent) [CSA 2004]. In contrast, data indicates that in urban areas, a staggering 42 per cent of the residents depend on kerosene as their primary fuel for cooking. This figure is very high compared to dependence on LPG (6.5 per cent), electricity (6.5 per cent), woodfuel (25 per cent), crop residues (8 per cent), and charcoal (4.5 per cent).

The disparity between the rural and urban dwellers' use of traditional and modern household energy for lighting as well as cooking emanates, according to the Ministry of Water and Energy (2012), from different but interrelated factors. Among the primary factors that created and perpetuated the urban-rural disparity are the unavailability, inaccessibility and unsustainability of modern energy in rural areas, and imbalance between household energy demand and population growth as 84 per cent of the national population lives in rural areas. In addition, lack of substantial mitigation measures for energy poverty, scattered settlement of the rural population and the costly electricity expansion also account for the disparity.

Taking into consideration this huge disparity between the urban and rural energy consumption, a study by Ethiopian Rural Energy Development Program Committee (2002) demonstrates that in Ethiopia, emphasis is given to the rural population in the provision of alternative energy technology projects such as solar cookers, Lakech-improved charcoal stoves (with 25 per cent fuel saving), *Mirit*—improved *injera*²-baking stoves (with 50 per cent fuel saving), and Gonzie-improved multipurpose (cooking and baking) stoves (with 54 per cent fuel saving) that are being promoted to remedy the energy poverty situation.

Consequently, such government and organisational interventions have neglected and misrepresented the urban poor, who are highly affected by urban poverty, which in contrast to rural poverty, is less visible. Energy poverty is prevalent in urban areas such as Addis Ababa, where the use of traditional energy sources is a common feature amongst most of the urban poor. Moreover, urbanisation as a way of life does not permit urban poor dwellers to use traditional and environmentally unfriendly energy such as charcoal but compels them to use modern energy sources, such as electricity, kerosene and improved cooking stoves, which are incompatible with their purchasing power.

Messeret (2011) argues that the socioeconomic factors related to the utilisation of household energy make women more vulnerable than men due to their traditional responsibilities in the household. Consequently, men and women are affected differently by the lack of adequate and safe energy and by the price increment of modern energy, complicating women's access to and control over energy resources. Additionally, women's status in the energy sector gets worse due to the feminisation of poverty and the gender-based division of labour, which have direct implications and impacts on the economic powerlessness of women. Messeret also illustrated that much of women's time is taken-up by difficult and time-consuming chores related to producing and processing food without mechanical or electrical equipment, clean-burning fuels and energy-efficient appliances.

It is important to bear in mind that inasmuch as women severely suffer from, and are desperate to access sustainable and economically suitable energy for domestic purposes, they are also active in responding to their problem through their adaptive management strategies to conserve fuels such as by shortening cooking duration, exploring less fuel-intensive cooking and food processing methods, cooking fewer meals, serving cold leftovers, changing the types of food eaten, and purchasing other fuels (Clancy Skutsch and Batchelor 2002).

This study is an attempt to explore the implication of poverty on women's access to and control over household energy in urban settings, which plays a crucial role in determining the economic and health status, living conditions and position of women in a society. In light of this, the current study focuses on women who make *tiftif* as a local alternative energy source in Yeka sub-city, Addis Ababa. *Tiftif* is a flat pancake-like, local household energy, made with a mixture of miniature charcoal, clay soil and water. The study also revolves around analyzing the challenges women encounter due to the absence and dearth of household energy sources, as well as the opportunities they make use of, in their abject living conditions.

The general objective of this study was to explore the coping mechanisms that women of Yeka sub-city, Addis Ababa, deployed to adapt to their household energy challenges, in demand, access and consumption. The specific objectives were:

- to identify the impetus that drives these women to make *tiftif*;
- to examine the efficiency of *tiftif* as a source of household energy;
- to find out the impact of *tiftif* on women's lives; and
- to explore the challenges faced by women in making *tiftif*.

Conducting the current research was deemed relevant for three main reasons. First, studying women's issues, from their own perspective, gives due recognition to women's coping mechanisms and problem-solving ability in the energy sector, irrespective of the advantages and/or disadvantages of the mechanism employed. Second, this study also has the potential to provide significant evidence on policy gaps regarding national energy demand and distribution in relation to women's access to and control over household energy resources. Third, the study contributes to enriching and contextualising the available scholarly literature on gender, energy and poverty in Ethiopia, thereby serving as a stepping stone for other researchers to study the subject area further.

The scope of the study was limited to exploring the relationship between women's challenges in demand, access and consumption of household energy, and the alternative energy source that they used, known as *tiftif*, in Yeka sub-city, Addis Ababa. However, the voices of other subjects related to the women and *tiftif*, as well as the scientific and laboratory analysis of *tiftif* and its impact on the environment, were not incorporated in this study.

1.1. Methodological Preliminaries

Limited literature is available on gender and energy in Ethiopia in general, and in urban settings, in particular, and few studies have been conducted in this area. As a result, little is known about women's coping mechanisms to energy challenges in urban areas such as Addis Ababa. The few publications and other works that address the issue of gender and energy, mostly present women from a vulnerable point of view, depicting them as victims of circumstances. In order to echo the unheard voices and activities of women, the current study predominantly relied on a qualitative approach so as to enable subjects of the study to thoroughly interpret their realities from their own perspectives. The qualitative method was chosen because it is a favourable approach for issues that little is known about (Mildred 2005).

The empirical data of this research was drawn from primary sources, through a semi-structured in-depth, face-to-face interview, relying mainly on open-ended questions that were administered to women who make *tiftif* in Yeka sub-city, Addis Ababa. Descriptive questions were also included in the interview to elicit unique features of the research subjects. Moreover,

secondary data sources from previously published and unpublished relevant materials, such as books, reports and archival documents, were included.

The research study area is Yeka sub-city, which was purposely chosen because women who make the *tiftif* are more visible in this area. According to the 2007 population census, Yeka sub-city has a population of 377,091, of which 201,311 are women and 175,780 are men, with a population density of 4,385.8 persons per square kilometre. The sub-city comprises 13 districts and covers a total size of 85.98 kilometre square, which makes it the third-largest sub-city of Addis Ababa, next to Bole and Nifas-Silk Lafto sub-cities (CSA 2007).

Women who make *tiftif* within Yeka sub-city are scattered and unknown in number, which compelled the researcher to deploy a snowball sampling technique to trace participants in the study. When deploying snowball sampling, it is difficult to predict the sample size, which in turn makes the generalisation of the research findings to other populations impossible. As a result, the recruitment of ten women was possible for this study, based on the available time and resources.

The open-ended responses of the interview were coded and analyzed thematically, to address the study objectives and research questions. The coding took place both at the open and axial stages. The open coding stage was done to break down a wide range of data into more manageable segments, which were further coded in a conceptually condensed manner at the axial stage of coding (Carol 2007). In addition, descriptive summaries were considered for discrete questions, and the combination of the two was thereafter presented thematically.

1.2. Organisation of the Study

This study is organised into four sections. The first section presents the introduction. The second section deals with the empirical and theoretical frameworks of the study. The third section presents the analysis and discussion of primary data gathered from semi-structured in-depth interviews. Finally, concluding remarks and recommendations are presented in the fourth section.

2. Literature Review and Theoretical Framework

2.1. Empirical Literature

Empirical literature on key issues raised in this study is provided so as to create a link between concepts of urban poverty, energy and gender. Samson (2008) elaborates that people's living conditions in urban areas have improved significantly through the provision of public services, proliferation of businesses and industries, and increasing modernisation. This proliferation of life in urban settings rendered urban poverty, mainly evident within poorer settlements and low-income households, invisible. Consequently, urban areas have also become places where the quality of

life of the urban poor has deteriorated and they are denied opportunities. Momson (2010) also claims that in many urban cities, urbanisation has not been accompanied by industrialisation but merely by rural–urban migration as a result of the impoverished lives of the rural poor and their perception of better life in urban areas. As a result, the influence of urbanization extends beyond city boundaries, impacting living conditions, resource use, social and economic processes, and values of the general population.

Poverty has an intricate gender dimension. Women and men experience poverty differently, and women are impoverished partly as a result of gender-based discrimination in education, employment opportunities, and decision-making processes, not to mention gender-based norms and cultural practices (Emebet 2008). A large proportion of women in urban households in Ethiopia are found in poor and very poor categories, which indicates the predominance of feminisation of poverty. Women are becoming poorer because of gender-based experiences and opportunities. Particularly in urban areas, it is women in general, and female-headed households in particular, who constitute the majority of the excluded and vulnerable groups in the economic sphere of the society (MoFED 2006; Emebet 2008).

The quality of life prevailing in many developing countries is reflected in the source, supply and use patterns of household energy. Clancy, Skutsch and Batchelor (2002) incorporate energy under the list of basic needs because of its great importance in determining society's quality of life. One-quarter of the world's population does not have access to electricity and the annual expansion of new connections does not keep up with population growth. As a result, some 2.4 billion people depend on biomass for heating and cooking, and the number is increasing (Lefebvre 2002b).

According to a survey conducted by Muzzini (2008), unaffordability of modern energy affects the demand, access and consumption pattern amongst the urban poor. Illegal or unauthorised settlements, coupled with irregular and unstable income, caused the urban poor to be excluded from energy poverty alleviation projects. Moreover, urbanisation as a way of life put pressure on urban poor dwellers not to make use of traditional energy sources.

In particular, rapid population growth coupled with rapid urbanisation has increased the demand for energy, especially cooking fuel, in urban settings. However, growth in energy demand has not been matched by a corresponding growth in the supply of alternative clean, efficient and convenient sources of energy. Momson (2010) argues that less polluting forms of energy are more expensive but failure to meet the energy needs of the urban poor is reducing the prospects of achieving the Millennium Development Goals (MDGs) of environmental sustainability and eradication of extreme poverty and hunger.

As reported by the World Bank (2006), the traditional responsibilities of women and girls as food growers, water and fuel gatherers, and caregivers, connect them with acquiring sufficient household energy, making them more likely to be impacted by energy hardships. The longstanding patriarchal social system created differences in responsibilities in the household, and perpetuated intra-household inequality that leaves women's voices unheard and their needs neglected.

The World Health Organisation (WHO 2004) estimated that indoor air pollution results in 1.6 million deaths worldwide each year, 24 per cent of which occurs in Africa. The primary cause of this indoor air pollution is household fuel use, particularly from traditional fuels burnt in highly inefficient stoves. Furthermore, WHO also estimated that just over half of the worldwide deaths in children under the age of five were caused by indoor air pollution, while the proportion of the total global burden of disease in children of the same age caused by indoor air pollution was a staggering 80 per cent.

As the greater proportion of household energy demand in Ethiopia is due to cooking, women also share an unequal burden of death and disease from indoor air pollution (Jargstorf 2004). The health impacts also include, but are not limited to, coughing, wheezing, acute respiratory infection in children, chronic obstructive lung disease, adverse pregnancy outcomes, and lung cancer. Additionally, in urban areas, meeting family fuel needs can entail juggling tight household incomes in order to buy charcoal or kerosene, and coping with increased fuel prices, resulting in less money for food and other essential items, thus increasing household vulnerability.

It is important to consider the role of energy in alleviating poverty, sustaining livelihoods and meeting women's strategic needs. Providing improved access to energy services for lighting, cooking and productive activities alleviates time and work pressure for women. The more time women spend on collection of energy sources for preparation of food, the less time they spend pursuing more productive activities. It also has a significant positive impact on women's education, literacy, nutrition, health, economic opportunities, and involvement in community affairs, which in turn, will benefit all family members, and the society at large (UNDP 2004). Therefore, it is quite obvious that unmet household energy consumption needs not only impasse the efforts to overcome poverty, but perpetuate inequalities within the household.

Though women are victims of energy poverty, they also have the resilience to withstand it. They possess knowledge and skills that are critical to finding local solutions to their challenges. Experience shows that the resilience of households and communities depends greatly on the resilience of women. Women are key allies in promoting renewable energy solutions, and have valuable knowledge of local circumstances and needs.

2.2. Theoretical Framework

A livelihoods framework, as an approach to poverty, is deployed in order to understand women's coping strategy to energy poverty. The framework is adopted mainly from Barnett (2001). The livelihoods approach is a new way of looking at development and is primarily concerned with people, their assets in terms of skills, status, and possessions, and how they convert these assets to climb out of poverty and improve their livelihood security.

Emebet (2008) tried to elaborate the concept of livelihood, besides income, as it involves the gaining and retaining of access to resources and opportunities, dealing with risk, negotiating social relationships, and managing social networks and institutions within households and communities. Livelihood security, more specifically household livelihood security, is defined by Haregewoin and Emebet (2002) as adequate and sustainable access to sufficient income and resources to meet basic needs. The basic needs include food, water, health, education, shelter, community participation, and leisure.

According to Barnett's (2001) livelihoods approach, human beings should have five types of assets that are necessary to attain access to energy. These are natural, social, human, physical, and financial assets. Natural assets involve falling water, wind, solar heat, soil, biomass energy, and land. However, access to, ownership and sustainability of these natural resources is affected, for instance by people's geographical location, their social positioning, the climate, economic, and political systems.

Social capital involves human relationships and belonging to groups that enable people to gain access to different livelihood opportunities. Networks and social relations often determine an individual's access to natural resources, access to other people's skills and information on energy. Social capital includes informal relationships that people forge to access social, psychological and material resources such as family, friendship and mentorship. Human capital refers to the skills, knowledge, ability to work, and good health that enable people to overcome energy challenges and livelihood insecurity. Human capital incorporates people's ability and knowledge to generate employment, their indigenous knowledge, and improved health status. It also involves people's personal characteristics such as optimism, perseverance, and ability to access social and natural resources.

Physical capital refers to assets such as basic infrastructure, shelter, water, transport, production equipment, access to clean and adequate energy sources, sanitation, and access to information communication, which enable people to attain sustainable livelihoods. Financial assets include savings, credit and pension benefits, which enable people to assume access to energy. It is the availability of monetary assets or their equivalent that enables people to maintain their livelihood status.

The livelihoods approach recognises energy as one of the physical assets people have but it is also a tool or means for acquiring other assets. According to UNDP (2007), access to affordable energy services is an essential prerequisite to achieving economic growth, secured livelihoods, poverty reduction, as well as expanding individual choices and capabilities. Energy can also be a liberator and a catalyst, a means of empowerment, providing opportunities, security and an instrument to confront inequity.

In this regard, women's decision-making power, economic status and the role they play in their private and public lives, determines their ability to acquire and utilise assets as well as the kind of assets that are viable for them to sustain their energy demand and secure their livelihoods. In light of this, the current study is an extension of the effort to explore the lives of women who make *tiftif* as a local household energy source in Yeka sub-city, Addis Ababa. Consequently, and more importantly, the different assets the women acquire and convert into capabilities to cope with energy challenges, as well as their agency and responsiveness to their economic and social distresses are vital points explored in the study.

3. Data Analysis and Discussion

Qualitative data was gathered through in-depth interviews with the objective of exploring the coping mechanisms deployed by women in Yeka sub-city to adapt to their household energy challenges. This is presented and analyzed in this section, from a livelihoods approach. The first section of this chapter describes the biographical sketches of the respondents, highlighting what they have in common as well as how each case is unique. The second section addresses the household energy demand and consumption choices of the women and how they enter into *tiftif*-making. The third section discusses the efficiency of *tiftif* in sustaining household energy consumption, whereas the fourth section discusses the impact of *tiftif* on women's lives. The fifth section revolves around women's access to assets and how they convert these assets to sustain their livelihood. The last section discusses the challenges faced by women in making *tiftif*.

3.1. Biographical Sketches of Respondents

Azalech

Azalech is a 57 year-old woman born and raised in Gojam, Amhara Region. She got married when she was only seven and before she turned 12, had been married to four men consecutively, forced by her parents, especially her father. She received an elementary education up to 6th grade. Azalech came to Addis Ababa with her uncle to escape from the unwanted marriages her parents arranged for her. She was employed as a housemaid before she got married to her fifth husband, who was a soldier, but is now retired. She gave birth to a daughter who is now living by herself. Azalech raises her 12-year old stepson, who is in 4th grade. Additionally, Azalech's 89 year-old mother lives with her. Currently, the main source of income for

Azalech is the irregular money that her daughter provides. In addition to this, Azalech is trying to generate money from selling *tiftif*. The two-roomed house that Azalech and three of her family members live in is rented from the *kebele*.³

Zuriyash

Zuriyash is a 30 year-old woman, born and raised in Gurage Zone in the Southern Nations, nationalities and Peoples Region (SNPPR). She came to Addis Ababa in search of a job opportunity. She is illiterate because her parents sent her to herd livestock instead of attending school. Zuriyash has been married for 17 years and has no formal job. Her husband does not have a permanent job but sometimes engages in unskilled work. Zuriyash has two boys and two girls, of which three are enrolled in a government school while one is below school-going age. The total family size is six. The main source of income for Zuriyash is the money she gets from selling *tiftif*. She rents the house she lives in with her family from an individual.

Abebech

Abebech is a 40 year-old woman, born and raised in Gurage zone of SNPPR. She has never been enrolled in school. She gave birth to two boys, aged 18 and 15 years, who are students. Her husband died 15 years ago, consequently she raises her sons herself. Although she has never been employed, she used to do a homemade business of selling *injera* but was unable to proceed with the business due to the economic inflation. She said: "I used to bake *injera* for sale before my *mitad*⁴ broke, and the price of *teff*⁵ is inflated". Currently, the main source of income for Abebech is the money she gets from selling *tiftif*. The house she lives in with her two sons is a shelter which is not legally registered; hence she does not pay anything for it.

Werkhat

Werkhat is a 30 year-old woman, born and raised in Gurage zone of SNPPR. She came to Addis Ababa in search of a better lifestyle and employment opportunity, eight years ago. However, immediately after she arrived in Addis Ababa, she got married to a 38 year-old street vendor, illiterate like her. Werkhat has one boy and one girl, aged five and three years, respectively, who are enrolled in a public school. She rents the house she lives in with her family. In addition to her husband's unpredictable income, Werkhat tries to generate income and provide for her family by washing clothes and selling *tiftif*. She has never been formally employed.

Yeshi

Yeshi is a 35 year-old woman, born and raised in Oromia Region. She attended school upto 6th grade. She came to Addis Ababa in search of job opportunities and has been employed as a housemaid in many households. Although she has never been married, she conceived and gave birth to two boys, presently aged ten and three years, sired by male employers who

denied their fatherhood, forcing Yeshi to raise her children by herself. Her eldest son is enrolled in a government school. Yeshi's main income is the money she gets from selling *tiftif* and charcoal. In addition, she tries to generate income by doing informal jobs such as washing clothes and braiding hair. Yeshi sublet the place she lives in with her children from an individual.

Enanu

Enanu is a 35 year-old woman, born and raised in Amhara Region. It has been 20 years since she came to Addis Ababa with her relocated family. By then, she was married and had a daughter. Currently, she has given birth to four children and is also raising her nephew. Enanu is now a widow. In all, there are three boys and two girls living with Enanu. Four of her children go to school. The eldest daughter works as a part-time housemaid during the day and gets back home in the evening to complement the income her father used to bring. The other daughter sells *kolo*⁶ in the evening after she gets back from school. One of the older boys works as a shoe shiner in the evening. Enanu has never been formally employed. She used to sell homemade bread but it was not profitable as the price of wheat became inflated. The one-roomed house Enanu lives in with her children is a shelter which is not legally registered; hence she does not pay for it. Currently, Enanu is trying to generate income by making *tiftif* for sale.

Tirunesh

Tirunesh is a 60 year-old woman, born and raised in Amhara Region. She is illiterate. She came to Addis Ababa, was employed as a housemaid, and subsequently married her employer. Tirunesh used to collect firewood and leaves for sale, to supplement the income her soldier husband makes. She gave birth to four children, of which three are girls and one is a boy. Tirunesh's husband died 17 years ago. Three of her daughters left home and are living on their own. Now it is only her youngest son and her granddaughter who live with her. Tirunesh is not employed and does not have a stable income except for the money she gets from selling *tiftif*. In addition, her son provides for her by doing a part-time taxi driving job. Tirunesh rents the place she lives in from the *kebele*.

Menbere

Menbere is a 65 year-old woman, born and raised in Oromia Region. She came to Addis Ababa following relatives who promised her an education opportunity. However, she did not get enrolled in school but was employed as a housemaid until she got married to a carpenter. Menbere and her husband were unable to have a child, hence it is only the two of them living together in a house they rent from the *kebele*. Menbere is currently working as a daily labourer while her husband is a security guard in a private business.

Kelem

Kelem is a 60 year-old woman, born and raised in Oromia Region. She was enrolled in elementary school but dropped out due to marriage. Leaving her husband and daughter behind, she migrated to Addis Ababa following her relatives. Kelem was employed as a housemaid in Addis Ababa. She got married again and gave birth to another daughter in Addis Ababa. Her husband has become old, and is unable to see and hear as well as walk. The place Kelem lives in with her husband, daughter and three of her granddaughters was obtained through a government resettlement project. Currently, the main source of household income for Kelem and her family is the money she gets from selling *tiftif*, and the money she earns from renting out the living room of her house. In addition, Kelem does any casual work she can find such as baking *injera*, washing clothes, making *tella*,⁷ and making *wot*⁸ for different occasions and ceremonies such as weddings and mourning.

Selas

Selas is a 45 year-old woman, born and raised in Tigray. She only received elementary education. She migrated to Addis Ababa in search of employment, following her relatives. Selas got married when she was 17 and gave birth to five children, but one of them died. Her husband died after 9 years of sickness. Now she lives with her four children of whom three are boys and only one is a girl. Except for the elder male child who has just finished high school, three of her children are still learning. The main source of income for Selas is the money she gets from selling *tiftif* and braiding. The place Selas lives in with her children is a squatter place, constructed out of plastic.

According to the data, the majority of the respondents are between the ages of 35 and 60 years, with the youngest being 30, and the oldest, 65 years. In terms of ethnicity, of the ten respondents, three are from Gurage, another three are from Amhara, three are from Oromia, and one is from Tigray. All the respondents migrated from different regions of the country and came to Addis Ababa in search of better education, employment opportunities and to escape from unwanted marriage. This finding correlates with the national rural-urban migration status which indicates that while male rural-urban migrants are more dominant in other African countries due to the employment opportunities available for men in urban areas, females in Ethiopia dominate the rural-urban migration. Despite limited employment opportunities, more women than men migrate to urban cities although they are rendered vulnerable to poverty (Feleke *et al.* 2006; Momson 2010).

Regarding marital status, the data shows that five of the respondents are married; four of them are widowed while only Yeshe is single. Accordingly, five of the households are *de jure* female-headed household whereas the other five are *de facto* female-headed households.⁹ Out of the four households headed by women, Enanu and Selas have large families, with

five and four children, respectively. The rest are widowed and single women with small families and live only with their children.

With respect to the education status of the respondents, four of them have received basic education whereas the remaining six have never been to school. All the respondents have not received education beyond primary school; hence, their employment choices and pattern of employment have been limited to housemaid work as it is an easily accessible job for many women in Ethiopia. Marriage was another choice for these women, to get out of the suffering of housemaid work, and become economically dependent on their husbands. These findings of the study comply with the findings reported by Emebet (2008), who reflected on the implications of women's lack of education on their employment opportunities, health situation, family planning, and development in general.

The current occupation and employment status of the respondents shows a similar pattern, whereby only Menbere is employed as a daily labourer while the rest are self-employed. Perhaps, the women who are not employed generate money from informal and temporary jobs at home, using nothing but their labour and skills to wash clothes, perform catering and make *tiftif*. As a result, it was only Menbere who was able to calculate the exact amount of monthly income that she and her husband earn (600 birr),¹⁰ but for the rest, it was impossible to do so. Data from CSA (2004) supported the above finding, which indicates that women in Ethiopia are highly involved in the informal sector more than in any other sector. This sector operates on a very small-scale, without a fixed location in places such as small shops, outlets or home-based activities, which do not require a high level of expertise.

While conducting the interviews, the physical space of the respondents was observed to substantiate the findings of the research, which postulate that these women are the poorest of the poor. They live in places where a lot of small shanty government-owned houses are attached together in a compound, where sewage and waste disposal systems are very poor, and the sanitation system is horrific. There were cases whereby people who live in these places use toilets built out of wood and plastic, by the corner of a river. Some of the houses do not have appropriate ceilings. In addition, in all of the houses where the interviews took place, a room serves as a living room, bedroom and kitchen, all in one, with little or no furniture. The women do not own physical assets, such as houses (except for Kelem who gained a house from the government's resettlement project), and lack basic infrastructure such as water lines, transport and sanitation.

3.2. Household Energy Demand and Consumption

With regard to the gender-energy nexus, it is evident that men and women have different needs, and consumption patterns, which implies that they are not affected by the energy crisis in the same way. Women in Ethiopia are engaged in the productive, reproductive and community maintenance roles

because of the gender division of labour. Providing the household with efficient and sustainable energy is a woman's role, which makes women direct victims of the energy crisis prevalent in Ethiopia (Messeret 2011).

Regarding reproductive roles played in the house, all the respondents stated that they are responsible for domestic chores and child-rearing activities. To perform these chores, respondents who have children, both married and widowed, get some help from their children. However, in the case of married respondents, the role of husbands in taking care of household responsibilities is negligible. In general, domestic responsibilities are a woman's job, making them responsible for the provision of household energy.

From the responses of the women, it was clear that the primary household heating and cooking energy they currently utilise is *tiftif*, substantiated by charcoal. *Tiftif* is a type of homemade household energy used by women. In order to prepare *tiftif*, all of the women testified to using the same ingredients, namely clay soil, miniature charcoal, water, and ash. They also follow a similar preparation procedure. First, they put the clay soil into water for some time to make it wet and smooth, then mix one handful of the wet soil with two handfuls of charcoal. They form circular shapes with the mixture, and sprinkle ash onto these to prevent the *tiftif* from cracking and sticking onto the surface, when left to dry. The *tiftif* is then spread on an open surface to dry. Sunshine is an important ingredient, just like the others, because the drier the *tiftif* is, the more efficient it is when burnt.

Previously, eight of the respondents used kerosene for cooking while two respondents used charcoal. However, the increase in price of energy fuel, especially kerosene, compelled the women to begin making and using *tiftif* as an alternative source of household energy. Regarding electricity, almost all the respondents had never used it for cooking. In general, the impetus that drives the women into cutting off their expenditure on kerosene and charcoal is their poor economic status, coupled with the increasing price of both modern and traditional biomass energies, a clear manifestation that these women are victims of energy poverty.

From their responses, it was evident that these women use *tiftif* because it is cheaper, homemade and easily accessible. Except for Tirunesh who uses electricity, five of the women use firewood for baking *injera*, whereas the other four purchase *injera* for their daily household consumption because they lack the baking space and baking pan, and/or the price of *teff* is unaffordable.

3.2.1. The Genesis of 'Tiftif'

Two different responses emerged concerning the origin of *tiftif*. One is an oral story which explains that *tiftif* has been produced and used since the time of Emperor Haile Selassie's¹¹ regime in Addis Ababa, around *Aware*¹² area. Menbere told the story like this:

“During Emperor Haile Selassie’s regime, there were two housemaids in Yeka sub-city who used to work in an Indian household. These women are said to have imported the practice of *tiftif*-making from the Indians to their own homes and used to get money out of it. Although these women faced challenges of acceptance from the society to buy the *tiftif* at first, they were able to manage the market and perhaps transfer the knowledge and skill to neighbouring communities. That is why there are more women in Yeka sub-city who produce *tiftif* than anywhere else” (Menbere, Fieldwork respondent, May 30, 2012).

In relation to this story, nine of the respondents confirmed that they learned to make *tiftif* from neighbourhood women, who used to make *tiftif* before them or along with them. Selas has been involved in the production and consumption of *tiftif* for about 13 years, whereas Abebech got involved five months ago. The majority of the respondents have been producing *tiftif* for between two and nine years.

On the contrary, Tirunesh who started making *tiftif* five years ago gives due weight to the indigenous knowledge she acquired from the society she grew up in. She said she did not learn to make *tiftif* from anybody else but from the recollection of her childhood experience with clay soil.

Concerning the raw materials used in preparing the *tiftif*, they revealed that they purchase charcoal from retailers, with the average price being 15 up to 45 *birr*, depending on the size of the quintal, whereas they fetch clay soil, for free, from any place where a pile of soil is dumped from construction sites. Regarding water, all the respondents do not have water taps of their own. As a result, nine of them purchase water from communal pipe lines while Menbere relies on the generosity of her neighbours. Natural resources are accessible to everyone, by default, but fair distribution is affected by human as well as natural factors. The women in this study have access to natural resources such as clay soil, rainwater and solar heat. These natural assets are ingredients used by the women to produce *tiftif*. However, it is doubtful whether accessing these natural resources is performed sustainably, raising concerns of natural resource management.

All the respondents indicated that they prepare the *tiftif* either in the morning or in the late afternoon because making it during daytime is difficult, as the sun becomes very strong. Depending on the size and quantity of the *tiftif*, it only takes an average of two hours to prepare the mixture to be scorched. However, it takes the whole day for the wet *tiftif* to dry out and be prepared for consumption. Furthermore, the women also revealed that they make the *tiftif* once every three days because they have to regain the money they spent on purchasing the ingredients, which is required to produce more *tiftif*. In order to do so, they have to finish selling all the *tiftif* they make for the market. Additionally, because they walk a long distance, carrying the miniature charcoal and clay soil on their shoulders, it is physically impossible for them to produce *tiftif* on a daily basis.

3.2.2. The Purpose of 'Tiftif'

When asked about the factors that made the women start making *tiftif*, poverty and financial insecurity were at the centre of their inclination towards *tiftif*-making. However, the purpose of making the *tiftif* varies among the women. Thus, seven of the respondents started making *tiftif* for both household consumption and income-generation. The rest— Azalech, Menbere and Selas— started to make *tiftif* in reaction to the energy shortage experienced in the household. However, later on, except for Menbere, they started to produce *tiftif* for sale as well.

The women sell the *tiftif* at different prices, based on the size. The average diameter of one piece of *tiftif* is 14 centimetres; hence, a relatively large *tiftif* would be sold for 75 cents whereas three relatively small pieces would be sold for 1 *birr*. However, none of these women have a place in the market or a shop where they sell the *tiftif* but they use their own houses for production as well as sale.

Without calculating the cost of their labour, the women who make *tiftif* for the market generate some amount of income. All the women did not know how much money they made per day or weekly or monthly as they spend the money from *tiftif* sales on their immediate day-to-day household consumption, and since all of them do not have a stable monthly income, they are unable to purchase monthly household goods. As a result, they are forced to buy their day-to-day necessities with the money obtained from *tiftif* sales and other income-generating activities they undertake such as braiding, catering and washing clothes.

However, Selas, Kelem and Yeshi have started saving with other women in their neighbourhood, in the form of *iqub*¹³ and *mahber*.¹⁴ Selas said that she is saving the money to rebuild her plastic shelter whereas Kelem has bought household accessories with the money she gets from her savings. Yeshi, on the other hand, pays her house rent from the *iqub* she makes every month.

3.2.3. The Efficiency of 'Tiftif'

The efficiency of energy can be measured using factors such as time consumption, safety, smoke reduction, house heating, convenience, and food taste (Messeret 2011). The time the *tiftif* takes to cook is identified in terms longevity. All the respondents stated that the time *tiftif* remains burning depends upon factors such as the size and dryness of the *tiftif*. Thus, two small pieces of *tiftif* which are equivalent to one big piece can stay lit, cooking for five hours, on average. Moreover, the amount of energy emitted by *tiftif* gets stronger when the *tiftif* is well dried. The respondents also revealed that *tiftif* does not need any backup energy to burn except to ignite it. Thus, in order to ignite the *tiftif*, the women use a couple of pieces of charcoal, to facilitate the process. Moreover, the women use the *tiftif* for any cooking, heating and warming purposes in the household.

Taking into account the time used during consumption, *tiftif* has two interrelated benefits. On the one hand, the women use *tiftif* for all their cooking and heating activities, without any hassles, hence inculcating a sense of stability because they can simultaneously carry on with other household chores, alongside cooking. On the other hand, *tiftif* does not take a long period of time to cook or heat but it emits a proliferate amount of heat, to get any kind of food or drink prepared in good time, and decreases the amount of time women spend on cooking.

Nevertheless, in terms of production, all the women preferred to use either kerosene or charcoal because they do not have to exert any energy and money in production. However, when it comes to *tiftif*, the production process is manual, time-consuming and labour-intensive, which is challenging for the women, considering their adult age and weaker physical strength. They also stated that they would prefer kerosene because it does not take time to heat up like *tiftif* does. Zuriyash elaborated: Of course kerosene is much better in terms of urgency. But when it comes to efficiency, *tiftif* is better because it does not run out soon though it takes time to heat up. (Zuriyash, Fieldwork respondent, May 28, 2012).

In addition, these women put the taste of the food or drink prepared with *tiftif*, kerosene and charcoal as a crucial factor, and chose *tiftif* and charcoal. Zuriyash said:

The taste is much better when I make *wot* using *tiftif* and charcoal than kerosene. (Zuriyash, Fieldwork respondent, May 28, 2012).

Regarding safety and convenience, all of the respondents stated that one of the reasons they prefer utilising *tiftif* is because it does not expose them to danger, and mentioned two important factors about the safety of the *tiftif*. One, *tiftif* does not have disturbing and polluting smoke like kerosene and charcoal. Azalech explained:

No, it does not have smoke. I even bring the lit *tiftif* in the house for warmth and no accident has happened” (Azalech, Fieldwork respondent, May 28, 2012).

Two, *tiftif* is not explosive like kerosene. Menbere’s response is self-explanatory.

I prefer *tiftif* to kerosene because the smoke of kerosene is not good for my eyes, and I believe it is more dangerous and explosive. (Menbere, Fieldwork respondent, May 30, 2012).

These factors provide the rationale for the women to utilise *tiftif* from any situated time and space in their households.

3.4. The Impact of *Tiftif* on Women’s Lives

Clancy, Skutsch and Batchelor (2002) argue that addressing household energy issues improves women’s practical, productive and strategic needs.

For instance, providing women with improved household energy saves their time and labour; increases their productivity and income-generating activities; improves their health and working conditions; and provides them with the opportunity for information communication, political and social engagements, all of which are vital ingredients of empowerment.

Although the meaning of empowerment is contested, it is understood that it is a process, not an end. Empowerment is not what people receive, but something that has to come from “within”. It also comprises the personal, interpersonal and collective dimensions and scale of human life (Chant 2007). In this regard, it is necessary to deal with women’s empowerment in relation to the impact of *tiftif* on their lives.

3.4.1. Economic Impact of ‘Tiftif’

The interrelated economic and social benefits of *tiftif* to women are threefold. First and foremost, by converting their human capital such as their skills, and social capital such as their children’s labour, into the production of *tiftif*, the women are able to generate income for their households. Second, because the women started using *tiftif* for their own household energy consumption, they are able to change their energy expenditure pattern by cutting off the expenditure on other energy fuel previously used, and saving the money. Many of the women used to utilise kerosene and charcoal for household energy consumption until the price became unaffordable.

The women who sell *tiftif* stated that besides its importance for household consumption, the additional profit made from selling *tiftif* is insufficient to transform their life styles, yet it enables them to sustain their subsistence and decision-making power in the household. Thus, they do not experience problems in providing their families with daily basic needs, one of which is food. In addition, their community role and relationships have been improved because they can participate in any activity that demands contribution of money.

Third, all of the respondents are able to participate more fully in the society and get involved in informal associations like *mahber* and *iqub*. In Ethiopian culture, involvement in such informal social associations requires regular contributions from members, in form of some amount of money. Accordingly, because the women get some money from *tiftif* and other activities, they are able to initiate and sustain their involvement in informal associations.

The respondents stated that making money from their own labour has boosted their self-worth because they are no longer just passive victims of a poor economy, but have become agents of change, which makes them develop a sense of ownership in the household. Monetary assets available to the women are derived either from their formal or informal employment, access to pension or credit schemes and other irregular sources of income. Accordingly, except for one, nine of the respondents do not have formal

employment or an occupation but are engaged in informal income-generating activities, such as selling *tiftif* and charcoal, braiding hair, catering, or washing clothes, which are not an enduring means of sustaining livelihoods. In examining the women's access to credit and pension, it is clear that none of them has access to such facilities. Financial assets serve as a springboard to accessing other assets, and secure energy needs and livelihood. This finding has a similar connotation with a research finding on Nigerian women's livelihoods (Jaiyebo 2003), which indicates that access to finance creates access to social assets, physical assets (housing and transport), human assets (good health, skills and education) and even natural assets (land and water).

With regard to social assets, it was seen that men's engagement in *tiftif* production is negligible. According to the married women respondents, their husbands do not put any effort or support into *tiftif*-making. However, these women also stated that they had never asked their husband for help because they believe that it is not a man's job, as explained by Zuriyash. Almost all the respondents indicated that they had never known a man to make *tiftif* in their community. In addition, the women revealed that their main customers are women and men seldom purchase *tiftif*.

Albeit the lack of support from their husbands, many of the women use their social assets to engage in income-generating activities. For instance, Werkhat, Kelem, Yeshe and Selas engage in extra income-generating activities using their social networks, labour and skills, such as catering, braiding and washing clothes, which make them financially able and productive. In the case of Enanu, she engaged her children, both male and female, in income-generating activities such as, helping in domestic activities, selling *kolo* and shoeshinning. This finding supports the findings of other studies such as Mulumebet cited in Emebet (2008). Mulumebet stated that in order to cope with poverty, women engage in petty trading, selling homemade breads and drinks. Women also engage their children in similar activities.

Unfortunately, out of the ten respondents, it is only Selas who is legally associated with women in her neighbourhood for business purposes. The *kebele* provided Selas and her neighbourhood women with a small shop and credit facilities. With these resources, the women were able to engage in the food industry. This association paved the way for Selas to join a savings group, which is a social support system offering members new exposure in terms of information and alternative job opportunities.

3.5. Challenges of *Tiftif* Production

In relation to production, marketing and consumption of *tiftif*, the women face many human-made and natural challenges. One challenge faced by the women is lack of space as all the women live in shanty and squatter areas, where they do not have a space of their own to mix and lay down the wet *tiftif* to dry out but have to use public lanes instead. Kelem said:

I am always frustrated when I am making *tiftif* because the place I make *tiftif* is a communal yard where people discharge dirty water and urinate on. I had to put my dignity behind to overcome my problems. (Kelem, Fieldwork respondent, May 30, 2012).

Another challenge the women face is in bringing the raw materials home. All the respondents carry the soil and miniature charcoal to their homes from distant sites. They have to carry the clay soil and charcoal on their back and walk very long distances, struggling with exhaustion. Even if they wanted to use taxis and buses for transportation, the prices are difficult to bear. In addition, the taxi and bus drivers do not permit their entry as the dust and dirt on the women is a discomfort to other passengers and spoils the cleanliness of the vehicles. This leaves the women with no option but to carry the raw materials on the back.

Another challenge is that the dust from the charcoal and soil is a cause of respiratory and sight infections. In order to prevent this problem, some of the women sprinkle water on the charcoal and soil. Yeshi said:

The challenge I encountered was the dust that comes out of the miniature charcoal when I am clearing it before mixing it with the wet soil. I used to have a throat pain because of the dust but now I am putting a little amount of water to make the dusty charcoal wet so that there is nothing hurtful. (Yeshe, Fieldwork respondent, May 29, 2012).

One of the natural challenges faced by the women is the rainy weather that brings other interrelated problems for the women. In order for the *tiftif* to dry out, it requires the sun's heat, which is impractical during *kiremt*.¹⁵ The rainy weather makes it difficult for the women to collect the ingredients from distant sites, which in turn affects the quantity and efficiency of the *tiftif* as it deteriorates due to lack of sufficient heat from the sun, on the one hand, and on the other hand, the quantity of the *tiftif* decreases, both for household consumption and for the market. A coping mechanism deployed by the women to overcome this energy scarcity for household consumption is compromising the quantity of *tiftif* for the market during *bega*¹⁶ and accumulating it for *kiremt*.

Except for Menbere, the women also face challenges in their time-use because all the respondents, both married and unmarried, have children and elderly family members to take care of. Many of them experience time-use problems because they have to spend an average of two hours in *tiftif* production in the morning, and at the same time, they have to prepare their children and grandchildren for school. In the process, they miss a suitable time for making *tiftif* while engaged in their social reproduction roles. Azalech said:

Having unemployed husband by itself is a challenge for me in addition to taking care of my elderly mother and a child. (Azalech, Fieldwork respondent, May 28, 2012).

None of the respondents own a shop in the marketplace; hence, the *tiftif* they make for sale is inaccessible to the majority of the population. Consequently, only those who know the whereabouts of the *tiftif* can purchase it. In relation to finance, the women are not motivated to produce *tiftif* in large quantities because of their financial insecurity and their fear of not finding accessible markets and customers. Additionally, the women are unable to access credit facilities from microfinance institutions and credit associations mainly due to absence of collateral, which in most cases requires ownership of tangible assets. This finding is similar to a claim that women account for 38 per cent of microfinance clients yet they are estimated to own two-thirds of informal micro-enterprises (Association of Ethiopian Micro-Finance Institutions [AEMFI] cited in MoFED (2006).

However, with regard to market, the women sell *tiftif* to some retailers, majority of whom are males, who have access to the market and own shops. Without calculating the cost of their labour and the price of the raw materials purchased to produce *tiftif*, the women receive less benefit than the retailers who never had to add any value into the *tiftif*. According to MoFED (2006), women tend to have little or no access to organised markets, credit institutions, modern technology, formal training, and many public services and amenities due to the male-dominated market structure. Lack of formal education, stereotypes, and reproductive and community roles further restrict women's full participation in the economy.

Another challenge faced by the women is the manual nature of *tiftif* production. Except for Menbere who has no child, all the others have to spend their time and energy caring for their children. In addition, looking at the age of the respondents, most of them are in the adulthood phase, with a physically weakened status due to low quality of life and poor health conditions. All these factors hinder the women from being more fully engaged in the production and sale of *tiftif*. Abebech explained:

Because *tiftif*-making is manual, it is very exhausting; it takes every muscle and energy of my body. I don't have the strength to make the *tiftif* in large quantity for sale. (Abebech, Fieldwork respondent, May 28, 2012).

Despite the natural, human, physical, social, and economic challenges these women face in *tiftif*-making, and in sustaining their livelihoods, they persevere to go further and prolong their homemade businesses. As challenges get more serious, the women come up with innovative solutions to the challenges they face. Werkhat's concluding remark is a good example of how women are active in converting challenges into opportunities, hence sustaining their livelihoods and self-worth.

For me, making my own income makes me powerful. It makes me feel good about myself because I never expect anyone to provide for me ever since I started this business. (Werkhat, Fieldwork respondent, May 29, 2012).

4. Conclusions and Recommendations

4.1. Conclusions

The main objective of this research was to explore the coping mechanisms deployed by women of Yeka sub-city, to adapt to their household energy challenges, in demand and consumption. A semi-structured in-depth face-to-face interview, relying mainly on open-ended questions, was administered. While changes in energy supply affect everyone, women are affected far more than men. The traditional responsibilities of women and girls as food growers, water and fuel gatherers, and caregivers, connects them more firmly to energy hardships and makes them more likely to be impacted.

All the respondents stated that they are responsible for their household domestic chores and provision of household energy. The primary household heating and cooking energy they utilise is *tiftif*, substantiated by charcoal. The women use *tiftif* because it is cheaper, homemade and easily accessible. The response of the women revealed that poverty and financial insecurity have forced them to start making *tiftif*.

Regarding how the women started making *tiftif*, two different stories are presented in the analysis. Nine of the respondents confirmed that they learned how to make *tiftif* from neighbourhood women, while one began to make *tiftif* by recollecting the indigenous knowledge of her childhood.

The majority of the respondents had been involved in the production and consumption of *tiftif* for between two and nine years. Almost all the respondents use *tiftif* for both their household consumption and for the market. The women sell the *tiftif* at different prices based on the size. Without calculating their labour, the women who make *tiftif* for the market generate some amount of income, which they spend on immediate day-to-day household needs and consumption due to their economic instability and inability to purchase monthly household goods. In addition, many of the women are engaged in other income-generating activities such as braiding, catering, and washing clothes, in order to supplement their *tiftif* income.

The efficiency of *tiftif* was explained according to different criteria. Primarily, *tiftif* only needs a couple of pieces of charcoal to be ignited. Moreover, the women use *tiftif* for any cooking, heating as well as warming purposes in the household. In relation to time consumption, *tiftif* has two interrelated benefits. On the one hand, the women use *tiftif* for all their cooking and heating purposes, without any hassles, which inculcates a sense of stability as the women can perform other household chores, alongside cooking and heating. On the other hand, *tiftif* does not require a long period of time, to cook or heat food and drinks, but emits a prolific heat that gets any kind of food or drink prepared in time, which decreases the amount of time women spend in cooking, hence availing time to be engaged in other productive activities.

Regarding safety, the reasons the women prefer utilising *tiftif* is because it does not expose them to danger. The women do not experience disturbing and polluting smoke from *tiftif* as they did with kerosene and charcoal. Likewise, *tiftif* is not fatally explosive like kerosene. Another important factor the women pointed out was the fact that kerosene and charcoal are expensive and unaffordable, and do not meet additional economic purposes besides household consumption, unlike *tiftif*. Moreover, these women stated the delightful taste of the food or drink prepared with *tiftif* as a criterion for preference. However, taking the manual production of *tiftif* into consideration, the women prefer to use either kerosene or charcoal as they do not have to exert any effort to produce or utilise these other forms of energy fuel.

Other than addressing household energy issues that improve women's practical, productive and strategic needs, *tiftif* has brought interrelated economic and social advantages to the women. First, by converting their human capital such as skills, and social capital such as their children's labour, into the production of *tiftif*, the women are able to generate income for their households. Second, because the women started using *tiftif* for their own household energy consumption, they were able to cut off their other household energy expenditure and use the money for other purposes. On one hand, all the women are able to participate more fully in the society and get involved in informal associations such as *mahber* and *iqub*, where they access information as well as social, moral and financial support. The respondents stated that making money out of their labour has boosted their self-worth as they have demonstrated to the community that they are not just passive victims of a poor economic system but are agents of change as well.

The women face both human-made and natural challenges, including lack of space as all the women live in shanty and squatter areas; lack of transportation facilities; exposure to the dangerous dust from the charcoal and soil, which causes respiratory and eye infections; rainy weather hinders effective drying of *tiftif*; lack of access to markets, which renders *tiftif* inaccessible to the majority of the population; financial insecurity; imbalanced time-use in taking care of domestic responsibilities and attending to income-generation activities; and the manual production process of *tiftif*, which is time consuming and labour intensive. However, it can be seen that these women are not just passive victims of natural and human-made challenges but they respond to these challenges with different approaches, to fulfil their intense desire for self-sufficiency. The women, for instance, accumulate *tiftif* during *kiremt* for household consumption, and devise mechanisms to reduce the side effects on the eyes and respiratory organs.

With regards to assets, the women are deprived of access to, control over and ownership of resources, and lack secure financial status and entitlements. However, irrespective of ownership and sustainability

limitations, the women make use of available natural resources such as soil and sunshine; human resources such as their skills, knowledge and ability to work; and social networks in the household as well as informal relationships with other women, through *iqub* and *mahber*, and actively convert these into a sustainable livelihood and alternative access to energy.

4.2. Recommendations

This study sheds light on the energy demand of poor Ethiopian women in general, and the urban poor, in particular. Therefore, an intervention strategy to overcome energy poverty in Ethiopia needs to integrate a holistic approach to women's vulnerability, agency and coping strategies. Policymakers, institutions and organisations should explore *tiftif* further, to identify the following gaps:

- How can access to, and demand of, modern and improved household energy, for urban poor women be addressed?
- What is the implication of *tiftif* on the environment, natural resource utilisation and degradation?
- Is there a possibility of compromising the negative and positive aspects of *tiftif*, in making it more humane as well as an environmentally-friendly alternative household energy source?
- What do these research findings tell us about the differential impact of the government's development interventions, infrastructure expansion work, investment schemes, and resettlement projects on men and women?
- Is there a way to think of *tiftif* as a national intervention, to address both rural and urban household energy needs, at large?

Notes

1. The author of this research is very much grateful to Mr. Daniel Abraham, lecturer, Economics Department, Arbaminch University, for his unlimited support and contribution in conducting this study.
2. *Injera* is flat pancake-like bread, commonly made of locally grown grain called *teff*.
3. *Kebele* is the lower administrative unit in the city of Addis Ababa.
4. *Mitad* is an *injera* baking pan
5. *Teff* is flour from locally grown grain, which is used to bake *injera*.
6. *Kolo* is roasted grains made of bean, wheat or corn.
7. *Tella* is a home-brewed alcoholic drink.
8. *Wot* is a sauce to be eaten with *injera* or bread.
9. Moghadam (2005) categorised female-headed households in two forms. The first one is *de jure* female-headed households, whereby the women maintain their households alone, while the second one, known as *de facto* female-

headed households, may include men who are unable or unwilling to work. Moreover, female-headed households may consist of elderly women (widowed or divorced) with no dependents or younger women (divorced or never-married) with dependent children.

10. Ethiopian currency.
11. Emperor Haile Selassie was the last emperor of Ethiopia, 1930–1974.
12. Aware is one of the districts located in Yeka sub-city, Addis Ababa.
13. *Iqub* is an indigenous saving scheme where members contribute a certain amount of rotating money per week or monthly, to be given to a member who is picked out randomly using a lottery method, until all the members have received the money.
14. *Mahber* is a religious as well as secular association in which members get together on a settled day regularly, to share meals and contribute money to be used to support members and their families during times of death and weeding.
15. The rainy and coldest season of the year in Ethiopian calendar.
16. The warmest season of the year in Ethiopian calendar.

References

- Barnett, A. 2001. Looking at household energy provision in a new way: The sustainable livelihoods approach. *Boiling Point*, 46 (Spring).
- Carol, A. B. 2007. *A guide to qualitative field research*. 2nd edition. CA: Pine Forge Press.
- Central Statistical Agency (CSA). 2004. Report on urban informal sector sample survey. Addis Ababa, Ethiopia.
- . 2007. *The 2007 population and housing census of Ethiopia: Statistical abstract*. Addis Ababa, Ethiopia.
- Chant, S. 2007. Contribution of a gender perspective to the analysis of poverty. *In: Women and gender equity in development theory and practice: Institutions, resources, and mobilization*, edited by J. Jaquette and G. Summerfield, 87–106. NC: Duke University Press.
- Clancy, J. S., Skutsch, M. and Batchelor, S. 2002. *The gender-energy-poverty nexus: Finding the energy to address gender concerns in development*. Retrieved June 3, 2012, from doc.utwente.nl/59061/1/Clancy99gender.pdf.
- Emebet, M. 2008. Negotiating poverty: Problems and coping strategies of women in five cities of Ethiopia. *In: Urban poverty in Ethiopia: The economic and social adaptations of women*, edited by E. Mulugeta, 9–72. Addis Ababa: Addis Ababa University Press.
- Ethiopian Rural Energy Development and Promotion Centre. 2002. *Profile of energy development activities in the country*. Addis Ababa, Ethiopia.
- Feleke, T. Alula, P., Philippa, B. and Lavers, T. 2006. 'Migration and rural-urban linkages in Ethiopia: Cases studies of five rural and two urban sites in Addis

- Ababa, Amhara, Oromia, and SNNP Regions and implications for policy and development practice'. Irish Aid Ethiopia.
- Haregewoin, C. and Emebet, M. 2002. *Country gender profile Ethiopia*. Addis Ababa: Swedish International Development Cooperation Agency (Sida).
- Jargstorf, B. 2004. Renewable energy and development. Deutsche Gesellschaft für Technische Zusammenarbeit and Ethiopian Rural Energy Development and Promotion Centre, Addis Ababa, Ethiopia.
- Jaiyebo, O. 2003. Women and household sustenance: Changing livelihoods and survival strategies in the peri-urban areas of Ibadan. *Environment and Urbanization*, 15(1): 111–120.
- Lefebvre, F. 2002. Heated talk on energy. *Courier ACP-EU*, 194: 15–17.
- Messeret, L. 2011. 'Assessment of household energy project from a gender perspective: The case of GTZ-supported *Mirt* dissemination project in Bahir Dar City'. Addis Ababa: Addis Ababa University press.
- Mildred, L. 2005. *Understanding research methods: An overview of the essentials*. 5th Edition. CA: Pyrczak Publishing.
- Ministry of Finance and Economic Development (MoFED). 2006. *Ethiopia: Building on progress. A plan for accelerated and sustained development to end poverty (PASDEP) (2005/06-2009/10)*. Volume I: Main Text. Addis Ababa.
- Ministry of Water and Energy. 2012. *Scaling-up renewable energy programme. Ethiopia investment plan*. Addis Ababa.
- Moghadam, M. 2005. *The feminization of poverty and women's human rights*. Paris: UNESCO.
- Momson, J. 2010. *Gender and development*. 2nd Edition. London: Routledge.
- Muzzini, E. 2008. *Urban poverty in Ethiopia: A multifaceted and spatial perspective*. Washington, D.C: World Bank.
- Rai, G. D. 2004. *Non-conventional energy source*. 4th edition. New Delhi: Khanna Publishers.
- Reddy A. K. N. 2000. 'Energy and social issues'. *In: World energy assessment*. NY: UNDP. Samson, K. 2008. Urban poverty in Ethiopia: Problems and prospects for improvement. *Journal of African Development Studies*, 1 no. 1: 104–134.
- United Nations Development Programme (UNDP). 2004. *Gender and energy for sustainable development. A toolkit and resource guide*. N.Y.: UNDP.
- . 2007. Will tomorrow be brighter than today? Addressing gender concerns in energy for poverty reduction in the Asia-Pacific region. Regional Energy Programme for Poverty Reduction. Bangkok: UNDP Regional Centre.
- World Bank. 2006. *Ethiopia: Country gender profile*. Washington, D.C: World Bank.
- World Health Organisation (WHO). 2004. Indoor air pollution, health and the burden of disease. Retrieved June 3, 2012, from www.who.int/entity/indoorair/info/briefing2.pdf.

CHAPTER NINE

Gender-Sensitive Clean Energy Technologies for Sustainable Development amongst Pastoralist Maasai Communities, Kenya

Truphena E. Mukuna

Abstract

According to the World Bank women of all developing countries spend 2–9 hours a day collecting fuel and fodder, and performing cooking chores. This becomes a burden to women. Since in many low- and middle-income countries women are the primary energy managers in households and communities, involving women in the various steps of the energy value chain can expand both the scale and the quality of sustainable energy initiatives. More than half of the world's households cook with wood, animal waste, crop residues and untreated coal. Population increase and the resultant environmental degradation has severely impacted the traditional biomass-based energy sources, especially in rural areas and because the responsibility for nearly every aspect of the domestic energy system rests squarely on the shoulders of the rural women, they are by far the most significantly affected by ever increasing fuel scarcity. Among the pastoralist Maasai, women have taken to charcoal burning and selling as an alternative source of livelihood to adapt to climate change and the lack of formal social protection. Charcoal selling and burning is the main socio-economic activity for Maasai women in Kajiado and Narok Counties. They also use the same biomass in their poorly ventilated houses to cook. This exposes them to pollution and respiratory tract infections. Inasmuch as they have a variety of renewable energy options that are environmentally friendly, they lack capital for initial installation of solar, wind pumps or electricity. Additionally, the National Energy policy is silent about the plight of women who bear the brunt of energy poverty. It singles out lack of capacity as a major challenge to adoption of renewable energy technologies but does not zero in on women as a critical concern. Further, studies on gender, energy and poverty in Kenya have not explored the clean energy technologies; leave alone the pastoralist women who are very vulnerable to the impact of climate change. This chapter fills this gap in knowledge by reporting a best practice initiative by an NGO called Centre for Livelihoods Opportunities Unlimited Technologies on innovative clean energy technologies among the Maasai Pastoralists in Kenya.

1. Introduction

It is estimated that 70% of the 1.5 billion people living on less than a dollar a day are women (Pius *et al.* 2013). According to the World Bank (2001) women of all developing countries spend 2–9 hours a day collecting fuel and fodder, and performing cooking chores which becomes a burden to women (UNDP 2004; UN 2012). Since in many low- and middle-income countries women are the primary energy managers in households and communities, involving women in the various steps of the energy value chain can expand both the scale and the quality of sustainable energy initiatives. More than half of the world's households cook with wood, animal waste, crop residues and untreated coal. Population increase and the resultant environmental degradation has severely impacted the traditional biomass-based energy sources, especially in rural areas and because the responsibility for nearly every aspect of the domestic energy system rests squarely on the shoulders of the rural women, they are by far the most significantly affected by ever increasing fuel scarcity (*ibid.*). Furthermore, it has been shown that taking women's needs into account as a key variable in energy interventions makes it more likely that energy will have a significant impact on household and community poverty and on gender equality. Without significant political commitment and investment, energy poverty is set to deteriorate even further over the next 20 years (Danielsen 2012).

Access to energy is a critical enabler for economic and social development. Once communities have access to modern energy services, the impact on human development is significant: from cleaner indoor air and improved health to more income generating opportunities and more time for other pursuits (Mugo and Gathea 2010). Moreover, promotion of renewable energy technologies has the potential of increasing access to modern energy services in rural areas that currently have no access to grid electricity and pay higher prices for energy service delivery because of the transportation costs and inefficiency of traditional energy forms (UNIDO 2009). Moving directly to smaller-scale, renewable energy systems such as stand-alone systems of wind and solar energy can provide communities with affordable energy, promote productivity and help in creating employment by empowering enterprises for both the rural and urban poor.

At the same time, large-scale, renewable energy systems based on hydropower, modern clean biomass, geothermal, wind or solar energy can diversify energy supply, reduce energy imports and provide significant local and global environmental gains (UNIDO 2009; IEA 2011a; IEA 2011b). Because of the gendered nature of energy poverty, access to modern, sustainable energy can also significantly enhance the empowerment of women by reducing their time and labour burdens, improving their health, and providing them with opportunities for enterprise and capacity building. Access to clean, affordable, sustainable energy is thus an enabling factor for economic development and poverty

reduction as well as for achievement of internationally agreed development goals, including ensuring environmental sustainability and promoting gender equality. And also, access to energy services can be argued to be a human right in itself (IGAD 2007; WHO 2010; Biogas for Better Life, An Africa Initiative 2007).

The Kenya National Energy Policy underscores the importance of adoption of clean energy technologies for sustainable development (RoK 2012). The Kenyan rural population is highly dependent on biomass for fuel. Natural resources management institutions have put in some effort in addressing the energy challenge by raising concern on the higher levels of forest depletions (NEMA 2009, 2008; NFA 2005). The recommendation of the natural resources management institutions has been to plant more trees to replace the forest cover lost through biomass harvesting for energy. Use of biomass in rural households burdens the women and the girl-child whose gendered roles expect them to collect firewood and cook for the family.

Among the pastoralist Maasai, women have taken to charcoal burning and selling as an alternative source of livelihood to adapt to climate change and the lack of formal social protection (Mukuna 2013; Njiru 2013). Charcoal selling and burning is the main socio-economic activity for Maasai women in Kajiado and Narok Counties (*ibid.*). They also use the same biomass in their poorly ventilated houses to cook. This exposes them to pollution and respiratory tract infections (Practical Action 2006). In as much as they have a variety of renewable energy options that are environmentally friendly, they lack capital for initial installation of solar, wind pumps or electricity. Additionally, the National Energy policy is silent about the plight of women who bear the brunt of energy poverty. It singles out lack of capacity as a major challenge to adoption of renewable energy technologies but does not zero in on women as a critical concern. Further, studies on gender, energy and poverty in Kenya have not explored the clean energy technologies; leave alone the pastoralist women who are very vulnerable to the impact of climate change.

This chapter is a desk research that sheds light on the gender, energy, poverty, and climate change nexus. The policy question that this study seeks to answer is “What interventions have been put in place in Kenya to leverage gender and energy poverty in the context of sustainable development?” This analysis has been guided by the system thinking concept by Haraldsson (2004). It explains the energy and gender crisis, analysis of gender roles in the energy perspective, climate change and energy, renewable energy and sustainable development, status of renewable energy in Kenya, effects of biomass use, and innovative gender-sensitive clean energy technologies that have been introduced to pastoral Maasai women in Kajiado and Narok counties. The rationale behind this chapter is to up-scale the work that CLOUT started of clean energy technologies for the vulnerable Maasai community so as to develop resilience to the impacts of climate change and also conserve the environment. I also hope to inform

policy makers to mainstream gender in the National Energy Policy and legislation because of the socio-economic benefits that go with it. Lastly, I hope that this chapter will generate further debate that will be useful in the Post-2015 discussions on Sustainable Development Goals where gender, energy, poverty and climate change are positively correlated.

1.1. Statement of the Problem

Energy policies and programmes that recognise women's work and roles in the energy sector, and build on their expertise and influence within households and communities, can be effective in promoting access to sustainable energy solutions for all (ENERGIA 2007). Women's involvement in the design of sustainable energy solutions, for instance, can help to ensure that solutions are tailored to women's needs, and women's engagement in distribution and marketing can help to encourage the use of sustainable energy services by providing other women with comfortable spaces within which to learn about technologies and discuss their particular concerns (Gill *et al.* 2007). Thus, where energy interventions address women's equal participation, the potential for benefits is much higher for all (ENERGIA/DfID 2006). Modern energy access acts as a catalyst for development in education, health, food security, productive enterprise, environment and participatory democracy that in turn supports further improvements in energy access (Smart Villages Initiative, July 2014).

International Energy Agency (IEA) has clearly stated that the current global trends in energy supply and consumption are patently unsustainable (IEA 2008). Heavy dependence on biomass fuel has led to wood fuel scarcity and increased opportunity costs due to the additional time spent collecting fuel wood (Mugo and Gathea 2010). As such, there is an urgent need to reduce dependence on oil and biomass (*ibid.*). In Kenya, wood fuel accounts for 68% of the total primary energy consumption. This consumption is higher in rural areas where it is estimated to be 80% (UNEP 2006; RoK 2012). This explains the reason behind Kenya's low forest cover of 1.7% (Masinde and Karanja 2011) against the world's recommended 10% (GoK 2011). Lack of a lead agency to spearhead renewable energy development compounds with absence of local credit schemes and financing mechanisms and inadequate public awareness on the economic opportunities offered by renewable energy and renewable energy technologies (RoK 2012). Further, capacity building programmes for players in renewable energy technologies in collaboration with training institutions and the energy centres are minimal. A master plan for renewable energy that involves all stakeholders including financiers, women, and experts in energy and key ministries is lacking.

In pastoralist communities, lack of formal social protection targeting them to improve their livelihoods has made most of the women to turn to wood selling and charcoal trade (Mukuna 2013; Njiru 2013). Most of these pastoralist rural women lack awareness and information regarding climate change and the most effective and sustainable ways of coping with their

situation (*ibid.*; Oxfam International 2005; NEMA 2007). A study carried out in Narok County on Micro-finance and women empowerment (Mukuna 2012) revealed that most of the women who were financed by Kenya Women Finance Trust and Equity Bank were engaged in charcoal selling. It also revealed that 95% of the rural Maasai women lacked collateral for business loans. Studies on gender and energy have focused on gender poverty but omitted climate change. Moreover, pastoralist women communities that are very vulnerable to the impacts of climate change have been understudied. Despite these facts, women remain marginalized from decision-making processes in relation to energy, and gender-sensitive energy projects and research (ENERGIA/DfID 2006; Oxfam International 2005). There is, therefore, a significant need for policy makers, donors and international development organizations to engage women directly in policy making, project design and implementation of energy strategies, policies and programmes, as well as to develop gender-responsive policy frameworks that take women's needs into account. Efforts to mainstream gender in energy policies, programmes and projects in Kenya are urgent now.

1.2. Objectives

The specific objectives of the study were:

- i. to establish the status of household energy supply and use in Narok and Kajiado counties;
- ii. to investigate the impact of biomass on socio-economic development in the two counties; and
- iii. to document best practices on innovative gender-sensitive clean technologies by an NGO working in Kajiado and Narok counties.

2. Literature Review

2.1. Women and the Energy Crisis

Nexus between gender poverty, energy and climate change has been understudied. Recognizing that access to sustainable energy services is central to addressing many of today's global development challenges and for achieving sustainable development, a growing focus on energy as a key development issue has emerged within the international community (UN 2012). The outcome document of the 2012 UN Conference on Sustainable Development (Rio+20), "The Future We Want", called for commitments to specific actions to achieve sustainable development, including universal energy access, and the launch of a process to develop Sustainable Development Goals (SDGs) to be integrated into the successive framework of the MDGs.

In the context of the post-2015 development agenda, considerable attention is being drawn to issues of energy within the UN-system with, among others, the designation by the United Nations General Assembly of 2012 as

“International Year for Sustainable Energy for All”, and the Secretary-General’s “Sustainable Energy for All Initiative” (SE4ALL). The SE4ALL initiative aims to ensure universal access to modern energy services, double the global rate of improvement in energy efficiency, and double the share of renewable energy in the global energy mix by 2030 (http://www.un.org/wcm/webdav/site/sustainableenergyforall/shared/Documents/SG_Sustainable_Energy_for_All_vision_final_clean).

The International Renewable Energy Agency working paper elaborates how the UN Energy in collaboration with the SE4ALL initiative coordinates the “Global Thematic Consultation on Energy” that seeks to inform the design of the post-2015 agenda by means of a global online discussion, regional consultations, and a high-level meeting held in Oslo in April 2013 (IRENA REMAP 2012). The consultation process has led to, among others, a focus on the importance of gender considerations when working towards energy for all, and a proposal to extend the SE4ALL objectives with two additional targets: reducing by half the number of premature deaths due to indoor and outdoor air pollution; and providing modern energy services to 400,000 primary healthcare service providers in developing countries (IISD 2013).

Energy has an equity dimension: poor households use less energy than wealthier ones in absolute terms. Further, the energy-poverty nexus has distinct gender characteristics (UNIDO 2009). Gender roles of men and women, with their accompanying responsibilities, constraints, opportunities, and needs, are defined by a particular society. These roles change over time and vary widely within and across cultures. In many developing countries, women are particularly affected by lack of accessible and affordable energy services due to their traditional roles, household responsibilities, and low social and political status. The responsibility for household energy provision affects women’s health disproportionately to men’s. More than half of the world’s households cook with wood, animal waste, crop residues and untreated coal. Biomass collection to meet a household’s energy needs is the burden of women and girls. In rural areas, it can mean spending several hours a day collecting fuel wood loads of 20 kg or more. Men and women have different energy needs and may have different ideas about sustainable livelihoods. Men are mainly responsible for technical decisions and investments while the women have the responsibility for energy conservation. The energy divide is also gendered with women in most developing countries experiencing energy poverty differently and more severely than men (World Bank 2001).

Gender issues have come to the forefront in many development sectors including agriculture, forestry and water; but the energy sector has been slow to acknowledge the links between gender equality, energy and development (IPCC 2009). Energy must be an instrument for advancing economically viable, need-oriented, self-reliant and environmentally sound development — what is now referred to as sustainable development. Lack

of energy services is directly correlated with the major elements of poverty, including inadequate healthcare, low education levels and limited employment opportunities (Barnes 1995). Alleviation of poverty and the promotion of gender equity are the primary goals of sustainable development. Lack of access to affordable energy services is a serious barrier to sustainable livelihoods and emergence from poverty. Energy scarcity is a problem that has a disproportionate effect on women and girls. Thus, without access to modern energy services, women and girls spend most of their day performing basic subsistence tasks, including time-consuming and physically draining tasks of collecting biomass fuels, which constrains them from accessing decent wage employment, educational opportunities and livelihood enhancing options, as well as limits their options for social and political interaction outside the household (Danielsen 2012).

2.1.1. Gendered Roles and Energy Use

Gender issues have a key role in energy policies primarily because gender differences and inequalities have consequences for energy needs, use and priorities (Njiru 2013). In many developing countries women are particularly affected by lack of accessible and affordable energy services due to their traditional roles, household responsibilities, and low social and political status. The absence of gender in policy and practice is most evident in the energy sector. Further, the energy sector is also technical in nature and is characteristically male-dominated. According to Barbara Bamberger (2003), energy is an input to other sectors in Kenya. She observes that energy needs have been “invisible” and therefore ignored. This is also due to the absence or scarcity of sex-disaggregated data related to energy consumption and production. The gender divide with respect to energy needs becomes more obvious when one recognizes women’s role within the household and beyond, such as in agriculture, food processing, services and manufacturing, micro enterprises, and the local market and community. Further planners view energy as a technology-driven issue that is gender-neutral, that they do not recognize it as part of the poverty and economic development agenda (*ibid.*).

The gender variations in rural household energy management can be studied from the following four angles:

- 1. Division of Labour:** Women have always shouldered the responsibility of managing the household energy needs, playing a key role as the collectors, processors and users of biomass fuels. In rural areas of India, wide differences are known to exist in the work burden of men and women. While women are engaged for six hours daily in collection of fuel wood and fodder, and cooking, men spend approximately ten times less time on these tasks (World Bank 2000). Women are the chief repositories of knowledge concerning the use and management of trees and other forest products. Thus, their knowledge of ecosystem

management systems can provide significant contributions to energy planning processes.

2. Decision-Making: The decision-making structure in rural households is normally segregated along gender lines. In households where there are adult men and women, the gendered division of labour generally allocates to women the responsibility for household energy provision related to their spheres of influence in the household, in particular activities centred on the kitchen. Men are mainly responsible for technical decisions and investments while the women have the responsibility for energy conservation. Men will often decide on the stove technology if it is to be purchased (Tucker 1999). In many rural areas, acceptance and popularity of any technology by rural women are socially administered by the male head of the household (Hafeez 1998). In such situations, the success of any pro-women technology is largely linked to the parallel motivation and involvement of the family's male members with the technology itself and their involvement throughout the process.

3. Access and Control: Women and men have different degrees of access and control, especially with respect to biomass resources. In spite of the fact that women are closely involved with obtaining resources from the surroundings, they rarely have control over them (UNDP 2000). The lack of resources devoted to indoor air pollution has been cited as a sign of gender bias in the energy sector due to the fact that cooking is a major area of women's invisible work and women are the main group affected (UNIDO 2011).

4. Perception of Benefits of Energy Services: Women and men have different perceptions about the benefits of energy. For example, men see the benefits of electricity in terms of leisure, quality of life, and education for their children, while women see electricity as providing the means for reducing their workload, improving health, and reducing expenditure (Clancy and Skutsch 2003; Clancy 2002; Clancy, Skutsch and Batchelor 2002; Clancy *et al.* 2007). The benefits from modern energy carriers also have distinct gender aspects. For example, the evaluation of a rural electrification project in Tamil Nadu in India showed that men benefited more than women since the electricity was used to run irrigation pumps substituting for oxen-drawn water (Rengasamy *et al.* 2001). As a result, limited access to energy resources is a problem that has a disproportionately greater effect on women, especially in rural areas.

Skutsch (1998) argues that it is important to see energy as not just an efficiency or welfare element in development, but also as an indirect means for enhancing gender equity. In most countries, the primary emphasis of energy policy is still on petroleum fuels, and efforts are focused on increasing the efficiency in the electricity sector through privatization, and reducing subsidies on fossil fuels, with little attention to the energy demand

characteristics of women and rural communities. It may be said that women's energy needs have been left out of energy planning because they do not fit into the traditional energy paradigm. Access to sustainable energy can provide women with green employment opportunities by freeing up their time, enhancing their productivity and unleashing new economic potential (UNIDO 2011).

2.2. Climate Change and Energy

Climate change is the greatest challenge to livelihoods in the 21st Century. The interior of semi-arid margins of the sub-Sahara and Central southern Africa will be the most affected by climate change, which results from global warming (AMCEN 2011). An extensive review of long-term scenarios (Fisher *et al.* 2007) revealed that economic growth is expected to lead to a significant increase in gross domestic product (GDP) during the 21st century, associated with a corresponding increase in the demand for energy services. In order to be confident of achieving an equilibrium temperature increase of only 2°C to 2.4°C, atmospheric greenhouse gas (GHG) concentrations would need to be in the range of 445 to 490ppm CO₂eq. This in turn implies that global emissions of CO₂ will need to decrease by 50 to 85% below 2000 levels by 2050 and begin to decrease (instead of continuing their current increase) no later than 2015 (IPCC 2007). Alternative energy sources for electricity (biomass, solar, geothermal, hydro, ocean, wind, etc.), heat (biomass, solar, geothermal) and transportation (biofuels) offer GHG mitigation benefits from household and industrial energy uses, which account for over 75% of total energy consumption (IPCC 2009). The application of renewable energy technologies in household uses, such as improved biomass stoves, has shown significant environmental benefits by mitigating deforestation and reducing the demand for fossil fuels (*ibid.*).

To tackle the phenomenon of climate change effectively, human societies have put in place a combination of mitigation and adaptation mechanisms and strategies. Whereas mitigation aims at avoiding or lessening the impacts of the unmanageable, the goal of adaptation is to manage the unavoidable (The World Bank 2008b). Mitigation strategies entail taking deliberate steps to counteract the risks from climate change by making choices that reduce greenhouse gas pollution (AMCEN 2011). Other initiatives for the mitigation of climate change effects include investments in clean energy in the developing world to help their transition to a lower carbon development path, the adoption of less greenhouse gas-intensive technologies, searching for efficient transportation technologies so as to reduce carbon emissions, and adopting better forestry and agricultural techniques to improve livelihoods, reduce soil erosion, and protect biodiversity (The World Bank 2008a and b).

On the other hand, Adaptation refers to “changes in progress, practices, and structures to moderate potential damages or to benefit from opportunities associated with climate change” (AMCEN 2011). It is basically the

adjustment in natural or human ecosystems as a means for ameliorating the actual or anticipated adverse effects associated with climate change by moderating the harm or exploiting beneficial opportunities (UNFCCC 2012). It is developing coping mechanisms through taking practical steps to cushion oneself from likely disruption and damage resulting from the effects of climate change (IPCC 2007). Adaptation aims at reducing the vulnerability of affected communities, regions, and nations and promoting sustainable development (Mulinge 2013). Adaptation mechanisms could be structural, technological and behavioural changes. They could be anticipatory or reactive, private or public, autonomous or planned (IPCC 2009; AMCEN 2011).

Studies by Oxfam International (2005) and Neumayer and Plumper (2007) cited in Mulinge and Getu (2013) and Mukuna (2013), indicate that climate change and variability affect men and women differently. They confirm that in as much as women and children are more vulnerable to the effects of climate change, they are insufficiently represented in decision-making processes on community-based climate change adaptation and mitigation strategies. The same reports indicate that women's relative lack of education and access to information on projected climate change impacts, such as rainfall patterns, effective natural resource management strategies, limit their ability to cope with or adapt to the effects of climate variability and change (*ibid.*).

Among pastoralist communities, the limited available evidence supports the view that women, relative to men suffer more from climate change-related problems (Mukuna 2013; Njiru 2013; Anderson, Hesse and Nassef 2009; Aklilu and Alebachew 2009; UNFCCC 2007; Denton 2002). This is because of the women's reproductive roles like taking care of the family, fetching water and firewood and cooking. All these activities are highly dependent on the natural environment (Dinkelman 2008). This implies that adaptive mechanisms for men and women differ. Studies done by Mukuna (2013) and Njiru (2013) on pastoral communities and their adaptation to climate change in Kenya revealed that most women have turned to charcoal selling as an alternative livelihood. These studies support the notion that the rural Maasai women may not be aware of the negative impact that the charcoal burning and selling is causing to their environment. For them, land degradation, expansion of desertification and impact on the environment are not as important as the income generating activity that they are engaged in. To them, household income is more important.

2.2.1. Renewable Energy as an Option to Mitigate Climate Change for Sustainable Development

Sustainable development (SD) is relatively a new concept, aiming to consider the impact of climate change on the environment. It is a principle to be pursued in order to meet the needs of the present without compromising the ability of the future generations to meet their own needs. (Karekezi, Kimani and Onguru 2009; Karekezi and Kithyoma 2002; UNDP

2011). These authors ascertain that energy for sustainable development has three major pillars: (1) more efficient use of energy, (2) increased utilization of renewable energy; and (3) accelerated development and deployment of new and more efficient energy technologies. The nexus between renewable energy and sustainability has its foundation on depletion of primary energy sources and environmental degradation (IPCC 2009). Most of the development pathways already focus on SD goals, such as poverty alleviation, water and food security, access to energy, and reliable infrastructure.

Renewable energy technologies are the ones that consume primary energy resources that are not subject to depletion. Their benefits vary across sectors and regions. For example, the use of bio-energy and efficient cook stoves can enhance productivity and promote social harmony and gender equality. Additionally, this promotes good governance, equitable income distribution, housing and education opportunities, and health impacts among others (Karekezi and Kithyoma 2002).

On a global basis, it is estimated that renewable energy accounted for 12.9% of the total 492 EJ of primary energy supply in 2008 (IEA 2010a). The largest renewable energy contributor was biomass (10.2%), with the majority (roughly 60%) of the biomass fuel used in traditional cooking and heating applications in developing countries but with rapidly increasing use of modern biomass as well. Hydropower represented 2.3%, whereas other renewable energy sources accounted for 0.4% in 2008 (*ibid.*). The same source also indicated that renewable energy contributed approximately 19% of the global electricity supply (16% hydropower, 3% other RE). Global electricity production in 2008 was 20,181 TWh (or 72.65 EJ) (IEA 2010a).

Deployment of renewable energy has been increasing rapidly in recent years. Under most conditions, increasing the share of renewable energy in the energy mix will require policies to stimulate changes in the energy system. Government policy, the declining cost of many RE technologies, changes in the prices of fossil fuels, and other factors have supported the continuing increase (IEA 2010b). IEA further states that the annual production of ethanol increased to 1.6 EJ (76 billion litres) by the end of 2009; and biodiesel production increased to 0.6 EJ (17 billion litres). Of the approximate 300 GW of new electricity generating capacity added globally over the two-year period from 2008 to 2009, 140 GW came from renewable energy additions. Collectively, by the end of 2009, developing countries hosted 53% of global renewable energy power generation capacity (including all sizes of hydropower). The use of renewable energy (excluding traditional biomass) in meeting rural energy needs is also increasing, including small hydropower stations, various modern bio-energy options, and household or village photovoltaic (PV), wind or hybrid systems that combine multiple technologies (UNIDO 2009).

Most renewable energy technologies have low specific emissions of CO₂ into the atmosphere relative to fossil fuels; this makes them useful tools for

addressing climate change. For a renewable energy resource to be sustainable, it must be inexhaustible and not damage the delivery of environmental goods and services, including the climate system. For example, to be sustainable, bio-fuel production should not increase net CO₂ emissions, should not adversely affect food security, or require excessive use of water and chemicals or threaten biodiversity. To be sustainable, energy must also be economically affordable over the long term; it must meet societal needs and be compatible with social norms now and in the future. Indeed, as use of renewable energy technologies accelerates, a balance will have to be struck among the several dimensions of sustainable development. It is important to assess the entire lifecycle of each energy source to ensure that all of the dimensions of sustainability are met (IPCC 2009).

2.2.2. Barriers to Development of Renewable Energy

There are barriers that stifle the development of renewable energy and its significant role in national energy strategies, and the pursuit of climate change policies, particularly vis-à-vis energy. With respect to renewable energy development, coherent, consistent and favourable policies are usually lacking in Africa's context. This makes it difficult for investors to capitalize on this sector. According to UNIDO (2009), energy and renewable energy are missing in most development plans (Poverty Reduction Strategy Papers-PRSPs) of countries. Moreover, institutional capacity that could facilitate the various technical, economic, and marketing dimensions are either lacking or weak. Technical skills shortage and financial barriers are also constraints. Of the estimated annual US\$27 billion total investment required to achieve universal access to reliable and cleaner electric power by 2030, only about US\$2 billion has been leveraged. Government support is weak and discourages private sectors, banks and lending facilities from investing in renewable systems. Similarly, support is lacking in the area of promoting the market environment of technologies (The World Bank 2008a, b).

It is important to note that attempts to develop renewable energy policies in Africa have been centred more on removing barriers that would hamper the expansion of the renewable energy technologies instead of promoting the development of renewable energy itself. This is reflected in the low budgetary allocations or other dedicated funds for the promotion of renewable energy. Most renewable projects are pilot projects that are externally financed and dedicated funds are less than 3% of total public expenditure (UNIDO 2009). Beyond the barriers, little is also known about climate policy integration in the energy sector (UNDP 2011; Clancy *et al.* 2011). But, if these synergies become effective, energy can lead the way to de-carbonization by seeing increasing role of renewable energy resources (Hansen *et al* 2008).

At the local level, several barriers have been identified to prevent the rapid introduction of renewable energy technologies into the energy market.

These include: high cost of renewable technologies; lack of data and information about resources; challenge of integrating renewable energy technologies into the electricity grid; subsidies for conventional generation; lack of storage facilities; inadequate capacity to build and monitor performance of renewable energy resources; and impact on agricultural land use (IPCC 2009). Capacity building is also a key barrier to the rapid transfer of technologies across and within the countries/regions. Lack of capacity to set policies and design and implement programs delays, and sometimes negates, implementation of renewable technologies. Within countries, lack of maintenance in rural areas prevents adoption or limits the scale up of commercially available technologies (Waruru 2014). The Kenya National Energy Policy (RoK 2012) supports these claims.

2.3. Kenya Energy Policy and Renewable Energy

According to the Kenya National Energy Policy, the energy sector plays a critical role in the socio-economic development of the country. Of the total energy consumption, 88.6% is estimated to be sourced from biomass (firewood and charcoal). The remainder comes from petroleum (9.2%) and electricity from hydropower (1.8%). In 2012, 96% of the population lacked access to grid electricity and more than 80% of the population relied on solid fuels (RoK 2012). The Kenya National Energy policy emphasizes renewable sources of energy to meet the national vision and the targets set in the millennium development goals (*ibid.*). Policy Paper No. 4 of 2004 and the Energy Act of 2006 are the Kenyan policy and legal frameworks, respectively, for energy development. Through these documents, the government expressed its commitment to promote electricity generation from renewable energy sources (RoK 2012; Kendagor and Prevost 2013).

Kenya is one of six countries selected by Climate Investment Funds for their targeted program *Scaling Up Renewable Energy Program [SREP] in Low Income Countries* (<https://www.climateinvestmentfunds.org/cif/site>). Domestic households are the major consumers of fuel wood, and charcoal is the largest source of household energy in urban areas (Mwakubo *et al.* 2007; Kamfor 2002). Petroleum and electricity as sources of energy are the main drivers of the economy, while biomass is mainly used in rural communities and part of the urban population. Currently, the energy sector relies wholly on the importation of all petroleum requirements. However, with the discovery of oil in Northern Kenya, this trend is likely to change (RoK 2012). Electricity generation is predominately from hydro, supplemented by geothermal and thermal sources. Apart from wood fuel which is overexploited, the other renewable energy resources, though abundant, have not been fully exploited.

2.3.1. Status of Renewable Sources of Energy in Kenya

Kenyan sources of renewable energy are diverse and at varied stages of development. The widespread introduction and adoption of renewable energy technologies remain high on virtually every national development

policy agenda; renewable energy systems can assist national energy autonomy, decentralize resource management, promote environmental conservation, and serve as a means to reduce global warming (Waruru 2014). The ERC report indicates that Kenya has developed legislation that could see a major take off in the sub-sector.

Hydropower Generation is by far the largest source of renewable energy supporting commercial and industrial manufacturing. Hydropower currently generates 57 per cent of national electricity (UNEP 2009). There are seven hydroelectric generating plants set along two major rivers, the Tana and Turkwel. The power generated is transmitted to the national grid for further distribution. Kenya has considerable hydropower potential consisting of large hydros (sites with capacity of more than 10MW) and small hydros. Of the large hydros, 750MW has been exploited and accounts for about 50% of installed electric power generation capacity as at 2011, while about 1,450MW remains unexploited (RoK 2012). Potential for small hydros is about 3,000MW, 45% of which is located in the Lake Victoria Drainage basin. Only about 30MW had been developed (*ibid.*).

With the introduction of the Feed-in-Tariff policy in 2008, small-scale candidate sites are expected to be developed for supply of villages, small businesses or farms, as well as grid supply. The Ministry of Energy has carried out feasibility studies for small hydros in tea growing areas covering 12 sites with an estimated combined potential generation capacity of 33MW. Feasibility studies are on-going at 14 other sites and will be expanded to cover other areas and the results used for capital mobilization for development of the sites. As at 2011, only a few schemes have been developed as stand-alone systems or to feed to the national grid (*ibid.*).

Geothermal Energy is a renewable energy source with great promise. Kenya's geographical position on the Great Rift Valley that has great geothermal potential has favoured her. Her geothermal potential is about 350MW of capacity (Waruru 2014). In Kenya, geothermal energy involves tapping geysers and channelling steam through pipes to turn turbines and mainly has been developed along the Rift Valley (Esipisu 2012). Currently, geothermal energy converted to electricity contributes approximately 15 per cent of Kenya's electric energy to the national grid (Gachau 2011). According to the Ministry of Energy, geothermal generation has great potential for development. Olkaria currently hosts three geothermal power plants. Once new geothermal power plants at Olkaria and Menengai are commissioned, notes [Permanent Secretary Patrick M.] Nyoike, geothermal power capacity will increase by 490 [megawatts]. Kenya is one of the few African countries that [has] successfully tapped geothermal energy (Gathanju 2010). Geothermal expansion builds on the concepts of Vision 2030 and is intended to promote the government and the private-sector partnership program.

For Vision 2030 to materialise, Kenya needs more than 10,000 megawatts of electrical (MWe) output, and of this, a minimum of 5,000 MWe is

expected to come from geothermal sources. Kenya's geothermal potential is in excess of 7,000 MWe spread over more than 14 locations (RoK 2014). According to Energy Regulatory Commission (ERC), more than 10,000 MW of geothermal resource potential is in west of Nairobi. This opens new investment opportunities from supply of equipment to construction of power plants; the planned developments are enormous and the Geothermal Development Company is committed to facilitate and stimulate investor entry (www.gdc.co.ke/index.php?option=com_content&view=article&id=161&Itemid=155) and will drill wells and absorb some of the costs that usually would be incurred by private companies.

Wind Energy in Kenya relies on windmills that are erected along the wind path. This source has huge potential as the country experiences strong winds throughout the year. The average wind speed in Kenya is 3 to 10 meters per second, and the country has several sites conducive to wind energy. The most recent national energy policy envisions at least 1,000-MW wind generation capacity by 2016 (RoK 2012). The Ministry of Energy jointly with private investors has carried out extensive feasibility studies in the Northern Province and construction is due to commence around Lake Turkana (*ibid.*). The Lake Turkana Wind Power Project aims to provide 300 MW of reliable, low-cost wind power to the Kenya national grid, equivalent to approximately 20 per cent of the electricity generating capacity currently available. This project is expected to be completed by 2019. The project is of significant strategic benefit to Kenya and, at a cost of KSh75 billion (\$893 million), will be the largest single private investment in the country's history financed by the African Development Bank. The wind farm site in north-eastern Kenya covers 40,000 acres and is located in Loyangalani District, Marsabit West County, approximately 50 kilometers north of South Horr Township. Data collected and analyzed since 2007 indicate that the site has some of the best wind resources in Africa, with consistent wind speeds averaging 11 meters per second and from the same direction year round (*ibid.*). The World Bank reports that Kenya has nearly 1000 MW of wind capacity potential but only 6MW has been installed near Nairobi (Kendagor and Prevost 2013).

Wind energy uses naturally occurring energy of the wind for practical purposes like generating electricity, charging batteries, or pumping water. Large, modern wind turbines operate together in wind farms to produce electricity for utilities. Kenya has a proven wind energy potential of as high as 346 W/m² and speeds of over 6m/s in parts of Marsabit, Kajiado, Laikipia, Meru, Nyandarua, Kilifi, Lamu, Isiolo Turkana, Samburu, Uasin Gishu Narok, Kiambu Counties among others (RoK 2012).

The Ministry of Energy developed a Wind Atlas in 2008 with indicative data. To augment the information contained in the Wind Atlas, MoE, with the assistance of Development Partners has installed 55 Wind Masts and Data Loggers (as at 2011) to collect site-specific data. With the rising cost of oil, exploitation of wind energy has become more attractive. Substitution

of thermal generation with wind power plants will cut down on the large amounts of foreign exchange required to import fossil fuels for the thermal power plants. Further, partial substitution or combining wind with gen-sets (wind–diesel hybrid) and some form of renewable energy storage such as pumped storage in hydropower could cut down on running or overall costs by substituting renewable energy sources for significant amounts of diesel (*ibid.*).

Using wind energy to substitute thermal generation will also lead to less CO₂ emissions, thus contributing to reduction in global warming. The carbon credits associated with the reduction of the emissions can be sold as certificates of emission reduction. The installed wind energy capacity to the grid is 5.45MW as at December 2011 and a further 20MW is expected to be commissioned by the end of 2012. The 300MW Lake Turkana Wind power project is expected to be commissioned in 2014. Other committed projects include 110MW at Kinangop and Ngong. As of 2011, proposals for development of 650MW have been received for wind energy capacity at Marsabit, Isiolo and Ngong. Local production and marketing of small wind generators has started and few pilot projects are under consideration. However, only a few small and isolated wind generators are in operation so far (RoK 2012).

Solar Power also offers potential as a renewable energy source. It is the most cost-effective renewable source of energy where there is abundance of sunlight with little or no cloud cover. Kenya lies in the tropics which equate her to a big solar potential (Waruru 2014). Solar energy can be used for lighting, heating, drying and generating electricity. Kenya's geographical location astride the equator gives it unique opportunity for a vibrant solar energy market. The country receives good solar insolation all year round coupled with moderate to high temperatures estimated at 4–6 kWh/m²/day. Solar energy is widely used for drying coffee, cereals, vegetables, fish, hides and skins; for water heating; and for electricity generation using photovoltaic systems (*ibid.*).

Solar water heating systems are mainly used in homes, hotels, hospitals and learning institutions. The demand for solar water heating (SWH) is projected to grow to more than 800,000 SWH units by 2020 equivalent to 300,000 TOE. This represents a growth rate of 20% per annum. A private investor—Greenmillenia Energy Limited—is developing a 40MW solar plant in the north of Kenya. Solar power is most prevalent in the outskirts of large towns and rural areas. It has huge potential considering that much of the country enjoys sunlight throughout the year. Unfortunately, this source does not currently contribute any electricity to the national grid. Instead, solar energy is consumed at the generation site or in close proximity to it. It is estimated that close to 500,000 homesteads in Kenya use solar power to heat water. The government is committed to making serious efforts to expand this resource (RoK 2012).

Private-sector firms and individual entrepreneurs, to some extent supported by both governmental and nongovernmental organizations, are responsible for the development of solar energy. In fact in 1995, Richard Acker and Daniel Kammen (1996) reported that 20,000 to 40,000 small photovoltaic systems had been installed in Kenya over the previous decade. In more recent decades, Kenya has registered additional increases in the use of solar power.

Kenya is well known for a large-scale market-driven penetration of small PV systems with capacity of 12 – 50 watts power (Wp) consisting of low cost amorphous silicon modules and both mono- and polycrystalline silicon modules. It is projected that by 2020, the installed capacity of solar photovoltaic systems will reach 10MWe generating 22 GWh annually. The government initiated a programme for electrification of institutions far from grid using solar PV systems. As at 2011, solar PV systems have been installed in 945 institutions including primary and secondary schools, dispensaries, health and administrative centres.

The Government has also embarked on a programme to provide solar/diesel and solar/wind hybrid generation capacity to off-grid stations, including the following:

- (a) 60kW solar/diesel at Lodwar;
- (b) 30kW solar/wind at Habaswein;
- (c) 10kW solar/diesel at Merti in Isiol;
- (d) 60kW solar/diesel at Hola; and
- (e) 50kW solar/diesel at El Wak in Wajir.

As at 2011, the following eleven diesel plants were being converted to hybrid stations:

- (a) 9 x 230 kVA at Laisamis, North Horr, Eldas (Wajir), Takaba (Mandera), Rhamu (Mandera), Hulugho, Kiunga (Lamu), Lokichogio, Lokitaung, and Lokori (Turkana);
- (b) 450 kVA at Faza Island; and
- (c) 800 kVA at Lokichogio (RoK 2012).

Practical Action Initiative has reported that micro grid technology is improving in Kajiado and Narok Counties. There is expanded use of solar energy including solar photovoltaics (PVC) (Waruru 2014). PowerGen Renewable Energy installed 10 solar micro-grids around Kenya. A 3KW micro grid has been installed in Kajiado county and 3.75KW in Narok County. The Narok County Strategic Plan (2012–2016) underscores the importance of tapping into the solar energy natural resource. To hasten the rural electrification process, considering the pastoralist community context, the strategic plan has proposed to install solar energy in the schools that are in remote areas. In Kajiado County, World Wild Fund (WWF) has

embarked on a clean energy program. Solar power is mainly used for lighting (RoK 2012).

Biofuels are among the most promising alternatives to fossil fuels, and Kenya is making significant efforts to develop them. Many farmers are encouraged to invest in non-edible plants that have high yields (Bwakali 2008). This resource remains underdeveloped, and the government has identified it in the Vision 2030 development plans (Muok *et al.* 2008). Unlike other renewable sources, biomass can be converted directly into liquid fuels called bio-fuels (ethanol and bio-diesel) to meet transportation needs. The use of bio-fuels would reduce vehicle emissions and save on foreign exchange required for importing petroleum fuel, improve on the balance of trade and create employment. A strategy for introduction of bio-fuel blends in the market was developed by the government in 2010. Facilities for ethanol-gasoline blending have been completed in Kisumu to be followed by Eldoret and Nakuru. However, commercial extraction of biodiesel for blending has yet to be initiated (RoK 2012).

Land will need to be set aside for the production of energy crops as feedstock for bio-fuels. This calls for the formulation of strategies to optimize land use, as well as to harmonize land use policies with the energy policy. Most bio-fuel projects underway or being planned involve sugarcane and sweet sorghum as the main feedstock for ethanol; and jatropha, castor and other vegetable oil crops such as, coconut, croton and cotton seed for biodiesel (*ibid.* 2012).

Biomass: Biomass is organic matter that can be used to provide heat, make fuel and generate electricity. This could be firewood, charcoal, farm residues and animal wastes. Wood-fuel, the largest source of biomass has been used to provide heat for thousands of years. Many other types of biomass are also used as an energy source such as plant residue from agriculture or forestry and the organic component of municipal and industrial wastes. Landfill gas is also considered a biomass source (See photos 1–3 of a woman carrying a heap of firewood on her back, cooking using wood fuel and a poorly ventilated manyatta). Biomass resources can be replenished through cultivation of crops such as fast growing trees and grass. Biomass fuels are the most important source of primary energy in Kenya with wood-fuel (firewood and charcoal) accounting for over 68 per cent of the total primary energy consumption. About 55 per cent of this is derived from farmlands in the form of woody biomass as well as crop residue and animal waste and the remaining 45 per cent is derived from forests. Studies on biomass energy point to a widening gap between supply and demand for wood fuel, a challenge that requires dedicated policy interventions to redress. Wood fuel supply does not match demand over various parts of the country (FAO 2009).

Studies on biomass energy point to a widening gap between supply and demand for wood-fuel, a challenge that requires dedicated policy interventions to redress. Wood-fuel supply does not match demand over

various parts of the country (FAO 2009). In spite of past efforts to promote wood fuel substitutes, the number of people relying on wood fuel is not decreasing. Consequently, wood fuel will continue to be the primary source of energy for the majority of the rural population and urban poor for as long as it takes to transform the rural economy from subsistence to a highly productive economy. Wood fuel supply management is crucial to ensure sustainable supply to meet the growing demand. Key issues here include: competing land use activities, the growing imbalance between supply and demand and the attendant adverse environmental as well as related land and tree tenure issues, among others.

The Government has promoted Agro-forestry and social forestry programmes to increase the stock of woody biomass on farms to make up for the loss of forest trees as forestland is converted into agricultural and settlement land (NEMA 2009 and 2008; NFA 2005). This is a multidisciplinary effort involving the Ministries of Energy, Agriculture and Environment and Natural Resources. The purpose of this study is to shed light on the relationship between gender poverty, energy and climate change with a view of up-scaling the adoption of renewable energy technologies among pastoralist Maasai women. This will improve their livelihoods and sustain the biomass in use presently. It will conserve the environment and lead to adaptation and mitigation of climate change.

This source, which involves the use of firewood and pulp, is by far the oldest in Kenya and the most widespread source of energy in the rural areas. It is the major cause of deforestation, with great adverse effects on the environment and long-term economy. In fact, the country has lost forest cover from 9 per cent at independence (1963) to a mere 3 per cent today (UNEP 2009 and 2006). This report adds that the government faces great challenges in trying to curb the use of biomass; it meets up to 70 per cent of Kenya's final energy demand and provides for more than 90 per cent of rural household energy needs with approximately one-third in the form of charcoal and the rest from firewood. It is estimated that 80 per cent of urban households' wood-fuel demand is met by charcoal.



Figure 1. A Woman Carrying Firewood

SOURCE: Field pictures



Figure 2. A woman Using Woodfuel to Prepare Food

SOURCE: Field pictures



Figure 3. Poorly Ventilated Maasai Manyattas wherein Cooking Is often Carried out
SOURCE: Field pictures.

Nuclear Energy: Nuclear Energy is recognized as another source of power that will be considered in the future (GoK 2004). Many experts have long believed that nuclear energy is the best cure for the seasonal vagaries that tremendously affect the nation's hydropower generation (Majtenyi 2011). Notwithstanding the high initial costs, safety concerns, and technical skills required to acquire nuclear power, there remains a strong national will to pursue this option. According to the Ministry of Energy, the government is considering building a nuclear power plant (Nyoike 2012). Developing local and national expertise in the nuclear field will be a challenge as will addressing the issue of spent nuclear fuel. These challenges are made more acute given Kenya's plan to be a nuclear-energy generating nation by 2030. The government needs to do more research on this and invest heavily in the infrastructure required including developing capacity to deal with it.

2.4. Rural Household Energy Choices in Kenya

Studies have shown that there is a shift from biomass fuel to kerosene and liquid petroleum gas (LPG) by middle-income urban households, and to LPG and electricity by higher-income urban households (TERI 1992; Reddy and Reddy 1994). In rural areas, the pattern is different. Studies in western and central Kenya (Mugo 1999 and 1997) found that all households regardless of socio-economic status used woody or high quality crop residues (like maize cobs) before changing to other forms of biomass energy for cooking (UNEP 2006). In western Kenya, all the maize cobs were used before the population turned to wood or maize stalks, and in

central Kenya, all the coffee and tea pruning and maize cobs were used before the population turned to wood or other lower forms of residues. Therefore, in rural households of a given area, the types of fuels used for cooking were nearly uniform among all income groups. However, as scarcity increased, the better-off switched to using wood while the poorer groups of society turned to lower forms of crop residues (Mugo 1997). In urban areas, the choice of cooking fuel depends on income while those in the rural areas decide based on available alternatives, which can change from region to region. Policy interventions and plans for sustainable energy supply have, thus, to be customized to regional needs.

Although quality of data is still lacking, there is indication of rapidly changing demand for these fuels in rural and urban areas. Demand for charcoal has dropped from 2.91 million tonnes in 1997 (Kituyi 2000) to 2.48 million tonnes in 2000 (Government of Kenya 2004) and to 1.6 million tonnes in 2004. The use of forestry and agricultural residues shows an increase from 1.37 million tonnes in 1997 to 2.9 million tonnes in 2000. The cost of alternative clean energy options is too high for most poor households to afford. Although the cost of renewable energy technologies such as PV systems have fallen significantly over recent years, they remain uncompetitive compared to alternatives such as kerosene. LPG is out of the reach of most of the population due to tariffs and duties (18 per cent VAT and import duty on LPG, and 18 per cent VAT on cylinders and appliances (UNEP 2006). Charcoal production for nearly 80 per cent of urban households (Government of Kenya 2004) destroyed over 50,000 hectares of the country's dryland savannah woodlands and rangelands in arid and semi-arid regions in 1989 (Kakerezi, Kimani and Onguru 2009). Trees felled from clearing land for agriculture and settlement is another source of charcoal. The forested area also continues to diminish each year. Charcoal production is more intensive than wood gathering, continuing until wood resources at a site are exhausted. The demand for biomass fuels in 2000 stood at 35 million tonnes, of which only 15 million tonnes were sustainably supplied (Government of Kenya 2004). Despite the potential of agro-forestry to supply firewood from most parts, this option is yet to be fully exploited, owing to land tenure problems (Kituyi *et al.* 2001b).

The supply of energy in rural areas will play part in overall rural development in Kenya and this may be done by using renewable energy sources and technologies which are cost-effective and environmentally friendly. The use of renewable energy technologies such as improved wood-fuel stoves will reduce the risk of indoor air pollution, which is said to be the major cause of respiratory illness in many rural areas (Miller *et al.* 2007). Alternative sources of energy in rural areas will also address the alarming rate of deforestation resulting from overdependence on firewood and charcoal (Elliott 2004).

2.5. Conceptual Framework

The conceptual framework for this study is based on systems thinking. Systems thinking has been used in the study so as to understand the relationship between energy supply, rural development and gender dynamics. Furthermore, system thinking has been used to understand social, economic and environmental factors which may influence the linkage between energy supply, gender power roles and rural development. Understanding the connections will influence policy makers to mainstream gender, climate change and disaster risk reduction in the energy policy. This will leverage the environmental degradation that is currently going on and not only encourage climate change adaptation, but mitigation too. It will improve socio-economic and health practices of the pastoralist Maasai women.

System thinking is a science based on understanding connections and relations between seemingly isolated things. The concept is used to understand the causal relationships and feedbacks of a problem (Haraldsson 2004, 9). In order to map the understanding of a problem and make it transparent and visible for others, Causal Loop Diagrams (CLDs) are used (Haraldsson 2004). The CLDs can be used to understand the trend of an issue or a problem in a system and through them we can develop strategies to deal with the identified problem/issue (*ibid.*). Haraldsson further explains that in the CLD, the arrow shows causality between variables. A plus sign near the arrow head indicates that the variable at the tail of the arrow and the variable at the head of the arrow change in the same direction. A minus sign near the arrowhead indicates that the variable at the tail of the arrow and the variable at the head of the arrow change in the opposite direction. Figure 1 illustrates this.

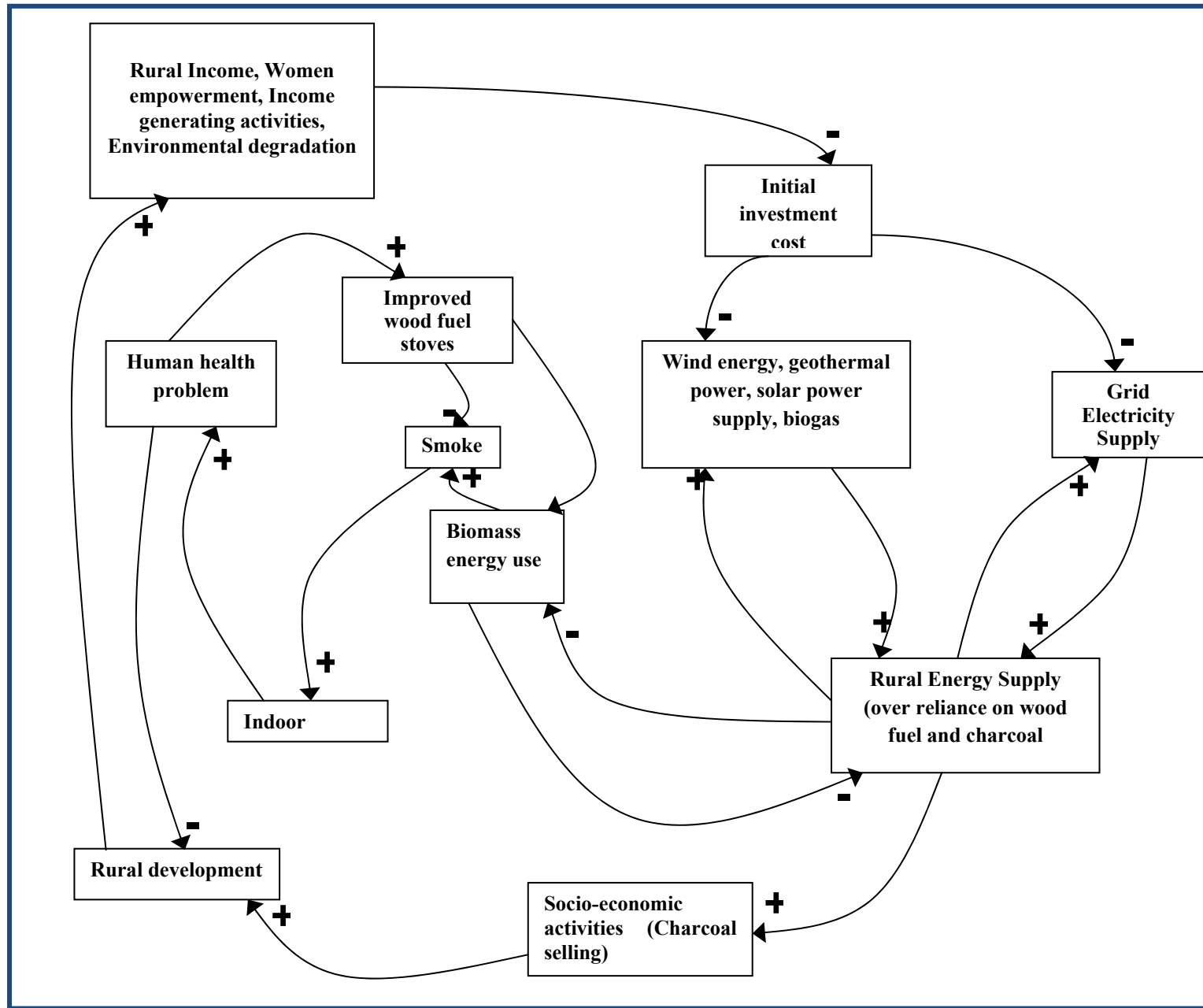


Figure 1. The Conceptual Framework for the Study

CLD for energy dissemination among the pastoralist Maasai women in Kajiado and Narok is a mental model illustrating the importance of supplying energy in rural areas. The Causal Loop Diagram is backed up with some theoretical approaches from the literature on energy and rural development. The basic assumption is that the supply of the energy source is dependent on the initial cost involved in acquiring it. The logic in the CLD is that if all available energy sources have higher initial costs, none of the energy sources would be sufficiently supplied in rural Tanzania. On the other hand, if any of the energy sources proves to be costly, only affordable energy sources available would be adequately supplied. With inadequate rural energy supply, there will be less socio-economic activities which would lead to less rural development. Less rural development would lead to inadequate rural income and eventually this would affect those who need energy services since initial costs would be higher. The report, 'Energy After Rio', showed that the energy choice of households is highly influenced by income (UNDP 1997). This means that poor people give greater weight to initial costs than what they give to the life-cycle costs. Thus, they tend to avoid efficient devices or convenient carriers of energy due to the high initial costs associated with them, giving preference to inefficient, but low cost devices and inconvenient energy carriers (Habtetsion and Tsighe 2002).

On the other hand, the lower the initial costs to supply grid electricity, the higher the grid electricity supply and rural energy supply. This would stimulate socio-economic activities and give room for rural development. The increased rural development would create opportunities for the rural poor to earn income which will allow them to exploit the available energy sources. Similarly, the higher the initial costs to supply solar photovoltaic systems, the lesser the availability of solar PV systems will be to rural households and this would lead to insufficient rural energy supply. Inadequate rural energy supply could affect the socio-economic activities and rural development. With less rural development, there will be less rural income and this would limit the ability of the rural households to acquire the energy services due to higher initial costs and vice versa.

The increased use of improved wood-fuel stoves by rural households may reduce the biomass energy use. Smoke will be reduced as a result of less use of biomass energy sources and this would help reduce the risk of indoor pollution; and the lesser the indoor pollution, the lesser the human health problems associated with it. At the same time, improved wood-fuel stoves will emit less smoke and this will also reduce the risk of indoor pollution. With less human health problems there would be more rural development. The Kenya National Energy policy (RoK 2012) has outlined an ambitious plan to adopt gender-friendly renewable energy technologies such as solar photovoltaic systems, improved wood-fuel geothermal power, hydro electric power, electricity grid and biogas. These are clean energy technologies that are hoped to help adapt to climate change, conserve the environment, improve the Maasai women's livelihoods, increase food

security and empower the women. The initial cost of installing these clean technologies remains a challenge to most of the rural Maasai women.

3. Study Area Description and Methodology

3.1. The Study Areas

Imbirikani Group Ranch is approximately 1,300km² (320,000 acres), bordered on the eastern edge by the Chyulu Hills National Park in Kajiado County. Imbirikani is owned and run communally by about 4500 members of Ilkisongo Maasai. There are just over 10,000 people living on the ranch, along with some 60-90,000 head of livestock. The vegetation on the ranch ranges from upland grasslands to flat savannah grasslands to dense bush. The low rainfall regime makes it difficult for the community to generate income for other means besides pastoralism. This area is referred to as the Chyulu West Game Conservation Area; this is a proposed conservation area as none of this land is legally protected. Ol Donyo Wuas is a lodge located on Imbirikani Group Ranch and it is working to secure approximately 25,000 with a lease, supported by income from the lodge. The proposed carbon easement would cover the 40,000 acre lava forest; thus, no conflict with additionality. The major threats to the forest include: logging for timber, for construction poles, for firewood and for illegal charcoal production; harvesting of honey using traditional harvesting methods that often cause fires; overharvesting of medicinal herbs and poaching for wild meat.

Narok District covers an area of 15,088 square kilometres. It is situated in the southwestern side of the country, in the southern part of Rift Valley Province. Administratively, the district is divided into 8 divisions with 54 locations and 103 sub-locations. The divisions are: Narok Central, Loita, Mara, Mau, Mulet, Ohukurto, Ololulung'a and Osupuko'. Mau, Olukurto, Loita, Mara, Mulet, Ololulung'a and Osupuk' are rural. The total population of the district was 365,750 in 1999. The district has a varying topography with altitude varying from 3,098 metres above sea level (masl) in the highlands to 1,000 masl in the lowlands. In the high potential areas, land is individually owned. The rangelands are largely used as group ranches; however, there is an increasing trend towards subdivision into individual holdings.

These two counties fall within the Arid and Semi Arid Lands of Kenya. Wildlife conflict, livestock diseases, food insecurity, water scarcity, unavailability of credit, high illiteracy levels, human ill health, poor leadership (Mukuna 2013) are the main challenges facing pastoralists in the district. The main income comes from tourism, wheat farming (for Narok) and trade, charcoal burning, petty trade and business. The main alternative livelihood is charcoal selling.

3. Methodology

This work is based on desk review and experiences of work that I have done among the Maasai community first as a volunteer Programme Officer for Centre for Livelihoods Opportunities Unlimited (CLOUT) and as a Lecturer at Maasai Mara University, where I was in charge of the Gender Outreach Programme sponsored by PROMARA. The work documents clean energy technologies that were introduced to the pastoralist Maasai women as a climate adaptation and ecosystem management strategy. The programmes came up with a project on innovative renewable energy sources. Thirty households were randomly selected from each site. The project involved both men and women. Observation method of inquiry was adopted together with demonstrations and explanations. This study employed community appraisal research approach from the inception and planning stage to enable the community members to own the innovative renewable energy strategies that they were introduced to. A baseline survey was first carried out in the two districts and the findings shared with community members, local administration, community-based organizations, media and academia before this interventionist approach was adapted.

4. Results and Discussion

4.1. Household Energy Use

One of the objectives of this research was to find out the household's energy use. Most, if not all, of the homesteads rely on paraffin lamps for lighting and wood fuel for cooking. Only 6 households have paraffin cooking stoves. Two respondents said they used natural gas for cooking and solar for lighting. Though electricity supply is gradually reaching rural areas in Kenya through the Government's Rural Electrification Program, the number of households already connected is dismally low. They consider electricity as 'something for the rich', as indicated from their responses.

4.1.1. Effects of Wood fuel Use on Women

As indicated in the literature review section, a lot of research has been done on the use of wood fuel on women. In this research, I have compiled the findings and arranged them according to themes. Due to their gendered roles, women bear the brunt of the impact of biomass use. They are the most vulnerable group. These findings cut across all rural women of whom the pastoralist Maasai women are not an exception. The impacts include:

Economic Impacts: The introduction of household energy conservation programs in rural areas also increases job opportunities for women and men outside of agriculture. These include stove building as an artisanal profession and making use of the extra time saved to start other income-generating activities, such as chicken or rabbit raising, which also improves the protein diet, or food processing, or establishing a tree nursery and selling the seedlings (ETC/ENERGIA 2011). In the Women and Energy

Programme (WEP) in Kenya, more than 300 women's groups started their own tree nurseries, planted the seedlings on their farms and sold extra seedlings to neighbours. At one time there were over twenty production centres for ceramic stove liners throughout the country with hundreds of women and men earning extra cash by making liners and as stove building artisans (Smart Villages Initiative 2014; IEA 2011a and b). With access to such technologies, women can increase their incomes and young girls, previously burdened with labour-intensive chores, can attend primary school. However, due to social and legal restrictions on women's rights, including rights to own land, borrow money and make their own economic decisions, women are often ineligible for financing for new equipment that can improve the productivity of their labour (ETC/ENERGIA 2011).

Further, women's economic contribution to the energy sector, such as fuel collection, is unpaid, unrecognized and undervalued; and women's patterns of energy service use are often not reflected in national statistics. As a result, energy planners are unaware of women's energy demands, and less attention is paid to technology development and investments aimed at improving women's work in comparison to men's (ENERGIA 2007). It is, therefore, critical that policy makers address legal and regulatory frameworks that prevent women from accessing credit and other financial services, and that recognize the role of women in the energy sector in part by collecting and using gender-disaggregated data to establish the specific energy use patterns of women and men and their potential for creating and benefiting from green employment.

Energy access provides opportunities for women entrepreneurs to make an income and enhance their social status by creating and disseminating sustainable energy solutions. Barriers, such as lack of training and education, and social norms that view modern energy technology businesses as "men's work", limit women's opportunities to engage in sustainable energy entrepreneurship. Enhancing women's leadership and participation in the energy sector, developing targeted training programmes for women, and improving women's access to credit should be a path that social scientist should pursue to reduce their vulnerability to impacts of biogas and climate change. The fact that women possess valuable knowledge relevant to sustainable energy solutions should be spelt out loudly and clearly to policy makers so that they can include women in energy policy debates. Women can become key actors in creating and disseminating sustainable energy solutions, allowing them to make an income and giving them the opportunity to take part in and drive sustainable development of their local communities, thereby enhancing their economic autonomy and social status. This goes with UNDP's (2012) report, which concluded that the greatest potential for poverty alleviation comes from combining energy service delivery with efforts to support income generation through information services, training in business development skills and access to capital and markets, including support for

the active engagement of women in the energy sector through new enterprises, entrepreneurial activities and sustainable resource management.

Women entrepreneurs do, however, face barriers such as lack of education and training on business management and technical aspects of sustainable energy technology, as well as lack of access to credit and other financial services necessary to start up sustainable energy businesses. Moreover, in some countries, modern energy technology businesses are viewed as men's work, while women are expected to operate more traditional, and less profitable, biomass-based micro-enterprises (Danielsen 2012). There is, therefore, a need to develop targeted training programmes for women in the energy sector, as well as to improve women's access to microcredit and loans.

Environmental Impacts: Research has revealed that over-reliance on biomass is detrimental to the environment. It leads to environmental degradation, which may spread desertification. The smoke from a burning biomass contains Sulphur dioxide, Nitrogen dioxide, Carbon monoxide, Carbon dioxide among other greenhouse gases. These lead to global warming that results in climate variability and change (NEMA 2009 and 2008; UNEP 2009; IPCC 2009; NFA 2005; Hansen *et al.* 2008).

Health Impacts: The responsibility for household energy provision affects women's health disproportionately to men's. More than half of the world's households cook with wood, animal waste, crop residues and untreated coal. Biomass collection to meet a household's energy needs is largely the burden of women and girls. In rural areas, it can mean spending several hours a day collecting fuel wood loads of 20 kg or more. According to the World Health Organization (2010), exposure to indoor air pollution is responsible for the nearly two million excess deaths, primarily women and children, from cancer, respiratory infections and lung diseases. Where people cook inside, the most significant health concern is indoor air pollution (World Bank 2003 and 2001; Gathanju 2010). Although it is difficult to isolate cause/effect factors, enough studies by outstanding scientists from the World Health Organization have been conducted to suggest strong evidence for causal relationships and compounding effects. These include acute respiratory infection in children, upper respiratory tract infections in adults, and negative health impacts on pregnant women and thus on births (WHO 2010).

Other negative health effects related to cooking are children burned by open fire, mothers' exhausted from carrying heavy loads of fuelwood over long distances, and nutritional deficiencies arising from fewer warm, healthy meals being cooked when fuel is lacking. Improved health resulting from successful household energy interventions also impacts on the productive labor capacity of rural households. The argument here is that healthy people are more productive, and that high productivity improves chances of breaking the vicious cycle of poverty. Negative health effects, on the other hand, reduce the working power of women, children and

sometimes even men, or they absorb women's time since they have to care for sick children. This situation is especially serious in the case of women-headed households, which, with the rising rate of urbanization, are on the increase (World Bank 2008; UNIDO 2009). How, one has to ask, can rural development projects expect to be successful unless these serious problems are addressed? Since efficient household energy conservation measures improve health and economic opportunity of rural households, they should be considered investments in human capital.

Shifting from fuel wood to cleaner sources of energy, like kerosene or LPG, halves the mortality rate of children under five. In fact, illnesses from indoor pollution result in more deaths of women and children annually than do HIV/AIDS, malaria, tuberculosis and malnutrition combined (IISD 2013). Other important direct health impacts from dirty energy use and indoor air pollution include life-long or chronic diseases, such as asthma; burns to children; injuries to women from carrying wood; and increased violence against women and girls because of lack of street lighting at night (ESMAP 2007).

Violence against women can also occur during daylight hours in situations where resources are scarce and women are obliged to collect fuel from remote and isolated areas (ENERGIA/DfID 2006). Women have to be empowered to make choices about energy. This vicious cycle of energy poverty needs to be broken. The invisibility of energy-poverty issues leads to decision-makers not being fully aware of their significance, and so policies and strategies fail to address the issues fully. Fuel wood use has adverse impacts on both the safety as well as health of women. Sometimes girls have to forgo their education to fetch wood for the family; this traps them in inter-generational poverty. The amount of time women spend on domestic work reduces the amount of time they can devote to income generating activities to enhance their livelihoods. These roles change over time and vary widely within and across cultures.

Access to modern energy can significantly support the functioning of health clinics in rural areas, which is crucial for improving women's health, in particular sexual and reproductive health, as well as the diagnosis and treatment of certain infectious and non-communicable diseases, such as tuberculosis and breast cancer, which are often undetected in women.

A key objective of rural energy must therefore involve the displacement of this manual labour with appliances. In the case of cooking, the perspective should be to go from the present inefficient, unhealthy stoves using arduously gathered fuel wood through improved woodstoves to gaseous-fuelled stoves to clean, efficient and convenient stoves operating on electricity or on gaseous bio-fuels. Awareness-raising and resource mobilization are necessary to finance sustainable electrification of health facilities and to inform women and communities about clean and efficient cooking technologies.

However, women in many rural communities lack information and capacity about clean, efficient, cooking technologies that could facilitate changing cooking habits (IISD 2013). In order to produce health benefits from modern sustainable energy services, building the awareness and capacities of women and men – the entire community – about clean energy technologies is critical.

Socio-political Empowerment: When household energy conservation is part of a rural development program, women automatically come into focus. In the process, women acquire organizational, technical and management skills to participate in the whole development process. A prerequisite for this kind of socio-political empowerment is that they live in a healthy environment and are set free from time-consuming daily tasks such as fuel and water collection and the like. Household energy conservation programs help to strengthen the organizational capacities of women (Mugo and Gathea 2010). In the two districts of Meru and Murang'a in Kenya, 30 women's groups organized themselves solely for the purpose of participating in household energy technology innovation activities and acquiring such technologies. Later these groups stayed together and on their own initiatives started other development activities such as roofing their houses with metal sheets, guttering their roofs for water collection and building water tanks. Hence, household energy conservation activities are a good mechanism for changing people's (and especially women's) attitudes about their own capacities, since they have the experience of improving their own lives through their own skills (Danielson 2012; Waruru 2014).

Having explained the energy use and impacts of biomass use on women, I hereby report a best practice scenario of an NGO working among the vulnerable and marginalised communities in Kenya. One of their projects is reducing pastoralist women's vulnerability to the impact of climate change through innovative gender-sensitive clean energy technologies.

Innovative Gender-sensitive Clean Energy Technologies: In the energy innovation study's best-case scenario, rapid advances in renewable energy technology significantly bring down carbon dioxide emissions. Yet, because CO₂ lingers in the atmosphere for more than a century, reducing emissions means only that less gas is being added to the existing problem. Research by James Hansen shows that reducing global CO₂ levels requires both a drastic cut in emissions and some way of pulling CO₂ from the atmosphere and storing it (Hansen *et al.* 2008). Climate scientists have definitively shown that the build-up of carbon dioxide in the atmosphere poses a looming danger. Whether measured in dollars or human suffering, climate change threatens to take a terrible toll on civilization over the next century. To radically cut the emission of greenhouse gases, the obvious first target is the energy sector, the largest single source of global emissions (*ibid.*). Unfortunately, most of today's clean generation sources can't provide power that is both distributed and dispatchable. Solar panels, for

example, can be put on every rooftop, but can't provide power if the sun isn't shining. Yet, if we invented a distributed, dispatchable power technology, it could transform the energy marketplace and the roles played by utilities and their customers.

Smaller players could generate not only electricity but also profit, buying and selling energy locally from one another at real-time prices. Small operators, with far less infrastructure than a utility company and far more derring-do, might experiment more freely and come up with valuable innovations more quickly. Incremental improvements to existing technologies aren't enough; we need something truly disruptive to reverse climate change. What, then, is the energy technology that can meet the challenging cost targets? How will we remove CO₂ from the air? We don't have the answers. Those technologies haven't been invented yet. However, we have a suggestion for how to foster innovation in the energy sector and allow for those breakthrough inventions (Koningstein and Fork 2014).

Promotion of renewable energy technologies has the potential of increasing access to modern energy services in rural areas that currently have no access to grid electricity and pay higher prices for energy service delivery because of the transportation costs and inefficiency of traditional energy forms (UNIDO 2009). Moving directly to smaller-scale, renewable energy systems such as stand-alone systems of wind and solar energy can provide communities with affordable energy, promote productivity, and help in creating employment by empowering enterprises for both the rural and urban poor. At the same time, large-scale, renewable energy systems based on hydropower, modern clean biomass, geothermal, wind or solar energy can diversify energy supply, reduce energy imports, and provide significant local and global environmental gains (*ibid.*).

African Wildlife Foundation (AWF) sponsored Centre for Livelihoods Opportunities Unlimited Technologies to train Maasai community in Imbirikani Ranch Kajiado and Narok Olurkuto division on environmental conservation through innovative clean energy technologies. They were mainly solar energy and improved cooking stoves. The different types of solar cookers such as, solar cookits and parabolic cooker were introduced to the community members (see Figures 4–6). Other cooking technology called the fireless cooker, is an insulated basket container or a box that is designed to complete the cooking that has been partially started on a conventional cooking methods, e.g. open fires, charcoal, firewood, paraffin, gas and electrical cookers. It is also a food warmer as it can keep already cooked food hot for more than 8 hours. Cold drinks can be kept in the fireless cooker to maintain their temperatures. These innovations are clean energy that is environmentally friendly. Burning of wood contributed significantly to air pollution and global warming, and so, the Maasai community was discouraged from its use. To make the solar cookits, one needs the following: the sun, the Cookit, pot and lid, transparent polythene bag, three small pot rests (stones or wooden), a string and food. The cooker

should be placed where there is no shade and facing the direction of the sun. The reflector should be adjusted in order to capture maximum sun rays.

To ensure effectiveness of the cookit:-One should start early- use solar cooker during clear or cloudless weather; place the cooker in the sun on a protected surface; for faster cooking, use light-gauge pots (Sufuria) painted black with lid; recommended measurement for food must be half the pot; when cooking, baking, steaming and boiling, cover your Sufuria with black painted lid. A tight fitting lid cooks food faster; for hard grains like maize and beans, pre-soak overnight before the day of cooking. This will reduce the time spent in cooking.

A solar cooker can cook a variety of foods, such as both roasted and stewed meat, ugali, kales, rice, eggs/omelets, githeri (mixed maize and beans), cabbage, fish, chicken, cassava, and bananas. Some of the foods that you can cook without covering Sufuria with the lid include:-roast meat, groundnuts, roast chicken, roast fish and maize on the comb. Besides roasting, with solar energy one can bake biscuits, cakes, bread and boil water for drinking. To make cookits, one needs a foil, carton box, a pair of scissors, a cutter, wood glue and binding tape.



Figure 4: Demonstration of Fireless Cookers

SOURCE: Field pictures



Figure 5. Cooking Beans in a Fireless Cooker

SOURCE: Field pictures.

Making of fireless cookers is fairly involving because one has to have the following materials in place:-basket, waste blanket, news papers, black polythene paper, black cotton/coloured material, sewing needles, sewing thread, scissors, thimbles and masks. Making of a fireless cooker involves the following process:-Lining the newspaper in the basket to cover all the breathing spaces to prevent moist; Lining the blanket/cotton waste in the basket then put a fitting pot to get the inside shape of the fireless cooker; After lining, put the black polythene paper and the black piece of cotton material, and then you start sewing so as to a line all the materials inside the basket.



Figure 6: A Man Demonstrates a Making of a Fireless Cooker

SOURCE: Field pictures.

Jiko kisasa: is a stove that was developed in Kenya in the 80's after intensive research by many institutions under the leadership of Ministry of Energy, GTZ and Maendeleo ya Wanawake Organization (MYWO). Kisasa stoves have an efficiency of 35 – 40 per cent compared to the three stones fire place. Jiko kisasa has many other local names such as Maendeleo jiko, Up's jiko. In the last 30 years many organizations have been disseminating and promoting the technology.



Figure 8. People Showcase a Fireless Cooker that They Have Just Learnt to Make



Figure 9. Jiko Kisasa
SOURCE: Field photos

The Rocket Stove: is a recently developed technology by APROVECHO research centre with trials done in many African countries. According to APROVECHO, rocket stoves have an efficiency of 50 – 60 per cent compared to the three stones fire place. These stoves are made in different versions and sizes to meet each client's needs, such as households, hotel, institutional stoves and ovens.

Briquettes: Briquettes are a renewable form of energy produced from agro or forestry waste. A special machine called Briquetting press machine produces the white coal. The Agro-forestry waste is recycled into cylindrical briquettes with the help of Ram Punching Terminology which works on binderless technology. Briquettes don't emit fly ash content when burnt. They do not produce sulphur so they do not pollute the environment. CLOUT introduced this clean energy to community members, but the initial capital for making the briquette press machine is so high.

5. Conclusions

Energy is a very GHG-emission-intensive sector. To effectively deal with the climate change and variability threat, the solution lies in the reduction of the emission of GHGs. This requires concerted efforts into technology invention, innovation and transfer and changes in behaviour that reduces the GHGs intensity of energy services. Accelerating the receipt of the clean energy technologies for women, especially the most vulnerable rural women and the marginalized communities is very critical. Over reliance on biogas has health, environmental and economic impacts on women but a solution lies in clean energy technologies. However, the clean energy technologies require heavy capital investment that most of the rural women may not be able to afford. In the case of the pastoralist Maasai women, the environment that they live in has forced them to develop adaptive mechanisms and alternative livelihoods. Unfortunately, the charcoal burning business that they really cherish is destroying the environment. Their lack of ignorance due to their low literacy levels does not make it better.

Other than adapting clean technologies, natural resources in the pastoralist communities are not protected. Inasmuch as a high proportion of livelihoods and economic activities depend on their ecosystem, they have been neglected. Rehabilitating and conserving the natural resources should be invigorated. The implementation of the Disaster Risk Reduction policy for the Arid and Semi-Arid Lands in Kenya and the National Strategy for Climate Change needs to be evaluated.

Exposure of Maasai pastoralist women to stresses caused by climate change, their capacity to resist or adapt, cope with or recover, is very important. The vulnerable communities' capacity depends on their interactions with the environment, demographic, social, economic, political, cultural and technological characteristics. It is evident that climate change has gender-differentiated impacts. The danger is higher where

natural systems are severely degraded and human systems are falling because this deepens poverty, hunger and famine, poor health, and collapse of rural livelihoods. Land degradation is an amplifier of vulnerability to climate change. Additionally, it destroys ecosystems and causes biodiversity loss. For the Maasai women and the community at large, this is dangerous to them because they depend on their biodiversity for indigenous medicine, also as an alternative livelihood. Charcoal burning and selling is weakening this ecosystem.

Inasmuch as gender is treated as a cross-cutting theme in the ending MDGs, gender mainstreaming is still at a nascent stage in energy policy planning and legislation in Kenya. For example, the Ministry of Energy, Ministry of Water and Irrigation and the Ministry of Environment and Mineral resources, Ministry of Gender and Social Services, ministries of Finance, Land, and Health in Kenya do not seem to factor in the gender concerns in their sectoral planning. Women who are highly at risk are not involved as revealed in this study. These ministries need to allocate financial and human resources to this agenda and engage in participatory methods for improving livelihoods and reducing vulnerability to impacts of climate change. This will lead to sector-specific expertise that will engage stakeholders on mainstreaming gender in the energy policy.

Renewable energy, water and sanitation, food security, climate change and gender are closely correlated. Research on this nexus is scarce. Women empowerment programmes focus on income-generating activities and lose out on these themes. Most of the women empowerment programmes omit the ecosystem management; yet it is very critical. The multiplier effect that these programmes can have if they factor-in these themes is immeasurable. Thus, adaptation to climate change should be integrated into development plans so that climate change hazards don't undermine development achievements.

There is limited knowledge and awareness on climate change adaptation, impact of the use of biomass on livelihoods and simple clean energy technologies. The ignorance displayed by the Maasai women on this issue calls for immediate action. Efforts by state and non-state actors to increase and communicate climate change knowledge on historical and future climate variability, estimates on climatic impacts and risks, causes of vulnerability, and disaster risk management and technologies are negligible.

Institutional strengthening among pastoralist communities was weak. Institutions play an important role in enabling adaptation. They do this by sharing knowledge, mobilizing community resources, regulating land use, training improved technologies, sharing public health information or services, disaster relief, early warning for disasters, among others.

Given the complexity of the interplay between climate change, energy, poverty, gender and agriculture and the fact that the process of

methodological development of appropriate mitigation and adaptation strategies and measures is costly and requires multi-faceted experts, there may be the need for creating an international instrument or process that provides a global framework for action and support for energy reform.

6. Recommendations

Raising awareness of policymakers: Policies should specifically target rural household energy needs, and politicians should recognize the importance of gender-sensitive participation when formulating energy programmes. Rural energy is an effective entry point for reducing poverty and promoting sustainable development. Women's lives are intimately connected to and affected by water and energy resources because of their central role as primary collectors, users and managers of these resources for household use. The primary end users of energy, in particular women, need to be provided with the necessary knowledge to better influence energy projects, programs, and policies.

Addressing the future role of biomass energy: This energy use has been detrimental to Kenya's bio-diversity and limited forests. Adverse impacts of biomass energy on the environment remain a major concern, and the government should take measures to reduce, over time, the use of biomass as an energy source. The government should revise the environmental regulations through the newly commissioned National Environment Management Authority. For example, integration of environmental costs of fuel wood production in charcoal licensing schemes encourages producers and traders to be more responsible. Through legal associations of charcoal producers, it will be easier to monitor the trade, tree species used and types of kilns, etc. In view of the forest degradations, the government should consider, in addition to regulations, incentives for the use of natural gas and kerosene through tax exemptions to make them affordable.

Provision of alternative sources of energy: The government should ensure availability of fuels that can be used in lieu of biomass. Individuals and local entities should be encouraged to invest in smaller domestic windmills for off-grid consumption at the villages. Notwithstanding these efforts at the rural level, the government should consider investment in wind sources through installation of massive windmills capable of integration to the grid.

Investing in Clean energy technologies: Biomass fuels are likely to remain for some time the primary fuels for heat and cooking because electricity is, in almost all situations, more expensive for such applications. Continuing to promote improved cooking stoves; pricing mechanisms to encourage a shift from biomass to alternative energy sources, such as LPG; and developing biogas etc can be used to decrease traditional biomass use and indoor pollution. This means that the government should invest in clean energy technologies for the rural communities.

Development of gender-responsive frameworks: In order to achieve internationally-agreed upon development goals, as well as the targets of the Future We Want and the SE4ALL initiative, gender-responsive policy frameworks should be developed and indicators and targets for gender mainstreaming need to be expanded in the upcoming Sustainable Development Goals. The policy frameworks should take women's needs into account; leverage women's participation and leadership in the design of energy strategies, policies and programmes; expand training and education of women on sustainable energy and entrepreneurship; and raise awareness in order to mobilize resources to finance sustainable energy technologies, among others. The national and county governments in Kenya should ensure that gender issues are mainstreamed in governance and decision-making processes related to policy development, implementation and monitoring, service delivery and financing of sustainable energy. This will promote women's participation and leadership in energy governance and energy institutions at the local and national levels.

Additionally, the Kenya national government should revise the energy policy to recognize women as independent users of energy solutions and enable them to benefit from energy access, taking into consideration the challenges of land ownership/rights, access to credit, and social constraints. This will make it possible for them to access loans to install clean energy technologies for sustainable development.

Gender-sensitive planning in the energy sector: The national and county governments should promote gender equity in planning, budgeting, designing, producing, supplying, and managing sustainable energy solutions. Gender analytical tools like the Moser Framework, Harvard matrix should be used to do a gender analysis in the energy sector development plans. This should go together with facilitation of inter-sectoral dialogues and consultations among key actors from government, civil society, the private sector and community leaders to discuss gender equality and women's needs and priorities as related to sustainable energy. It will also ensure that policies, programmes, and projects equitably valorise women's and men's time and labour burdens and expenditures to take care of gendered roles in society.

The government with development partners in the energy sector should support generation, collection and use of gender-disaggregated data on energy use, energy sector employment and impacts of energy development. This will serve as a baseline for evaluation purposes, and be instrumental in defining gender-sensitive targets and indicators. It will also facilitate understanding of gender-energy linkages. Both quantitative and qualitative data will be needed to capture social, economic, and environmental aspects. This data will give the evidence needed to understand women's practical needs and to help energy projects identify how women can be instrumental

in making energy projects more effective, for example, by marketing energy solutions or being involved in technology design.

Capacity building in the energy sector: Capacity building in the energy sector should be up-stepped. The national and county governments should initiate capacity building for women to work in the clean energy sector as policy makers, designers, managers, and suppliers of sustainable energy solutions. A “critical mass” of qualified women should be built to have an impact on the gender balance in energy institutions. This can be done by supporting women’s career development through training courses and mentorship programmes. Also important will be encouraging commitment from energy institutions to commit to gender objectives in their management. Together with this is capacity building for both women and men to engage with gender issues in energy solutions. This involves training of female and male energy practitioners, researchers and policymakers who need tools to engage effectively with gender.

The capacity of civil society to work on gender issues in energy should also be built as active partners in this endeavour. This will raise awareness among the local population, as well as ensure ownership. A strong awareness of gender-energy issues at the grassroots level can hold local enterprises, donors, and governments accountable. There is need to support linkages and networks among women researchers, policymakers, and grassroots organizations as a means for generating self-confidence and increasing visibility at every level. They must be provided with adequate information about the advantages and disadvantages (for example price, environmental effects, health impacts, maintenance) of various energy technologies. They also need to be trained on how to maintain, and repair etc so that they will be able to make concerted, choices in terms of energy uses and technologies. Further, the benefits of mainstreaming gender issues into the energy sector need to be given wide publicity through networks, workshops, and conducting training in the local language is critical for both women and men.

References

- Acker, R., and Kammen, D.M.1996. The quiet (energy) revolution .Analysing the dissemination of photovoltaic power systems in Kenya. *Energy Policy*, Vol.24(1):81–111. Elsevier Science Ltd.Great Britain.
- African Ministerial Conference on the Environment (AMCEN). 2011. *Addressing climate change challenges in Africa: A practical guide towards sustainable development*. Nairobi: AMCEN Secretariat.
- Aklilu, A., and Alebachew, A. 2009. ‘Assessment of climate change-induced hazards, impacts and responses in the Southern lowlands of Ethiopia’. *FSS Research Report, No. 4*. Addis Ababa: Forum for Social Studies.

- Anderson, S. Hesse, C. and Nassef, M., 2009. *Pastoralism and climate change: Enabling adaptive capacity*. London: ODI.
- Ban Ki-Moon. 2011. 'Sustainable Energy for All'. A Vision Statement by the Secretary General of the United Nations on Renewable Energy. United Nations.
- Bamberger, B. 2003. Bottlenecks of rural energy planning: A gendered perspective. *Working paper*. New Haven: Yale University.
- Barnes D. 1995. Consequences of energy policies for the urban poor. *FPD Energy Note*, No. 7. Washington DC: The World Bank.
- Biogas for Better Life, An Africa Initiative. 2007. *A feasibility study by Shell Foundation*. Nairobi, Kenya.
- Bwakali, J. D. 2008. *Biofuels boom and bust*. Inter Press Service News Agency. October 24, 2008. 36.
- Clancy, J. 2002. *Household energy and gender: An introduction*. Technology and Development Group. University of Twente: The Netherlands.
- Clancy, J.S., F.U. Malik, I. Shakya, and G. Kelkar .2007. Appropriate Gender-Analysis and News. *Dispatch, Inc.*, 15(2): 241–257.
- Clancy, J. and Skutsch, M. 2003. *The gender energy poverty nexus: Finding the energy to address gender concerns in development*. DFID Project CNTR998521.
- Clancy, J.S., Skutsch, M.M., and Batchelor, S. 2002. 'The gender-energy-poverty nexus: Finding the energy to address gender concerns in development'. Prepared under DFID contract CNTR998521.
- Clancy, J.S. et. al. 2011. 'Gender equity in access to and benefits from modern energy and improved energy technologies – Executive Summary'. World Development Report Background Paper. ETC/ENERGIA and Nor/Soer-konsulenterne. The Netherlands.
- Danielsen, K. 2012. *Gender equality, women's rights and access to energy services*. February 2012.
- Denton, F. 2002. Climate change vulnerability, impacts, and adaptation: Why does gender matter? *Gender and Development*, 10:10–20.
- Dinkelman, T. 2008. *The effects of rural electrification on employment: New evidence from South Africa*. Michigan: University of Michigan.
- Elliott, L., 2004. *The global politics of the environment*. 2nd ed. London: MacMillan Press.
- ENERGIA. 2007. *Where Energy Is Women's Business: National and Regional Reports from Africa, Asia, Latin America, and the Pacific*.
- ENERGIA/DFID. 2006. *From the Millennium Development Goals towards a gender-sensitive energy policy research and practice: Empirical evidence*

- and case studies*. Collaborative Research Group on Gender and Energy (CRGGE).
- Esipisu, I. 2012. Kenya: Nation becoming economic heartbeat of continent. *All Africa*, April 25, 2012.
- ESMAP. 2013. Integrating gender considerations into energy operations. *EMAP Technical Paper*, no. 042. Washington, D.C: World Bank.
- ETC/ENERGIA in association with Nord/Sør-konsulenterne. 2011. *Gender equity in access to and benefits from modern energy and improved energy technologies*.
- Fischer, E.M, Seneviratne, S.M D. Lu`thi and Schar, C. 2007. Contribution of land-atmosphere coupling to Recent European Summer Heat Waves. *Geophysical Research Letters*, Vol. 34.
- Food and Agricultural Organization (FAO). 2009. *Enabling agriculture to contribute to climate change mitigation*. Rome: FAO.
- Gachau, E.M. 2011. 'Social aspects of geothermal development: A case of Olkaria Geothermal Power Project in Kenya'. A Paper Presented to a Short Course VI on Exploration for Geothermal Resources, Lake Bogoria and Lake Naivasha, October 27th–November 18, 2011. Kenya Electricity Generating Company, Geothermal Development Company and United Nations University-Geothermal Training Programme.
- Gathanju, D. 2010. Denis Gathanju's Articles. *RenewableEnergyWorld.com*.
- Gill, S., and Handley, J. 2007. Adapting cities for climate change: The role of the green infrastructure. *Built Environment*, 33(1): 115–133.
- Government of Kenya. 2011. *Scaling up renewable energy program (SREP). Investment Plan for Kenya*. (May). Nairobi, Kenya: The Government Printers.———. 2004. *Sessional Paper No. 4 on Energy*. Nairobi: Ministry of Energy. The Government Printers.
- Habtetsion, S. and Tsighe, Z., 2002. *Current energy utilisation and future options in rural areas*. AFREPREN/FWD and Sida/SAREC.
- Hafeez, D. 1998. *Towards environmentally sustainable agriculture in the Indus Basin irrigation system*. Lashore: Pakistan National Program, International Irrigation Management Institute.
- Hansen, J Makiko S, Pushker K, David ,B, Valerie M, Mark P, Maureen R, Dana L. R, James C. Z. 2008. Target atmospheric CO₂: Where should humanity aim? TargetCO₂_2008407.pdf. Available at www.columbia.edu.
- Haraldsson, H., 2004. 'Introduction to systems thinking and causal loop diagrams'. Reports in Ecology and Environmental Engineering. Institute of Chemical Engineering; Lund University. <http://siteresources.worldbank.org/INTPSIA/Resources/490023-1120845825946/>.

- IEA. 2011a. *World energy balances*. Paris: Organisation for Economic Co-operation and Development and IEA. <http://data.iea.org>. Accessed 15 June 2011.
- . 2011b. *'Energy for all': Financing for the poor*. Paris, France: International Energy Agency.
- . 2010a. *Energy balances of Non-OECD countries*. Paris: International Energy Agency.
- . 2010b. *World energy outlook 2010*. Paris: International Energy Agency.
- . 2008. *Issues behind competitiveness and carbon leakage. Focus on heavy industry*. Paris: International Energy Agency.
- IISD. 2013. *Post-2015 development agenda bulletin*. Summary of the High Level Meeting on Energy and the Post-2015 Development Agenda.
- Inter- Government Authority on Development (IGAD). 2007. *Annual report*. Nairobi, Kenya.
- IPCC. 2009. *UN Summit on Climate Change*. Statement of Dr. R. K. Pachauri, Chairman, IPCC Director General. The Energy and Resources Institute Director: Yale Climate and Energy Institute.
- . 2007a. *Climate change 2007: Synthesis report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Core Writing Team, R.K. Pachauri, and A. Reisinger (Eds.). Cambridge: Cambridge University Press.
- IRENA REMAP. 2012. 'IRENA REMAP 2030: Doubling the global share of renewable energy. A roadmap to 2030'. Working paper. Available at www.irena.org/Publications.
- Kakerezi, S., Kimani, J. and Onguru, O. 2009. 'Climate change and energy security in East Africa'. A Report Prepared for the Global Network on Energy for Sustainable Development by Energy, Environment and Development Network for Africa.
- Kakerezi, S., and Kithyoma, W.K. 2002. Renewable energy strategies for rural Africa: Is PV-led approach for providing modern energy to the rural poor of Sub-Saharan Africa. *Energy Policy*, 30:1071–1086.
- Kamfor. 2002. *Study on Kenya's Energy Demand, Supply and Policy Strategy for Households, Small Scale Industries, and Service Establishments: Final Report*. Nairobi: Ministry of Energy.
- Kendagor, L. K. and Prevost, R.J. 2013. *Energy diversity and development in Kenya*. Kenya: National Defense University (NDU).
- Kituyi, E. 2000. 'Atmospheric emission budgets for domestic biomass burning in Kenya'. Ph.D. Thesis, University of Nairobi.

- Kituyi, E., Marufu L., Huber B., Wandiga S. O., Jumba I. O., Andreae M. O., and Helas G. 2001b. 'Biofuel consumption rates and patterns in Kenya'. *Biomass and Bioenergy*, 20, 83 – 99.
- Koningstein, R. and Fork D .2014. *What it would really take to reverse climate change: Today's renewable energy technologies won't save us. So what will?* IEE SPECTRUM. Retrieved on 18th September 2014 from www.spectrum.ieee.org/energy/renewables.
- Majtenyi, C. 2011. *Kenya eyes nuclear power development*. Lanham, MD: Federal Information.
- Masinde, S. and Karanja, L. 2011. *Global corruption report 2011: Climate change*. London: Transparency International. Miller,K.A., Sisconik,D.S.,Sheppard, *et al.* 2007. Long-term exposure to air pollution and incidence of cardiovascular events in women. *N.Engl.Med*, Volume 356:447–458.
- Mugo, F.W. 1999. 'Charcoal trade in Kenya'. *RELMA, Working Paper, No. 5*.
- . 1997. Factors Contributing to Wood Fuel Scarcity and the Consequent Use of Crop Residues for Domestic Energy in Rural Kenya. MS Thesis. Cornell University, New York: USA.
- Mugo, F. and Gathe, T. 2010. 'Biomass energy use in Kenya'. A Background Paper Prepared for The International Institute For Environment and Development (IIED) for An International ESPA Workshop On Biomass Energy, 19–21 October 2010, Parliament House Hotel, Edinburgh. Nairobi: Practical Action.
- Mukuna, T.E. 2012. *The impact of micro-finance on rural women empowerment in the Pastoralist Maasai community. A case of Kenya Women Finance Trust*. A Paper Presented at an OSSREA Kenya Chapter Workshop, June 16th–18th 2012. Eldoret. Moi University. Unpublished.
- Mukuna, T.E. 2013. 'Assessing the impact of climate change on coping strategies and social safety networks among the pastoralists of Narok District, Kenya'. *In*: Devereux, S. and Getu, M. 2013. *Informal and formal social protection systems in Sub-Saharan Africa*, pp.191–214. Kampala: Organisation for Social Science Research in Eastern and Southern Africa (OSSREA) and Fountain Publishers.
- Muok, B.O.,Kirui,S.,Theuri, D.,and Wakhungu, J.W. 2008. 'Policies and regulations affecting biofuel development in Kenya'. *PISCES Policy brief*, No.1, 2008.
- Mulinge, M. 2013. 'Introduction: Climate change— The challenge of the 21st century'. *In*: Mulinge, M.M. and Getu, M. (2013), *Impacts of climate change and variability on pastoralist women in Sub-Saharan Africa*, pp.1–16. Kampala: OSSREA and Fountain Publishers.

- Mwakubo, S., Mutua, J., Ikiara, M., and Aligula, E. 2007. 'Strategies for securing energy supply in Kenya'. *KIPPRA Discussion Paper*, 74.
- National Environment Management Authority (NEMA). 2009. *Uganda atlas of our changing environment*. Nairobi: Kenya: UNEP.
- . 2008. *Pilot integrated ecosystem assessment of the Lake Kyoga catchment area*. Kampala: NEMA, Uganda.
- . 2007. *Effects of climate change and coping mechanism in Kenya*. Nairobi: Kenya. NEMA/ UNDP.
- National Forestry Authority (NFA). 2005. *The value of Ugandan's forests: A livelihood and ecosystem approach*. Kampala: NFA.
- Neumayer, E. and Plumper, T. 2007. 'The gendered nature of natural disasters: The impact of catastrophic events on the gender gap in life expectancy, 1981–2002'. *Annals of the Association of American Geographers*, 97(3): 551–566.
- Njiru, B. 2013. Challenged livelihoods as a result of water scarcity among Maasai women pastoralists in Kajiado county, Kenya'. *In*: Mulinge, M.M. and Getu, M. (Eds.). (2013). *Impacts of climate change and variability on pastoralist women in Sub-Saharan Africa*. Kampala: Fountain Publishers, pp. 45–8. Organization for Social Science Research in Eastern and Southern Africa (OSSREA).
- Nyoi, P. 2012. Kenya aims to build a nuclear power plant by 2017. *Businessweek.com*.
- Oxfam International. 2005. *The Asian tsunami: The challenge after the Jakarta Summit*. London: Oxfam International.
- Pius, F., Abiodun, A., Adetayo, O., Adesanwo, A., and Oladunjoye, A. 2013. 'Viewing energy, poverty and sustainability in developing countries through a gender lens'. Open access article. InTech. Retrieved from <http://dx.doi.org/10.5772/51818>.
- Practical Action. 2006. *Biogas practical answers, technical information online*. Rugby: U.K.
- Reddy, A. K. N. and B. S. Reddy. 1994. Substitution of energy sources for cooking in Bangalore. *Energy*, 19: 561–572.
- Rengasamy, S. et. al. 2001. *The land without a farmer becomes barren: Policies that work for sustainable agriculture and rural livelihoods in Virudhunagar district, Tamilnadu*. London: IIED.
- RoK. 2012. Third Draft National Scaling-up Renewable Energy Program (SREP). The Climate Investment Fund. Available at <www.climateinvestmentfunds.org/cif/srep>; *SREP Investment Plan for Kenya*, Nairobi: Ministry of Energy, Republic of Kenya.
- Skutch, M. 1998. The gender issue in energy project planning: Welfare, empowerment, or efficiency? *Energy Policy*, 26(12): 945–55.

- Smart Villages Initiative. 2014. *Smart villages: New thinking for off-grid communities worldwide*. Arusha Tanzania.
- TERI. 1992. *TERI energy data directory and year book 1990–1991*. New Delhi: Tata Energy Research Institute.
- Tucker, M. 1999. Can Solar Cooking Save Forests? *Ecological Economics*, 31:77-89.
- UN Women. 2012. *The future women want: A vision of sustainable development for All*. RIO+20. United Nations Conference on Sustainable Development. UN Women.
- UNDP. 2012. *Towards an energy plus approach for the poor: A review of good practices and lessons learned from Asia and the Pacific*. UNDP.
- UNDP. 2011. *Human development report 2011. Sustainability and equity: A better future for all*. UNDP.
- UNDP. 2004. *Human development report 2004: Cultural liberty in today's diverse world*. Carfax Publishing, Taylor and Francis Ltd.
- UNDP. 2000. *Human development report 2000: Human rights and human development*. New York: U.S.A.
- UNDP. 1997. *Human development report 1997*. Oxford: Oxford University Press.
- UNIDO. 2011. *Industrial development report 2011. Industrial energy efficiency for sustainable wealth creation: capturing environmental, economic and social dividends*. UNIDO.
- . 2009. 'Scaling up renewable energy in Africa'. 12th Ordinary Session of Heads of State and Governments of the African Union. Addis Ababa, Ethiopia. UNIDO.
- . 2009. 'Industrial development report 2009. Breaking in and moving up: New industrial challenges for the bottom billion and the middle-income countries'. *UNIDO ID, No.* 438.
- United Nations Environment Programme (UNEP). 2009. *Kenya: Atlas of our changing environment*. Nairobi: UNEP.
- United Nations Environment Programme (UNEP). 2006. *Protecting Mau forest in Kenya's economic Interest* Press Release, July. <http://www.unep.org/documents.multilingual/default.asp?documentid=540&articleid=5877&language=en>.
- United Nations Framework Convention on Climate Change (UNFCCC). 2012. 'The Durban platform for enhanced action'. Report of the Conference of the Parties on its Seventh Session, held in Durban, South Africa, 28th November – 11th December 2011. Bonn: United Nations Framework Convention on Climate Change.

- United Nations Framework Convention on Climate Change. 2007. *Climate change: Impacts, vulnerabilities and adaptation on developing countries*. Bonn: United Nations Framework Convention on Climate Change.
- http://www.un.org/wcm/webdav/site/sustainableenergyforall/shared/Documents/S_G_Sustainable_Energy_for_All_vision_final_clean). Retrieved 11th September 2014.
- Waruru, M. 2014. *East African countries move to adopt renewable energy technologies*. RenewableEnergyWorld.com.
- World Bank. 2008b. *Climate change adaptation and mitigation in development programmes: A practical guide*. New York: The World Bank.
- . 2008a. *Biodiversity, climate change and adaptation: Nature-based solutions from the World Bank portfolio*. New York: The World Bank.
- . 2006. *Gender Equity as Smart Economics: A World Bank Group Gender Action Plan (Fiscal years 2007 – 10)*. September 2006.
- . 2003. *Household energy use in developing countries: A multi country Study*. Washington, D.C: The World Bank.
- . 2001. *Engendering development through gender equality in rights, resources, and voice*. Washington, D.C: World Bank.
- . 2000. Indoor Air Pollution Newsletter. *Energy and Health for the Poor, Issue No. 3; December 2000*.
- World Health Organization (WHO). 2010. *Guidelines for indoor air quality: Selected pollutants*. Bonn: The WHO European Centre for Environment and Health.

CHAPTER TEN

Bridging the Gender Gap in Access to Energy in East Africa: A Needs-Based Approach

Paschal B. Mihyo

Abstract

Both conventional and indigenous sources of energy serve individual and community needs and activities. The energy needs of those in society, especially women and children, who search for and use energy to meet the needs of households and communities, do not seem to have been given a prominent place in the planning, development and distribution of energy resources. The existing systems have concentrated more on individual needs of energy users for a long time. Only in the last one and half decades have community needs attracted the attention of policy makers and planners in the new drive for energy for all. But, even in that drive, the emphasis is still on modern energy sources and technologies most of which are likely to reach more people than before but leave the poorest of the poor at the bottom of the energy pyramid. This chapter assesses the efforts undertaken in the past decade in Kenya, Tanzania and Uganda by different actors to increase access to modern sources of energy especially in rural areas and uses a needs-based approach to indicate the extent to which these efforts have contributed to the reduction of the gap in the access to energy by men and women.

1. Introduction

Men and women perform different roles as prescribed by norms and practices in their different societies. Some of these roles relate to household and communal needs and some relate to individual needs. The distinction between individual and household needs may sometimes be very blurred. For example, a man who needs an electric saw to cut timber to make furniture to earn some income may end up sharing the income with his other household members but he personally owns the income and how much of it he shares with the other members depends on him. It is not the same with those who perform chores which cater for household and community needs. Women and children, especially girls, search for and use traditional sources of energy, such as wood fuel and other biomass, dung cake, and plant residue to prepare food, warm water, prepare medication, and preserve food. When they get access to electrical energy their needs are extended. Their ascribed roles make them require energy to preserve food, to help children to read and do homework, to nurse and take care of the sick, to repair clothes of the other household members and other activities. In the use of conventional and traditional sources of energy women provide services to the household or the community and do not benefit from these

services as individuals. Table 1 shows the varying needs of men and women in relation to various sources of energy.

Table 1. Differentiated energy use by women and men

Type of energy	Women's household needs	Women's community needs	Men's household needs	Men's community needs
Biomass	• Food and drink processing and preservation • Medication • Warming stuff • Pest control	• Solid waste disposal • Preparation of food and drinks for ceremonies • Community funerals, rituals and vigils • Drying fish and crops	• Personal warmth • Smoking • Roasting • Solid waste disposal	• Security • Rituals of passage • Peer group entertainment • Night meetings
Electricity where available	• Refrigeration of food and medicine • Sawing and repair of household wares • Supporting children to learn • Taking care of the sick	• Small enterprises—hairdressing, tailoring, baking, boutiques • Confectionery • Large-scale food and beverages preparation • Telephone charging • Internet cafes • Lighting for poultry farms and small stocks • Domestic security	• Radio and TV news and games • Shaving • Lumbering • Welding and joinery • Lighting for livestock • Domestic security • House repairs involving drilling	• Commercial activities such as, shops, cafes, restaurants • Carpentry and lumbering • Welding and joinery • Butcheries • Tanning • Commercial tailoring and shoe repair • Entertainment • Commercial photography
Mechanical energy	• Milling and grinding • Pumping well	• Transport of farm and off-farm products to	• Mobility to visit relatives and	• Commercial transport • Food milling

Type of energy	Women's household needs	Women's community needs	Men's household needs	Men's community needs
	water	markets	friends	and packing
	• Transport generally • Transporting products to markets • Carrying water • Transporting food purchases	• Catering services and facilities • Mobility for services at social functions • weddings, religious ceremonies, funerals	• Moving goods to and from markets	• Abattoirs and butcheries • Service provision of transport to and from markets
Animal power	• Carriage of water • Carriage of firewood • Carriage of harvested products • Ploughing and tilling • Carriage of commodities to and from markets	• Carriage of water, firewood and products for social community functions • Collective farming activities	• Riding and entertainment • Transport to distant areas	• Commercial transport • Commercial portage • Commercial water pumping • Commercial wind milling • Commercial entertainment

Within these energy needs of women and men, it is clear that the roles that women play using energy do not benefit them personally, but benefit their households as a whole and their communities. On the other hand, the activities of men that use energy do not directly benefit all at community or household level. Most of them are commercial and accessible by those who can afford to purchase services they entail. The purpose of this chapter is to examine the extent to which the energy needs of women and children are promoted and advanced in the various programmes and policies of three countries in East Africa: Kenya, Tanzania and Uganda. At the end of the chapter, indications will be given of what needs to be done to address women's productive and strategic needs.

2. The Problem Addressed in the Chapter

In November 2006, the five countries of the East African Community adopted the *East African Community Strategy to Scale-Up Access to*

Modern Energy Services. The strategy was aimed at helping to provide a common framework to Member States in their efforts to implement the Millennium Development Goals. It was acknowledged that unless drastic measures were taken, 80 per cent of East Africans would have no access to clean cooking fuels by 2015. It was also felt that in the absence of concrete concerted efforts, 90 per cent of the local schools and clinics would have no access to electricity and access to motive power for mechanical chores would still be lacking (EAC 2006). The MDGs have now been replaced by SDGs and, in the period between 2006 and 2015, the three East African countries on which this study is focused launched several programmes aimed at increasing access to clean energy fuel especially for the poor. This chapter seeks to assess how much of these efforts have been aimed at bridging the gender gap in the access to energy resources in Kenya, Tanzania and Uganda.

3. Methodology

This study has relied mainly on existing literature on gender and energy issues and reports on current efforts being mounted by Kenya, Tanzania and Uganda to increase access to electricity and renewable energy sources by their citizens especially those living in rural areas. The countries selected for the study are Kenya, Tanzania and Uganda.

4. Energy and the Poor in Africa

People who live in the tropics are blessed with continuous energy supply from the sun which keeps them warm, helps to dry crops and can be a major source of clean energy for domestic, commercial and industrial use. But, rarely do people in the tropics sit back and reflect on how blessed they are to have such a renewable and inexhaustible source of energy. This is because most of them depend on electricity. However, about 580 million or two thirds of the people in Africa do not have access to electricity. In some rural areas, only about 2 per cent of the people have access to electricity and on the average about 92 per cent of the people living in rural areas on the continent have had no access to electricity. Although globally only one in five people has access to electricity, Africa is the least connected continent in the whole world (Klunne 2008, 2). The urban poor and rural dwellers in general are the most disadvantaged. They lack the necessary purchasing power to enable them acquire cleaner and safer sources of energy and as a result they depend exclusively on biomass. However, while in all poor communities men and women are disadvantaged, women and girls bear the brunt of this disadvantage. The collection of biomass in most African communities is the responsibility of women and girls. When men engage in fetching fuel wood and other biomass for energy, it is usually for commercial purposes. The women and girls collect the biomass and use it to prepare food, warm water and undertake other activities requiring heat in their households.

The exclusive involvement of women and girls in the collection and use of biomass for household needs in disadvantaged and poor communities puts them in situations not experienced by their male counterparts. While they collect biomass and cook, they do not get time to engage in activities for self-advancement and recreation and education. Similarly, these chores deprive them of the time they would otherwise use on learning, political activities and networking. Most of the household chores are carried out at zero cost and are never captured in national statistics, plans and policies (Klunne 2008). This is one of the factors behind the appalling gender blindness in energy and other policies. In the urban areas where poor communities have limited access to electricity, cooking and household warming and drying are still done using biomass. Even heating required for commercial activities, such as informal food services, cloth dyeing, weaving depends on biomass. Only the commercial activities of women such as hair dressing, beauty parlours, internet cafes, and dress boutiques use electricity. Some of these are not operated by women from disadvantaged or poor households even when they are located in disadvantaged communities.

The plight of women as regards energy has been aggravated by climate change which is causing recurrent droughts that affect the generation of electricity which supplies 80 per cent of the commercial and industrial electric power in East Africa. This is causing energy instability in the formal sector but climate change has hit the informal sector and rural communities harder because, biomass, once upon a time a free and easy-to-get commodity, has become very hard to get and is becoming increasingly commercialised even in the rural areas. These areas depend for over 80 per cent on biomass (IPCC 2005). Although climate change is causing energy crises across the globe and affecting women more than any other social group, the voice of women in climate change negotiations has been missing because very few women at the top have been involved (Szołecsky 2008) and when gender issues have featured on the negotiation agendas they have been treated as tangential (Browns and Spitzner 2004; Denbossche, Gabison and Bock 2008). The scarcity in biomass has not led to shifts in the division of labour between men and women. Only when it is commercialised do men jump in and take primary responsibility not for collecting but managing the collection using women's cheap labour.

5. Hazards of the Traditional Cooking Stove

At one gender issues workshop one participant said that the most dangerous place in the household is the kitchen. As people laughed or giggled she tried to explain that it is not only the electric wires, knives and other protruding gadgets in a modern kitchen that can readily cause harm. She emphasised kerosene which is inflammable and can cause fires; slow poisons caused by fumes that people cooking, whether male or female, inhale from morning to evening slowly being driven to their graves and the salts and peppers that enter eyes and nostrils and find their ways into their

lungs. It was only at the end of her analysis that people kept quiet and began to see a lot of sense in what she was saying. The traditional cooking stove using charcoal, firewood and other biomass has remained a soft but steady killer in poor household communities. According to the Global Alliance for Clean Cooking Stoves (2011), the smoke and poisonous gases they emit contribute to nearly 2 million deaths a year globally. These gases and fumes affect women and young children who spend more time near open fires and most of the deaths caused by pneumonia among children under five are due to smoke exposure (Global Alliance for Clean Cooking Stoves 2011, 13–14). The Alliance argues that more people die from diseases arising out of lack of clean cook stoves fuels than those that die from HIV/AIDS, malaria or tuberculosis and they assert that it is estimated that the figures on deaths associated with crude cook stoves and open fires are more than double the number of deaths from malaria, more than three times those caused by tuberculosis and almost equal the number of those caused by HIV/AIDS (Global Alliance for Clean Cooking Stoves (2011, 13–14). The WHO has predicted that if the remarkable progress on controlling malaria, HIV/AIDS and TB continues at the current rates, cook stove smoke will be the biggest killer by 2030 (Global Alliance for Clean Cooking Stoves 2011, 16; WHO 2010).

As the search for biomass pushes the women further from home and deeper into the wild, they become vulnerable to attacks from wild animals and men. They get assaulted, raped and even killed and the Women Refugee Commission (2006) has raised alarm that in DRC, Somalia and other conflict areas, women are being raped on daily basis as they look and search for wood fuel. This is confirmed by the Global Alliance for Clean Cooking Stoves (2011, 14) and was raised for consideration in the Rio discussion and deliberations (Ceceleski 2001). It is indeed a paradox that with the rapid rates of unprecedented economic growth over the last three decades and having frog leaped the IT revolution with one of the highest rates of internet and mobile phone growth and penetration in Africa, very limited political space has been devoted to the discussion of and raising awareness about the link between diminishing biomass resources and the plight of women caused by human insecurity encountered in the search for wood fuel and the increasing mortality caused by traditional cooking stoves and fuels. It is because this is a problem which predominantly affects the poor and, as long as they suffer and die from smoke-generated diseases, most of which are not infectious and are therefore unlikely to spread to affluent neighbourhoods, they pass either unnoticed or noticed but unattended. It is also possible that to address the problems caused by smoke stoves, there is need for technological innovations and investments in R&D with uncertain rates of returns because most of the victims live in poor communities at the bottom of the social pyramid. They are assumed to be unable to pay the costs of clean cook stoves and fuels (Global Alliance for Clean Cooking Stoves 2011).

But, as the former President of Tanzania Mwalimu Nyerere once said, 'poverty is very expensive'. He was right because the poor spend more than other social groups on the crude energy they use. If one calculates and valorises the time spent by women per household in the search of biomass and the actual amounts they spend on the purchase of kerosene, charcoal, firewood and other biomass, they spend a lot more than affluent families spend on electricity and gas. Some poor households spend more than 70 per cent of their total household incomes on fuel, leaving very little for other social services such as education and health (Global Alliance for Clean Cooking Stoves 2011, 14). In addition, although biomass is a renewable source of energy, it is not easily reusable once put on fire. Charcoal, for example, can be made inactive by pouring water on it after cooking but it becomes inefficient when attempts are made to re-use it for further cooking. Therefore, it has to be completely burnt and it is hard to save. The same goes for other sources such as saw dust, dung cake and others. On the other hand, gas and electricity can be easily switched off and saved and do not have to be burnt to the end. These characteristics of biomass increase the cost of fuel to the poor. Furthermore, the affluent can preserve food in cold storage facilities powered by electricity. Therefore, the poor cannot buy bulk stocks of perishable foods – such as milk, meat and fish. They can only buy as much as they can cook and consume quickly because they do not have cold storage facilities. For the affluent households, bulk purchases enable them to buy a lot at cheaper prices. On the other hand, poor families buy small amounts of perishable food stuffs and have to cook and finish them within short periods because they lack refrigeration facilities. The frequency of cooking increases their energy costs and the time of exposure to fumes and poisonous gases on the part of those cooking.

Attempts have been made to develop cook stoves that reduce emissions such as the Kenya Ceramic Jiko which reduces the amount of poisonous gases emitted and is user-friendly. But innovations in this area have encountered numerous obstacles that have made the diffusion of these new technologies problematic. First and foremost has been the lack of objective systems of quality assurance and certification. The development and manufacture of these stoves has remained a domain of the informal sector, working sometimes with NGOs and small-scale firms. In East Africa, the bureaus of standards have not made an effort to develop standards and harmonise their quality assurance systems as regards these technologies. Secondly, there have not been serious widespread campaigns on the health hazards arising out of the use of open fires and traditional cook stoves. The research has been scanty and it has not involved serious policy dialogue and awareness campaigns. The media in East Africa has not been involved in addressing the issues and this could be because the health ministries and public health researchers have not been involved in the generation of evidence on the health hazards of cook stoves and the health dividends of cleaner energy stoves.

The third factor is that of dependence on aid. Most of the innovations on the cook stove have been triggered by donor-aided projects. This phenomenon has a few negative elements. One of them is the lack of internal drive for change. Once a product comes out of donor-funded project, it lacks the potential to generate its own internal dynamics unless it gets a local champion from the industrial and political communities to push for its domestication. Another disadvantage is that some of the projects have been producing and distributing new clean energy stoves rather indiscriminately without designing them bearing in mind issues of their adaptation. As a result, some are not suited to the types of food common in some areas. Some fail to last because of ecological and atmospheric conditions of certain localities and some are distributed in areas where they are resisted because of cultural or religious values and practices. This also brings in the issue of subsidies. Most of the stoves distributed under donor aid projects tend to be subsidised. This may seem to be pro-poor but it creates a dependency which cannot be sustained after the project ends. In areas where such aid was used to distribute these stoves, rates of absorption of these technologies have been low (Global Alliance for Clean Cooking Stoves (2011, 19).

Cultural factors also have played a role in influencing absorption rates. In some conservative communities and households, beliefs have been institutionalised about the importance of cooking food on a traditional cook stove. Most men do not think food prepared on alternative cooking systems is well prepared. In some households in urban areas, even affluent men resist food prepared on electric cookers or cookers powered by solar energy. They claim it is hastily prepared and most nutrients are lost. In other communities, food preparation is culturally structured. Acceptable food has to be prepared on open fire powered by firewood. In some of such communities, nothing short of firewood is acceptable. The use of three cooking stones has been built into some cultures in East Africa to the extent that politicians when campaigning remind people that the best food is cooked on three stones and therefore they should vote their political parties to enable them hold positions in the three key institutions of governance: local authorities, parliament and the presidency. In other communities, men are encouraged to have relationships with at least three women. The ideology used to justify this is the concept of the three cooking stones because it is argued a man cannot survive a relationship with only one or two women, but like the African cooking pot he needs three stones to prop him. Such ideologies and beliefs make the open fire three stone cooking stove not only rational but also a yard stick of perfection.

6. East African Community Policies Aimed at Increasing Access to Energy Resources

In 2006, the five East African Community countries adopted the *East African Community Strategy to Scale-Up Access to Modern Energy Services* (EAC 2006). This policy has four main targets. The first one is to

provide access to modern cooking practices for 50 per cent of the population that was using cooking fuel by ensuring that 50 per cent would have access to liquefied petrol gas, improved cooking stoves, and biomass by 2015. The target was at least 2.7 million of the urban poor, 6.1 million among the rural poor and 0.9 million in nomadic and conflict areas. The second target was to provide access to reliable electricity for all the urban and per-urban poor and the targeted numbers were 5.3 million of the urban poor and 2.2 million in urban slums. The third target was to provide access to modern energy for all schools, clinics, hospitals and community centres. The target numbers were 46,545 schools, 10,323 clinics and 750 hospitals. The fourth target was to provide access to mechanical power for heating and productive uses for all communities and the target number was 23,240 communities.

6.1. Kenya Energy Policy

The most recent energy policy for Kenya was passed in February 2014 (Government of Kenya 2014) with the overall goal of ‘facilitating the provision of clean, sustainable, reliable, affordable, competitive and secure energy services at least cost while protecting the environment’. In the area of fossil energy, the policy underlines the need for adequate petroleum production capacity, adequate petroleum reserves and adequate coal production while protecting the environment. It emphasises affordability, accessibility, reduction of losses and connection costs in the production and distribution of electricity and it contains provisions on balancing revenue collection and accessibility of electricity to low income segments in the taxation and pricing of electric power services. In this area the policy vests the responsibility for developing electricity resources in the national government while the counties are charged with planning and coordinating supply networks.

The policy puts a lot of emphasis on alternative sources of energy, especially renewable sources. But, it identifies several challenges to each of these sources. It notes that geothermal projects need very long lead time of 5–7 years from conception to completion; they involve lengthy development processes; they have high resources development risks; most potential sites are in remote locations and establishing projects requires long consultations and negotiations with local communities. It recognises the potential for large-scale hydroelectric power projects but also notes that they are vulnerable due to climate variations that cause frequent droughts or floods; they are capital-intensive and their development requires massive relocation of local communities; there is a serious lack of data on hydrological resources and they entail conflicting and competing interests between land and water users. It also commits the government to establish small hydroelectric projects on small rivers but notes that sites for such projects will be in remote rural areas; there was a problem of capacity for conducting feasibility studies, the design, construction and maintenance of

small dams and tariffs charged for electricity services generated by small hydroelectric projects were normally inadequate to cover costs.

It is noted in the policy that biomass accounts for 60 per cent of primary energy consumption in Kenya and that the government has tried over the years to promote wood fuel substitutes but the number of people depending on fuel wood has been increasing. The policy therefore recognises that wood fuel will continue to be the primary source of energy for the majority of the poor in rural and urban areas, 'for as long as it takes to transform the rural economy from subsistence to highly productive economy' (GoK 2014, 50). Due to this, it calls for continued efforts by the government and other actors to intensify agroforestry and social forestry programmes to increase the stock of wood fuel 'to make up for the loss of forest trees lost as forest land is converted into agricultural and settlement land' (*ibid.*). In the area of biomass, the policy takes cognisance of the negative impact use of biomass has on the environment; health hazards caused by emissions in the use of biomass; lack of knowledge and awareness about growth and commercialisation of fast-growing species of fuel wood; lack of policy coordination among agencies dealing with biomass; lack of data on biomass production and consumption; failure by government in the past to recognise biomass as a major source of energy in order to support its development in spite of the fact that it serves the majority of the population; use of inefficient technologies in the conversion and use of biomass; and competing interests between wood fuel plantations, food producers and commercial users of land resources.

In the light of these challenges, the policy commits the government to establish a database on trees and biomass potential; to coordinate commercial and subsistence biomass production; upgrade standards for cleaner biomass conversion and use; develop capacity for biomass energy technologies; facilitate popular participation in conservation under Article 69 of the 2010 Constitution; promote inter-fuel substitution to reduce overreliance on biomass and to undertake studies on the possibility of phasing out the use of kerosene in households (GoK 2014, 51–52). In the policy, the contribution of biogas is recognised and commitments to continue using animal wastes, cow dung, cut flowers waste, banana leaves and sisal waste to generate electricity. It takes cognisance of the involvement of the private sector in the generation of electric power using biogas, which has a potential for producing more than 200 MW. But, it also acknowledges that there is little information on the benefits of and technologies for biogas; limited R&D on biogas technologies; inadequate skilled contractors capable of installation, servicing and maintenance of biogas equipment and technologies and a severe lack of clear regulations for registration of installation contractors.

In the backdrop of these challenges and constraints, the policy commits the government to create awareness of biogas technologies and benefits; promote R&D in biogas technology; provide incentives for local

manufacture and importation of biogas equipment; help polytechnics at village level to develop capacity for installation, servicing and maintenance of biogas equipment; promote community-based biogas plants to cater for the collective needs of the poor; demonstrate and disseminate information on the viability and importance of biomass and biofuels; and facilitate the construction of at least 5000 bio-digesters by 2017, 6500 by 2025 and 10,000 by 2030 under the global programme of 'Biogas for Better Life'.

In this policy, it is also recognised that there has been a remarkable market penetration of small PV solar energy systems in Kenya. It is predicted in the policy that by 2020, the installed capacity will have reached 10 MW. By December 2013, the government had already installed 977 PV systems in schools, dispensaries, health and administrative centres. It has also started promoting solar-diesel and solar-wind hybrid generation capacity to off-grid stations at Lodwar, Habaswein, Merti, Hola and El Wak. By the time the policy was adopted in 2014, the government had started converting 11 diesel plants into hybrid stations at four stations in Wajir, two in Mandera, two in Lamu and two in Turkana. All these stations are in remote historically marginalised areas. The policy commits the government to popularise widespread use of solar energy; strictly enforce regulations; ensure all commercial buildings adopt solar and hybrid solar energy for water heating and lighting; provide incentives to promote local production and use of local solar systems; provide framework for connecting solar-generated power to national and isolated grids; formulate and enforce minimum standards for solar technologies and provide incentives for solar panels and equipment and outlaw vandalism. However, in the policy some constraining factors and challenges are identified, which include: the high preponderance of disjointed solar projects in the country; apparent disparities between potential and installed capacity; high cost of homemade solar systems in spite of existing incentives; erosion of consumer confidence due to inappropriate standards; faulty installations and poor post-installation service culture; rampant thefts of PV solar panels and public unawareness of the potential, opportunities and benefits of solar energy.

6.1.1. Kenya's Progress on Reaching the EAC Strategy Targets: Kenya has made a lot of progress in its attempts to meet the four targets before the end of the Millennium Development Goals. The most successful programmes have been in rural electrification. The Rural Electrification Authority (REA) was formed in 2010. It has launched a programme for the electrification of all primary schools in support of the government's goal to provide laptops to all standard one pupils. This will be completed during the operational year 2014/2015. Kenya has a total of 21,278 public schools which will benefit from this programme and, by December 2014, REA had connected 15,717 primary schools to the national grid. The target was to complete connecting the remaining 5,316 schools by April 2015 (REA Newsletter, December 2014). By the time this chapter was being written, there was no report on whether the target had been reached. However, the

overall balance sheet on energy access in Kenya hangs in a balance. It is more the case of much done but still a lot to be done. A study by the COMESA Secretariat in 2012 on renewable energy in that region in 2012 gave some insights into some of the constraints that will delay the attainment of the stated goals in the policies of most countries including Kenya.

The report spells out several systemic and institutional barriers to the development of renewable sources of energy, most of which reflect market failure and barriers. The first is capital costs of renewable energy technologies which are relatively higher than those of conventional sources. It is noted that 'with renewable energy generators operating at below 50%, the capacity factors of renewable energy technologies tend to require higher tariffs than the conventional energy generators to be financially viable' (COMESA 2012, 17). Secondly, the national electricity suppliers treat renewable energy as a source for people in disadvantaged communities or areas. Therefore, they install them in remote areas where the users or potential users cannot afford to pay and use it adequately. This makes renewable energy very expensive (COMESA 2012, 18). Third, investment risks are very high. Apart from low capacity of users to pay, there is the problem of cost which developers have to incur, including verification of viability, environmental clearance, project appraisal, and several permits and licences which have to be obtained before actual development. Most of them take time. In addition, developers require loans and loan guarantees. Loan guarantees for renewable energy developers do not seem to be on the agenda of governments in the COMESA region, including in Kenya. Without such guarantees, banks are hesitant to lend to such developers. Other weaknesses that one can notice in the Kenya energy policy include the following.

- Although the policy requires the government to promote research and popularise growth of fast-growing species of fuel wood, there is very little effort for popularisation and most of the activities are left to NGOs and a few private commercial farmers.
- The policy has comprehensive guidelines on what should be done, but very little is reported on strategies of how it should or was done.
- Climate change features prominently in the policy as a challenge, but in the strategies and guidelines, there is no mention of what should be done to mitigate its impact on energy sources.
- Municipal waste which is not only abundant in large quantities in urban areas is still not assessed for massive use in generating electricity.
- In spite of the capacity for research and a plethora of environmental organisations, it is a paradox that there is scarcity of data on renewable energy sources which can be used to make investment and other decisions. The paucity of data on biomass is even more confounding given the controls existing on commercial charcoal and firewood trade.

- Regulatory systems are still very lengthy, rigid and bureaucratic, leading to some investors to avoid investing in renewable energy.

In summing up on Kenya, it is important to acknowledge that the hope for reaching out to the poor most of whom are female lies in extending grid-based connectivity to rural areas on a large scale, harnessing renewable resources, popularising clean energy cooking stoves in rural areas, undertaking thorough studies on the energy needs of women and men at household and community levels and sensitising citizen's representatives in County Assemblies on how to factor these into county energy plans and involving the ministries of health, education and information in the campaigns for clean energy stoves.

6.2. Tanzania's Energy Policies and Efforts to Meet the EAC Goals and Targets

6.2.1. An Overview of Tanzania's Energy Policies: The first energy policy of Tanzania was adopted in 1992 and it was revised in 2003. The vision of the government is to use energy resources to raise the standards of living of all citizens. The mission is to provide a framework on the development, management, procurement, storage, transportation, distribution and use of energy resources in sustainable manner, bearing in mind gender factors. Of the three countries in this study, it is only in the Tanzania energy policy that there are explicit provisions requiring gender issues to be factored into its implementation. In the policy, it is stated clearly that biomass is the main source of cooking and heating energy for the majority of Tanzanians and this will remain the case for a long time in the foreseeable future. It is cautioned, however, that given the rate of deforestation in the country, biomass cannot be considered as a renewable source of energy unless concerted measures are taken to ensure it is reproduced on a massive scale. The objectives of the policy include: the establishment of an efficient energy development, management and use systems; securing a balance between use of imported and indigenous energy sources; developing and facilitating the exploration and exploitation of existing natural resources; using forest and agricultural residue for power and cooking energy production; minimising fuel price fluctuations and strengthening energy security and capacity for developing energy resources. (Government of Tanzania 1992, Clauses 67–8). The policy is very strong on rural electrification and commits to establish a rural electrification fund resourced by funds contributed through a surcharge on electricity tariffs and a contribution by the Petroleum Development Corporation. It also provides for encouraging villages to establish homestead woodlots; promoting the manufacture of simple and cheap electric cookers; supporting the formation of biogas plant construction teams and the design and fabrication of biogas end use devices.

The Revised Energy Policy of 2003 is more robust on renewable energy and contains commitments to support research on the development and application of viable renewable energy technologies; mitigating climate

change by protecting woodland through promotion of effective alternative conversion and end user technologies that reduce dependence on fuel wood and other biomass. It also commits government to establish standards and regulations to govern the development and licensing of technology developers and contractors in the area of renewable energy and promoting the development of efficient biogas and facilities and technologies. The policies are very detailed and robust on commitments, but very brief on strategies for implementing these commitments. Some commitments are vague and do not show how results will be achieved. For example, the commitment to undertake research on renewable energy at national and regional levels does indicate which areas and by which organisations the research will be conducted. Both the 1992 and 2003 policies are short on implementation strategies, networking between and among government ministries and agencies, monitoring and evaluation mechanisms and implementation targets. Regulatory mechanisms are missing from both policies as are mechanisms for follow up and reporting (Mzava 2013). It is not surprising, therefore, that in implementing these policies, more success has been recorded in the area of grid electricity, a sort of comfort sector not requiring too much in terms of dominant paradigms and capacity development. In the next section we will examine achievements and later assess how the developments have impacted on the poor communities in which women are the ones who carry the heaviest burden of energy development and use of energy resources.

6.2.2. Increased Grid-based Electricity Supply in Tanzania, 2005–2015:

In general, Tanzania has made substantial progress in increasing access to electricity. According to a report published by the Tanzania Electricity Company in the *Mwanachi Newspaper* (11/08/2015), the target was to raise the capacity from 891 MW in 2005 to 2,780 MW by the financial year 2015/2016. By the end of 2014, the capacity had been raised to 1501.24 MW but by July 2015 it had gone down to 1246.24 MW because some contracts of companies found to be problematic had been terminated. In terms of increasing grid and off-grid connectivity, substantial progress has been made between 2005 and 2015 (see data in Table 2). It is worth noting, however, that increased installations and generation of more electricity has increased connectivity in urban areas with a possibility of increasing access to the urban poor in urban communities. As there are no aggregated statistics on the demographic characteristics of those who reside in the various areas, we assume connectivity for urban and rural poor communities has a big potential for easing the burden of energy on women if it meets some of their needs as identified in Table 1 earlier.

Table 2. Electrical installation and connection in Tanzania, 2005 to 2015

Project/Phase/Area/District	Capacity installed/Kilometres connected	Date of completion/Cost
Connection to national grid and capacity enhancement		
Ubungo- Dar Es Salaam Phase I	100 MW	November 2008
Tegeta – Dar Es Salaam	45 MW	December 2009
Ubungo – Dar Es Salaam Phase II	105 MW	June 2012
Mwanza	60 MW	September 2013
Somanga Fungu	7.5 MW	
Buyanhulu-Geita-Nyakanazi	KV220	Due for completion June 2017
North – West Grid- Geita, Kagera, Katavi, Kigoma, Rukwa, Mbeya and Shinyanga	Upgrading from 220KV to 400 KV	Due to be completed 2018
Connecting villages, centres, administrative offices- in Geita (Bukombe); Mwanza (Magu and Kwimba), and Simiyu (Bariadi)	Total 731 Kilometres - 33KV	To be completed September 2015
Strengthening transmission lines in villages and towns in Dodoma, Iringa, Manyara , Mbeya , Morogoro, Mwanza, Njombe and Tanga regions		On-going
Dar Es salaam Service Improvement	Diverse	December 2015
New transmission to Zanzibar-marine cable		Completed
Arusha –Kilimanjaro transmission	238 km	Completed 2015
Makambako -Songea, Ludewa, Nantumbio Mbamba Bay	220 KV and 1125 km	
Iringa -Shinyanga	200KV (backbone)	To be completed 2016
Dar Es Salaam , Chalinze, Tanga, Arusha	400KV	To be completed 2017
Connecting national grid to neighbouring countries - Zambia		To be completed

Project/Phase/Area/District	Capacity installed/Kilometres connected	Date of completion/Cost
and Kenya		2018
Off-grid co-generation with private companies		
TANWAT	1 MW	On-going
Tanzania Planting Company (TPC)	3 MW	On-going
Mwenga Mini-hydro	4 MW	On-going
Ngombeni	1.4 MW	On-going
Andoya Hydro	0.5 MW	On-going
Off-grid generation using diesel		
Kasullu District	1.25 x 2 KV	Completed
Kigoma Urban District	1.25 x 2 KV	Completed
Loliondo District	1.25 x 4 KV	Completed
Nantumbo District	0.32 x 1 KV	
Sumbawanga District	1.25 x 4 KV	
Mawenzi hydro project	300KW (1,153 households served)	November 2011
Kinyereze I (gas generated)	150 KW	August 2015
ORIO –Mpanda-Ngara-Biharamulo two generators per town	1.25 x3	October 2013
Rusumo hydro project	220KV	Due to be completed 2019
Kakono Hydro project	87 MW	On-going

SOURCE: Extracted from a Report in the *Mwananchi Newspaper* 11/08/2015 (Tanzania)

6.2.3. Rural Electrification in Tanzania: In the year 2005, the Tanzania Government passed the Rural Energy Act (Act No. 8 of 2005) aimed at fast-tracking rural electrification in the country. The Act established the Rural Electrification Agency (REA) as an autonomous body under the Ministry of Energy and Mineral Development. REA's main task is to facilitate improved access to modern energy services to rural areas of Mainland Tanzania. The Act also establishes the Rural Energy Fund which provides funds for rural energy development. REA started operations in October 2007 with the statutory functions of: identifying and promoting

rural energy projects; evaluating projects for eligibility for grants from the fund; building capacity for project developers; advising government on rural energy policy; promoting pilot projects; promoting productive use of electricity as an economic means of income generation in rural areas; promoting the use of modern energy technologies in business, agriculture and rural industrial activities; and providing modern energy services as a means of improving social services in rural areas such as education, health, water and communication.

Between 2007 and 2015, REA had managed to install systems in various villages and small towns in rural areas (see Table 3).

Table 3. Installation of grid-based systems by REA, 2007–2015

Project/Phase/Cost	Capacity/Distance	Region and capacity installed
Turnkey project Phase I costing TShs 129 billion for 41 projects.	• 1,825.5 kms of medium voltage power distribution lines • 1043 kms low village power distribution lines • 443 transformers connected to schools, health centres, water pumping stations • Connected 26, 305 units	Kigoma, Kagera, Mwanza, Mara, Shinyanga, Arusha, Kilimanjaro, Manyara, Tanga, Pwani, Morogoro, Dodoma, Singida, Mbeya, Rukwa, Tabora. In addition the electrification of district headquarters in Ngorongoro , Liliondo, Nkasi, Nantumbo, Rorya , Kibondo and Kasulu
Turnkey project Phase II Started October 2013 Costing TShs. 381 billion	• Six step up substations • 13,600 kms medium voltage power lines • 700 kms low voltage power lines • 300 transformers • Customers connected 250,000	Kigoma (5 MVA), Kasulu (3 MVA), Kibondo ((3 MVA), Ngara ((3MVA), Tunduru (3MVA), Mbinga (5MVA) All regions: 2500 villages will be electrified in 133 districts connecting about 1.25 million customers

SOURCE: REA Newsletter Downloaded from www.rea.go.tz on 08/08/2015.

The Agency advances loans to developers working on projects for renewable energy in remote areas far from the national grid. The loans are facilitated by the government and the World Bank through the Tanzania Energy Development Access Expansion Programme. Under this facility, there are three types of grants. Matching grants worth US\$ 3.1 million were

given to developers to support feasibility studies, socio-economic, market and environmental impact assessment and between 2010 and 2014, thirty renewable energy projects with capacity to generate 94 MW and connect about 52,500 customers benefited and out of those funded feasibility studies had been completed in Kilosa (0.95MW), Kilolo (2.4MW) Tulila in Songea (7.5MW) (REA 2015). The second type is that of performance grants for installation and operation of projects. By May 2015, grants worth US\$ 5.4 million had been given to fund projects in Mufindi (4MW), Mawengi ((0.3MW), Lupali (0.317MW), and Andoya (7.5MW). Thirty more projects will be funded in 2015 (REA 2015). The third type is a credit line facility which was launched in 2010 to facilitate long-term loans to renewable energy developers. By May 2015, it had extended loans to projects in Mwenga (Mufindi), Andoya (Mbinga), and Mgombeni in Mafia. The loans are available on commercial terms from seven partner banks of REA (REA 2015). Most of the new projects are in remote areas away from the national grid. It is possible the installed energy systems will serve commercial and administrative facilities, from which women and men will benefit.

REA has also started working with local councils to facilitate the installation of PV systems. By May 2015, it had worked with the Sumbawanga District Council to install PV systems in 82 villages located in nine wards (Muzye, Laela, Mpui, Kaengesa, Matai, Kipeta, Mwimbi, Mtowisa and Kasanga). The main facilities were installed at secondary schools, dispensaries, health centres, police stations and staff houses for nurses, doctors, teachers and other public servants. The same projects are being replicated in Biharamulo, Sikonge, Chato, Bukombe, Kasulu, Kibondo, Tunduru and Nantumbo districts and will cover 452 villages (REA 2015). In addition, to the above narrated activities REA intends to increase access from the current 36% to 75% by 2025 at national level and from the current 21% to 65% in rural areas by 2025 (REA 2015). The overall projection of access by REA is indicated in Table 4.

Table 4. Access Figures projected by the Tanzania Rural Electrification Agency

Access	2008	2013	2014	2025	2030
Nationwide (%)	10	21	36	75	100
Rural Areas (%)	2	7.1	21	65	100

SOURCE: REA Newsletter Downloaded from www.rea.go.tz on 08/08/2015

In summary, according to the 2012 census, Tanzania has 15,186 villages of which only 3,734 were connected. Therefore, 11,452 were not connected to any form of electricity. Between 2012 and 2015, a total of 1700 villages were connected, bringing the total of connected villages to 5,434, an increase of 30% in three years. If REA continues at this pace and access in urban areas is increased at a similar pace, Tanzania stands a high chance of

meeting the *UN Target of Sustainable Energy for All by 2030*. This will go a long way to bridge the gender divide in access to energy.

6.3. Uganda's Energy Policies and Efforts to Meet the EAC Goals and Targets

This section examines briefly the Uganda Energy Policy 2002 and the extent to which the government of Uganda has managed to achieve the goal of increasing access to all citizens for increased development and wellbeing.

6.3.1. The Energy Policy Objectives and Guidelines: The primary goal of the policy is to meet the energy needs of Uganda's population for social and economic development in an environmentally sustainable manner. The foreword to the policy states, among other things, that, 'This constitutional requirement makes it incumbent upon the government to formulate an energy policy that will not only sustain the impressive economic growth of the last decade or so but also 'ensure widespread access to affordable modern energy services for improving the living standards for all the people of Uganda' (Government of Uganda 2002). It is acknowledged in the preamble, however, that sustainable development is difficult to achieve because it is inconsistent with economic poverty which is prevalent in the country and that therefore the government has to increase access to affordable, reliable and adequate energy services and supplies that help it to address poverty issues. The policy underlines the issue of energy poverty which it defines as, 'the absence of sufficient choice in accessing adequate, affordable, reliable, good quality, safe and environmentally sustainable energy services'. It asserts that evidence of this energy poverty can be found in the low levels of consumption of modern forms of energy, the inadequacy and poor quality of energy services and the dominant reliance of the majority of the population of wood fuel and biomass. (Government of Uganda 2002).

The 2002 Energy Policy made a thorough assessment of energy capacity, consumption levels and potential in every energy sub-sector. In summary, at the time it was adopted in 2002, only 5% of the population had access to electricity and annual connectivity growth rate was between 5.5% and 7.5%. Most of the consumption was for residential purposes (55%), commercial activities (24%), industrial use (20%), and street lighting (1%) (Government of Uganda 2002, 8–9). Biomass constituted 90% of total energy consumption, charcoal businesses employed over 20,000 people and generated about US\$ 20 million and its consumption was growing at annual rate of 6% (*ibid.*, 20). The capacity for solar energy and wind generation was very low; but the potential was high. In 2007, the government passed the Renewable Energy Policy with the objective of raising the contribution of renewable energy from 4% at that time to 61% by 2017. Measures were taken to introduce feed in tariffs and it provides for tax incentives on investments in renewable energy technologies. The government standardised power purchase agreements to enable renewable energy

operators to sell power to the national grid. The policy also provides for fossil fuel companies to mix their products with biofuels. The Atomic Energy Act 2008 was passed to establish a framework and facilities for the generation of peaceful nuclear energy. It established an Atomic Energy Council and the Nuclear Energy Unit to support research and the development of nuclear energy. Research is still at its infancy stage.

6.3.2. Increasing Access to Energy by Government Agencies: Uganda has for a long time been a big supplier of hydroelectric power to its citizens and its neighbours Kenya and Tanzania. Between 2005 and 2013 the government had installed more capacity to meet the needs of the people as can be seen from Table 5.

Table 5. Installations by Government agencies in Uganda, 2003–2013

Type of energy	Capacity	Location
Hydro power	• 180MW • 200MW • 53MW	Nalubale Mwikiira Bujagali Mini hydro
Potential sites	• Over 3000MW • Total 683MW	Isimba, Kalagal, Ayago, Murchison Falls, Oriang, Kiba
Generated electricity	• Installed 820.5 MW • Available 558.5 MW • Peak demand 487 MW • Average growth 10%	
Generation mix	• Large hydro 82% • Thermal 10% • Min hydro 5% • Co-generation 5%	
Renewable energy	• Solar — over 3000 PV systems • Geothermal— estimated potential 450MW • Small hydro—over 50 potential sites with 164MW capacity • Wind – data	

SOURCE: Sarah Nafuna (2013)

The Uganda government-based rural electrification programme was launched in 2001 and it aims at electrification of administrative and community centres and productive areas. It relies on grid extension, decentralised grids and solar PV systems for schools, health centres and staff houses. The government operates an energy efficiency policy which serves two purposes. It facilitates services to remote and off-grid areas and at the same time it promotes use of local renewable resources. The government is intensifying awareness campaigns of solar energy in rural areas not connected to the grid and as we shall see in the next section, it is supporting investors in renewable energy technologies for remote areas with incentives and relaxation of taxes and regulations. It is also promoting the supply of energy-saving equipment such as efficient lighting technologies, efficient motors, efficient cook stoves, soft starters and similar equipment (Sarah Nafuna 2013).

6.3.3. Non-state Actors in Increasing Access to Energy in Remote Areas:

Social entrepreneurship which combines a pursuit of social and economic benefits has helped to increase access to energy by communities in the remote areas of Uganda. Social entrepreneurship combines elements of the market and humanitarian developmental values. It seeks to balance access, affordability and availability with a cost-recovery element in serving disadvantaged communities. What distinguishes a social entrepreneur from others is the motivation to stimulate social change in communities or areas not catered for by mainstream entrepreneurs (Mori and Fulgence 2009). Social entrepreneurs have joined efforts with the government in Uganda to reach where normal energy service providers dread. The following subsections present a short account of the role of two such enterprises in rural electrification in Uganda.

6.3.4. Barefoot Power Uganda: Barefoot Lighting Uganda is a social enterprise distributing solar light equipment, bulbs and chargers to the poorest households in Uganda through their famous *Light Up a Village* programme. They distribute what they have branded as ‘safe, affordable and healthy alternatives to kerosene and candles’ (Barefoot Uganda 2015). The Light Up a Village project distributes infrastructure for decentralised pico solar systems in form of five watts solar systems capable of lighting four bulbs for a period of eight hours each night and solar chargers for mobile telephones. They have three varieties of systems ranging from 1.5 watts capable of lighting one lamp and charging a phone; 2.5 watts capable of charging two lamps and charging phones and 15 watts systems capable of lighting seven lamps and charging phones. In one of the rural areas Barefoot Power Uganda has teamed up with the Diocese of Kiyinda in Mityana District to light up 100 households in Kalagala, Nsozibuirye and Kigumba villages. Installations were commissioned on 1st October 2014. Each household received a 6 watts pico solar system with capacity to light 4 lamps and charge phones. Households pay a small affordable amount in instalments of six months (Barefoot Uganda 2015).

6.3.5. Village Energy: This is another social enterprise active in rural energy initiatives in Uganda. It runs a programme known as ‘Better Energy, Better Communities’. It has joined the off-grid initiatives and sells simple technology products such as solar lanterns and home systems to individual households. It has managed to reach the most remote areas using motorcycles on rough and rugged terrain. It has established a network of rural technicians with an intention of creating capacity for installation, servicing and maintenance of supplied systems. The avowed goal is, ‘Getting rural households from kerosene onto reliable, affordable sources of clean energy’ in order to ensure such energy systems have environmental credibility and are good for health, education and safety and have economic and cultural benefits to rural communities. To create local technical capabilities, they have a vocational training programme (Village Energy Uganda 2015). By June 2015, they had trained 15 technicians two of whom are female. They offer them courses on supply chain management, and provide technicians with tools, batteries, spare parts and equipment as their agents for which they paid commissions while being paid for their services by local clients. They organise events where villagers are invited with their broken gadgets for on-the-spot repairs.

Village Energy aims at eliminating kerosene lamps not only to reduce carbon emissions which aggravate climate instability but also to create jobs and support the development of healthy communities. They believe that the poor can afford new technologies because they pay more for hazardous energy sources. According to them, buying a lamp saves a family about US\$70, which is about 20% of the family’s annual income that can be spent on other social services. They also argue correctly that eliminating kerosene will save lives from poisonous gas inhalation and burns from accidental fires and reading from solar lamps will reduce reading difficulties such as eyes problems and headaches which are normally caused by reading using kerosene lamps (Village Energy Uganda 2015).

7. Challenges to the Goal of ‘Energy for All’ in the Three Countries

The three East African countries covered by this study have made big strides in implementing the EAC Strategy of scale up access to clean energy for their people. All of them share a common aspiration of being able to reach the UN goal of ‘energy for all’ by 2030. But, each of them faces a lot of challenges as they struggle to reach that goal. The Kenya 2014 Energy Policy has captured most of the challenges which are almost generic and some seem to be endemic in all the three countries (Ngigi 2008; Okure 2008). In the area of biomass which accounts for averagely 70% of energy consumption in the region, there is a paradox that although the resources such as charcoal and wood fuel are transported on daily basis across these countries and subjected to all kinds of road blocks, taxes and levies, each country has expressed a sever lack of data about the stocks and actual consumption. Similarly, apart from Kenya, which has committed to

encourage agroforestry and social forestry, and Tanzania which has committed to encourage villages to develop wood lots to increase wood fuel, none of the three has committed seriously to invest in agroforestry in order to increase biomass stocks while developing alternative cleaner sources of energy. In Kenya, which is doing more than the rest on this, wood fuel development programmes are still left to NGOs and small-scale commercial wood fuel farmers as was the case 20 year ago (Bradley and Huby 1993). While all the three governments acknowledge that unsustainable use of biomass will accelerate environmental degradation and climate change, afforestation programmes are not given much emphasis in terms of budgets and political mobilisation. There is need to recognise that while unsustainable use of biomass is detrimental to climate stability and environmental development, it is still the biggest source of energy and while the search for alternatives continues, it has to be developed in a sustainable manner. Other challenges for developing biomass include competing interests in land use with loggers, mining companies and food crop farmers more interested in clearing land than growing wood fuel crops.

Each of the three countries is keen on promoting biogas and acknowledges the potential of municipal waste as a major source of energy for generating electricity. But, so far the main electricity generating companies have not developed serious strategies for using this waste which has turned our formerly garden cities into garbage cities. Instead, solid waste is thrown on dumps which aggravate health and environmental hazards. The challenge here is for the mainstream companies to move away from relying only or mainly on conventional sources of energy to harvesting municipal waste and not only burning it to energise our cities but also to contribute to solid waste management in urban areas. Even for small urban and industrial sites where there is a lot of crop residues and factory crop waste, there is a general lack of awareness and information on the potential of waste to energy programmes, their benefits and their contribution to environmental and solid waste management. Knowledge on biogas technologies is scanty and where new technologies are available, they are still very costly because of the low level of demand on the market. There is no clear regulatory framework for registering and training contractors, technicians and standards of the equipment imported or manufactured locally. In some rural areas, biogas is still a pre-occupation of NGOs and donor projects.

As was seen in earlier sections, solar energy is becoming more and more popular and governments have invested in solar power installations in rural electrification programmes, thereby meeting the energy needs of communities as regards common services. Social entrepreneurs have taken solar energy to villages and households as we saw in the case of Uganda. However, there is still a big gap between the actual potential and installed capacity and this disparity is due to the problems of accessibility of some remote areas; lack of knowledge and information about the actual costs and benefits of this source of energy; negative cultural beliefs and practices

about food prepared without traditional sources of energy; bad experiences caused by faulty or shoddy installations that fail immediately; lack of local technical capabilities for installation, servicing and maintenance which undermines consumer confidence in these technologies; and theft of solar panels which discourages investors from developing this source of energy in remote areas where security cannot be guaranteed.

As we noted earlier some alternative energy companies would like to introduce solar energy technologies such as biogas and cleaner cook stoves. But the Global Alliance for Clean Cook Stoves (2011, 17–20) has identified seven challenges that need to be addressed to accelerate rates of adoption of the emerging clean stove technologies. First is the lack of international, regional or national standards that can be used to indicate efficiency levels of various models that are entering the market. The Alliance notes that at local level, technology scanning and testing capabilities are lacking. To establish them requires training and setting up laboratories, for which resources are scarce. Second there is lack of compelling evidence regarding the health benefits of clean cook stoves and fuels. Third the media in developing countries has not been active in raising public awareness on the hazards of conventional cook stoves or the advantages of the clean cook stove and fuel technologies. Fourth the Alliance raises issues of the conflict between technological innovation and cultural or religious values, beliefs and practices especially about how food should be prepared as in some cultures food has to be prepared using certain types of energy if it has to be accepted. Fifth, the Alliance raises the issue of mass production which is also associated with cook stoves manufactured under projects which sometimes fail to take into consideration specific interface conditions in particular localities. Such interface conditions could be cultural, climatic, atmospheric, and the like, and if ignored; the stoves produced and marketed tend not to last.

The sixth challenge relates to distribution and supply chain issues that were seen in the case of Light Up a Village project in Uganda involving difficulties of reaching inaccessible remote rural villages; distance from nearby retail stores for villagers; shortage of qualified technicians to repair systems when they break down; and limited capabilities of some people in rural areas to abide by operational instructions. Some of these challenges tend to discourage villagers from adopting new cook stoves and some resort to old familiar, though unsafe, technologies after experiencing some technical setbacks. Seventh is the predominance of the informal and small-scale sectors in the development of these stoves. In the absence of quality standards, some of the products from these sectors have not been reliable or durable. Large scale firms have not entered this market and this is a disadvantage for consumers because the volumes of production remain low and the prices consequently high.

8. Addressing the Challenges and Bridging the Gender Gap: Conclusions and Recommendations

By increasing access to energy in poor communities, the three East African countries have a possibility of not only making a lot of progress in implementing the EAC strategy and making big strides towards the UN Goal of Access to Energy for All by 2030, but also of being able to narrow the gender gap, especially in terms of the community-based needs of both men and women as indicated in Table 1. However, to bridge this gap, the policy implementation should go beyond increasing access to villages and poor communities in rural and urban areas. They should address the productive, social and developmental roles of women and men equally and their differentiated needs as regards household and community responsibilities. The current electrification and installations of solar systems will increase access to energy for women to meet their energy needs arising from community roles but may not necessarily reduce their physical, physiological, psychological and other problems that arise from the current or may arise from the new technologies. The introduction of efficient energy technologies may reduce health hazards caused by fumes and poisonous gases but may increase the intensity of female labour exploitation at household level. Reduced cooking time may produce more space for more household chores for which time was not enough when women spent half of the time searching for firewood and water. Therefore, there is need for looking at the social and developmental needs (see Table 6) of women and girls in a holistic manner.

Table 6. Women's development and capacity needs to enable them benefit from increased access

Social needs	Advancement needs	Technical capability needs
Health: technologies should reduce muscular strain caused by standing, bending and head portage and reduce exposure to poisonous gases, insect bites, etc.	Educational: Time freed by new technologies should help them to acquire new skills, learning and equal time for reading for boys and girls.	Technical capability: Training for installation, service and maintenance should include both women and men. Ownership: Growing and tending wood lots for domestic and commercial use should involve men and women to avoid the traditional divide of cash crops for men and food crops for women
Participation: they should release time for partaking in political and social activities leadership	Organising and networking: resistance to new technologies by men, e.g running water, milling machines etc.	Power for women's enterprises: the energy needs for special women's enterprises in dyeing cloth, weaving, hairdressing, baking etc. should be

Social needs	Advancement needs	Technical capability needs
Control: the new technologies should be controlled by women who mostly use them and not at the pleasure of men as is with TV and radio in some households. Security and safety: energy resources should strengthen human security and women's safety. Women saved from sexual attacks in the bush when fetching firewood should not be victims of burns from new electrical gadgets due to gender-based violence. Social protection: to ensure women are compensated for unpaid household and community work, community health insurance and other forms of social protection need to be introduced to enable them to benefit from technological changes taking place.	is sometimes due to fear that women will get together and share knowledge, build solidarity and organise. New technologies should create free time for women to network and share knowledge including on knowhow of these technologies. Transfer of knowledge: women should be given an opportunity to be repositories of the new knowledge and pass it to young generations. Training in policy making: concerted efforts are needed to train women in policy making and evaluation. Training in entrepreneurship: if women have to benefit equally, they have to get training in enterprise development and management.	considered when choosing site for installations. Gender sensitive technologies: equipment should be gender friendly. Machines introduced should be compatible with the physiological make up of women. Forest and biomass development: local governance structures should reserve special space and voice for women on issues of forestry and agroforestry development. Incentives: incentives should be developed for technology developers who design programmes that involve women in supply chains, training for installation, technical services and maintenance of existing and new energy technologies. Troubleshooting and maintenance capabilities: women should be empowered to solve and not only to manage problems related to use of the new energy technologies. More often, the troubleshooting capabilities are a reserve of men and boys in the household.

In summary, bridging the gender gap cannot success especially for energy needs of women as long as we continue with business as usual. The empowerment of women is crucial if they have to be emancipated from drudgery and domestic forms of undisguised slavery imposed by the burdens of energy poverty. To get out of the mode of business as usual, the voices and choices of women have to be embedded in any policy framework, negotiations, planning and implementation processes from the local to the global level (Szołecsky 2008; Browns and Spitzner 2004). The absence of women in shaping the climate change agenda and in the discussion on climate change has led to the failure to discuss issues related to climate and energy (Rohr, Clancy and Oporoacha 2004), leading to what gender experts viewed as gross gender injustice (Denbossche, Gabizon and Bock 2008) and the token concessions on gender issues that came out of the 51st Conference of Parties on climate change have been considered as tokenistic half measures with the potential for zero impact on climate change, gender and energy issues (Rolle and Somera 2010). If the participation of women in all key decisions on livelihoods is increased, the possibility to meet their needs indicated in Table 6 increases.

If women have to enjoy the benefits of increases in access to energy, the enabling conditions need to be created though increasing their technical and technological capabilities to install, operate, manage, service and maintain the new technologies. This independence and autonomy will reduce their reliance and dependence on men and boys. The diffusion of cleaner energy cook stoves in Bangladesh and India was facilitated by massive programmes of education, awareness and technical training on new technologies (Krishnan 2001; Hossain 2001). The role microcredit for women has played in enabling them to acquire these technologies in India and Bangladesh has been well documented and lessons can be learnt (Winmer 1999; Krishnan 2001). In refugee camps in Uganda, women have been trained by international NGOs to use simple solar stoves. More than 9500 families have been helped to cook using solar cookers (Dennery 2004). Women should not be forced to wait until conflict breaks out to be free from the traditional cook stoves.

Finally is the issue of community participation. Development can be facilitated by government and development partners but sustainable development has to be based on community participation and women have to be involved in community activities including those on rural electrification (Partin 2004; Abdyrasulova 2008). In the case of small hydro power, the involvement of communities in planning projects helped the communities in the Tungu-Kabiri micro hydro project to divert a river and channelling it to a valley where there was a cliff and creating waterfalls without having to build a dam and without resettling any members of the community (Practical Action Kenya 2008). This is an excellent example of invaluable dividends that can arise from community participation involving men and women.

It is a fair conclusion therefore that installation of more energy sources or the adoption of better and cleaner energy solutions will not in themselves bridge the gender gap in access to energy. Structural and systemic changes need to be undertaken to reduce the energy and other burdens of women and girls in meeting the productive and reproductive needs of households and communities. At the same time, in order to meet the UN goals of 'energy for all' and the East African Community strategy objectives of 'up-scaling access to energy for all', there is need to assess the challenges identified in the policies of the countries covered in this study and find solutions to address them. The following, among other measures are therefore, recommended to the three governments:

- *Reduce* reliance on fossil energy sources even if the new discoveries are commercially viable and easier to develop.
- *Undertake* comprehensive mapping of renewable energy resources and use generated data to make decision of budgetary allocations for each energy subsector.
- *Recognise* that given levels of poverty and lack of awareness about the benefits of renewable energy technologies, the majority of East Africans will depend on biomass for a long time. With that in mind, develop strategies for improving supply of biomass through community agroforestry and social forestry.
- *Encourage* and provide incentives for local authorities to enter into partnerships with energy developers to use municipal waste to generate electricity.
- *Work* with universities, research institutions and private sector on strategies for capacity building for renewable energy development and utilisation.
- *Facilitate the establishment or strengthening* of technology laboratories for testing and ensuring quality of energy technology products.
- *Support* community colleges and polytechnics to build capacity for supporting rural energy access programmes and to organise awareness creation campaigns on the benefits of renewable energy sources and technologies.
- *Create enabling conditions* for skill development, and raise the technical and technological capabilities to participate in the development of merging renewable energy technologies.
- *Institutionalise participation of women* in all meetings, conferences and platforms at which decisions on energy are made and include women in positions of leadership in managing institutions, negotiating or otherwise dealing with energy.

- *Review and harmonise* policies with the view to ensuring coordination among actors and establish clear regulatory frameworks for the development, and management of energy sources and standards.
- *Provide incentives* for local design and production of renewable energy technologies and encourage public-private partnerships in the entire energy sector.
- *Tighten regulations* on quality assurance, technology imports and registration of contractors for installation, servicing and maintenance of renewable energy technologies.
- *Review security measures* and penal provisions relating to theft of transformers, solar panels, power lines and importation of faulty equipment in the energy sector.
- *Promote social entrepreneurship* in rural energy programmes by providing incentives and support to the training and capacity building efforts of social entrepreneurs at community level.
- *Link up* all policies and initiatives on increasing access to energy with policies that seek to change gender relations in the systems of power, production, distribution and entitlements.

References

- Abdyrasulova, N., 2008, 'Women's grass-roots participation'. *In: Gender in Sustainable Energy News*, Issue No. 60.
- Barefoot Uganda. 2015. The 'Light Up a Village' project. Downloaded from www.barefoopoweruganda.com downloaded on 08/08/2015.
- Bradley, P.N. and M. Huby (Eds.). 1993. *Wood fuel, women and woodlots, Volume 2: The Kenya Wood Fuel Development Programme*. London and Basingstoke: MacMillan.
- Browns, B. and M. Spitzner. 2004. Gender – Forgotten pillar of climate policy. *In: Gender in Sustainable Energy News*, Issue No.47.
- Ceceleski, E. 2001. 'Why women and energy: Gender perspectives on 'Energy for COP- 9.' *In: Gender in Sustainable Energy News*, Issue No. – 2001.
- COMESA. 2012. *Baseline renewable energy database for the COMESA Region*. Lusaka: COMESA Secretariat.
- Denbossche, V.C., S. Gabison and S. Bock. 2008. No climate justice without gender justice. *In: Gender and Sustainable Energy News*, Issue No. 32, p. 6.
- Dennery, P., 2004, Portable cookKit to save millions of lives.' *In: Gender in Sustainable Energy News*, Issue No. 47.
- EAC, 2006 *East African community strategy to scale-up access to modern energy services*. Arusha: East African Community Secretariat.
- Global Alliance for Clean Cook Stoves. 2011. *Igniting change: A strategy for universal adoption of clean cook stoves and fuels*. Washington, D.C.: Global Alliance for Clean Cook Stoves and Fuels.
- Government of Uganda. 2002. *The energy policy of Uganda*. Kampala: Government Printer.

- Government of Kenya. 2014. 'Kenya draft energy policy'. 24 February, 2014. Government of Uganda. 2002. *The energy policy of Uganda*. Kampala: Government Printer.
- . 1992. *National energy policy*. Dar Es Salaam: Government Printer.
- Hossain, R., 2001, Grameen Shakti Micro Credit in Bangladesh: Women's way from darkness to light, from carriage to mobile phones and internet. *In: Gender in Sustainable Energy News*, Issue No. 32.
- IPCC. 2005. *Report of the IPCC*, International Panel on Climate Change. Nairobi and Geneva: UNEP and WMO,
- Klunne, W. J. 2008. Indicateurs sur le Genre, la Pauvreté et l'Environnement sur les pays Africains 2008.
- Krishnan, B.L. 2001. 'Micro credit to 100 million poor women in India.' *In: Gender in Sustainable Energy News*, Issue no.32.
- Mori, N and K. Fulgence. 2009. 'Social entrepreneurship in Tanzania: Assessment of enabling environment.' Paper presented at the EMES International Conference on Social Enterprises, Trentol (Italy) July 1–4, 009. Downloaded from www.emes.net/content/uploads/publications on 12/08/2015.
- Mzava, A. 2013. 'Current energy policy of Tanzania and challenges on supporting renewable energy sector'. Paper presented at a workshop of the Tanzania Renewable Energy Association, University of Dar Es Salaam on 12/11/2013.
- Ngigi, A, 2008, *EAC Strategy for Scaling Up Access to modern Energy Sources: Kenya Country Report*. Nairobi: Government of Kenya.
- Okure, M. 2008. *EAC Strategy for Scaling Up Access to modern Energy Sources: Uganda Country Report*. Kampala: Government of Uganda.
- Partin J.G., 2004, 'Gender-sensitive framework for rural electrification projects.' *In: Gender in Sustainable Energy News*, Issue No. 60.
- Practical Action Kenya. 2011. 'Community hydro power in Kenya.' *In: Gender in Sustainable Energy News*, Issue No. 72
- REA. 2015. 'Status of the implementation of rural energy project in Tanzania.' Press Release downloaded from www.rea.go.tz on 10/08/2015.
- Rohr, U., J. Clancy, and S. Oporoacha. 2004. Gender is not something to ignore.' *In: Gender in Sustainable Energy News*, Issue No.47.
- Rolle, M. and N. Somera. 2010. Gender justice at COP 15: Half of nothing is nothing.' *In: Gender in Sustainable Energy News*, Issue N0 68.
- Sarah Nafuna, M. 2013. Uganda policy on energy and power'. Paper presented at the JICA Training Workshop on Energy Policy, Tokyo, Japan, 2–22 June 2013. Downloaded from www.ieej.or.jp/data/5012.pdf on 11/08/2015.
- Szoleczky, J. 2008. 'More women needed for decision: Break the 'glass ceiling' on sustainable energy.' *In: Gender in Sustainable Energy News*, Issue No. 32.
- Village Energy Uganda. 2015. 'Better energy better life Project.' Downloaded on 08/08/2015 from www.villageenergyuganda.com.
- Von Denbossche, S. Gabizon and S. Bock. 2008. 'No climate justice without gender justice.' *In: Gender in Sustainable Energy News*, Issue No. 60.
- WHO. 2010. *World health statistics*. Geneva: World Health Organisation.
- Winmer, N. 1999., Micro-credit introduces renewable energy. *In: Gender in Sustainable Energy News*, Issue No. 24.

CONCLUSIONS AND RECOMMENDATIONS

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The ten chapters of this book provide the reader and policy actors with ten lessons. The first one is that gender equality should not be viewed only as in the context of civil and political rights but also from the perspectives of economic, social and cultural rights under the UN framework of these rights. This comes out clearly in the chapters by Mutasa, Osiro, Mukuna and Mihyo. They argue that for energy to meet the needs of men and women alike, policies have to provide frameworks that break women out of the gender divides in terms of household and community roles in production and reproduction. The main conclusion on this is that increasing sources of energy to all areas without transforming the social, cultural and political spheres, in which this energy is used, may end up increasing inequality between males and females by increasing the roles and chores of women in the use of energy. The second lesson arising from this is that energy policies that only mention the need to take into consideration women's roles without providing guidance on how these needs differ and strategies for addressing the needs of each gender group separately and all gender groups collectively, cannot be helpful in changing the structural and systemic factors that perpetuate the differentiated access to energy resources in gender terms. We conclude from this that policy makers and implementers need increased awareness about the economic, social, cultural, technical and technological needs of women and men.

The third lesson is that even where access is increased in rural and urban areas, women's voice in deciding on the choice of technology to be used is vital. In chapter 6 by Anna Wawa on biogas in Tanzania, it is shown clearly that if men resist and prevent women from participating in the choice of technology, adoption rates of new technologies become low. In chapter 10 by Mihyo, it is argued that cultural factors on how acceptable food has to be prepared based on cultural or religious beliefs and practices can affect shift from conventional to new technologies. It can be concluded from these findings that to accelerate rates of absorption and adoption of new technologies and liberate women from the drudgery of biomass as a source of energy, men and communities have to be socialised and to accept the value and benefits of these technologies.

The fourth lesson which comes out of all the chapters is that most policies and interventions are trying to tackle dependence on biomass not primarily because it is harmful to health and safety but mainly to save the environment from further depletion. This is clear in all the chapters but more prominent in chapters 5 and 7 on Swaziland and Sudan, respectively.

What is also clear from those two chapters and chapter 10 is that in spite of the concern about depletion of biomass for energy use and the determination to reverse the current rates of environmental destruction, there is a glaring lack of organised research to collect data on actual consumption volumes of charcoal and firewood and a stark lack of efforts to introduce quick growing species of wood fuel while working on alternative technologies. We conclude from the assessment of these several authors that a holistic approach is required in addressing biomass as an energy source. It should be looked from the environmental, security, health and safety perspectives and, while search for new safer and cleaner sources of energy is going on, environmental renewal should bear in mind the need to meet the existing demand for biomass through introduction of community wood lots, fast-growing species of fuel wood that are also friendly to the environment in general. Controlling deforestation by controlling the use of wood fuel and charcoal without providing alternatives in the short-term increases the price of these sources of energy and the burden on women to search for them.

The fifth lesson about charcoal and firewood related to the puzzling lack of reliable data on charcoal and firewood is that in spite of all the road blocks and taxes levied on charcoal and firewood in urban areas, there is no reason for most countries to have no data on these factors. It is assumed from the presentation in Chapters 4, 9 and 10 that energy sources on which the poor depend do not feature prominently in national statistics and as a result attract very little attention in national planning and budgeting. The mere lack of data on them often gives excuse to planners and policy makers to turn a blind eye to these sources in energy policy. It is noteworthy that charcoal and now firewood generates a lot of business and revenues in Eastern Africa and many leaders are involved in charcoal trade including export to the Gulf countries. This could also be one of the factors behind the failure to have clear data on the volumes of demand and consumption for charcoal and related biomass sources of energy. We conclude from this that until actual data is developed the biomass sectors in general and wood fuel and charcoal in particular will not attract more attention in planning and budget allocation.

The sixth lesson is about challenges that have been encountered in the introduction of cleaner technologies such as new clean cooking stoves, solar and biogas technologies. These challenges have been discussed in chapters 6 by Wawa, 9 by Mukuna and 10 by Mihyo. Prominent among them is lack of information to potential beneficiaries about their benefits and risks; lack of regulatory frameworks for quality assurance, installation and maintenance capabilities; lack of laboratories to test and approve imported or locally produced technologies and equipment; limited involvement of local media in popularising these alternative sources of energy; lack purchase power by women to acquire these alternative source; relegation of the production and distribution of new technologies to donor

funded projects, small scale and informal sector operators; distribution and supply chain constraints that hinder rural remote areas from benefiting; distance from nearby retail stores for villagers; shortage of qualified technicians to repair systems when they break down and limited capabilities of some people in rural areas to abide by operational instructions. These and other limitations are not captured by policy makers, planners and importers of these alternative systems. It is concluded from these challenges that unless they are factored into the plans and strategies, diffusion and absorption of these technologies will continue being problematic.

The seventh lesson is that while policies in all the countries studied make robust commitment to support research and development especially in the area of new and renewable technologies, none of them seems to give indication on which actors should be involved in this. From Chapters 9 and 10 it is indicated that innovation is left to social entrepreneurs and philanthropic organisations. In Chapter 6 on biogas projects in Tanzania the state programme that supports biogas technology for rural areas does not seem to have a clear science and technology development plan. In chapter 8 on the women who are trying to produce '*tiftif*' as an alternative to charcoal and firewood in Ethiopia do not seem to be attracting any political or technological support from state and non-state actors of any kind. The key question arising from these observations is whether the introduction and adoption of new technologies of this kind can succeed without the involvement of state and non-state actors working together. We conclude that these isolated small-scale, unsupported initiatives cannot generate a robust movement for a technological shift that can support the acquisition, adoption, absorption and assimilation of the technologies.

The eighth lesson arising from almost all chapters is that the gender gaps in accessing and using energy sources are more determined by differences in technical and technological capabilities and skills of men and women. As indicated in chapters one by Mutasa, six by Wawa, nine by Mukuna and ten by Miho, the differentiated use of available energy sources is determined by the types of activities each group gets involved in. If women's technical and technological capabilities and skills were enhanced, this could widen the scope of their activities, structurally change their roles and give them space and voice in determining policies and technology choice in access to energy. It would structurally change their energy needs and bridge the gap between their needs and those of their male counterparts. The conclusion therefore is that increasing access without changing the gendered roles of men and women will not go a long way in transforming the lives and livelihoods of women.

Lesson nine is that regional integration has helped all countries in Eastern and Southern Africa to develop common policies especially on renewable energy resources and common power pools. However the new policies have common shortcomings and challenges such as lack of coordination between

agencies involved in energy development, lack of quality standards; lack of clear mapping of gender needs; lack of incentives for non-state actors to encourage them to invest in less commercially viable areas where the poor live; over dependence on donor funding for most programmes in the energy sector and lack of visible drive to challenge research institutions to get heavily involved in the development of new technologies.

Finally we note from the ten chapters that gender mainstreaming has been on top of the policy agendas for the last three decades but a thorough examination of how gender has been mainstreamed in many energy policies in the region shows that it is still an agenda issue or 'work in progress'. This may be an indicator that gender mainstreaming has been talked about in many policies but never integrated into several policies including those on energy. It implies therefore that this is a research issue that needs more work and capacity development so that the next generation of energy policies will be more gender balanced and based on clear rights based approaches.

Recommendations

The book contains a good number of common and country specific recommendations. In the light of the lessons learnt and the observations, it is recommended to governments in the region to:

- **Review** their policies and assess the extent to which they could capture the differentiated gender needs of men and women.
- **Adopt** a more holistic approach to gender rights ensuring they include both civil and political rights on the one hand and economic, social and cultural rights.
- **Mainstream** gender issues in the energy policies after a through mapping of the needs of each gender group.
- **Raise** the awareness of policy actors on gender issues and integrate them in planning, implementation and evaluation of energy projects.
- **Generate** adequate data on the actual demand and potential of all sources of renewable energy.
- **Provide** financial technical and other support to developers of and trainers on new alternative sources of clean energy.
- **Promote** access to solar, biogas and municipal waste as cheap and readily available sources of energy.
- **Adopt** policies that promote gender equity in planning, budgeting, designing, producing, supplying, and managing sustainable energy solutions.

- **Promote** gender analytical tools like the Moser Framework, Harvard matrix and use them in the training of gender specialists and planners in all agencies of government, CSOs and private sector.
- **Support** the development of capacity for women in the design, management, installation and maintenance of new and alternative energy technologies.
- **Reduce** reliance on fossil energy sources even if the new discoveries are commercially viable and easier to develop.
- **Undertake** comprehensive mapping of renewable energy resources and use generated data to make decision of budgetary allocations for each energy subsector.
- **Recognise** that given levels of poverty and lack of awareness about the benefits of renewable energy technologies, the majority of East Africans will depend on biomass for a long time. With that in mind, develop strategies for improving supply of biomass through community agroforestry and social forestry.
- **Work** with universities, research institutions and private sector on strategies for capacity building for renewable energy development and utilisation.
- **Support** community colleges and polytechnics to build capacity for supporting rural energy access programmes and to organise awareness campaigns on the benefits of renewable energy sources and technologies.
- **Tighten** regulations on quality assurance, technology imports and registration of contractors for installation, servicing and maintenance of renewable energy technologies.
- Review security measures and penal provisions relating to theft of transformers, solar panel, power lines and importation of faulty equipment in the energy sector.
- **Promote** *social entrepreneurship* in rural energy programmes by providing incentives and support to the training and capacity building efforts of social entrepreneurs at community level.