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THE USE OF MIRT MITAD AND ITS CONTRIBUTION TO HOUSEHOLD ECONOMY AND ENVIRONMENT: THE CASE OF MEKELLE AND ITS SURROUNDING RURAL AREAS

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Abbreviations

BoFED	Bureau of Finance & Economic Development
EFAP	Ethiopian Forest Action Program
EESRC	Ethiopian Energy Studies & Research Center
EEPCO	Ethiopian Electric & Power Corporation
FDRE	Federal Democratic Republic of Ethiopia
GTZ	German Technical Cooperation
HHs	Households
PAs	Peasant Associations
REPDA	Rural Energy Promotion & Development Agency
TFAP	Tigray Forest Action Program
TNRS	Tigray National Regional Government
UNDP	United Nations Development Program

List of local terms

The meanings of the local terms used in this thesis are given below:

Buna	Coffee
Injera	Traditional food of Ethiopians prepared from Teff
Kedamay woyane	Name of tabia in Mekelle
Messob	Used to contain Injera
Mirt Mitad	Improved stove
Quiha	Name of tabia in Mekelle
Tabia	Smallest unit of administration in Tigray
Teff	Small sized crop localized to Ethiopia only
Tella	Fermented local drink

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Abstract

This study was conducted in Mekelle and its surrounding rural areas. It attempted to assess the use of Mirt Mitad and its contribution to household economy and environment in Mekelle and its surrounding rural areas. In conducting this study, sample survey design was employed and 121 sample households were selected and interviewed using systematic random sampling technique. In addition, focus group discussions and key informant interview were conducted to triangulate the data collected through questionnaire survey. Both primary and secondary data were used and the data consist of both qualitative and quantitative types.

The findings of this study showed that Mirt Mitad has got both positive household and community contributions in terms of time, wood and money saving as well as health improvements. Household income and occupation of households were found the main factors that affected the use of Mirt Mitad.

Its contribution to environmental (forest resource conservation) was found significant in terms of reducing the quantity of wood households consumed per baking time there by prolonging the timing of forest cutting for fire wood purpose from the sources.

How ever, the dissemination process in the region is far below expected. The reasons were the following:

- Poor promotional strategy used (not reachable by many)
- Socio-economic problems (high prices, lack of information)
- Technological problems (narrow opening, short height)

Hence, with good promotional strategies used, dissemination could be improved and its contributions be further multiplied.

Chapter One

Introduction

1.1. Background

The majority of Ethiopian households have no or only limited access to modern energy supplies. Kerosene, LPG, and electricity are often not available, accessible or affordable to the people (BoFED, 1998). Traditional biomass fuel consumption accounts for about 96% of the total energy consumption in Ethiopia, out of which 88% is used in the household sector, mainly for cooking and lighting. A rapid decline in forest resources has led to severe fuel wood deficit in many parts of the country particularly in Tigray. For 2005, fuel wood deficit of 50 million m^3 has been projected (TNRS, 2004).

Tigray, which is found in the northern part of Ethiopia, is affected by severe energy crisis more than other regions due to fuel wood scarcity. Forest resources have declined to a surface coverage of 0.2 % (natural forests) and 6 % (woodlands), and fuel wood prices are the highest in the country (BoFED, 2001). The increasing need of the fast growing population for agricultural land and grazing areas, for construction wood and firewood, and inefficiency of fuel wood utilization are rapidly depleting the woody biomass resources and severely degrading land productivity, endangering the ability of the local population to maintain their subsistence existence (FDRE, 2004).

1.2. Statement of the problem

The majority of Tigrian households depend on biomass to meet their daily energy requirements. In rural areas, biomass fuel dependency for cooking is almost 100 % while in urban areas a small proportion of the households use kerosene and electricity as a supplementary energy sources for cooking (TNRS, 2004).

Kerosene and electricity are mostly not affordable or not available for the poor and low-income households. In addition, the preparation of the staple food 'injera', which is eaten by the majority of the people at least twice a day, needs fast heat and evenly distributed over a large wide ceramic plate. The dissemination of two types of improved mitads for baking 'injera', the electric injera mitad and the 'Mirt Mitad are still insignificant in Tigray (GTZ, 1998).

In 2005, there was an assessment conducted by the water and energy office of Tigray region on the use of Mirt Mitad. This study focused only on business enterprises to see the benefits of Mirt Mitad. The sample size for this assessment was 40 hotel and restaurant owners. The objective of the study was to identify the time, energy and money saving ability of the Mirt MItad. In the study, it was identified that the users of this mitad was found to save up to 50% of their money and 25% of their time (Fesseha, 2005). Apart from that preliminary assessment, no study has been conducted in Mekelle on the uses and benefits of Mirt Mitad. More over, the previous study did not look into the household sector for which it is known to consume the majority of the energy in the study area. The environmental and health dimensions of the Mirt Mitad were also not assessed in the previous study.

Hence, this study was initiated to fill the knowledge gap with the uses and benefits of Mirt Mitad in relation to the household sector. More over, this study attempts to look into the environmental and health dimensions of the Mirt Mitad.

1.3. Objectives of the study

1.3.1. General Objective

- The main objective of this study is to assess the economic, environmental and health contributions of the use of Mirt Mitad at household and community level.

1.3.2. Specific Objectives

1. To assess the pattern of fuel wood inflow from the surrounding rural areas into Mekelle city
2. To estimate the amount of fuel wood saved by Mirt Mtad and indicate its contribution to forest resources conservation.
3. To estimate the amount of household income saved by use of Mirte Mitad as compared to the use of the traditional Mitad.
4. To assess health impacts that are gained or lost due to the use of Mirte Mitad over the traditional Mitad.
5. To assess acceptance level of Mirte Mitad by end users.
6. To identify the problems with the use of the Mirte Mitad.

1.4. Research Questions

This research attempted to answer the following questions.

1. How many kilograms of fuel wood do Mekelle receive in a day from the surrounding rural areas?
2. How much fuel wood do households save due to the use of Mirte Mitad as compared to the traditional Mitad?
3. How much money do households save due to use of Mirte Mitad as compared to the traditional Mitad?
4. What would be the impact of using Mirte Mitad on forest resource conservation?
5. What are the positive/ negative health impacts due to the use of the Mirte Mitad?
6. To what extent is improved Mirte Mitad accepted by the community?
7. What are the problems that user households encounter in using Mirte Mitad?

1.5. Scope & Limitations of the study

Although the introduction of improved Mirte Mitad covered the whole region, this research was limited to the city of Mekelle and its surrounding rural areas. This was because more than 60% of Mirte Mitad users were found in this area. The study covered those households using improved Mirte Mitad and those who do not use for various reasons.

There were problems of obtaining well-organized data in most of the relevant organizations and kebele administration bodies. This was especially evident during sample frame preparation.

1.6. Organization of the thesis

This thesis is organized into five chapters. Chapter one briefly introduces about the background of the study, statement of the problem, objective of the study, research questions, and scope and limitations of the study. Chapter two discusses the review of related literatures. Chapter three describes the methodology of the research emphasizing on description of the study area, the research design, sampling technique, data types and sources and instruments of data analysis. Chapter four discusses the results and discussions of the study. Chapter five contains the conclusions and recommendations of the study.

Chapter Two

Literature Review

2.1. Fuel Crisis and Land Degradation

Natural forests in the country have, in the past, represented a major source of energy (CESEN, 1986c; Aklog, 1990). The depletion of the forest resources, however, has resulted in a serious fuel wood deficit. Regardless of the variations in the estimates from one study to the other and the limitation of the theoretical basis underlining the estimates, different studies confirm of the existence of a wider gap between supply & demand.

There is consensus that the volume of wood harvested in the past few decades far exceeds the incremental yield the forest resources could generate leading to an ever diminishing stock (World Bank, 1984, CESEN 1986b, EFAP, 1994). And this has led to the mining of forest assets (EFAP, 1994).

According to Wood (1990), the present use of wood, in the country exceeds the rate of sustainable supply from the existing resources by the range of 50 to 150 percent depending on the estimates used. The demand for wood and woody biomass product is composed of demand for industrial wood products, construction wood, and fuel wood. However, fuel wood constitutes the major part of the demand (Aklog, 1990; EFAP, 1994).

In Alemneh (1990), it has been indicated that the annual demand for fuel wood exceeds the supply by nearly twofold. For instance, as opposed to the supply, which was 24 million, the demand was estimated to be 42 million m^3 (Alemneh, 1990). As a result, some of the forests are lost every year (Wood, 1990). The annual loss of close or natural forests has been estimated to be 150,000 to 200,000 ha (Aklog, 1990; Alemu, 1998). There is also a fear that if continued at this rate; the last highland forests would disappear by the year 2020 (Wood,

1990). Davidson (in Wood, 1990), postulated that some 16 million ha of rural fuel wood plantation, with another 1.2 million ha of forest that provide timber are required to meet the growing rural fuel wood needs and replace the use of dung as fuel by the year 2010. But more accounts confirms that the demand for fuel wood which was 45 million m^3 solid in 1992, is almost three and a half times greater that the sustainable supply, indicating a significant imbalance between rural energy required and the capacity of the forest resources to produce (EFAP, 1994).

In Tigray context, one may observe such an overwhelming gap between demand and supply. TFAP (1996a) attempted to estimate the present demand and supply of wood and woody biomass products taking 1994 as base year. It also attempted to project into the future under two different scenarios, the "with" and "without" intervention. Nevertheless, the supply of wood and woody biomass products was found to fall short of demand in both cases. The present supply was found to fall short of demand by 3,664,722 m^3. But, what is more worrying is the fact that the gap between demand and supply would widen from 3,664,722 m^3 to 8,144,753 m^3 over the next two decades, even under the "with" intervention scenario (TFAP, 1996a).

Trees around the homestead and farmland; natural woodland within and outside the community; community forests; and state forests (large-scale plantations) constitute the supply sources of fuel wood and wood in general in the country (Alemneh, 1990; EFAP, 1994; Berhanu, 1998).

In parts of the country such as Wello, trees around homestead and farmland constitute the single most important source of fuel for peasant households. The history of community wood lots in Ethiopia goes back to the second half of the 1970s (Alemu, 1998). These community wood lots were initiated with two main purposes in mind. That is, to provide fuel wood and construction material for the community and to reclaim degraded lands (EFAP, 1994). Nevertheless, the

contribution of community forests to increased fuel wood supply was found to be insignificant (EFAP, 1994). Community wood lots were found to suffer from absence of utilization guidelines, that is, lack of clear framework as regards to the ownership and utilization and trees were not used even when ready for use (Alemneh, 1990; Berhanu, 1998). More importantly, community wood lots were initiated and implemented in a top down approach with little or no consultation of the local people (Alemu, 1998). In addition, most peasants considered them as part of the government owned forests (Alemneh, 1990). Peasants were vague as whom the community wood lots belonged which led to both poor management of community forests (wood lots) as well as survival rate of seedlings (Alemneh, 1990).

Several afforestation programs were undertaken and great deal of human and capital resources were committed in an attempt to overcome the fuel wood crisis. Most of these afforestation activities were dependent on outside assistance. Examination of documents revealed astonishing figures regarding the number of seedlings planted annually. Over 51 million, 67 million, and 48 million seedlings were planted by the State Forest Development Department, community Forest and Soil Conservation Department and the peasant communities between 1982 and 1987 (Alemneh, 1990). Some 500 millions of tree seedlings covering 180,000 ha were planted and another 100,000 ha of land have been closed for natural regeneration between 1976 and 1988 (Wood, 1990). However, past tree planting efforts have focused on number rather than quality and afforestation has been considered as only planting trees. Seedlings were inappropriately cared and handled; planting sites were inadequately prepared, after planting tending operations were lacking, etc. As a result their survival rate has been very poor (Alemneh, 1990; TFAP, 1996a).

2.2. Energy Policies and Strategies: A Review of Past Efforts

2.2.1. Past energy strategies and policies in developing countries

Until the early 1970s, energy has been considered as cheap and abundant resource (Gebru, 1982; Bernardini, 1983) and energy planning was conceived as synonymous with energy supply planning. It was regarded that any increase in demand could be met within real time, almost anywhere around the globe by expanding the supply. Some authors also went to the extent of arguing that economic development can proceed or the world can get along without natural resources (Hall and Hall, 1993). In addition, information on the aspects of energy use patterns was non-existent in the early 1970s (Bernandini, 1983). However, all this came to an abrupt end with the first and second oil price shocks of the 1970s (Dunkerley et al, 1981; Bernandini, 1983; Hall and Hall, 1993). Especially the fossil fuel resources were considered infinite. Moreover, there were beliefs that there are no limits to the number of people that the earth can support or at least technology by itself will be able to deal with the problem of both increasing human population and resource degradation (Gebru, 1982; Hall and Hall, 1993).

The macroeconomic impact of the first (1973-74) price shock on developing countries as a group was less severe than was feared. But, the impact of the second shock, i.e., that of the 1970-80, was found out to be sharper (Dunkerley et al, 1981). The rise in the cost of energy and limitations in supply, which occurred as a result of these shocks, put energy on a much more equal footing with other factors of production such as capital and labor (Gebru, 1982; Bernandini, 1983). All these gave an additional urgency to the search for economically viable replacements for imported oil as well as for means of improving energy efficiencies (Dunkerley et al, 1981). They also gave way to the shift of emphasis to the renewable energy resources as well as to the improvement in energy (end use) efficiency (Hall and Hall, 1993).

Particularly after the second shock in 1979 and the spontaneous return to fuel wood in many end use sectors, many oil-poor developing nations began to give

serious consideration to their neglected traditional fuel sources, which at least did not imply deficits in foreign exchange. However, in many instances, the deterioration of forest resources and wood fuel supplies was far advanced to allow any immediate hope of salvation from this direction (Bernandini, 1983; Leach and Mearns, 1988).

The 1970s was also a decade, which bore witness to the discovery of the existence of a *'double energy crisis'* in developing countries (Bernandini, 1983), that is, fuel wood crisis or the deterioration of *'traditional fuels'* in addition to the oil-price shocks. Traditional fuels are fuels that have been used for centuries and are usually freely gathered. Wood fuel, dung, crop residues, sisal, and similar substances are the most significant fuels falling in this category (Hosier, 1985). The rediscovery of the traditional fuels also gave rise to considerable activity in almost all developing countries to obtain the necessary cognitive base relating to wood fuels and other biomass patterns of supply and demand. For instance, by early 1980s, almost all developing countries had either undertaken one or more major wood fuel and rural energy surveys, or were planning to undertake one (Bernandini, 1983; Leach and Mearns, 1987).

The traditional approach to solving rural energy problem was to plant more trees (Van de Laar, 1991), with the oil price shocks of the 1970s and the recognition of the scale of deforestation across the third world, the gaps theory or model was conceived to measure the scale of the wood fuel crisis and the remedies which would be needed to alleviate it (Leach and Mearns, 1988). Energy strategies and policies of the 1980s were also greatly influenced by this theoretical or methodological premise. The gaps theory recognizes wood fuel consumption as the principal cause of deforestation and the mounting wood fuel scarcities (Leach and Mearns, 1988).

Afforestation or demand management by the dissemination of more efficient cooking mitads has been the common recommendations of the days, as a remedy to the rising fuel wood crisis. For instance, the World Bank study, which

is a variant of the gaps model, estimated that tree planting in Sub-Saharan Africa should increase by fifteen-fold in order to close the projected gaps in the year 2000 (Leach and Mearns, 1988). Even some of them had gone to the extent of giving strong justification for large-scale centrally directed plantation forestry projects focused on wood fuel provision (Leach and Mearns, 1988; Mengistu, 1989). However, the gaps theory is blamed for exaggerating the scale of fuel wood problem and to have led to inappropriate large-scale and energy-focused remedies at the expense of other actions, which could have done much more to improve welfare, reduce deforestation, and generally support sustainable development.

2.2.2. Energy policies and strategies in Ethiopia

Deforestation had been here in the country since the time of Axumite civilization. As Wright and Yeshiningus (1984) indicated, the woodlands around Axum were cut down to supply fuel for the city dwellers and the land so cleared was ploughed to supply food to the growing population. Nevertheless, government intervention in the sphere of energy in Ethiopia dates back to the reign of Emperor Menelik II, in the late 1880s. At that time there was a scarcity of wood in and around Addis Ababa. The strategy adopted by the Emperor was to alleviate the fuel wood crisis through the normal operations of the market. That is, encouraging individual farmers to grow eucalyptus and bring it to the market. Two important policy instruments were pursued to induce individual farmers to grow eucalyptus. Delivering seedlings to farmers at subsidized prices and exempting the land for specific area planted with eucalyptus tree from tax. Besides ameliorating the fuel wood problem, these two policy instruments or incentives combined with the higher fuel wood price at that time have contributed to the spread of eucalyptus among smallholder cultivators (Alemu, 1998).

After Menelik II, it was in the Second Five Year Plan (1963-68) that some concrete targets were formulated about forestry development (Aklog, 1990). But, in between, no indications were found about policies and strategies in the sphere

of energy and forestry. The subsequent five-year plans, that is, third and fourth year plans also contained some targets on management of natural forests, plantations and community forestry. The National Forestry Program for Ethiopia Project Plan and the revised plan of October 1977 also had targets on forestry development (Aklog, 1990). However, all of the these targets or policies were much concerned about expanding the supply of raw materials (timber and saw log) suitable for increasing wood requirements of the forest based-industries; replacing the import of wood products with domestic output and establishing efficient wood using industries (Hunting, 1976a).

Despite the longstanding fuel crisis, forest policies and strategies were rather commercial oriented and fuel wood or household energy was of little significance. On top of the fact that only the commercial energy sector was planned consciously, the plans that have been practiced were deficient in that they lacked the foresight into the distant future and failed to give due regard to the long range and underlying problems (Mengistu, 1982).

Fuel wood has been regarded as a free good in Ethiopia, until the advent of the 1974 revolution (Gebru, 1982). Rather it was late in the early 1980s that energy as a sector, particularly household energy at least regained the attention of the government. A national committee on household energy was set up in October 1980. The household energy problem was recognized to be at the forefront of the energy sector issues facing Ethiopia (Mengistu, 1989).

The committee endeavored to investigate the household energy situation. Re-forestation programs to increase the fuel wood supply base; expanded development and utilization of substitute fuels like briquette or condensation of agricultural residues, improvement in efficiency of charcoal kilns, as well as improvement in efficiency of cooking through the use of fuel-efficient mitads were among the strategies opted to overcome the problem (Ibid). However, all these efforts did not only fail to go beyond relieving the fuel problem in the main urban

centers, their effectiveness was proved to be limited to the scale of the household energy problem (Ibid).

Irrespective of the critical problem of deforestation and fuel in the region at that moment (Mengistu, 1989; CESEN, 1986), no tree planting measure had been undertaken in Tigray Region prior to 1970 (Hunting, 1976). This is with exception of the largely undocumented tradition/ indigenous initiative by private peasant holdings/ farmers (TFAP, 1996a; Alemu, 1998). It was afterwards that some USAID sponsored afforestation programs were started (hunting, 1976). A strategy was also designed for the supply of wood products in the region for the period between 1975 and 1985.

Included in these were, firstly, the reservation and exploitation of natural forests and scrub on the eastern escarpment including Dess'a forest, and secondly, the development of small plantations of trees in land units in collaboration with PAs (Peasant Associations) or cooperatives. The second strategy, in particular, envisaged tree planting on poor arable lands withdrawn from cultivation and to some extent on conservation structures. These were aimed at providing a reliable supply of fuel wood and charcoal to main urban centers notably Mekelle and Quiha and to a lesser extent Maichew, Adigrat and Wukro towns as well as to meet the estimated study area demand (Hunting, 1976a).

The 1983 UNDP/ World Bank assessment of the country's energy sector also recognized the large gap between supply and demand of firewood and the need for an immense effort to reduce the discrepancy (Newcombe, 1998). There in, a strategy was developed to remove the dependency of urban settlements on their rural hinterlands for fuel and to reestablish a dynamic equilibrium between the supply and demand for fuel wood in rural areas (Newcombe, 1989). For example, expanding the supply of household energy through greatly increased allocation of financial and trained human resources was among the major tenets of the strategy.

Within this strategy, particular attention was paid to reforestation, including improved forest management; expanded development and utilization of substitute fuels, like agricultural briquettes from residues; and improvement in efficiency of cooking through the use of mitads with improved fuel economy and the use of aluminum pots and pans. Expanded involvement or participation by the private sector in selected areas such as in the supply of biomass fuels (firewood, charcoal, agricultural residues briquette) to households was also another important theme of the strategy. It also emphasized that energy and agro-forestry should have to be placed among the nation's top priorities for there to be any chance of success (World bank, 1984). The strategy further envisaged a potentially achievable program of planting 960 thousand ha of rural energy-forestry with special emphasis on agro-forestry and 195 thousand ha of peri-urban forestry (World Bank, 1984).

The current policy of the government of Ethiopia attempts both the energy supply and demand sides (TRBIDMPP, 1977). As regards to the traditional fuels, the policy focuses on afforestation to enhance the supply of fuel wood. The policy envisages afforestation to be achieved by providing incentives for communities and the private sector to invest in forestry as well as through encouraging agro-forestry. The policy also emphasizes promoting the production and use of agricultural residue briquettes as source of fuel for domestic, commercial and industrial purposes. It also gives emphasis to the promotion of biogas technology and renewable sources of energy (TRBIDMPP, 1997c).

On the demand side, the policy emphasizes on the most efficient use of available energy resource through improvement of the efficiency of energy use to reduce losses and avoid wastage. Particularly, as regard to the household sector, the policy focuses on the continual improvement of the energy efficient end-use devises such as the improved *injera* mitad and charcoal mitad by facilitating research and development in this field, sensitizing and educating the public at large towards the increased use of these energy efficient devices (TRBIDMPP, 1997c).

2.2.3. Towards new energy strategies and policies in Ethiopia

According to Leach and Mearns (1988), measures taken to reduce fuel wood use are a matter of improving welfare by cutting costs rather than attempts to save the trees.

More importantly, however, agricultural intensification, i.e., intensifying cropping and grazing systems, should be viewed as the main strategy of halting deforestation for new land is needed as population grows (Leach and Mearns, 19789; Mengistu, 1989).

According to Godoy (1992), African countries would still require a fifteen-fold increase in current planting rates to meet the increased demand for fuel wood, even when demand for fuel wood in Africa dropped by 20-30 percent. It seems unlikely foe African governments to achieve such an objective (Godoy, 1992). Given the resource limitations of developing countries to undertake the required replanting and new planting through projects, there is a need to search for less credit and management-intensive mechanisms to promote smallholder tree cultivation. A more diffused approach towards this end use is the assumption that small holders will plant on their own without or with minimal outside assistance provided they face attractive commercial incentives.

That is, smallholders are rational decision makers interested in change. Under such conditions, the need to diffuse new technologies, managerial expertise, and credit through projects becomes less pressing. Moreover, the role of governments and donor organizations shifts away from directly funding or managing projects to different and more distant spheres such as untangling market distortions, alerting farmers to new technologies, and listening to farmers needs (Godoy, 1992).

Experiences also tell us that government run large-scale peri-urban plantations such as the ones in Ethiopia were too expensive and there is a need for less costly methods that would involve the participation of the private sector by way of

private or community afforestation programs (Mengistu, 1989). There is also a need for limiting the role of government to assisting the private and community schemes through expert advice and screening and introduction of appropriate tree species whenever necessary (Mengistu, 1989). Woody biomass fuel consists of two-thirds of the household energy consumption in Ethiopia. Owing to this fact, it seems not feasible invest in forestry assets at a pace that would provide enough fuel wood supplies to meet fuel wood consumption levels in the future, which are equivalent to current per capital consumption levels (EFAP, 1994). Major efforts should be directed towards improving the efficiency of energy use, which include the use of improved cooking mitads, and promotion of alternative energy sources particularly for rural households (EFAP, 1994).

Generally, the new approach calls for multiplicity of measures to overcome the problem. It emphasizes the need to restrict population growth to reduce the pressure on the environmental resources, particularly on forest resources caused by increasing demand for fuel wood. It requires pursuing energy policies that accelerate the development of energy sources other than wood that can provide affordable energy especially to rural households. This includes the need for reducing the competition for land, thereby, making it available for planting trees and forests through higher/ improved productivity of agricultural lands and poverty reduction.

It also emphasizes the need of implementing a policy and institutional framework for the development, management, and conservation of forest resources, backed by a public investment program that improves the efficiency in use of forest assets and provide for investment in new assets (EFAP, 1994). Moreover, the wrongly held thinking of viewing rural tree growing in terms of area of forest or number of trees planted rather than individual surviving trees also need to be reserved (Leach and Mearns, 1988; Alemneh, 1990). Further more, household energy should not be viewed in isolation. It has to be integrated into wider development objectives so that it can produce synergy effects (Klingshirn, 2000).

2.3. Energy Conversions, Technologies and Efficiency

2.3.1. Energy conversions and efficiency

The basic feature of energy is that it has many forms and can be converted from one form to another. However, some of the conversions may not have practical value (RWEDP, 1997). Energy conversions are just the ways in which we utilize or harness energy. When dealing with energy conversions one would be concerned with two things: the quantities of energy involved and the rate at which energy is converted from one form to another. When one form of energy is converted into another form for a particular purpose, not all the energy ends up where one would like it. It all depends upon the type of device or appliances used (Encyclopedia of science and technology, 1960). Rather, part of it is wasted or lost in the conversion process in the form of heat (RWEDP, 1997). The ratio of the useful energy output to the required input is the efficiency of the process (RWEDP, 1997). The higher the efficiency, the lower the loss of energy. In general, the efficiency of a given energy conversion process may be as high as 90 percent but never 100 percent (RWEDP, 1997). Although some losses are inherent in the nature of energy conversions, it is possible to reduce inefficiency by good equipment design and use. Hence, an understanding of these inherent inefficiencies is the key to optimizing energy use. However, it should also be born in mind that the efficiency of an energy conversion process not only depends on the equipment/ conversion device used but also the form of the input energy (RWEDP, 1997). That is, depending on their actual potential to do work (or energy), some forms can be converted more efficiently than others.

2.3.2. Wood, charcoal and crop waste technologies

Except for Tigray, the traditional 'three-stone open fire mitads' constitute the dominant mitads for millions of rural and urban households in the country both for cooking and baking (World Bank, 1984; CESEN, 1986a; EESRC, 1995). Studies have confirmed that these open fire mitads have a very low efficiency. That is, 10-15 percent for cooking and about 7 percent for baking (World Bank, 1984;

EESRC, 1995; TFAP, 1996b). Thus, most of the potential energy 90-85 percent is wasted. The Tigray type injera mitad, the one enclosed with clay wall, was found to have a relatively better performance in fuel saving (World Bank, 1984; CESEN, 1986c). In the case of open fire mitads, the plate or *Mitad* rests on stones over an open fire. The low utilization efficiency of the open fire mitads have resulted in a relatively higher demand for biomass particularly for households that primarily or entirely rely on biomass fuels (EESRC, 1995).

Similarly much of the traditional use of wood as cooking fuel in most developing countries is also carried out in campfires or mitads where the efficiency of heat use is very low. For instance, according to Dunkerley et al (1981) wood and crop wastes are typically used with efficiencies not exceeding 10 percent. Despite their very low efficiency, the open fire mitads have other major draw backs: children can easily burn themselves on the open flames; smoke in the kitchen is detrimental to the health of mothers and children (TFAP, 1996b; Bruce and Doig, 2000; Mishra et al, 2000; Zenebe et al, 1998). In addition, women are also forced to travel increasingly long distance on foot to gather fuel as a result of the increased consumption emanating from the very low efficiency of the open fire mitads (TFAP, 1996b). Acute lower respiratory infections (ALRI), chronic obstructive lung diseases (COLD), low birth weight, tuberculosis and eye problems are the most important frequently reported effects of exposure to smoke (Bruce and Doig, 2000). Respiratory diseases caused by exposure to smoke effect 46 percent of Nepal's population (Amacher et al, 1992).

2.4. The Household Energy Situation in Ethiopia and its Linkage to Environment

The household sector is the major consumer of energy in Ethiopia. Households' share is more than 88% of the total energy consumption of the country, mainly used for cooking and lighting. For most households, the only available and affordable sources of energy are biomass fuels. The traditional biomass fuels such as fuel wood, forest and agricultural residues and dung account for more

than 94% of the country's total energy consumption. The use of modern fuels like electricity, kerosene and LPG in general is restricted to the major urban centers and to the high and medium income households. Only 4% of the population has access to electricity. Prospects for substituting biomass fuels by modern forms of energy are limited due to economic and planning constraints and poor distribution systems (UNDO/ ESMAP, 1996).

In the past decades the demand for fuel wood has raised considerably, while the supply has sharply decreased. From the total forest area of Ethiopia, which covered about 16 % of the land surface in mid 1950s, at present less than 2.5% have remained. Estimates of the Ethiopian Forest Action Plan (1996) indicate that in the year 2000 the fuel wood consumption was already 4 times higher than the sustainable supply. The current forest depletion rate is about 160,000 to 200,000 hectares per annum. A dramatic deterioration of the demand and supply balance and of the natural resource base is forecasted for the coming years, unless there is concerted effort to promote alternative energy supplies and a more efficient utilization of the available biomass resources (Gregory, 1997).

Fuel wood users are not the primary cause for deforestation. More than by other factors, the depletion of forests is aggravated by alarming rate of population growth at 3% per annum. The growing population demands more land for agriculture and livestock. Forests are cleared for the expansion of farm land; wood lands are overgrazed by growing livestock numbers. The cutting of wood for construction and fire wood and the wasteful and inefficient utilization of biomass fuels on open fire mitads add to the pressure on the existing resources (UNDP, 2000).

2.5. Factors Affecting the Adoption of Mirt Mitad

Amacher et al, (1992) considered improved mitad as technological substitute for fuel wood. They argued while a substantial literature exists on the important features of adopting new agricultural production technologies, knowledge on the characteristics of mitad adoption is sparse and little empirical evidence exists on

the adoption of consumption technologies such as the improved mitad (Amacher et al, 1992).

They considered a usual utility maximizing household and assumed that the utility function is separable in fuel wood and other goods. They tried to analyze (estimate) both the household's decision to adopt (purchase) the mitad and the decision to use it efficiently, using probit model. They considered fuel wood price, agricultural residues consumed as a substitute fuel, fuel wood reduction, farm profit, and non-farm income, household characteristics including family size and ethnicity as explanatory variables in their model.

In the adoption equation, fuel wood price was found to be positive and significant agricultural residues (as negative proxy for price of related good) were found to have anticipated negative and significant; fuel wood reduction was also found to be positive and significant as anticipated; farm profit was insignificant and exogenous (non-farm) was significant and positive and a negative but significant constant term.

There have been attempts of developing and introducing or popularizing improved mitads of certain type, such as that of the *"Bako improved charcoal mitad"* by the MoA (Kebede, 1995) and that of *"Lakech* and *"Mirt"* by EEC (EESRC, 1995; TFAP, 1996b). Since some years back, in Ethiopia, *Lackech* is a charcoal mitad and *Mirt* is an injera-baking mitad. However, no research has been carried out in this sphere.

Except for little descriptive works, empirical research results on the adoption of these technologies and on the socio-economic characteristics that determine their adoption is almost non-existent (Kebede, 1995). Among the descriptive ones is the work of Bess et al, (1994) on the impact of an improved biomass *injera* mitad in Addis Ababa. Bess et al, (1994) described aspects such as its fuel saving ability contributes to the acceptance of the technology. Moreover, other mitad characteristics also contribute to the acceptance of mitad technologies. These include the absence of smoke when using the mitad because of chimney,

the absence of *"back fire"*, i.e., the fact that it does not throw heat and flames back to the cook when fuel is fed to the fire (Bess,et al, 1994).

The production, conversion, distribution and use of energy have impacts on the environment. Over the past decades, how ever, the link between energy and environment has come under growing debate, in particular since the discovery of the green house gas effect and the global climate change phenomenon (Bess et al, 1994).

The present energy consumption pattern of Ethiopia has also direct negative impact on the environment and on the wellbeing of people. The high dependence on traditional energy and the extreme over exploitation of the existing biomass resources are putting Ethiopia's natural resource base, which is the basis of agriculture and socio economic development at risk (Hall & Hall, 1993).

2.6. Intervention Strategies

Different intervention strategies to cope with the increasing energy demand at household level will have to consider energy needs, the choice of technology and financial requirements for their implementation. Strategies can start on the supply and demand side, but have to fulfill the criteria for sustainable development. The major strategies are (UNDP, 2000).

2.6.1. Supply side interventions

- Enhancing the supply of fuel wood
- Inter-fuel substitution
- Grid extension
- Rural electrification
- Off grid renewable energy systems

2.6.2. Demand side interventions

- Improving the energy efficiency of conversion and end use technologies
- Promotion and dissemination of improved fuel-saving cook mitads

2.7. Traditional Energy Use and Environmental Degradation

Biomass fuels such as fuel wood, crop residues and dung account for 94% of the total energy consumption of Ethiopia, but households' share alone is more than 7 times higher than the total energy demand in all sectors. In general the utilization of traditional biomass fuel is sustainable as long as biomass resources are abundant and as long as the rate of fuel wood utilization within a certain area does not exceed annual incremental forest yields. In a sustainable context, traditional biomass fuels not only provide cheap energy to the individual consumer, they also have positive effects on the national economy, since biomass fuel use creates income and employment opportunities for those involved in fuel collection and marketing and allows major foreign exchange savings that otherwise would be required for the provision of alternative energy supplies (Gregory, 1997).

The magnitude of biomass demand has risen considerably during the past decades due to the high population growth of 3% p.a. In light of increased fuel wood demand, clearance of forests for agriculture and livestock grazing and low end use energy efficiencies, in many parts of the country the supply of biomass fuels has fallen far behind accrual consumption levels. National balances reveal that the demand is already five times higher than the sustainable supply. Forest areas have dramatically decreased from 16% in 1950s to less than 2.5% of the total land area today and forest depletion rates are estimated to reach 160,000 to 200,000 hectares per annum. Even though there are considerable spatial variations due to climate conditions and other factors, the depletion and over

utilization of forests is certain areas have led a serve energy crisis (Gregory, 1997).

Table 1: Fuel wood demand and supply balance for Ethiopia (in million m3)

Year	Demand	Supply	Deficit
1997	52.9	11.7	41.2
2000	58.4	11.2	47.2
2005	68.5	10.4	58.1

Source: EFAP, 1994.

2.8. Limitations of Conventional Modern Energy Supplies

While traditional biomass fuels provide the bulk of Ethiopia's energy supply, the majority of Ethiopian households have no or only limited access to modern energy supplies, kerosene, LPG and electricity are often not accessible or unaffordable to the people, in particular in the smaller towns and rural areas outside of Addis Ababa. More refined forms of energy also require more sophisticated appliances that are generally more expensive than the traditional ones (EFAP, 1994).

Only 4% of the population has access to electricity. It is envisaged that after successful completion of EEPCO's recently launched ambitious rural electrification program, about 17% of the population will have access to electricity. Even though Ethiopia has a huge hydropower potential there are serious limitations with regard to further expanding the capacity of electricity supply in the conventional system (EEPCO, 2000).

2.9. Fuel Preference and Consumption

Cooking is highly energy intensive in Ethiopia due to the practice of open fire baking of injera on flat discs (mitad). The rural population has a strong preference for firewood, thus fuel wood is the first choice fuel and where fuel wood is scarce other lower quality bio-fuels such as dung and agricultural residues are used. Of the total rural energy consumption in 1982, 81.6% was in the form of firewood and tree residues, 17.9% other bio-fuels such as dung and agricultural residues, 0.4% in the form of charcoal and 0.03% in petroleum products. From the above it is clear that biomass fuels account 99.5% of energy consumption (Zenebe, 1999).

Fuel wood

Fuel wood, which Includes branches, leaves, twigs and roots, is the greatest fraction of the total of biomass resources for household activity. These wood resources can be divided into those which exist in the major forest areas and the smaller category of dispersed wood lands.

The traditional way of using this fuel is more prominent in the rural households. Most rural households satisfy their energy need by collecting fuel from near by areas. Since the availability of this fuel has drastically decreased with time, they are forced to go much farther from year to year in order to satisfy their need.

From the figure of biomass energy consumption, of the year 1985/86-1989/90, an increment of average 2.6% per year of fuel wood is exhibited. This is due to a rapid increase of natural resource exploitation compared to natural replacement rates. The fuel wood scarcity which forced the farmers to use agricultural residues and animal wastes as a substitute fuel has greatly contributed to the ecological crisis of the country.

Dung

Dung is the fuel type consumed for household activity with the second highest contribution. Since dried dung has higher energy content, people are shifting to use this fuel as second option next to fuel wood. Utilization of this fuel is practiced by direct burning. Direct burning application of this fuel has a major impact in the agricultural production which is caused by deterioration of soil fertility. In addition to that there is the difficulty of collecting this fuel especially for those landless people who do not have cattle and land to collect from.

Crop residue

Using of crop residues for household energy need, rather than being a feed for livestock and nutrient for the soil, is now becoming familiar in most rural households, which is caused by fuel wood shortage, though the availability of this fuel is seasonal due to its dependence on the harvesting time. Application of agricultural residues as household energy fuel is practiced by the traditional way, which is direct burning. The rapid glowing characteristics of this dried fuel will cause the fuel to exhibit lower calorific values. In order to increase its energy content it has to be converted to a briquette form or to other form of fuel.

End use devices used

The end use devices used for cooking activities in most parts of the country is open fire (three stone) mitad. Utilization of this highly inefficient mitad makes the cooking activity highly energy and time intensive. In some urban areas a shift to other better cooking devices such as charcoal, kerosene, LPG, and electric mitads is shown. But households which use such devices are very limited in number relative to the total number of households.

When we take the case of Addis Ababa, rapid penetration of electric injera mitads and kerosene mitads showed a great reduction of biomass consumption in this area. But this trend is not much applied even in other urban areas. Improved charcoal mitads, which are disseminated by private sector, have

achieved impressive market share in this city. How ever, improving of efficiency of charcoal production and production of other substitute fuel did not yield positive outcome.

Table 2: Share of household owning different mitads, Addis Ababa, 1994

Share of household owning each device	Mitad efficiency (%)	1985 (%)	1994 (%)
Open fire place	8-10	92	86
Charcoal mitad		93	91
Lakech charcoal mitad	42	0	22
Lakech as % of all charcoal mitads in households		0	18
Kerosene mitad	42	38	91
LPG mitad	55	15	17
Electric mitad/hot plate	60	3	3
Electric mitad		23	62
Regularly cook injera on open fire place	9	76	45

Source: CEEPE, 1986 & UNDP/ESMAP, 1995

As it is shown in the above table, by 1994, considerable number of electric mitad mitad was 62% and kerosene mitad 91% penetrated to households. This had shown great impact on reducing load on natural resources. How ever, as the electric tariff rose currently, most of the households shift back to use biomass fuels. Therefore, it is difficult to say that how many percentage of this figure are using electric Injera Mitad currently.

2.10. Health Effects of Biomass Fuel

Every bio-fuel has different combustion products which depend on the chemical composition of the fuel. Some of these combustion products are measurable pollutants which cause air pollution (Hiwot, 2000). These main pollutants are carbon monoxide (CO), hydrocarbons (CmHn), nitrogen oxided (NOX), sulphur oxides (SOX), soot dust and particles, and formaldehyde (HCHO).

Table 3: Expected concentrations of pollutants from various fuels

Fuel	Heating value (MJ/Kg)	TSP d<10μm (Mg/m3)	CO2 (Vol %)	CO (Mg/m3)	CmHn (Ng/m3)	NO2 (Mg/m3)	SO2 ((Mg/m3))
Wood	16	4-20	8	12-156	1300	0.31	0.16
Dung	12.5	5-80	--	17-175	8200	0.14	0.24
Charcoal	30	5.5	--	--	--	0.075	0.83
Coal	23	24.9	--		4200	0.17	1.7

Source: Promotional strategy of improved mitads dissemination, 2000.

2.11. Improved Biomass Mitads

The need for improved biomass mitads emanates from the fact that most Ethiopian households use biomass fuels for household cooking. It is for injera baking, wot and buna preparation, grain roasting and water boiling, which is performed highly inefficient on open fire places. Since biomass fuels like fuel wood, BLT (branches, leaves and twigs), dung and agro residues are freely collected in rural areas most of the time there is little tendency of households to shift to other higher grade fuels in the near future. In urban areas, where fuels have to be purchased, household energy expenditures already make up a considerable proportion of the household budget, reaching 35% and more of the monthly income (Hiwot, 2000).

While *buna* and *wot* are also prepared on charcoal mitads, especially in urban areas, and improved charcoal mitads (lakech) are now available in the market at a fairly low price (8-12 ETB depending on the quality). In areas where there is sustainable supply of kerosene, households are largely using kerosene mitad as it is affordable due to its subsidized price. Taking the case of rural areas, biomass seems to be the only option for almost all household cooking purposes; charcoal is used to a low extent, but produced a means of income generations for selling it to urban settlements. Kerosene, due to its unreliable supply and the high fuel costs, is only purchased for lighting (Hiwot, 2000).

The main problem currently exist is to design and disseminate an improved energy saving mitad at a wider scale.

Improved biomass injera mitads have been developed by different centers, in particular

- Burayu Basic Technology Center (BBTC)
- Ambo Mud Technology Center (AMTC)
- Rural Technology Promotion Centre (RPTC)
- Ethiopian Energy Studies and Research Center (EESRC)

Looking in to the rate of dissemination, except mirt mitad that is designed by EESRC, others disseminated only limited number of mitads. This is mainly caused by the bulkiness of the mitad, lack of ease of production, efficient promotional strategies and etc. Besides of technical problems related to the development and production of improved mitads, one has to bear in mind that dissemination will become the most important task, once an improved fuel saving mitad have been designed. A number of technical centers have been concentrating on the technical aspects of mitad design and testing, but dissemination strategies have not been received due attention, which probably is the major reason for low success. Key issues for successful dissemination are

the acceptability of the mitad by the end user, the dissemination strategy chosen and adequate monitoring and follow up, including quality control (Hiwot, 2000).

Chapter Three

Methodology

3.1. Description of the Study Area

3.1.1. Biophysical features

Topography

Mekelle is located between 13^0 32' north latitude and 39^0 28' east longitude and elevation between 2000 to 2200 meters above sea level. It was founded by Emperor Yohannes 4^{th} in 1860s. It is located in the northern highlands of Ethiopia, covering an area of 130 square km. The eastern side, *Enda-Eyesus* ridges are the highest peaks of the city. The major land form of the city territory can be classified into four categories namely: flat to gently sloping, gently sloping to rolling, sloping to moderately steep and steeply to very steeply sloping type. The fuel wood consumption of Mekelle inhabitants has a great pressure in the environmental degradation of the outskirts, such as *Hintalo-wajerat and, Samre-Seharti weredas* causing high deforestation.

Mekelle is located in the geographical center of the Regional State of Tigray. Mekelle is located less than 10 hours from Dessie, and a couple of hours from the Tigrayan cities of Adigrat and Axum. Mekelle is approximately the same distance, a one and quarter hour flight from the major Ethiopian cities like Addis Ababa, Gonder and Bahir Dar.

Geology

Geologically, it is part of agile shale formation (Mesozoic rock formation) and Cenozoic Mekelle dolomite occurring mostly as sills. The Agile shale formation, which forms the most extensive flat plain areas of the Mekelle outlay, is the upper most formation of the *Hintalo* limestone. It is composed of marble, shale, block limestone, and gypsum. The Mekelle dolomites are block limestone forming sills, dykes, and small stoics intruded through out the sedentary sequence. We have a

promising geology favorable for mineral exploitation. Limestone, marble, clay, dolomites (Block granites), sandstone, oil and gypsum and gypsum and shale are the most important mineral resources of the city.

Climate and vegetation

Mekelle enjoys a mild climate that can be described as Woina Dega. During the dry season, the days are pleasantly warm and the nights are cool; in the rainy season, both days and nights are cool. There are two rainy seasons namely the *Kiremt* and *Belg*. The rain falling in the *Belg* rain season is too low for growth of plants as a whole. The main rain season is *Kiremt* whereby sufficient rain and moisture is available for plant growth. It is estimated that the average annual rain fall ranges from 579-650 mm. Even though the amount of rain falling in years is not showing significant difference, the erratic nature of the rain in the day records shows variability at once and didn't rain for weeks. Mekelle, as part of the globe, is suffering much from global warming aggravated by the neighboring area deforestation and desertification influences. So, in the absence of cooling agent forest in the city and neighboring areas, the temperature variation is high even from hour to hour. Out of the four seasons, *Kiremt* is cooler and *Bega* is hot. The average maximum temperature per year is 24.1 ^{0}c and the minimum is 11.11 ^{0}c. There is a time record where the maximum temperature reaches 29.9 ^{0}c and the minimum 1.6 ^{0}c. This shows that there is high temperature fluctuation in Mekelle. Temperature is high in March-May and low in October-December. As the result of the neighboring area deforestation and very little tree plantation coverage in the city, there is almost no wind barrier that is able to break the wind speed and force. Then the high wind speed and force blown over the bare areas blew up the dust and fine soil very easily. The blown dust and soil bring serious sanitation and health problems to city inhabitants. The easterlies wind blown from the east during the dry season for a longer period of time in the year (October-March) is the most serious wind with high speed and force that blown up the dust and soil. The average wind speed of Mekelle per year is 3 m/s. The minimum wind speed

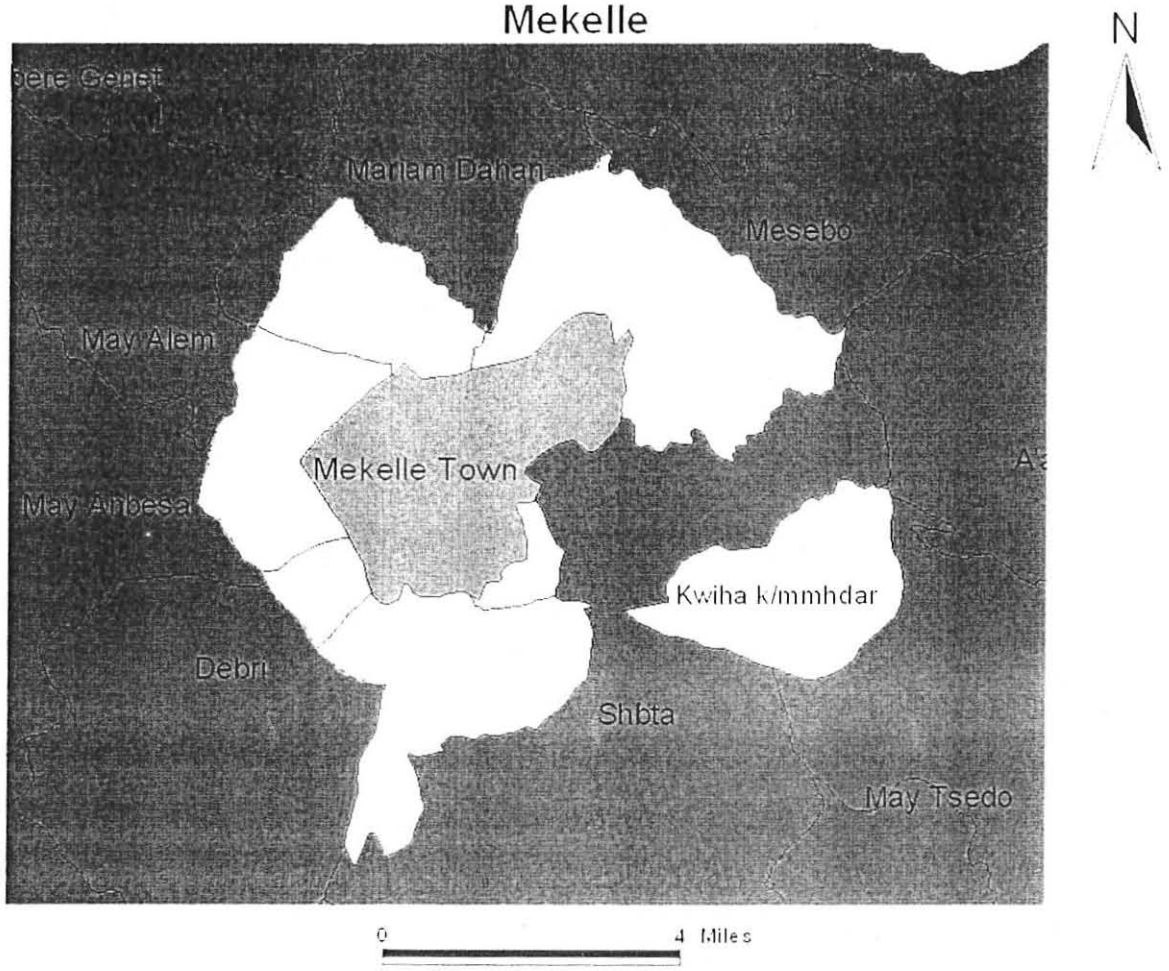
per month recorded is 5 m/s. The day time maximum wind speed, 14 m/s, was recorded in 1/6/1996 E.C. It is believed that when the wind speed reaches 20 m/s, which is called "Gasty wind", it will be destructive. Therefore, if wind break trees are not planted in the city, in the near future, Mekelle will be prone to the destruction due to the occurrence of "Gusty wind". The sunshine hours are lower in summer season (June-August) due to the cloud formation. The average sunshine is 8.35 hr/ day. The maximum and minimum sunshine per month are 10.5 hr/ day and 4.1 hr/ day respectively. There is a day time record also maximum recorded 11.7 hr/ day and minimum recorded 0.0 hr/ day.

It is believed that Mekelle and its periphery areas were covered by natural forests like Olea-Africana, Ficus-Vasta, Ficus-Sur, Juniperous-Procera, Dodonia-Viscasa, etc. One can see the remnant forests in *Enda-Raesi* recreation center, which is recorded by Ethiopian Genetic Authority as genetic reserve area, and in various churches. Due to the demographic growth of the city inhabitants and need of high energy demand for fuel consumption, due to the absence of alternative energy resources, the neighboring forests have been cleared completely. The fuel wood consumption of Mekelle inhabitants has a great pressure in the environmental degradation of the outskirts, such as *Hintalo-Wajerat, Samre-Saharti weredas* causing deforestation.

The planting of esthetic value around road sides and palaces have been started during the time of Emperor Haileselassie by the regional administrator, Mengesha Seyoum, while he was trying Mekelle to have master plan and roads under construction. During the Dergue regime, tree planting has been continued in a campaign base called *Arenguade Zemecha* but lacks follow up and technical support. How ever, Don Bosco technical school from 1987-1990 E.C. was carrying out good roadsides plantation. The existing vegetation of the downhill of *chomea* to *Endayesus* is reserved under protection and intensive enrichment plantation. After the fall of the *Dergue* regime, several roads, buildings, colleges,

residences etc have been constructed but comparatively little is done to plant these areas with trees.

Map 1: Map of Mekelle and its surrounding rural areas



3.2. Methodology

3.2.1. Data type and sources

Both qualitative and quantitative data were used in order to answer the research questions and thereby arrive at valid and reliable conclusions. Concerning sources of data, both primary and secondary sources were used.

Primary sources: - Being the main input for analysis, primary data were collected through interview and focus group discussions. For this purpose, a

structured questionnaire and checklist were prepared. In addition, key informants, household sample respondents (users and non users of mirte mitad or mitad), GTZ project managers, producers of mirte mitad or mitad (micro & small-scale enterprises) have been contacted and interviewed to generate the necessary data.

Secondary sources: - For the purpose of this study, published and unpublished materials have been used to obtain available secondary information. These sources include rural & urban energy policy and proclamations, magazines, research papers, annual plans & performance reports of GTZ and rural energy development and promotion centre, and other related publications.

3.2.2. Research Design: data collection methods, sampling technique & methods of data Analysis

The process of data collection had involved triangulation technique i.e. it is a technique of combining different methods, data & people, using each method to supplement and check upon the others. Such data collection method was selected in order to have reliable and full picture of the research problem. Besides, cross sectional survey method was employed for the research since this method involves the sampling of various segments of a population at one point in time. The different methods that had been employed in the field for the collection of primary data are described below.

3.2.2.1. Sample survey & sampling technique

The sample unit for this study (data collection through questionnaire) is a household. Household in this study is defined as "a group of people that eat from the same pot and share a common stake in perpetuating and improving their socio-economic status from one generation to another (FAO, 1992)" and household membership refers to any one who resides in a particular household (sharing food, living arrangements etc in the same household) for at least one month continuously.

A total sample of 121 households was taken from two *tabias* of Mekelle namely Kedemay Woyane and Quiha using a systematic random sampling technique. In addition to this 40 fuel wood sellers were also included in the survey to assess the condition of fuel wood supply to the city.

Two weeks before the start of the study, an assessment was conducted on the two *tabias* selected for the study. The objectives of this assessment were: (1) To provide orientation to all respective bodies that were expected to have stake in the study. The orientation has focused on the general purpose of the study and the kind of role each stakeholder would have to play and how they would carry out their roles. (2) To verify and/ or prepare the list of households in the *tabias* from where the sample households would be selected. Accordingly, the master list of the two *tabias* were verified and prepared. Finally, the households to be interviewed were selected using systematic random sampling technique. The selected households were then identified and oriented by the interviewers.

Sample survey method was employed to make the paper work more reliable and representative. The sample survey has focused on both *mirte mitad* users and non users. For this study, structured questionnaire & checklist were used.

3.2.2.2. In-depth interview

In-depth interview was conducted with two GTZ and Rural Energy Promotion & Development Agency (REPDA) officials. These are the two institutions that are responsible for the introduction of improved *mirte mitad* across the region. In addition, in-depth interview with four *mirte mitad* producers and distributors have also been conducted.

3.2.2.3. Focus group discussions (FGDs)

Two focus group discussions, each containing 8 respondents, were conducted with selected sample respondents in order to cross-check the data collected

through questionnaire were relevant and reliable. For this purpose, checklist was prepared to make the discussion lively and attractive.

3.2.3. Data entry and analysis

The data collected through different methods were analyzed using appropriate quantitative and qualitative statistical techniques. Hence, descriptive statistical techniques like averages, frequency, and tables were used.

Data was entered using the DOS version of SPSS developed by a statistician based on the questionnaire. This version of SPSS was chosen for its advantage of easily employing the skip and range rules, which were really helpful in ensuring the quality of the data. The data was checked/ cleaned using both excel and SPSS tools. The data was finally converted to the Windows based SPSS 12 for analysis.

Chapter four

Results and Discussions

4.1. Socio-economic Profile of the Respondents

4.1.1. Household characteristics

Collecting information on demographic characteristics is usually done in household surveys to see the relationship between the dependent and the independent variables. Based on the collected data, estimated values of the population by sex, age, level of education, marital status, occupation and income are presented as follows.

4.1.2. Sample respondents

For this study, 121 household members from the two *tabias* of Mekelle, namely Quiha and Kedemay Woyane, were interviewed. In addition, to assess the fuel wood inflow into Mekelle, 40 fuel wood sellers from the three market places were randomly selected for interview. Table 4 shows sample household members by sex and *tabia* distribution. Here those 40 fuel sellers interviewed were not included because these are not the main part of the household survey. The survey revealed that 87% the total respondents from the two sampled tabias were female and the remaining 13% were male.

Table 4.1. Distribution of sample household members by sex and tabia

Sex Composition of Sample Households	Distribution by Tabia					
	Kedamay Woyane		Quiha		Total	
	Num	%	Num	%	Num	%
Male	6	9	10	6	16	13
Female	58	91	47	94	105	87
Total	**64**	**100**	**57**	**100**	**121**	**100**

Source: Survey data, 2008.

In this study, the number of female interviewees showing 87 percent does not mean the female headed households in Mekelle is 87 %.

4.1.3. Marital status

Table 4.2. Marital status of sample respondents (N= 121)

Tabia	Marital Status			
	Married	Single	Divorce	Widowed
Kedamay Woyane	28	2	4	30
Kuha	29	0	26	2
Total	57	2	30	32
Percent (%)	47	2	25	26

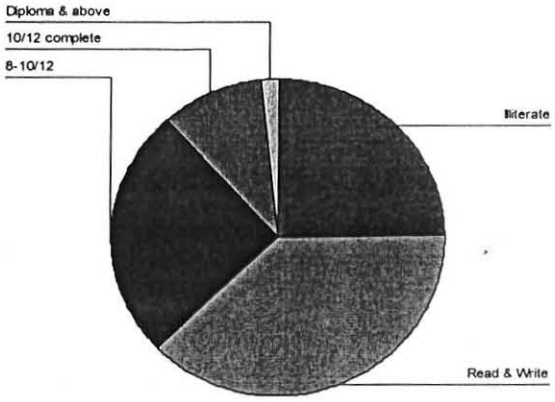
Source: Survey data, 2008

Table 4.2 shows that of the total respondents involved in the study, 47%, 25% and 26% were found to be married, divorced and widowed respectively. According to the survey made, in the two *tabias* of Mekelle, people who are married out number the widowed or divorced but were less that the sum of the two. How ever, the percentage of people who were divorced in Quiha was relatively found high (21%). This was probably due to the high military presence in the area.

4.1.4. Educational level of the respondents

Regarding the educational level of the respondents, the survey result showed that 24 % are illiterate, 38 % can only read and write and 26 % of them have completed grades 8/10 while the remaining 10% and 2% of the sample households have completed grade 12 and diploma courses respectively.

Chart 1: Educational level of sample households



4.1.5. Main occupation of the sample households

In this study, an attempt was made to assess the main occupation of the sample households. Accordingly, the survey result indicated that 44.6 % of the sample households make their living out of making 'tella', local beverage, 27.3 % from 'enjera' making & selling, and the remaining 28.1 % are civil servants.

Table 4.3. Distribution of sample respondents by main occupation and sex

Main Occupation	Sex			
	Male	Female	Total	%
Enjera making & selling	2	31	33	27.3
Tella making & selling	8	46	54	44.6
Civil servant	6	28	34	28.1
Total	**16**	**105**	**121**	**100**

Source: Survey data, 2008.

4.1.6. Income level of households

Income level of respondent households could be categorized into six based on the type occupation they are involved in. As can be seen from the table 4.4, 24% of the respondents earn monthly income of 900-1200, 20% earn income of 301-600, 17.5% earn income of 601-900, 16% earn income less than 300 and the remaining 22.5% earn greater than 1201 birr. From this we can see that the maximum and minimum incomes respondents earn are 300 and 1500 respectively.

Table 4.4. Income level of respondents by occupation

Occupation of Households	Monthly income of Households in birr						Total
	<=300	301-600	601-900	901-1200	1201-1500	>1500	
Enjera making & selling	8	9	3	10	7	2	40
Tella making & selling	7	8	16	8	6	6	51
Civil servant	4	7	2	11	4	2	31
Total	**19**	**24**	**21**	**29**	**17**	**10**	**121**
Percent	**16**	**20**	**17.5**	**24**	**14**	**8.5**	**100**

Source: Survey data, 2008

4.2. The Use of Mirt Mitad

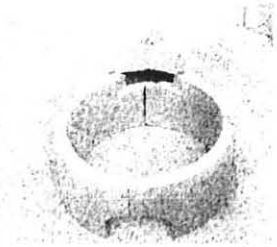
Out of the 121 sample households interviewed, 57 % were found to have used *mirt mitad* for the last 5 years. About eighty six percent have started to use *mirt mitad* between the years 2004 and 2006 G.C. Only 2 and 6 percent respectively have started to use *mirt mitad* between the years 1999 and 2000. Respondents were asked to give reasons of why they have chosen to use *mirt mitad*. Fifteen percent said it reduces labor, 29.8% said it saves energy, 9.9% said it saves money and the remaining 1.7% said it increases productivity.

Respondents were also asked about the sources where they first got *mirt mitad*. Only 2.9 % of them have got it from GTZ and the majority 88% have got *mirt mitad* from private producers and distributors, where these distributors have got trained by GTZ and are given some equipments to establish their business while 8.6 % of them got it from women's association in the form of awards for the good job they have done for the association.

Regarding the owner ship of *mirt mitad*, 88.4% have got it through purchase while 8.69 % have got the *mirt mitad* through donation. Regarding the purchase price, 74.6% have purchased it for 30 birr, 19% for 50 birr and the remaining 6.4% bought it for 25 and/ or less birr. The differences in the purchase price were because of the distributors' interest and plan to promote the mitad. Especially at the first it was sold for 50 birr prior to the subsidy and the two price differences was because some distributors had sold it for 25 birr just to start with the promotion works.

Respondents were also asked if the price they paid to purchase *mirt mitad* were expensive or not. Surprisingly, 52.3% and 34.9% of respondents said the price was moderate and cheap respectively and 12.8% said the price was expensive. And these group of respondents suggested if the purchase price could be reduced in the ranges between 10 and 15 birr. So it can be concluded that the overwhelming majority have accepted and could afford the price. Of course. the selling price of one *mirt mitad* could have been decided between 50 and 60 birr if it hadn't been subsidized by the GTZ. The unsubsidized price could have even been higher to most of the poor users especially to those categories of people who are in the low income bracket.

Photo: Yirgalem, Mirt mitad producer, installing the mitad



4.3. Acceptance Level of Mirt Mitad

Respondents were asked about the continuance and/or discontinuance of mirt mitad. Out of the 69 mirt mitad users interviewed in this study, only 3% of them have reported to discontinue the use of mirt mitad mainly because they had purchased electric mitad, while 97 % of them indicated that they will continue to use it. The main reasons of those respondents still continuing to use mirt mitad are summarized as follows (table 4.5).

Table 4.5. Reasons for continuing use of mirt mitad (N= 67)

Reasons	Responses	
	N	Percent
Saves time	67	27.9%
Saves energy	67	27.9%
Saves money	57	23.8%
Less smoke release	22	9.2%
Convenient	27	11.3%

Source: Survey data, 2007.

Photo 3: User when using M*irt Mitad*

The survey result indicated that Mirt Mitad users will continue to use it mainly because it gave them the advantages of time and energy saving for 27.9% respondents, money for 23.8%, provided convenience for 11.3% and released less smoke for 9.2% (Table 4.5).

Hence, we can conclude *Mirt Mitad* user households gave more weight to time, energy, and money saving quality of M*irt Mitad* than convenience and less smoke release qualities of it.

The above numbers that are shown in the table could be justified when *Mirt Mitad* is compared to the traditional *Mitad.*

Mirt Mitad users were asked to compare the Mirt Mitad with the traditional they had been using for many past years based on certain criteria. Accordingly, they were asked to compare the two mitads based on the time they took, the quantity of wood they consumed, the amount of money they spent to bake one '*messob'* of enjera and the number of times they visited eye clinic with both the traditional and mirt mitad.

Accordingly, in terms of the time taken to bake one Messob of injera, 85% of households indicated that Mirt Mitad took less than 30 minutes while with traditional 98% said it took them greater than an hour. Similarly, in terms of wood consumption, all said Mirt Mitad took less than one donkey and traditional Mitad consumed between 1 and 2 donkey. Further more, smoke release was less in the case of mirt mitad for all respondent households and the reverse was true for traditional mitad. Therefore, mirt mitad is by far better in all the criteria set than traditional mitad. From this, we can calculate the amount of time and money they could save at household level and the quantity of wood (forest) that could be saved from being cut at community level on an annual basis. This comparison was made for only one time spot. Hence, the following assumptions were considered:

- Households bake injera twice a week (70% of sample households)
- There are 52 weeks in a year (365 days/7)
- Households save 1 hour per week with the help of mirt mitad
- Average price of one donkey of wood is 10 birr (minimum scenario)

- Households save 1 donkey of wood per week, and one donkey of wood weighs on average 10 kg (minimum scenario).
- Respondent households using Mirt in Mekelle are 67

Hence, time and money wise, a household that get to use Mirt Mitad during the study period had an advantage of 52 hours and 520 birr more per annum that could be used in other productive purposes than households that used traditional Mitad at that time period.

In terms of forest conservation, 520 kg of wood could be saved annually by using a single Mirt Mitad in Mekelle. The total numbers of respondent households that were found to use Mirt Mitad in Mekelle during the study time were 67. Hence, household members, in Mekelle, that were included in this study had contributed towards the conservation of forest cover of the surrounding rural areas amounted to the maximum of 34,840 kg per annum. Hence, great effort should be done to aware the people to use Mirt Mitad to reduce the high rate of deforestation.

Mirt Mitad and traditional mitads were also compared with regards to smoke release and the resulting consequences. As mentioned above, respondents said the quantity of smoke released during the use of mirt mitad was less than when using the traditional one. This could be analyzed based on the effects the smoke could bring to users in terms of affecting their health condition and the resulting money they spent to cure them selves. Out of the 69 who have reported to use traditional Mitads, 79.7% reported that they have got eye problem, 17.3% reported they have got nasal problem and the remaining 3% indicated that there was high accumulation of soot on the walls and roofs of their kitchens. The smoke release forced 67% of respondent households to spend between 100 and 200 birr for medication per annum while Mirt Mitad users spent less than 50 birr. The remaining 33% reported they did not visit clinics because they had money shortage for medication. Further more, the number of times they visited a clinic and the amount of money they spent for medication have significantly been reduced after they started to use Mirt Mitad, they reported. The traditional Mitad

has produced more smoke than Mirt Mitad because it has few smoke outlets and lacks chimney. On the other hand, Mirt Mitad user households had mentioned that, apart from its strengths, it had also got its own weaknesses. These include:

1. 18% of the respondents said the presence of narrow opening which forced them to use small and thin sized woods, this in the first place, demands additional labor to the household to cut the large sized woods into small pieces and, in the second place, consumes more wood if the wood is small in size
2. 23% of the respondents indicated that the height from the ground is too short that exposed users to back pain
3. 13% of the respondents indicated that the buying price was expensive

Households that have not at all used mirt mitad were also asked why they were not willing to use. The reasons given were:

1. 57% of the respondents said that they did not have knowledge and information at all
2. 31% of the respondents said the price was very high to them that they could not afford to buy
3. 21% of the respondents indicated that they used electric Mitad hence they found it less important to incur additional money to install Mirt Mitad while they can use traditional Mitad when electricity is interrupted.
4. 11% of the respondents said the narrowness of the opening does not allow easy entry of large sized woods as they could not afford to use small sized woods as they thought they could lose the charcoal that could be obtained from the large sized woods.

The above results that were found through the survey questionnaire were also supported through the results obtained from the focus group discussions with selected respondents and key informant interview with GTZ and rural energy

promotion office experts. These results also indicated that there was similarity in terms of the factors that were indicated by the respondents. Hence, the strengths and weaknesses of Mirt Mitad could be summarized into socio-economic and technological aspects. These are the two factors that influenced households from using or not using Mirt Mitad in the study area.

Socio-economic factors include

- Cannot accommodate large sized woods for cooking for 29% of household respondents
- Expensive for 44% of household respondents

Technological factors

- Height of the Mirt Mitad is too short for 23% of respondents
- Opening is narrow for 29% of respondents
- 84% of users do not know how to produce Mirt Mitad as they don't have the mould and they don't know the mix of the different materials like cement and sand etc
- 72% indicated lack of flexibility (con not be modified to widen its diameter hence households can not use big size ceramic plate where 'injera' is baked)

Plate 4.1. User indicating the narrowness of the opening as disadvantage

4.4. Advantages and Disadvantages of Mirt and Traditional Mitads

The results of the focus group discussions conducted with two groups of respondents (household respondents and GTZ) showed there are advantages and disadvantages associated with using *mirt* and traditional *mitads*. These are summarized in table 4.6.

Table 4.6. The advantages & disadvantages of *mirt* & traditional *mitads*

	***Mirt* Mitad**	**Traditional *Mitad***
Advantages	• Save fuel wood • Reduce baking time • Standard is maintained by using mould during production • Serves two purposes at the same time (baking and boiling) • Beautiful appearance • Durable when installed • Safe to users by protecting from external heat and smoke	• Raw material is obtained locally for free (uses mud) • No need of transporting traditional mitads since produced in place • Very cheap • Wide opening hence can accept large sized woods
Disadvantages	• Fragile and need careful transportation • Expensive • Short height • Narrow opening hence inhibits entry of large sized woods	• User build production inhibits standardization of products dimensions, which implies uncertainty of fuel wood saving

Source: survey Result, 2008.

From the photo indicated below, one can vividly see the difference in the opening of both mitads. Mirt (left) looked to have narrow opening as compared to the traditional (right) one. The opening has a determinant factor on the acceptance of Mirt Mitad. Hence, to increase its height from the ground, households used to construct 5-10 cm of wall just before installing the Mirt Mitad. This may reduce the efficiency of the Mitad in terms of energy conversion and was unacceptable from the point of view of the technology designers and promoters. How ever, respondents found it necessary to increase the height as they suffered from back pain.

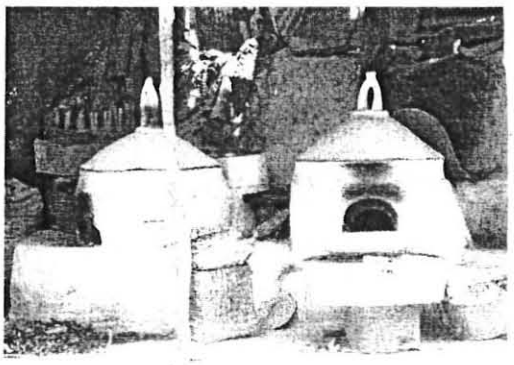


Plate 4.2. Mirt (left) and traditional (right) *mitads* set up side by side in one household

4.5. Factors Affecting Use of Mirt Mitad

The use of mirt mitad could be affected by factors like type of occupation and level of house hold income. Households were asked about the factors that affect the use of mirt mitad. Household income, type of occupation and level of education are the main factors affecting the use or non-use of mirt mitad. Out of the 121 households who are interviewed in this study, 69 (57%) of them were found to use mirt mitad. Out of the factors that contributed, type of occupation and household income were found directly proportional where as level of education were not. This could be observed from the following table.

Table 4.7. Respondents using Mirt Mitad by occupation

SN	Type of Occupation	Number	Number used mirt mitad	% used	X^2 test (chi-square)
1	Enjera making	30	26	86.6	13.25**
2	Tella making	51	39	76.4	
3	Civil servants	31	4	13	
4	**Total**	**121**	**69**	**56**	

** $P < 0.01$

Source: Survey Data, 2008.

From the table 22, we can see that the type of occupation households are involved in is directly proportional with the use of mirt mitad. Out of the 121 interviewed households, 81 (70%) are involved in enjera and tella making and out of these, 80% were found to use mirt mitad. It was mainly because these categories of households, by the very nature of their job, use more wood and they frequently bake 'injera' and 'tela kita'. Hence they found it necessary to use mirt mitad as it gave them the advantages of saving wood, money and time.

On the other hand those households who are civil servants were not found to use mirt mitad as they could afford to purchase and use electric mitad.

Education level was not found to affect negatively the use of mirt mitad. 62% of households who were found to engage in enjera and tella making were found illiterate or at low level of education (only read and write). How ever, these were the household categories that were found to use mirt mitad than the category of households that were found at high level of education. Hence, we can conclude that level of education attained has nothing to do with the use of mirt mitad. Where as type of occupation and level of income were found to affect, either positively or negatively, the use of mirt mitad. To conclude, types of occupation that demand more wood and by their very nature are frequent were found to

encourage the use of mirt mitad. And households that earn more income were found to prefer electric mitad than mirt mitad.

4.6. Fuel Inflow to Mekelle

Fuel-wood from the surrounding rural areas inflow into Mekelle through three main routes. In this study, three main routes and days were selected to count the number of fuel wood inflow from the surrounding rural weredas to Mekelle city. The routes were identified as the Samre route, the Lachi route and the Ad-ha route. On these three routes, on average 385 fuel wood sellers enter the city every day with the highest count observed in the Ad-ha route (52%) followed by the Lachi route (29%). The samre route is the route that counted the least inflow (19%). This was probably due to the high afforestation programs conducted during the last 15 years in the two highest routes and was protected for long period of time as this was a free zone area which was administered by the TPLF during the civil war time and the samre route was depleted because the area was a drought hit area since long time and people still sustained their lives from wood selling so this area was relatively depleted as compared to the two routes.

Table 4.8. Number of fuel sellers counted by route

Route of fuel wood inflow	Counted	in Kg
Samre (East)	72	1,440
Lachi (North)	113	2,260
Ad-ha (North-West)	200	4000
Total	**385**	**7,700**

Source: Survey data, 2008

Similar to the inflow component, the marketing and prices component of the survey was limited to selected locations and times. The selection of open markets for fuel wood and dung was relatively straightforward. Three open market places, Adi haqi, Quiha and kedamay woyane were selected from the city

of Mekelle. Daily tallies of fuel wood, dung and root carriers and sellers at these market places were made during the first half of the survey time of three hours, from 9:00 am to 12:00 noon. The second half of the day was used for recording weights and prices of fuel wood bundles and dung and interviewing the sellers. Out of the 385 fuel wood sellers counted, about 10 percent were interviewed during the survey period.

4.7. Inflow of Fuel-wood, Dung and Root

The daily inflow tallies made at the three survey posts during the survey period are summarized in tables 4.9. They relate to the number of carriers and the type of fuel wood, dung and root inflow and the type of transport used. A three days count was made in each of the inflow routes. Over these days, a total of 385 carriers were counted transporting fuel wood, dung and root through the three routes into Mekelle, of which 78 % were females. Out of the total fuel wood carriers counted in the three survey days, 46% and 42% were counted on the two major market days- Monday and Saturday respectively.

In addition to the reason given above for the presence of wide variation in the number of carriers using the three routes was linked to the relatively high degree of depletion of the forest plantation lying closest to the city. For example, relatively low carriers were recorded passing through the Samre route which leads to and from that part of the government plantation which lies immediately adjacent to the city boundary. Because of its proximity to the residence of urban fuel wood carriers, this section of the plantation has presumably been over exploited and hence does not attract as large numbers of carriers as the other part of the plantations located further from the city.

Table 4.9. Fuel wood sellers categorized by survey day, route and sex

Survey Day	Route/ Number of Sellers							
	Samre		Lachi		Ad-ha		Total	
	Num	% F	Num	% F	Num	% F	Num	% F
Monday (1)	31	61	53	75	92	73	176	70
Wednesday (2)	8	77	13	82	27	22	48	81
Saturday (3)	33	78	47	85	81	85	161	83
Total	**72**	**72**	**113**	**67**	**200**	**81**	**385**	**78**

Source: Survey result, 2008

The fuel wood loads consisted of wood, dung and roots. The survey result showed that wood and root carriers constituted about 46% and 42 % of the total number of carriers respectively. On the other hand as compared to the three route counts made at Samre route indicated that counts carrying fuel wood were below 10 percent (Table 4.10). This is mainly due to, as noted above, increased depletion of the nearby sections of the forest plantation offered the carriers little opportunity of cutting trees and large number of them were collecting dung and roots.

Table 4.10. Fuel wood sellers categorized by type of fuel wood and routes

Type of fuel	Route/ Number of Carriers					
	Samre	Lachi	Ad-ha	Total	%	X^2
Wood	14	71	92	176	46	34.79**
Dung	23	24	27	48	12	
Root	35	28	81	161	42	
Total	**72**	**113**	**200**	**385**	**100**	

** $P < 0.01$

Source: Survey data, 2008.

The variation in the inflow of the different types of fuel wood in the different routes was found significant. In the Samre route, we can see the inflow of wood is less (7.9%) and was found very high in the routes of Lachi (40%) and Ad-ha (52%). How ever we can see the inflow of dung and root in the Samre route was relatively higher than the wood. The relatively higher number of dung and root inflow in the Samre route that the wood inflow was because of the higher deforestation and over exploitation of the natural forest. Hence people were obliged to dig the roots and to use the cow dung for fuel wood rather than to use it as green manure.

The amount of fuel wood, dung and root inflow was estimated by the average weight of fuel loads. As indicated in table 8, a total of not less than 7700 kg of fuel wood, dung and root was transported to Mekelle during the survey period. It should, how ever, be noted that the survey time was limited to the two peak carriers and one slack market day and is limited to only three hours of the day, i.e. three to six o'clock. The study was based on the assumption that the amount of fuel inflow during these peak hours roughly estimated to be half of what presumably transported during the entire survey day. Therefore, 144 quintals of fuel wood, dung and roots assumed to be transported to Mekelle during the three day survey period. This represents an annual inflow of about 17,424 quintals. Wood constituted the largest component of the supply, in terms of the number of carriers and in the quantity transported. This was apparent from table in which wood represented about 46 percent of the total weight of fuel wood, dung and root inflow over the survey period. Almost all wood (93 percent) was being transported through the Lachi and Ad-ha routes suggesting that it was originated from the rural parts of the plantations.

4.8. Sources of Fuel Wood for Household Respondents

Wood is identified as the main source of fuel wood in the study area. Out of the 121 sample households interviewed, 60 % of them have used wood as their main source of fuel. The remaining 40 % have used other sources of fuel like electric mitad, dung and leaves. Out of the 60 % respondents who used wood as their main source of fuel, 98.3 % of them got the wood through purchase and only 1.7 % of the respondents have collected fuel wood for their daily energy consumption. This is mainly because the respondents are urban dwellers and the 1.7 % who used to collect fuel wood for their daily consumption are those who lived in the periphery of the city of Mekelle especially from Quiha.

Of the tree species that most frequently used by the sample households, Eucalyptus took the lion share (65 %) followed by 'Weira' (17.5 %) and 'Girar' (17.5 %). The dominance of the use of Eucalyptus as the main source of fuel wood as stated by the sample households is because of its:

1. Easy access or availability (31 %)
2. Easy combustibility (12 %)
3. Ability to provide charcoal for later use (11 %)
4. Cheapness (5 %)

4.9. Mirt Mitad Production and Market Demonstration

Production of Mirt Mitad in Mekelle city has begun in 1995 by the GTZ. Six producers from Mekelle city alone were trained on producing and marketing of Mitads by the same organization. How ever, three producers gave up the business three years ago and three remained producing the Mirt based on customer order only. Thus it is possible to unveil the fact that there was no practical Mirt dissemination in Mekelle and its surrounding areas for the last three years and just before the commencement of this particular project.

4.9.1. Selection of potential producers

The criteria to identify potential producers differ for different target groups. How ever, it is important to identify trainees who are enthusiastic, capable of satisfying the responsibility envisaged for them on completion of the training course, and who are likely to cooperate with the project for a reasonable period.

The following major identification approaches were used in Mekelle

- List all possible sources of potential producers and identify potential producers
- Study existing producers status
- Identify only those who have shown interest
- Evaluate during the training period
- Evaluate producers based on their performance
- Use the preset criteria
- Finally based on the training evaluation and the criteria select producers

It should be known that there is no universal formula for producer selection especially when they are from the informal sector. This probably is the most difficult part of the whole process. Producers who have expressed strong interest at the beginning of the project and who could score highest on the criteria would fail to continue for some hidden and unknown interest. Therefore the selection should be a process composed of using the criteria set by the project, training session evaluation and also during the pilot production stage. It is only in this way that we could increase the chances of selecting producers who could remain for a reasonable period of time. How ever, it is inevitable that the project should spend reasonably more finance and other resources.

4.9.2. The identification approaches

Individual: this is a method used to identify through a study of individuals who are recommended by known persons and by the concerned individuals from the different government offices. How ever, this did not work in Mekelle as no one could come out with a recommendation of individuals who are interested to work on mitad production and marketing.

Government offices: possible sources for potential producers were social affairs office, women's affairs office, agriculture office, energy office, home agents and survey enumerators who have worked with the project. How ever, none could come out with recommended individuals within the time limit given to this particular activity and despite two visits made to the offices except for women affairs. Women's affairs office selected from known two poor kebeles in Mekelle and nominated randomly using kebele notice boards. Kedemay weyane is one poor kebelle in Mekelle where there is already the use of traditional closed mitads construction and installation. As the office is engaged in women's affairs only it is impossible to expect men for nomination by the same office.

Existing mirt mitad producers: Except one producer all were engaged in different activities. The producers training rejected the existing producers for they are still demanding that would mess up the training for the new ones, some of them are busy doing something else for which they have dedicated most of their time, bad experience especially on revolving funds etc. some of them have produced poor quality mitads by using non recommended type of raw materials and wrong mix ratio etc.

Existing traditional and electric mitad producers: the existing two known electric mitad producers in Mekelle were observed that they have already shifted to other businesses. One of them is working on furniture manufacturing and the other on sheet metal processing. Therefore, there is no good reason found to spend time working with these workshops who are making more profit from what

they are operating than mirt at the time of the visit. Also they did not show any interest to be involved in mirt mitad production and marketing.

4.9.3. Selection criteria for new mirt producers

The principal area of selection criteria would basically be on the level of enthusiasm, capability of understanding the training, competent to properly operate in the business after the training and the probability to continue with the project for a reasonable time. The selection criteria set initially were the following.

Table 4.11. Criteria used for selection of mirt mitad producers

SN	Criteria	Responses (%)
1	Level of interest to participate	10
2	Existing technical, business and communication skills	10
3	Availability of workshop space and access to water	10
4	Basic literacy and numeration	5
5	Level of matching input that would be committed to the business	8
6	Level of cooperation with the project to provide relevant and correct information	5
7	Position in/ or acceptance by community	8
8	Behavior	5
9	Artisan skill	10
10	Any different type of experience	6
11	Entrepreneurial skill or experience	10
12	Current job or business	5
13	Seriousness	8
	Total	**100**

Source: GTZ Annual Report, 2002

The ultimate goal of setting such fairly rigorous criteria for screening was to ensure project sustainability as much as possible.

4.9.4. Mirt Mitad producers training (month and year)

Training of mirt mitad was one of the basic components of the GTZ project. As the mirt mitad was a new technology and concepts and principles involved in its production were also unfamiliar to the producers, intensive producers training on production and marketing were indisputable.

4.9.4.1. Training objectives

The major objective of the training was to transfer the skills on mirt mitad design, production and the basics on issues related to improved mitads marketing. The training was timely and imperative to react on the positive aspects and impacts of mirt mitad to be used by households.

4.9.4.2. Training Program

The theoretical session, which took about half of the whole program, started off with introduction of the objectives of the training and the project. On the marketing aspect of the training, topics covered included basic business skills, business planning and management, marketing and publicity, basic book keeping and inventory, competition, product/ service quality, customer relations and market intelligence. In order to enhance the effectiveness of the training session, handouts on basic business principles were prepared and distributed to trainees and counterpart staff. Theoretical session on the mitad design and manufacturing aspects covered topics on basic theory of combustion and heat transfer, thermal efficiency of mitads, chemical and physical properties of biomass fuels, basics of improved mitad designing, thermal characteristics of raw materials used for improved mitads manufacturing, identification of the right raw material, organization of production, and management of workshop, tools and equipment.

As practical session is the most important part of the whole exercise more energy was devoted to actual hands-on training on manufacturing of the mirt biomass injera mitad. In this session trainees learned every single step in the process of manufacture of mirt mitads. This had included raw material selection and preparation, sieving and mixing in a recommended ratio, molding and de-molding mitad sections, curing, storing and installation. At the end of the session, trainees were left and supervised to produce a complete mitad independently. In order to raise level of confidence by the trainees, additional pilot mitads were also produced, which gave the trainees the chance to exercise and learn from their own mistakes. At the end of the training program, all trainees were capable of producing mitads to the required quality and standards.

The Mekelle mirt producers training was conducted with the aim that although the training was on mirt production and marketing, they pick up many things from the course tidiness, respect for tools, pride in skills, politeness and respect for people with different backgrounds, honesty in admitting mistakes, enthusiasm, time keeping & discipline etc.

Table 4.12. Names, production and sales of mirt mitad in Mekelle

SN	Producer Name	Time of stay in production	Mirt produced	Mirt Sold	% sold
1	W/ro Etsay	10 months	883	462	52
2	Ato Belay	4 years	941	545	58
3	W/ro Almaz	4 years	820	443	54
4	Ato H/mariam	4 years	1036	550	53
5	W/ro Kiros	3 months	80	0	0
	Total		**3760**	**2000**	**53**

Source: Producers Report, 2001.

Table 4.13 shows that only 53 % of *mirt mitad* produced by producers was sold out. From this we can understand that the promotion work was very poor and the producers did not get more support from the project that was supposed to provide promotion support of *mirt mitad*. This forced 2 *mirt mitad* producers to get out of the market.

4.9.4.3. Raw materials and *mirt mitad* production

The reconnaissance survey conducted in Mekelle to make an initial assessment of the potential for production and marketing of mirt enabled to collect some information on raw materials too. The findings indicated that if mirt has to be produced in Mekelle, it would have to be produced with scoria that is available abundantly within a reasonable distance from the city. How ever, despite the availability of scoria, it was not easy to purchase the raw material since suppliers at the quarry could not prepare enough materials in a short period of time.

Therefore, further search was made to another scoria quarry site or other types of raw materials of which sand and pumice are the two tested types. The sand that was purchased is of lower quality. The sand quarry that was about 20 kms from Mekelle was rejected for its very low course size (below 10%) that affects the mechanical strength of the mitad, low quality sand mixed with soil, and other unknown impurities and higher price mainly due to transport. Pumice was found more preferable as it was of best quality (white pumice), it has lower weight and has enough course size for mirt manufacturing. How ever, the pumice acquisition is yet difficult, as there are some conflicts on the issue of land ownership by the local communities. Since the conflict is not expected to last in a short period of time further assessment would be required to sustain the supply of pumice.

4.9.4.3.2. Workshop establishment and pilot mitad production

Up on completion of the training on the mirt mitad production and marketing, the newly trained producers were requested to produce some mirt mitads in each workshop. This was what was known as the pilot production that was believed to

give the producers the chance to produce mitads independently so that they can have the confidence in the future and gain experience in the process of production. Also with the help of promotion campaign they could sell and install their mitads and necessary marketing experience.

Therefore, workshop spaces were selected and five sheds were constructed by the project, molds and all other necessary manufacturing accessories were provided depending on the number of group members. Also raw materials were provided to produce the pilot mitads. Once the quality of the first few mitads was checked, an order of one hundred mitads was placed for all workshops for market test program and the quality was distributed to the workshops depending on the number of members of the group. The produced mitads were checked for quality to guarantee standardization of the products and that it would be possible to use them for the promotion campaign.

4.9.4.3.3. Mitad production cost estimates

Prior to moving a broader project activity on mitad dissemination it was important to have a clear idea on what the mitad costs to produce and what the consumers are prepared to pay. Therefore, with the current situation, the mirt mitad production cost was calculated as follows.

Table 4.13. Production cost estimate for mirt in Mekelle

I. Variable costs:	**Mekelle**
Raw material purchase price	
Scoria/Pumice including transport	6.00
Cement/water	8.60
Labor & Material preparation	4.00
Molding	2.00
Transport	1.50

Raw material (excluding scoria/pumice)	
Sub total (variable cost)	**22.10**
II. Fixed costs:	
Utilities	0.50
Space rent	1.40
Repair and maintenance	1.00
Tools depreciation at 25% per annum	1.75
Loan payments for tools at 15% over 3 years	5.35
Other costs	0
Sub total (fixed costs)	**10.00**
Total production cost per mitad	32.10
Profit (40%)	12.48
Mitad price	**44.94**

Source: GTZ Annual Report, 2000.

The major cost item in mirt mitad production is the cement, price that influences the most and shares 20% of the mitad price. The fact that the mitad is produced from locally available materials has brought the production cost down by about 20% compared to transporting the finished product from somewhere else. It was believed that such reduction in costs would attract more consumers in and around Mekelle.

4.9.4.3.4. Business start up

For an improved energy efficient mitad to yield the desired effects, it has to be used in actual household where it is intended to serve. For a housewife or any user, to make a decision, she has to be aware of the existence of the mitad, its whereabouts, price, its potential and advantages and how to use and maintain it

as necessary. Therefore, publicity and promotion are tools through which targeted consumers are reached and made aware of the benefits of existing products, services and innovative technologies such as improved mitads.

4.9.4.3.5. Actual cooking demonstration on market places, Mekelle

Publicity and promotion of mirt mitad was conducted in Mekelle. Over one hundred mitads were produced during the pilot production stage and made available for the market test program in the project area. The purpose of actual cooking demonstration was to give the audience the chance to see the mitad in real world situation. During the demonstration, the audience was told the advantages of the new mitad with emphasis of fuel savings, environmental impacts and reduction of women' kitchen drudgery.

Table 4.14. Estimated number of people attending the demonstration

Date	Demonstration site	Estimated number of audience
08/02/00	Mekelle	400-450
10/02/00	Maichew	200-250
12/02/00	Adi Gudom	150-200
13/02/00	Adigrat	300-350
13/02/00	Wukro	275-300
14/02/00	Axum	300-350
	Total	1625-1900

Source: GTZ Annual Report, 2000.

A total of 1625-1900 people were estimated to have attended six actual cooking demonstrations conducted in Mekelle, Maichew, Adi Gudom, Adigrat, Wukro, and Axum. A number of questions about the mitad asked by the audience were answered during the session, and housewives were encouraged to have used a closer look at the mitad while it was being used. Members of HPNER, experts

from Mekelle city department of agriculture, and Enderta wereda agriculture have attended and/or assisted the demonstration.

Most of the cooking demonstrations were conducted at very convenient hours of the day so that it was possible to get the attention of may people. Hence, demonstrations were conducted between 8:30 am – 2:00 pm during the morning hours. Latecomers to the market were also given the chance to know about the mitad by keeping the installed mitad the whole day in the demonstrations so that they could learn the marketing process from practical demonstration and simultaneously sale their mitads if anyone would like to buy at the spot. They also registered others interested to buy later and advertised their workshops and addresses. In the case of sales at the demonstration places, it was possible to sale about 20 mitads. How ever, about two hundred people were registered to buy the mitads in a week time and it was an encouraging start.

Audio cassette: audio cassette with a horn speaker mounted on a vehicle was also used to sensitize the public about the new mitad and its whereabouts, price, advantages, installation and how to use it.

Printed materials: as part of the promotion campaign, posters, and leaflets explaining the uses and advantages of the mirt mitad was used and distributed. How ever, since the printed materials are in short, the project should immediately get more copies of the posters and leaflets for more distribution.

4.9.4.3.6. Distribution of mirt mitad in and around Mekelle

According to GTZ household energy baseline survey in 1999, mirt mitad sales records indicated that only 6% of the households were using the mitad in and around Mekelle. How ever, it was estimated that about 50% of the counted mitads were in poor physical condition and affect the saving of the mitads. This was due to the poor quality of the mitads produced by previous producers (poor and improper raw materials, low cement etc).

The project in this regard should establish a periodical quality control mechanism and should assign someone from the project and the Mekelle zuria agricultural office.

Since the commencement of production and marketing of the mirt in Mekelle, the trainees distributed over 100 mitads in a month time. The publicity and sensitization campaign conducted in the project area raised awareness and demand for the mitads, which was evident from a waiting list of 30 people registered for the mitad to buy either in credit or cash. How ever, as indicated earlier, cement price unexpectedly raised as high as 60 birr at the time of the beginning of the commercialization. This would create frustration as producers should reduce their profit margins by 10% and project should encourage them by frequent contacts, visits and technical advice.

4.10. Promotion and Dissemination Strategies of Mirt Mitad

4.10.1. Dissemination strategy

The GTZ household energy project had used three main strategies to disseminate Mirt Mitad through out the region. These are:

Commercial Approach

1. Semi commercial Approach
2. Self built Approach

The commercial approaches were implemented in such away that an already finished product is introduced to the market. This approach has its advantages as well as disadvantages:

- Usually only where fuel wood is purchased
- Mediators are private sector
- Reduced external support requirements mainly for dissemination

- Long term sustainability
- Quality standards will be maintained

The semi-commercial approaches were implemented in such away that only the technically important mitad part is commercialized- mitad body is constructed by the owner. This approach has the following advantages and disadvantages:

- Available for low income groups
- Technical standards easy to control
- Some training of *mitad* users necessary

The self-help approaches were implemented in such away that the complete *mitad* production is made by the owner. This approach as well has its own strong and weak sides:

- No cash required- even for the poorest population groups available
- Intensive support for sensitization, training with direct contact to the target groups required
- Low speed of dissemination
- Quality control nearly impossible

Of course, the GTZ project used these three approaches at different times and in different places. More weight should be given to speedy dissemination and easy access by the poorest households. These important factors could be attained when a semi commercialized strategy is widely used across the region. Now the GTZ is implementing the self help strategy where users produce and sell the complete *mirt mitad*. And it was clearly indicated in this study that the acceptability level of *mirt mitad* across the region and around the study area was found at a very low level.

4.13.2. Promotion strategy

The GTZ-HEPNR project, the Ethio-German bilateral project, is the only project currently actively involved in the promotion of mirt mitads. This project is jointly

implemented by MoA and GTZ since 1998. This project promote commercialization of the mitad by organizing market demonstration with actual baking sessions (injera baking on mirt mitad) on different market days and public gathering events. Posters and users leaflets are also used as a tool for promotional activity. Newsletters, magazines, radio and TV displays, billboards and participation in exhibitions and trade fairs are also used for promotion. How ever, most of these promotional especially the radio and TV displays, newsletters and magazines and not at ease reach for the majority of the households. The demonstration strategies could work better to promote the dissemination of the mitads but are not handled in a consistent way due to budget and time limitations of the project. Hence it can be said that the promotional strategies used are not helping very much as most of them are either not reachable by the most poor or are handled very rarely and in small numbers like leaflets are printed in small copy where they are not accessed by many people.

Plate 4.3. Road side Bill board and posters used as means of promoting mirt mitad

CHAPTER FIVE
CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions

For the purpose of this study, 121 household heads and 40 fuel wood carriers and sellers were interviewed. Out of the 121 household members interviewed, 57% of them have used mirt mitad and the remaining 40% have used electric and traditional mitads with significant number using traditional mitad than electric. Eucalyptus was found the major species used by households for fuel (65%) followed by weira and girar consisting of 17.5% each. Households chose to use eucalyptus than weira and girar because of it easy accessibility, easy combustibility, ability to provide charcoal and cheapness. When prices are compared for fuel obtained from eucalyptus (60 birr/qt) is half the price of fuel obtained from weira (120 birr/qt).

Out of those reported to have used mirt mitad, only 12% of them said the purchase price was expensive. From this we can conclude that if mirt mitad have been promoted very well on the public using appropriate strategies of promotion, many people would have used it. And out of those who started using mirt mitad only 3% have discontinued using it. This shows that the technology was adopted by households who once started to use it.

Some of the factors that contributed for the continual use of mirt mitad by users were its ability to save time, wood and money. Households that are currently not using mirt mitad have a loss of 52 hours and 520 birr more per annum respectively that could, otherwise, be used in other productive activities than households that are using mirt mitad. The use of mirt mitad was also found to be affected by type of occupation and level of income where as level of education had nothing to do with it.

In terms of forest conservation, 520 kg of wood could be saved annually by using a single mirt mitad. Hence, respondent household members in Mekelle that are currently using mirt mitad are contributing annually towards the conservation of forest cover of the surrounding rural areas to the maximum of 34,000 kg per annum. Hence, great effort should be done to mobilize the people to have them introduced mirt mitad as part of the effort the different concerned bodies are making to reduce the existing high rate of deforestation. The ability of mirt mitad to release minimal smoke and its less resulting consequence on human health and medical care were also made mirt mitad to be liked by user households. How ever, user households and sample respondents have also mentioned some points which they consider them as disadvantages of mirt mitad. These are:

1. 18% of user and 11% of non user households said that the presence of narrow opening had forced them to use small and thin sized woods which in the first place demands additional labor to the household to cut the large sized woods into small ones and in the second place it consumes more wood
2. 23% of user households indicated that the height from the ground is too short that users are obliged to have faced back pain
3. 13% of user and 31% of non user households indicated that the selling price was expensive
4. 57% of non user households indicated that lack of information and knowledge about mirt mitad was the main constraint for them not to use mirt mitad

To sum up, user as well as non user households were found to be affected by both socio-economic and technological factors. Among the socio-economic are mentioned: unable to accommodate all types of fuel, not portable, do not provide space heating and lighting and its expensiveness for poor households. Technological ones are: short height, narrow opening, lack of flexibility and lack of know how on how to produce or acquire it.

To conclude, the benefits of mirt mitad both at household as well as community level was found large. How ever, despite the large benefits that could be derived out of it, the dissemination process was found very low.

The majority of Tigrian households depend on biomass to meet their daily energy requirements. In rural areas, biomass fuel dependency for cooking is almost 100 % while in urban areas a small proportion of the households use kerosene and electricity as a supplementary energy sources for cooking (BOFED, 1998). The dependency on biomass has brought fast deforestation in the region. To reverse the situation, the government in collaboration with the GTZ has introduced the mirt mitad project since 1998 G.C. How ever, the dissemination of mirt mitad is still insignificant in the study area.

The total amount of wood, dung and root transported to Mekelle during the three day survey period was estimated at 144 quintals and by the same token 17,424 quintals could be transported annually. Wood, originating mainly from the rural sections of the eucalyptus plantations, represented about 46 % of the total inflow to the city followed by root (42%) and then dung (12%).

The push factor into collecting and carrying fuel wood is the lack or inadequacy of alternative sources of livelihood. It became apparent that nearly three in four of urban based carriers are likely to be entirely dependent on carrying and selling fuel wood for their livelihood, of the rural carriers interviewed, nine in ten were engaged in carrying fuel wood for sale at least 2-3 days a week, making fuel trade the major occupation next to farming. There is hence ample evidence to conclude that fuel trading, though mostly illegal, is a major income earning activity on which a considerable number of both urban and rural people depend for a substantial portion of their livelihood. The carriers spend a considerable amount of effort and time to make a living out of the fuel trade. For many of them, it involved traveling distances of between 10 and 20 km and carrying fuel loads of on average 20 kg on their human or donkey back. Their labor time is increased

by the fact that they sell the fuel door to door direct to consumers and along the road sides as well as on open market places.

The survey findings on the mode and place of sale as reported by the carriers are also significant for two other reasons. Firstly, they suggest that as both major suppliers and sellers direct to consumers, carriers, likely to have greater market control that if they were to use a large number of wholesalers and retailers as intermediaries. Secondly, the findings that house to house and along road side were used as market outlets by as many carriers as those using open market places suggest that both permanent, semi formal open markets and other informal markets are equally important outlets for fuel wood and dung.

5.2. Recommendations

- Refreshment training on the production, installation and practical usage of improved mitad has to be given to potential producers to generate the faint status of the mirt mitad in Mekelle and its surrounding areas.

- Awareness creation and raising on household and environmental benefits derived from the use of mirt mitad have to be made at regional level and to do this, appropriate methods of promotional strategies should be selected, used and disseminated in enough numbers, like posters and leaflets, and it is important to timely review whether these methods are serving the purpose they are meant for.

- The dissemination process has to be given great attention by all respective bodies like Agriculture bureau of the region and GTZ.

- Technical assistance on marketing should be given to producers in order to avoid market problems and close follow up on the distribution of mirt mitad should be done to avoid operational problems.

- The physical condition, like its height and opening, of mirt mitad has to be improved to increase user satisfaction and attract new users.

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Annexes

Annex 1: Household Survey Questionnaire

Topic: The Use of Mirt Mitad and its contribution to household economy ans Environment: the case of Mekelle and its Surrounding Areas

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April 2000

Mekelle

1. GENERAL DESCRIPTION

1.1. City: _____

1.2. Wereda: North: _____ South: _____ Quiha: _____ Enderta: _____

1.3. Tabia: _____

1.4. Date of Interview: _____

1.5. Name of Enumerator: _____

2. HOUSEHOLD CHARACTERISTICS

2.1. Name of Household Head _____

2.2. Sex Male _____ 2. Female _____

2.3. Family size _____

2.4. Level of education of household head

Illiterate _____

Read & Write _____

8 - 10/ 12 _____

10/12 complete _____

Diploma & above _____

2.5. Main Occupation of the household head?

No occupation at all _____

Enjera making & selling _____

Tella making & selling _____

Bread baking _____

Restaurant _____

Others specify_____

2.6 Marital status

Married_____

Single_____

Divorced_____

Widowed_____

3. ENERGY ISSUES

3.1. What is your main source of fuel? Select only one.

Wood _____

Dung _____

Roots _____

Others Specify _____

Fuel Wood

If the answer to question (3.1) is wood, ask the following questions.

3.2. How do you get it?

Self collected _____

Buying _____

3.3. If for 3.2 is self collected, where do you collect it?

Homestead _____

Community woodlot _____

Natural forest _____

Farm land _____

Others Specify _____

3.4. Who collects the fuel wood?

Men (adult male) _____

Women (adult female) _____

Female youth students _____

Male youth students _____

Others specify _____

3.5. Did you encounter any problem during fuel wood collection? (List 5 problems)

_____

_____

3.6. How frequent do you collect fuel wood in a week? ___ Times

3.7. For how many times of baking do you use one donkey of fuel wood? _ Times

3.8. How much time does it take you to collect wood? _____Hours

3.9. Which tree species do you most use for fuelwood? (List in their order of priority. Use local names)

_____

_____

3.10. Why do you prefer the ones mentioned above? (Give 5 reasons)

_____

_____

3.11. If for 3.2 is buying, where is it from? (Specify the market place(s))

_____

_____

3.12. How long does it take you to bring fuel wood from market place? ___Hours

3.13. For what purpose do you use fuel wood most?

1. Enjera baking _____
2. Bread baking _____

3. Tella making _____
4. Other specify _____

3.14. During which season/ months of the year do you use fuel wood most?

1. June - August _____
2. September - November _____
3. December - February _____
4. March - May _____

3.15. Why do you use it in that specific season? Give 5 reasons only?

_____
_____

3.16. What are the advantages or disadvantages of using wood as fuel?

Advantage(s)

_____
_____

Disadvantage(s)

_____
_____

DUNG

If the answer to question (3.1) is dung, ask the following questions.

3.17. How do you get the dung?

1. Self collected _____
2. Buying _____
3. Self prepared around backyard _____

3.18. If for 3.17 is self collected, where do you collect the dung from?

1. Private sources _____
2. Communal areas _____

3.19. How much time does it take you to collect the dung? _____ Hours

3.20. Which member of the family collects the dung most frequently?

Men _____

Women _____

Children _____

3.21. Did you encounter any problem during dung collection? (List 5 problems)

_____

_____

3.22. During which months of the year do you use them most?

1. Dry _____
2. Wet _____

3.23. How many dung cake do you use per baking time as fuel? _____
Dung cake

3.24. What are the advantages or disadvantages of using dung as fuel?

List 5 Advantage(s)

_____

_____

List 5 Disadvantage(s)

_____

_____

4.25. If you buy the dung, can you tell me how much does it cost? _____Br

ROOT

If the answer to question (3.1) is root, ask the following questions.

3.26. How do you get the dung?

1. Self collected _____
2. Buying _____

3.27. If for 3.26 is self collected, where do you collect the root from?

3. Private sources _____
4. Communal areas _____

3.28. How much time does it take you to collect the root? _____Hours

3.29. Which member of the family collects the root most frequently?

4. Men _____
5. Women _____
6. Children _____

3.30. Did you encounter any problem during root collection? (List 5 problems)

_____
_____

3.31. During which months of the year do you use them most?

3. Dry _____
4. Wet _____

3.32. How much root do you use per baking time as fuel? _____Kg

3.33. What are the advantages or disadvantages of using root as fuel?

List 5 Advantage(s)

_____
_____

List 5 Disadvantage(s)

_____
_____

3.34. If you buy the root, can you tell me how much does it cost? _____Br

4. Improved vs. Traditional Mitads Related Questions

4.1 Do you have mirte mitad?

1. Yes_____
2. No_____ (Go directly to 4. 24)

4.2. If yes for 4.1 when did you start to use mirte mitad? _____E.C

4.3. Why did you decide to use mirte mitad? Give 5 reasons in order of priority.

_____

_____

4.4. Where did you get it from?

1. GTZ _____
2. REPDA _____
3. Distributors _____
4. Others specify_____

4.5. How did you get mirte mitad at first?

1. Purchase _____
2. Donation _____
3. Other specify _____

4.6. If for 4.5 is by purchase, how much did you purchase it? _____ Br

4.7. In your opinion, did the purchase price for mirte mitad?

1. Expensive _____
2. Moderate _____
3. Cheap _____

4.8. If for 4.7 is Expensive, how much should have been the selling price? ___ Br

4.9. Did you discontinue using mirte mitad?

1. Yes _____
2. No _____

4.10. If for 4.9 is yes, give 5 reasons in order of priority as to why you discontinued?

_____

_____

4.11. If for 4.9 is no, why no? Give 5 reasons in order of priority as to why you did not discontinue?

_____

_____

4.12. What type of purpose(s) does mirte mitad serve(s)?

1. Cooking only _____
2. Baking only _____
3. Both cooking & Baking _____

4.13. What type of kitchen do you have?

1. Outdoor (no kitchen) _____
2. Indoor (traditional kitchen) _____
3. Modern kitchen _____

4.14. Did you use traditional type mitad before?

1. Yes _____

2. No_____

4.15. How do you compare both Mirte and Traditional mitads in terms of the time it takes to bake, the quantity of wood and money it consumes to make one full of" Messob"? On average one Messob contains 30 Enjera

Type of Mitad	Time in hours	Wood in donkey	Money in Br
Mirte			
Traditional			

4.16. How much money on average do you spend for fuel wood per month?

1. When used with traditional mitad _____
2. When used with mirte mitad _____

4.17. Would you compare the amount of smoke released by traditional and mirte mitad? Which one releases the highest smoke per baking time?

1. Traditional mitad _____
2. Mirte mitad _____

4.18. Why do you think is the reason? Give 5 reasons for more release of smoke.

_____

_____

4.19. What negative consequences are happening to you due to the release of more smoke?

1. Eye problem becoming serious _____

2. Nose problem become serious _____
3. More soot accumulation on walls _____
4. Disturbing the neighbors _____
5. Others specify _____

4.20. If you get sick due to smoke release, how many timed do you visit a clinic?

1. When you use traditional mitad_____times.
2. When you start to use mirte mitad_____times

4.24. How much money did you spend for medication per year in relation to smoke problem?

1. When do you use traditional mitad _____ Birr
2. When you start to use mirte mitad_____Birr

4.22. What are the weaknesses of mirte mitad over traditional? List 5 weaknesses in order of priority

_____
_____

4.23. What are the strengths of mirte mitad over traditional? List 5 strengths in order of priority

4.24. If the answer for 4.1 is No why didn't use mirte mitad? Give five reasons in order of priority

_____
_____
_____

4.25. Did you see any disadvantage for not you use mirte mitad?

1. Yes _____ 2. No _____

If yes, what are these?

_____
_____

4.26. If no why no?

_____
_____

5. FOOD HABIT OF THE HOUSEHOLD

5.1. How many times does your family eat in a day?

1. Once _____
2. Twice _____
3. Three times _____
4. Others specify _____

5.2. What is the usual type of food your family is accustomed to eat?

1. Enjera _____
2. Bread _____
3. Others specify _____

5.3. If the answer to question (5.2) is enjera, how frequently do you bake in a week? ____ Times

5.4. If the household is accustomed to bake bread, how frequently do you bake in a week? _____ Times

5.5. What is bread's fuel requirement relative to enjera?

1. Higher _____
2. Lower _____
3. Equal _____

Questions 6.1 – 6.10 will be answered by Mirte Mitad Producers

6.1. What are the materials that mirte mitad is made up of?
1. Metal _____
2. Cement _____
3. Mud _____
4. Other specify _____

6.2. Did you get any training on how to produce mirte mitad?
1. Yes _____
2. No _____

6.3. If Yes, Who gave you the training? _____
6.4. Was the training Sufficient? Yes _____ No _____
6.5. How much is the selling price for one mirte mitad? _____ Br
6.6. Is it worth profiting? Yes _____ No _____
6.7. If for 6.6. Is No, How much should have been the selling price? _____Br
6.8. Who are your customers?
1. Urban poor households _____

2. Rural poor households _____
3. Urban rich households _____
4. Rural rich households _____
5. Hotels & restaurants _____
6. Bread bakery _____
7. Others specify _____

6.9. What do you thing are the problems with mirte mitad? List 5 problems.
1. _____
2. _____

6.10. What do you think are the strengths of mirte mitad? List 5 strengths
1. _____
2. _____

7. FUEL INFLOW INTO MEKELLE FROM THE SURROUNDING AREAS

7.1. Wood Inflow [1]Day _____

1. Name of Inflow Route _____
2. [2]Direction _____
3. Name of Area _____
4. Date of Inflow _____
5. Name of Enumerator (s) _____
6. Carrier Sex: 1. Male _____ 2. Female _____
7. Type of Fuel & means of transport
   - 7.1. Wood _____human
   - 7.2. Dung _____ human
   - 7.3. Root _____ human
   - 7.1. Wood _____ donkey
   - 7.2. Dung _____donkey
   - 7.3. Root _____ donkey

[1]. 1= Day One, 2= Day Two, 3= Day Three

[2] 1= North, 2= South, 3= East, 4= West, 5= North East, 6= North West, 7= South East, 8= South West

3 = Name of the Wereda Where the feul wood is coming from

7.2. FUEL WOOD MARKET

7.2.1. General about the Seller

1. Sex: 1. Male ____ 2. Female ____

2. Age: ____
3. Place of Residence: Kebelle _____
4. Major means of livelihood
    1. Fuel selling _____
    2. Other specify _____

7.2.2. About the fuel being sold

5. Price paid by the buyer? Birr per Kilogram
    1. Wood _____ kg _____ Br
    2. Dung _____ kg _____ Br.
    3. Root _____ kg _____ Br
6. How much kg fuel wood do you sell in a day?
    1. Wood _____ kg
    2. Dung _____ kg
    3. Root _____ kg

Annex 2: Fuel Inflow Survey Inflow Tally Sheet

Inflow Route: _____

Date: _____

Enumerator: _____

Carrier		Type of Fuel			Means of transport*				
Ser	Sex	Wood	Dung	Root	1	2	3	4	5

Transport* = 1= Human 2= Donkey 3= human & Donkey 4= truck 5= other vehicle

Annex 3: Check list for FG Discussion with GTZ & Experts, Mirte Producers & Respondents

1. What were the prime objectives for the introduction of Mirte Mited?
2. How & why the project on Mirte Mitad was incepted at first?
3. How is now the project going on?
4. Who were the target beneficiaries at first and who are now actually benefiting?
5. To what extent do you believe the introduction of Mirte Mitad is successful? What are the indicators?
6. What policy, technical & financial supports did you provide so far?
7. What marketing and promotional strategies are you using currently?
8. How can its impact be explained on forest conservation?
9. Other relevant questions will be raised from the courses of the discussion.