

## Woodfuel Consumption and its Potential Effects on the Environment in Misungwi District, Mwanza Region

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### ABSTRACT

*This study was conducted in Misungwi Ward, Misungwi District to determine woodfuel consumption trends and its potential effects to the environment. Specifically, the study aimed at examining the current status of wood fuel consumption in the study area, identifying the effects on the environment as a result of wood fuel consumption and assessing the effectiveness of measures taken to enhance sustainability of forest resources in the study area. Data were collected using questionnaire survey, interview with key informants and documentary review. Descriptive statistics, regression model and content analysis were used to analyze the collected data. The findings of this study indicate that, woodfuel is the main source of energy whereas almost 97% of respondents use woodfuel for cooking. Annual woodfuel consumption in the selected villages was 18525 m<sup>3</sup> and per capita consumption was 2.5 m<sup>3</sup> m. Household size was noted to have influenced the woodfuel consumption at the household level. Results of this study also indicate that the minimum time spent by the respondents was 0.5 hour and maximum time was 3 hours per one trip. In addition, 0.5 kilometer was a minimum distance and the maximum distance was 5 kilometers covered per trip. This implies that, 16% of the production time is spent on firewood collection or looking for charcoal and hence reduce the time for production and also affects the time of children going to school. Effects of woodfuel consumption were reported to have accelerated deforestation, land degradation and climate change. It is therefore recommended that concerted efforts should be put in place as among the many effective mechanisms for ensuring sustainable energy supply in the area. Among the initiatives to be carried out may include diversification of source of energy, intensifying agroforestry farming system and provision of environmental education.*

**Key words:** woodfuel consumption; potential effects; environment;

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## BACKGROUND

It is estimated that more than 2 billion people in the world are facing fuel wood shortages. Forests in the developing countries are shrinking by more than 15 million hectares a year. The ratio of forests-to-people is less than half what it was in 1960 (Journey to forever, 2009). This implies that the poor people are now more at risk from the global fuel wood crisis. Wood energy consumption is higher in both urban and rural households and thus deforestation has been accelerated due to over exploitation of the resources (Malila and Zilihona, 2011). It has been reported that unless concerted efforts to protect the resources are taken, the sustainability of the environment in developing countries will be in jeopardy.

Tanzania has 946,000 km<sup>2</sup> land area whereas forest and woodland cover about 50%, of which 1.7% is covered by closed high natural forests, while the remaining area of about 45.7% are miombo woodland (URT, 1998). About 90% of Tanzania population depends on these forests as their main source of woodfuel. The quantitative distribution of the different energy sources to the energy balance of Tanzania in 2008 were biomass (90%), petroleum 8%, electricity 1.2%, coal, solar and biogas combined 0.8% (NBS, 2008; MEM, 2009).

The estimated population of Tanzania was about 42 million people in 2009 of which 39.5 million people (95.8%) relied on biomass fuels for cooking (URT, 2009; World Bank, 2009). It is thus clear that, wood fuel is the major source of energy for the greatest majority in Tanzanians. However, this resource has been under high pressure because the poor majority has no access to modern energy resources. This has resulted in the over exploitation of the resource base forcing it beyond its carrying capacity and resilience ability (Abdullah, Mombo, Mgumia and Kingazi., 2006).

Despite the fact that Tanzania, through the implementation of MKUKUTA was expected to reduce the proportion of the rural population depending on biomass energy for cooking from 90% in 2003 to 80% in 2010, it has been noted that, such a dream has been realized yet. According to URT (2009), it was reported that, by the end of 2009, the proportion of rural population depending on biomass fuels for cooking and without affordable alternatives at national level was over 99%.

According to Kaale and Shirima (2011), illegal harvesting of forest products in particular for charcoal production have turned some of the gazetted forest reserves to grassland. They indicated, for instance, that Biharamulo Forest Reserve with an area of 55,000 ha has lost most of its tree cover due to ongoing illegal harvesting. In addition, rapid population growth also contributes to rapid loss of forest cover. For example, the Tanzania forest cover per capita declined from 6.3 ha from 1961 to only 0.8 ha in 2009 (ibid).

It suffices to say that, utilization of woodfuel has great potential effects on the environment and livelihood of the people at large. Understanding of the issue within specific localities can assist in devising measures that can reverse the trend. This study was therefore conducted to determine woodfuel consumption trend and its potential effects on the environment in Misungwi District. Specifically, the study aimed at examining the current status of wood fuel consumption in the study area, identifying the effects on the environment as a result of wood fuel consumption and lastly assessing the effectiveness of measures taken to enhance sustainability of forest resource in the study area.

## MATERIALS AND METHODS

This study was conducted in Misungwi ward, Misungwi district. Generally, Misungwi District was selected due to the reason that, the district is one of the districts that are affected highly with deforestation in Mwanza Region (Msuya, 2009). Population of the study villages is 7502 whereby 3787 are males and 3715 are females. The villages have a total of 1059 households.

Data were collected from both primary and secondary sources. Primary data were collected through household survey, observation and interview of key informants while secondary data were collected through reviewing of relevant documents from various sources. The sample size of about 5% was chosen from the number of household in the villages selected due to the fact that 5% sampling is enough to represent population under simple random sampling (Nichols, 2000).

Collected data were processed and verified prior to analysis. Data were also edited to detect errors and omissions, classified and coded into numerals to make them amenable for analysis. Analysis of data was based on inferential statistics and comparison analysis and Statistical Package for Social Science (SPSS) version 11.5 was used. Content analysis was used to analyze data collected through verbal discussions with key informants.

The annual wood fuel consumption was calculated according to the equation given by Open Show (1971):

$$Y=1.13x + 8.41$$

Where by

Y= Annual volume consumption in m<sup>3</sup>

x= Number of people living continuously in the household

This equation was preferred because it is easy and can give wood fuel consumption for a household, village, ward and division (Mnilago, 2004).

To determine the relationship between household size and wood fuel consumption for household, the following regression equation was used according to Zilihona, Nummelin and Mnilago (2008):

$$Y=0.185 + 0.763x$$

Where by

Y=Amount of wood fuel used

x= household size

Use of regression model analysis was favoured during the analysis of data of the present study due to the fact that, Nkonoki (1980) noted that, use of regression model analysis is more advantageous because; (i) the effects of a particular independent variable is made more certain as the probability of sorting influence factor from other independent variables is removed and (ii) it offers further explanation to the dependent variable since very few phenomenon are the product of a single cause.

## RESULTS AND DISCUSSION

### Characteristics of Respondents

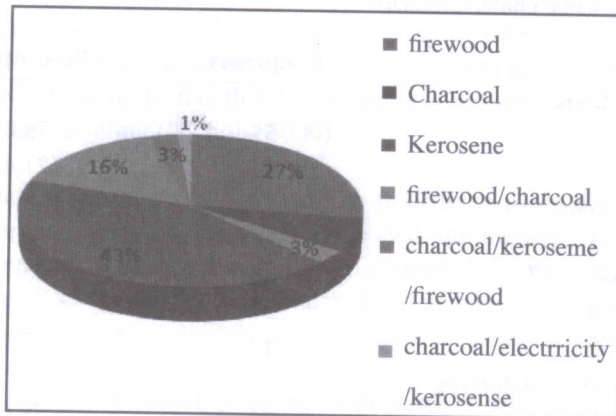
Table 1 indicates the general characteristics of interviewed respondents. The result indicates that 79% were male and 21% were female. About 52.9% of respondents were age group of 41-50 years. The results further show that 37.1% of households had average people of 4-6. 45.7 % of household heads had primary school education.

Table 1: Respondents' characteristics

Characteristics	Frequency	Percentage
<b>Sex of respondents</b>		
<input type="checkbox"/> Male	55	78.6
<input type="checkbox"/> Female	15	21.4
<b>Age of respondents</b>		
<input type="checkbox"/> 15-30	3	4.3
<input type="checkbox"/> 31-40	18	25.7
<input type="checkbox"/> 41-50	37	52.9
<input type="checkbox"/> 51-65	12	17.1
<b>Household heads' gender/sex</b>		
<input type="checkbox"/> Male	55	78.6
<input type="checkbox"/> Female	15	21.4
<b>Size of family</b>		
<input type="checkbox"/> 1-3	10	14.3
<input type="checkbox"/> 4-6	26	37.1
<input type="checkbox"/> 7-9	16	22.9
<input type="checkbox"/> 10-12	18	25.7
<b>Marital status</b>		
<input type="checkbox"/> Marriage	56	80
<input type="checkbox"/> Single	3	4.3
<input type="checkbox"/> Widow	11	15.7
<b>Education level</b>		
<input type="checkbox"/> No formal education	23	32.9
<input type="checkbox"/> Primary	32	45.7
<input type="checkbox"/> Secondary	6	8.6
<input type="checkbox"/> College/university	9	12.9
<b>Occupation of respondents</b>		
<input type="checkbox"/> Farmer	40	57.1
<input type="checkbox"/> Wood fuel vender/farmer	16	22.9
<input type="checkbox"/> Student	3	4.3
<input type="checkbox"/> Formal employment	11	15.7

### Current Status of Wood fuel Consumption in the study area

The study revealed that, 42.9% of respondents use firewood and charcoal as their source of energy, 27.1% use firewood only, 15.7% use charcoal and kerosene while 2.9% use kerosene only for cooking. Electricity is used only by 1.4% of respondent for cooking (Figure 1). These findings imply that, 97% of the households use wood fuel for cooking. The observed trend is similar to other rural areas in Tanzania. For instance, Kaale and Shirima (2011) reported high dependence on woodfuel for cooking in Kwimba and Magu districts which stood at 99.3% for Kwimba and 99.5 for Magu.



**Figure 1: Types of energy Sources used in Misungwi District**

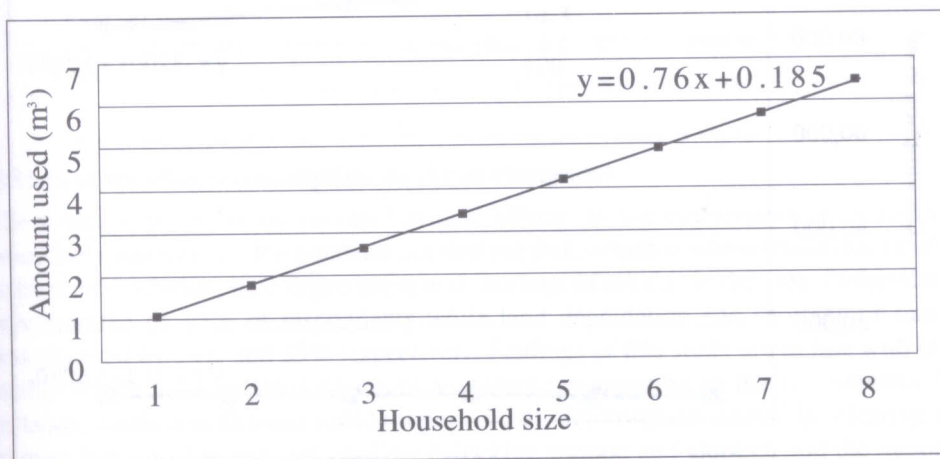
This study established that, the main source of wood fuel utilized in the study area was household woodlot (Ngitiri) which account for 37.1% while natural forest was reported by 32.9% of the respondents. About 30% of respondents bought wood fuel from wood fuel vendors who collected from neighboring villages. The study further revealed that, wood fuels sometimes were collected by cutting the whole tree in natural forest. This practice does not enhance sustainability of the resources and it accelerates land degradation. As noted by Kaale and Shirima (2011), the high dependence of woodfuel without sustainable management of natural resources has caused severe deforestation and scarcity of energy for cooking. The need to diversify energy sources is inevitable if environmental conservation has to be attained.

### Household size and wood fuel consumption

The dependent variable in examining this factor was amount of wood fuel consumed per household and the independent variable was household size as shown in Table 1 and Figure 2. Household size was considered as combination of persons and relatives who share the income expenditure, common kitchen and were living under guardianship of the head of the household. The household size is an important variable determining the demand of woodfuel hence determination of woodfuel consumption and possible supply of family labour for various environmental conservation activities such as tree planting. The average number of people living in the household in sample area was 7 persons per household. This average size is high compared to that of the Kwimba District with 6.4, Mwanza region 5.9 and Tanzania 4.9 (URT, 2002).

Figure 2 presents the relationship between household sizes against amount of wood fuel consumption of 5.505m<sup>3</sup>. It was observed that, an increase of household size led to an increase of wood fuel utilization. The relationship is related to that of Nyamilama division in Kwimba District (Zilihona, Nkonoki, Mnilago and Gisabu., 2005), which indicate that, an increase in one variable result in an increase of other variables. This implies that, the increase in number of people living in a household demand more volume of wood fuel.

According to this study, the annual wood fuel consumption in the study area was 18,525m<sup>3</sup> and per capital consumption of wood fuel is 2.5m<sup>3</sup> (Table 1). The figure is higher than that of 1.78m<sup>3</sup> in Nyamilama division-Kwimba District (Zilihona et al., 2005), and of 2.33m<sup>3</sup> in Lushoto district (Nkonoki, 1999).The difference in the figure obtained is due to the fact that, this study was concentrated on wood fuel consumption (firewood and charcoal) in terms of energy. Other studies referred above included also pole and timber consumption per person per year.



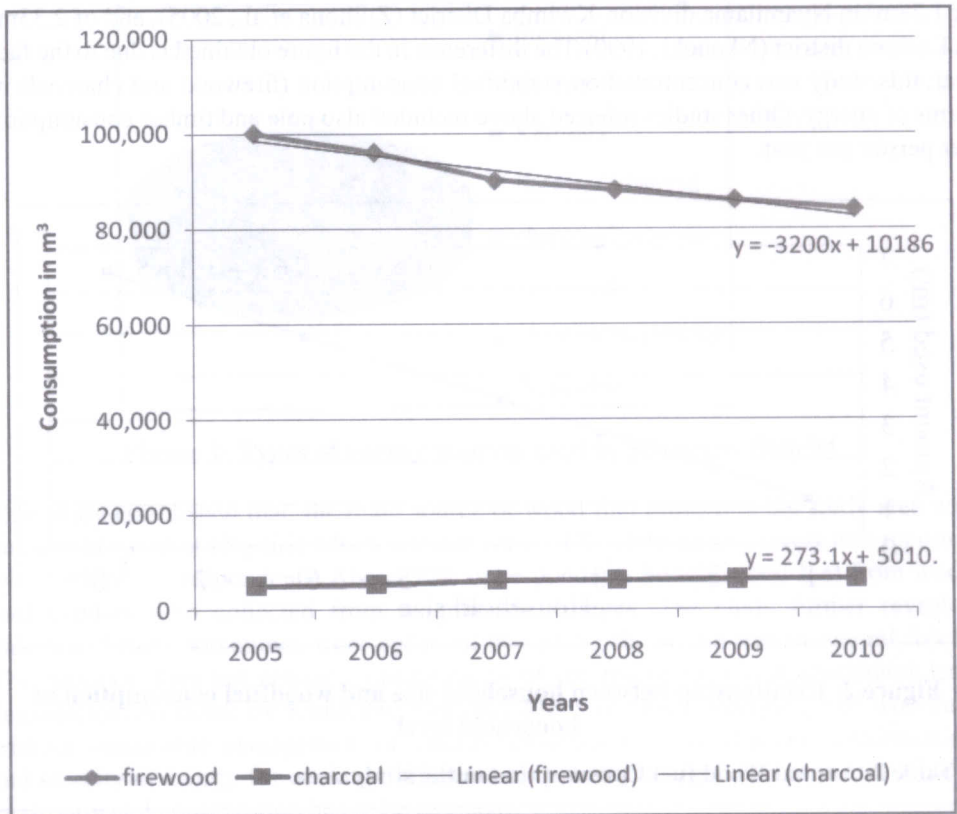
**Figure 2: Relationship between household size and woodfuel consumption at household level**

**Table 2: Annual Wood fuel Consumption in the study area**

Village	Population 2010	Number of Household	Average no. of people/Household	Fuel consumption m <sup>3</sup> /Year	Per capita Consumption in m <sup>3</sup>
Misungwi	4179	597	7	10440	2.5
Mabuki	3223	462	7	8085	2.5
Total	7410	1059	7	18525	2.5

At district level, the five-year trend of wood fuel consumption shows an increased consumption of charcoal while decreased consumption of fire wood. For instance in 2005 charcoal consumption was 5142.85m<sup>3</sup> and 6439.64m<sup>3</sup> in 2010 while 100,000m<sup>3</sup> in 2005 and 84,000m<sup>3</sup> firewood consumption (Figure 3).Firewood consumption per

household in 2006 dropped by 4%, and 6% in 2007 as well as 2% from 2008-2010. The reason contributed to this could be some of household adopting charcoal as source of energy especially in the small centers. The findings of this study are in line with those recorded in Zanzibar where Yussufu, et al., (2002) reported five-year trend of charcoal consumption from 1997 – 2002 showing an average of 4367.18m<sup>3</sup> per year, which makes an average of 363.92m<sup>3</sup> per month. Furthermore Kaale and Shirima (2011) noted changes of consumption of woodfuel where they noted increase of charcoal consumption and decrease of firewood in Dar es Salaam city.



**Figure 3: Wood Fuel consumption trend in Misungwi District in m<sup>3</sup>**

**Time spent and distance covered by household members on woodfuel collection**

The study revealed that, the minimum time spent by respondents was 0.5 hours and the maximum time was 3 hours for one trip. The minimum distance covered was 0.5 kilometers and the maximum distance was 5 kilometers. This implies that, 16% of the production time is spent for firewood collection or looking for charcoal and hence reduce time for other activities. It was noted that, respondents who collect wood fuel and look for charcoal were women who accounted for 40% followed by children 32.9% (Table 2). The results can be compared to that of Mpwapwa District where Malila, Nyankweli

and Sebyiga, (2009), reported a considerable amount of time to work and produce was spent by household members usually women and children to collect woodfuel. Women and children walk between two and eight kilometers to and from and one to three hours collecting fire wood. It is obvious that, this situation accelerate poverty to the majority since productive time is not utilized accordingly. This is a serious challenge which needs to be dealt with effective measures.

**Table 3: Proportion of Respondents involved on wood fuel collection**

Wood fuel collector	Percentage (N=70)
Women	40.0
Men	12.9
Children	32.9
Charcoal vender	14.3
<b>Total</b>	<b>100</b>

### Effects of woodfuel consumption on the environment

The findings of this study revealed critical effects on the environment as a result of woodfuel consumption. Respondents pointed out that, woodfuel consumption has resulted to high deforestation, land degradation and shortage of rainfall in the area. Deforestation was reported by 48% of respondents while land degradation and shortage of rainfall was reported by 34% and 25% respectively. Findings of this study are in line with other studies which have reported effects of woodfuel consumption on the environment. For instance, Kaale and Shirima (2011) reported that, deforestation caused by clearing tree to meet household energy for cooking is locking women and children and the nation at large into a serious poverty vicious cycle. This is due to the fact that, soil erosion, water scarcity and the need to spend many hours to fetch for woodfuel are factors contributing to low agricultural production of both food and cash crops.

According to CHAPOS (2002), wood fuel consumption was responsible for degradation of 289 hectares (38%) of Mamani forest and deforestation of 252 hectares (27%) of Sisu forest. In Dar es Salaam CHAPOS (2002), reported charcoal production to be responsible for degradation of 29,268 hectares (24.6 %) of closed woodland and deforestation of 23,308 hectares (19.58 %) of closed woodland and 92,761 hectares (50.8%) of open woodland in the catchment area to the west and north of Dar es Salaam that supplied charcoal to Dar es Salaam City. Kale and Shirima (2011), also noted the effect of woodfuel on the environment in Mwanza region where unsustainable use of biomass fuels for cooking was noted to be the main contributor to climate change being caused by burning of wood and clearing of forest for woodfuel. The consequence of this is decline of the supply potential of biomass fuels causing deforestation that is now causing soil erosion, floods, destruction of catchment areas for water, drought and reduction of agricultural productivity, hence accelerating poverty.



It suffices to say that, woodfuel consumption is one of the great agents accelerating negative impacts on the environment. It is therefore important to devise mechanism that can reverse the situation and thus, restore the quality of the environment for the benefits of the present and future generation. Introduction of agro forestry farming system in the area would not only enhance land conservation efforts, but also increase availability of wood fuel. If the problem is not seriously addressed, woodfuel demand is expected to continue increasing at an increasing rate due to rapid population growth. The increasing demand for woodfuel therefore will intensify the negative consequences on the environment and thus, survival of the people in the area and Tanzania at large will continue to be in jeopardy.

### **Measures to enhance sustainability of forest resource**

Respondents indicated several methods to enhance sustainability of forest resources and thus environmental conservation. Among the methods used and mentioned by respondents to have potential impact on reversing the trend include tree planting, provision of environmental education and adoption of alternative source of energy (Table 3).

*Tree planting:* There are several reasons as to why trees are being planted in the study area. According to this study 54% of respondents indicated that they plant trees for getting fuelwood, 25% for timber, 14% for both timber and fuelwood while 7% of respondents said that, they plant trees for timber and poles for house construction. This trend was also observed by Zilihona et al., (2005) in Kwimba District. It can be said that, the Sukuma<sup>4</sup> who are indigenous people of the study area are aware that tree planting enhances availability of forest resources and thus conservation of the resources and the environment at large. It is therefore argued that stakeholders in Misungwi District including the District Council, Non Governmental Organisations and individuals should promote use of agroforestry farming system in the area. It is well documented that, use of agroforestry farming system not only enhance land conservation efforts, but also increase availability of woodfuel and hence reduces the woodfuel crisis in the area (Zilihona et al., 2005; Mgumia et al., 2008).

*Provision of environmental education:* This is very important strategy which empowers community with knowledge and skills on how best they can manage their environmental resources in a sustainable manner. During discussion with respondents, it was noted that, various agencies are involved in provision of environmental education and respondents commended on the efforts made so far. For instance, one respondent pointed out that, “*thanks to God for having people who are involved in provision of environmental education since now we can plan how to manage our environment. Without such efforts our village could have already been a desert*”. It is clear that, environmental education is not something to be overnight injected in people’s mindset. According to Mahonge, Nsenga, Kitundu and Nkonoki, (2006), environmental education needs strategies and plans involving various stages on how well to involve individuals or communities in the learning process to acquire environmental knowledge which can be used to ensure effective implementation of environmental management. It is important that such efforts need to be intensified to enable people to have relevant environmental education

<sup>4</sup> Sukuma is a major tribe in Mwanza, Shinyanga and Tabora Regions. This study was conducted in Misungwi district which is one of the districts in Mwanza Region.

because when this is imparted, change of mindset would be attained and thus, sustainable environmental conservation measures can be adopted by the majority and hence, achieve the objective of sustainable management of environmental resources.

**Table 4: Measures to be taken to enhance sustainability of forest resource in Misungwi District**

Measures	Percentage (N=70)
Tree planting	37.1
Provision of environmental education	31.4
Conservation of tree planted	22.9
Conserve source of water	8.6
Adoption of alternative source of energy	62.0
Enforcement of by-laws and regulation	58.0

*Enforcement of by-laws and regulation:* The study revealed that, 67% of respondents were not aware with the existence of by-laws. Even those who were aware indicated clearly that, enforcement of those by-laws and regulations was ineffective. It is clear from this result strategies for effective enforcement of by laws need to be sought out otherwise the sustainability of the environmental resources will continue to be jeopardized.

*Adoption of alternative source of energy:* Use of alternative source of energy in the area was noted to be not common despite the increased crisis of wood fuel. According to this study, 76% of respondents said, they were aware of the existence of alternative source of energy but they were not using it. About 23.5% lacked completely knowledge of alternative source of energy. Only less than one percent reported to be using biogas, kerosene and gas for cooking and solar energy and kerosene for lighting.

The observed result on the use of alternative source of energy is not only a problem in Misungwi district but it exists also in other areas both in rural and urban area. For instance, NBS (2008) and MEM (2009), indicated that, Tanzania in 2008 the main source of energy were biomass (firewood, charcoal and farm residues) accounted for (90%), petroleum (8%) electricity (1.2%), coal, solar and biogas combined was only (0.8%). According to Kaale and Shirima (2011), the main source of energy in Mwanza region is biomass (95.84%), kerosene (2.96%), electricity (0.73%), gas (0.07%) and others (0.04%). In addition, they indicated that, use of biomass at household level for cooking accounts for 99.26% and 99.45% in Kwimba and Magu districts respectively.

It is clear from the findings of this study that, use of alternative source of energy need to be highly advocated if the remained forest resources have to be conserved. Use of alternative source of energy would reduce pressure from the use of woodfuel and hence rejuvenate its status.

## CONCLUSION AND RECOMMENDATIONS

### Conclusion

Woodfuel is the most popular source of energy for cooking to the majority of households. Based on the findings of this study, it can be concluded that, Misungwi district is facing acute scarcity of energy for household cooking. The consequences of this have far reaching effects. For instance, persistence of woodfuel crisis accelerates land degradation and thus affects land productivity and hence, increases poverty level to the majority. This implies that, efforts to eradicate extreme poverty and hunger would not be attained. The crisis also contributes to poor performance of children at school due to the fact that children from poor families spend many hours during school time fetching firewood.

### Recommendations

Based on the results of this study it is therefore recommended to initiate concerted efforts of ensuring sustainable energy supply in the area.

Initiatives that could reverse the trend include planting trees through agroforestry practices and other purposes need to be intensified. The district authority and other stakeholders should design mechanisms to enhance agroforestry system which will ensure both availability of forest resources for woodfuel supply and land conservation.

Another issue which needs to be given high priority is to diversify source of energy in order to reverse the pace of deforestation in the area. Possible alternative energy sources that could be opted include solar energy, biogas and conversion of agricultural and industrial residues to briquettes as well as use of rice husk in brick making. In addition, use of improved cooking stoves should be intensified to minimize the amount of woodfuel consumption per household.

Environmental education should continue being provided to the community so as to create awareness and sensitize sustainable utilization of environmental resources. Furthermore environmental education should also emphasize the issue of enforcing by-laws and regulations responsible for environmental management. Tough measures should be instituted to all defaulters, this would enhance sensitivity to the proper use of environmental resources and its conservation mechanisms.

## REFERENCES

- Abdallah, J.M., Mombo, F., Mgumia, F.H. and Kingazi, S.P. (2006) Household Woodfuel consumption in Dar es Salaam: A Case of Ilala District. *Journal of the Korean Association of Africa Studies* 23: 99-116
- CHAPOPSA (2002). Charcoal Potential in Southern Africa. INCO\_DEV: International implication. A study in Shivapuri watershed, Nepal Msc.Thesis in Management of Natural Resources and Sustainable Agricultural. Agricultural University of Norway 128pp.

- Kaale, B.K. and Shirima, A. (2011). Sustainable energy services for sound community development in Mwanza region. Paper presented to a workshop on Strengthening natural Resources Management and Reporting held in Mwanza 17<sup>th</sup> to 20<sup>th</sup> January 2011.
- Mahonge, C.P.I., Nsenga, J.V., Kitundu, K.M.B. and Nkonoki, J.B. (2006): Assessment of School Pupils Understanding on Environmental Education: A Case of Pupils of Kindimba primary School in the Matengo Highlands. *Rural Planning Journal* 7(2): 57-72.
- Malila, M.N., E.M. Nyankweli and B.D. Sebyiga, 2009. Energy Utilization Status in Dodoma Region with Special Reference to Mpwapwa and Dodoma Urban Districts. *Rural Planning Journal* 10(2): 59-71.
- MEM (2008). Draft Report on Joint Energy Sector Review for 2008. Ministry of Energy and Minerals, Dar es Salaam, Tanzania
- Mgumia, F.H., Mombo, F. and Zilihona, I.J.E. (2008): Good Governance and participatory Forest Management in Tanzania: lessons from Duru Hayitemba Forest reserve. *Rural Planning Journal* 10(2): 1-11.
- Mlinago, M. M. (2004) Fuel wood demand and supply situation in Kwimba district: a case of Nyamilima division. A dissertation for partial fulfillment for post graduate diploma in environmental planning, Institute of Rural Development Planning Dodoma.
- Monela, G.C. and Kihyo, V.B.M. (1999) Wood energy in Sub-Sahara Africa In: Palo, M. and Uusiviro (ed) *World Forest, Social and Environment* 153-160. Kluwer Academic Publisher
- Msuya, H. (2009): Potentials of Rice Risks as alternative source of energy for brick burning in Misungwi Ward, Misungwi District. Unpublished Dissertation for Bachelor Degree in Environmental Planning and Management, Institute of Rural Development Planning, Dodoma, Tanzania
- National Bureau of Statistics. 2002. Household Budget Survey 2000/01. Dar es salaam
- NBS (2008). Household Budget Survey 2006-07. National Bureau of Statistics
- Nichols, P (2000) "Social Survey methods: a field guide for development workers." Development Guidelines 6.
- Nkonoki, J.B. (1999): The contribution of Agroforestry Tree Species as Source of Fuelwood in Lushoto District, Tanzania. MSc. Dissertation, Sokoine University of Agriculture, 1999, 104 pp.

- Nkonoki, S.R. (1980). "The poor main energy crisis" A Report of Tanzania Rural Energy consumption survey.
- Open Show (1971) Wood fuel-a time for reassessment, unpublished manuscript Division of Forest, Faculty of Agriculture, Forest and Veterinary Science, University of dare s Salaam
- URT (2009). Poverty and Human Development Report 2009. United Republic of Tanzania.
- URT, (1998). National Forest Policy. Ministry of Natural Resources and Tourism, Government Printer, Dar es Salaam, pp 59.
- URT, (2002).Tanzania Population Census, Government Printers Dar es Salaam.
- World Bank (2009). Environment Crisis or Sustainable Development Opportunity? Transforming the charcoal sector in Tanzania. The World Bank.
- Zilihona, I.J.E., Nkonoki, J.B., Mnilago, M.M and Gisabu, D. (2005).Analysis of Fuelwood Demand-Supply Situation in Semi Arid Areas in Tanzania: A Case of Nyamilama Division, Kwimba District. Rural Planning Journal 7(1):1-12
- Zilihona, I.J.E., Nummelin, M. And Mnilago, M.M. (2008): Fuelwood Crisis: A Challenge towards environmental conservation in Kwimba District, Tanzania. Journal of Continuing Education and Extension 3(1): 106-114.