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# Assessing Rural Energy Needs and Solutions in North-East Tanzania

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**Abstract**

In Tanzania, planning for bioenergy has received relatively little attention although it accounts for about 90% of the country's energy supply. Due to its complexity and diversity, the sector is plagued by lack of reliable data and information on the supply of bioenergy, its consumption and interaction with social, economic, institutional and environmental factors. In order to address the lack of data and methodology, a two year research project was, in 1995, initiated by the then Tanzania Ministry of Water, Energy and Minerals in collaboration with the Stockholm Environment Institute (SEI),[4] and executed by the Institute of Resource Assessment at the University of Dar es Salaam. The objectives of the research was to develop and test a multi-disciplinary research method for identifying bioenergy options that can contribute to satisfying the energy needs of the rural household, agricultural and small scale industrial sectors, promote growth and facilitate sustainable development. This article describes how the project was carried out and presents the major findings and lessons to be drawn for the future.

## 1. Introduction

### *1.1 Project Background*

Bioenergy planning, or more particularly planning for woodfuels in Tanzania, like in many other developing countries, has so far received little attention because most efforts in the past were directed towards planning for commercial

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energy systems. The reasons are quite obvious. While demand and supply and the associated planning and analytical methods are well-established and more easily understood for commercial energy, there continues to be a lack of understanding of bioenergy system, which accounts for about 90% of the country's energy supply, because it is more diverse and complex. Some of the constraints contributing to such a situation include:

- Lack of reliable data and information on resources and consumption and interaction of social, economic, institutional and environmental factors.
- Lack of adequately developed and easily understood methods of data and information development, analysis and methods of evaluating available potential options.

In order to contribute towards addressing this problem, the then Ministry of Water, Energy and Minerals (MWEM) and The Stockholm Environment Institute (SEI), in 1993, developed a project concept whose general objective was to develop and test a multi-disciplinary research method for identifying bioenergy options. The project was executed by the Institute of Resource Assessment at the University of Dar es Salaam from end of 1995 to June 1997.

The development and testing of the research methodology was conceived to facilitate dialogue with the rural people in the identification of salient development issues and problems from their own perspective and how these relate to identification of bioenergy options. These options should contribute to satisfying the energy needs of the rural household, agricultural and small scale industrial sectors, promote growth and facilitate sustainable development. The study area selected for the application of the method is located in the northern region of Tanzania, Kilimanjaro, focusing on three villages in Rombo District (Kelamfua, Maharo and Shimbi Mashariki) and three villages in Mwanga District (Chomvu, Kagongo and Kigonigoni). District authorities assisted the research team in selecting the villages using the set of criteria developed by the research team.

### *1.2 Bioenergy Status in Tanzania*

In Tanzania, bioenergy (biomass energy) and in particular firewood and charcoal remain the dominant energy sources for most rural and urban households respectively. In addition to supplying domestic energy requirements, bioenergy is also used in supplying process heat for many rural industrial production activities (Sawe, 1995) such as:

- ***Brick burning***

There are few medium scale brick burning industries in the country, they include Kisarawe, Mbeya na Zuzu brick factories. The majority of burnt bricks in the country are produced from small scale individually owned village based kilns which utilize substantial amounts of firewood.

- ***Fish smoking:***

In the absence of adequate cold storage facilities, especially in the rural areas, smoking is the best way of preserving fish. It has been estimated that between 0.2 to 1.1$m^3$ of fuelwood or 20 kg of charcoal are required to smoke 1 ton of fish.

- ***Beer brewing***

Brewing of local beer is in many rural communities a major activity which consumes a considerable amount of fuelwood. It is estimated that for every 100 litres of brew a range of between about 0.03 and 0.15$m^3$ of fuelwood are required. Variations depend on the type of brew.

- ***Pottery making***

Within the villages, this is a specialized activity for certain households. The process uses woodfuel in a very inefficient way. There are now efforts to introduce efficient kilns. Firing time varies depending on the fuel, the number and size of pottery items. Pottery making therefore creates a localized demand for fueldwood.

- ***Salt-drying***

In Tanzania, salt is produced from drying sea and underground waters. It is estimated that in total, about 350,000$m^3$ of wood are used annually for salt production in Tanzania.

- ***Lime burning***

Lime is a product of limestone obtained after calcination (firing). In Tanzania, there are about thirteen lime production factories. It is estimated that about 4,400$m^3$ of woodfuel are used annually for lime production.

- ***Tobacco curing***

Both the method of growing tobacco and the way the crop is processed affect the consumption of fuelwood. Quantity of firewood used for tobacco curing in Tanzania is not known to any degree of accuracy. Only estimates have been

given by various authors, with a lot of variations. One such estimate is given by ESMAP (1986) which indicates that $15m^3$ of solid wood ($20m^3$ of stacked woodfuels) are used to cure 1 ton of tobacco in Tanzania.

- ***Tea drying***

  It is estimated that about 1.5 tones of dry wood (with moisture content 20%) is required to dry one ton of tea. It is estimated that 120-140 kg of dried tea require about 1 cubic metre of wood. This translates to 1 hectare of wood for drying 5 tones of tea (Kulindwa and Shechambo, 1995). Thus, if the output of tea is known, then the quantity of wood required to dry it can easily be estimated.

### *1.3 Bioenergy Options*

Bioenergy options as considered in this project, comprise of a whole set of activity chains from given bioenergy resource to a given end0use. Each step in a bioenergy activity chain involves choices between a multitude of practical solutions.

In Tanzania, traditional bioenergy options which are mainly used for cooking e.g. firewood, charcoal, cowdung, crop residues, etc. are characterized by low investment requirements, simple indigenous technologies, relatively large inputs of human labor (compared to modern alternatives e.g. biogas, electricity produced from biogas, gasifiers, steam/boiler, etc) and low energy efficiencies. One example of such an option is the use of fuelwood from natural forests for rural cooking and provision of heat for process heating in small-scale industries. The fuel is harvested manually and transported mostly as headloads. Fuel preparations involved are cutting wood to size and natural air drying. The end-use device is often comprised of three stones fireplace.

It is now known that there are alternatives to most traditional bioenergy options that offer potential merits. These include: increasing the resource base by, for example, using biomass from agroforestry practices, forest plantations, or residues which are otherwise wasted. Some aim at improving the efficiency of specific process steps, for instance, by introducing more efficient end-use devices. Others create possibilities for improving the overall efficiency of the supply chain by introducing new energy carriers like liquid or gaseous biomass fuels.

Programmes to improve the situation have suffered from lack of national priority, inadequate information and lack of the requisite institutions and skills in the face of a challenge that is far from being simply or purely technically based. Instead, it is believed that the problems and solutions reach into the heart of the economic, social and cultural life of villagers.

(village Chairperson and Village Executive Officer) for purposes of introducing each other, explaining the objective of the research study, getting study clearance and lastly to prepare village specific research study workplan for study activities that are expected to be undertaken in the village.

### *2.3 Techniques used to Gather Data and Information on the Study Villages*

It is important to collect adequate and detailed background information on the study villages in order to under stand the economic, social institutional and environmental conditions of each study village. The following activities were undertaken:

#### *2.3.1 Preparation of Village Map*

Drawing of the village map was one of the first concrete activities that required the participants' input. Maps help to indicate areas with adequate or inadequate social and economic infrastructure, and also indicate the natural resources found in the village as well as prevailing environmental conditions. Village leaders and key informants were encouraged to take a leading role. This exercise provided the first visible concrete output of the interaction with villagers.

#### *2.3.2 Discussion on Village History and Significant Events*

The next step was to initiate a discussion on the village history. The village history helped to reveal important information that enabled the team to understand the present situation of the village. The review stimulated a hot exchange of ideas about events and problems as far back as the oldest village leaders could remember to have seen or to have been told by their parents and grand parents. The events included things like:

- Outbreaks of epidemics;
- Droughts and famines;
- Changes in land tenure;
- Introduction of new crops;
- Building of social and economic infrastructure (e.g. schools, hospitals, roads, etc.);
- Changes in administration and organization;
- Major political events:

#### *2.3.3 Discussion on Significant Changes and Trends*

The third activity is the identification of significant changes and trends that had occurred in the village history. The changes and trends indicated quantitative and qualitative changes overtime for variables like crop yields, area under cultivation,

livestock population, prices, migration patterns, time and distance to collect fuelwood and fodder, water availability, population size and number of households, weather patterns, environmental changes, etc.

*2.3.4 Preparation of Annual Seasonal Work Calendar*

The fourth activity is the of seasonal work calendar. The seasonal work calendar attempts to establish regular cycles or patterns of activities and occurrences within the village over one year. The calendar showed the major activities, problems and opportunities throughout the annual cycle. The calendar also helped to identify the months of greatest work load and other variances which have significant impacts on peoples' lives e.g. periods of food shortages.

*2.3.5 Preparation of Daily Routine Diagram of Activities*

The fifth activity is the preparation of the daily routine diagram of activities. The daily routine diagram helped the team to collect and analyse information on the daily patterns between activities of village members and to compare the daily routine patterns for men and women and seasonal changes in these patterns.

*2.3.6 Conducting Semi-Structured Interviews with Village Leaders*

Semi-structured interviews and discussions based on a pre-determined checklist of topics and questions for village leaders were undertaken to help the team to gather general village-level information and data that were yet to be collected from the previous activities. More technical questions focusing on various sectors and social services e.g. water, land, health, agriculture, transport, energy, institutions and groups in the village were posed. The interviews and discussions provide further access to a larger body of knowledge and also provided a means of cross-checking information that was received from others in the meeting. Major problems facing the villagers in relation to the above sections were also be discussed.

*2.3.7 Meeting with leaders of Various Groups, Enterprises and Institutions*

With the assistance of the village leaders, development related institutions and groups in the village were identified and invited for a meeting with the research team. The groups narrated their activities, problems and how they relate to the community at large.

*2.3.8 Transect Walk Across the Village*

A transect walk was undertaken in each village to explore the full the spatial differences in the villages under study. The team walked across the village periphery after reviewing the village sketch map to estimate the line of greatest

diversity. The transect enables an exploration of differences in land-use, vegetation, soils, cultural practices, infrastructure, livestock, water availability, etc. At the end of this exercise, a transect sketch diagram for each village was prepared.

*2.3.9 Household Interviews and Farm Sketches*

With the assistance of the village leaders, a few households were randomly selected from a section of each sub-village. The selected households included those from among well-off, poor families and those headed by women.

The interviews are conducted by using the checklist of important issues or topics prepared in advance for guidance. Additional information was collected through on spot observations on such aspects as the quality of houses, ownership of property (e.g. radios, TVs, bicycles, sewing machines, etc.) and appearance of family members which would indicate the extent of wealth or poverty of the households. Farms sketches of the selected households were prepared with the assistance of the heads of household.

***2.4 Organization of Emerging Issues***

After the above data gathering exercise is completed, a structure for analysis was established. This consists of a meeting between the research team, district extension staff and a few representatives of villagers and groups representatives to draw a preliminary list of emerging issues. The listing of the emerging issues is by problem or sector e.g. water availability, land, health, famine, leadership, energy, etc, without any attempt to weight or to rank the issues.

***2.5 Village General Meeting (PRA Workshop)***

After preparing the list of issues, a village general meeting of twenty to twenty five persons consisting of village leaders, key informants, representatives of common interest groups, village residents (both women and men) PRA team and district Extension Staff was held. During this meeting, a presentation of the emerging issues is made after which participants are given an opportunity to prioritize and rank the issues.

After the voting and ranking activities the exercise of giving potential solutions options for each of the ranked problems and issues is conducted. The villagers will then be prompted to propose potential solution options and also suggest who would be responsible for the execution of the proposed solution options and indication of the time frame for execution.

### *2.6Data Analysis by Research Team After Fieldwork and Feedback*

After the above fieldwork exercise which includes PRA workshop further analysis was carried out by the research team back at the Institute. This involved detailed assessment of the issues/problems raised by the villagers in relation to the actual situation in each village. Capitalizing on the knowledge and experience of research team members, additional potential solutions were suggested, linking up the issues/problems with solutions and how the sector under study (bioenergy) can address some of the problems/issues raised by villagers.

In order to obtain a feedback, researchers had go back to the villages for additional assessment and verification with villagers of the possible village-specific bioenergy options and their potential for solving major problems perceived by the villagers. After such feedback, assessment and verification, it became possible to propose with villagers one or several projects for implementation in each study village.

## 3. Findings and Implications of the Study

### *3.1 Findings*

The field work results indicate that local communities differ widely according to ecological zones, socio-economic stratification, leadership, development experience and so on. The importance of the developed methodology under this project is the possibility to apply its approach and operational principles in most rural areas of differing characteristics found in developing countries.

It was established that the low ranking of energy issues relative to other issues or problems as perceived by villagers in general village meetings (known as the PRA workshop). However, this low ranking of energy issue differs sharply to results of household interviews (especially with women) which suggest that firewood was indeed a serious problem. The women, in particular, were adopting various coping mechanisms to address the problem, e.g. the use of crop and animal feed residues for fuel, and few households were beginning to use improved stoves. Women and children spent three to give hours covering more than five kilometres to collect only enough firewood for a day's cooking for a household of five to six people.

In two study villages, leadership was ranked as the number one problem, while in two others it ranked as number three. Leadership was found to be a problem which has often led to failure of communal/collective/cooperative or village government economic ventures hence, the recommendation for private enterprises to under take bioenergy projects in the villages. Another problem

ranked high by the villagers, both in general meetings and in household interviews was lack of or limited income earning opportunities. This led to a recommendation that if bioenergy options are to be adopted by rural people, they should not be promoted in isolation from the context of economic development and poverty alleviation. Bioenergy technologies should, for example, be linked with the delivery of social services such as water pumping and refrigeration of medicines and vaccines.

After the study, some specific bioenergy options were recommended and adopted for each study village in the two districts. The participative approach was extended to the selection of possible projects that villagers could implement using their own rsources as far as possible. Some of these projects include: visiting other villages to observe improved stove making techniques; planting multi-purpose trees; venturing with biogas and improved fish smoking and drying ovens. Where villagers keep cattle under the zero-grazing system and can afford initial costs, simple biogas plants were recommended. The need for information on available technologies, development of skills and financing mechanisms were seen as critical elements for the adoption of bioenergy options.

### *3.2 Implications*

#### *3.2.1 Methodology*

The methodology developed in this research project can be applied in the identification of feasible bioenergy options, potential projects and interventions. It also helps in determining which interventions are feasible and within the ability of the community in the short term and those which require external inputs and are of a long term perspective. Also the methodology is applicable in the evaluation of options that can be implemented as local projects and which one are not within their ability.

The methodology as adopted in this project is a systematic yet semi-structured approach carried out in the field by a multidisciplinary team designed to acquire quickly new information on local development needs in general and in particular on bioenergy needs. The methodology involves holding discussions with village leaders, villagers including women and other key informants during PRA meetings to solicit information on the history of the area, trend lines for important variable which included; natural resources, environmental issues, economic issues, social services and infrastructure, social cultural issues, technical issues, institutional issues, leadership issues. The approach also include on site observation through transect walks as well as farm interviews. The type of information that results from this participatory methodology is usually qualitative, reflecting the diversity and complexity of the situation it is

describing. The information therefore gathered is of a very wide range and all the material should typically be analyzed by a multidisciplinary team involving villagers also.

However, it must be stated that the use of participatory approaches in research studies e.g. bioenergy options identification and other development initiatives has not been without its constraints. A number of drawbacks and difficulties were encountered when working in an area with local people to analyze their situation. These could include:

- Since it is facilitated by outsiders, the methodology can raise expectations of local people for continued involvement and support. The intense involvement of local people in research and development tends to generate much enthusiasm and anticipation about the action that they have identified. Although in principle this can be considered to be a positive aspect, it can cause problems if any support promised by the facilitating agency is not forthcoming.
- The outcome of the methodology approach depends on the attitude and vision of the persons facilitating the process
- If carried out too quickly, they can lead to incorrect insights. Therefore time and patience are required.
- The choice and sequence of methods needs to be adapted to fit each situation.
- In most cases, the methodology will not lead to quantifiable results.

### *3.2.2 Lessons Learned*

*(a) Policy issues*

The approach and analysis of both national and local bioenergy policies discussed in this study offers hope for achieving sustainable change to bioenergy problems which are complex and often intractable. Such change is centered on the participation of local communities in planning and executing development project, which in turn may not happen until a policy environment is created which opens up opportunities for the empowerment of local communities.

The conclusion is that bioenergy problems and potential solutions to those problems are specific to people in their areas. If policies in these areas are to be successful, they must be able to capture this local specificity and build on particular ways in which the people who count as the actual users of bioenergy respond to the problems they face and opportunities they perceive.

The significance and origins of bioenergy problems in, for example, a semi-arid area such as Kagongo are very different to those found in a mountainous area such as Chomvu or a high population density and high production area such as Maharo. The policy options which are appropriate for each of these different sets of circumstances of people in their areas in order to work. A top-down single sectoral technology driven approach to bioenergy issues tends to limit the options open to the local communities and frequently demands of their inputs which affect other issues of higher priority in their lives.

The role of the government as policy and decision maker as well as facilitator should provide effective decentralization in which control over local resources is given to local communities is required.

On the basis of the study findings, an improved institutional framework and capacity at local and national levels is needed if the methodology principles for bioenergy identification and evaluation outlined in this project are to be translated into effective action. The policy environment must create circumstances in which the following can be realized:

- Empowerment of local communities to have effective control over their local resource base;
- Create an economic and political environment conducive to local empowerment and sustaining of local solutions based on their priorities;
- Provide effective support to ensure the availability of adequate and appropriate information, technical inputs and resources for effective local level solutions of their priority problems;
- Provide an atmosphere that allows for bioenergy beneficiaries to continue to develop and adopt appropriate bioenergy options through private ventures rather than community ventures which are vulnerable to leadership and managerial problems;
- Articulate institutional arrangements that would allow relevant sectors (e.g. forestry, agriculture, livestock, community development, lands, etc) to cooperate in ensuring that rural people manage bio-resources properly.

*(b) Income Earning Activities and Bioenergy Options Use*

The results of the bioenergy options project suggest that energy issues cannot be considered in isolation from the context of the need for economic development of the local communities as such. It has been seen that the major concerns of the villagers in the study areas are the ones related to economic development, infrastructure and social services development.

The first lesson learned from the project is that if energy issues in general shall have a bearing on the priorities of the people in the villages, it is not simply by satisfying the already known and prioritized energy needs. If at all energy solutions in general, and bioenergy options in particular are going to be successful in solving the people's problems, it is necessary to identify the linkages between energy solutions and the areas which are highlighted as the major problems by the villagers.

**References**

Bahagavan, M.R. and S. Karekezi (eds.). 1992. *Energy for Rural Development*, London: Zed Books.

Barnett, A.; M. Bell and K. Hoffman. 1982. *Rural Energy and the Third World: A Review of Social Science Research and Technology Policy Problems*. Oxford: Pergamon Press.

Bureau of Resource Assessment and Land Use Planning (BRALUP). 1970. *Agro-Economic Zones of Northern-Eastern Tanzania* (Research Report No.13).

Butera, Federico. 1989. *Renewable Energy Source in Developing Countries: Success and Failure in Technology Transfer and Diffusion*. Rome: PFE (LB-18).

Chachage, C.S. and A.A. Mvungi. 1988. Village Participation Survey, (for TFAP). Dar es Salam: Ministry of Lands, Natural Resources and Tourism.

Carlos, E.S. 1984. A Methodology and Planning Style for Developing Countries, In: Proceedings of the International Seminar on Methodology and Institutions for Energy Planning, Rio de Janeiro, Brazil.

Chambers, R.,. 1994. The Origins and Practice of Participatory Rural Appraisal. *World Development* 22. 1994) 7: 953-969.

Chopra,S.K. 1990. *A New Integrated Approach for Energy Planning for Sustainable Agriculture and Rural Development in Developing Countries*. Rome: FAO (Environment and energy Pager 12).

ETC Foundation. 1987. Wood Energy Development: *A Study of the SADDC Region*. Luanda, Angola.

FAO. 1990. *A New Approach to Energy Planning for Sustainable Rural Development*, Rome.

Foley, G., 1991, Energy Assistance Revisited, Paper Presented at SEI, 16th April, 1991.

IIED. 1994. RRA Notes Number 19: Special Issue on Training. London.

INSTRAW, ILO. 1980. *Women and Renewable Sources of Energy*. Turin, Italy.

Karekezi, S. 1988. *Review of Mature Renewable Energy Technologies (RETs) in Sub-Saharan Africa*. Research Report for NIR/SAREC/IDRC

Karekezi, S. 1990. Energy for Rural Development. In: Proceedings of United Nations Group of Experts on the Role of New and Renewable Sources of Energy in Integrated Rural Development. Stockholm.

Karekezi, S. and G.A. Mackenzie. 1993. *Energy Options for Africa: Environmentally Sustainable Alternatives*. Cambridge.

Karenzi, C.P. 1994. *Introduction tot he Biomass Study. In: Biomass, Energy and Coal in Africa*, London. Zed Books.

Kristoferson, L. and V. Bokalders. 1991. *Renewable Energy Technologies: Their Applicants in Developing Countries*, London IT Publications.

Kulindwa, K. and F. Shechambo. 1995. *The Impact of Rural Energy use on the Environment during the Economic Reform Period. 1981-1992): Some Evidence from Tanzania*. UTAFITI (New Series) Vol. 2, No.1 & 2, 1995 p. 110-131.

Leach, G. 1995. *Information Needs for Bioenergy Options*. Paper presented at the Methods for Exploring Bioenergy Options Mid Term Seminar, Bahari Beach Hotel, Dar es Salaam, 26-27 July1995.

Leach, G. and M. Gowen. 1987. *Household Energy Handbook*. Washington, D.C.: World Bank Technical Paper No. 67.

Leach, G. and R. Mearns. 1998. *Beyond the Woodfuel Crisis: People, Land and Trees in Africa*. London: Earthscan.

Mascarenhas, A. 1985. *Keynote Address to the Workshop on Biomass Resources Assessment*, Arusha, Tanzania, 30 June 5 – July, London: Commonwealth Science Council (Technical Publication No.177).

Millington,A. and J. Townsend. 1989. *Biomass Assessment: Woody Biomass in the SADCC Region*. London: Earthscan.

Mnzava, E.M. 1980. *Village Afforestation: Lessons from Experience in Tanzania*, Rome: FAO.

—. 1987. *National Survey of Biomass/Woodfuel Activities*, Tanzania, Luanda:TAU.

Moyo, S.P. O'Keefe and M. Sill. 1993. *The Southern African Environment: Profiles of the SADC Countries*, London: Earthscan.

Mwandosya, M.J. and M.K. Luhanga,. 1988. *A Comprendium of Energy Sources in Tanzania*. Ottawa, IDRC (IDRC/MR 176 e)

Mwandosya, M.J., M. Kinyajui and E.N. Sawe. 1992. *Development and Diffusion of Wood Conservation Technologies in Tanzania: The Experience of the Energy Project I.* Dar es Salaam.

Mwihava, C.X. and A. Towo,. 1994. *A Study and Assessment of Energy Projects and their Effective Utilization in Tanzania, Dar es Salaam*: MWEM.

Pretty, J.; I.Guitt and J. Thompson. 1995. *A Trainer's Guide for participatory Learning and Action.*

Sawe, E.N. 1995. *Bioenergy Based Industries in Tanzania: Report for the UNIDO Bioenergy for Industrial Development Programme in Africa.* Dar es Salaam, MWEM.

Sawe, E.N. and G. Leach. 1989. *Bioenergy:* A paper prepared for the Tropical Forestry Action Plan. Dar es Salaam, MWEM.

Skutch, M.M. 1983. *Why People Don't Plant Trees: The Socio-Economic Impact of Existing Woodfuel Programmes.*

Theis, J. and M.G. Heather. 1991. *Participatory Rapid Appraisal for Community Development: a Training Manual Based on Experiences in the Middle East and North Africa.* London: IIED.

UNIFEM. 1993. Gender, Environment and Development (GED) *Guide: Strengthening and Maintaining Environmental Awareness in UNIFEM – Supported Programmes.* New York: UNIFEM.

United Nations, 1993, UN Conference on New and Renewable Sources of Energy, Nairobi.

URT. Ministry of Agriculture. 1982. *The Tanzania National Agricultural Policy*, Dar es Salam.

—. Ministry of Community Development, Women Affairs and Children. 1992. *Policy on Women in Development in Tanzania*, Dar es Salaam.

—. Planning Commission and Ministry of Finance. 1994. *The Rolling Plan and Forward Budget for Tanzania, Dar es Salaam:* Planning Commission, President's Office.

—. Ministry of Livestock Development. 1983. *The Livestock Policy of Tanzania.* Dar es Salaam.

—. Ministry of Science, Technology and Higher Education. 1993. The National Science and Technology Policy (Draft. Dar es Salaam: MSTH.

—. Ministry of Water Energy and Minerals. 1986. Dar es Salaam: MWEM (Mimeo)

—. Ministry of Water, Energy and Minerals. 1996. *Draft Energy, Master Plan and Programme*, Dar es Salaam: MWEM, 1991.

—. Ministry of Water Energy and Minerals. 1992) *The Energy Policy of Tanzania.* Dar es Salaam: MWEM.

—. Vice-President's Office. 1996. *The National Environment Policy* (Draft. Dar es Salaam.

Van de Ven, H. 1996. *The Sustainability of the Small-Scale Brick-Burning Industry in Tanzania: With Special Attention to Biomass Energy Consumption.* M.Sc. Thesis, Eindhoven, University of Technology, April 1996.

Walubengo, D. 1989. (Ed.) *Proceeding of the International Biomass Course.* Nairobi, Kenya.

World Bank. 1994. *Estimating Woody Biomass in Sub-Saharan Africa*. Washington: IBRD

World Bank/UNDP. 1984. ESMAP 1984: *Tanzania: Issues and Options in the Energy Sector*. Washington: World Bank/UNDP (Report No.4969 TA).

World Resources Institute, Egerton University and Clark University. 1993. *Participatory Rural Appraisal Handbook: Training Notes on Participatory Rural Appraisal*, London: IIED.