Southern African ENERGY & ENVIRONMENT programme

Energy and environment challenges in Southern Africa: the case of Tanzania

November 1995

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SOUTHERN AFRICA ENERGY AND ENVIRONMENT PROGRAMME (SAEEP)

Energy Related Environment Problems In Southern Africa

TANZANIA REPORT

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November, 1995

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1.0 Introduction

1.1 SAEEP Programme

The Southern African Energy and Environment Programme (SAEEP) aims at providing policy analysis for sustainable energy development within the post-apartheid southern Africa. It involves five centres in Tanzania, Zambia, South Africa and Zimbabwe. The Centre for Energy, Environment, Science and Technology (CEEST) is one of them.

The Centre for Energy, Environment, Science and Technology has the overall mission of fostering research, development analysis, information and expertise on matters related to energy, the environment, water and sanitation, and natural resources use and management. The success of this endeavour will to a large extent depend on the application and judicious use of science and technology for development.

Some of the studies carried by CEEST in energy and environment, include Greenhouse Gas Emissions, Ozone Depleting Substances (ODS), Greenhouse Gases Mitigation, Assessment of Vulnerability and Adaption to Climate Change and Environment Impact of Small Scale Mining: A case study on Merelani, Kahama, Nzega, Geita and Musoma.

1.2 Literature Review

Some of the literature under review include:-

Energy Policy volume 21 Number 5 Special Issue - Urban energy and environment in Africa Butterworth - Heinmann May, 1993. This included the Tanzania Urban energy study which was carried out by the Energy Research Project of the University of Dar es Salaam in collaboration with the Stockholm Environment Institute. It zeroed in on the energy consumption patterns in the household and commercial sectors in relation to wood depletion and environment.

Further energy projections were made in this study and an analysis of energy price of urbanisation. Energy pricing structure and policy issues were covered in the study.

Although energy related problems were mentioned in this study no detailed account was made on implications and future aspects.

Climate change studies carried by CEEST include:

- Pollution in the manufacturing sector - CEEST Report No. 2/1994. A study and a roundtable discussion was held on 20th May 1994 in respect of pollution in the manufacturing sector.

- Sources and sinks of greenhouse gases in Tanzania; 1994 Energy use has been cited as one of the sources of greenhouse gases while forests are sinks. This study, carried by CEEST tried to evaluate the extent of the sources. Tree depletion is associated with more emissions. Also combustion fuels like diesel and petrol in motor vehicles are other sources of GHG emissions. These few examples are the energy related sources covered in the study.

- Study on Technological and Other Options for the Mitigation of Greenhouse Gases in Tanzania - CEEST working document, 1995: This was carried by CEEST and was concerned with developing technical and other options for mitigation GHG emissions in Tanzania.

The Energy Policy of Tanzania April, (1992).

The policy advocates use of energy for sustainable development. The main focus is to reduce forest depletion and reduce dependency on imported oil. Options advocated include use of natural gas, hydropower, solar and biomass energy as alternatives.

The Draft National Environmental Policy, (1994)

The policy advocates on sustainable use of energy resources, especially the forest resources.

National Environment Action Plan (NEAP), (1994)

This was prepared by Ministry of Natural Resources and Environment. A first step, June, 1994 in recognition of depletion of forests due to woodfuel and other uses, the NEAP proposes remedial measures including general education to the people through information and awareness.

1.3 **Other related research projects**

There are other related research projects from which SAEEP can borrow some information. Such projects include:

- Development and Diffusion of Wood Energy Conservation Technology in Tanzania.
- Urban Households Energy Use in Tanzania: Price substitute and Poverty.
- Industrial Energy Use in Urban Tanzania.

1.4 **Organisation of the report**

The report will first focus on the particular ERP problems rather than only on policies. Secondly we will identify the stakeholders, within the state and society; thirdly, we will analyse how and to what extent the government of Tanzania

expends efforts to solve the problems; and fourthly we will survey the impact of policies or non-policies in the area.

2. Country description

The United Republic of Tanzania comprises the mainland Tanzania (formerly Tanganyika) and the islands of Zanzibar and Pemba. The official currency is the Tanzanian Shilling.

The country is located in Eastern Africa between longitude 29° East and longitude 41° East and latitudes 1° South and 12° South. The country borders Kenya and Uganda to the North, Burundi, Rwanda and Zaire to the West, Zambia, Malawi and Mozambique to the South and the Indian Ocean to the East.

The land area of mainland Tanzania is 881,289 square kilometres and Zanzibar has an area of 2,450 square kilometers. Its inland waters are with an area of 61,495 square kilometres are included, the total area for the country is about 945,234 square kilometres.

Major lakes in the country include Victoria in north-eastern part (34,850 square kilometres), Tanganyika in the west (13,350 square kilometres), and Nyasa in the south (5,600 square kilometres). In the central part of the country there is lake Eyasi (1,050 square kilometres) and others covering about 3,795 square kilometres. Arable land is about 3,634,000 hectares. Tanzania is the land of Mount Kilimanjaro which rises 5,895 metres above sea level and mount Meru 4,566 metres above sea level.

There are 19 main game reserves in the country occupying about a quarter of the total area. Such game reserves include the world famous Serengeti National Park, Ngorongoro Crater, Mikumi National Park, Selous Game Reserve, etc.

The climate of Tanzania is mainly of two rainy seasons. The main occurrence is from March to May, while the other one is from October to December. Generally, there is a well distributed rainfall throughout the year. Peak occurrence is from March to May.

2.1 Overview of the economy

The Tanzania economy consists of a large rural sector, with a population of 22,533,348 (1988 census). The growth rate is 2.8% (using the 1978 and 1988 censuses). The country depends heavily on exportation of primary products, especially agricultural ones. Table 1 summarises the performance of the external sector from 1980 to 1987.

Table 1: **Some indicators of export performance in indices**

Year	Export (mil US$) 1980=100	Imports (mil US$) 1980 = 100	Export of main crops (Mil US$) 1980 = 100
1980	100	100	100
1981	109	95	128
1982	82	91	95
1983	75	67	93
1984	67	72	101
1985	56	82	74
1986	69	86	90
1987	69	-	76

Source: Tanzania Economic Trends, Vol. 1, No.4, 1989: M.F.1988

In 1974/75 the country was hit by drought which resulted in a serious hunger. Further, the oil price increases of 1974 strained the economy and the manufacturing sector was accounting for only 13% of the total GDP by 1976.

From 1977 the economy started to deteriorate and as a result, the growth of its sectors was seriously affected. The problems included the break up of the East African Community (1977), oil shocks (1979), droughts (1979), Iddi Amin's war (1978/79) and inappropriate macro policies. The crisis manifested itself in large budget deficits, foreign exchange problems, balance of payment deficits, high rates of inflation, low rates of growth of output and sometimes negative and declining per capita incomes and standards of living. The country's social and physical infrastructure also deteriorated.

Table 2: **Average annual rates of growth of GDP at 1976 prices (%)**

Year	1977	1978	1979	1980	1981	1982	1983	1984	1985
GDP Growth	0.40	1.12	2.99	-0.50	0.59	-2.38	3.38	2.63	3.26

Table 2: **Cont.**

Year	1986	1987	1988	1989	1990	1991	1992
GDP Growth	5.09	4.23	4.00	4.77	3.89	3.60	

Source: National Accounts of Tanzania 1976-1992; Bureau of Statistics, Planning Commission.

In an attempt to arrest the situation, different measures have been adopted since 1980. The initial programmes of NESP, (National Economic Survival Programme) and SAP (Structural Adjustment Programme) were not very successful because they did not address the serious problems of macro imbalances and incentive. ERP (Economic Recovery Programme) has addressed many of these problems and performance has improved. Table 2 shows the GDP performance from 1977 to 1992.

Inflation averaged 11% per annum in the 1970's and 33.3% in 1986. It is now 20% in the 1990's. Tanzania faces a severe debt problem with a total debt stock of $6.4 billions at the end of 1991 equal to 256% of GNP.

Deficits have been a major feature in the national budgets. This has led to reforms in the public sector, including the introduction of cost sharing in education and health services. Table 3 summarizes the main features of the government budget from 1987 to 1993.

Table 3: **Revenue and expenditure (Year ending June, 30th)**

	1987	1988	1989	1990	1991	1992	1993*
Recurrent revenue	34.5	58.0	71.8	94.7	135.9	173.6	21.6
Recurrent expenditure	40.4	61.8	92.3	116.0	160.3	195.7	251.5
Development revenue	15.1	15.1	15.7	16.3	38.2	32.6	102.1
Internal	9.6	8.5	6.2	4.6	20.0	20.0	30.0
External	5.5	6.6	9.6	11.7	18.2	12.0	72.1
Development expenditure	15.1	15.1	15.7	16.3	38.2	32.6	102.1
Total revenue (R&D)	49.6	73.1	87.5	110.9	174.1	206.2	317.7
Total (R&D)	55.5	76.9	108.0	132.2	198.5	232.4	353.6
Budget deficit	5.9	3.8	20.5	21.3	14.4	26.2	35.9
Deficit/Exp.	17%	6%	28%	22%	10%	15%	166%

Source: Tanzania in figures 1992; Bureau of Statistics, Planning Commission, President's office.

* = estimates

R&D = Reccurent and Development

The economic recovery programmes have tended to reduce the recurrent budget deficits at the expense of social service provision although there have been significant increases from 1992.

The economic Recovery Programme (ERP) II, which is a continuation of ERP I focusses on social services especially education and health. This includes improvement in the two sectors through cost sharing programmes, whose impact is yet to be researched.

2.2 Energy resource base, production and use

The sources of energy in Tanzania include, forest and agriculture residues, woodfuels, coal and natural gas, hydro electric energy and solar energy.

2.2.1 Woodfuel

The total forested area of Tanzania is 28 million hectares and about 12 million hectares of these are reserved forests. There is only a mere 200,000 hectares of village woodlands. But forest areas are being depleted at a rate faster than the regeneration rate of forests.

2.2.2 Forest and agriculture residues

Limited residues of these are used for electricity and mechanical power generation as a fuel substitute in various parts of the country. According to the Energy Policy of Tanzania the current size of forest and crop residues are estimated at 1.1 million tonnes and 15 million tonnes respectively per annum and could, account for 10% of the nations energy requirement.

2.2.3 Coal and natural gas

Coal and natural gas are the other indigenous commercial fuels of high potential. Coal reserves are estimated at about 1,200 million tonnes of which 304 million tonnes may be considered proven. Natural gas exists at Songo Songo and Mnazi Bay. A field with 29.02 billion cubic metres of proven, probable and possible recoverable high quality natural gas has been discovered at Songo Songo. (1).

2.2.4 Solar, wind and geothermal energy

2.2.4.1 Solar energy

With close proximity to the Equator, Tanzania has greet, potential of solar eneryg. It is estimated that the sunshine periods in the country range from 2800 to 3500 hours annually.

Solar technologies available in the country include photovoitaics, solar water-heaters, solar-frier and solar refrigeratin equipment (5).

2.2.4.2 Wind energy

Wind energy in Tanzania has been used to pump water for irrigation and to meet domestic and stock wter needs. Very little has been done to use water for electricity generation.

There has been little success at the design and manufacture of windmills locally. But even imported windmill designs have bad little success. This is mainly due

to poor designs and lack of maintenance had and spares, lack of skills, for repair, and lack of reliable data on wind charcteristics (1).

2.2.4.3 **Geothermal energy**

Geothermal sources exist in Tanzania. This is mainly due to the presence of active volcanoes, numerous geological faults and hot water springs, indicating the possible occurrence of hot water reservoirs which could be used for power generation. The discovery of geothermal sources in the Kenya part of the rift system show the possibility of such sources occuring in the Tanzania side to the rift system.

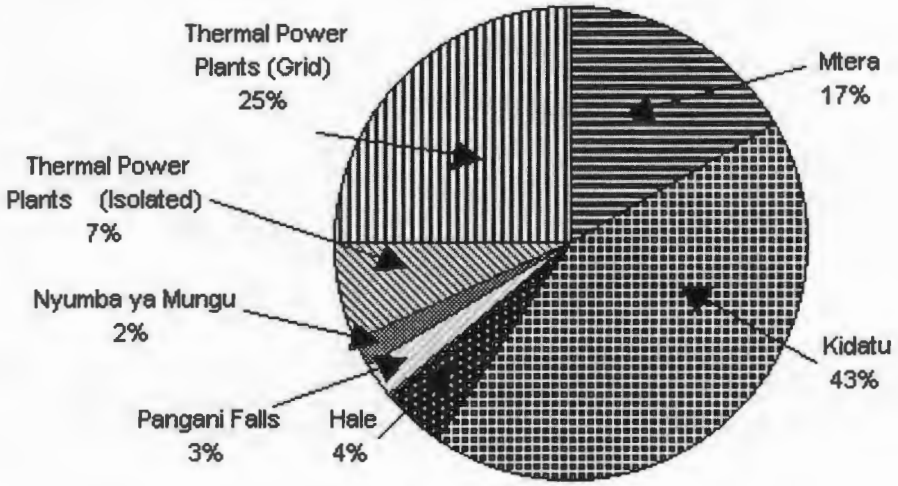
Since it is very expensive to develop geothermal sources, it is possible that these can be developed in the very distant future, but studies can still be undertaken to establish their potential (1).

2.2.5 **Electricity potentials and generation**

This is the most important indigenous source of commercial energy in the country. The country has a potential of 4.7 GW of installed capacity and about 3.2 GW of firm capacity. Only 10 percent of the potential installed capacity has been developed (1).

The present power system is composed of isolated thermal power plants and thermal plants which are interconnected to the national grid system. The thermal plants are powered by reciprocating diesel engines. Total installed capacity of the isolated power plaints in 1990 was 32.82MW. Most of these plants are old and in dire need of spare parts to make them operational. The grid system is composed of hydro-power generating sets and the interconnected thermal power plants. The total generating capacity for the whole system was 478MW in 1990 from various sources as shown in Fig. 1.

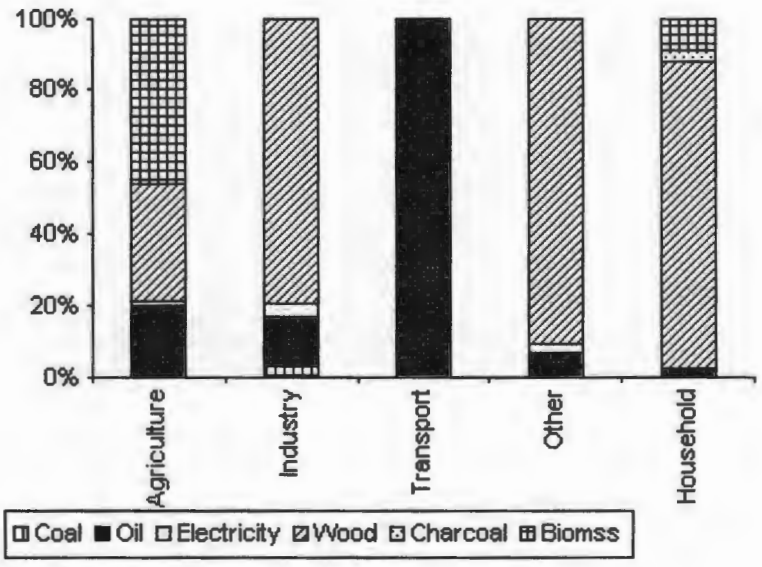
Fig. 1: **Electricity generation capacity in 1990**



2.2.6 Energy consumption pattern

Energy consumption in Tanzania is dominated by woodfuel in the household sector and petroleum in the transport sector. The industrial sector uses both electricity and petroleum. Fig 2 shows the energy consumption pattern in Tanzania.

Fig. 2: Structure of energy consumption by sectors



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2.2.6.1 **Electricity consumption**

Electricity accounts for 0.8 percent of final energy consumption. Tanzania consumes very little electricity compared to other countries. In 1988 the consumption was 1060 gigawatt hours (Gwh) which correspond to a per capita consumption of 46 kWh. Those who have electricity constitute only 5 percent of the entire population. Consumers of electricity have be grouped into 10 categories. The long term goal in the electricity subsector is to double the percapita electricity consumption by type in the year 2005.(1)

2.2.6.2 **Petroleum**

It accounts for 7.2 percent of final energy consumption. It is estimated that in 1989, Tanzania final energy consumption was 15.0 million tonnes of oil equivalent (TOE). The per capita energy consumption was therefore of the order of 0.65 TOE (1).

As far as petroleum is concerned, in 1965 Tanzania consumed 337,000 tonnes of petroleum products whereas in 1986 the level of imports had increased to 855,000 tonnes. The transport sector accounts for nearly 51 percent of petroleum used in the country. The industry sector and the household sector account for 26 percent and 10 percent respectively. (1)

2.2.6.3 **Woodfuels**

Fuelwood, charcoal and agricultural residues account for 92 percent of final energy consumption in Tanzania in 1989 of which about 80 percent was used for domestic cooking and heating (1).

2.3 **National energy and development priorities**

2.3.1 **The National Energy Policy**

Tanzania adopted the National Energy Policy in 1992 after realising that energy is a crucial input into the development process. The overall policy objective of energy development will be to develop an input into the development process of the country through an effient energy production, procurement, transportation, distribution, and end-use system in an environmentally sound manner and with due regard to gender issues.

The overall goals of the National energy Policy are as follows:-

. exploitation of the abundant hydro-electric sources;

. development and utilisation of natural gas and coal resources;

. stepping up petroleum exploration activities;

- reduction in the pace of woodfuel depletion through the evaluation of more appropriate and management practices and more efficient woodfuel technologies;

- development and utilization of forest and agriculture residue for power and cooking energy production;

- minimization of energy price fluctuations in order to contribute to general price stability through strengthening and rationalisation of energy supply sources and infrastructure and a rational pricing structure;

- investment in appropriate human resources for energy sector management and energy technological development; and

- ensuring the continuity and security of energy supplies.

The main thrust of the Economic Recovery Programme (ERP) has been directed at rehabilitation of social and economic infrastructure. Within this general time frame, the immediate short and medium term strategical of the national Energy Policy will include:-

- the efficient use of energy in the transport and industrial sectors;

- the rehabilitation of the electricity system;

- the rehabilitation and rationalization of the petroleum infrastructure;

- the generation and distribution of electricity and affordable prices, commensurate with demand;

- the development and dissemination of efficient woodfuel conversion and utilization technologies; and

- the supply of electricity to small townships and industries lying adjacent to the grid system (1).

2.3.2 **National development programmes in the environment sector**

The National Environment Action Plan (NEAP) was adopted in 1994. It is Tanzania's first step towards a comprehensive incorporation of environmental concerns into the fabric of national planning and development. The importance of this step is the fact that most Tanzanian's depend on the national resources of the country for their livelihood and the future generation will need those resources for their well-being.

The current state of the Tanzania environment is a matter of concern. This national analysis identifies six major problems of urgent national attention. These show:

- that land degradation is reducing the productivity of soil in many part of Tanzania;

- that despite considerable national effort, over half the people in towns and in the country side do not have access to good quality water for washing, cooking, drinking and bathing;

- that the pollution in towns and the country side is affecting the health of many people and lowering the productivity of the environment;

- that loss of habitats for wildlife is threatening the national heritage and creating an uncertain future for the tourist in study;

- that the productivity of lake, coastal and river waters is threatened by pollution and poor management; and

- that Tanzania forest and woodland heritage is being reduced year by year through clearance for agriculture, for woodfuel and for other demands.

To address the pressing issues of natural resource use and environmental management the government has undertaken a policy and strategy formulation process including an action plan which provides the context for an first step long-term national approach to environmental sustainability. After this step the formulation of the National Environment Policy followed (3).

2.4 **Energy Institutions**

2.4.1 **The Ministry of Water, Energy and Minerals (MWEM)**

It is responsible for overseeing and guiding the development of the energy sector in order to meet the goals of energy development.

2.4.1.1 The Department of Energy and Petroleum was formed on 1988 - looks at affairs related to energy and petroleum in the country.

2.4.1.2 The Tanzania Electric Supply Company Ltd (TANESCO) - deals with production and distribution of power. Nearly all the electricity produced in the country is by TANESCO.

2.4.1.3 The Zanzibar State Power and Fuel Corporation (ZSFF) - deals with the distribution of power and fuel in Zanzibar.

2.4.1.4 The Tanzania Petroleum Development Corporation (TPDC) - deals with the procurement exploration and overseeing of oil companies in Tanzania.

4.2.1.5 The Tanzania and Italian Petroleum Refinery Co. Ltd. (TIPER)- This company refines petroleum products for use in the country.

2.4.1.6 TAZAMA Pipeline jointly owned by Zambia and Tanzania with 67% and 33% shareholding respectively, transports crude oil from Dar es salaam to Ndola, Zambia.

2.4.1.7 The State Mining Corporation (STAMICO) through Kiwira Coal Mine produces coal for use within the country. The coal mine also runs a 6 megawatt power station.

2.4.1.8 Other Institutions

2.4.1.9 Oil Marketing Companies - There are a number of oil companies operating in the country. These include BP Tanzania Limited, AGIP, CALTEX, TOTAL, and ESSO.

2.4.2 The Ministry of Tourism, Natural Resources and Environment (MTNRE)

It has a key coordinating role. This ministry through the Forestry Division and the Division of Environment (DoE) deals with environmental issues.

The Division of Environment is responsible for policy formulation.

2.4.2.1 The National Environment Management Council (NEMC) - It provides an advisory role to the Ministry.

3 Energy related Environment Problems

There are a number of ERPs in the country within household, national, regional and global levels.

3.1.1 The nature of the problem

3.1.1.1. The main characteristics

(i) Household

The major problem here is air pollution caused by smoke from woodfuel and charcoal used by nearly 90 percent of the population. Pollution also occurs from Kerosene stoves. Indoor use of fuelwood, charcoal and kerosene contributes to air pollution and causes respiratory problems.

In areas where woodfuel is scarce due to deforestation like Shinyanga, Mwanza, Singida and parts of Tabora and Arusha people use cowdung as fuel for cooking purposes. This has the effect of producing fumes which make women's eyes red. In some cases old women who have such red eyes due to burning cowdung are taken for witches.

(ii) National

- The cutting of the wood depletes forests and so desertification is imminent in some areas in others there is soil erosion

- Hydropower involves the construction of dams. Siltation is very common in dams such as Mtera and Kidatu which provide water for the generation of electric power.

- The TAZAMA Pipeline which transport crude oil form Dar es Salaam to Ndola in Zambia is also a source of pollution of rivers and land through which it traverses.

(iii) Regional

So far this is not a big problem as yet because the coal utilisation is still at its infancy so there is no acid rain between Tanzania and Zambia, Malawi or Mozambique.

(iv) Global Level

Tanzania cannot isolate itself from global pollution which is caused by emission of GHGs and it is also a contributer of emission of carbon dioxide and other gases caused by agricultural, industrial activities and the burning of forests especially when collecting firewood.

3.1.1.2 **Threats**

These environmental problems are a threat to people, the economy and ecology.

(i) People

People are affected by air pollution caused by burning of fuelwood and kerosene stoves. This leads to respiratory diseases especially in the rural areas where houses are not well ventilated.

(ii) Economy

Tanzania is mainly an agricultural country and since the cutting of trees for fuelwood depletes the land and thus fertile land is decreased. This leads to less agricultural production.

- cutting of trees also reduces the availability of water in the country. Many areas are drought-prone.

- petroleum exploration leads to destruction of the environment both marine and mainland areas.

- Electricity transmission lines are an eyesore and sometimes lead to probable ill health to those living near high tension lines

- Gas

  There was an incident whereby there was a blow out and fire ensured at Songo Songo. This is a loss to the economy because valuable gas was lost.

(iii) Ecology

Tree cutting for fuelwood depletes the vegetation cover and the habitat for wildlife, birds, insects etc. This damage is to the environment and the economy.

3.1.2 **Stakeholders**

3.1.2.1 **Supportive**

Many of the stakeholders are supportive to tackling environmental problems by instituting of EIAs in their projects even with no laws to bind them. For example TANESCO undertakes EIAs in her projects. TPDC as well has commissioned an EIA on the proposed gas pipeline from Songo Songo to Dar es Salaam.

3.1.2.2 **Non-Supportive**

The majority of the people are not supportive to the call for less destruction of the forests in search of fuelwood and charcoal making. Afforestation and reforestation campaigns are not well received.

3.1.2.3 **Policy Brokers (NGOs and governmental)**

Many NGOs (environmental and energy) are coming up and they act as watchdogs and cry for better environment, environmentally friendly technology, energy saving appliances and greenbelts. The NGOs, are working hand in hand with the Government, on environment and energy related issues. Workshops, seminars and roundtables are organised by NGOs and the government to discuss environmental and energy related issues.

The government on the other hand has produced policies on energy, land, agriculture, forestry science and technology and is currently preparing the National Environmental Policy. NGOs are also involved in these initiatives.

3.1.3 **Government Policies, Programmes and Projects**

As mentioned above the government has produced a number of policies which involve different sectors. In all of these environmental issues and sometimes energy matters are covered. Programmes touch on the environment and

energy for it is correctly said that there cannot be sustainable development without looking at these live issues.

3.1.4 **Impacts of Action on the Problems**

Both the public and the government are conscious of the environmental and energy issues. Public awareness campaigns are being called for, environmentally friendly technologies are being advocated and energy saving devices are being promoted. These problems can be tackled by good policies and enacting relevant laws.

3.2 **Conflicting or harmonising instruments?**

3.2.1 **Local, regional and global**

(i) Local

There are conflicting legislations on these energy and environmental related problems. There is need to harmonise them.

Institutional arrangements are also conflicting for example the role of the NEMC and the Environment Division leave a lot to be desired. There is a need to define their roles, properly and where possible harmonise their roles.

(ii) Regional

Some problems are transboundary for example the TAZAMA Pipeline between Tanzania and Zambia. There is also a possibility of air pollution between the two countries. Laws can be made which are in harmony between the two countries so as to arrest the problems.

(iii) Global

Global issues should also be looked at especially at the problem of climate change. The SADC countries can look at this issues as a group so that they can harmonise their laws.

3.2.2. **Economy, equity and environment**

The economy of Tanzania is a liberalised one with market forces taking their course, there is no equitable distribution of income. There are many people who are living below the poverty line. Such people are the ones who cannot afford electricity and petroleum products. Therefore they resort to cutting firewood and making charcoal. This leads to land degradation. Signs of desertification and soil erosion are there.

4. Recommendation

Energy for sustainable Development

4.1 Viable paths that have not been explored:

(a) Tanzania is endowed with a number of energy resources and some of them have been hardly tapped. Even the hydro-electric power is below its potential

(b) Natural gas resources are about to be exploited and these are also very promising.

(c) Coal resources abound. These can be utilised fully after the exploitation of iron reserves at Mchuchuma. Energy from coal will be used in the steel industry there.

(d) The National Energy Policy calls for stepping up of petroleum exploration activities. These have not been fully explored. Should petroleum be discovered then the socio-economic position of Tanzania will change because at the moment the whole economy depends on imported oil.

(e) Not much effort has been made to arrest woodfuel depletion by evolving more appropriate land management practices and more efficient woodfuel technologies.

(f) The development and utilisation of forest and agricultural residues for power and cooking energy production hasn't been practiced fully. Of late it is the Taka Gas project which utilises municipal waste. It is now on the drawing board and it aims at producing electricity from the waste.

The energy-related environmental problems (ERPs) could have been reduced if the National Energy Policy and the proposed National Environment Policy were adhered to.

4.2 **Barriers (what conditions can make such proposed solutions possible?).**

(a) As stated above, the government policies should be adhered to.

(b) Good laws related to energy should be made. For example laws and regulations relating to the protection of hydropower sources should be reviewed and strengthened. Where necessary new laws should be enacted. Also laws and regulations regarding the protection of existing reservoirs for hydropower should be reviewed and strengthened.

(c) Environmental Impact Assessment must be undertaken before the exploitation of new energy resources.

(d) Solutions can also be possible where there is an awareness campaign from the public and stakeholders on energy-related environmental problems.

(e) The economic climate should also allow for the tackling of these environmental problems. Business and industry should be in the forefront of reducing these problems.

(f) The government should work hand in hand with the public and private sector in these issues, and not forgetting the non-governmental organisations (NGOs).

4.3 Policies and state recommendations

(a) Laws and regulations should be made on matters related to energy as recommended by the National Energy Policy.
(b) Laws between the SADC countries (on energy and environment) should be harmonised.
(c) Energy and environmental experts should be consulted in all energy related projects.
(d) Capacity building in these issues should be enhanced and where possible there should be cooperation among the SADC countries.
(e) Environmentally friendly technologies should be encouraged.
(f) Energy servicing devices e.g JIKO BORA (good cooking stoves) should be promoted.
(g) Exchange programmes of personnel e.g., NGOs in the SADC countries should be encouraged.

4.4 Directions for further studies

(a) We should go for studies which are regional in nature (after completing the national ones). For example Tanzania and Zambia could study the effect of connecting their electricity grids on the environment or the effect to the TAZAMA Pipelines on the environment of the two named countries.

(b) We could also study role of NGOs (energy and environment) in the development of the SADC countries.

(c) Specific studies could be undertaken on transboundary pollution.

(d) Studies on the distribution of petroleum products and their effect on the environment in SADC countries.

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