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A COMPUTER-BASED INFORMATION SUPPORT SYSTEM FOR ENERGY RESOURCES DEVELOPMENT IN TANZANIA

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A Computer-Based Information Support System

For Energy Resources Development in Tanzania

by

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Dedication

To my Mother, Anyamidze whose contribution in laying the foundation for my education is undescribable.

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ABSTRACT

Energy is a critical input into any country's development process. It is a pre
for the proper functioning of almost all sectors of the economy, and a resource v
continuous supply of which human society cannot survive well. Therefore, elaborate
and strategies need to be organized to develop sufficient energy supplies. On the
hand, working out successful planning and strategies is knowledge based and require tir
and sufficient information.

This study set out to investigate the information support services available
institutions related to energy resources development in Tanzania. Among the things whi
the study investigated include: the information flow pattern, information resource sharing
application of information Technology, the kind of services offered by information centres
and how the people engaged in energy development planning and decision making are
benefited by these information centres.

Results of the survey conducted among six information centres indicate that the
performance of information services supporting energy development in the country is weak.
This dismal performance originates from among other things the ineffective information
flow pattern, lack of coordination of information centres related to energy development,
inadequacies in data collection, processing and dissemination, especially at the Energy
Development Unit, low level of application of Information Technology (IT) in handling and
dissemination of information, inadequacy in trained information personnel, and absence of
computer-based services.

In order to overcome the shortcomings mentioned above this study proposes the
establishment of a Computer-Based Information Support System for Energy Resources
Development in Tanzania (CBISSERD), which would work on a LAN established at the
Ministry of Water, Energy and Minerals. Two types of prototype databases have been
developed. The first one is an integrated database called 'JORAM' which consists of
Bibliographic Records, Profiles of Experts, Profiles of Projects, Profiles of Institutions and
Profiles of Information Systems. The second type is a set of specialized databases named

TASEC, ENERT and ENTAB. These prototype databases are expected to be a source of valuable information to help the process of energy development in Tanzania.

Among the recommendations made following this study, include: the immediate establishment of the National Information Policy on Information Systems and Services, the establishment of a National Information System to coordinate information institutions, for the government to give reasonable attention to information as an important resource for development, and improvement of IT application in the information sector in Tanzania. These suggestions are expected to improve the information systems' capacity in supporting energy resources development in Tanzania.

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LIST OF ABBREVIATIONS

AACR:	Anglo American Cataloguing Rules
ADIPA:	Association of Development Research and Training Institute
AFREPREN:	African Energy Policy Network
CAS:	Current Awareness Services
CBISSERD:	Computer-Based Information Support System for energy Resources Development (in Tanzania)
CDS/ISIS:	Computerized Data System/Integrated Set of Information Systems
CDTT:	Centre for Development and Transfer of Technology
COSTECH:	Tanzania Commission for Science and Technology
ECA:	Economic Commission for Africa
ERP:	Economic Recovery Programme
ESAMI:	Eastern and Southern African Management Institute
ESAP:	Economic and Social Adjustment Programme
GDP:	Gross Domestic Product
IEDC:	International Energy Development Corporation
ILCA:	International Livestock Centre for Africa
IRA:	Institute of Resource Assessment
LAN:	Local Area Network
MAL:	Ministry of Agriculture and Livestock
MNRT:	Ministry of Natural Resources and Tourism
MSTHE:	Ministry of Science Technology and Higher Education
MWEM:	Ministry of Water Energy and Minerals
NEMC:	National Environment Management Council

NESP:	National Economic Survival Programme
NORAD:	Norwegian Agency for International Development
NRSE:	New and Renewable Source of Energy
OECD:	Organization for Economic Cooperation and Development
PADIS:	Pan African Development Information System
RPFB:	Rolling Plan and Forward Budget
SAP:	Structural Adjustment Programme
SAREC:	Swedish Agency for Research Cooperation with Developing Countries
SDI:	Selective Dissemination of Information
SEI:	Stockholm Environmental Institute
SISA:	School of Information Studies for Africa
STAMICO:	State Mining Corporation
TAI:	Tanzania Association of Inventors
TANDOC:	Tanzania National Documentation Centre
TANESCO:	Tanzania Electric Supply Company
TANRIC:	Tanzania Natural Resources Information Centre
TAZARA:	Tanzania Zambia Railways Authority
TIPER:	Tanzania and Italian Petroleum Refinery
TLA:	Tanzania Library Association
TPDC:	Tanzania Petroleum Development Corporation
TRC:	Tanzania Railways Corporation
TTC:	Tanzania Telecommunication Corporation
UDSM:	University of Dares Salaam
WAN:	Wide Area Network

CHAPTER 1

INTRODUCTION

1.1. STATEMENT OF THE PROBLEM

Energy is a critical input into any country's development process. It is a prerequisite for the proper functioning of nearly all sub-sectors of the economy. Basically, there cannot be sustainable development or satisfaction of basic needs of society without sufficient and efficient supply and use of energy. Normally, energy availability and its quality determines the success or failure of development endeavour of a country (MWEM 1992).

For a country to achieve sufficient and efficient energy supply for its development, it requires elaborate and articulate plans to develop the available indigenous energy resources. On the other hand, elaborate and articulate development plans are dependent on timely availability of relevant and reliable information and data to the planners, decision makers and executives in the energy development sector.

Tanzania has significant energy resources which are not yet sufficiently developed. These resources include hydro-power, natural gas, coal, geothermal, biomass, solar and wind energy. Some of these energy resources can be developed to substitute for expensive petroleum imports which are heavily used in the industrial and transport sectors in Tanzania; to reduce the country's negative balance of foreign exchange payment.

Since the oil price crisis of 1973, the objectives of energy resources development planning in Tanzania have always been trying to address itself to two issues relating to energy in Tanzania. The first issue is that of ensuring that energy demands are met in the most economic manner. This is done so by encouraging the use of effective technologies, and development of indigenous energy resources. This strategy emphasizes on reduction of oil imports to an affordable level. Currently, petroleum energy source imports consume 50% of the country's scarcely earned foreign exchange. This situation has always disturbed the country's foreign exchange balance of payment to the detriment of the development of other economic sectors (Planning Commission 1994).

The second issue is that of developing the available indigenous energy resources in the country to reduce or substitute for the current overdependence on fuelwood and charcoal energy sources. Currently, fuelwood and charcoal dependence which is in the order of 90% of the total energy sources used in Tanzania (MWEM 1994,18).

The overdependence on fuelwood and charcoal energy sources has proved to have adverse effects on environmental preservation efforts. For instance, the rate of deforestation in the country has been discovered to be growing at an alarming rate, especially in rural areas (MWEM,1994).

Tanzania's efforts to develop its indigenous energy resources have, for many years now, not been quite successful. On its economic analysis for the year 1993/94, the Planning Commission made it clear that the performance of the energy sector was still quite unsatisfactory. One of the problems, which was singled out as the cause of this failure, was the absence of a strong and reliable energy information system and databanks to support the

planning process (Planning Commission 1994).

The importance of information systems and databanks to stimulate economic development cannot be underestimated. For instance, following the 1970s oil crises, the industrialized countries responded to the problem by establishing databanks and clearing houses that contained valuable information on energy resources development, and information on efficient energy technologies in their countries (World Resource Institute 1992). This has not been the case in Tanzania. A number of plans for developing energy resources in Tanzania have up to now been not supported by an adequate and sound information base.

The absence of an effective information system to support energy planning in Tanzania, has led to an ad hoc approach to planning, a move which has resulted to very slow growth of the energy capacity of the country. For instance, between 1973 and 1983 there was an annual growth rate of 5.9%, and 2.6% for energy consumption (Kurian 1987).

Compared to other developing countries, Tanzania remains a relatively small consumer of energies like electricity. This is not as a result of people's reluctance to use this power but rather the inadequate output and distribution system to meet the requirements.

In 1988, the electricity consumption in Tanzania was only 10% of the average consumption for all developing countries, and only 1% of the average for industrialized countries. Those who have access to electricity constitute only 5% of the entire country's population (MWEM 1992). The rest depend much on fuelwood, charcoal, and agricultural

residues. This is not a healthy situation for economic development.

The shortcomings highlighted above require a solution if Tanzania really aims at meeting its energy sustainability goal by developing indigenous energy resources. Normally, issues relating to energy development are directly linked to the overall national economy development. This is so, because, reliable energy supply sustains socio-economic growth of a nation (Goldemberg et al 1988). As indicated above, industries, transportation, agriculture, and households, cannot survive without adequate energy supplies.

A wealth of information and ideas have been, and continue to be, generated from various sources, e.g. government departments, parastatal organizations, industries, and scientific and academic institutions in Tanzania. These indigenous information resources need to be properly organized and managed for supporting effective planning to develop the energy sector. At present, most of these valuable information resources are dispersed and therefore are difficult to access.

The absence of an effective information system to coordinate the dispersed valuable information sources, which could be a supporting base in making sound decisions on energy development, appears to be the major stumbling block in the overall energy resources development in Tanzania. This is a problem which has been crippling the measures taken to develop sustainable energy supplies in the country. It is a problem which several studies have already discovered to be blocking development (Mwandosya and Luhanga 1983). Unless this problem is solved, there will not be sustainable energy resources development in Tanzania. It is by taking this problem into consideration that this study sets out to

propose some solutions to tackle it.

1.2. JUSTIFICATION

As already mentioned above, the importance of energy to socio-economic development cannot be underestimated. Human society cannot survive without continuous supply of energy. This fact, makes all plans to develop energy resources of great importance. The fundamental link between energy development issues and those of short term and long term goals of development, indicates that the energy development issues will continue to draw much attention of the national development planners, if at all they really focus on sustainable development.

Effective economic planning of any country has to be linked to the available as well as future sources of energy. This makes the question of developing energy resources of great significance (Goldemberg et al 1988). Any plan to increase a country's energy capacity paves the way for economic development.

However, development of suitable energy strategies depends to a large extent on sound information base. Energy information arises from the production, conversion, flow, storage and use of energy. It also encompasses the technology management and other activities that are necessary for the production and use of energy to produce goods and services needed in society. It is through energy information circulation and use that optimum use of energy and its application to development, will become a success.

In Tanzania, the Ministry of Water, Energy and Minerals is the institution responsible for overseeing and guiding the development of the energy sector in order to meet the goals of energy development. To be able to discharge this responsibility, the Ministry's task will be to evolve effective policy initiatives on the sector. This will require assessment and analysis of the developments in all sub-sectors of the energy sector. To succeed in this undertaking, the Ministry requires to make intensive use of timely and reliable information on energy demands, available energy technologies, indigenous energy resources potentiality, environmental impacts in the country and the like.

The need for establishing an effective information support system to cater for effective planning and decision making has been realized and recommended by several study reports (Mwandosya and Luhanga 1983, MWEM 1992, Planning Commission 1994). These studies show that the energy sector requires an efficient information support system in order to break away from the past history of slow energy development.

This study sets out to examine the problem in detail with a view to formulating proposals and recommendations for strengthening and enhancing the existing information systems related to energy development in Tanzania.

1.3. OBJECTIVES

1.3.1. General Objective

The general objective of this study is to formulate proposals, plans and

recommendations for organizing an effective and efficient computer-based information support system for energy resources development in Tanzania.

1.3.2. Specific Objectives

With a view to achieving the general objective stated above, the following specific objectives are to be taken into account:

1. To identify the existing information support facilities related to energy resource development and examine their contribution to the sector.

2. To identify information needs of people engaged in energy resources with a view to suggesting an effective system for the development of the energy sector.

3. To examine the information flow pattern in the existing information systems with a view to finding out any possible shortcomings, and proposing some more efficient ways of handling information.

4. To propose a plan for the establishment of a computer-based information support system for energy resources development.

5. To design prototype databases by using Micro CDS/ISIS on:

- Bibliographic records;
- Profiles of institutions;

- Profiles of experts;

- Profiles of projects; and

- Profiles of information systems.

6. To design specialized database of the profiles of core concepts going with the study of energy resources development in Tanzania.

7. To demonstrate how these databases can be used to produce different kinds of output that would support the user community engaged in the activities related to the energy resources development in Tanzania.

1.4. SCOPE AND LIMITATIONS OF THE STUDY

1.4.1. SCOPE

The concern of the study, is to propose an information support system for the sectoral planning of energy resources development at the energy development unit in the Ministry of Water, Energy and Minerals (MWEM).

The study does not cover information support for the discrete functional developmental planning as handled in distinct energy resources development organs, such as electricity generation and supply as performed by Tanzania Electric Supply Company (TANESCO), petroleum sources prospecting, importation and distribution as performed by Tanzania Petroleum Development Corporation (TPDC), coal production and supply as

performed by State Mining Corporation (STAMICO) or the biomass energy resources development, preservation and effective utilization strategies as performed by the Forestry Department in the Ministry of Natural Resources and Tourism (MNRT).

1.4.2. Limitations

Energy resources development involves a range of activities of different bodies which operate to develop particular energy resources. Among these developmental bodies, there are research, planning and functional institutions which perform day to day activities to develop the energy capacity of Tanzania. These organs, have information facilities which support their activities.

This study does not go into details of studying how each of these individual information facilities operate to support the achievement of the goals of research, planning and functional activities of the organs they serve, because of time and financial limitations. The study is limited to finding out the manner these institutional information systems share information resources with the energy information system, and also to find out how the energy information system operates with a view to proposing a design of a more effective information support system for the energy resources development unit.

The thrust of the study is to be confined to studying and proposing the establishment of an effective CBISSERD for the energy resources development unit in the Ministry of Water, Energy and Minerals in Tanzania.

Poor response to the questionnaires and interviews, and scarcity of data which are discussed in detail in Chapter 2, Sections 2.3.1 through 2.3.4. are other limitations which have affected the availability of some crucial data in certain energy resources development, and those concerning the operation of information systems. As a result, in some areas the data collected were not sufficient to depict a clear picture, and thereby enable to present some elaborate comparative figures.

CHAPTER 2

METHODOLOGY

2.1. DATA COLLECTION AND ANALYSIS

In collecting data for this study, a combination of methods were adopted in order to facilitate substantive collection of data within the limited time available. The methods employed in the collection of data were questionnaires, interviews, on-site visits and observation, as well as literature survey.

Eight institutions related to energy resources development were initially identified for investigation of their information systems pursuant to the specific objectives as shown in Chapter 1, (section 1.3.2; sub-section 1 and 3.) However, the efforts to collect data from Tanzania Electric Supply Company (TANESCO) were thwarted by some bureaucratic practices, to the extent that even the questionnaires given to them were not received. As a result, the required data, concerning this company is basically obtained from literature survey.

The remaining seven institutions among which a survey was carried, and information collected include:

1. The Energy Department at the Ministry of Water, Energy and Minerals (MWEM);
2. Tanzania Commission for Science and Technology (COSTECH);
3. Institute of Resource Assessment (IRA);
4. Tanzania Natural Resources Information Centre (TANRIC);

5. Tanzania National Documentation Centre (TANDOC);

6. Planning Commission; and

7. Bureau of Statistics.

The selection of these institutions was based on their being very instrumental to energy resources development, specially in areas of Research (COSTECH and IRA), Information Analysis, Consolidation and Dissemination (TANRIC and TANDOC), Economic Development Planning Coordination (Planning Commission), and as a source of various statistical data (Bureau of Statistics).

2.1.1. Questionnaires

Questionnaires were designed and pretested before they were distributed, in order to collect information about the information systems, information intermediaries and specialists working in the information systems.

The questionnaires which were administered to collect information about the information systems, aimed at inquiring the methods of information handling, processing and dissemination with a view to ascertaining how they collaborate with the energy development planning unit in terms of data exchange. Information for the creation of database of profiles of institutions and information systems was also collected through this questionnaire. A separate questionnaire was used to tap information for profiling experts in the energy sector.

2.1.2. Interviews and Discussions

Interviews and discussions were held to extract more details from the personnel of the information systems and institutions, on how the systems worked.

Interviews and discussions with the Energy Resources Development Unit personnel helped much in the process of analyzing their information system. The enquiries made in this unit, helped in the collection of information and examining whether the resources and equipment available in the existing system were adequate to provide the necessary information support for the energy resources development process.

Researchers in the selected institutions related to energy development, were interviewed to find out the extent of their interactions with the Energy Resources Development Unit in terms of communications of their findings and general information resource sharing.

In conducting interviews, a set of unstructured questions were used. These were asked in a particular pertinence to extract the required information. The questions gave room for the interviewees to express their opinions about the information services and how they helped them to meet their objectives. The sample of the schedule of interview questions is shown in Appendix 5.

Concerning the discussions, outlines containing issues to be discussed such as the information resource sharing, communication of research findings (for researchers) and the

utilization of information in the process of energy planning, were prepared and made available to the targeted researchers, information specialists, and energy resources development planners and decision makers in the energy development unit. This was done to allow for a fruitful discussion.

2.1.3. Observation

On-site observations supplemented the findings obtained through interviews and discussions. This method proved to be quite useful in assessing the procedures followed and some of the operations of the information systems. The information seeking habits of the users were also observed.

2.1.4. Literature Survey

Many libraries and information systems were searched to get the required information in the process of literature survey. This exercise aimed at seeking a broader insight on the energy resources development question. It also intended to investigate how the development process made use of available relevant information on the sector. For the reasons mentioned in Section 2.0, literature survey was the only method used to collect the much needed data for TANESCO.

The following libraries and information systems were searched for the information on energy resources:

1. Addis Ababa University Libraries and Documentation Centres;

2. University of Dar es Salaam Library;

3. COSTECH Library;

4. Institute of Resource Assessment Documentation Centre;

5. Bureau of Statistics (documentation room);

6. ECA Library; and

7. The PADIS and ILCA database resources.

2.2. DATA PROCESSING AND ANALYSIS METHODS

The data collected was analyzed using both manual and automated techniques. This was done because most of the data collected was predominantly qualitative and descriptive. The software packages available at SISA computer laboratory were made use in this analysis. These software packages include:

- Harvard Graphics in processing graphical data and diagrams.
- Micro CDS/ISIS for creation of prototype databases
- Word Perfect 5.1 for word processing of data and the related text.

The detailed analysis of data is presented in Chapter 5.

2.3. PROBLEMS ENCOUNTERED DURING DATA COLLECTION

2.3.1. Bureaucratic Procedures

Bureaucratic practices in most of the institutions earmarked for data collection, were

a problem which proved to be a setback in speedy and successful data collection. Some of the problems experienced as a result of the bureaucracy were:

- difficulty in meeting the intended officials in their offices for data collection. In most offices, this required appointments, some of which were even deferred when the researcher arrived for them.

- lengthy procedures of securing permission or clearance from the department heads to set appointments with earmarked people for interviews/discussions. Much of the limited time allocated for the data collection exercise was spent unproductively in trying to meet these bureaucratic requirements.

2.3.2. Confidentiality

Confidentiality is a problem which, if not solved, will continue to hinder smooth flow of information. Almost in all the institutions visited, the officials were reluctant in giving even the simplest plain facts without prior permission of their heads. Respondents appeared to take interest in explaining issues pertaining to their institutions' success. Any question touching on aspects thought to have some weaknesses was not quite welcome. Other respondents would give explanations and would ask not to be quoted for what they might have disclosed.

2.3.3. Scarcity of Current Data/Record

There was an observed scarcity of current data/records on important issues relevant to my research topic. This made the work of collecting data very difficult as I was supposed to move from one information system to another to try to look for the required information.

2.3.4. Unorganized Data/Records

In some institutions visited, the people concerned reported the existence of certain required information sources, which they failed to retrieve because of misplacement.

All these problems militated against smooth and speedy collection of data.

CHAPTER 3

TANZANIA: BACKGROUND INFORMATION

3.1 THE COUNTRY

The United Republic of Tanzania is situated between longitude 29^0 and 41^0 east and latitude 1^0 and 12^0 south of the equator. It occupies an area between lakes victoria, Tanganyika and Nyasa and the Indian Ocean to the east, with a coastline extending some 800 kilometres from Umba river in the north to Ruvuma river in the south. The total area of the country is 945,234 square kilometres of which 20,000 square kilometres is covered by water. Tanzania is made up of the mainland, formerly Tanganyika, and Zanzibar, (composed of the islands of Zanzibar and Pemba) which together have an area of 2,500 square kilometres. To the north, Tanzania shares borders with Kenya and Uganda; to the west it borders with Rwanda, Burundi and Zaire; to the south-west are Zambia and Malawi; and Mozambique in the south.

3.2. PHYSICAL DESCRIPTION

Tanzania includes both the highest and lowest places in Africa i.e, the peak of Mount Kilimanjaro (5950 metres above sea level) and the floor of Lake Tanganyika (358 metres below sea level). Except for the coastal belt, most of the country is part of the Central African plateau broken by scattered hills and low-lying wet lands (Berry & Berry 1971). The country has a coastline of varying width between 20 kilometres to 70 kilometres in some places, gradually raising to a plateau. The plateau forms a larger part of the interior

and generally the characteristic topography is that of flat or gently undulating plains. There are volcanic highlands in the north and south-western Tanzania.

In the north and north-east, there is a mountainous area which constitutes the Usambara and Pare mountains, the snow-capped Mount Kilimanjaro, and Mount Meru near Arusha. The Southern Highlands, as the south-west volcanic highlands are referred to, include the Uporoto and Rungwe ranges and the Livingstone mountains. The volcanic north and south-west are important both topographically as well as economically as a result of their fertile soil.

3.3 DRAINAGE

There are five major drainage basins:

i) Rivers flowing into the Indian Ocean which include Pangani, Wami, Ruvu, Rufiji, Matandu, and Ruvuma.

ii) Rivers draining into Lake Nyasa, including Ruhuhu, Songwe/Kiwira, Lufilyo, and Mbaka.

iii) River Malagarasi flowing into Lake Tanganyika.

iv) Rivers draining into Lake Victoria which include Kagera and Mara Rivers.

v) Rivers and Streams which end up in smaller lakes like Lakes Rukwa, Eyasi and Manyara of the Rift Valley area.

3.4 CLIMATE

Tanzania has a great diversity of climatic conditions, with mean annual temperatures ranging from 24^0 - 34^0 C, while mean annual rainfall varies from below 500 millimetres to over 2500 millimetres per annum, depending on altitude and latitude (Bureau of statistics, 1993). The country can be divided into three main climatic zones. These are:

i) The warm and humid coast with temperatures seldom below 27^0 C during the October - May period and averaging 21^0 C during the year. There are two distinct rainy seasons between October and May. The short rains occur between October and November and the long rains occur from March to May. The period from June to September is mainly dry throughout the country with the main airflow being from south or south-east (the south east monsoon).

ii) The hot and dry central zone which lies between 500 metres and 1000 metres above sea level. The mountain ranges from Lake Nyasa to Morogoro give a large rainfall shadow over the central zone and the Masai steppe. As a result the rainfall in this zone is rather low about 75 centimetres per year on an average.

iii) The semi temperate regions of Kilimanjaro and Usambara mountains which are in the north and north-east and the southern highlands in south western Tanzania. The topography of these areas has a marked effect on the rainfall. For example, in the south-west, the combined effect of the alignment of lake Nyasa and the local topography causes large amounts of rainfall in Rungwe district. There is a similar effect of lake victoria on

the Kagera region in the north-west.

In general, the major characteristics of Tanzania's climate are governed by its proximity to the equator and the influence of the Indian Ocean and the other large bodies of water in the interior.

3.5 VEGETATION

More than half of Tanzania is covered by miombo woodlands together with bushland thicket. Wooded grassland occupies another quarter of the area of Tanzania in scattered patches. There is grassland in a little over one percent of Tanzania's land which is cultivated in widely distributed areas. About two thirds of the country is entirely uninhabited.

3.6 POPULATION

Tanzania's population is estimated to be about 26.6 million with a population growth rate of 2.8% (Planning Commission 1994). The country has a low overall population density, averaging about 19 persons per square kilometre. However, some areas are more densely populated with over 200 persons per square kilometre. Examples of densely populated areas include Ukerewe island, Kilimanjaro, Mwanza and Dar es Salaam (Bureau of Statistics 1988). Other areas are more sparsely populated. These include Lindi, Rukwa and Tabora Regions. Some of these regions are areas with low and unreliable rainfall and mainly, infertile soils.

The country's population has been increasing steadily since independence in 1961. For instance, in 1961, Tanzania (mainland) had a population of 9 million. The 1967 census showed that the population had increased to 12.3 million. In 1975, the population had risen to 14.9 million. The 1988 census gave the figure of the population of Tanzania as 23.2 million, with an annual growth rate of 2.8% which continues to date. Table 1 shows the population growth between 1988 and 1993.

Table: 1 Population Growth 1988-1993

Year	Population in million
1988	23.2
1989	23.7
1990	24.4
1991	25.1
1992	25.8
1993	26.6

Source: Planning Commission 1994. The Economic Survey 1993, Dar es Salaam, Government Printers.

3.7 THE ECONOMY

Tanzania's economy, like that of many developing countries is dependent on agriculture. About 90% of population is engaged, directly or indirectly, in agricultural activities which provide about 50% of GDP, and more than 75% of foreign exchange earnings (ministry of Agriculture 1983). Table 2 shows the sectoral contribution to the GDP.

Table 2. Sectoral Contribution, to the GDP

(in percentage)

Sector	Year and Percentage							
	1986	1987	1988	1989	1990	1991	1992	1993
Agriculture, Forestry and Fishery	58.9	58.9	62.7	61.6	56.9	54.1	54.9	56.0
Minerals	0.4	0.3	0.2	0.3	1.2	1.3	1.7	1.3
Industry	6.2	7.4	5.3	4.5	4.5	6.6	5.4	4.9
Electricity & Water	1.6	2.5	1.6	1.5	1.8	2.2	3.1	3.4
Construction & Building	1.7	3.2	4.1	3.2	5.6	4.5	4.8	4.9
Commerce & Hotelling	13.8	13.0	14.6	14.3	13.6	14.8	15.0	14.4
Transport & Communication	6.5	5.8	5.0	7.5	8.8	10.0	7.9	10.8
Finance & Commercial services	6.2	5.5	5.0	5.7	5.9	5.5	5.0	4.3
Government & other services	6.3	6.6	6.0	6.7	7.9	6.3	6.7	6.5
Bank Services income	1.8	3.2	4.5	5.4	6.1	5.4	4.5	6.5
Total Percentage	100.	100.	100.	100.	100.	100.	100.	100.

Source: Planning Commission 1994. The Economic Survey 1993. Dar es Salaam, Government Printers.

Since the mid 1970s, the country's economy has declined. The sharp rise in oil prices, low export commodity prices, the Tanzania-Uganda war of 1978-79 and the break-up of the East African Community in 1977 are among some of the reasons for that (Boessen, et al. 1986). Performance over the last three years has been encouraging, following measures taken under the government's Economic Recovery Programme (1986/87-1988/89) and following successive years of favourable weather (FAO 1990).

According to the world Bank figures, in 1989 Tanzania's Gross National Product (GNP) was equivalent to US$ 3097 million (at the 1987/1988 exchange rates). The per

capita income was put at US$ 120. The annual inflation rate declined from 42.9% in 1984 to 28.2% in 1985. However the inflation shot up to 44% in 1986 before it was reduced to about 19% in 1990. Table 3 shows the country's GDP growth by sector, for a period of 5 years.

Table 3. GDP Growth by Sector (in Percentage) (Actual and Projected growth)

Sector	1993	1994	1995	1996	1997
Agriculture	7.3%	2.7%	4.1%	5.2%	5.8%
Industry	2.1%	5.7%	6.5%	6.9%	7.4%
Mining	-19.1%	8.9%	10.6%	11.4%	12.3%
Construction	-4.2%	7.5%	5.3%	6.0%	6.7%
Services	4.0%	5.0%	4.9%	5.9%	6.4%
Overall GDP Growth	4.1%	4.4%	4.8%	5.8%	6.3

Source: Planning Commission 1994. The Economic Survey 1993.
Dar es Salaam, Government Printers.

3.8 SCIENCE AND TECHNOLOGY

Since 1968, the development of Science and Technology in Tanzania was being coordinated by the Tanzania Scientific Research Council. The council established a National Science and Technology Policy which was adopted by the government in 1985. From the policy recommendations, the Government transformed the Scientific Research Council into the Tanzania Commission for Science and Technology (COSTECH) in 1986. In 1990, the

Government further strengthened the move to develop Science and Technology by establishing the Ministry of Science, Technology and Higher Education (MSTHE). The new Ministry reviewed the 1985 Science and Technology Policy and came up with an updated policy, in 1993. Other achievements after the formation of a new Ministry include the establishment of the Centre for the Development and Transfer of Technology (CDTT), under the supervision of COSTECH, and the establishment of the Tanzania Association of Inventors (TAI). However, the development and promotion of Science and Technology have been constrained by lack of funds and effective coordination with other sectors.

3.9. INFORMATION INFRASTRUCTURE

3.9.1. Information Policy

For a long time Tanzania organized and ran its information infrastructure without any elaborate policy to direct them. However, the fast changing socio-economic environment in the world in general, and Tanzania in particular, has been drawing more attention of the country towards effective handling of information. The economic structural adjustment programs which were launched one after another in the 1980s, viz NESP (1981), SAP (1982), ERP (1986), and ESAP (1989), had implications on the information infrastructure in the country. The RPFB, a new approach to planning and budgeting introduced in Tanzania in 1993, singles out reliable data as the backbone of effective planning.

The opening up of the country's economy to a more competitive economic ventures, meant that planning in all sectors required more reliable information and data for the economy to be able to compete. This, however, calls for more efficient information infrastructure.

The 1990s have witnessed several measures being taken to improve the existing information infrastructure. In 1991, a study of the existing information infrastructure in Tanzania was conducted. The study, among other things, came up with a proposal for the establishment of a National Information Policy on Information Systems and Services in Tanzania (Sekimang'a 1992). At about the same time, COSTECH prepared a project proposal on the establishment of a National Information System for Science and Technology (COSTECH 1991,16). Later in 1993, the government appointed a task force to review the National Science and Technology Policy of 1985. The review aimed at rationalizing the policy with the changes which took place in the socio-economic policies starting in the 1980s as shown above. Among the important changes in the economy were the privatization of state owned enterprises and the introduction of free market economy.

Currently, the National Information Policy proposed by Sekimang'a (1992) is the most comprehensive and articulate document for the effective organization and mobilization of information infrastructure, although the government has not yet adopted it.

3.9.2 Libraries

3.9.2.1 Public Libraries

Tanzania has government owned public libraries maintained in 15 (out of 25) regional headquarters. In addition to providing lending and reference services to the registered members of the community, reasonable loans are offered to academic institutions, community centres, industries etc. The National Central Library (the headquarters) coordinates the operation of all public libraries.

3.9.2.2 Academic Libraries

In this group of libraries, the college and university libraries are considered. Tanzania has 18 institutions of higher learning and a good number of educational, commercial, agricultural and other college libraries. Among the institutions of higher learning there are three universities: the University of Dar es Salaam, Sokoine University of Agriculture and the Open University. The university libraries which are relatively better stocked and staffed, have not yet made effective use of Information Technology. The traditional card catalogue retrieval system is still the predominant method. This creates problems against easy accessibility of information sources (Kiondo and Kimbunga 1992). The inadequate fund allocation to these libraries also reduces their efficiency in rendering services.

University libraries are important in disseminating new knowledge and ideas. The

dissertations, theses, and research reports which are deposited in the library, constitute an invaluable source of new knowledge from the different departments' research projects.

3.9.2.3 Special Libraries

Special Libraries are maintained to support the activities of government ministries, parastatal organizations, non-governmental organizations etc. They range from book corners to well built information centres, maintained by qualified personnel. This kind of libraries is the predominant in the country. They are likely to be found in every institution/organization; where they cater for their information needs.

CHAPTER 4

ENERGY RESOURCES DEVELOPMENT IN TANZANIA

4.0 OVERVIEW

Since the early 1970s increasing attention has been paid to energy questions throughout the world. This has been so because of the steep rise in the prices of crude oil throughout the globe, from less than US$ 2 per barrel in 1970 to more than US$ 34 in 1981 (Mwandosya and Luhanga 1983).

The oil price crisis started in 1973 when OPEC imposed a sudden four fold increase in oil prices following the Middle East war in that year. The 1979 Iranian revolution and the consequent disruption of the country's oil production instigated OPEC to impose another three fold increase in oil prices (Foley 1992).

This increase in oil prices had a serious impact on the economies of the oil-importing developing nations like Tanzania. Most of these nations spend huge amounts of their scarce foreign earnings in purchasing petroleum products.

The money previously spent in developing other economic sectors is now used mostly in importing petroleum energy resources, to meet the ever rising demands for energy. In 1981, for instance, Tanzania used 60% of its foreign exchange earnings in oil imports (Mwandosya and Luhanga 1983).

Although in absolute terms, developing countries use less energy than developed countries, energy use in developing countries has been increasing at a faster rate than in developed countries, despite the exorbitant oil prices. The annual average increase in energy use by developing countries during 1981-91, was 5.2% compared to a 1.3% annual average increase in OECD countries (Abdalla 1994). Furthermore, energy use by developing countries is expected to increase from 2.1 billion tonnes of oil equivalent (toe) of 1991 to 3.8 billion toe by the year 2005 (International Energy Agency 1992). Rapid urbanization in these nations contribute significantly to this growth.

For the oil-importing developing countries, increase in energy consumption means increase in expenditure for petroleum imports. Pursell (1983) comments that spending huge amounts in energy imports alone does not help in building a healthy and balanced economy. The reason is that funds that could advance the development of the country's economy goes for energy imports to maintain the present economic position or at best to achieve very slow economic growth. Pursell (1983) observes that the only solution for the problem is to develop the available internal energy resources to reduce the energy deficit.

Currently, the developing world is in essence a victim of two crises. One is the continual increase in prices of petroleum and its derivatives, and the other, equally serious problem, is that of over consumption of fuelwood, the traditional source of energy in rural areas. In a way, the high price of imported oil products perpetuate the growing dependence on fuelwood as most low income people cannot afford the expensive commercial energies.

Repetto (1986) recommends that the main response to these problems should be to promote energy efficiency and conservation in the most cost effective manner. Another important response according to him should be to encourage the development of indigenous renewable energy resources and technologies, such as solar, wind, hydro, and biomass. In many developing countries like Tanzania, biomass, wind and solar energy sources, have been grossly neglected in favour of fossil fuels which claim much from the little foreign exchange they earn. Elaborate plans need to be initiated if at all the developing oil-importing nations intend to solve the energy deficit problem.

However, planning for energy resources development, being oriented towards the future, has to rely on a knowledge as complete as possible, of the attributes of the components of the society that the plan covers. This implies that the planner definitely needs information on all the present aspects of the society and the recent past which has created the conditions for the development.

4.1 ENERGY RESOURCES SITUATION IN TANZANIA

Tanzania's geographical location has had a strong bearing on its energy resources. The rift valley structure which exists in the country, has endowed the country with a geology that is similar, in some important energy related aspects, to the geology of Zambia and Zimbabwe to the south. For instance, just like Zambia and Zimbabwe, Tanzania has significant coal deposits.

Along Tanzania's coastline, there are indications of the presence of hydrocarbons. But so far, only exploratory work on petroleum is being done. At the moment, all petroleum consumed in Tanzania is imported. The only success lies on the discovery of natural gas at Songo Songo and Mnazi Bay around the coast strip.

The rift valley part of Tanzania is an area that is still geologically active. Areas to the north-west, south-west and south-east of the country have hot springs that are manifestations of geothermal energy sources. A preliminary survey of these geothermal energy sources has been done.

Tanzania lies completely within the tropics. This explains why more than half of the country is covered by miombo woodlands and bush land or thicket. These woodlands play a very important part in meeting the energy needs of the vast majority of Tanzanians in both urban and rural areas.

Some of the major rivers in Tanzania have been harnessed to produce hydroelectricity. Areas without hydroelectric energy supplies are, however, still being supplied with thermal electricity.

Tanzania's Savannah type vegetation is ideal for cattle raising. By virtue of this environment, Tanzania has more than 13 million heads of cattle, being the second largest cattle raising country in Africa after Ethiopia (MAL 1993). The production of methane gas from cow dung is a large potential energy resource.

The hot and dry central zone in Tanzania, and areas near the Indian Ocean have good wind system and a lot of sunlight. Wind energy and solar energy utilization possibilities are developing although at a slow pace.

4.2 TRENDS IN ENERGY RESOURCES DEVELOPMENT IN TANZANIA

Within the context of social goals regarding provision of basic needs and environmental considerations, energy issues emerge as key components of overall economic development. Energy is a crucial input into development process. In order to facilitate national development, it is important to articulate energy development goals and those of the overall economic objectives.

In Tanzania, several steps are being taken to develop the available energy resources with the aim to improving the energy output in order to meet the country's social and economic requirements.

4.2.1 Fuelwood and Charcoal (Biomass)

Fuelwood and charcoal are the energy sources used by the majority of Tanzanians in both the urban and rural areas. Fuelwood is generally preferred in rural areas, mainly because it is obtained free. Charcoal is preferred in towns on account of its being easy to transport, distribute and store. It is also smokeless and has a higher calorific value (30 MJ) than fuelwood (15.5 MJ). Wood fuel alone accounts for 92% of the primary energy

consumed, while petroleum and electricity account for 7% and 1% respectively (Hosier et al. 1993). The heavy dependence on biomass in the form of woodfuel and charcoal has contributed to the rate at which forests are disappearing and also to the environmental degradation (Mwandosya 1990). Table 4 shows final woodfuel consumption in 1992.

Table 4. Final Woodfuel Consumption in 1992.

Sector	Consumption (in million TOE)	Percentage
Household	8.955	79.53
Industry	0.805	7.15
Commerce	0.250	2.22
Transport	1.000	8.88
Agriculture	0.250	2.22
Total	11.260	100.00

Source: Bureau of Statistics; Environmental Statistics in Tanzania,April 1994.

Several measures have been taken to develop and introduce different biomass technologies in Tanzania. These include, biogas production, bioelectrification (generating electricity by using biomass as fuel instead of other fuels like diesel), improved charcoal production, biomass briquetting, improved tobacco curing and coconut shell carbonization (Mwihava and Towo 1994). Table 5 shows existing biomass fuelled plants in Tanzania.

Table 5. Existing Biomass Fuelled Power Plants in Tanzania.

Name of the Plant	Region	Power (KW)	Fuel Type
Kilombero Sugar Company 1	Morogoro	2x3,000(ST)	Bagasse
Kilombero Sugar Company 2	Morogoro	1200+2X800(ST)	Bagasse
Mtibwa Sugar Estate	Morogoro	2,500+1,502x400 (SE)	Bagasse
Tanganyika Planting Company	Kilimanjaro	2,5000+1,650 (ST)	Bagasse
Kagera Sugar Company	Kagera	2x2,500(ST)	Bagasse
Sao Hill Saw Mill	Iringa	1,025(ST)	Sawmill Waste
Tanganyika Wattle Company	Iringa	250(ST)	Sawmill Waste

key:SE:Steam Engine. ST: Steam Turbine
Source: Mwihava, N. 1992. Position Paper on Bioelectrification in Tanzania, SEI/BUN Rural Electrification Seminar for SADCC. Nyanga, Zimbabwe.

Wood, apart from being a traditional fuel, can be used in the modern sector as a boiler fuel or in either gaseous or liquid forms, to drive stationary or moving engines. Therefore wood could continue to play an important role in the economic development of the country. It is also a relatively cheap fuel to grow, especially in terms of the small amount of foreign exchange required to produce and use it (Hosier and Kipondya 1993).

The stumbling block towards effective development of the biomass sector has in most cases been the missing link between researchers and implementors, a problem emanating from absence of dependable information support for energy resources development in the

country. Lack of funds to enable the implementation of research findings and recommendations is another problem affecting the biomass resources development. All these need to be resolved if energy resources development is to be successful.

4.2.2 Petroleum

Consuption of petroleum products in Tanzania accounts for 8% of the total energy consumption in the country. However, despite this low percentage, petroleum products are looked on as the most important energy source, mainly because they account for 92% of the total commercial energy used in Tanzania. By contrast, electricity accounts for a mere 7%. The transport sector accounts for about 42% of the petroleum products consumed in the country. The next most important petroleum consumers are industry (22%), household (11%), commerce (6%), and agriculture (5%) (Barongo 1991). The high energy value per unit weight of petroleum products is another point which makes this source of energy important (Openshaw 1982). Currently, the importation of petroleum products use up to 50% of the total foreign exchange earnings of Tanzania.

Petroleum development in Tanzania is supervised by Tanzania Petroleum Development Corporation (TPDC), a parastatal owned by the government. TPDC is in charge of programs for the exploration and development of oil and natural gas, and also, of imports of crude oil. The Corporation arranges for refining the crude oil into the desired proportions of products at the Tanzania and Italian Petroleum Refinery (TIPER), a plant jointly owned by the Tanzania government and Italy. TIPER distributes its products through the five oil distribution companies (BP, AGIP, ESSO, CALTEX and TOTAL) besides

distributing directly to certain selected remote areas. Up to now, the Tanzania government owns 50% of the shares in TIPER and another 50% in AGIP, while all the shares in ESSO, CALTEX and TOTAL are privately owned (MWEM 1992).

Prior to 1973, the importation of petroleum products into Tanzania increased every year. Following the rapid increases in oil prices after the Middle East War of 1973, the Tanzania government instituted control measures against petroleum consumption in 1974. The petrol consumption control measures which included high oil prices, a Sunday afternoon driving ban, a limit of 60 litres of fuel per week for government and parastatal organizations, have resulted in drop in the consumption of petroleum products. Although the drop in oil consumption reduced the level of imports of oil, the exercise slowed down the pace of growth in the industrial and related sectors. This is because any rapid growth in industry is normally marked by increased consumption of energy. Table 6 shows petroleum imports in Tanzania between
1985-1994.

Table 6. Petroleum Imports in Tanzania 1985-1994

(in thousand metric tonnes)

YEAR	CRUDE OIL		REFINED OIL	
	Imports (metric Tonnes)	Cost in (US$)	Imports (Metric Tonnes)	Cost in (US$)
1985	512.3	135,273,034	199.5	52,053,169
1986	561.2	117,802,753	293.6	49,512,123
1987	484.7	71,713,332	258.7	44,689,394
1988	628.9	84,524,465	306.6	46,251,918
1989	652.7	91,310,613	331.9	61,086,127
1990	495.8	101,801,300	434.6	110,036,167
1991	440.2	55,802,573	357.7	87,027,153
1992	526.9	76,676,615	541.5	114,734,046
1993	530.5	71,657,736	482.3	92,392,045
1994	480.0*	75,600,000*	520.0*	118,500,000*

* estimated figures

Source: TPDC Statistics, MWEM 1994. Budget Speech to the National Assembly, June, 1994.

The dramatic increase in oil prices prompted Tanzania to step up the petroleum exploration activities in the country. Historically, the petroleum exploration activities in Tanzania started in 1950s. Four conventional wells were drilled which indicated signs of oil presence. The four wells were at Zanzibar, Pemba, Mafia and Mandawa. The oil companies involved in the exercise were BP and Shell.

During the oil crisis period of the 1970s and early 1980s, most oil companies were making huge profits and hence had funds to invest in petroleum exploration. During that period Tanzania was also privileged to have several foreign companies involved in petroleum exploration. These included: Shell/ESSO Petroleum Development, Agip (Africa) Ltd., AMOCO (with Petrofina and Pecten), TEXACO, the International Energy

Development Corporation (IEDC), Oil and Natural Gas Commission of India (ONGC), the World Bank and Society Nation Elf Aquitane (Mwihava and Towo 1994).

However, later on most oil companies pulled out their support to Tanzania in favour of countries where oil wells are existent, such as Mexico, South Yemen, former Soviet Union States, etc. This has forced Tanzania to amend its production sharing agreement to become more attractive to foreign investors. Based on the preliminary geological surveys done in Tanzania, the most attractive areas identified for further study are mostly along the coastal belt and adjacent areas.

The petroleum exploration carried out by different companies as shown above did not end in vain. In 1979, AGIP discovered the Songo Songo Natural Gas deposit. So long as AGIP'S interest was in oil, it declared the natural gas deposits un economical. In 1982, AGIP and AMOCO discovered the Mnazi Bay natural gas field which again the companies were not interested in. However, following the recommendation given by Oil and Natural Gas Commission of India (ONGC) which justified the economic feasibility of Songo Songo natural gas and that of Mnazi Bay, the government embarked on projects to develop natural gas production. At the moment, there are 31 conventional wells out of which 9 are producing wells. The gas is now planned to be used to supply electricity for the Dar es Salaam city.

4.2.3 Coal

The discovery of coal in Tanzania was first reported towards the end of the 19th

century. In spite of this early knowledge of its existence, little development has taken place, mainly because of the inadequate transport linkages between the coal fields and the major population centres. Coal reserves in Tanzania are estimated to be about 1900 million tonnes out of which 304 million tonnes could be considered to be proven (Mwandosya and Luhanga 1993).

Currently, coal mining in Tanzania is carried by the Kiwira Coal mine which operates under the supervision of the State Mining Corporation (STAMICO). The Kiwira coal mine was inaugurated in 1988 and is now operational with a capacity to produce 150,000 tonnes of coal per year. The mine is however, faced with problems related to liquidity and finance. The main consumers of Kiwira coal are the Mbeya Cement Factory and the Southern Paper Mills in Mufindi. Initially the two enterprises did not want to purchase Kiwira coal on account of its high ash content. However, the Mine has been able to rectify the ash problem, reducing the ash content of coal produced from 28-30% to below 25%. Unfortunately for Kiwira Coal Mine, both the cement factory and the paper mill are presently facing severe financial problems and can not buy Kiwira coal. Efforts are underway to promote household use of coal, a move which is at its preliminary stages.

Kiwira Coal Mine has a coal fired power plant with an installed capacity of 6 MW. Unfortunately due to low electricity demand in the vicinity of the mine, the thermal plant operates only at about 1.0 MW. Recently, a power line has been built up to Kyela where so far the demand is just at 0.2 MW. There are plans to connect the plant's electrical output to national grid to enable the plant optimally utilize its generating capacity. Arrangements with TANESCO have already been made for that case. It is hoped that the substitution of

coal for diesel in electrical power generation will reduce the petroleum consumption and reduce the country's foreign exchange drainage. Table 7 shows the coal mining output between 1989-1993.

Table 7. Coal Mining Output Between 1989-1993

Year	Tons of Coal Mined
1989	15,140
1990	16,929.4
1991	33,213.3
1992	31,150
1993	40,248

Source: Mining Statistics, MWEM 1994. Budget Speech to the National Assembly, June 1994.

4.2.4 Hydroelectric Resources

Tanzania has a hydropower potential of about 4.8 GW. However, only 10% of this potential has been developed (TANESCO 1990). The prime objective for production of hydro-based electric energy, among others, is to decrease the dependence on imported fuels. Several hydropower projects have been initiated by the National Power Utility i.e Tanzania Electric Supply Company (TANESCO).

Since the hydropower potential is not well developed, Tanzania is forced to continue to generate electricity at thermal power plants at some towns of the country. Table 8 shows the generation unit status of the grid system for hydroelectricity.

Table 8. Generation Unit Status of the Grid System for Hydroelectricity

Generating Station	Unit No.	Installed Capacity(MW)	Unit Status (January, 1991)
Hale	2	21,000	Operational
Kidatu	4	204,000	One unit grounded due to damaged excitor
Mtera	2	80,000	Good condition
Kikuletwa	3	1,160	All out of service awaiting spare parts
Mbalizi	2	0.340	Not working - canal and pond silted (both)

Source: TANESCO. Planning Directorate 1991, "Power sector in Tanzania"

As a result of underdevelopment of the hydroelectric potentialities, Tanzania still runs diesel powered stations which, owing to the high cost of oil, are very expensive to maintain. Table 9 shows diesel powered stations interconnected to the National Grid at mid 1992.

Table 9. Diesel Powered Stations Interconnected to the National Grid at Mid 1992

Power Station	No. of Sets installed	Installed capacity (KW)	No of sets operating	Available Capacity (KW)
Ubungo	8	34,367	3	12,000
Mwanza-Nyakato	4	18,000	2	8,000
Mwanza-South	4	6,000	3	2,500
Mbeya-Iyunga	6	17,804	4	8,400
Tabora	4	10,275	3	6,251
Musoma	11	7,850	5	2,860
Dodoma-Zuzu	3	7,424	1	2,200
Arusha	6	3,700	3	1,830
Kiabakari	3	525	2	180
Total	47	105,945	26	44,221

Source: TANESCO, Planning Directorate 1992.

So far, hydroelectric energy is the highest quality energy in Tanzania, just like is the case in most countries of the world. This is the most developed of all energy technology forms in the country.

The major projects of TANESCO, the only organization responsible for electrical power development, include the electrification of rural Tanzania where about 88% of the population live. The development of hydroelectric sources available in the country is the only best and economic way to meet that goal. This is because diesel operated plants are understood to be expensive to run, owing to the high costs of fuel.

Up to 1990 there were 34 district towns and many agro-based industries in Tanzania

which were yet to be electrified (Mjema 1990). TANESCO is determined that the technology for rural electrification will focus on extension of the large-hydro in the national grid, and development of mini-hydro (from 100kw to 500 kw) and small-hydro (from 500kw to 1000kw) power schemes. The success of these plans depend on effective generation, processing and dissemination of information on appropriate technologies and approach to this project.

4.2.5 New and Renewable Source of Energy (NRSE)

4.2.5.1 Solar Energy

Solar energy has been in use in Tanzania for several generations in the past mainly for drying crops, clothes, wood, salt etc. With the average country's solar irradiation of about 215 Wm. (Kashinje 1990) and a mean solar energy density of 4.5 kw per square meter per day (MWEM 1992), some efforts have been made to harness the solar energy potential using modern technologies. Among the technologies used include solar electricity generation (photovoltaic systems) and solar thermal.

Under photovoltaic systems, the electricity generated has been used mainly for telecommunications, medical refrigeration, lighting, water pumping, and to a very insignificant scale for powering tower clocks (Mwihava and Towo 1994). Use of solar thermal, solar water heating, crop/salt drying and direct cooking technologies, have started in Tanzania, although at a small scale at this time.

Solar radiation intensity has been recorded by Meteorological Department for several years but data here are in the form which suits their communication needs. This calls for effective data collection on the resource to achieve sustainable development in the solar energy sector.

The photovoltaic system are quite useful for decentralized electricity production. The technology is well proven in developed countries, and solar energy in Tanzania is basically abundant and widely available. The challenge for development is to find applications which are economically justifiable, socially appropriate and technically suitable. To be able to do that a sound information base is, by no doubt required.

Currently, solar photovoltaic technology development and utilization in Tanzania is predominantly in the field of telecommunication.Tanzania Telecommunication Corporation (TTC), Tanzania-Zambia Railways Authority (TAZARA) and Tanzania Railways Corporation (TRC) are the organizations which are making use of the solar energy at a somewhat reasonable scale.

The TTC launched the first solar energy project in 1981 after facing power problems with diesel engine generators, which were used to power the carrier repeater stations in remote areas. The project solved the corporation's experienced problems of too much fuel consumption, frequent mechanical breakdowns, noise pollution and the need for monthly routine maintenance and annual major repairs for generators.

Table 10 shows Sharp solar installations by TTC in Tanzania.

Table 10. Sharp Solar Installations by TTC in Tanzania

STATION NAME	REGION	INSTALLED QUANTITY	PEAK WATT	CELL QTY	CAPACITY A.H.	SYSTEM VOLTAGE
Mwalolela	Mwanza	11	385	24	1068	12
Geita	Mwanza	23	805	36	2160	12
Ikoka	Kagera	11	385	24	1060	12
Kisanda	Kigoma	11	385	24	1060.8	12
Kakonko	Kigoma	11	385	24	1060.8	12
Madaga	Kigoma	11	385	24	1060.8	12
Musela	Kigoma	12	455	24	1060.8	12
Karambi	Kagera	13	805	36	1060.0	12
Muyaga	Kigoma	23	805	36	2160	12
Moroninya	Kigoma	23	805	36	2160	12
Rubya	Kagera	27	945	36	2160	12
Sekeseke	Kagera	12	420	18	1060.8	12
Itunduma	Iringa	30	1194	12	3200	12
Uwemba	Iringa	18	715	6	1980	12
Wino	Ruvuma	22	875	12	2640	12

Source: S.P Kashinje, "Photovoltaic Devices which are used in Tanzania" Dept. of Physics, UDSM. Report Submitted to IDRC, 1990.

Table 11 shows Domestic solar Photovoltaic units in Tanzania as of November 1993 (lighting, entertainment, refrigeration etc).

Table 11. Domestic Solar Photovoltaic Units in Tanzania as of November, 1993

Region	Number of Customers
Dar es Salaam	83
Coast	7
Tanga	5
Kilimanjaro	5
Arusha	10
Morogoro	23
Iringa	18
Mbeya	11
Ruvuma	7
Mtwara	5
Lindi	4
Mwanza	5
Mara	9
Tabora	3
Dodoma	1
Kigoma	14
Kagera	35
Singida	3
Shinyanga	6
Rukwa	3
Total	256

Source: Mwihava, Ngosi C.X and Towo, Arnold. 1994.

A study and Assessment of Energy Projects and their Effective Utilization in Tanzania. Dar-es-Salaam, COSTECH.

As shown in the two tables above, solar energy utilization has not however, taken deep roots in Tanzania. Nevertheless, this is the technology which promises to answer energy problems in remote parts of Tanzania. It is a technology which can be used in rural areas to relief the environmental problems by saving forests.

The problem with photovoltaic system and other solar related technology is that, very little information is known about them, even among people living in cities. The availability of information on this source of energy could definitely step up the application of it, despite its being relatively expensive for the poor people. Technologies like solar water pumping and solar thermal/water heater can promote agriculture and reduce fuelwood consumption, respectively, in rural areas.

4.2.5.2 Wind Energy

Wind energy in Tanzania has been used to pump water for irrigation and to meet domestic and stock water needs. Few attempts have been made to use wind for electricity generation. There have been several attempts at local design and manufacture of windmills, but none of the local designs has been successfully disseminated. The introduction of imported windmill designs has also met with limited success even in areas such as the interior plateau in the centre of Tanzania which have good wind establishment. The reasons for failure seem to be:

i) production of poorly designed or expensive prototypes;

ii) introduction of windmills for demonstration purposes only;

iii) lack of maintenance and spares and lack of skills for repairs; and

iv) lack of reliable data on wind characteristics to aid in the siting of windmills.

Successful exploitation of wind energy in Tanzania appears to hinge on entrepreneurship on the part of local research organizations and businesses, to develop a sound design of a local windmill. The cooperation will help also in mounting dissemination

programmes with an effective extension network to help in maintenance and training of personnel for the repair and maintenance of windmills, and the creation of a national wind characteristics data base, to aid in the siting of windmills. The Government needs to assist these efforts by allocating reasonable amount of funds for research institutions like COSTECH.

The little statistical data available in Tanzania on wind, has been mostly collected by meteorological stations in the country. Unfortunately the country is not adequately covered with meteorological stations. In addition, meteorological data on wind power potential for various sites suffer from the fact that wind velocities are obtained at only one height (2 metres). Since windmill towers are taller than 2 metres and wind velocity varies with height, extrapolation formula have to be used to get wind velocities at heights of interest. This cannot always produce correct results. Therefore it is important to have a mechanism to collect wind energy data which suits the developmental needs of the resource. Successful plans in wind energy will help in meeting domestic water needs, stock watering and irrigation water needs.

4.2.5.3 Geothermal Energy

Geothermal sources do exist in Tanzania. Active volcano centres, the rift valley system, numerous geological faults and hot water springs, are an indication of the possible occurrence of sub-surface steam or hot water reservoirs that may be used for the generation of power. The Olkaria geothermal development in the Kenyan part of the rift valley system increases the possibility of occurrence of this source in Tanzania, which is adjacent to

Kenya. However, all of the sites which have shown geothermal energy potential are situated far from centres of population and industry. It is therefore quite unlikely that geothermal energy in Tanzania will be used for purposes other than electricity generation. The electricity generated at a geothermal site would then be transmitted to centres found in urban areas.

For the time being, the government of Tanzania does not give priority to development of geothermal sources. Due to the fact that geothermal sources are expensive to develop, the Government thinks it important to develop the less expensive abundant resources in the form of hydropower, coal and natural gas. Nevertheless, many countries, including the neighbouring Kenya, have benefited from this energy resource.

4.3 CHALLENGES AND PROSPECTS

Energy resources development Planning in Tanzania, like in many African countries, is more complex than in the developed world. This is partly because the majority of the energy needs in Tanzania are met at present by woodfuels, most of which are only collected and not purchased.

As shown in section 4.2.1, fuelwood accounts for over 90% of the total energy consumed in Tanzania. The market forces which dominate European and American energy development planning are largely absent in Tanzania. In such a scenario, energy resources development planning will have to realize a balance between demands on conventional sources of energy and alternative ones such as woodfuels, which dominate the consumption.

The heavy dependence on oil imports which drain 50% of the foreign exchange reserves, always leads to general national budget deficits, balance of payment problems and debt crisis. There is also a dilemma of striking a balance between this oil dependence on the one hand, and on the other the urge to develop indigenous fossil energy resources which are available in the country.

Up to now, new and renewable energy resources, such as the solar, wind, and geothermal, have provided little energy sources in Tanzania. The fierce competition from the conventional sources and the traditional ones like fuel wood (which is basically cheap) have not been offering good conditions for the development of these sources. In addition, the new and renewable technologies are still expensive. For instance, installation of a small powered pump can cost from US$ 10,000 to 20,000 (Timberlake 1991).

Currently, although the importance of energy resources development planning is acknowledged in Tanzania, several problems stand against its success. Most of the problems relate to institutional commitment in the Energy Department such as:

- Unsystematic collection and processing of data and information;
- infrequent periodic reviews and updating of the goals and policy issues;
- Failure to attract high quality staff in sufficient number to sustain serious energy resources development; and
- External funding of individual projects, which have in most cases failed to justify themselves within a comprehensive policy framework thus turning to be dubious, etc.

4.4 ENERGY POLICY IN TANZANIA

The efforts put on energy resources development in Tanzania have not yet been successful to bring the intended results. Tanzania continues to spend 50% of its meagre foreign exchange earnings in importing oil products, and fuelwood and charcoal still account for 92% of the primary energy consumed, while electricity accounts, for only 1% of the total energy consumed in the country. (Mwandosya and Luhanga 1993).

For a long time Tanzania, carried its energy resources development activities without a clearly enunciated energy policy. This situation saw energy planning being carried in an ad hoc manner. The presentation given in sections 4.2.1 - 4.2.5.3, reveals the existence of uncoordinated efforts in energy resources development. Under such a circumstance, it is not easy to set proper national priorities and strategies in the sector because of lack of direction. It is the country's energy policy which spells out development directions, priorities, policies and strategies for effective energy development.

Serious efforts to formulate an energy policy for Tanzania began in 1980 when the government of Tanzania sought the assistance of the Common Wealth Secretariat to review the performance, organization and strategies of the energy sector. This came after the country had realized that the growth of the sector had been slow. The documents which resulted from the review were discussed by the interministerial seminar, which then made recommendations to the government on actions to be followed. In 1988, the government formally established a task force on energy policy to draft proposals for a national energy policy and to advise the government on the implementation process. Later on, a national

seminar on energy policy was held in cooperation with TANESCO, TPDC, and the Energy Research Project of the University of Dar es Salaam, with the assistance of Stockholm Environmental Institute (SEI) and Norwegian Agency for International Development (NORAD).

This process helped to arrive at a consensus that Tanzania's principal energy policy goals should be to enable the essential social and economic service of energy provision to support the implementation of national social and economic policies and plans. The energy policy was finally published in 1992, being a result of inputs from a number of organizations - governmental and non-governmental, external cooperation partners, energy users, energy suppliers and interested academics.

The major objectives of the National Energy Policy can be summarized as:

i. exploitation of the abundant hydro-electric sources;

ii) development and utilization of indigenous natural gas and coal resources;

iii) Stepping up petroleum exploration activities;

iv) arresting woodfuel depletion by evolving more appropriate land management practices and more efficient woodfuel technologies;

v) Provision of the continuity and security of energy suppliers;

vi) Minimization of energy price fluctuations in order to contribute to general price stability through strengthening and rationalization of energy supply sources, infrastructure provision, and maintenance of a rational energy pricing structure; and

vii) investment in appropriate human resources for energy sector management

and energy technology development.

More encouragingly, the energy policy recognizes the importance of existence of an efficient information support system for effective development of energy resources in Tanzania. It is hoped that this elaborate Energy Policy of Tanzania will redirect all efforts towards energy resources development to achieve a more appealing energy and economic development in the country.

4.5 INFORMATION NEED FOR ENERGY RESOURCES DEVELOPMENT IN TANZANIA

Through the foregoing discussion on the trends in energy resources development in Tanzania, in this chapter, it may be noted that one of the major problems which appear to have thwarted the development efforts is the absence of reliable information on the technologies used in projects. Modern society depends much on information. Information is vital for rational decision making in all areas at all levels. All sectors of society and the activities of individuals depend on the availability and efficient handling of information.

Information and data are, by all means, prerequisite for meaningful energy development activities in all contexts. The need to develop techniques for capturing, processing, evaluating and disseminating information becomes indispensable in the move to develop energy resources in Tanzania. Always, there is a need to strike a balance between information overload and the arising need to use this information in performing a wide range of analyses for development. This problem can be handled effectively with the

establishment of an information system to support the cause of energy development. The energy policy of Tanzania enunciates this reality quite clearly.

An information base that is oriented towards both problem finding and solution finding is essential. The system is supposed to be capable of presenting analyzed and synthesized data in a readily usable form to different user groups in the energy sector, at different levels. The different sub-systems of the information system need to be designed to relate to, and be compatible with, each other for effective functioning for development.

CHAPTER 5

FINDINGS OF THE SURVEY: SYSTEM ANALYSIS AND EVALUATION

5.1 OVERVIEW

This chapter deals with the analysis and evaluation of information systems and services that support energy resources development in Tanzania. The chapter also analyzes information needs of energy resources development planners, researchers and decision makers in the energy department.

The process of energy development planning is intersectoral by nature. The process, therefore, depends largely on acquisition of data from various related institutions, such as research and functional ones, in the field of energy resources development. Moreover, the energy sector is not isolated; it is a sub-set forming part of economic and social set, and articulates on other sub-sets. The other subsets, which include agriculture industry, transport, services, housing etc., influence the way energy development should be carried out in the country. It therefore becomes apparent that energy cannot be required in itself but in connection with the satisfaction of the needs of other economic and social sectors. It is by taking the above mentioned reality into consideration that, a survey of the information systems in institutions related to energy resources development was carried out. This aimed at assessing whether there was any reasonable information, and data communication, between these institutions, and the energy resources development unit in the Department of Energy in the MWEM.

5.2 SYSTEM ANALYSIS: INFORMATION SYSTEM AT THE ENERGY RESOURCES DEVELOPMENT UNIT

5.2.1 Institutional Structure

The Energy Resources Development Unit, falls under the Department of Energy in MWEM. The Department of Energy has three other units in addition to the one dealing with development. These are: Petroleum and Gas, Electricity, and New and Renewable Energy Sources. The Department also has the responsibility of supervising energy development institutions such as TANESCO, TPDC, STAMICO, oil distribution and marketing companies, and the Zanzibar State Power and Fuel Company (ZSPF). Moreover, there are many other organizations, governmental and non-governmental, involved in energy resources development in the country, primarily in areas such as research, development, and dissemination activities focused on new and renewable sources of energy. These organizations have to operate in accordance with the energy policy, as spelt out by the MWEM.

5.2.2 The Information Support System

There is a Documentation Centre supporting the Energy Resources Development Unit in the MWEM. This was established to cater for the information needs of the four energy departmental units shown in section 5.2.1. This Documentation Centre is still in its infancy. The Centre was established in a response to the call of the national energy policy on establishing an information support to step up energy development activities in Tanzania.

At the time of the survey (August, 1994), the Documentation Centre had hardly been in operation for more than a year. The documents available at that time were not properly catalogued/classified. All documents were grouped in order of the energy sectors they addressed, under a temporary arrangement devised by the Centre, called "In House Based on Subject Matter Classification."

The person in charge of the Documentation Centre explained that there were plans to develop the Documentation Centre to enable it meet the needs of the Energy Department. Some of the activities expected to be undertaken (as mentioned during the survey) include:

i) cataloguing/classifying documents using one of the internationally known classifying methods such as: the Library of Congress, Dewey Decimal Classification, Universal Decimal Classification etc.,

ii) identification of information needs of planners, executives, decision makers etc, in the Energy Department with a view to organizing the Documentation Centre to meet these needs;

iii) designing/developing an information service structure which will support planning and decision making in the areas of:

   a) energy balance

   b) energy supply and demand

   c) energy production

   d) energy resources development etc.

iv) establishing linkages with researchers, planners and decision makers, working in institutions related to energy development, so as to strengthen the information system; and

v) computerizing the information system to make it more effective.

Due to the strategic nature of the energy sector, the information system has attracted attention of donor agencies from Europe who are willing to support the efforts to strengthen it.

5.2.3 Computer Application

The Documentation Centre at the energy development unit is not a computer-based system. However, the Centre has two micro-computers; ATNT 486X, and Morse System Computer 486DX. These are stand alones, and at the time of the survey their application had not extended to activities related to information storage and retrieval.

The software found in use at the Documentation Centre were Word Perfect 5.1, Micro-soft words for windows, dBase III and dBase IV, which are used in creating and maintaining records of documents and statistical data in the system.

5.2.4 Mode of Dissemination of Information

The information system is still at its preliminary stage. The methods used to disseminate information are mainly statistical outputs of various kinds of data on energy resources, on the request of users, and for users reading the documents. At the time of survey, the latter did not look feasible because of the documentation room being poky. No Current Awareness Services and Selective Dissemination of Information (SDI) were

operational at the time of the survey.

5.2.5 **Information Users**

Although the Documentation Centre is open to all staff of the MWEM, it was established specifically to cater for the needs of energy development planners, decision makers, researchers and executives to step-up the energy resources development in Tanzania.

There are 10 officials in this category: four related to energy development planning; three dealing with decision making and executive responsibilities, and the other three deal with research, project coordination and monitoring. Out of these, four officials were not available for this study, and therefore the questionnaire survey and interview were limited to six officials. The responsibilities of officials who were involved in the survey were as follows: two planners, two researchers/project coordinators, and two decision makers/executives.

The officials who were interviewed, appreciated the importance of information in successful handling of their activities. However, all raised concern on inadequacy of relevant information to suit their needs.

The interview revealed that utilization of reliable data in planning for energy development is a culture which is yet to take deep roots. It was also revealed that, the past experience was that, most plans were heavily influenced by political interests, a tendency

which prevails in studying the feasibility of whatever project to be undertaken in this regard. As a result, many projects once started either failed after a short time, or were subjected to a natural death in course of time. It was expressed that, if the attitude is not rectified, it may be a hindrance to successful contribution of information support systems to energy development.

The respondents, stated that the usefulness of the Documentation Centre was largely confined to energy development planning and decision making functions. As energy development planning is a multisectoral activity, they recommended that, information ranging from agricultural, forestry, industrial, environmental and other social aspects should be generated and disseminated to enhance the capacity of planning and decision making for the energy sector development.

5.2.6 **Recency of Data and Information**

The respondents felt that the data and information available from the Documentation Centre was not current in most cases. Useful data for forecasting in energy development planning was always a problem due to poor mechanisms of collecting them, and also absence of viable linkage with other information systems.

5.2.7 **Data Sources**

The person in charge of the Documentation Centre expressed concern that up to the

time of the survey, the Ministry did not provide adequate financial support to help the Centre acquire adequate information from different sources to meet the users demands. It was also mentioned that the way of collecting data and information from different energy development related sectors was not quite systematic. The Documentalist said at that time, the Ministry was working to design special kind of forms to be filled every month to facilitate data collection on energy resources utilization, energy demand, energy balance etc.

The existing data sources at the time of survey were:

- Socio-economic statistical surveys conducted by Bureau of Statistics;
- Monthly and Annual Reports on electricity fuel and coal from TANESCO, TPDC and STAMICO respectively;
- Reports of oil marketing companies, such as TOTAL, AGIP, BP, CALTEX AND ESSO;
- Annual Reports from Tanzania and Italian Petroleum Refinery (TIPER); and
- Reports on wind and solar energy from the Meteorological Department.

5.3 **INFERENCE FROM THE SURVEY FINDINGS**

The Documentation Centre is basically in its infancy. However, the plans envisaged to develop it, as explained by the person running it, were quite encouraging, if at all they would be implemented. Nevertheless, it appeared that these aspirations were just a broad goal, which had no clear strategies worked out for the implementation. No study had been taken at the time of the survey to try to understand the nature of the intended undertaking.

At the time of the survey, the information system still did not provide comprehensive services to energy resources development planners and decision makers to support their various planning tasks.

The survey revealed also that, the coverage of data, and information generated, has not yet met the needs of energy development planners, researchers and decision makers. This makes energy resources development planning process data deficient, a situation which is prone to risky decision making. All the respondents showed that sometimes they are forced to perform their duties without adequate information base, as a result of a narrow coverage of information in the Documentation Centre. This tendency is prone to erroneous decision making which can do much harm instead of bringing the much needed development.

The unsystematic ways of collecting data and information and the absence of effective linking mechanism to other information systems, especially those of research institutes add to the weakness of this Documentation Centre. Except for the annual reports, which have to be submitted at a given time by regulations, there is no stipulation arranged for research findings in institutions related to energy development, to be made available in the Energy Department.

The available manpower in the documentation Centre is inadequate. Currently, there is only one person who holds a postgraduate diploma in Information Science. Owing to the plans underway to strengthen the centre, more manpower is required.

The Documentation Centre experiences budgetary constraints. This limits its capacity to meet the needs of users. The over-dependence of the information centre on donor agencies for its development have not helped for a speedy progress of this Documentation Centre. The Ministry needs to include the developmental plans of the Documentation Centre in its budget. The Ministry's energy policy acknowledges the importance of information towards sustainable energy resources development. This is a good reason for the Ministry to spend as much as possible to step up the energy development endeavour.

5.4 USERS REQUIREMENT ANALYSIS

As mentioned earlier (in Section 5.2.2) the Energy Documentation Centre was reported by the person in charge to be studying the information needs of planners, executives, decision makers etc., with a view to meeting their requirements. The interviews carried out with the six important users of the Documentation Centre, out of the total of ten within the Ministry, revealed that the critical information required for effective energy resources development include: energy end uses, energy demand, energy supply, energy consumption pattern, energy pricing, energy balance, energy distribution, indigenous energy resources, and research reports in various fields related to energy development. They also expressed the need for information in socio-economic and environmental data to support energy planning which is a multisectoral undertaking by its nature.

The current missing link between the Documentation Centre and research institutions like COSTECH and IRA which have reasonable research coverage on energy resources development, adds to the deficiency of the Documentation Centre. This situation further

reveals that the information flow pattern between these institutions is inadequate.

5.5 SURVEY OF INFORMATION CENTRES IN INSTITUTIONS RELATED TO ENERGY RESOURCES DEVELOPMENT.

Information centres of six institutions other than the Documentation Centre of the MWEM, were selected for this study. The selection of these information centres was based on their being very instrumental to energy resources development process. The COSTECH and IRA information centres were selected because of the role they are expected to play in disseminating information emanating from research findings carried out by these two important research institutions. TANRIC and TANDOC were selected because of their important role in analyzing, consolidating and disseminating information on natural resources and in general fields respectively. TANDOC, for instance, is entrusted with the activities of abstracting and indexing different information sources and producing the national bibliographies for Tanzania. The Planning Commission Documentation Centre was selected because of its role as a resource centre for all planning, plan drafts, census etc. for the total national economic planning. And lastly, the Bureau of Statistics Documentation Centre was selected because of its resourcefulness in various statistical data and records to support different economic sectors in the country.

The services rendered by these information centres, the computer resources available, and the magnitude of their cooperation in data/information exchange and dissemination with the energy development unit, were assessed. Questionnaires were sent

to each of these information centres, and were supplemented by interviews and on-site observations. The findings of the survey are presented in the following subsections.

5.5.1 **Use of Computers**

All the six information centres have computers which are, however, used mostly for word processing. Out of the six information centres, only one, viz the Tanzania Natural Resource Information Centre, is fully computer-based. This is followed by COSTECH which, although the information centre is not computerized, it makes reasonable use of computers by employing a number of software. Table 12 shows the number and type of computers used by the surveyed information centres.

Table 12. The Number and Type of Computers Used

Type of Computer	The Existing Number	Number of Information centres using	Percentage of all the institutions
Mainframe	0	0	0
Mini-Computers	2		16.7
Microcomputers		1	
	12		83.3
		5	
Total	14	6	100

Tables 13 and 14 show the location of computers, and the extent of computer utilization in the surveyed information centres, respectively

Table 13: Location of Computers used by Surveyed Information Centres

Location of Computers	Number of Information centres	Percentage of all the institutions
Located in the library/documentation centre	3	50
Located in the parent organization's different offices	3	50
Total	6	100

Table 14: Extent of Computer Utilization in the Surveyed Information Centres

Type of Utilization	Number of Institutions	Percentage
Word Processing	6	100
Database Management	3	50
Financial Management	1	16.7
Statistical Packages	1	16.7
Data Processing	6	100.0

5.5.2 **Software Used by the Surveyed Information Centres**

Table 15 summarizes the kind of software used in the information centres.

Table 15. Software Used in the Surveyed Information Centres

Software	Number of Institutions	Percentage
Word Perfect	6	100
Micro CDS/ISIS	2	33.3
dBase III &IV	5	83.3
Mini/ISIS	0	0
Others	3	50

5.5.3 **Type of Databases Available in the Surveyed Information Centres**

Table 16 summarizes the databases developed by the surveyed information centres.

Table 16. Databases Developed by Surveyed Information Centres

Type of Database	Number of Institutions Using	Percentage
Bibliographic database	5	83.3
Profiles: Institutions, expert, Projects	4	67.0
Specialized data Object/Mission oriented databases	2	33.0
Factual database	2	33.0

The tables reveal that the computers are largely used for word processing and statistical data processing. Even in the institutions which claim to have bibliographic and factual databases, they are not full-grown databases. The institution which shows encouraging development on databases is TANRIC.

All information centres provide information services in the form of libraries or

documentation centres. The only exception is TANRIC which is entirely a computer-based information system. Nevertheless the documentation centre at the Bureau of Statistics is not properly organized. The documentation room has a pile of unclassified documents which makes it difficult to retrieve the needed documents. The person, running it, holds a certificate in Librarianship. He explained that the documents were grouped by fields of the subjects they addressed.

5.5.4 **CD-ROM and On Line Databases**

Two information centres i.e COSTECH and TANRIC have CD-ROM databases and CD-Rom drives. COSTECH have four CD-ROM databases: Science Index, Patent Information, Biotechnology Index and LISA. TANRIC recently established Information Centre has one CD-ROM database: Biotechnology Index. However none of the six information centres has on line database services.

5.5.5 **Networking**

In the six institutions surveyed, all the computers are stand alones. However, apart from TANDOC and the Documentation Centre in the Bureau of Statistics, other institutions expressed willingness to work for a networking mechanism. It was discovered that most of the information centres personnel talking on this issue, had only a vague idea about networking. The importance of networking and the advantages occurring from it seem to be vaguely appreciated. Two respondents, expressed their concern about data security and privacy. It was only after discussions that they realized that more advantages are gained

from networking systems.

Information systems networking is a relatively new concept in Tanzania arising from the need to come together to facilitate easy access to information, and also sharing of resources. The need for networking arises out of problems faced in information transfer due to rapid rate of growth in production and use of information (Wesley 1992).

The information resources required in the generation, processing and dissemination of information such as, skilled manpower, finance, and other materials make it difficult for a single institution to generate or acquire alone, all the necessary information sources needed for various purposes by users. Networking facilitates sharing of resources which alleviates most of these problems. Moreover, the developments in information technology provide possibilities to get fast access to a wide range of information resources.

At the time of the survey, there was no mechanism which effectively linked the information centres among themselves or with that of the Energy Development Department. This hindered possibilities of sharing of information resources. It also hinders possibilities of smooth communication of new discoveries originating from research activities. Even the important research institutions like COSTECH, which has a research unit dealing with New and Renewable Energy Resources, does not have linkage with another unit dealing with the same issue in the Energy Department. This, more than entertaining unnecessary duplication of efforts, cripples the contribution of research to development. The research findings become useful only when they are communicated to people who can put them into practice. It is this application of the findings which actually brings development to a nation.

5.6 INFERENCE FROM THE SURVEY OF INFORMATION CENTRES

The following is the inference drawn from the findings of the survey and interviews carried out in the selected six information centres:

- The existing information support facilities of the institutions related to energy resources development, have very little contribution at present towards the development of energy resources in Tanzania. This results from the missing link existing between these information centres and that of the Energy Development Department. The survey conducted through questionnaires and interviews, reveals that energy research findings which are produced by research institutions like COSTECH and IRA do not reach the energy department information centre.

- The responses revealed that, up to the time of the survey for this study, the information flow pattern between the information centres surveyed and that of the Energy Development Unit, was poor. Valuable information sources emanating from energy research findings remained on the shelves of the libraries/documentation centres without reaching the Ministry responsible for energy development. The research findings which could push forward energy development fail to contribute towards that end. It is a fact that, fast development in the developed countries has always depended much on research, hence the term "Research and Development". (Wesley 1992). This problem needs to be rectified for sustainable energy development.

- All information centres have computers, although the application of the computers has not gained much ground. However, this can serve as a good starting point in resolving linkage problems using the available computers.

- Almost all the institutions worked in isolation. The information centres supporting these institutions work in accordance with the stipulated organizational framework. There is very little connection with information centres outside the institutional boundaries. This is not helpful in resource sharing efforts.

- The absence of a coherent national information policy on information systems and services, makes the information acquisition, processing and handling to be done in isolation, without taking into consideration that, they are a subsystem of the national information system supposed to contribute to the country's overall economic and social development. This problem has even resulted in a random acquisition of computer hardware and software to a level whereby there are numerous different brands. This can cause problems in networking efforts because of compatibility and protocol difficulties. At the moment, a draft proposal on national information policy on information systems and services, worked out by Sekimang'a, former SISA student, in 1992, has not yet been adopted by the government.

The shortcomings discovered in this survey need to be rectified if the whole question of energy resources development is to be successful. While the National Energy Policy shows clearly that a strong information base is a prerequisite to the total success of the energy development endeavour, the survey results indicate that the existing information facilities are far from adequate. Planners, researchers, and decision makers, all need

adequate, accurate and timely information to discharge their duties effectively. Otherwise the planning, decision making or research undertakings may lead to sheer wastage of the scarce financial and other material resources, without achieving any reasonable development.

It is by taking this problem into consideration that the next chapter proposes a Computer-Based Information Support System for Energy Resources Development (CBISSERD) in Tanzania. The proposed system suggests some approaches thought to be a remedy for the existing shortcomings in the present information centre for the energy sector.

CHAPTER 6

THE PROPOSED COMPUTER-BASED INFORMATION SUPPORT SYSTEM FOR ENERGY RESOURCES DEVELOPMENT IN TANZANIA (CBISSERD)

6.1 INTRODUCTION

Shortcomings of the current information support for the energy resources development in Tanzania have been discussed in Chapter 5. The situation presented in the analysis in Chapter 5, calls for efforts to strengthen this information unit so that it can meet the requirements of planners, decision makers, executives and researchers for sustainable development in the sector.

Davis and Olson (1985, 474) observe that, an information system should meet the needs of the organization it serves, and applications should meet the needs of their users. The requirement of the information system are therefore determined by the strategies goals, procedures, and behaviour of individuals within the organization acting individually or collectively. In addition, section 163 of the Energy Policy of Tanzania (1992) states clearly that all information related problems affecting the energy development sector now, could be solved by establishing an efficient information support system which can link the Ministry responsible for energy development with the energy development parastatal organizations, energy oriented research institutions and other internally based institutions related to energy development.

It is apparent that, redesigning and modification of the existing information support system is the only rational approach to arrest the identified shortcomings. Information is viewed as a resource much like land, labour, and capital. It is not a free commodity. It must be obtained, processed, stored, retrieved, manipulated and analyzed, and then distributed. An organization with a well-designed information system will generally have a competitive advantage over organizations with poorer systems (Davis and Olson 1985, 21) An underlying point here is that information systems add value to an organization.

The information support system proposed in this study is to hinge on the premise that a well designed information system adds value to the organization. The proposed information system focuses at alleviating the information related stumbling-blocks currently affecting the effective developmental planning for energy resources development in Tanzania.

6.2. SYSTEM OBJECTIVES

Having identified that the existing information support services related to energy resources development are weak; and that the weakness of these services have led to a slow process of energy resources development; and also, having realized through the surveys and interviews carried out, that the information flow pattern from point of generation to the relevant users are inadequate, the design of the proposed information system intends to rectify these shortcomings, to perfect the energy development activities of the MWEM. As Davis and Olson (1985) correctly observe, information is a vital ingredient for the operations and management of any organization. The scope of an information system in an

organization is limited by the data that can be obtained, the cost of obtaining, processing and storing the data, the methods of communication, the value of information to the users and the capability of humans to act on the information.

The information needs of people engaged in energy resources development which were identified through the survey carried out by this study, are going to be taken into consideration in the design of the proposed new information system.

To achieve these broad objectives, the following undertakings will be expected from the new system:

1. To strengthen the link between existing information centres related to energy development with that of the Energy Development Unit.
2. To create different databases such as referral ones like: bibliographic records, profiles of experts, institutions, information systems, and profiles of projects.
3. To enhance the capacity of the old energy information centre by introducing a computer-based information support system.
4. Designing specialized database of profiles of core concept going with Energy Resources Development in Tanzania. This database aims at meeting the information needs of the professionals engaged in energy development as identified in the survey. Prototype databases on information aspects like those of energy end use, energy demand, energy supply, energy consumption pattern, energy pricing, energy balance etc. are going to be designed in a way thought to be commensurate with the needs of the identified energy development users.

6.3 STRUCTURE OF THE PROPOSED CBISSERD

The proposed new information system at the Energy Development Unit is computer-based. Hawryszkeiewycz (1989) explains that computer-based information systems use computers to store data about organizations and make this data available to the organization's personnel.

The decision to opt for a computer-based information system lies on the fact that the computer is the most powerful tool for the fast handling of large quantities of information. Mathies and Watson (1983,4) observe that whatever the field, computerized information service will more and more become a tool for those working with new configurations of knowledge in the future. The computer provides the capability for doing highly complex searches organized on any of the fields in a record and massive quantities of data. This applies to whatever type of information which is made machine readable whether bibliographic, citations, summary statistics, raw numeral data, or full text.

In addition to the computerized information support system there will be a back-up in the form of a documentation centre. Hard copies of various reports from institutions related to energy development will be kept there and made available to users, in addition to the computerized data and information. Figures 1 and 2 show the organizational structure of the MWEM incorporating the CBISSERD, and the proposed structure of the CBISSERD itself.

FIGURE 1: ORGANIZATIONAL STRUCTURE WITHIN THE MINISTRY (MWEM)

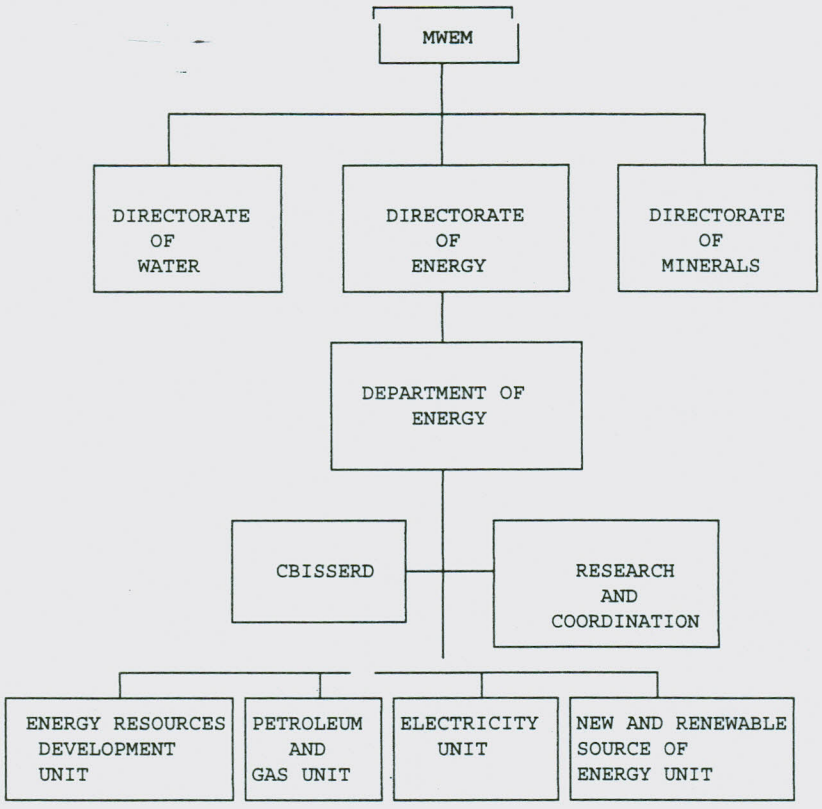
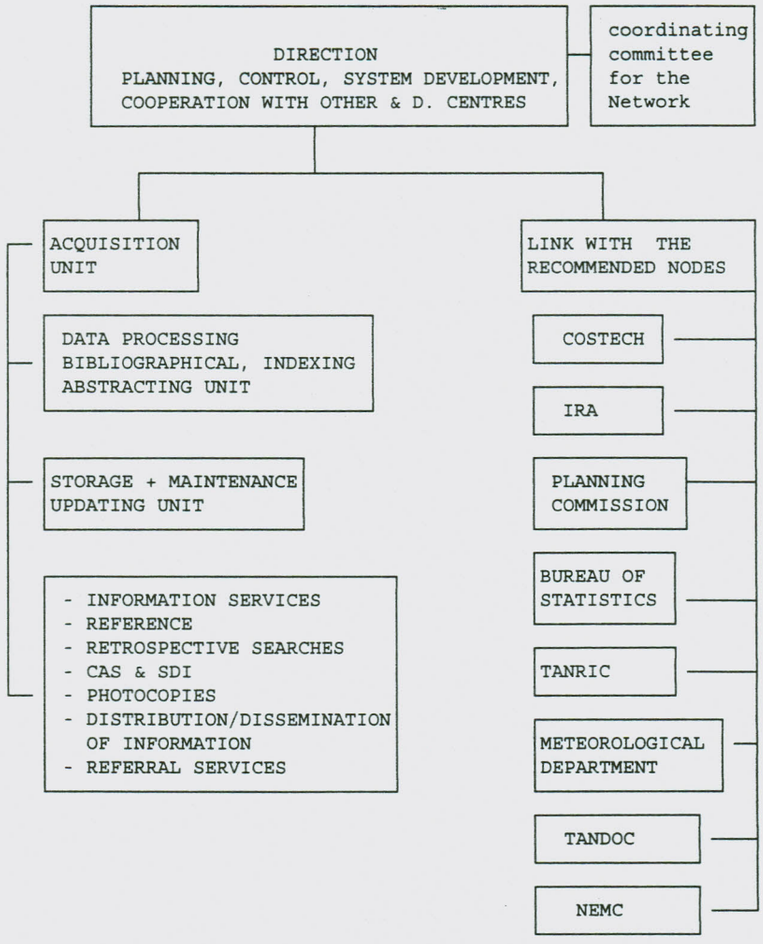


Figure 2: ORGANIZATIONAL STRUCTURE OF THE COMPUTER-BASED INFORMATION SUPPORT SYSTEM FOR ENERGY RESOURCES DEVELOPMENT IN TANZANIA (CBISSERD)



The computer-based information support system (CBISSERD) will have links with other information centres to facilitate smooth and effective flow of information to it. The linking mechanism will be through the nodes to be established for that case. These nodes will be in research institutions such as COSTECH, IRA, Meteorological Department and University of Dar es Salaam (Department of Electrical Engineering). Other nodes will be established in functional energy resources development organizations such as TPDC,

TANESCO and STAMICO. Strategic information Centres like TANRIC, TANDOC, Bureau of Statistics and the Planning Commission will also have linking nodes, each, to the CBISSERD.

Most of these institutions earmarked for nodes, participated in the seminars which were convened to work out the Energy Policy of Tanzania (Mwandosya and Luhanga 1993). The institutions are aware of the energy policy goals, and what each of these institutions, depending on the field of specialization, is expected to perform to make the energy policy a reality. The public hearing approach which was used by MWEM in drawing views on strategies for the development of the energy sector, widely publicized the energy policy itself. The significant contributions made from these institutions of diverse background, make the energy policy a strong and dependable guide to energy development, in accordance with the Energy Master Plan Projects (MWEM 1992).

The need for a link and coordination of information services which are related to energy development through the proposed nodes, arise from the quest to rectify the shortcomings discovered during this study. The situation which manifested itself during the study leads to conclusions that:

1. Information is a valuable resource which, in order to take full advantage of it, it requires a properly structured information system to handle and disseminate it effectively. Effective handling and dissemination of information will contribute to faster development of the energy sector.

2. In Tanzania energy information sources and services are still dispersed in different libraries, documentation and information centres related to the energy sector. This dispersal calls for a coordinated information system if the information generated is to be disseminated effectively to make a significant contribution towards the energy development process.

3. Information needs are varied and complex. No one information centre, however powerful, can serve all users needs (Wesley 1992). A resource sharing information system in energy development is thought to be very important to meet the various information needs for energy development in the country.

4. Information services are becoming exceedingly expensive as it is to other commodities in Tanzania. The creation of an information resource sharing can minimize the cost of production of information by eliminating unnecessary duplications of efforts, while at the same time optimizing the efficiency of its dissemination for development.

6.4 INFORMATION FUNCTIONS

6.4.1. Information Retrieval

6.4.1.1 Interactive Searches

Computer-based information systems increasingly involve online interaction between the user and machine (Davis and Olson 1985). A critical element of the design of these systems is the user interface. The interface consists of screens, keyboards, languages etc.

as means by which the information searcher can exchange inputs and outputs with the computer. The proposed CBISSERD is to have this services. Section 6.10 of this Chapter exemplifies the demonstration on procedures that can be carried step by step for retrieving. This illustrates how a user can conduct both the interactive and retrospective search of the databases.

6.4.1.2. Retrospective Search

Retrospective search services are going to be rendered also, by the proposed CBISSERD. Using the computer the user can search for the information in the databases to meet their requirements. The search in this case may be by author, by subject, etc.

Reference Services 6.4.1.3.

Reference services will be discharged also by the proposed CBISSERD. Reference services add value to the information system because they help users in shaping correctly their queries. The best sources to get the information they may be looking for are normally communicated to them depending on how the user intends to utilize that information. The reference services help users to know which catalogues, directories, files, secondary publications or databases to consult so as to get the required information to solve a specified problem. This is expected to be quite useful to the users related to Energy Resources Development in the MWEM.

6.4.1.4. Referral Services

Referral services are among the functions which the proposed CBISSERD is going to discharge. Referral services do not normally, provide the user with the document or the actual information required by the user, but refers the user to the relevant sources where he or she can get the required data or information. The databases bearing records such as research works, profiles of experts, projects, institutions, information systems etc. are going to be quite helpful in rendering this service. The professionals dealing with energy development are expected to benefit by this service because they will be directed to the resources, whether documental, institutional or of personal skills to do consultations and solve whatever problems they experience in energy development.

6.4.2. Current Awareness Service

This is one of the services which the proposed CBISSERD is going to discharge with the aim to making the energy development personnel informed of the latest information on the sector. It is a system for notifying users of an information service on a periodic basis of the acquisition which should be of interest to a specific user or group of users. This is expected to reform the services of the old system by breaking away from the traditional or passive approach "the wait for the user to come for it" by actively getting involved in taking the information to them at periodic intervals - every week every two weeks, every month etc.

6.4.3 Selective Dissemination of Information (SDI)

SDI is another service which is going to be introduced with the CBISSERD. Musana (1992) defines SDI as a highly refined and personalized form of current awareness service. The method assumes that the information manager knows and fully understands users information requirements, and that the latter has full confidence in the information manager to the extent that he is prepared to delegate information searching to him. The essential elements to be incorporated in the SDI include:

- selecting and acquiring documents for input;
- indexing of incoming documents;
- users needs identification and selection;
- matching of documents against profiles;
- production of outputs (abstracts, full text, citation etc);
- transmission of output to users; and
- evaluation and modification of the SDI system.

6.4.4. Networking and Information Resource Sharing

Resource sharing represents advanced levels of formal cooperation which utilizes computer networks and telecommunication technology. Massil (1989) explains that resource sharing implies a partnership in which each member of the network has something useful to contribute to others and which each is willing and able to make available when needed.

A network is formed by diverse autonomous information sources which are linked in a formal relationship to provide increased access to materials and services from other information centres. It provides a conducive environment in which the information professionals (documentalists, librarians, information scientists, etc) can exchange ideas and share resources. The network therefore, provides the organizational structure which facilitates resource sharing.

Ways to ensure optimum cooperation between the information centres related to energy development and the CBISSERD will be based on Wesley's (1992) principles which, among other things recommend that:

1. In the information resource sharing endeavour, each unit should have something useful to give to others. It is not "I join so that I get, but I give so that I receive".

2. A two-way cooperation model will be used to ensure that there is a shared responsibility where each centre contribute to the network.

3. An agreement on objectives of the network and the joint action necessary to achieve those objectives is to be worked out.

4. A network committee shall be formed to prepare a written work plan and getting their commitment for its implementation. This is meant to enhance effective cooperation between the information centres and the CBISSERD.

5. The resource sharing shall aim at securing adequate resources and efficient communication.

6. There shall be a provision for legal responsibility for the realization of the network

objectives to develop the energy sector.

7. Training activities will be required to ensure the successful implementation of network programs and procedures adopted for the network.

8. Efforts will be made to ensure commitment to network standards, procedures, policies and activities.

9. To ensure that every participant (information centre) understands that the key of the success of the network lies in the participants themselves, in the support they provide, in their willingness to surrender a certain amount of self-sufficiency and in their determination to make the program succeed.

6.5 PROPOSED DATABASES

In order to provide some of the services discussed in the preceding sections successfully, there is need for development of databases. For this case two kinds of prototype databases have been developed using Micro CDS/ISIS version 3.0. The two kinds of prototype databases are: the integrated database and the specialized databases. It is hoped that the prototype databases developed can be adapted and expanded by CBISSERD when it gets approval by the government for implementation.

6.5.1 Integrated Database

The integrated database consists of profiles of experts, institutions, research projects, information systems and bibliographic database. A sample output of the records of the databases is shown in the next sections corresponding to them.

6.5.1.1. Bibliographic Database

The prototype integrated database 'JORAM' contains sample bibliographic records where each record contains bibliographic descriptions of documentary sources of information. The descriptive elements such as, name of the author, title of the document etc. conform to the descriptions of accepted cataloguing codes like that of AACR2 .

The bibliographic record which consists of bibliographic descriptions of document on energy development, are meant to help the people concerned with energy development to know which sources to pick for the problem they want to solve in the process of energy development. Figure 3 shows a sample record of the bibliographic database.

Figure 3. Sample of Bibliographic Record

BIBLIOGRAPHIC RECORD

LANGUAGE OF TEXT:	English
TITLE:	Energy Resources Flows and End-Uses in Tanzania.
PERSONAL AUTHOR:	Mwandosya, M.J.,Luhanga, M.L.
AFFILIATION:	Ministry of Water Energy and Minerals
PUBLISHER:	Dar es Salaam, Dar es Salaam University Press
DATE OF PUBLICATION:	1983
LOCATION:	Library, University of Dar es Salaam, Tanzania
ABSTRACT:	The book illustrates in detail on the available energy resources, the energy flows, and strategies to develop energy in Tanzania.

6.5.1.2. Profiles of Experts

The prototype integrated database 'JORAM' incorporates some sample records of experts in the field of energy development in Tanzania. The objective of creating the profiles of experts database, is to have a repository of resourceful persons in the field of energy development. This will indicate data of important intellectuals, energy experts, energy researchers etc, who can be consulted by planners, decision makers, executives or researchers, for important information to enhance the energy development process.

The experts are valuable human source of information which complement the information available in the form of documents or databases. The profile of expert database can be useful when new energy development projects are thought of being established. For years, it had been the tendency in Tanzania, to rely upon foreign experts in the execution of energy projects, because of little information on the available local experts. Most of these foreign experts tend to be less informed on the environmental aspects of the country, causing the project they supervise to fail. A good example of this is the multimillion RUBADA electric project which has not been successful for the ten years it has been in implementation(MWEM 1992). The referral database of expert will help the government to try to check within the list of available local experts before turning their eyes to external experts. Figure 4 shows a sample record of the profile of expert database.

Figure 4. Profile of expert

```
                ***PROFILE OF EXPERTS***
NAME OF A PERSON:    Mwandosya, Mark J.,Professor

SEX:                 Male

ADDRESS:             P.O.Box 2000, Dar es Salaam  TZ

QUALIFICATIONS:      B.Sc.(Eng.), Aston, (UK)1974;
                     Ph.d, Electrical and Electronics
                     Engineering, Birmingham, 1977

DISCIPLINE:          Electrical Engineering

CURRENT EMPLOYMENT:  Commissioner for Energy (Admin. &
                     Research and Development)

AFFILIATION:         Ministry of Water,Energy and
                     Minerals, Energy Directorate

              ************************
```

6.5.1.3. Profiles of Projects

The profiles of projects created within the prototype integrated database 'JORAM' are intended to help energy development planners, decision makers, executives and researchers know the on-going projects, how they are being implemented and the problems or progress experienced in undertaking them.

In Tanzania, like in many other developing countries, most of the projects are carried out with little relevance to the nation's priority needs. In addition there have been cases of duplication of projects, a practice which results into wastage of the scarce resources in the country. The Project database can minimize this because the data can be consulted to check the projects currently in operation in the sector, before embarking on a new project. Figure 5 shows a sample record of the profile of project database.

Figure 5. Profile of Projects

```
              ***PROFILE OF PROJECTS***

TITLE:                    Tanzania Railways Corporation
                          (TRC) Solar Project

PRINCIPAL OFFICER:        Mrope, Gideon, Project Engineer

PERFORMING INSTITUTIONS: Tanzania Railways Corporation

TYPE OF INSTITUTION:       Parastatal, Commercial

ADDRESS:                  P.O.Box 7798  Dar es Salaam TZ

LANGUAGE OF PROJECT:      Kiswahili, English

LOCATION:                 Dar es Salaam
DURATION:                 1988-1996
CURRENT STATUS:           On going

DESCRIPTOR:               Solar Energy, Photovoltaic

GEOGRAPHICAL AREA:         Tanzania, East Africa
DISCIPLINE:               Solar Energy
STARTING DATE:            1988-07-01
TYPE OF RESEARCH:         Applied
OBJECTIVE:           Substitute Solar for thermal
```

6.5.1.4. Profiles of Institutions

Some sample records of profiles of institutions have been created within the integrated 'JORAM' database. This is developed to help energy planners, executives, decision makers etc. to know which institutions are involved in which type of energy resources development.

The database may be quite useful in the exercise of allocating resources to institutions. The institutions dealing with energy sources of the priority of the nation, at a given time, may be known and supported accordingly. The database can also be quite helpful in overall planning and distributing responsibilities among institutions related to energy resources development. Figure 6 shows a sample record of the profile of institution.

Figure 6. Profile of Institution

```
          ***PROFILE OF INSTITUTION***
NAME OF INSTITUTION:  Tanzania Commission for Science
                      and Technology
DISCIPLINE:           Science, Technology
YEAR OF ESTABLISHMENT:1986
NUMBER OF STAFF:      Research Scientists,21
TYPE OF INSTITUTION:  Parastatal, Research Centre
OBJECTIVES:           Advancing Science and Technology
WORKING LANGUAGE(S):  Kiswahili, English
PARENT ORGANIZATION:  Ministry of Science, Technology
                      and Higher Education
GEOGRAPHICAL COVERAGE:Tanzania, East Africa
DESCRIPTORS:          Science, Technology

          ****************************
```

6.5.1.5. Profiles of Information Systems

Information systems related to energy development are valuable repository of data and information generated by them as they discharge their duties. A profile of these institutions would help energy developers to know which other systems could furnish them with required information not found in the information system they use at that time. Figure 7 shows a sample record of the profile of information systems

Figure 7. Profile of Information System

```
        ***PROFILE OF INFORMATION SYSTEM***

NAME OF INFORMATION SYSTEM:COSTECH DOCUMENTATION CENTRE
PRINCIPAL OFFICER:         MLAKI, T. E.
PARENT ORGANIZATION:       TANZANIA COMMISSION FOR
                           SCIENCE AND TECHNOLOGY
                           (COSTECH)
TYPE OF INSTITUTION:       PARASTATAL
LOCATION:                  DAR ES SALAAM
WORKING LANGUAGE(S):       KISWAHILI, ENGLISH
SERVICE OFFERED:           SDI, CAS, INDEXING, REFERRAL
                           ABSTRACTING
GEOGRAPHICAL AREA:         TANZANIA
DATE OF ESTABLISHMENT:     1968-7-01
PERSONNEL:                 INFORMATION OFFICERS,
                           RESEARCHERS
ACTIVITIES:                INFORMATION RELATED ACTIVITIES
PERSON ENTERING DATA:      KILEMILE J

          ************************************
```

6.5.2. SPECIALIZED DATABASES

Specialized database of the profiles of core concepts are becoming increasingly the basis for knowledge based systems, expert systems etc, and for generating value-added products and services, especially at the institutional level (Neelameghan 1994).

A specialized database usually provides information about an "object", such as energy, electricity, coal solar energy, woodfuels, etc. Such databases can be home-grown on microcomputers to meet the needs of specialized user groups and can effectively supplement or be integrated with conventional bibliographic and referral type of database and services (Neelameghan 1994). Three specialized prototype databases have been created. These are: ENERT, TASEC and ENTAB.

6.5.2.1. ENERT DATABASE

The ENERT database mainly focuses on the development of different forms of energy in Tanzania and draws experiences from other developing countries as well. Its main concern is to record some trends in energy policies, current situation, forecasts, experiences including impacts of renewable energy sources indicating market trends, to chronological developments and other projections. Figure 8 shows a sample record of the ENERT specialized database.

Figure 8. Sample of ENERT Database Record

```
                ***ENERT RECORD***
COVERAGE:              TANZANIA
TOPIC:                 WOODFUEL
CURRENT SITUATION:     Woodfuel dominates the energy
                       consumption in  Tanzania. Woodfuel

                       alone accounts for 92% of the pri-
                       mary energy consumed. Petroleum
                       contributes 7% and electricity 1%.

FORECAST:              The current energy balance is expe-
                       ted to remain so for a number of
                       years if new strategies are not
                       applied in developing energy in
                       Tanzania. Rural electrification
                       for instance is very slow. Rural
                       areas are the leading in woodfuel
                       consumption. High prices of  oil
                       products discourage rural people
                       to use them and relief the fast
                       growing deforestation.

POLICY ISSUES:         For the time being MWEM does not
                       have elaborate policy to improve
                       the consumption pattern of wood-
                       fuels in the country.

OPERATIONAL EXPERIENCE: Woodfuel production and market-
                         ing remains an informal sector
                         for years now. In a way this
                        affects the government control and
                       directing towards efficient use of
                          this source of energy. Deforest-
                          ation has brought with it a
                          series of problems to the conce-
                         rned areas. Drought is one among
                         these problems.

SOURCE OF INFORMATION: 1.NEMC: STATISTICS  1994.
                       2.BUREAU OF STATISTICS  1994.
                       3.MNRT: FORESTRY DEPT.   1993.
```

6.5.2.2. TASEC DATABASE

The TASEC database is meant to allow energy development planners and decision makers to have trend reports on the consumption patterns of the different categories of energy utilized in Tanzania, such as petroleum, electricity, coal, and non-conventional energy sources such as woodfuel and charcoal. Figure 9 shows a sample record of the TASEC database.

Figure 9. Sample Record of TASEC.

```
                    ***TASEC RECORD***

TYPE OF ENERGY:     Solar Energy

CURRENT PRODUCTION:Solar Energy is not very popular amo-
                   ng many Tanzanians. The current produ-
                   ction of solar energy is mainly throug
                   the imported solar photovoltaic units.
                   Although this technology is quite
                    useful in remote areas, the developme
                -nt of it has up to now been limited to
                   communication and a few remote health
                   centres.

 CURRENT CONSUMPTION: Up to now there are few users of
                      solar photovoltaic energy. In 1993
                      the total solar units in domestic
                      use in Tanzania did not reach 300.

 PRODUCTION FORECAST: The problem with solar energy lies
                      on scarcity of information about it
                      Even the Government has not shown
                      much commitment in promoting it.
                      The market is promising if informa-
                      tion is duly disseminated on it.

 EXPERIENCED PROBLEMS: Lack of sufficient information.
 SOURCE OF INFORMATION: COSTECH 1994.
```

6.5.2.3. ENTAB DATABASE

ENTAB is a prototype database whose output is in tabular form and shows the consumption patterns of different types of energy as consumed in various sectors in the national economy in Tanzania over a given period of time. This helps in deciding which energy resources are to be developed fast t meet the growing demand. Figure 10 shows a sample record of the ENTAB specialized database.

Figure 10.Sample record from ENTAB Database.

```
        ******ENTAB RECORD******

TOPIC:              ELECTRICITY CONSUMPTION
SOURCE:             TANESCO, MWEM
UNIT OF MEASURE USED: PERCENT
YEAR:                1989   1990   1991   1992   1993
DOMESTIC USE:        32.9    37.12  43.13  40.62 41.2
COMMERCIAL:          25.38   23.8   25.79  24.16  21.8

LIGHT INDUSTRY:       4.4     5      4.1    4.36  3.9

AGRICULTURE:          4.53    4.89   4.9    5.29  4.8

HEAVY INDUSTRY:       27.76  24.44   26.36  20.76  23.4

PUBLIC LIGHTING:      0.33   0.55    0.54   0.93   0.8

WATER SERVICES:      4.66    4.40    4.20   3.87   4.1

TRANSPORT:           -       -       -      -      -

TOTAL:                100     100     100    100    100
```

6.6 INFORMATION PRODUCTS

6.6.1. Input Specifications of Data

The sources of data of the prototype specialized databases are mainly institutional, human (experts) and documentary sources of information on energy in the Energy Resources Development unit, and institutions related to it in the energy sector and other sectors.

Among documentary sources identified and used for this purpose include:

- the Energy Statistics from the MWEM;
- TANESCO Reports on electricity;
- Meteorological Department Reports on Solar and wind energy;

- Bureau of Statistics bulletins;

- COSTECH Reports;

- TPDC Reports; and

- Tanzania, Economic Survey Reports by the Planning Commission.

6.6.2 Output Formats

Several information products are expected to be produced by the proposed CBISSERD. Hard copies (printed formats) of products like SDI, CAS, directories and statistical outputs will be produced for dissemination to contribute to the energy resources development process.

6.7 INFORMATION SYSTEM REQUIREMENTS

In order the proposed CBISSERD to be operational, there are several requirements which are considered to be basic for its success. The following is the recommendation of the system requirements.

6.7.1. Hardware

The survey carried out during this study revealed that about 75% of the microcomputers used by information centres were IBM compatible ones. Taking this into consideration, the computer hardware to be purchased for the CBISSERD is recommended to be 4 IBM compatible microcomputers with the following specifications (all these are for

the MWEM only the other information centres recommended for nodes will use the available computers)

- 486 Microprocessor;
- 4 MB RAM and Upgradable;
- 200 MB Internal hard disk storage;
- 1.44 MB 3.5" Drive
- 1.20 MB 5.25" Drive
- 150 MB straining tape drive
- capable of running MS-DOS version 6.2
- All necessary cables and connections
- 2 monochrome graphics with 80 columns by 24 lines.
- 2 VGA colour monitors with 80 columns by 24 lines.

Keyboard Consideration

The following considerations will be taken into account, to get the best keyboards.

- convenience of Function keys
- programmable keys
- standard alphanumeric keys
- detachable keyboard

Printers:

- 3 EPSON LQ1170 Dot-Matrix Printers
- 2 Letter quality, laser jet Printers
- Both with automatic sheet feeders

6.7.2. Software

The choice recommendation include:

- MS DOS 6.2
- MICRO CDS/ISIS V.3 +
- Word Perfect 5.1
- Novell (Network software)
- dBase IV plus
- Lotus 1-2-3 R 3-1

6.7.3. Accessories

- 4 stabilizers (Uninterrupted Power Supply) matching local power supply
- 10 3.5" diskettes, 5 5.25" diskettes
- ribbons
- dust cover for each PC.

6.7.4. Network

A Novell Netware configuration is recommended. For the time being it is recommended that the Network to be established be Local Area Network (LAN); because

of the availability of facilities. The LAN should in the long run be connected to the nodes in other institutions in a WAN.

6.8 IMPLEMENTATION PLAN FOR THE INFORMATION SYSTEM

The implementation plan for the CBISSERD hinges on the acceptance of the proposal by the Government (MWEM). On acceptance of this proposed information system, several considerations need to be taken into account. First, is the fact that the CBISSERD cannot be implemented all at once. This is because there are many factors which need to be put in consideration. Among these include manpower development, to meet the requirements of the new system. Currently, there is only one qualified information professional who cannot meet the demand of even the existing Documentation Centre.

The existing manually operated Documentation Centre has some rich and valuable sources in the form of documents. These will require time to be adapted to suit the computer-based system. Conversion of documents in machine readable form can not be accomplished in a week or one month. Therefore, it will be quite helpful if the Ministry understands the magnitude of this work and works out strategies to do that work within a reasonable time.

A new space for the CBISSERD will be required at the MWEM. The current room housing the Documentation Centre is poky and does not have a structure to alow for enough light and ventilation. This also, will need to be solved if the CBISSERD is to succeed in

its mission.

Dar es Salaam, where the CBISSERD is going to be based is a hot and humid area, and there are dry months marked with heavy dust. This will require air conditioning of the computer rooms for effective and efficient operation.

All these considerations, and many others which have not been mentioned in this section will require financial support. Owing to the unhealthy economic condition in the country, it is likely to be impossible to accomplish the plan in a short time. Therefore, it is recommended that the CBISSERD implementation be divided into phases for a period extending up to three or five years, depending on how the economy of the country will allow. During this time the required manpower will have to be trained also, ready for the operation.

6.9 USER SYSTEM INTERFACE

The proposed CBISSERD is expected to make use of the MICRO CDS/ISIS software to render its services. CDS/ISIS is now widely used and version 3.0 can operate in a network environment like the one recommended in this study. CDS/ISIS network can enable users to interact directly from different terminals with data bases in the server or in other networked systems, to perform online search/retrieval. Most of the functions of Micro CDS/ISIS are menu-driven. However, help and other facilities can make the system more user friendly (Perera, 1992).

For the purpose of making use of the system with the prototype databases described earlier in this chapter, the SISA (System Interface Search Assistance), written in CDS/ISIS Pascal will be used. SISA is designed to assist end-users in performing search and retrieval in Micro CDS/ISIS databases. Major functions provided for by SISA include:

- Selection of databases for searching;
- formulating of search expressions using CDS/ISIS search language and use of the different search capabilities of CDS/ISIS;
- retrieval and display of records using different display formats;
- Saving of retrieved records selectively; and
- Storing of search queries and the results for review of search performances on each database.

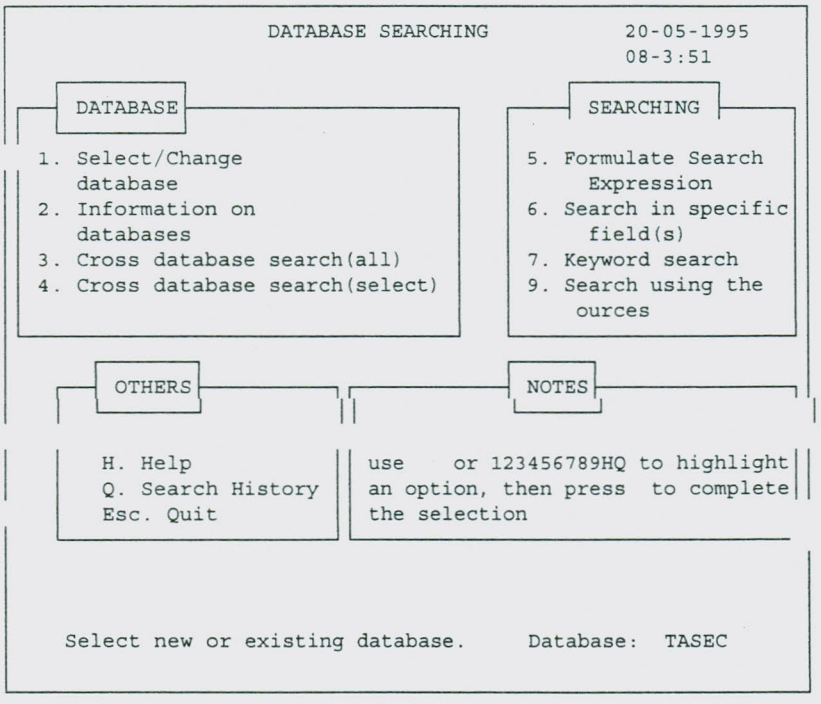
6.10 DEMONSTRATION OF THE SYSTEM

For the purpose of showing how the prototype databases can be searched in the CDS/ISIS created databases, using the CDS/ISIS SISA interface, the following demonstration will be of help. Suppose a user wants the following information from the system: 'Energy consumption in the Industry Sector in 1993', with this query the search expression may be 'Energy Consumption 1993'.

The demonstration will show step by step how to select databases, from the SISA interface Main Menu and how to key in search expression and performing the search itself.

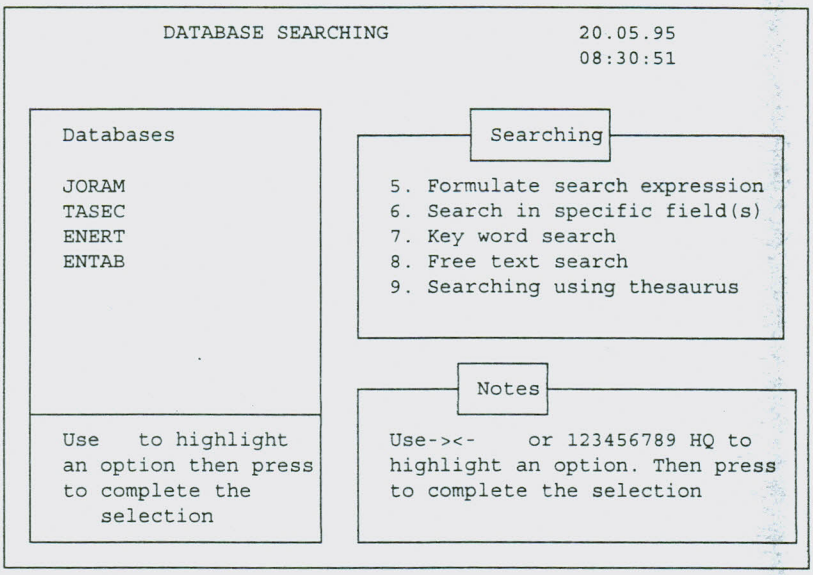
After login, and the user accessing the SISA interface, the first screen to appear is the SISA Main Menu with 9 options to be selected by the user depending on the requirements. Selection is done by moving the cursor to the required option and pressing the 'enter' key to complete the selection. Figure 11 illustrates the SISA Main Menu.

Figure 11. SISA Main Menu



If the user opts for option 1 for instance; names of available databases will be screened as shown in figure 12.

Figure 12. Database Spread (list of available databases)



The desired database is highlighted by using appropriate keys provided, and pressing the 'enter' key selects it. In this case the user has to choose 'ENTAB'. More information about the databases is screened when an end-user presses F1 key as shown in figure 13. Having selected the database, the system returns to the main menu to facilitate selection of search options. At the bottom, the selected database name 'ENTAB' is indicated.

After this the user has to choose option 5 whereby a blank screen asking for a search expression will appear. At this point the user has to type 'Energy Consumption 1994'.Then the system conducts a search and enlists (on the screen) the available display format, which in this case is 'ENTAB'. Once the user chooses the formats the system will display the output as shown in figure 10.

The application of SISA interface in data retrieval in the proposed system will strengthen its services. Not every decision maker, researcher or executive can search the

available data without problems. The illustrative guidance of SISA interface makes it a necessary software to be acquired for the CBISSERD. This software can be obtained by writing to the Regional Information Science School SISA, Addis Ababa University.

CHAPTER 7

CONCLUSION AND RECOMMENDATIONS

7.1. CONCLUSION

This study has revealed that the existing information services supporting the Energy Resources Development process in Tanzania are weak. The existing Documentation Centre in the MWEM fails to meet the information needs of energy development planners, decision makers, executives and researchers to step up the development of the sector.

The poor performance of the existing information services, as the study reveals, originate from among other things: the ineffective information flow pattern which fails to facilitate effective communication of information from the point of generation to the Energy Department; lack of coordination between information centres related to energy development with the Ministry responsible for Energy Development; inadequacies in data collection, processing and dissemination at the Energy Documentation Centre; low level of application of Information Technology (IT) in handling and dissemination of information; inadequacy in trained information professionals; and the absence of a mechanism to facilitate information resource sharing like networking.

The absence of a national policy on information systems and services, is another factor which creates a gap in the information service sector, leading to information centres operating in isolation, with little effort to cooperate to enhance their efficiency.

These are great drawbacks when one thinks of the role information is supposed to play in the national development process. It is not surprising to learn that the development of the energy sector in Tanzania, has been slow for many years now.

Effective energy development planning is knowledge-based and information intensive. The information required by energy development planners, decision makers, researchers etc to execute effectively their tasks must be precise, reliable, timely and adequate for the purpose. To achieve that, there is need for critical selection and processing of information to adapt to the dynamism and time constraints of such a process. Admittedly, this can only be realized through the application of IT in information processing management and dissemination.

The CBISSERD proposed in this study, is an attempt to respond to this problem. Demands for information and data services have been identified before this proposition, as Vespry (1991) recommends. The proposed Information support system will work in a LAN in the first days as explained in Chapter 6. For the time being LAN can be supported by the existing communication facilities without significant problems. However, in the long run the system is expected to be connected to all institutes dealing with energy resources development in Tanzania, and later on, with other organizations thought to be helpful in the sectors development the world over, in a WAN configuration. It is the hope of the researcher that this proposed purpose-oriented CBISSERD if adopted, will help in furnishing the energy development unit with analyzed and synthesized data, in a readily usable form to meet the needs of the people involved in energy development.

As Hong (1991) correctly observes, information is a vital commodity, which, in addition to its being a renewable source, it is also capable of giving power and mastery to those who possess it. Hong (1991) attributes the success of the Developed Countries in Socio-economic development to possession, and effective handling of information. If this is acceptable, Tanzania requires to increase its efforts in developing effective strategies of handling and dissemination of information for sustainable socio-economic development.

7.2. RECOMMENDATIONS

In order to develop effective means of capturing, processing, storage, and dissemination of information to support sustainable energy development in Tanzania; the following shortcomings discovered during this study, need to be rectified:

1. Establishment of National Policy on Information Systems and Services to direct information services in the country. Currently, information services are neither coordinated nor directed towards a clearly defined national goal. Mascarenhas (1988) observes that, the establishment of efficient information services to support the nation's scientific and technological development activities, can be best achieved if there exists a national information policy. The draft proposal worked out by Sekimang'a (1992) a former SISA student, could be a valuable document to start with, in this important issue.

2. The National Information System should be established to coordinate the information services in Tanzania. Information sources and services, are dispersed in many

libraries, archives, documentation and information centre, which work in isolation. This dispersal requires a mechanism to coordinate these information centres to enhance their efficiency. The creation of a coordinating mechanism will greatly help the function of the proposed CBISSERD.

3. Up to this moment, the Tanzania Government has not given priority to information as a vital resource in the development efforts. As a result, no funds are allocated to develop information services as a sector. It is important for the government to recognize information services as a vital sector and provide it with enough funds to develop it for effective development of all social and economic sectors.

4. The government may work out a mechanism to facilitate effective communication of research findings in energy and other sectors to areas of application. Research findings become useful only when they are applied to real problems in a given society. This can be facilitated by establishing effective electronic communication among all the research institutions for communication within and outside the country. Necessary measures are to be taken to improve the telecommunication facilities in the country.

5. There is observed shortage of qualified personnel in the information service sector. The government needs to support the establishment of competent local information professionals training institutions, rather than relying solely on external training as it is now. Experience shows that, the output of external training has always been far from meeting the requirements. Effective information services require the

services of qualified personnel.

6. The government may try its level best to make effective use of information in planning, decision making etc, to break away from the old practice whereby politicians influenced the undertaking of projects with little or no feasibility study taken on them. This practice is likely to lead to wastage of the valuable scarce resources in the country.

7. The Ministry of water, Energy and Minerals need to allocate enough funds for the development of the proposed CBISSERD to meet the goals of the Energy Policy of Tanzania. The Energy Policy is the master plan for the overall energy development in Tanzania.

8. Deliberate efforts should be taken by the government to promote IT application in Tanzania, to improve information communication. Currently, the application of IT in information handling is minimal. Computers are understood to be powerful tools in processing and handling large quantities of data.

9. As stated in Chapter 1, this study did not cover the aspects related to how the information centres meet the requirements of the institutions they serve. To develop an effective energy resources development information support, the researcher thinks that it is important to study in detail the weaknesses and strength of these institutions. Therefore, the researcher, recommends further studies in this issue. It is hoped that the findings of the studies will help to strengthen the concerned

information centres, the CBISSERD and the overall information system in the country.

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Appendix 1

The University of Dar es Salaam Library,
P.O. BOX 35092,
Dar es Salaam
10th July 1994.

Dear Sir/Madam,

Re: COMPUTER-BASED INFORMATION SUPPORT SYSTEM FOR ENERGY RESOURCES DEVELOPMENT IN TANZANIA(CBISSERD)

I am a graduate student at the School of Information Studies for Africa(SISA),Addis Ababa, Ethiopia. I am conducting a research on " Computer-based Information Support system for energy Resources Development in Tanzania."

My study among other things, involves investigating the existing information support services related to energy resources development in Tanzania, to understand how they operate. The information exchange pattern and the application of IT are among the important issues to be investigated , with a view to proposing plans and recommendations to consolidate the services, by proposing a computer-based information system to help in the development of the energy sector in Tanzania.

The information you provide in the questionnaire will facilitate the planning and development of the prototype databases of energy experts, institutions related to energy development, energy project profiles and profiles of information systems.

Please assist me by filling in the attached questionnaire(s), which I need to get it/them on or before August 20, 1994. Completed Questionnaire(s) be returned to:

Joram S. Kilemile
University of Dar es Salaam Library,
P.O. BOX 35092
Dar es Salaam

Thank you in advance, in anticipation of your cooperation!

Appendix 2. QUESTIONNAIRE

SURVEY OF INSTITUTIONS AND INFORMATION SYSTEMS RELATED TO ENERGY PLANNING AND DEVELOPMENT IN TANZANIA

A. INSTITUTION'S PROFILE

1. a) Name of the Institution: _____b) Type of Institution:(Research, Educational, Planning) Please choose by putting a tick to whichever applies.

2. Type of Information System in the institution (eg. library, documentation centre,or information centre) please choose whatever applies _____

_____

3. a) Address _____ b) Telephone_____ c) Fax____

4. Date of establishment _____

5.Objectives _____

6.Parent organisation (if any) _____

7.(a) What is the end use of information generated or organized in the Information System? Tick whatever applies.

(i) Forecasting/modelling [ ]

(ii) Resource allocation [ ]

(iii) Research and Development [ ]

(iv) Others (if any) please mention.

(b) Type of documentation activities conducted by the information support system: tick whatever applies

i) Bibliographic [ ]

ii) Numeric/statistical [ ]

iii) Referral [ ]

(c) Type of information services offered to the users (tick whichever applies)

(i) Reference service [ ]

(eg. Technical enquiry, retrospective searches etc)

(ii) Current awareness [ ]

(eg. selective dissemination of information (SDI). Newsletters, bulletins, research in progress information etc), please tick whichever applies

(iv) Technical/specialised services [ ]

(eg. trend reports, tender notices, forecasts, contracts etc), please tick whichever applies.

(v) Information analysis and consolidation [ ]

(eg. research abstracting, digest for planners, decision makers, executives etc.; numerical data services etc.) please tick whatever applies.

(vi) Common Services

eg. Lib. Services i.e. acquisition, processing and storage of delivered documents.

[ ]

(vii) Online searches or CD-ROM services [ ]

(viii) Other services (mention if any) _____

8. What classification scheme does your information system use? (If it is classified)

(a) Library of Congress (LC) [ ]

(b) Dewey Decimal Classification (DDC) [ ]

(c) Universal Decimal Classification (UDC) [ ]

(d) Colon Classification system [ ]

(e) Others (specify if any)

9. Does your information system conduct the indexing exercise? Yes/No

If yes, which kind of it is used? Tick whatever applies.

(a) author indexing [ ]

(b) subject indexing [ ]

(c) description indexing [ ]

(d) Title indexing [ ]

10. Number of staff of the Information System.

(a) Professionals (Librarians, Documentalists, Information Scientists) _____

_____

(b) Paraprofessionals _____

(c) Support staff _____

(d) Is the number of staff sufficient for the operations?

_____

11. Is your information system linked to:

a) Any other information system (eg. the Ministry responsible for energy resources development or other information systems dealing or not dealing with energy resource development?) Yes/No

(b) If yes, is the information exchange smooth? Please tick:
Yes/No.

12. What usefulness of data and information is it to clients? (please tick whatever applies)

(a) Useful to planning units [ ]
(b) Useful to parent institution [ ]
(c) Useful to international agencies [ ]
(d) Useful to other units. [ ]

13. What time frame use/usefulness is the information from your system.

(a) for immediate use [ ]
(b) for near future [ ]
(c) for distant future [ ]
(d) difficult to predict [ ]

B. **Computer-based Information System Survey**

14. Does your Institution have any computer facilities? Tick what applies.

Yes [ ], No [ ]

15. If yes, is the information support system computer - based?

_____

16. Where are the computer facilities located? Indicate by tick.

a) In the information centre [ ]

b) In different offices of the parent institution [ ]

c) Other locations , please specify. [ ]

17. What are the main applications of computers in the institution/information system (tick whatever applies)

a) word processing [ ]

b) database management functions [ ]

c) house keeping application [ ]

d) numerical/statistical applications [ ]

e) financial management [ ]

18. What kind of computers are used by your information system (if any) please mention the number of them and model

a) Mainframe_____ number____ model _____

b) Minicomputers _____ number___ model _____

c) Microcomputers_____ number____ model_____

19. Is the system networked? If yes, what kind of network configuration is used?

a) Local Area Network (LAN) [ ]

b) Wide Area Network (WAN) [ ]

20. Does the institution have CD-ROM/Online databases? If yes, please name them _

_____

_____

21. What kind of database management which your information system deals with, (if any) please indicate type by ticking.

(a) Bibliographic [ ]

(b) Profiles (eg. expert, institutional etc). [ ]

(c) Object or mission oriented [ ]

(d) Others (specify) if any. _____

22. What kind of problems do you encounter in the use of computers in your information system (if any). Please tick whichever applies:

(a) Equipment

(i) lack of software [ ]

(ii) little computer memory [ ]

(iii) slow processing speed [ ]

(iv) poor environmental conditions e.g (heat, dust, unstable electricity etc) [ ]

(b) Personnel problems

i) Manpower shortage [ ]

ii) lack of training opportunities in computer use. [ ]

iii) Any other. Please specify _____

_____

23. Are the members of staff trained in the use of computers? Yes [ ] No [ ]

If yes, what is the percentage of those trained in the staff?

24.If your information system is not yet computer-based, are there any plans in the near future to do so? Yes/No

If Yes, what kind of computers in mind do you want to apply?

a) mainframe [ ]

b) minicomputer [ ]

c) microcomputers [ ]

25. What kind of computer application do you intend to make after installation? Please give a short explanation.

_____

Thank you very much for filling in this questionnaire!!

Appendix 3 EXPERTS PROFILE QUESTIONNAIRE

Main Name _____

Other Names _____

Sex _____ Year of Birth _____

Nationality _____

Permanent Address _____

Telephone _____ Fax _____

Academic Qualifications_____

A) Field of Study _____

Degree/Diploma _____

Year Obtained _____ Name and Place of Institution _____

_____

B) Field of study _____

Degree/Diploma _____

Year Obtained _____ Name and Place of Institution _____

C)Field of Study _____

Degree _____

Year Obtained _____ Name and Place of Institution_____

Main Fields of Specialization _____

_____

Publications _____

_____

____

Main Working Language(s) _____Current Employer_____

_____

Title of Post _____

Duration From _____ to _____

Description of Responsibilities _____

_____

Last Employer _____

Title of Post _____

Duration from _____ to _____

Description of Responsibilities _____

_____

THANK YOU FOR FILLING IN THE QUESTIONNAIRE.

Appendix 4.

List of Tanzanian individuals with whom interviews/discussions were held during the Study.

1. Professor M.J. Mwandosya - Commissioner for Energy (MWEM)
2. Mr. Mwihava, Ngosi -Researcher, Ministry of Water Energy and Minerals
3. Mr. A. Towo - Researcher , (MWEM)
4. Mr. Aloysius Nyenza - Principal Energy Planner(MWEM)
5. Mr. A. Mwasumo - Energy Planner (MWEM)
6. Mr. S.M. Chipanda - Energy information officer (MWEM)
7. Mr. G.Sawe - Executive(MWEM)
8. Mr. I. Rutabanzigwa - "
9. Dr. J.O. Ngana - Associate Director IRA
10. Dr. F.C. Shechambo - Research Fellow IRA
11. Dr. E.K. Shishira - Senior Research fellow IRA
12. Mr. J.G. Lyimo - Research fellow IRA
13. Mr. T.E. Mlaki - Director of Information and Documentation ,COSTECH
14. Mr. E.Yonaz - Information Officer COSTECH
15. Mr. E.C. Mjema - Senior Scientific Officer COSTECH
16. Eliud T. Myauhenga - Senior Economist, Planning Commission
17. Daudi Msangi - Senior Planning Officer, Planning Commission
18. Eliud Lukwaro - Head, TANDOC
19. Mr. A. Kamugisha - Bureau of Statistics Documentation Centre
20. Dr. S. Mohammed - Information Scientist TANRIC

Appendix 5. List of Questions for Interviews

1. What kind of information do you require in energy resources evelopment planning/research?

2. What sources do you normally consult for your energy resources development process/energy resources development researches?

3.In terms of type, form and formats do you find the information available useful for your activities.

4. Does the information system provide all the relevant information and data needed for your activities in energy development planning/research? Consider this in terms of the following information characteristics:

- Relevance
- Coverage
- Timeliness
- Accuracy
- Validity

5.What services does the information system render? (e.g. CAS, SDI, Referral Services etc.)

6.In your view does the information system offer satisfactory services?

7.Which ways do you think the information system can be modified to meet your activities related to energy development?

Appendix 6: ABNCD Field Definition Table

?3	Tag3	Name	3Len	3Type	3Rep3	Delimiters/Pattern3
-	1	Participating centre code	100	X		
_	2	Participating centre record no	6	N		
_	3	Record status	1	P		A
_	5	Date record entered	10	P		9999-99-99
_	6	Date record changed	10	P		9999-99-99
_	7	Bibliographical level	5	A		
_	8	Bibliographical level - parent	1	A		
_	9	Country of origin of record	2	P		AA
_	10	Record number of parent	6	N		
_	11	Record number(s) of part(s)	6	N	R	
_	12	Record no of other language(s)	6	N	R	
_	20	Language of analysis	18	A		
_	21	Language of text(s)	2	A	R	
_	22	Language(s) of summaries	2	A	R	
_	25	Record heading	50	X		
_	100	Title	500	X		
_	101	Parallel title(s)	500	X	R	
_	102	Translated title - English	500	X		
_	105	Translated title - other	500	X		
_	110	Personal author(s)	80	X	R	ab
_	111	Corporate author(s)	500	X	R	abcdz
_	112	Affiliation	500	X		abcdz
_	113	Other associated inst(s)	500	X	R	abcdez
_	114	Meeting	500	X		abcde
_	115	Trans. name of instn.	200	X		
_	116	Address	300	X	R	abcdefghi
_	120	Edition	25	X		
_	121	Publisher	250	X		abc
_	122	Date of publ/issue - free form	30	X		
_	123	Date of publ/issue - ISO form	10	P		9999-99-99
_	130	Collation (M/C)	200	X		abc
_	131	Part statement	150	X		ab
_	140	Monographic series	200	X	R	abz
_	141	Thesis	200	X		abcd
_	142	Related project(s)	200	X	R	ab
_	150	Notes	700	X		
_	160	ISBN	13	X	R	
_	161	Document number	50	X	R	
_	162	Availability	100	X		
_	200	Title of serial	400	X		z
_	201	ISSN	9	P		9999-99-99X
_	202	Title of parent (M/C)	500	X		
_	210	Personal author(s) - parent	80	X	R	ab

_ 211	Corporate author(s) - parent	500	X	R	abcdz
_ 300	Primary descriptors	200	X		
_ 301	Secondary descriptors	400	X		
_ 302	Geographic descriptors	200	X		
_ 303	Local descriptors	200	X		
_ 303	Proposed descriptors	100	X		
_ 310	Abstract/Description	1000	X	R	
_ 320	Broad subject heading	100	X		
_ 400	Processing status	4	X		
_ 410	Location	10	X	R	
_ 411	Call number	40	X		
_ 412	Number of copies	2	N		
_ 415	Accession numb.	10	X		
_ 420	Type of material	50	X		
_ 430	Documentalist (initials)	10	X	R	
_ 500	Acquisition type	4	X		
_ 509	Order number	25	X		
_ 510	Date ordered	10	P		9999-99-99
_ 511	Date claimed	10	P		9999-99-99
_ 512	Date received	10	P		9999-99-99
_ 513	Number of copies ordered	2	N		
_ 514	Requester	25	X	R	
_ 515	Supplier	200	X		abcdez
_ 516	Price	20	X		ab
_ 517	Acquisition notes	200	X	R	
_ 901	Corporate body	500	X		abcd
_ 902	See reference(s)	500	X	R	
_ 903	Other language version(s)	500	X	R	
_ 904	Former name(s)	500	X	R	
_ 905	Later name(s)	500	X	R	
_ 908	Reference code	20	X		
_ 911	Serial title	400	X		
_ 912	ISSN	9	P		9999-999X
_ 913	See reference(s)	400	X	R	Z
_ 914	See also other lang edition(s)	400	X	R	
_ 915	Former name(s)	400	X	R	
_ 916	Later name(s)	400	X	R	
_ 921	Supplier authority code	4	X		
_ 922	Supplier name and address	200	X		abcde
_ 997	Authority record notes	200	X		
_ 998	Authority record date	10	P		9999-99-99
_ 441	Duration	50	X		
_ 442	Date:proposal/approval	25	X		ab
_ 443	Date:starting	10	X		
_ 444	Date:expect. compl.	10	X	R	
_ 445	Date:actual compl.	10	X		
_ 446	Date:terminated	10	X		
_ 447	Date of birth	100	X		

_	830	Nationality	100	X	R	
_	831	Qualifications	100	X	R	abcd
_	832	Specialization	100	X	R	
_	833	Work experience (last)	200	X		abcde
_	834	Current work	200	X		abcde
_	835	Marital status	10	X	R	
_	836	Sex	6	X		
_	850	Recommended by	100	X	R	abcd
_	855	Honours and awards	200	X	R	abc
_	856	Membership in societies	200	X	R	abcd
_	525	Language competence	100	X	R	abc
_	556	Assignments	200	X	R	abcd
_	895	Databases	300	X	R	ndrfa
_	896	Classification system used	100	X	R	
_	897	Subject headings list	100	X	R	
_	898	Thesaurus	100	X	R	
_	899	Periodical publicat.	300	X	R	ij
_	890	Patents taken	200	X	R	abcdefgh
_	900	Services offered	200	X	R	
_	570	Personnel	100	X	R	ab
_	625	Objectives	500	X	R	
_	700	Financial aspects	200	X	R	sacp
_	950	Project status	50	X		
_	952	Training courses	200	X	R	
_	954	Project number	50	X	R	a
_	955	Contract number	50	X	R	
_	957	Resources(equipment...)	200	X	R	
_	960	Type of institution	100	X	R	
_	961	Type of research	100	X	R	
_	965	Research priority	100	X		
_	966	Committee's decision	100	X		
_	999	Record type	1	P		A
_	1000	Name of object	100	X		
_	1001	Local name (Eng.)	100	X	R	
_	1010	Function	300	X	R	
_	1015	Source/Donor (Person)	100	X	R	sfh
_	1016	Source/Donor (Organization)	300	X	R	
_	1017	Vendor	300	X		
_	1018	Price	100	X		cp
_	1020	Provenance	100	X		
_	1021	Archaeological site	500	X		
_	1025	Ethnic group	100	X	R	
_	1028	Date	100	X		
_	1030	Material	300	X	R	
_	1035	Condition	1000	X	R	
_	1040	Dimension (Front)	100	X		hwld
_	1041	Dimension (Back)	100	X		hwld
_	1042	Weight	100	X		

_ 1050 Description	1000	X		
_ 1055 Fine number	100	X		
_ 1056 Photo number	100	X	R	
_ 1060 Negative number	100	X	R	
_ 1065 Accession number	100	X		
_ 1070 Other numbers	100	X	R	
_ 1075 Location/storage	100	X		rs
_ 1080 Location/exhibit	100	X		rs
_ 1085 Classification/Keywords	100	X	R	
_ 1090 Treatment	500	X	R	
_ 1091 Lab. treatment dates	25	X	R	
_ 1100 Exhibitions	300	X	R	
_ 1105 References	300	X	R	
_ 1110 Remarks	300	X		
_ 1115 Date of entry	20	X		
_ 1120 Date(s) of update	20	X	R	

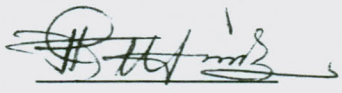
Appendix 7: Integrated database (JORAM) Field Select Table

	ID	IT	Data extraction format
-	5	0	v005
-	21	0	(v21/)
-	100	4	v100
-	110	0	(v110/)
-	111	0	mhl,v111^a|%|
-	111	0	mhl,v111^b|%|
-	111	4	(v111^b| |,v111^a|%|),v112^||,v112^a|%|, (v113^b| |,v113^a+|%|)
-	111	0	(v111^c/,v111^d/,v111^z/)
-	111	0	v112^c/, v112^d/, v112^z
-	111	0	(v113^c/, v113^d/, v113^z/)
-	112	0	(v112^a/, v112^b/, v112^c/)
-	113	0	v113
-	114	4	v114^a+|%|
-	114	0	(v114^b/, v114^c/, v112^e/)
-	116	0	(v116/)
-	120	0	v120
-	121	0	v121
-	122	0	v122
-	150	0	v150
-	160	0	v160
-	200	0	v200
-	201	0	v201
-	300	2	v300
-	300	3	v300
-	301	2	v300, v301, v302, v303, v304
-	302	0	v302
-	303	0	v303
-	310	4	v310
-	320	0	v320
-	410	0	(v410/)
-	411	0	v411
-	412	0	v412
-	441	0	v441
-	443	0	v443
-	445	0	v445
-	447	0	v447
-	525	0	(v525/)
-	570	0	(v570/)
-	625	0	(v625/)
-	700	0	(v700/)
-	830	0	(v830/)
-	831	0	(v831/)
-	832	0	(v832/)
-	834	0	v834
-	836	0	v836

- 895 0 (v895/)
- 896 0 (v896/)
- 897 0 (v897/)
- 898 0 (v898/)
- 899 0 (v899/)
- 900 0 (v900/)
- 950 0 (v950/)
- 960 0 (v960/)
- 961 0 (v961/)

Declaration

This thesis is my original work and has not been submitted for a degree in any other university.



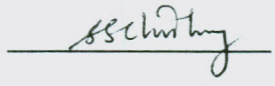
Joram Stephen Kilemile

24th May, 1995.

The thesis has been submitted for examination with our approval as university advisors.

Dr. Taye Tadesse

24th May, 1995



Dr. G. G. Chowdhury

24th May, 1995