

National Strategy for Energy



prepared for

Tanzania Sisal Board

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1. Introduction

Tanzania has an area of 945,749 km² and a population of about 34.6 million, according to the national census carried out in 2002. It is estimated that about 70 per cent of the population live in the rural areas.

There is only one body that has the legal mandate to generate, transmit and sell electrical energy in Tanzania. This is the Tanzania Electric Supply Company (TANESCO), a public corporation wholly owned by the government. The corporation is responsible for 98% of all power generated in the country. According to information from the Ministry of Energy and Minerals¹, the country had an installed capacity of 950 MW in 2005. The same source has it that the average national electrification level in 2005 was about 10%, with rural electrification accounting for only 2% while urban areas accounted for 39%.

More than half the population of Tanzania lives in poverty. About a third of the population is unable to access the basic necessities of life. These people depend on traditional biomass for their energy requirements. It is said that fuel wood comprises about 90% of the cooking energy requirements of the rural and semi-urban population. This reliance on biomass fuel leads to reduction of its availability, which in turn leads to longer distances that women and children need to travel to get fuel wood.

2. Vision Statement

A vision statement is essentially a summary description of the long-term goal of a strategy. The vision statement of this proposed strategy for energy production from sisal is:

To contribute 500 megawatts of electricity from energy farming, reduce reliance on non-renewable sources for energy production, create employment opportunities and reduce poverty

through

Production of 1 million tons of sisal fibre by 2025 through the existing plantations, new plantations on 120,000 hectares and an additional 115,000 small-scale farmers throughout the country and particularly in the regions of Dodoma, Manyara, Mara, Mwanza, Shinyanga, Singida and Tabora

The market for sisal fibre has an effective world potential of over 20 million tons. This was adequately covered in the concept paper on sisal development presented to sisal stakeholders on 27th April 2007. Tanzania has a comparative advantage and competitive advantage on the world market. The country has ample suitable land for sisal and adequate manpower in rural and urban areas.

¹ J. Uisso and N. Mwiwaha, 2005. *Tanzania Energy Policy: Focus on Renewable Energy and Poverty Reduction*. Partners for Africa Policy Dialogue Conference. 22 – 24 June 2005

3. Context of Bio-Energy Production in Tanzania

An effective strategy for bio-energy production must be developed in the context of Agenda 21 and the national energy policy. The context of bio-energy production in Tanzania can be extracted from the presentation of the Ministry of Energy and Minerals by Uisso and Mwhava (see footnote 1 on page 1). The document states that the objective of the Tanzania national energy policy is to provide an input in the development process by establishing efficient energy production, procurement, transportation, distribution and end-user systems in an environmentally sound manner with due regard to gender issues.

The specific objectives of the national energy policy are listed as being to:

- exploit the abundant hydro-electric sources in the country
- develop and exploit natural gas and coal
- step up petroleum exploration
- reduce deforestation through efficient biomass to energy conversion technologies
- promote development of renewable sources of energy
- promote energy conservation and efficiency
- develop human resources for facilitation of energy technologies development

Proposals for putting into operation of the Tanzania National Energy Policy include:

- establishment of a rural energy agency
- establishment of a rural energy fund
- implementation of on-going and planned projects
- formulation of a national energy strategy

The current national production of sisal is estimated at about 30,934 tons of fibre of which 10,394 tons were produced from hedge sisal in the Lake Regions and 20,540 tons from sisal estates. The production of 30,934 tons of sisal fibre had a potential to produce 12 MWe. This level of production was not sufficient to meet the demand gap for electrical and heat energy in the country now obtained from forest and wood products.

4. Rationale for Bio-Energy Production from Sisal

Domestic energy demand in Tanzania has been rising rapidly in recent years because of population growth. The forests supply the bulk of the energy demand. Wood accounts for 90% of the total energy used in Tanzania. While the supply of fuel wood is dwindling, demand is rapidly increasing. More than 90% of the population depends on wood fuel energy.

Charcoal is widely used in urban centres with an estimated consumption of 392,000 tons per annum. Charcoal producers are licensed to burn wood for charcoal in both public woodlands and productive forest reserves. Firewood is predominantly used in rural and urban areas.

In 1993 firewood consumption was estimated at 45 million cubic meters per annum, with a per capita wood consumption of 2.0 cubic meters of round wood per annum. The rural areas alone consumed about 43.8 million cubic meters of firewood. By the year 2000, firewood demand was expected to surpass 60 million cubic meters. It was also estimated that an

average of 45,000 trees of 0.2 cubic meters size were cut daily for firewood. Other uses of firewood included fish smoking; salt pans; tobacco curing; bricks and tile kilns; pottery, ceramics, and kaolin production.

Estimates of energy resources in Tanzania by the Ministry of Energy and Minerals are:

- an annual “sustainable” yield of biomass of about 24.5 million cu m from forest areas and 15 metric tons from crop residues
- a potential 1.9 billion tons of coal (of which less than 20% is proven)
- a potential hydropower of 4,700 MW, of which 561 MW have been developed
- average solar insolation of 218 kWm⁻²

Other sources such as ocean and geothermal energy have not been studied adequately.

In Tanzania, most of the electricity for industrial and domestic use is produced from hydro-power. However, due to deterioration of rainfall regimes, this source is plagued by frequent problems and now appears to be threatened. Apart from this unreliability, a basic disadvantage of hydro-power is that hydroelectric plants require large capital outlays not easily accessible to small producers. Construction of hydroelectric plants disrupts the natural ecosystem around dams and displaces many riparian communities. The transmission and distribution lines for such power are very expensive and act as a major hindrance to rural electrification.

Coal, gas and petroleum are now the next target for development. These sources are, of course, non-renewable and cannot be relied upon as a sustainable source of energy for generations to come.

So, a sustainable energy policy must incorporate sound strategies for development of bio-energy sources. Biomass fuel is said to be carbon neutral, and may be comparatively low-cost compared to other types of fuels. Using easily renewable biomass such as sisal reduces the demand on the earth’s non-renewable or less easily renewable resources such as forests.

In general the world has woken up to the dangers posed by extracting and relying on energy from the traditional sources such as coal, petroleum and even nuclear fission and knowledgeable people are calling for reforms in the energy sector. The Climate Change Action Group in the United States, for example, is currently collecting signatures on <http://www.thepetitionsite.com> to a global petition for the implementation of sustainable energy production and living systems. Production of energy from sisal has many comparative benefits.

The industry vision of producing 1,000,000 tons of sisal per year can only be achieved if the returns to sisal increase significantly. This vision was endorsed by the Tanzanian Sisal stakeholders as earlier reported. This vision goes hand in hand with total sisal plant utilization. The production of the 1,000,000 tons per year will generate large quantities of waste which need to be put to economic use to increase incomes to the sisal farmer and the nation at large. Production of 500 MWe from this waste was accepted as a necessary strategy in implementation of the vision. This strategy paper should be read hand in hand with the concept paper referred to earlier.

4.1 Creation of Profitable Rural Employment

For the majority of Tanzanians living in the rural areas, the main form of employment is agriculture. Most agricultural activities is for subsistence and produces little surplus for meeting non-subsistence needs such as improved housing, education and health. Furthermore, cash income from many crops tends to be seasonal. This strategy aims at creating many opportunities for gainful employment in the field of energy farming.

Due to its characteristics, sisal can be planted in conditions that other crops may not perform well. It can be planted and harvested any time of the year. As opposed to other crops that generally must be planted with specific timing and are commonly harvested once, sisal is planted once but harvesting continues for several years after the first harvest. Thus sisal farming provides sustained employment and cash.

Sisal growing goes hand in hand with the development of processing industries. This strategy targets, as its majority beneficiaries, the small-scale farmers, growing a minimum of 6 hectares. The widespread cultivation of sisal should stimulate light rural industry in the rural areas not only for its processing but in other areas as well, which will create further employment opportunities.

Tanzania has vast areas of land that is currently unutilized. The younger generation, driven by a desire for a high standard of living, is not motivated to go into agricultural production because of the low cash returns from traditional crops. Production of energy and organic fertilizer from sisal will not only produce opportunities for income from the sale of fibre, but will promote the growth of rural industries for processing of the residues for a variety of products including animal feed, medicines, energy production, organic fertilizer and operation of electricity mini-grids. It will also improve land productivity.

4.2 Environmental Protection

Studies show that in a large part of Tanzania soil erosion is a major cause of land degradation. This is accelerated by the characteristic long and windy dry season in most parts of the country and by pastoral practices. Sisal, unlike other cash and food crops, provides a continuous green and dense cover to the land throughout the year. If planted across slopes, its dense root system forms an effective soil erosion control structure on the land. In this way air pollution from dust clouds and soil fertility losses through surface wash are reduced.

Electrical and heat energy produced for biogas from residues after fibre production is readily available at or near the source. Organic fertilizer to improve productivity of land is also available. Availability of these new alternative sources of energy will reduce the society's depletion of forest and wood resources.

4.3 Improved Standard of Rural Life and Gender Equity

Availability of easily accessible clean energy for lighting and operation of electrical appliances will call for improvements in the standard of life in the countryside in several areas: education, recreation and money-generating activities. This might contribute to stemming migration to urban centres and reducing crime.

Accessibility to clean energy will reduce the amount of time and energy spent by women (and children) on energy-related chores such as collective fuel wood and processing food.

4.4 *Raised Literacy Level and Public Awareness*

Affordable and reliable energy supply in the whole country will promote increasing access to public education by powering information and communication technology (radio, television, internet services) and enabling distance learning and night study by pupils in the proliferating rural secondary schools.

5. Key Constraints to Bio-Energy Production

Constraints to production of electricity from sisal waste in Tanzania can be grouped into three main areas:

- lack of awareness
- economics of small-scale bio-energy production
- enabling environment

5.1 *Lack of Awareness*

Traditionally, sisal has been used for production of fibre. The by-products that result from the process of obtaining the fibre are considered as waste. It is now known that, in fact, almost 100% of the sisal plant is useful for a variety of applications. These applications include production of paper, animal feeds, fertilizer, energy, medicines as well as industrial uses. All the same these findings are relatively recent compared to the length of time in which the sisal plant has been in Tanzania and this knowledge has not spread around. The fact that technologies to utilize the non-fibre parts of the plant are either still under development or have only been tried on pilot scale is yet to produce an impact.

Ignorance is widespread among many stakeholders. Prospective investors in this field have not been made aware of the possibilities that exist. Decision makers are also ignorant of these possibilities.

As earlier noted, the technology of bio-energy production is relatively new. Tanzania does not have enough extension officers with biogas knowledge to disseminate biogas knowledge.

5.2 *Economics of Small-Scale Energy Production From Sisal*

The initial investment costs for production of bio-gas from sisal “waste” can be high. The material for construction of the fermentation tanks needs to be further studied.

5.3 *The Enabling Environment*

The present legislation is perceived by many as being deficient in incentives for new investors in bio-energy production. The Tanzania Electric Supply Company (TANESCO)

still has the full monopoly over power generation for public consumption. TANESCO uses this privilege to set threshold capacity for small producers who wish to sell power to it. Initial discussions with TANESCO officials have indicated that any plant producing less than 500 kWe cannot be eligible for connection to the grid but where TANESCO transmission and distribution lines are available, change over switches can be installed to route the electricity to local communities around the generation point.

6. Strategic Goals and Objectives

Strategic goals and objectives are formulated for addressing the constraints that have been identified. The goals have the following characteristics:

- they are necessary for attainment of the vision and accomplishment of the mission
- they must be measurable in order to allow planning and monitoring
- they must be actionable
- they must be achievable within the time-frame of the strategy

The strategy for energy production from sisal will aim to contribute to the overall national goals as stipulated in agenda 21. The results of this strategy will be actions towards achieving the following four goals:

Goal 1: Capacity to disseminate technologies for energy generation from sisal waste

Objective 1: Training of technical personnel

Production and processing techniques used in the sisal industry today are those developed many years ago. Tanzania Sisal Board and Katani Limited in Tanga have developed newer technologies with the assistance of UNIDO. Tanzania Sisal Board and Katani Limited have 18 people who have undergone training in China and can assist in training of extension officers in the districts, but they have other assignments in their organizations.

Objective 2: Identifying key players for demonstration

Because the technology of generating electricity from sisal waste is new, it is expected that the early adopters will be entrepreneurs and the more enlightened farmers. An important contribution to the success of this strategy would be to identify such individuals in the districts and use them as platforms from which others can learn by observing. The strategy for achieving this is a multi-step approach.

Objective 3: Establishment of a rural technical support service sector

This strategy targets the majority of the rural population with low know-how. Access to support services for the energy production technology will be essential. Such support can range from construction technology, energy storage and conservation to use techniques.

Goal 2: Enforcement of Appropriate Legislation

The government is keen to implement the national energy policy and to formulate a national energy strategy. It is expected that this goal will be achieved by government defining regulations for power production and distribution and providing incentives for renewable energy investors. In such regulations the role of TANESCO vis a vis small power producers must be reviewed, pricing guidelines laid down and licensing procedures for small producers stipulated.

Objective 1: Encouragement of small power producers

National regulatory mechanism and licensing authority for small power production and distribution has taken a long time. The establishment of EWURA is a step in this direction.

Objective 2: Incentives for environmentally-friendly energy sources

An incentive scheme for energy-farming must be put in place taking a leaf from such countries as Germany, China, India and others.

Goal 3: Promote sisal as an additional cash crop in six regions

The Tanzania Sisal Board (TSB) has carried out a preliminary study to determine the extent of suitable areas for cultivation of sisal in the six regions of Dodoma, Manyara, Mara, Mwanza, Shinyanga, Singida and Tabora. TSB has initiated promotion of sisal growing and has established a 10 cubic metre demonstration biogas plant at Manala Village in Magu District where hedge sisal is being processed to produce sisal fibre and sisal waste for biogas production by one farmer who also has cattle. The performance of the pilot household biogas plant has encouraged the farmer to consider investing in expanding his farm.

Objective 1: Establishing a minimum base of smallholder growers

The administrative system in Tanzania is such that local government authorities are responsible for executing the national development agenda. They control land and the technical personnel in their areas. Close collaboration between the Tanzania Sisal Board, research institutions, other crop bodies and local government authorities will be necessary in order to assist the authorities to place sisal bio-farming at the top of their poverty reduction strategies.

7. Activities to Meet the Strategic Goals

In order to meet the strategic goals stated in this strategy, actions need to be taken towards the objectives listed under each goal. The activities listed must be implemented in full. Sisal requires about six years to reach full production. In order for the vision of the strategy to be fulfilled, these activities need to be completed not later than 2018.

7.1 Activities to meet the strategic objectives of Goal 1

The project "Product and Market development of Sisal and Henequen" implemented by UNIDO has generated new knowledge and technology that not only forms the basis of further research but needs to reach smallholder farmers in regions other than those already growing sisal on large plantations.

NO.	ACTIVITIES FOR STRATEGIC OBJECTIVES IN GOAL 1 (Building capacity for disseminating the technology)	RESPONSIBILITY
1.	Train village and ward extension officers on sisal energy production	<ul style="list-style-type: none"> • Tanzania Sisal Board • Government
2.	Set up demonstration sites	<ul style="list-style-type: none"> • Tanzania Sisal Board • Government
3.	Establish a national bio-energy technology day	<ul style="list-style-type: none"> • Tanzania Sisal Board • Government
4.	Set up pro-active bio-energy technical support centres in each region	<ul style="list-style-type: none"> • Tanzania Sisal Board • Government
5.	Establish sustained media education campaigns through the papers, TV, Radio and Video shows	<ul style="list-style-type: none"> • Tanzania Sisal Board • Government
6.	Train trainers at Mlingano Agricultural Training Institute in the biogas, gasification and other energy generation technologies	<ul style="list-style-type: none"> • Tanzania Sisal Board • Government
7.	Carry out further research on affordable construction materials locally available for constructing biogas plants	<ul style="list-style-type: none"> • Tanzania Sisal Board • Government • Universities & Research Institutions
8.	Train construction teams for biogas structures both in steel, concrete and other materials	<ul style="list-style-type: none"> • Tanzania Sisal Board • Government • Research & Training Institutions

7.2 Activities to meet the strategic objectives of Goal 2

The current energy policy allows independent power producers to generate electricity and produce organic fertilizer from different sources, particularly for the rural areas. Legislation and an institutional framework need to be put in place to further the objectives of this policy.

NO.	ACTIVITIES FOR STRATEGIC OBJECTIVES IN GOAL 2 (Enforcement of appropriate legislation)	RESPONSIBILITY
1.	Reform the market for renewable energy sources and put in place an institutional framework favourable to renewable energy development	Ministry of Energy and Minerals
2.	Establish financing mechanisms to provide credit to potential producers	Government
3.	Establish links with EWURA	Tanzania Sisal Board
4.	Establish incentives for renewable energy generation and utilization such as prices per kWh, reduced taxes etc.	Ministry of Energy and Minerals

7.3 Activities to meet the strategic objectives of Goal 3

Tanzania Sisal Board has done preliminary studies in the regions of Dodoma, Manyara, Mara, Mwanza, Shinyanga, Singida and Tabora to determine the feasibility of increasing sisal production. Use of sisal waste for electricity generation can be feasible even at the small scale of some 10 kilowatts (sufficient power for one household). The pilot demonstration plant at Manala Village in Magu District, Mwanza Region, is a case in point.

NO.	ACTIVITIES FOR STRATEGIC OBJECTIVES IN GOAL 3 (Promotion and expansion of sisal as a cash crop)	RESPONSIBILITY
1.	Establish baling and brushing centres in areas with reasonable quantities of hedge sisal to improve incomes from sale of the fibre by reducing transport costs	<ul style="list-style-type: none"> • Companies processing sisal fibre into sisal products
2.	Start buying the hedge sisal fibre produced in the regions to show farmers clear economic benefits	<ul style="list-style-type: none"> • Companies processing sisal fibre into sisal products
3.	Establish seedling propagation sites in strategic sites in Dodoma, Manyara, Mara, Mwanza, Shinyanga, Singida and Tabora regions and in traditional sisal areas	<ul style="list-style-type: none"> • Tanzania Sisal Board • Government
4.	Identify and assist key players at the farmer level for demonstration plots and pilot biogas plants	<ul style="list-style-type: none"> • Tanzania Sisal Board • Government
5.	Promote establishment of sisal leaf processing centres in the target regions (450 decorticators)	Sisal industry stakeholders
6.	Assist at least 115,000 households to raise funds for sisal growing as sisal farmers with a minimum of 6 hectares each, mobilize resources and start planting sisal	<ul style="list-style-type: none"> • Tanzania Sisal Board • Government • Sisal companies
7.	Establish new plantations on 250,000 hectares of land within 100 km radius from major ports and install 157 units of hammer mills and biogas plants generating 172 MWe	Investors
8.	Establish sisal products manufacturing centres near sources of sisal fibre	Sisal industry stakeholders
9.	Create electricity mini-grids	Investors
10.	Promote use of organic fertilizer in agriculture and urban potted plants	Ministry of Agriculture, Food Security and Cooperatives

8. Outputs Resulting from Implementation of the Strategic Goals

The implementation of the activities listed in this strategy will result in the following:

1. Electricity generation capacity from sisal waste alone will reach 500 MWe by 2025
2. The biogas production process will produce 6 million tons of organic fertilizer
3. Processing of sisal boles for alcohol is projected to produce 1.2 billion litres of industrial alcohol for use in internal combustion engines including vehicles, for sterilization in hospitals and for pharmaceutical use.
4. The waste from the fibre extraction processes if not used for biogas can be used as animal feed.
5. More than 500,000 jobs will be created in agriculture, rural industries, commercial and technical support sector.
6. The 1 million ton fibre will be used to produce pulp and paper, composites, woven products, cordage, padding, mattresses and handicrafts.

7. A thriving rural light industry will be created which will raise the standard of living in rural areas and curb rural migration to urban centres thus reducing crime.
8. It will contribute to environmental conservation by reducing pressure on forest resources.
9. It will improve health in rural areas.
10. It will improve gender equity by reducing the time spent by women on energy-related household chores.
11. It will contribute significantly to the national literacy campaign.