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Renewable energy: its contribution to improved standards of living and modernisation of agriculture in Uganda

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Abstract

The biomass energy sub-sector is the major source of fuel in Uganda, providing over 90% of national energy demand. Biomass energy is mainly used for cooking and space heating. Investments in conventional forms of energy will have limited impact on most people in the country because of the high costs and limited access. Further development of the renewable energy sector to supply modern forms of energy will contribute to improving the livelihood of the rural poor in Uganda. Agriculture, the major source of income and employment in Uganda still relies heavily on iron and stone-age technologies and techniques for farming, harvesting and processing. Development and adaptation of appropriate environmentally sound renewable energy technologies will go a long way in improving the livelihood of rural Ugandans and modernising agriculture. This paper examines past interventions, and discusses some of the energy options that are bound to improve the standards of living and modernise agriculture in Uganda. © 2001 Elsevier Science Ltd. All rights reserved.

Keywords: Uganda; Renewable energy; Agriculture

1. Introduction

Energy has been a dynamic force in the growth and development of human society. The demand for energy is not an end in itself but for services like illumination, heating, cooking and mechanical power. Therefore, energy is crucial for the development of any nation. The level of development of a nation can be gauged by its level of energy consumption [1]. For instance, developing countries consume four to seven times less energy per person than industrialised countries [1]. Uganda's per capita energy consumption was 0.02 toe in 1992, and may not have increased much during

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this decade [2]. As shown in Fig. 1, the bulk of Uganda's energy supply is from biomass, mainly used in the household sector for cooking and space heating.

Uganda's energy balance often excludes energy used in agriculture. Sometimes it is categorised as energy used in transport where diesel is used in tractors for tillage. However, the quantities are still insignificant. About 90% of all energy used in agriculture is from human power. Animal power contributes about 8% and tractor power contributes about 2% [3].

2. Modernisation of agriculture

Modernisation of Agriculture is a dynamic process involving generation, effective transfer and sustained use of technologies to produce efficiently, profitably and ensure food security while conserving the natural resource base. The super goal of Uganda's modernised agriculture system is to improve the livelihoods of rural people. This can be achieved by increase in production, which would be achieved by:

1. Increasing labour input and land tilled every year.
2. Choosing crops which earn higher income.
3. Shifting from traditional energy (manual labour) to modern energy.

Since Uganda's economy depends on agriculture, modernising agriculture would imply an increase in energy consumption in this sector. However, this would result in increased environmental degradation, mainly as a result of pollution, de-vegetation and waste disposal. Uganda could avoid the path taken by developed countries and concentrate on use of clean, environmentally sound energy sources. Some of the energy options that would result in modernising agriculture are given in Table 1.

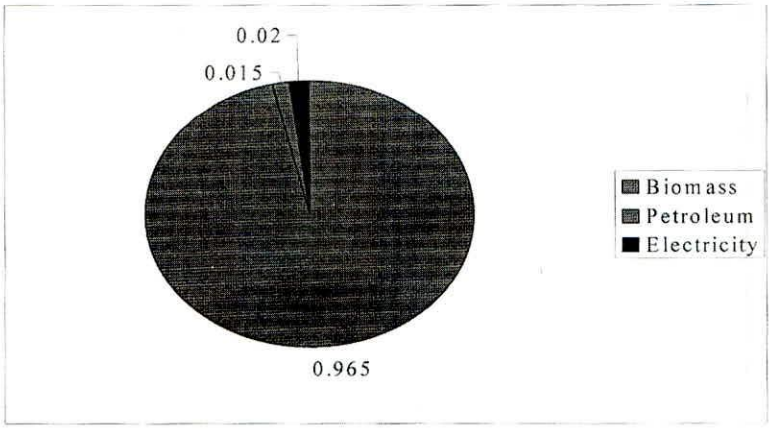


Fig. 1. Uganda's final energy consumption [4].

Table 1
Conventional and renewable energy options for modernising agriculture

Activity	Energy source	Conventional alternative	Renewable alternative
Tilling, planting and weeding	Manual labour using the hand hoe	Tractors using diesel	Hand ploughs/planters, ox-ploughs and tractor using bio-fuels
Irrigation	Manual labour using head loads	Canals, irrigation using diesel powered water pumps	Canals, irrigation using solar, wind and bio-fuels
Application of fertiliser	Rarely used, applied manually	Inorganic fertiliser	Compost and slurry from biogas, mulching
Harvesting	Manual labour using pangas, axes, hoes	Combine harvesters and power saws using petroleum fuels	Ox drawn harvesters, combine harvesters and power saws using bio-fuels
Transport	Manual labour using head loads	Tractors, lorries	Wheelbarrows, hand pushed carts, ox/donkey/horse drawn cart, bio-fuelled vehicles
Preservation	Direct sun drying, smoking	Electric or kerosene powered refrigerators, electric powered dryers (electricity generated using petroleum)	Solar and biomass kilns and dryers, solar/biomass/wind/micro-hydro powered refrigerators
Processing	Manual labour using pestle and mortar or grinding stones	Mechanised grinders using diesel generators	Paddle grater, mata mills, bio-fuelled generators

3. Previous experiences and new initiatives

3.1. Tilling, planting and weeding

The iron-age tool, the hand hoe, still dominates in Uganda. Efforts to use tractors in the early 1990s were ill-conceived because the distribution of diesel fuel in rural parts of the country was not taken into consideration. In addition, the low prices offered for most food crops discouraged investment in mechanised tilling planting and weeding. Most of the tractors distributed at sub-country level are now used in construction, for ferrying bricks and sand. Ox-ploughs were widely used in the northern part of Uganda. However, most of the animals were stolen or killed during wars and cattle rustlings. In central and southern Uganda, cattle are considered too valuable to use for ploughing. They are kept for milk and beef only. NARO has developed lighter animal drawn ploughs, weeders and planters. These can be used with donkeys, which have been introduced in the country by a number of non-governmental organisations. Hand pushed and bicycle drawn ploughs, weeders and planters have also been adapted.

3.2. Application of fertilisers

Only commercial farmers use inorganic fertilisers. Most Ugandans are subsistence farmers and cannot afford inorganic fertilisers. While composting and mulching are widely known practices, their use is still limited. Sustainable agriculture initiatives include the use of slurry from biogas, liquid manure from urine and compost. These have been adapted by some farmers, particularly in central region. As land fragmentation continues, more farmers will have to adopt these techniques to avoid soil exhaustion.

3.3. Irrigation

Irrigation is not a common practice for subsistence farmers. Most farmers rely on rainfall to provide water on farmland. Water is only collected for livestock. Manual collection of water, which is back breaking, is practised. Irrigation is an important pre-requisite for increased output since crop failure is often attributed to unreliable rainfall. Mechanised means of water pumping are required which would include solar, wind or biogas powered pumping systems. It is imperative to assess the options available and demand for crops before a drive towards irrigation is launched. Financing mechanisms should be instituted to ensure water pumping systems are purchased by individual farmers or groups of farmers. NARO has adapted a pedal water pump which is probably the cheapest option in sub-Saharan Africa.

3.4. Harvesting

Almost all crops are harvested manually except wheat and to some extent logs. Combine harvesters were imported for wheat harvesting in the Mount Elgon area. Unfortunately, the harvesters are usually out of order. Logs for timber production are sometimes harvested using power saws. Ox drawn and bio-fuelled harvesters are renewable energy options worth considering.

3.5. Transport

Head loads are used to transport produce from the farm to the house or market. In some cases, bicycles are used. Commercial farmers use tractor-trailers and lorries. The use of wheel barrows and animal drawn carts is still limited. Considering that an increase in productivity would result in an increase in harvesting and transportation operations, it is worthwhile investigating the renewable energy options for transporting different crops. Use of hand pushed and ox-drawn carts are some of the low cost options.

3.6. Preservation

Most crops are preserved by direct sun drying. As a result, some crops are often discoloured (especially fruit), infested with insects and micro-organisms, or contami-

nated with dust and small stones which have to be removed before further processing. Fish is preserved by refrigeration or smoking using wood fuels. There are limited options for fresh fruit and vegetable preservation resulting in great losses on farms and in the markets. Solar dryers have been adapted by NARO for fruit drying. Work on adopting a mobile solar kiln for timber drying is under way. Bio-solar dryers for both crops and timber have been adapted by NARO and Makerere University, Faculty of Technology.

3.7. Processing

Further processing on the farm would help increase rural incomes. Currently there is limited processing on-farm or in rural areas. Most on-farm processing is for local consumption and stone age tools like the mortar and pestle, and grinding stones are used. Processing raw materials at source would reduce the amount of waste hauled over long distances and increase options for rural employment. NARO has adapted a number of processing technologies, which include the cassava paddle grater; and, manual and mechanised maize and groundnut shellers.

4. Conclusions

Uganda has the requisite policy framework for modernising agriculture and eradicating poverty in place. The onus is on scientists to provide environmentally sound technology options to ensure policy implementation. Scientist will require support and innovative dissemination strategies, which include among others information dissemination and financing mechanisms to ensure that the technologies are adopted.

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