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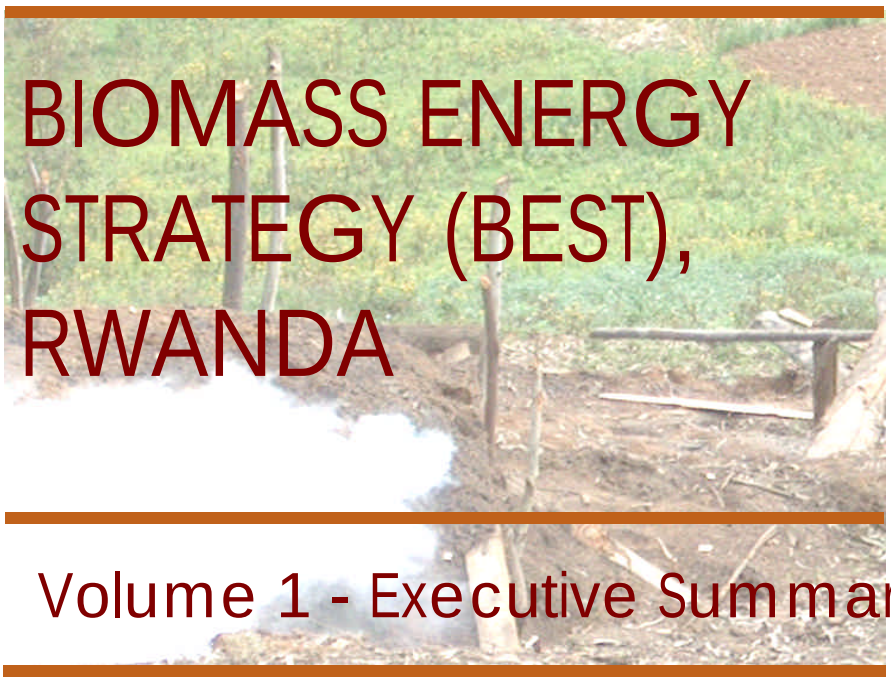
BIOMASS ENERGY STRATEGY (BEST), RWANDA



Volume 1 - Executive Summary

June 2009

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BIOMASS ENERGY STRATEGY

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Executive Summary

Biomass in the form of firewood and charcoal plays a crucial role in the economy of Rwanda. This is however, often not recognized and there are very few people who realize how much Rwanda has already achieved to obtain a sustainable wood supply situation. Pictures of the previous turn of the Century show completely denuded hills around Kigali. Today, these hills are green with trees, and in fact most of the firewood, charcoal, and pole wood in the country come from man-made plantations. There are very few other African countries where the same claim can be made; indeed, Rwanda is quite far ahead of the others.

There are at least 6 reasons why biomass is so important:

- The contribution of biomass to the national energy balance remains high; while it was as much as 95% some 20 years ago, today the contribution is still around 85%, and is expected to be 50% in 2020. Biomass remains by far the largest source of energy used in the country especially for domestic cooking and it is likely that this will continue for some years to come;
- Biomass provides an affordable source of energy for the Rwandese population, at least relative to the alternatives. These are either less convenient (such as agricultural residues) or (much) more expensive (such as electricity and LPG, which is currently heavily taxed);
- The two national sources of energy that are considered possible substitutes for biomass also offer their own problems: (a) electricity is expensive and its generation capacity is limited; in an hypothetical case if all households were to use a water cooker at the same time, the country's generation capacity would need to increase from the current 60 MW to over 600 MW; (b) methane from lake Kivu is often thought to become available for thermal purposes such as cooking, but the economic costs of storing it in bottles such as LPG or piping it to homes will be very expensive. Electricity generated from methane gas and from the hydro power will increase the electricity available to Rwandan customers, but it is not likely to reduce the electricity tariff considerably. Electricity will therefore remain too expensive for cooking;
- For national energy security reasons it is important that the largest source of energy used in the country is (a) renewable and (b) does not depend on external influences or foreign exchange.
- Biomass is a green source of energy; it is a renewable source of energy meaning that if the resources that produce firewood and charcoal are properly managed, there will be an eternal supply of it, or at least until economically viable alternatives are available;
- Last but not least, biomass generates an important source of income and labour; as will be shown in the report, the value of firewood and charcoal in 2007 was on the order of US$122 million, or 5% of GDP. What is more, some 50% of this value remains in rural areas where it is distributed among farmers/wood growers and charcoalers; as such, it is a true engine of rural development!

Given the above, the Government should assure that biomass obtains the proper political, fiscal, and technical attention it deserves. MININFRA is genuinely interested in biomass issues, but it is mainly concerned with end-users' aspects and energy conversion, transformation and efficiency; MINIRENA focuses on the silvicultural aspects and productivity of plantations, and MINAGRI on the agroforestry aspects of biomass. Other

Ministries such as MINECOFIN, MINILOC, MINICOM, etc have an interest in part of the technical and regulatory aspects of the biomass supply and use chain. However, the existing mechanism for national coordination and collaboration does not do justice to the economic importance of the sector.

It is therefore recommended that a more proactive and effective institutional mechanism is developed, creating better synergy between the relevant Ministries and other organizations and ensuring that all aspects of biomass are fully covered, from growing of trees to the emissions of stoves. It is hoped and expected that better coordination between all stakeholders will be realized once both the National Forestry Agency and the Energy Development Agency of the proposed Water and Energy Board are fully operational. However, it seems that an additional institutional responsibility and leadership at a higher level in the government is needed to ensure that biomass energy gets the place in the economy it deserves.

What if there was no more charcoal in the country

Rwanda would face serious problems if the charcoal supply in the country would reduce suddenly. Not only the rural employment and income opportunities will be lost lost but also because urban households would have trouble finding cooking fuels. There is no clear alternative that provides the same service for a similar price. If all households adopted kerosene as their replacement cooking fuel, at this point in time the next best and the least expensive alternative, kerosene imports would surge from an annual level of 20 thousand tonnes in 2007 to over 120 thousand tonnes. It would certainly create an important economic hurdle to cope with a kerosene import bill of over US$50 million per year.

Charcoal destroyed forests but this is no longer so

Charcoal is often blamed for the destruction of the forests and this is both true and false. In the past, charcoal was one of the factors that contributed to deforestation, although it was not the main factor: land clearing for agriculture, for habitation, and for creating tea plantations contributed more to the destruction of the natural forests than did the demand for charcoal. Also mistakes can be rectified such as demonstrated in the Bugasera region which has been denuded because of Kigali's charcoal demand from the 60s to the early 80s. Today, however, this region is covered with young trees (*Eucalyptus* and other species) and it could soon effectively contribute again to the charcoal supply.

Rwanda may well be the only country in Africa where the relation between charcoal and deforestation no longer exists[1]. Virtually all charcoal in Rwanda is now produced from planted trees, on private as well as community land, and only a small contribution still stems from natural forests. A shortage of charcoal would therefore mean that there are not enough trees planted. Almost every farmer in the country has set aside a small part of his land for *Eucalyptus* trees; this serves for his own energy needs, but also for the sale of stakes, poles, firewood, wood for charcoal making, and charcoal. Farmers appreciate *Eucalyptus* as it is fast growing, easy coppicing, drought resistant, well liked by consumers for a large number of uses ranging from construction wood to energy wood; there is simply no alternative known that is equally versatile and productive. There have been some ideas that Eucalyptus is damaging the environment because of it water requirement. However, there is little evidence

[1] Except the charcoal supply for Antananarivo, Madagascar, which also mainly comes from farmers' eucalyptus plantations; in much of the rest of the country, charcoal still comes from natural forests

that this is the case in Rwanda with its high rainfall patterns in contrast to other, dryer regions in Africa where Eucalyptus indeed may cause problems for other vegetations.

Farmers consider trees as a crop from which they earn part of their income, just like they do with other crops such as maize. If there is a shortage of wood, prices will rise and farmers respond by planting more. If prices are low farmers will not replace trees that they harvested. It is understandable therefore why farmers do not like the strict regulation governing the harvesting of trees that they planted themselves. In fact, the general perception that charcoal is illegal is forcing farmers and charcoalers to operate accordingly and incur high technical losses. Avoiding illegal charcoal operations could reduce the total annual harvesting of wood for commercial fuels by an estimated 15-20%.

Regulation to be adapted to current circumstances

It is clear that the current regulation is no longer appropriate as it is based on the assumption that charcoal and firewood are produced from natural forests and public plantations. However, charcoal is just a commodity produced mainly on farms or in plantations, and the Government should therefore reconsider regulation accordingly. Management and harvesting of Government and community plantations definitely needs clear rules and monitoring, but private farmer plantations should be treated differently little with minimal regulation. Farmers should be allowed to consider trees as a normal crop, without special regulation, on their own land only and under certain circumstances that avoid clear cutting large areas all at once.

Some 7% of the charcoal retail price is composed of taxes levied at the district, sector and cellule levels and vary per location, including for cutting permits, charcoaling permits transport permits, etc. Included also are unofficial "costs" paid to the various persons along the production chain who try to extract rents. The experience in other countries shows that a well designed and transparent taxation mechanism can actually be the driving force in promoting efficiency improvements along the entire production chain. A level of 10% would provide these benefits, including the funds to implement a verification and enforcement mechanism. The mechanism is based on the following principle: those who employ efficient technologies and use wood from legal sources are subject to a low tax level – but they[2] can keep most of the proceeds and the remainder is for the central forestry fund. In all other cases, the taxation level is higher and there is no or hardly any benefit for those involved.

Supply – demand balance

Rwanda has a very extensive tree cover and one might argue that there may not even be much more space to plant additional trees; anyone travelling in Rwanda can confirm this. However, there is uncertainty about the total land in the country covered by trees. The Forest Inventory recommended as a priority to take a specific detailed look at this by surveying the smallest patches of plantations[3]. These mainly privately owned patches are too small to show up on satellite imagery but do contribute to the supply of wood products. It is generally proclaimed that private lands substantially contribute to the wood supply in Rwanda, but better knowledge about the contribution from smallholder farms will be necessary before this can be confirmed. An equivalent size of a 50,000 ha plantation would be the result if most of the one million rural households have a small plantation on just 10% of their lands; this

[2] "They" meaning the actors involved: wood owner, charcoaler, and local administration at cellule, sector, and district level.

[3] This is review underway now, by MINIRENA/BTC and FAO.

would be a 20% increase over the known plantations and therefore a very important contribution to the total areas under trees.

The inventory shows that there are about 241,000 ha of plantations in Rwanda larger than 0.5 ha, of which 65% are owned by the State or Districts. The predominant species is *Eucalyptus* (64%) with an annual average growth of 7 m^3/ha. Literature shows that *Eucalyptus* productivity could triple[4] given prevailing climatic conditions; this low productivity could be a sign of over-exploited and poorly managed plantations as well as soil nutrient depletion, and should be addressed immediately.

Under a conservative scenario whereby the unknown contribution from private smallholder farms is minimal, the current demand for commercial woodfuels in the country is about twice the estimated sustainable supply. This in itself is not a reason for immediate panic, although action will be required to address this in the near future. If the productivity of all plantations increases by 50%, the estimated demand-supply gap is reduced to about 25%, requiring some other measures to be also realized. The proposed biomass energy strategy does just that: ensuring that an efficient wood fuel market exists, promoting energy conservation measures, and introducing new, alternative fuels. Improved regulation will be necessary, including a new fiscal strategy towards wood fuels. If implemented, Rwanda will continue to enjoy the fruits of its natural resources, providing a major rural income generator, resulting in a continued availability of low-cost energy for the lower income groups of the population.

What about the rural demand for energy

Rural households mainly collect agricultural residues and supplement these with gathered firewood, purchased firewood, and possibly charcoal. The use of agricultural residues – although free for the user and therefore appreciated – has two important negative effects with long term economic impacts: it deprives soils from new nutrients thereby reducing the agricultural and silvicultural productivity, and it generates health problems and related unnecessary expenses from the smoke in the kitchens as stoves are not adapted to this kind of fuel. It appears that the total rural biomass demand is more or less in equilibrium with the supply that in a large part comes from the households' homestead and farm land. The rural use of purchased firewood and charcoal in rural areas is expected to increase with rising incomes and this will put more strain on the sustainable supply for rural as well as urban use. The commercial urban supply of wood fuels can in fact be guaranteed because the rural population prefers to use lower grade fuels. It is unlikely that this will last for a long time, since rural living conditions are improving and rural households would like to see kitchens modernize too sooner or later.

Biomass can be a modern fuel

Many politicians and decision makers in Rwanda believe and state that biomass or wood energy are traditional, backwards, and its use should be eliminated as quickly as possible. It is time to rethink such opinions in view of recent developments such as rising oil prices (which reached US$150 per barrel in 2008) and suppliers as Russia threatening to cut back oil and gas supplies. In the USA and Europe, many households and firms are switching to biomass for heating their homes and fuelling their businesses. They claim that biomass is a renewable fuel, neutral to climate change issues, and above all cheaper than petroleum fuels. Modern

[4] *Eucalyptus* in Rwanda: Are the blames true or false? Review. ISAR Published in the Proceedings of National Conference on Agricultural Research Outputs, March 2007, Serena Hotel, Kigali. See also: Les *Eucalyptus* au Rwanda: analyse de 60 ans de experience avec reference particuliere a l'arboretum de Ruhande; C. Burren, 1995.

appliances such as automatically fed, low-emission stoves and furnaces indeed make the use of biomass viable for 21st century applications. In addition, new, low-cost, high efficient and modern cooking stoves for household use are now beginning to be produced and sold by multinationals; the first trials have started in Ghana and Kenya, following up on an earlier successful market introduction in India.

So, for future developments, Rwanda should reconsider its views on biomass energy. The country is well positioned to make use of biomass for a long time to come, particularly for cooking which is the main use of energy in the country. By doing so, it benefits from the many rural employment opportunities, from the availability of a source of cheap urban energy, and avoids having to import a lot of petroleum fuels quickly. By doing so, it can continue to create its infrastructure for electricity and petroleum fuels for the use of essential and non-cooking tasks. Although there is pressure on the resource base at the moment, this is expected to be under control within the next 7 to 10 years when the proposed strategy is fully implemented. Otherwise, pressure will lead to irreversible damage over the next decade.

More details are provided in Volume 2, Background and Analysis, and Volume 3 Rural Energy Use and Supply.

The proposed strategy

The proposed strategy hinges on four main elements, as described in Volume 4, The Proposed Strategy:

(I) Increase the sustainable supply of woodfuels. The result of this component is to make sure that in the future the supply of wood from non-sustainable sources stops completely and that the productivity of the sustainably managed resources is at a much higher level than today. This is expected to be done through the following activities: (i) improvements to the regulatory framework with regards to cutting permits and taxation policy; (ii) Efficient planning of woodfuel supply management activities; (iii) rehabilitation, better management and exploitation of State and District plantations; (iv) tree planting and increasing the productivity of private small-holder tree farms; and (v) professionalizing the charcoal value chain;

(II) Increase the energy use efficiency. The result is that less energy will be needed for cooking than today. This is expected to be done through the following activities: (i) capacity building among equipment manufacturers and importers to make available modern appliances for the use of biomass; (ii) develop a mechanism based on a Quality Label to promote the use of these modern appliances; and (iii) launch a long-term publicity and awareness campaign to convince households, institutions and firms to adopt the new equipment;

(III) Promote the production of alternative fuels, particularly based on peat, papyrus and typha as well as biogas if and when viable, and LPG for households and institutions (once taxes have been reduced), kerosene and some electricity.

(IV) Develop the institutional capacity of Government organisations (concerned ministries, specialised agencies, local authorities) to deal with biomass in the short and medium term future on an equal footing as gas, petroleum fuels, and electricity.

Investment Package and Economic Evaluation

The proposed Biomass Energy Strategy, as well as costs & benefits are presented in the second Volume. The total investments, including equipment and rehabilitation of plantations,

were estimated at $119 million, of which a direct public contribution of $52.5 million, a private contribution of $42.4 million, and $24 million can be raised through an improved taxation system and valuing environmental benefits. The rate of return of the project is about 27% without and 49% with environmental benefits.

Implementation

It is not the first time that a strategy is proposed. This is worrisome, as it indicates that previous studies ended up on a shelf. Can it be different this time around? The forestry law is under revision and a new energy law is under preparation. Until now biomass aspects had not been fully addressed, and it is hoped and expected that the proposed strategy will make an effective difference. The time is right as more and more Government officials begin to realize that the country will use biomass for many years to come and that there are no readily available and easy possibilities to substitute it quickly.

In addition, there already are substantial funds available to implement parts of the strategy, notably from the Royal Netherlands Government for the rehabilitation and management of 10,000 ha of community plantations and for the assistance to small private farmers for an intensification of agroforestry practices. In addition, funds are available for capacity building for institutions working on biomass energy, and for disseminating improved stoves. It is important that mistakes from previous efforts are now avoided: the package as a whole should be implemented, not just some parts of it. Financing may come from different sources and different institutions may be involved in the realization, but the activities should all be implemented.