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# Biogeography and Livelihood Effects of Edible Bamboo Shoots in Mt. Elgon National Park, Eastern Uganda

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**Abstract:** Forest foods are very important for the predominantly rural population surrounding Mt. Elgon National Park, eastern Uganda. The household survey was conducted in Mutushet and Kortek Parishes, Kapchorwa District between June, 2004-October, 2004. Among forest foods, local people consider edible bamboo shoots as the most important product. A study was carried out to explore the opportunities and challenges faced by poor local community in Mutushet village, set up a marketing group to improve its income from edible bamboo products. Initially the group was assisted by a local project with IUCN funding. Women were the key activity implementers. The outcome of the group formation was that village income from selling bamboo shoots increased at least 6 fold. The community has improved its cash income, reduced its debts and reduced its dependency on rain-fed subsistence agriculture. The successful marketing strategy has led to the community showing increased interest in managing its bamboo resources sustainably. The bamboo industry has not received policy support and remains a minor production commodity of no significantly appreciated economic development strategy. Yet evaluations and analysis elsewhere have shown that bamboo and rattan commodities of forest compositions have a high potential of contributing towards local regional development. It is therefore, urged that relevant actions be taken to tap available opportunities such as: articulation of NWTFP, including bamboo in the forest policy and legal actions; creating awareness on potentials of bamboo development and poverty eradication; improving the capacity of bamboo technologies and marketing opportunities; focus on value adding through improved processing of bamboo products and focused development of on-farm bamboo farming for supply of target products.

**Key words:** Income, marketing, NTFP, women groups, IUCN, bamboo shoots

## INTRODUCTION

Bamboo is a product of great importance to most village populations in Uganda (Banana and Tweheyo, 2001). The rural people collect bamboo for use as a building material and its shoots for consumption and selling. Houses in rural areas are mainly constructed using bamboo, with bamboo roofs, wall partitions, panelling, mats, ladders, blinds and furniture. Bamboo is also used in the production of certain fishing tools, paper and is sometimes used to make musical instruments such as the flute and guitar. Recognizing the importance of this NTFP (Non-Timber For-est Product), the IUCN (World Conservation Union)/NTFP project has worked with village people in Mutushet parish to develop a model for its sustainable harvesting and better marketing.

In Uganda, most of the country's bamboo resources are located in a few major sites, namely, the Northwestern district of Arua, the western and south, Western districts on Hoima and Kabale, respectively in addition to significant portions of the resource in the eastern district of Mbale. However, little has been done to explore the nature and extent of bamboo resource use in these areas. Most of the bamboo resources are located in protected areas under government control (Banana and Tweheyo, 2001). Due to restrictions on these areas, not all the bamboo forest is accessible to the harvesters. *Arundinaria alpina* Schum is one of the species that generally offers high utilisation potential and is abundant in most of the sites. *A. alpina* is a monopodial species with culms arising individually from running rhizomes. Culms grow to 20 m tall and up to 13 cm in diameter. New shoots are produced during the rainy season and live for between seven and 14 years (Banana and Tweheyo, 2001). Due to restrictions on harvesting and the lack of a well-developed market, little of it is used for commercial purposes (Buyinza *et al*., 2007).

Bamboo resources are recognised in Uganda, as providing increasingly substantial contribution to the income generation, employment and to some extent to the foreign exchange earnings of the country. These resources directly benefit mainly, but not exclusively, the people residing in the communities adjacent to the resource base (Buyinza *et al*., 2008). In general activity in these sectors cuts across gatherers, suppliers, processors (both primary and secondary) and traders in mainly furniture and crafts products. Traditionally, bamboo has been used by people as a source of building materials, for crafts, furniture, food (young bamboo shoots) and as well as areas for hunting wild game. The high productivity and economic potential of the rattan and bamboo sector in Uganda has barely been tapped and experience so far shows and this will be relatively easy once the socio-economic aspects of the sector are appropriately examined. Important issues for consideration include the rattan and bamboo production and the flow of the products through various processors to the final consumers.

Bamboo harvesting and processing in Uganda is concentrated in the Mt. Elgon forests in Mbale district in the eastern part of Uganda, Rwenzori in the west and Echuya, Bwindi and Mgahinga in Kabale district in the south western corner of the country. There are also other small pockets of bamboo vegetation scattered in various parts of Uganda. In areas like Bbajo (Mukono district), Metu and Otzi in Moyo district the bamboo thickets are exploited by local residents to provide bamboo reeds used mainly in construction. But bamboo activities in these areas are not as pronounced as they are in Kabale and Mbale districts (Banana and Tweheyo, 2001). The importance of bamboo has long been recognised by several cultures in the country. In particular, bamboo shoots are a major source of income to communities adjacent to bamboo forests, such as the Gishu in Mbale where they are regarded a traditional delicacy. However, the market for other products such as furniture is not yet well developed. Much of the bamboo is used for poles by people in villages on the fringes of the forest. Interest in the establishment of bamboo collectors_ committees has been expressed in many of the areas studied in order to promote development of the bamboo industry.

The ecological changes and taxanomic studies on afromontane bamboo species have been conducted since 1993 in Echuya Forest Reserve located south western Uganda (Banana and Tweheyo, 2001). So far, a total of 52 species from 15 genera have been documented. The mountainous northern part of Mt. Elgon is one of the richest areas for bamboo. Surveys show it holds at least 50 species, 30 of which differ from those in central and southern Uganda (Banana and Tweheyo, 2001). Some of these species are edible bamboo. Edible bamboo belongs to the group of bamboos with a monopodial or leptomorph rhizome system. The young reddish-black shoots are located underground, growing off mature root stock. The shoots gain bitterness with age, hence their name edible bamboo shoots'. Edible bamboo is found in the Mt. Elgon forest, in evergreen forests, some 400 m above sea level. One of the most important bamboo species is *Arundinaria alpina*. This species is important not only for eating, but also in the production of handicrafts and as a building material.

## MATERIALS AND METHODS

**Study area:** Mt. Elgon National Park (10'N and 34°30'E) is situated approximately 100 km northeast of Lake Victoria on the Kenya-Uganda border. The protected area covers 2045 km$^2$ with 114 km$^2$ comprising Mt. Elgon National Park on the Ugandan side. The mean annual rainfall ranges from 1500 mm on the eastern and northern slopes to 2000 mm in the south and the west. On lower slopes, the mean maximum temperatures decrease from 25-28°C and mean minimum temperatures are 15-16°C. The study was conducted around Mt. Elgon National Park (1°25'N and 34°30'E), approximately 100 km Northeast of Lake Victoria on the Kenya-Uganda border. It is one of the oldest volcanoes in East Africa. It rises to a height of about 4, 320 m above sea level. The region receives an approximately bimodal pattern of rainfall, with the wettest months occurring from April to October. The mean annual rainfall ranges from 1500 mm on the eastern and northern slopes to 2000 mm in the south and the west. On lower slopes, the mean maximum temperatures decrease from 25-28°C and mean minimum temperatures are 15-16°C.

Physiographically, this site is located in the middle mountain region. Settlement in the area started about 300 years ago by mainly *Bagishu ethnic* group. Mt. Elgon catchment occupies an area of about 124 ha and is about 6 km away from Mbale town. This site with sloping land represents a typical hill-farming situation (Bagoora, 1988). Deforestation leads to soil erosion, low agricultural productivity and increased household costs such as land management practices that ultimately lead to poverty in the area (Ellis-Jones and Tengberg, 2000). Farming much of the mid-hills and in Mt. Elgon Catchment in particular, is mostly of a subsistent nature. A majority of farm households in the area are small although, there are few farmers who produce marketable surplus of fruits like orange and banana (Buyinza *et al*., 2007).

**Data collection and analysis:** This study was based on primary data obtained through a questionnaire survey, key informant interviews, field observations and group discussions. The household survey was conducted in Mutushet and Kortek Parishes, Kapchorwa District between June, 2004-October, 2004. The 2 parishes were selected for the study after discussion with park authorities based on the availability of bamboo forest resources in the area. The sample size for the household survey was determined using the sampling method devised by Arkin and Colton (1963). We selected one parish with collaborative agreement (Mutushet) and one without (Kortek), with a sample of 60 households from each parish. Altogether 120 households were interviewed. We further selected villages within the 2 parishes with different distance to the forest. Households were drawn at random from village register lists. In addition, key informant interviews were conducted with the park wardens, village environment committee and local council leaders. Secondary data were obtained from Uganda Wildlife Authority, National Environment Management Authority, National Forest Authority and Makerere University libraries.

**Field experiment:** Making harvesting of bamboo sustainable, has become of great concern to the villagers as they discover its potential income. They are therefore, keen to experiment with different methods to achieve this. Two experiments were carried out in the hope of achieving better management. The first experiment was designed to study whether harvesting the culms has an impact on the production of shoots, because both prod-ucts are valuable. The 2nd of the experiments was designed to discover how much the culms changed when dried after harvesting. With assistance from local researchers, trials were set up to study the effect of var-ious cutting regimes on the yield of shoots.

**Shoot production:** A study area in the community forest that had many bamboo plants in it was divided into 15 plots, each 20×20 m in area. A 100% enumeration of all plots was made. The estimated age of each culms was recorded, from 1-4 years. Year 1 culms had recently emerged. Five treatments were tested, with 3 plots randomly assigned to each treatment. The randomly allocated positions are shown in Table 1.

The null hypothesis (Ho) stated that treatments Tl-T5 would have no impact on the production of new shoots for 1-2 years after treatment takes place. The 2 year time sample is necessary because shoots take this long to mature. The treatments used are described in Table 2.

The plots were re-enumerated on 25/02/2005 and 22/12/2005. Although not exact, these dates adequately represented the intervals of 1 and 2 years after treatment began. Shoots are actually harvested before, they emerge from the soil, but the number of recently emerge shoots in October was taken to be an accurate indicator of how many shoots were available for harvest earlier in the same year.

Table 1: Randomly assigned treatment positions

| 1 | 2 | 3 |
|---|---|---|
| T2 | T4 | T1 |
| 4 | 5 | 6 |
| T2 | T3 | T1 |
| 7 | 8 | 9 |
| T3 | T4 | T5 |
| 10 | 11 | 12 |
| T1 | T5 | T2 |
| 13 | 14 | 15 |
| T3 | T4 | T5 |

Plot numbers and treatment numbers (T)

Table 2: Treatments

| Treatment | Treatment description |
|---|---|
| T1 | Remove 50% of 3 years old stems |
| 12 | Remove 100% of 3 years old stems |
| 13 | Remove 50% of 4 years old stems |
| T4 | Remove 100% of 4 years old stems |
| T5 | Control (no treatment) |

**Culms weight:** A set of 33 culms of various ages, was cut, measured and weighed in 2005. They were dried in the sun and re-measured after 30 days. Any changes were analyzed.

## RESULTS

**Shoot production:** To measure impact of treatments, changes in annual shoot production in each plot. This use of paired mea-surement, i.e. before and after treatment helps prevent distortion of results through natural plot variation. Table 3 shows the results after 1 year.

Analysis of these results using a single factor analysis of variance (ANOVA) test, produces a p-value of $p = 0.33$. This value suggests the treatments are not having an effect any greater than chance and therefore, the null hypothesis is retained.

Analysis of the results shown in Table 3 using a single factor ANOVA test, gives a $p = 0.22$. Therefore, the null hypothesis is retained, as variation is almost certainly the result of chance factors as opposed to treatment.

**Culms weight:** The average change in circumference after the 30 days period of drying was 0.04 cm and the average change in length was 0.3 cm. These changes are considered too small to be of any significance.

The average change in weight over the drying period was 1.8 kg, equal to 38% of saturated weight. This change is considered to be very significant. Younger culms lose a greater total weight of water per culms. That means, the linear regression for net weight change vs. age, has a slope significantly different from 0 (weight change = 2.72-0.208 age-class, R (adj) = 0.145, p = 0. 018). However, if we look at the percentage change in weight, the slope is not significantly different from 0 (p = 0.161). Individual young stems lose a greater weight of water than old stems, but

Table 3: Number of new culms at the 1st and 2nd counts and the net increase

| Treatment | Number of new culms in each plot | | | Mean |
|---|---|---|---|---|
| **1st** | | | | |
| 1 | 65 | 136 | 48 | 83 |
| 2 | 86 | 59 | 84 | 76 |
| 3 | 126 | 34 | 11 | 57 |
| 4 | 63 | 117 | 65 | 82 |
| 5 (control) | 70 | 50 | 25 | 48 |
| **2nd** | | | | |
| 1 | 89 | 102 | 182 | 124 |
| 2 | 118 | 156 | 195 | 156 |
| 3 | 218 | 146 | 200 | 188 |
| 4 | 82 | 223 | 102 | 136 |
| 5 (control) | 159 | 181 | 101 | 0.147 |
| **Increase** | | | | |
| 1 | 24 | -34 | 134 | 41 |
| 2 | 32 | 97 | III | 80 |
| 3 | 92 | 112 | 189 | 131 |
| 4 | 19 | 106 | 37 | 54 |
| 5 (control) | 89 | 131 | 76 | 99 |

Table 4: Number of new cu1ms per plot at the 1st and 3rd counts and the net increase

| Treatment | Number of new cu1ms in each plot | | | Mean |
|---|---|---|---|---|
| **1st** | | | | |
| 1 | 65 | 136 | 48 | 83 |
| 2 | 86 | 59 | 84 | 76 |
| 3 | 126 | 34 | 11 | 57 |
| 4 | 63 | 117 | 65 | 82 |
| 5 (control) | 70 | 50 | 25 | 48 |
| **3rd** | | | | |
| 1 | 188 | 253 | 67 | 169 |
| 2 | 131 | 97 | 157 | 128 |
| 3 | 142 | 50 | 22 | 71 |
| 4 | 155 | 170 | 55 | 127 |
| 5 (control) | 171 | 120 | 81 | 124 |
| **Increase** | | | | |
| 1 | 123 | 117 | 19 | 86 |
| 2 | 4S | 38 | 73 | 52 |
| 3 | 16 | 16 | 11 | 14 |
| 4 | 92 | 53 | -10 | 4S |
| 5 (control) | 101 | 70 | 56 | 76 |

that a given weight (e.g., 1 ton) of fresh stems, old or young, would probably lose about the same amount of water when dried (Table 4).

## DISCUSSION

**Income and social effects of the bamboo marketing group:** there are many factors, which have an impact on the incomes of the local community. These include the size of the area a group has rights over, the status and type of forest, the richness of NTFPs, the number of family members available to collect NTFPs and most importantly, the method of marketing. Also, weather can have a pro-found impact on income. For example, in 2005, particularly the sporadic cold weather meant that bamboo shoots grew at a much slower rate than is normal for December. Then, early rainfall in February caused rapid growth, creating an abundance of supply, leading to diminishing selling prices. Prior to the start of the project, despite the fact that huge quantities of NTFPs were being collected, the mar-keting of the produce was poor and consequently selling prices were low. At this stage therefore, NTFPs were not an important source of income. The box below highlights this with an example of edible bamboo.

There are no established trading arrangements for bamboo. Transactions are home based, with both retail and wholesale buyers finding the processors at his/her residence. The size and design of products often depends on market preferences, or on special orders. It is common for buyer to order products and deposit part of the payment in advance. The establishment of marketing groups has been very successful and has made a great impact on the villagers' livelihoods. In 2004-2005 period, about 47060 kg of bamboo was sold for 51768900 kip. This compares to 46370 kg for Ushs. 56, 472, 000 in 1999-2000 (Table 5).

The local communities were encouraged to weigh the bamboo shoots they sold, using precise units, i.e. kilograms, as op-posed to in arbitrary bunches. Before project initiation, 36/42 families were short of bananas for 4-6 months of the year. Two years into the project, banana shortage occurred in only 12/42 families and lasted for only 1-2 months prior to harvesting. The improvement has been dramatic with incomes rising steadily over the period.

Originally, most members of the village were very poor and they put the vast majority of their income towards the purchasing of rice. Now standards have improved and many of the families have money left over after rice is bought. This has meant that some families have been able to save enough to buy such things as electricity generators, hand tractors and even televisions. Their standard of clothing has improved and so has their general appearance. All these improvements are obviously strongly welcomed by the villagers who now place a great deal of trust in the project and are much more motivated towards managing their forest for the production of NTFPs.

Between 2004 and 2006, the group fund accumulated Ush. 17,000,000/= through sales of edible bamboo and later, also cardamom. It was decided the funds would be spent on improving the village's water system and for providing loans for development of agriculture and livestock. In the year 2000, 15 families received loans from the fund, for a variety of purposes, both agricultural and non agricultural. Examples of items bought include hand tractors and house building materials.

The shoot production experiment could not reject the null hypothesis, as treatments created no impact on variation greater than that caused by chance. Therefore, it seems to be the case that culms harvesting cannot

Table 5: Off-take and income from bamboo shoots in Mutushet village, 2004-2006

| | 2004-2005 | | | 2005-2006 | | |
|---|---|---|---|---|---|---|
| Month | Sold (kg) | Selling price (Ush $kg^{-1}$) | Income (Ush) | Sold (kg) | Selling price (Ush $kg^{-1}$) | Income (Ush) |
| December | 4359 | 1200 | 5230800 | 2537 | 1900 | 4820300 |
| January | 9065 | 1200 | 10878000 | 5086 | 1800 | 9154800 |
| February | 13557 | 1200 | 16268400 | 13573 | 1700 | 23074100 |
| March | 14875 | 1200 | 17850000 | 25173 | 600 | 15103800 |
| April | 5207 | 1200 | 6248400 | - | - | - |
| Total | 47,060 | - | 56,475,600 | 46370 | - | 52,153,000 |

Table 6: Density and yield study for 2 blocks

| | | Stems (year old) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| User group | Area (ha) | 1 | 2 | 3 | >3 | Shoots | Av. Wgt. 1 shoot (kg) | Av. yield of shoots $ha.^{-1}$ |
| Bamasaba | 19 | 1937 | 2537 | 3925 | 5450 | 3487 | 0.18 | 627 |
| Basabiny | 117 | 1864 | 1353 | 2586 | 3377 | 3693 | 0.22 | 812 |

cause any significant effect on shoot production within 2 years time span. It should however be noted that because variation between plots was quite high, any small effects treatments may have had could easily have gone unnoticed. The high plot variation is illustrated by the fact that the coefficient of variation in effect after 1 year was >60%.

To be more certain of the results, it would be necessary to carry out a power analysis based on the information from this study, before another experiment was done. As with all experimentation, the greater the sample size, the more accurate the results. This experiment had a very small sample size, so the accuracy of results has to be doubted. It is also possible that the effects of treatment may take longer than 2 years to arise the plants may become tired after repeat harvesting. It is therefore, advised that the treatments should be repeated every year so, the experiment can continue over the longer term. The stem drying experiment showed that on average, stems lose 38% of their weight when dried, yet do not shrink significantly. Younger stems lose more water/stem when dried than older stems but they lose the same proportion of their total weight.

**Density and yield survey:** Using participatory methods, we carried out a density and yield survey. The survey was done in 3 blocks. The aim of this research was to assist the community user group to assess how many shoots are produced/ha; understand how these yields are influenced by harvesting and ecology; design a sustainable management. System and monitor sustainable management systems (Table 6).

Each block of bamboo forest was measured for its area. It was decided that from each, 2.5% of the total area would be studied as a representative sample. Therefore, 2.5% of land was calculated for each plot and the resulting area was made into plots measuring 10×50 m. The number of plots/block obviously depended on the block's total area.

The results of the study revealed that on average, the yield of edible bamboo shoots being produced/ha was 800 kg. By multiplying this figure by the land available for growing bamboo, the resulting figure should resemble the total amount of bamboo collected per annum. However, when this sum is carried out, there is a major discrepancy. The calculated yield per hectare, per annum, was 800 kg. Multiplied by 600 ha (the approximate total land area), the total annual figure should be around 480 ton. The actual figure of weight of shoots collected is only 50 ton a year. Therefore, there is a difference of 430 tons between yield and collection.

A poor yield can occur because bamboo is over-harvested. Obviously, the low collection figure indicates under harvesting as opposed to over harvesting, but there may well be instances of over harvesting. The extent to which a plot is harvested depends greatly on its location. The nearer a plot is to the village, the more likely the villagers are to go and collect from that plot. Furthermore, shoots growing in different plots become ready for harvesting at different times. The difference in time scale can be up to a few weeks. When the harvesting season has just begun, the first shoots sold get a much better price and as the season goes on and the shoots become more abundant, the price gradually drops due to the market pressures of supply and demand. This means that those plots which can be harvested relatively early tend to be over harvested, whereas those in which shoots develop later may not be harvested to their full potential as the price has become too low to make it worth selling.

The harvesting rate is frequent in, for example Bamasaba, which is located close to the village, but there is never any harvesting in Basabiny, which is located about 2 h away from the village by foot. Another reason why a block may not be harvested relates to quality.

The first concern should be the sustainable management of bamboo in natural stands by raising stakeholder awareness about the need for collaboration in handling the resource. Dialogue with the Uganda Wildlife Authority (UWA) should be initiated with the objective of replanting bamboo in the protected national park areas where it existed before, as a way of generating sustainable resources. The UWA should organize a proper monitoring and control of bamboo extraction and should be involved in setting up nurseries and plantations. This would also positively impact forest conservation and biodiversity.

Local communities should be encouraged and trained to sustainably manage the bamboo resources in the forests they use and become aware of the value of the material and the danger of depletion. They need to be integrated in proper rattan planning and management programmes.

Creating and developing improved market conditions in the urban centres is the first prerequisite for the establishment of an integrated bamboo industry. Training in business and entrepreneurship skills would enable producers to reap greater financial benefits from their products and to further develop their businesses. Higher quality products would find potential buyers in the export market, a market that is currently being emphasized by the government.

In Mbale, women are involved in bamboo collection, though not to the same extent as their male counterparts. In fact about a quarter of the collectors visited and interviewed in this study were women. Fifty seven percent of the collectors had attained at least primary education and only about 43% had not gone to school at all. Most bamboo collectors in this district are also farmers.

The harvesters work as individuals and do not own the harvested land, but still they do not have to pay access fees. On average collectors pay about Ush. 3500/= per annum to the market masters. Most of the harvesters interviewed see no need for instituting this fee, though they go ahead and pay. About four collection trips are made per month by teams comprising about 7 people. The team travels for about 5-7 km from the point of assembly to the source of the bamboo. The harvesters collect bamboo shoots, which are cut using pangas at about 1 m from the ground. They then chop off the hairy tip, which is not edible.

The harvest is transported on the head. On average, 30 shoots are collected per person per trip, with each shoot measuring about 1 m long and 3-4 cm thick. About 5% of poles are rejected due to pest damage. Bamboo is collected both for commercial and subsistence purposes. It is eaten as vegetable. The quantity of bamboo collected is influenced by factors such as the availability of capital, transport and seasonality of the bamboo shoots. Peak harvest takes place from April to July for edible bamboo. The peak harvest season for edible bamboo shoots takes place from April to July.

No transport or labour costs are incurred in bamboo collection in Mbale because the collection is mostly personal. Apart from the payment made to the market masters (3500/= per annum), collectors buy a box of matches at 50/= each and own a panga (annex 10). The edible bamboo is dried over a fire and this requires firewood, which is gathered from the forests. Shoots are sold direct to the consumers at local markets and beer communities at 40/= per shoot.

Most of the bamboo processors sampled in Mbale district are located in Busiu, Bundesi, Bukayemba, Sipi, Lukusi and Gamanyi. Processing activity however spreads to many other villages. Bamboo processing involves two stages. In the primary processing stage, all the side branches are removed and the bamboo is cut to size. It is then split, slivered and bundled. The tools used for this stage are pangas, knives, sickles and hammers. The secondary stage of processing involves the manufacture of handicrafts and furniture. In Mbale, processors mainly make bamboo beds and chairs.

There are very few cases of processors specialising in only primary or secondary processing. In both districts processors undertook both types of processing. Processors who manufacture end products also carry out primary processing but the actual processes carried out vary according to the type of bamboo and the products. Most processors work individually and on a part time basis. In Mbale processors work for 6 h for 4 days a week and devote 2-4 weeks of the month to processing. They work for 5-12 months of the year. Most processors are also farmers and earn most of their income from activities other than processing bamboo (e.g., trading, local artisan). Family labour is used in many cases but wives and children only assist in wetting the bamboo from time to time. When a weaver is handling a large order however, communal labour can be called upon. Processors learn the skills from family members and friends and it is from these people that they seek technical assistance. The skills are transferred via informal arrangements with families and friends. Lack of formal training opportunities limits progress. The labour costs are about Ush. 16,000/= per month, but vary quite widely depending on the product and processes involved in its manufacture. Raw materials mainly include bamboo stems and nails and the equipment used includes pangas, hammers, knives, saws and sand paper. The processors inputs include raw materials such as bamboo, nails, labour and equipment like panga, knife, plane hammer, saw and tape-measure.

## CONCLUSION

The harvesting of bamboo shoots in Mt. Elgon National Park is done on a small-scale for proper consumption and for commercialization on the market. A promotion of this vegetable in other parts of Uganda could develop a larger market for this NTFP in which women could be involved, generating income and a variation on the household diets.

Improved technologies should be introduced at the various stages of bamboo processing so as to increase efficiency in use of resource inputs. Adopt technologies to add value to bamboo crafts and other products combined with training and capacity building in bamboo utilisation. Ensure information on markets is available to the manufacturers. The village group has shown itself to be capable of improving income by better organisation of market-ing. The evidence suggests that management of collecting NTFPs for sale can reap greater financial benefits than agricultural production of maize and bananas, which is currently the main income source for many of the rural people in eastern Uganda. NTFPs, in this case edible bamboo, have been shown to be a good alternative to shifting cultivation. Through their collection, the need for slash and burn diminishes and can perhaps eventually disappear altogether.

A major advantage of sustainable NTFP development and particularly of edible bamboo, as an alternative to shifting cultivation, is that NTFPs are already known and harvested by villagers. Some of the proposed alternatives, such as contour farming are not known or understood. This could make setting them up extremely difficult, thereby making success less likely. The success of the marketing group has made villagers more interested in forest management. Rural people are now keen to try and establish a sustainable harvesting system through forest management and harvesting experiments.

The bamboo industry has not received policy support and remains a minor production commodity of no significantly appreciated economic development strategy. Yet evaluations and analysis elsewhere have shown that bamboo and rattan commodities of forest compositions have a high potential of contributing towards local regional development. It is therefore, urged that relevant actions be taken to tap available opportunities such as: articulation of NWTFP, including bamboo in the forest policy and legal actions; creating awareness on potentials of bamboo development and poverty eradication; improving the capacity of bamboo technologies and marketing opportunities; dissemination of available information and guidelines on management; focus on value adding through improved processing of bamboo products and focused development of on-farm bamboo farming for supply of target products such as bamboo shoots, poles and props.

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