AN ASSESSMENT OF THE VIABILITY AND POTENTIAL OF BAMBOO MICRO ENTERPRISES IN ENVIRONMENTAL CONSERVATION AND POVERTY ALLEVIATION IN NAIROBI CITY, KENYA

BY

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A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN URBAN ENVIRONMENTAL PLANNING AND MANAGEMENT

SCHOOL OF ENVIRONMENT AND EARTH SCIENCES

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ABSTRACT

Nairobi, Kenya's capital city has undergone rapid urbanization which has been associated with a number of development challenges. Key among these challenges is deterioration in urban environment and urban poverty. Bamboo is a fast growing, renewable, widespread, low cost, environment enhancing resource with great potential in environmental conservation and poverty alleviation. It has been established that bamboo has at least 1500 uses. Bamboo micro-enterprises (BMEs) have recently been put-up in Dagoretti, Kawangware, Karen, Gigiri and the city center of Nairobi, but their contribution to livelihood incomes and environment conservation had previously not been established. Therefore, the objectives of the study were to: explore the sourcing, processing of bamboo as well as the selling and marketing of bamboo products; determine the contribution of BMEs to livelihood incomes; examine the contribution of BMEs to urban environmental conservation; and assess factors influencing the sustainability of BMEs. Snowball sampling was used in primary data collection using questionnaires and interview schedules. A total of 13 key informants were interviewed and 60 questionnaires were administered to proprietors, employees, traders, customers. In addition, observations and photography were also used in data collection. Secondary data were collected from text books, scientific journals, periodicals, reports, published and unpublished theses, International Network for Bamboo and Rattan (INBAR) data bank and Internet. Quantitative data were analysed using descriptive statistics such as means and percentages. Qualitative data were organized and then categorized into themes and patterns, and then the usefulness of the information was evaluated in answering research questions. The study established that the BMEs are providing employment to urban residents who would otherwise have been unemployed and poor; bamboo was also used in several environmental rehabilitation and conservation initiatives in the city. The bamboo nurseries provide bamboo seedlings for aesthetic uses in the residential areas and city centre for beatification and greening programmes; they also provide seedlings for the city afforestation programmes. The bamboo *jua kali* (furniture and artifact) sector provides items from a sustainable renewable resource with minimal and bio-degradable wastes. The study revealed that the sustainability of the BMEs is influenced by ecological, economic, socio-cultural, technological and political/legal factors. Bamboo is a versatile crop with many uses. It is a high-yield natural resource and a viable replacement for wood in many scenarios. Bamboo in the BMEs was sourced mainly from the outskirts of Nairobi, was processed using simple technology and bamboo products were sold without formal marketing strategies. The bamboo sector is fairly new and has many untapped opportunities and the government needs to be more proactive and facilitate its citizens in exploiting the sector. More women need to be sensitized and recruited into the BMEs so as to start their home businesses such as weaving and making toothpicks and skewers.

1 CHAPTER ONE: INTRODUCTION

1.1 Background to the study

Bamboo is a fast growing, renewable, widespread, low cost, environment enhancing resource with great potential to improve poverty alleviation and environment conservation (Xuhe, 2003). Bamboo can be utilized at all levels of industrial activity from small craft based industries to modern highly integrated plants. Bamboo industry is making important contribution in providing food, housing and income generation for 2.2 billion people in the world. Half of the world's population is involved in the use and trade of bamboo products. As the market for environment friendly green bamboo is growing, it is estimated that the world bamboo market will grow from its present size of USD10 billion to over 20 billion by 2015 (Xuhe, 2003).

Worldwide, various bamboo products provide high income levels. For example, the global market for bamboo products is approximately USD 7 billion which is expected to triple by the year 2017 (Smith and Marsh, 2005). In China, bamboo has been used in many projects in rural areas to alleviate poverty and conserve the environment (Zhu, 2006). From the small organized microenterprises, China gets to package and market its bamboo products for export. China's annual export value from bamboo products is estimated to be more than USD 600 million, with the total value of bamboo industries estimated to be 12 billion (Smith and Marsh, 2005). Several counties have shown strong growth related from bamboo cultivation and processing and bamboo projects are being encouraged for rural poverty alleviation in several provinces (Zhu, 2006). Asia has recorded 1500 uses of Bamboo, (RELMA, 2003; Madhab, 2003), whereas in Africa, possibly due to lack of awareness, bamboo's great potential is rarely exploited. About 14 million hectares of bamboo cover exist in the world, out of which 80% is distributed mainly in Asian Tropical Region (Sharma, 1980). India has about 8 million hectares that provide 60% of its massive population requirements and meet much of its commercial timber needs (ICRAF, 2004).

On the other hand, Africa has a total of only 1.4 million hectares of bamboo, much of which is distributed over Eastern Africa. Ethiopia's bamboo resources contribute 67% of the total bamboo in Africa (Xuhe, 2003). In Kenya, bamboo covers about 150,000 hectares, which are either in pure stands or mixture with trees and shrubs and is of indigenous *Yushania alpina* formerly known as *Arundinaria alpina* and 20 introduced (exotic) species (Kigomo, 2007). The indigenous bamboo species is mainly found in gazetted indigenous forests and small proportions are in farmlands.

Kenya Forestry Research Institute (KEFRI) in collaboration with Asian Research and Development Institutions has since 1986 carried out research on bamboo species selection and growth. Through this research initiative, over twenty Asian bamboo species have been introduced into the country. Some of these are successfully growing in the field and on-farm in the rural areas of Western, Central and Coastal provinces of Kenya (Kigomo, 2007). Some of the species tried in Kenya include: *Bambusa brandisii, Bambusa vulgaris var. striata, Bambusa tulda, Dendrocalamus membranacea, Gigantochloa aspera, Oxytenanthera abyssinica* and *Thysostachys siamensis* (Kigomo, 2007).

There are some constraints to the development of the bamboo sector in Kenya. According to the Forestry Department, bamboo is classified as a minor forest product (Ongugo *et al*, 2000). This has slowed the recognition and development of this resource. There has been a slow but steady progress in the cultivation of exotic bamboo in Kenya. Brias (2006) noted that farmers have been increasingly showing interest in bamboo and large companies are considering bamboo as a biomass alternative to timber species. This has led to bamboo enterprises gradually being grown in several major towns in Kenya such as Nairobi, Kakamega, Nakuru and Malindi. So far some 48 local uses of bamboo have been recorded in Kenya (Ongugo *et al*, 2000) such as providing raw materials for many activities such as production of incense sticks, toothpicks, food and forage, water harvesting, medicine, supports for commercial flower growing, tea picking baskets and making handicrafts (see Appendix 3). These activities provide job opportunities and entrepreneurship to the poor rural population (Ongugo *et al.*, 2000). Furthermore, bamboo is used for fencing and construction and constitutes a potentially vital source of

raw material for the pulp and paper industry. Statz, (2007) identified a number of bamboo microenterprises found in Nairobi City. These ranged from unregistered home-based toothpick makers and weavers, roadside *jua kali* artisans to a small scale registered microenterprise.

1.2 Statement of the problem

Nairobi, Kenya's capital city is expanding rapidly both in human population, buildings and infrastructure. The city faces many problems such as mushrooming of slums, environmental degradation, unemployment and urban poverty (CCN, 2007). Due to inadequate opportunities in acquiring formal employment, many people set up informal enterprises such as Bamboo micro-enterprises (BMEs) to earn a living. However, the potential of BMEs in improving livelihood incomes has never been established in areas where they are practiced such as Dagoretti, Kawangware, Masai market, city market and Karen market center.

Moreover, Nairobi has many environmental concerns such as pollution of the Nairobi Rivers, air and noise pollution (GOK, 2008). Bamboo microenterprises such as bamboo nurseries have been used to promote rehabilitation of degraded areas and enhancing environmental aesthetics. KEFRI and BMEs along Gigiri roadside, among others have been selling bamboo seedlings, but their contribution in environmental conservation in Nairobi is unknown.

1.3 Objective of the study

The overall objective of the study was to assess the potential of existing bamboo micro enterprises in urban environmental conservation and alleviating urban poverty in Nairobi city.

Specific objectives of the study were:

i. To explore the sourcing and processing of bamboo as well as marketing of bamboo products.

ii. To determine the contribution of bamboo microenterprises to household livelihood incomes.

iii. To examine the contribution of bamboo micro enterprises to urban environmental conservation.

iv. To assess the factors influencing sustainability of bamboo micro enterprises.

1.4 Research Questions

i. How do the bamboo microenterprises source, process raw bamboo, market and sell their products?

ii. Do the bamboo microenterprises contribute to household livelihood incomes?

iii. How do the existing bamboo microenterprises contribute to urban environmental conservation?

iv. What are the factors influencing the sustainability of bamboo micro enterprises?

1.5 Justification of the study

Bamboo is a fairly new but emerging sector in Kenya. The government through KEFRI and KFS is encouraging its domestication. This study provides information on the potential of BMEs in enhancing the environment conservation and alleviating urban poverty in Nairobi city. The information obtained can be used as a basis for further research on the position of BMEs in alleviating poverty and conserving the environment. It is also helpful in the development interventions in the bamboo industries in urban areas.

1.6 Scope and Limits of the Study

This study was carried out between December 2008 and March 2009 in Nairobi city, Kenya. The city is currently facing challenges such as environmental degradation and in some areas poverty (CCN, 2007) with almost half of the population in Nairobi being estimated to be poor. The study has focused on poverty of money, where the urban minimum wage is Ksh.7, 578 per month (Wikipedia, 2010). The subject of the study is

bamboo micro enterprises which includes bamboo nurseries and bamboo processing and selling centers. Government departments, research institutes and NGOs running programmes on or related to bamboo were also sampled. This study has focused on the potential of BMEs in enhancing the urban environmental conservation and alleviating urban poverty. Problems encountered during the study include:

- Locating most of the BMEs was challenging as they were illegal and could close down whenever they felt threatened by the city council authorities.
- Some BMEs were not sampled as they felt they would be revealing sensitive information to their business rival.
- Most of the BMEs also did not have receipts on purchases and sales made; similarly, there was no documentation on payments made to employees or money earned by the BMEs. Therefore, the study only relied on what the respondents said.

2 CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter examines previous studies that are related to bamboo microenterprises. It highlights what has been done on related issues; lessons learnt and identify critical gaps existing. The chapter has been divided into four major sections and three sub-sections. The first section examines studies on the sourcing and processing of bamboo as well as marketing and selling of its products. The second section reviews studies on bamboo's contributions to household incomes. The third section examines the contribution of bamboo microenterprises in environmental conservation and the fourth section looks into the factors affecting the sustainability of the bamboo microenterprises. A conceptual framework that forms the foundation of this study is illustrated on the fifth section and, finally, a summary of the literature gaps is given on the sixth section.

2.2 The sourcing, processing and marketing of bamboo and its products

The utilization of bamboo has a very long history in the world, particularly in Asian countries but also in Africa and Latin America. Especially where it was available as the main plant and was used as a substitute for wood in many cases. In Kerala, India village based bamboo microenterprises were set up which utilized bamboo from nearby forests or home yards (Blowfield *et al.*, 1995). Traditional bamboo products include paper, construction and housing materials, household tools, handicrafts, furniture, weavings, carvings, and boats. Bamboo housing and construction materials from the large Latin American species, *Guadua angustifolia,* were also an important part of culture in countries like Colombia and Ecuador. Widenoja (2007) noted that Industrial processing of bamboo began first in India and China with pulp production for paper making. The first bamboo paper was made around 100 AD in China and the first paper mill was established in the 6th century. These early bamboo processing plants utilized bamboo as it was the dominating plant in their regions.

The bamboo sector in Kenya is not well established compared to the situation in most of the Asian countries. In a study on the production-to-consumption system (PCS) of the bamboo sector in Kenya, Ongugo *et al.* (2000) identified potential development interventions for the improvement of the livelihoods of the local people. Bamboo was also identified to be an environment enhancing grass with potential of rejuvenating degraded land. The study was done in the rural and peri-urban areas, the conclusions of the study were however drawn from the rural perspective, and i.e. bamboo in Kenya enhances rural livelihoods. So far there has been little or no research done on the development of BMEs in urban areas.

Statz (2007) analysed the current value-added chains of bamboo for Eastern Africa Bamboo Project (Kenya) and identified options for their development. Each value chain comprised of four elements design/product development, production, marketing, and consumption. Statz (2007) gave a profile, sourcing, sales and market of various bamboo enterprises in Kenya, but did not look into their contribution to livelihood incomes and environmental conservation.

2.2.1 Bamboo and poverty alleviation

Bamboo is a woody grass which occurs naturally on major continents except Europe (Oberoi, 2004). Bamboo is a grass, biologically, but a grass of great diversity and utility more closely related to trees in its use and appearance than other grass. There are about 1600 species of bamboo in the world, distributed across 111 genera (Oberoi, 2004). Bamboo is strong, versatile, highly renewable material- one that people and communities have known and utilized for thousands of years. INBAR (2007) reported on studies it has done in Asia, central and South America that have indicated bamboo's advantages from a livelihood perspective. The advantages include first, it can be harvested annually and non-destructively. However, clear cutting is detrimental to the stands but selective harvesting increases productivity. Secondly, bamboo establishes quickly with the first harvest generally available in 3-4 years or in some cases even in two years. Stand maturity is generally reached in 5-6 years at the most. Thirdly, the investment required for establishing a bamboo plantation is quite low compared to most commercial tree

species. Lastly, the plant regenerates itself and continues to yield for long periods, dozens of years in most cases and often up to 50 or 70 years.

In his study, Abdulaziz (2006) reported on the impact of bamboo economy on poverty alleviation in Ileje District, Tanzania. The results show that bamboo trade was a strategy to alleviate poverty which had manifested in the region. The immediate out-come of this strategy has been poverty alleviation among households engaged in bamboo trade. The bamboo goods were exchanged with commodities like rice, beans and millet that were easily stored. Also, most households indicated that they acquired the skills of making bamboo goods by inheriting from parents and grandparents (54.2%) and others acquired through training after realizing that bamboo goods trade is profitable (45%). The most popular period for making and marketing bamboo goods is in the dry season when the agricultural activities have been reduced to a minimum. Abdulaziz (2006) revealed that bamboo trade is employing a reasonable proportion of the population in Ileje District and it is a good source of income that helps to alleviate poverty in the district. The study was done in a rural setting in Tanzania; however, there is need to research on whether bamboo products can alleviate poverty in urban areas.

2.2.2 Bamboo Micro-enterprises and household livelihood incomes

Many countries have large bamboo resources in public forests, while others could easily cultivate bamboo resources either as a new plant or by reintroducing threatened native species (Sharma, 1980). INBAR (2006) indicated that livelihood strategies for the rural poor often include the use of bamboo for housing, utensils, and the collection of bamboo timber or shoots for sale all in the informal sector. INBAR (2006) also noted that much processing of bamboo is done at home, which is optimal for increasing income opportunities for women and children. Beyond traditional handicrafts and furniture, the weaving of mat boards, which have industrial uses, is an example of a promising activity for generating income in the home in India. However, the supply chain and market needs to be developed further. Promotion of bamboo cultivation and subsequent income generating activities by the government has boosted the bamboo sector.

Muchuan County, a poor area in China began promoting and developing the bamboo paper industry in the 1990's (Zhu and Maxim, 2006). Average income was still lower than USD 1 a day, at about USD 237 per capita, but the income from bamboo cultivation brought a 33.8% increase in the per capita income for farmers after a 13 year period. A County specializing in bamboo cultivation for weaving products, Xinyi County in Guangdong, had a total output of about USD 117 million in 2003 and exported USD70 million of that to markets in Europe, North American and Southeast Asia. Poverty statistics were not available, but the bamboo enterprises directly employ 5,100 people and the bamboo sector is estimated to involve at least 50,000 people (Zhu, 2006). These studies show that bamboo whether cultivated or from natural forests has huge potentials to increase household livelihood incomes. However, in China the bamboo boom has been on for many decades unlike Kenya, where the sector has been dormant. Kigomo (2007) recognized that there is good potential to raise bamboo plantations as a business in homestead farms, commercial plantations or agro forestry in Kenya. He reported that most processing activities of bamboos can effectively employ a low skilled rural labour force.

According to Blowfield *et al.* (1995) in many rural villages of India, clumps of bamboo are owned and managed by local people alongside food crop and trees. However middle-income households were more likely to benefit from bamboo farming compared to poor farmers and women. This was because poor farmers preferred to work on food crops and obtain direct benefits. As for men, they went to seek waged employment which prevented them from working in their home gardens.

2.2.3 Acceptability and competitiveness of bamboo products

For the BME's to alleviate poverty in Nairobi, their products have to be sold i.e. there has to be a market for bamboo products. A market is a set of potential and actual buyers and sellers of a product or a service with facilities to communicate with each other (Kotler, 1994). Worldwide commercial bamboo utilization is reported to be 20 million tons per annum. Total revenues from bamboo and its products were estimated in the 1980s at USD4.5 billion. The Chinese market for bamboo products and cultivation has been

developing rapidly since the market reforms of the 1980's. Although the Chinese government has supported bamboo plantation development since the 1950's, the potential of the plant for development only became evident after market and legal reforms have given the sector a boost (Widenoja, 2007).

In Kenya, the bamboo industry is fairly new, and its development is held back mainly by a ban on bamboo harvesting and utilization, making bamboo items rather unknown to many people. Kibwage *et al.* (2007) examined the structure and performance of formal retail market of bamboo products in Kenya with specific reference to market segments in Nairobi, Mombasa and Kisumu cities. The study revealed that most of the bamboo products (toothpicks, baskets, bowls, table mats, trays, skewers, flower vases and edible shoots) sold in the formal retail market is imported from China, India and Thailand a scenario that results in high market prices and low demand for the products, thus the need to encourage domestic production of the products especially in urban areas.

2.3 Bamboo and Environment Conservation

Bamboo is the world's tallest grass. Hunter (2003) has called it the wood of the future as it is the fastest growing grass with domestic, agricultural, environmental and industrial uses. Bamboo has been identified as the second largest sustainable forest resource (Brias, 2006), which has begun to show its significance in people's daily production and life. A study published by ICRAF (2004) revealed that bamboo absorbs water faster than most plants and in some parts of the world is used to clean sewage. Even more importantly, it soaks up heavy metals. It is a potential answer to polluted waters in Kenya, including those of Lake Victoria whose shores are dotted with large urban centers that discharge domestic and industrial waste into its waters. It is nature's fastest-growing woody plant, with some species achieving the phenomenal growth rate of one meter a day. Its culms (poles) are the strongest and lightest natural material known to man. ICRAF (2004) reputed bamboo's versatility in environmental conservation and commerce and recommended it to be a viable replacement for both hardwoods and softwoods. With a growth rate three times that of eucalyptus it matures in just 3 year. Moreover, the study further revealed that bamboo is very effective in controlling soil erosion as its rhizomes can anchor topsoil along steep slopes and riverbanks. Bamboo leaves, sheaves and old

culms that die and fall to the ground decompose and create a thick humus layer that enriches the soil.

Bystriakova *et al.* (2003) reported on a 2003 joint study between the UNEP and INBAR which showed that more than 400 bamboo species (about one third of the total species) are threatened by deforestation. Beyond the need to protect the biodiversity of the bamboo species however, bamboos are an important element of many ecosystems and bamboo forests are often indicators of areas with high biodiversity. According to Bystriakova *et al.* (2003) bamboo is often used for soil conservation and enrichment and watershed protection purposes. It also provides a favorable environment, particularly in mixed forests, for many types of wildlife. In China, 3 million hectares of bamboo forests distributed in high mountainous regions, in the Yangtze River watershed and in plantations along riverbank, lakes and sea shores help protect natural ecosystems as well as providing habitat for wildlife, the most famous variety of which is the giant panda.

Bamboos often flourish in moist or tropical old-growth forests and have been associated with the livelihood of a number of threatened plants and animals. Beyond the giant panda, some of these species include the red panda, the Himalyan black bear, the smallest known bat—which roosts in the bamboo species *Gigantochloa scortechinni*—and more than 15 Asian birds and several little-known invertebrates. Bystriakova *et al.* (2003) further noted that the extensive rhizome system of the bamboos, found mainly in the top layers of soil, is one of the main reasons for its positive effect on soil stabilization and securing hydrological functions of catchments and rivers. In many Asian countries, bamboo's environmental conservation potential has been known and is fully exploited. However, in Kenya and Nairobi in particular the ability of bamboo in environmental conservation is yet to be assessed and exploited.

2.3.1 Bamboo microenterprises and environmental conservation

Bamboo is a beautiful, resistant, flexible and versatile material that can be produced in an environmentally-friendly, renewable and sustainable manner. There is no doubt in the many benefits that bamboo and its products can provide (Vantomme *et al.* 2003). In India

for example, bamboo plantation projects were established as part of a development project from 1995 to 2003 on land degraded by decades of brick mining. Meanwhile, the farmers organized themselves into village based BMEs and benefited by selling bamboo culms and shoots from the plantations. The degraded land which had only supported grass in 1995 had been converted to bamboo plantations and some farmers had been able to resume farming on the rehabilitated soil by 2003 (Kutty and Narayanan, 2003). The extensive rhizome system of the bamboos, found mainly in the top layers of soil, is valuable for its positive effect on soil stabilization and securing hydrological functions of catchments and rivers.

In another study, Zhu (2006) noted that the bamboo plantations in the successful Lin'an County were mostly planted on degraded waste and sloping lands. The resulting forests had a favorable impact on the community: processing through village based BMEs boosted the local economy, tourists were also attracted to the bamboo hillsides, and the water and soil quality were improved. He also noted that experiments showed that the water and soil improvement capacity of bamboo plantations are 1.5 times that of the Masson's pine (*Pinus massoniana*), and 1.3 times that of Chinese fir (*Cunninghamia lanceointa*). It is evident from the above examples that bamboo has been used in other countries to boost both environmental conservation and at the same time earn an income to the local communities through village based BMEs. However, the studies Bystriakova (2003), Kutty and Narayanan (2003) and Zhu (2006) were all carried out in rural areas where it can be assumed there is a lot of space for forestry unlike urban areas with more infrastructures.

2.4 Factors influencing the sustainability of bamboo micro-enterprises

Bamboo microenterprises have been proven to alleviate poverty and enhance the environment in many previous studies such as Jiafu (2001) in China, Abdul-Aziz (2006) in Tanzania, Blowfield *et al.* (1995) in India and Vantomme *et al.* (2003) in Italy. In Kenya, bamboo has one native bamboo species *Arundinaria alpina,* which has existed for a long time and 20 other species have been introduced by KEFRI to suit different climatic zones and potential different uses (Kigomo, 2007). The sustainability of the BMEs and ability to meet their goals are constrained by many factors. Jiafu (2001) identified factors

affecting sustainability of the bamboo industry in China. From a microscopic perspective he observed that the bamboo forests are not well managed and could be perishing. In general he said that the potential productivity, value-added processing and ecological function of the bamboo forests in china had not been brought into full play. With regard to macroscopic management, Jiafu (2001) noted that state level administrative departments are not providing professional management to bamboo forests in China. He stated that the industry is heavily taxed and that discourages the bamboo farmers and thus negatively influences bamboo and shoot processing. As much as Bamboo associations exist, Jiafu (2001) argued that they had not been fully utilized. In Kenya, the development of the bamboo industry is also constrained. Blowfield *et al.* (1995) observed that the socio-economic status of someone prior engaging himself in a bamboo based village enterprise will determine the sustainability of the business. Middle class farmers who owned land and could plant bamboo would benefit more and were likely to sustain their businesses poor farmers who had to go seek waged employment to complement what they earned from their farms. It was pointed out by Uravu (2009) that the human potential (such as availability of prior skills, real need for employment and income, cohesiveness of a BME) and environmental potential (such as access to raw materials in the proximity of the units, assistance from the government for infrastructure and additional working capital etc.) could be a crucial yardsticks for the sustainability of the BMEs.

Kigomo (1988) had earlier observed that according to the Forestry Department, bamboo is classified as a minor forest product which slowed the recognition and development of this resource. Other factors affecting the development of the bamboo resource in Kenya include; the ban on harvesting, lack of awareness on its potential, production of unprocessed or semi-processed products, poorly developed marketing structures, lack of information on availability of planting materials, lack of information on the methods of propagation, establishment, crop management and harvesting (Ongugo *et al.*, 2000). It is, therefore, clear from the above studies why as much as bamboo is versatile; its potential is largely hampered by many external factors.

2.5 Conceptual Framework

The effects of bamboo micro enterprise on environment conservation and poverty alleviation are multifaceted. They operate indirectly through several channels and depend on a variety of conditioning factors. This section presents simplified conceptual frameworks of the relationship between Bamboo micro enterprises environment conservation and poverty alleviation.

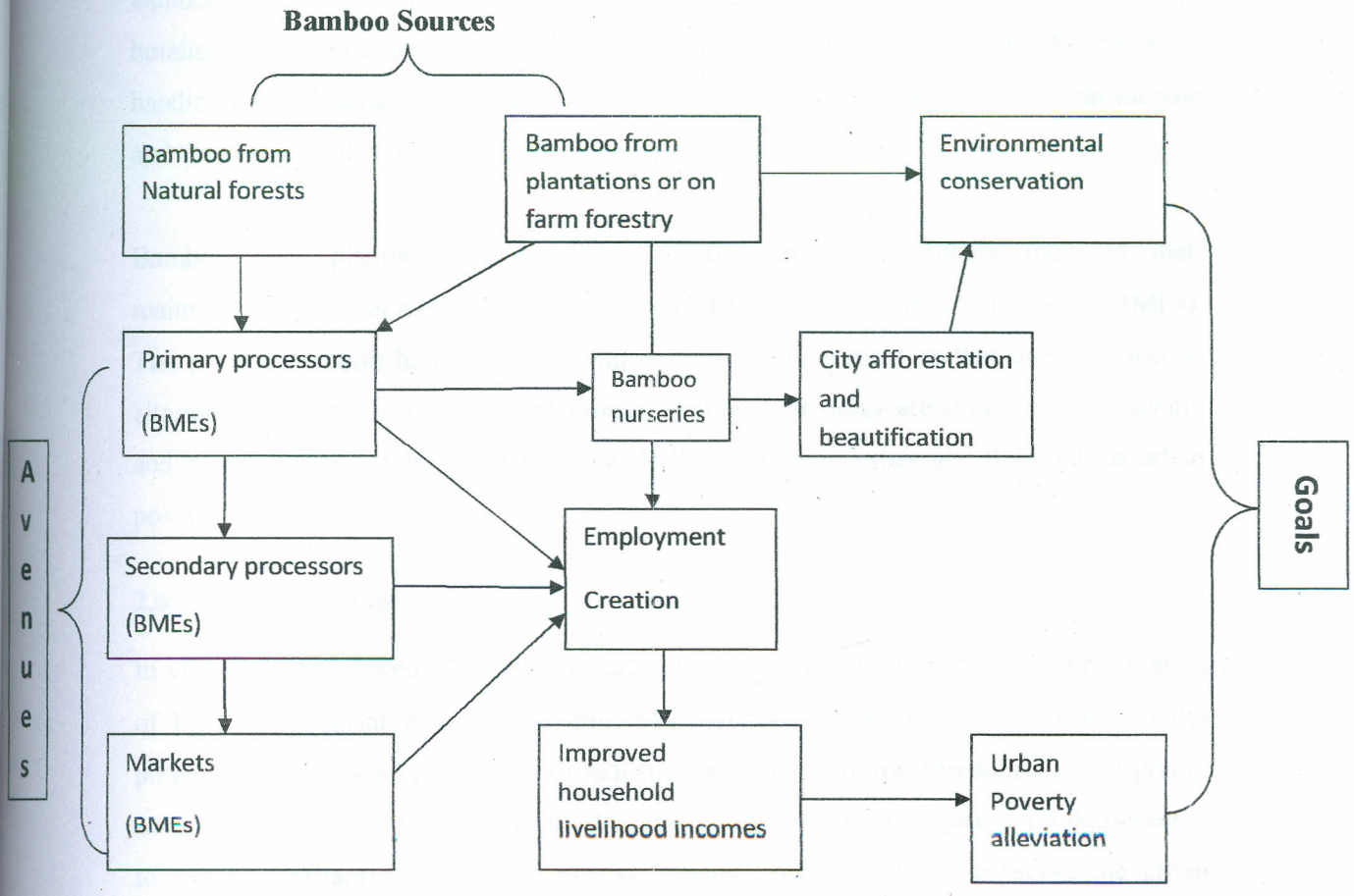

Figure 1 Conceptual Framework

Modified and Adapted from Ongugo *et al.* (2000)

Bamboo for use in the microenterprises is obtained mainly from the natural forest and partly from on-farm forestry. The bamboo from natural forests is either illegally, or legally harvested from the forests and sold to timber yards or other kinds of Bamboo micro enterprises (BMEs). Bamboo from farms is also sold to the BMEs. The primary

processors are mainly bamboo/timber yards whose main activity is to store and sell bamboo and bamboo nurseries that propagate bamboo seedlings. Secondary processors include artifact makers, toothpick makers and bamboo furniture. BMEs are adopted in the urban areas as they provide informal employment to the urban dwellers, most of whom would have been unemployed. The employment channels include bamboo nurseries, where seedlings can be sold to afforestation and beautification programmes, bamboo handicrafts, where items have a wide market range like individuals, tourists, hoteliers and home owners and bamboo agro forestry, which can supply culms to handicraft manufacturers. The BMEs at all levels create employment, provide an income and thus help to alleviate poverty.

Bamboo from plantations or on-farm forestry also creates employment to their maintainers and is an addition to the supply of bamboo for bamboo processors (BMEs). The planted bamboo helps in conservation of the environment in that they provide an alternative to bamboo from natural forests. Bamboo seedlings are sold for city greening and beautification. Jobs created by the BMEs provide incomes and thus reduce urban poverty.

2.6 Literature gaps

In view of the reviewed literature no studies have specifically been done on the potential of BMEs in alleviating urban poverty. Most of the studies done have examined the potential village based enterprises or industries in improving rural livelihoods, but giving no attention to urban livelihoods. Studies have also been done to determine its potential to restore rural/agricultural lands and no studies on its ability to conserve the urban environment. This therefore intrigued the researcher to carry out an investigation to determine the potential BMEs have in conserving the urban environment and alleviating urban poverty.

3 CHAPTER THREE: METHODOLOGY

3.1 Introduction

This chapter gives a description of the study area, it show the environmental profile of Nairobi city. The chapter then shows the research design, sampling procedures and data collection methods that were used in the study. Finally, the data analysis and presentation procedures are laid out.

3.2 Study Area

3.2.1 Nairobi city

Nairobi is the capital and largest city of Kenya. It takes its name from the Maasai phrase "enkare nairobi", which means "a place of cold waters". The area was originally grazing land and a livestock watering point and there was no permanent African settlement.

Figure 2 Location of Nairobi city in Kenya

(Source: Google maps 2010)

The city is located at 1°16'S 36°48'E and occupies around 150 km². It is situated about 1660 metres (5450 feet) above sea level (Figure 2 shows location of Nairobi in Kenya). Nairobi city has been identified by Ongugo *et al.* (2000) to be the leading town in the country in bamboo processing and selling. During the study, BME's that were sampled were located in the following areas of the city;

3.2.1.1 Dagoretti Corner

Dagoretti Corner is heterogeneous economically with a few relatively affluent land owners, a large body of laborers' artisans and subsistent workers who supplement cash employment with subsistence farming activities. There is also a growing population of landless mostly unemployed squatters who lack substantial resources or family ties in the area. Most of their houses are dilapidated and built with wood, which is unsustainable as they need constant repair. The settlement is congested with dilapidated buildings built using timber and iron sheet. Garbage is disposed on paths along the congested neighborhood. This diverse neighborhood hosts Zach's handicrafts, a family bamboo micro enterprise which makes mainly bamboo furniture.

3.2.1.2 Kawangware

Kawangware another big slum is located west of Nairobi, in Dagoretti division along Naivasha road and is estimated to host about half a million people (CCN, 2007), more than half of them are aged between 15 and 30 years and are unemployed. Kawangware has a very vibrant market centre which is mainly a source of employment for the area residents where they sell in small shops, eateries and many wood depots some of which stock bamboo too. The wood hardware stores are facing low supplies (sometimes they run out of supplies) are very high prices of wood/bamboo, their profit margins are reducing and thus the businesses and livelihoods are threatened. Kianda Mbao enterprise is a wood/bamboo culm depot in Kawangware. There are a total of around 300 small to medium sized timber yards in greater Nairobi.

3.2.1.3 Karen shopping centre

Karen is among the high income settlements in Nairobi with affluent environmentally conscious residents located south of Nairobi city centre in Kibera division. Most homes

have large compounds which have been adorned with many types of trees. Karen shopping centre provides employment to many poor people from neighboring slums. Among the type of stalls in the market are many curio and house decoration shops which stock items that could add up to the environmental degradation of the city in terms of pollution with plastics. Bamboo curios and weavers is one of the BMEs whose show room is located in Karen Shopping Centre.

3.2.1.4 KEFRI Forest Products Research Centre, Karura

KEFRI's Karura Forest products research centre is located in the Northern part of Nairobi. The bamboo related activities in the centre include the development of sample bamboo products in view of an expected boom in bamboo utilization once the ban on the cutting of bamboo will be lifted. Producing and selling bamboo furniture is also to become a commercial activity in line with the revenue generating policy of the centre.

While the KEFRI headquarters in Muguga wants to improve cultivation and management practices, the centre in Karura sees its mission in developing bamboo products for the Kenyan context. The centre is not a BME in itself; however, casual laborers have been employed in the bamboo nurseries and bamboo processing workshops. These were sampled because bamboo was an income generating activity in the centre. Bamboo experts and policy makers in the centre were also sampled.

3.2.1.5 Gigiri

Gigiri is a high income settlement area in the North west of Nairobi separated from Nairobi city centre by the 2,500-acre Karura Forest and several low, wooded hills, Gigiri houses both the United Nations (UN) complex and the new United States embassy. The area is popular with humanitarian workers and diplomats, drawn to the wide, leafy streets lined with impressive houses, all in an acre or more of landscaped gardens. This area also provides unskilled employment to many poor people from the neighboring slums.

3.2.1.6 Masai market

It is situated within Nairobi city. It is a mobile market i.e. it is found in different areas of Nairobi on specific days of the week. It is stationed in shopping malls in the outskirts of town on Fridays at the Village Market, on Sundays at Yaya Centre, on Tuesday in Capital centre on Mombasa road and Saturdays in the city center by the law courts. The market sells artifacts with an African but mainly Kenyan touch. The products are normally made from natural material like wood, horn, bones, cloth and even bamboo.

3.2.1.7 City Market

City market is located along the Muindi Mbingu Street in Nairobi City centre. The market sells a variety of goods including groceries; it, however, has a section dedicated to artifacts. Most of the traders are retailers buying their products from middlemen who obtain them from various parts of the country.

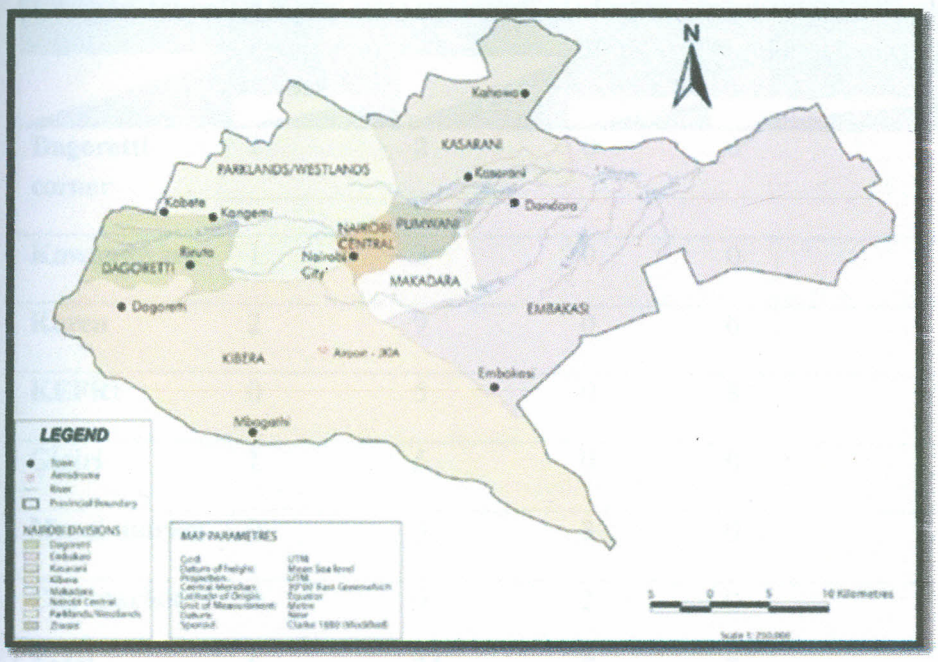

Figure 3 Divisions of Nairobi City

(Source: Google maps 2010)

3.3 Research Design

The study undertook an exploratory cross sectional survey. This method was used as the research topic is relatively new and has previously scarcely been studied in Kenya. People involved in various aspects of BMEs were carefully selected using snowball sampling as respondents to ensure a representation of their different types of experience. Relationships between various stakeholders in the BMEs were linked and their contributions to environmental conservation and livelihood incomes established.

3.3.1 Sampling Procedures

3.3.2 Sample Population and Sample Size;

Primary data was collected from bamboo micro enterprises scattered across Nairobi city. Individual respondents were purposively selected to fit study objectives and interviewed. The table below is a summary of the sampling frame.

Table 1 Sampling frame

Category/Area	Employer/ Proprietor	Employees	Traders/ Retailers	Policy makers/Experts	Customers	Study Population/ Sample size
Dagoretti corner	1	2	0	0	2	5
Kawangware	1	3	0	0	0	4
Karen	2	9	0	0	4	15
KEFRI	0	5	0	8	0	13
Gigiri	1	5	0	0	2	8
Masai market	0	0	3	0	13	16
City market	0	0	2	0	3	5
Total	**5**	**24**	**5**	**8**	**31**	**73**

3.3.3 Sampling Strategy

Using snowball sampling, responded were identified and data was obtained from the various categories of respondents in the bamboo industry i.e. bamboo micro enterprise proprietors, employees, retailers, bamboo experts and policy makers and bamboo customers.

3.4 Data collection

The study depended on primary and secondary data. Secondary data was collected from text books, scientific journals, periodicals, reports, published and unpublished theses, International Network for bamboo and Rattan (INBAR) data bank and Internet. Primary data was collected using the following data collection tools;

3.4.1 Questionnaires and interview schedules

Questionnaire and interview schedules with structured and semi structured questions were administered to employees of the various bamboo micro enterprises and bamboo traders/retailers. The questionnaires and interview schedules were extensively pre tested for clarity and comprehensiveness (Appendix 1A to 1F).

3.4.2 Key informant Interviews

Interviews with major stakeholders like enterprise proprietors, policy makers and bamboo experts were done to get an exceptional and in depth perspective of issues; this also helped bring out the factors affecting the sustainability of bamboo micro enterprises in Nairobi City (Appendix 1D&E).

3.4.3 Observations and photography

This method consists of systematically observing and documenting BME activities in their natural setting. This helped to verify the information given by the respondents and to understand the real situation on the ground. Photographs were taken to capture images significant to the study. Photos were taken to highlight:

- Bamboo micro enterprise Centers/workshops
- Production and processing activities

- Bamboo products
- Bamboo afforestation activities
- City beautification using bamboo
- Selling of bamboo items

3.5 Data analysis and presentation

Both qualitative and quantitative techniques were used in data analyses. This is because some objectives require in depth information (qualitative) while other objectives need quantitative data for drawing analysis and conclusions.

After data collection, the questionnaires were checked for completeness, cleaned and coded to represent specific responses to specific questions. Quantitative data was analysed using descriptive statistics such as means and percentages. For qualitative data the researcher created notes of the outstanding points; field notes were edited and cleaned up as the researcher is organizing the work, it was then cartegorised to themes in line with study objectives and the data were analysed. The results were presented in form of text, table, charts and photographs.

- Bamboo products
- Bamboo afforestation activities
- City beautification using bamboo
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4 CHAPTER FOUR: RESULTS AND DISCUSSIONS

4.1 Introduction

The results and discussions of this study have been divided into four major sections. The first section provides the results and discussions on the sourcing and processing of bamboo as well as marketing and selling of bamboo products. The second section shows the contributions of bamboo microenterprises to household livelihood incomes, the third section examines the contribution of bamboo micro enterprises in Nairobi to urban environmental conservation and finally the last part present the factors influencing sustainability of bamboo micro enterprises in Nairobi city.

4.2 The sourcing, processing and marketing of bamboo and its products

Bamboo micro enterprises (BMEs) are a type of small and micro enterprises (SMEs) that make items out of bamboo or informally sell bamboo items. From the BMEs, it was observed that the activities are largely undertaken by self-employed persons. Sometimes they consisted of employers with few workers in the open markets, in market stalls, in both developed and undeveloped premises. Some are done in residential houses or on street pavements as also observed earlier in 2003 by the Labour Force Survey. BMEs on average employed five people, with almost all of them employing less than ten people. Most of the BMEs are not registered as the entrepreneurs find registration expensive. The list of key respondents and their cell phone numbers' is given in appendix 2.

The Bamboo Microenterprises (BMEs) sampled obtained their bamboo for processing from farms in Limuru and Murang'a while others bought bamboo from bamboo/timber yards within Nairobi. There were no outstanding marketing strategies observed as was previously documented by Statz (2007) and selling was done on small scale. Most of the BMEs sampled are not registered as the entrepreneurs find registration expensive; Mitulla (2003) explained that business licensing imposes costs on businesses that are often out of proportion to the benefits delivered. Further, Mitulla (2003) argued that in practice, the regulatory provisions are abused and have become merely income earning opportunities

for those charged with enforcing the regulations. The initiative to have a single business permit (SBP) is appreciated, however not many BMEs can benefit from it. It has largely benefited the small and medium firms and not micro firms.

4.2.1 Bamboo curios and weavers

Bamboo Curios and weavers are situated in Karen shopping centre. It is a BME registered with the City Council that started off as a curio shop and with time the owner introduced bamboo items. Currently most of the products sold in the BME are made of bamboo (plate 1).

Their operations are flowing more smoothly as they do not face obstacles sourcing bamboo, since the BME is falling under the KEFRIs awareness missions. The BME has talented youths employed in the designing and carpentry section who make many bamboo items to meet the demand. The finishing of the bamboo items is however not neat enough.

Plate 1 Mr. David Mwangi in his Showroom in Karen shopping centre

4.2.1.1 Sourcing

Sourcing for this particular micro enterprise was made easy as it falls as part of KEFRI's research initiatives of bamboo utilization. Unlike earlier observations made by Brias (2006) where for many BMEs sourcing bamboo is the major obstacle, Bamboo curios and weavers have enough supply of the raw material they need. The micro enterprise obtains most of its bamboo from bamboo farms which are also KEFRI trial sites in Kamae and Kinale in Limuru district. They buy a bamboo culm at Ksh. 50 each and also incur transport costs from the bamboo farms to their workshop in Juja. Mr. Mwangi currently plans to train farmers in the outskirts of the city on bamboo propagation in order to ensure that he has sustainable supply of the bamboo culms.

4.2.1.2 Processing

Bamboo Weavers and Curios has five full time employees in charge of creating frame work of the bamboo items. This framework is done in Juja highpoint situated along Nairobi Thika highway. The proprietor is the chief designer and is assisted by his wife who is also the showroom manager. The furniture is later taken to the workshop in Karen where three people are also employed to finish the items, i.e. weaving with papyrus and sand papering. Like many small scale bamboo industries (Uravu, 2009), technology is limiting the capacity of the manufacturing and the quality of the work.

4.2.1.3 Sales and Marketing

The marketing strategy used by bamboo weavers is strategic positioning of their show room. The show room is found at the Karen shopping centre, inside the Karen exhibition area. This area has affluent clientele buying items, thus bamboo weavers have placed very high price for their products (see plate 1). By the roadside opposite the exhibition area, bamboo weavers have displayed some of their products; this is to catch the attention of the people (mostly affluent) who constantly pass by the busy road. The proprietor sets the price of the items. The BME does not have reliable marketing strategies as was observed by Statz (2007). The BME has only used strategic placement of its show room

to attract customers as its marketing strategy. The bamboo products that were found in the show room are listed in table 2 below:

Table 2 Bamboo products sold at Bamboo curios and weavers

Bamboo Product	Price (Ksh.)	Potential customers
Cushioned Arm chair	3000	Hotels/restaurants/homes
Table(4/3 feet)	8000	Hotels/restaurants/homes
Belt	1000	Individuals
Conner Stand	3000	Hotels/restaurants/homes
Flower Stand	2000	Designers & interior decorators
Fruit Basket	800	Hotels/restaurants/homes
Valentine's Flower Basket	500	florists
Wine Basket	500	Hotels/restaurants
Side Bed Drawer	3000	Hotels/homes
Curtain Blinders	200 per m^2	Hotels/homes
Shopping Basket	1000	Individuals
Ordinary baby cot	9000	Individuals
Decorated Baby Cot	12000	Individuals
Washing Basket	2000	Individuals
Lamp Shades	2000	Hotels/restaurants/homes

4.2.2 Timber-cum-bamboo yards

Kawangware area of Nairobi has a number of timber yards some of which stock bamboo. During the time of the study, Kianda Mbao Enterprise was the only one that had a small stock of bamboo left (plate 2). The enterprise sells bamboo culms of *Yushania alpina* and *Bambusa* spp which it says it buys from private farms. This company supplies all types of timber and bamboo culms to a variety of consumers. There is normally a small stock of bamboo which sells very fast

4.2.2.1 Sourcing

The bamboo culms are bought from private farms; the proprietor refused to disclose the specific location but says that they are licensed to trade in bamboo. Native *Yushania alpina* and *Bambusa* spp. are being traded. The key quality criterion applied is that the bamboo is mature, and this is determined by the dull yellow colour of the culm

Plate 2 Bamboo culms in a timber/bamboo yard

Sourcing bamboo is a challenge for the bamboo yard, as it is getting scarcer by the day. Ongugo *et al.*, (2000), Cindano and Omenda (2003) and Brias (2006) all agree that despite the ban on harvesting bamboo a significant amount of bamboo is being traded illegally. The person in charge of the timber yard did not have licenses for harvesting bamboo, this could be an indication that like previous studies suggested some or all of the bamboo in the yards was illegally harvested.

4.2.2.2 Processing

No processing is done with the bamboo. It is only being stored at the timber yard and resold (Plate 2). While storing the yard owners ensure that the bamboo is stocked at least a foot above the ground so as to protect it from moisture and termite attack.

4.2.2.3 Sales and marketing

The bamboo stored at the depot is being sold to small family businesses engaged in the production of sticks (skewers, toothpicks, ice cream sticks) and private consumers who use the poles to erect TV aerials. Other customers included those using the bamboo for weaving. Occasionally, bamboo has been sold to carvers and flower farmers who come to buy timber at the yard. The *Yushania alpina* culms are generally sold at Ksh 150 to 200, this price is set by the proprietor. Brias (2006), however, found that the culms in Nairobi

could cost as much as Ksh. 600. Ongugo *et al.* (2000), on the other hand, reported the highest bamboo prices of Ksh. 350 per culm to be in the coastal region. The price of the culm therefore varied with respective market places and species of bamboo. It was found that bamboo is mostly sold in December the festival season. During this time, there is a lot of bamboo furniture and other household items being made and sold. This was also reported by Brias (2006) and Cindano and Omenda (2007). Sales are much lower in January to April and very high in October to December. The main season for the sales of bamboo culms are October to December (the festive season) and the hot season (for production of ice cream sticks); it is also the season when many homes and hotels are refurbishing their quarters.

4.2.3 KEFRI Karura and Muguga centers

KEFRI's Karura Forest Products Research Centre is located north of the City Centre. The main activities of the Centre in Karura in the field of bamboo is the development of sample bamboo products in view of an expected boom in bamboo utilization once the ban on the cutting of bamboo will be lifted. Producing and selling bamboo furniture is also to become a commercial activity in line with the revenue generating policy of the centre, thus complementing the production of conventional furniture, which is no longer commercially viable.

4.2.3.1 Sourcing

The centre engages in the development and the production of bamboo furniture. To do so KEFRI has permission to use up to 400 culms (*Yushania alpina*) from Kinale, Kamae and Kamakia at a price of 80-150 each. Furthermore, culms of *Dendrocalamus giganteus* have been bought at a rate of 200 Ksh/m from the Bamboo Trading Company. Much of the stocks of unused bamboo are piling up in the centre and have been infested by unidentified borers. There were many experiments going on at the time of the study to come up with a good method of treating bamboo culms against pest attack as shown in plate 3. Despite this, the centre has still not come up with a method of treating bamboo against pest attack. Brias (2006) observed this as a challenge that holds back the progress of the bamboo sector in Kenya.

Plate 3 Infested bamboo culms

4.2.3.2 Processing

The production of sample bamboo furniture (chairs, coffee tables) and decorative items (flower pots and party lanterns) has picked up at the Karura product centre. The production of bamboo items is best done in this centre. This centre has qualified and talented technicians and brought good machines to increase the production and improve the quality of the work. Two key technical persons are in charge of this processing and have trained many technical assistants. The centre has recently obtained a number of new machines for the processing of bamboo items which include cutting knives, hand drills, block planer, hole drilling saws, hack saws, chisels, and kerosene burners.

4.2.3.3 Sales and marketing

The marketing of the furniture has not yet started, but this aspect of a commercial production is not expected to become a true bottleneck once the activity is in full swing. The centre, like other BMEs sampled, and as seen in previously by Statz (2007) does not

involve itself in major marketing activities. However, Open days are held and bamboo items are displayed and sold (Table 3).

Table 3 Bamboo products sold at KEFRI Karura products research centre

Product	Price (Ksh.)	Potential customers
Flower stand	400	Designers & interior decorators
Fruit basket	250	Hotels/restaurants/homes
Valentine's flower basket	200	florists
Wine Basket	250	Hotels/restaurants
Ordinary chair	500	Hotels/restaurants/homes
Table	500	Hotels/restaurants/homes
Shopping basket	300	Individuals
Baby cot	1000	Individuals
Washing basket	1000	Individuals
Lamp shades	500	Hotels/restaurants/homes
Coffee Table	2000	Hotels/restaurants/homes
Ladders	1,500	Hotels/restaurants/homes
Flower Basket	150	Florists
Wind chimes	400	Hotels/restaurants
Tea baskets	400	Hotels/homes
Bee hive	1,200	Homes/farms
Bird's house	200	Individuals
Rocking chair	1,500	Individuals
Cloths hanger	800	Individuals
Seedlings *Bambusaspp* 150 *Dendrocalamus* *Spp* 250 *Phyllostach* *spp* 300 *Gigantochloa* *Spp* 500		Companies, Hotels, Research Institutions and Individuals

Information regarding bamboo propagation, treatment and utilization is also given to interested people. Marketing is also done during the Annual Agricultural Society of Kenya (A.S.K.) Shows. Posters have been prepared to show the commercial uses of bamboo. Bamboo seedlings are also sold to afforestation related projects within and outside the city.

4.2.3.4 Bamboo Propagation

In the KEFRI Muguga centre, many trials of many plant species are done in a green house and a nursery. At the moment five species of bamboo which are used in construction are being propagated by seeds in the green house. Varieties with a mother stock are propagated by cuttings or rhizomes and seedlings are raised in the Nursery in Muguga. Plate 4 shows labeled seeds in the KEFRI's green house and bamboo seedlings in the nursery both in Muguga.

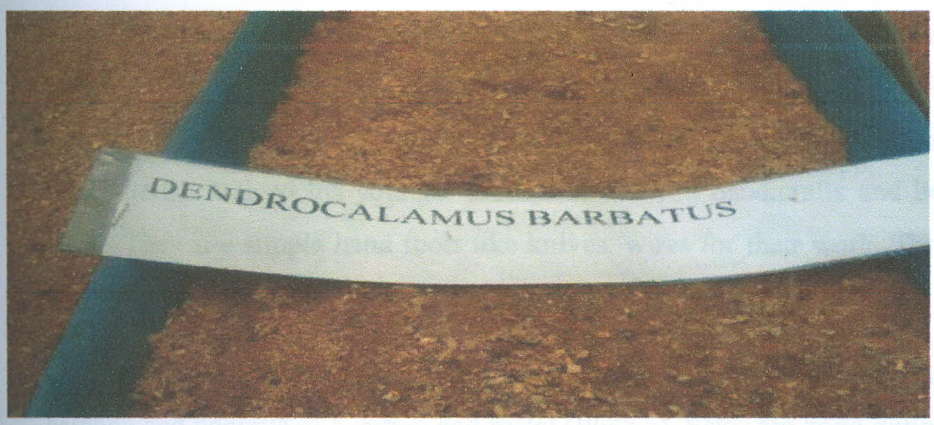

Plate 4 Labeled bamboo seeds in KEFRI's green house

4.2.4 *Jua kali* handicraft markets

Jua kali (handicrafts and artifacts) bamboo handicrafts are spread in many parts of Nairobi by the road sides (plate 5 & 6). They vary in the types of bamboo products made and sold. They make their products with simple tools mainly knives, sometimes drills and nails. All roadside bamboo microenterprises visited were not registered. Some were not easy to track because sometimes they were not operational. Since these businesses were illegal, they would close down temporarily when there is a rumor of the city council's officers in the vicinity. Mitulla (2009) recognized this to be a major obstacle for the

SMEs especially for the women who have to carry both their babies and goods to and from their operation sites. The situation gets even more challenging when traders engage in running battles across the city, with city enforcement officers. The *jua kali* BMEs had an unsteady source of bamboo culms, which reduced the production of bamboo items. They use both mature and immature culms as they do not know the difference between them. Brias (2006) noted a similar fault where the in *jua kali* bamboo nurseries, some of the seedlings sold did not have properly developed roots. This with time could reduce customer confidence in bamboo products. Marketing in the *Jua kali* BMEs is very minimal as was seen in previous studies by Statz (2007). The only marketing strategy seen was to display their products by a busy road. Unlike some *jua kali* BMEs in Statz (2007) studies, the *jua kali* BMEs sampled did not have catalogues for advertising themselves.

4.2.4.1 Zach's Handicrafts

Zach's handicraft is a family microenterprise based in Dagoretti Conner along Ngong road. The proprietor of the business, Mr. Zachariah Opiyo was previously an apprentice with Bamboo weavers in Juja and after acquiring ample skills he set up his own business, where he has trained his younger brother in bamboo handicrafts and brother-in-law on sales. They use simple hand tools like knives, wires for their work. The handicrafts are made by the road side, and sold at the same place.

Some furniture/artifacts sold are made of purely bamboo and others are a mixture of bamboo and papyrus or bamboo and metal (Plate 5). Sales are good during the weekends, where they can make up to Ksh.15, 000 and sometimes especially during week days they may make no money at all. The owner of the microenterprise buys bamboo from Murang'a area from farms that border rivers. They buy the bamboo at Ksh. 200 per cart that can carry up to 100 culms and also pay for it to be transported from Murang'a to Dagoretti. Bamboo items are displayed by a busy road at the Dagoretti roundabout. This strategy has been employed to catch the attention of passersby. Their pricing is high as the owner knows how unique his items are. Table 4 below shows the bamboo items sold by *jua kali* artisans.

Plate 5 Bamboo furniture at Zach's handicrafts

4.2.4.2 Joseph Faiya Workshop

Joseph Faiya runs a workshop by the Karen road near the Karen shopping Centre in the south of Nairobi. He initially made and sold furniture from papyrus, metal and wood. His reason for making bamboo products was to diversify his product range. Mr. Faiya obtains his bamboo from homes in Karen which range from 200 meters to two kilometers from his roadside workshop.

Table 4 Product sold by *Jua kali* artisans

Bamboo Product	Price (Ksh.)	Potential customers
Flower Stand	2000	Designers & interior decorators
Fruit Basket	800	Hotels/restaurants/homes
Side Bed Drawer	3000	Hotels/homes
Shopping Basket	1000	Individuals
Baby Cot	9000	Individuals
Lamp Shades	2000	Hotels/restaurants/homes
Candle holder	500	Individual tourists
Table (4 by 3 feet)	800	Individual tourists
Shelves	1500	Individual tourists

Some Karen residents have planted bamboo in their compounds, some to stabilize soils from nearby swamps and others for fencing or just as ornamental plants. The species seen were *Bambusa vulgaris* variety *vulgaris and Bambusa vulgaris* variety *vitata.*

Plate 6 Camping torch displayed by Faiya's workshop

Bamboo items are sold from his open air workshop which is at the roadside in Karen. The items are displayed and interested customers stop by to buy products. He says that he makes small quantities of bamboo items because of unavailability of bamboo. He however notes that the few items he makes are quickly sold.

4.2.5 Masai Market

This is a mobile market that sells a variety of curios, such as jewelry, baskets, carvings, *kikoys*, and household utilities. Everything sold in this market has an African and mainly Kenyan touch. The market is done in four different areas of Nairobi, of four days of the week. Every retailer pays revenue of Ksh. 50 to the City council. The products sold could be made of wood, papyrus, bamboo and paintings are done on canvas. In the market three retailers' were spotted selling bamboo items among other items (Plates 7 & 8). Supply of bamboo items was not constant to the retailers in Masai market. Some

depended on occasional, irregular traders who would sell the items for them. This could be attributed to the short supply of bamboo culms which Ongugo *et al.* (2000) attributes to the government ban on bamboo harvesting.

4.2.5.1 Zahra Ali Artifacts

Zahra Ali is a single mother who lives in Kibera; she has a stall in the Masai market which supports her and her three children. She has run the business for over 10 years. In her stall she stocks mats, different types of baskets and bamboo frames and trays (Plate 7). She buys bamboo from a retailer who sells them in open market days, a culm for Ksh. 50-200 and weaves from her home in Kibera.

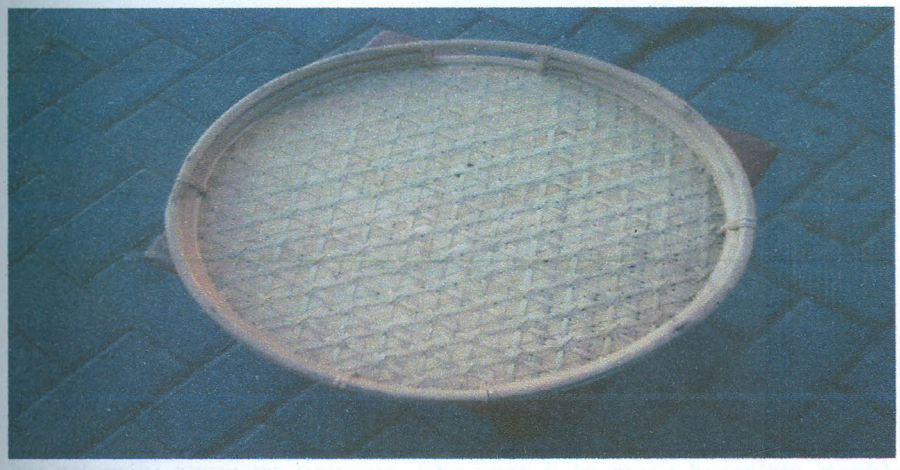

Plate 7 A Bamboo Tray sold at Zahra artifacts, Masai market

The supplier obtains them from Uganda. There is no special arrangement she has with him, instead she buys only when available. She sells the bamboo frames for K.sh 500 and the trays for Ksh. 800.

4.2.5.2 Dinah Amtani African Jewelers

Dinah is a single mother who also owns a stall in Masai market. She stocks jewelry of different types including soap stone, horns, woody jewelry and bamboo jewelry.

Plate 8 Bamboo jewelers sold from Masai market

She obtains bamboo for free from Turbo, Rift Valley province of Kenya where her native home is. It grows naturally by a river near her home. It's a variety that is very thin and has naturally exquisite patterns. She uses it to make bracelets, necklaces and ear rings (Plate 8). Since bamboo is free, her only input costs are in buying hooks, beads and thread. She sells bamboo earrings at Ksh. 50, necklace at Ksh. 100 and bracelet at Ksh. 50.

4.2.6 City Market

The City market is located at the Nairobi city centre along Muindi Mbingu Street. It hosts retailers selling curios, jewelry among items targeted to be bought by tourists. During the study, two retailers had stocked bamboo items and were thus sampled. Unlike other retailers and BMEs the city market items had a good finishing. Unlike Statz (2007) who noted that products sold in Kenya lacked elegance and refinement; the jewelry sold in city market were neatly finished and elegant (see plates 9 & 10). The sales of the bamboo items in the city market were good as only two stalls were seen to be selling

bamboo items during the study. This gave them an upper hand as they were dealing with unique products and at a strategic location. They sold the bamboo items at a higher price compared to other stalls in the roads of the city.

4.2.6.1 Oliver Kagima Curios

Oliver Kagima is a retailer at City market. He has specialized in selling curios. He sells a variety of items like jewelry, *kiyondos, kikoys* and carvings (Plate 9). He mainly targets tourists and charges high prices.

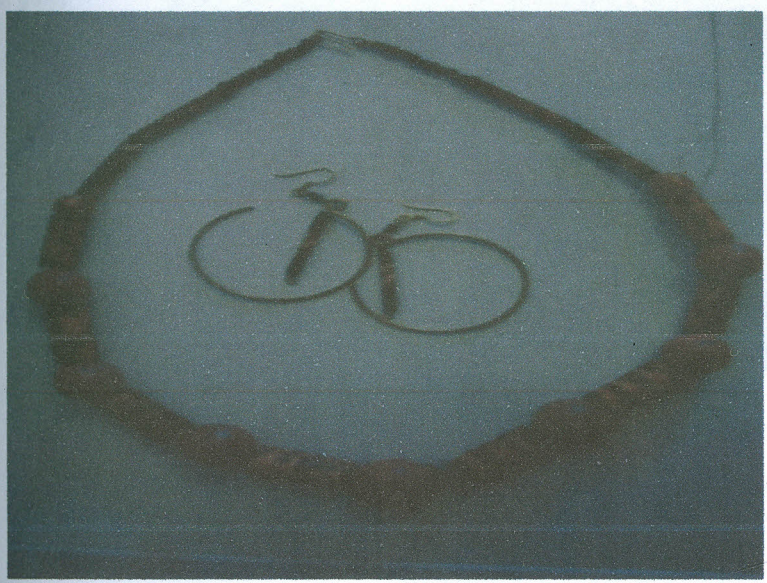

Plate 9 Bamboo Neck lace and earings sold at city market

He has been in the business for five years and began stocking bamboo items three years ago. He sells mainly bamboo jewelry; necklaces ranging from Khs. 800 to 2000, earrings ranging between Ksh. 200-300 and bracelets ranging between Ksh. 300-700 in price. He has a good sales language and convenient display location but lacks a clear marketing strategy. When asked about it, the retailer said that the convenient location of the market suffices as a marketing strategy.

4.2.6.2 David Ngovu Curios

David Ngovu is a retail stall owner at City market; he sells curios, *kiyondos*, carving and African traditional musical instruments (Plate 10). His musical instruments are made of bamboo. He sells bamboo flutes at Ksh. 300, bamboo *kayambas* at Ksh.700 and bamboo

drum at Ksh.1000. His bamboo items are mostly bought by tourists. He says they are very profitable and sell quickly because; he is the only one who stocks the bamboo musical instruments. Like the other bamboo retailer, Mr. Ngovu lacks a clear marketing strategy; maintaining that the items sell for themselves at the market.

Plate 10 Bamboo flute sold in City Market

4.3 Bamboo Microenterprises and household livelihood incomes

Most of the bamboo microenterprises are family businesses. They are normally initiated by one family member then; s/he draws in more members either as partners or employees into the business. Blowfield *et al.* (1995) also showed that rural based BMEs in India were mainly family based BMEs with the father as the proprietor and the wife and children as staff. The members of a family working in their BME were not paid. It is expected of them to work under their parents at a time which they live with their parents, and when old enough to live on their own, they start up their own BMEs. However, in this study, the staff in the BMEs, including family, was paid per month or per piece of work done. The retailers in Masai market and city market run a one person stall which is stocked with mainly curios. Table 5 shows the average monthly income from the BME employees that were sampled.

Table 5 Average monthly income of BME employees

BME/Area	Sex	level of Education	Designation	Income from BME (Ksh.)	Other Income (Ksh.)
Zach's	Male	High School	Sales man	5,000	5,000
Zach's	Male	High School	Carpenter	9,000	4,500
Juja high point	Male	primary School	Bamboo harvester	4,500	N/A
Juja high point	Male	primary School	Bamboo harvester	4,500	N/A
Juja high point	Male	High School	Workshop manager	40,000	5,000
Juja high point	Male	primary School	Carpenter	9,000	N/A
Juja high point	Male	primary School	Carpenter	9,000	N/A
KEFRI	Male	High School	Workshop Assistant	14,000	N/A
KEFRI	Male	High School	Workshop Assistant	14,000	N/A
Faiya's	Male	high School	Artist	9,000	N/A
Faiya's	Male	High School	Artist &sales Assistant	9,000	N/A
Karen	Male	High School	Carpenter	3,000	9,000
Karen	Male	High School	Carpenter	3,000	9,000
Karen	Female	High School	Sales Assistant	4,500	N/A
Kawangware	Male	High School	Sales assistant	4,500	4,500
Kawangware	Male	High School	Sales Assistant	4,500	4,500
Kawangware	Male	high School	Sales Assistant	3,000	4,500
Kawangware	Female	High School	Sales Manager	6,000	9,000
Nurseries	Male	primary School	Gardener	9,000	4,500
Nurseries	Male	primary School	Gardener	9,000	6,000
Nurseries	Male	High School	Gardener	5,400	N/A
Nurseries	Male	High School	Gardener	5,400	N/A
KEFRI	Female	primary School	Gardener	6,000	N/A
KEFRI	Female	Primary School	Gardener	9,000	N/A
KEFRI	Female	High School	Gardener	6,000	N/A
City Market	Male	College Diploma	Entrepreneur	9,000	18,000
City Market	Male	High School	Entrepreneur	2,500	9,000
Masai market	Male	College Diploma	Entrepreneur	12,000	18,000
Masai market	Female	High School	Entrepreneur	9,000	18,000
Masai market	Female	primary School	Entrepreneur	4,500	12,000

The average monthly income for BME employees was found to be Ksh. 7,896 (Table 5) while the Average monthly income for BME proprietors was Ksh.35, 900 (Table 6). The proprietors took up several roles like overall management and at the same time doing the hands on BME work. They earned much more than their employees. Despite this, the amount earned by the employees is reasonably high compared to the Kenyan urban minimum wage was Ksh.7, 578 per month (Wikipedia, 2010). Ongugo *et al.* (2000) revealed that an average, toothpick production enterprise, two employees on full time basis and five employees on part-time are employed. Full time employees earn about Ksh. 2 600 per month while part time employees earn Ksh. 1 800 per month. For some proprietors, part time employees are paid on piecework basis i.e., Ksh. 3 for 100 pieces of toothpicks and Ksh. 7.00 for skewers. These average amounts in the year 2000 were seen to be much lower to what BME workers are earning during the study period i.e. 2008/2009.

Table 6 Average monthly income of BME proprietors

BME/Area	Sex	Education Level	Designation	Income from BME (Ksh)	Other Income (Ksh)
Zach's	male	High school	manager	60,000	60,000
Faiya's	Male	High school	manager	4,500	12,000
Karen	male	College	Director	60,000	60,000
Karen	female	College	Manager	25,000	20,000
Nurseries	Male	High school	manager	30,000	N/A

4.3.1 Gender aspect in the BMEs

The BME's sampled by the study are male dominated with only 20% of the people working in BMEs were women and 80% were men (Table 5 and 6). This was unlike Mitulla (2003) who found out that 48% (almost half) of the SME operators are women. The women in the BME are mainly employed in the selling, weaving or small scale gardening. Men on the other hand, have taken up bamboo carpentry or harvesting. In the *jua kali* bamboo sector, no women were seen to be employed. This is because the artisans

work under hardly any shelter all day by the road sides. They operate without services such as water, sanitation, energy supply and storage facilities. This Mitulla (2009) finds to be the major challenge for women who operate with their children and have to do without basic services such as water and sanitation. They temporarily shut their businesses whenever there as a city council officer in the vicinity. This kind of work environment was thought not to be conducive to women and there were remarkably fewer women. Odhiambo and Manda (2003) observed that men always have taken up the high ranks in informal and formal sector employment. These findings concurred with findings of this study in many ways. Women in the BMEs earned an Average of Ksh. 8,750 compared to the men Ksh. 13,323 because most of the women in the bamboo micro enterprises were working at a very low capacity and sometime as part timers.

The retailers from Masai market all sold a few bamboo items as part of their diversified items. There were generally more women retailers than men, this is a similar situation to many other enterprises women have been seen to have better persuading skills thus are better sellers. Women with a low education level worked mainly as part timers, they would, for example, take part time gardening jobs in the tree nurseries.

The BMEs sampled were a good employment source for the youth, 21 of the BME employees sampled were below 35 years. Odhiambo and Manda (2003) reported that approximately 500,000 Kenyans getting into the job market annually majority of whom are the youth, the BMEs show potential of reducing the problem. The few BMEs sampled (Table 5 and 6) showed that people working in the sector are benefiting from it financially. If the sector is expanded, it has potential of employing more youth, from bamboo nurseries, bamboo plantations to bamboo utilization and will ease the unemployment issue.

4.3.2 Income and education

The Level of education was observed to be a determinant of the income one earns per month from the BMEs. The study showed that the average income per month from the BMEs increased as the level of education of the BME worker increased. Figure 4 shows the monthly average income of a BME worker: primary school education is Ksh.7000,

high school Ksh.11, 000 and the BME workers with college education had an average monthly income of Ksh.19, 700.

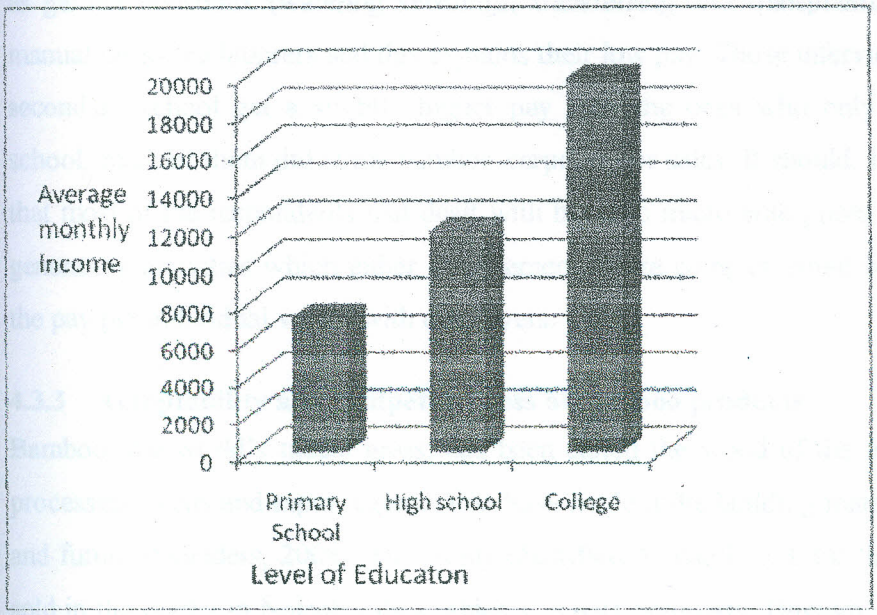

Figure 4 Average incomes from BMEs according to level of education

In their study on labour force in Kenya, Odhiambo and Manda (2003), found that respondents in urban areas who have secondary and post secondary education are more likely employed in the sales/services sector than any other sector. They also observed that the proportion engaged in the services sector increases with the level of education.

The BME employees earned an average income of Ksh.7, 896 per month which lays above the national minimum wage urban of Ksh.7, 578 per month (Wikipedia, 2010) for people living in urban areas of Kenya. Only 9 % of the people working in bamboo microenterprises had a past secondary school education. These had the highest average monthly income of Ksh. 19,750, (Figure 4). Blowfield *et al.* (1995) found that bamboo farming as microenterprise did not benefit the poor as much as it did the middle income. In a similar way the study has established that through education, the income bracket rises and the poorest do not benefit as much as the mid income level. This is so because the more education one had and professional experience that one had the more innovative they are. They have a better idea on how to start and run a business in most cases they

were the employer with employees (assistants) who had a lower educational background. Most of the people interviewed who went to primary school only, were mainly employed as garden assistants (watering seedlings, transferring and transplanting seedlings) or manual unskilled laborers and this explains their low pay. Those interviewed who went to secondary school get a slightly higher pay than the ones who only went to primary school, most of them did some bamboo carpentry or sales. It should, however, be noted that most of the respondents that dealt with bamboo micro enterprises had other income generating activities which either complement or are complemented by the BME. And the pay per individual varied with employers.

4.3.3 Acceptability and competitiveness of bamboo products

Bamboo, the world's tallest grass, has been called the wood of the future. Its minimal processing needs and rapid regeneration have made it the building material of the present and future (Saunders, 2008). This study identified 40 bamboo items that were made and sold in the BMEs in Nairobi city (Tables 2, 3 &4). Similarly, Ongugo *et al.* (2000) noted that Kenya has recorded up to 48 local bamboo uses, it provides raw materials for many activities such as production of incense sticks, toothpicks, food and forage, water harvesting, medicine, supports for commercial flower growing, tea picking baskets and making handicrafts. This, he said provides job opportunities and entrepreneurship to the poor rural population.

Bamboo items are increasingly being accepted and liked in the markets in Kenya. Many people interviewed have said they like the items for their unique beauty or it identifies them with a certain social class and some liked that they can be used in place of wood items and thus contribute to forest conservation. Bamboo and bamboo products can be used as a substitute for products from many other resources like wood, metal and even plastic and glass. For example one can substitute glass flower vase, with a bamboo flower vase; one can substitute a wooden bed, with a bamboo bed. Bamboo items have a high possibility of replacing items made of substitute materials like plastic, wood and even metal. Most people think so because of the fast rate of forest depletion, the pollution caused by plastic manufacturing and increasing rate of plastic waste generation.

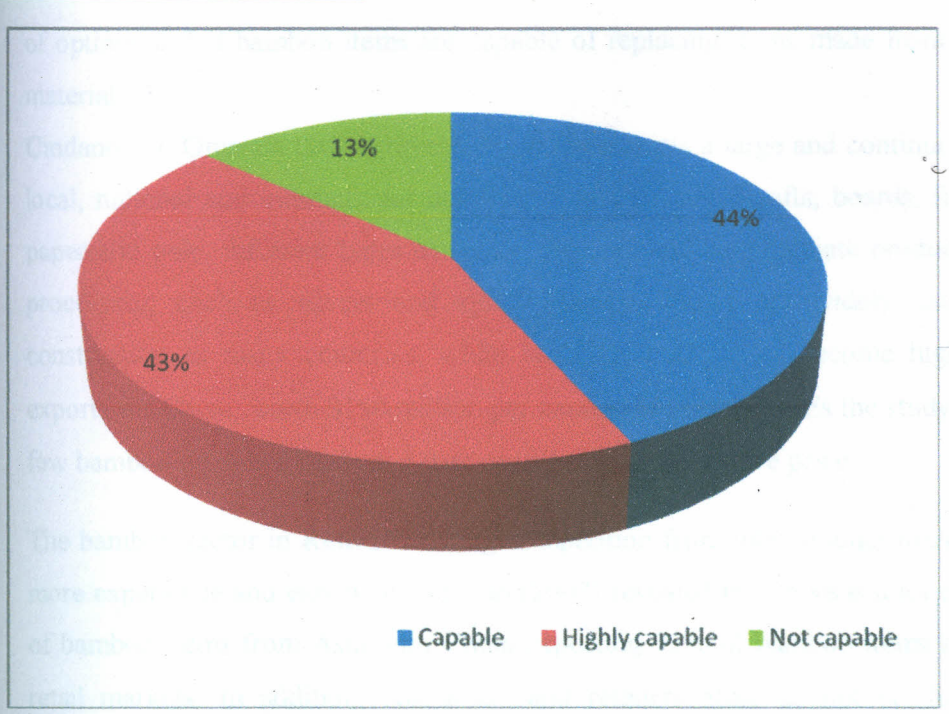

Figure 5 Opinions on capability of bamboo items to replace conventional products

Therefore bamboo's availability will provide a sustainable alternative for processing items. In this study 43% of the respondents think bamboo items are highly capable while 44% think of it as capable to replace items made of alternative material (figure 5). These opinions are positive in that, it shows that bamboo items, although new and not common, are acceptable to customers. The bamboo items are liked by customers and potential customers and therefore the BMEs can be assured of a market of their products.

Some domestic users still think of bamboo as a resource for temporary solutions that is prone to infestation and rotting. Of the study's respondents, 13% said bamboo was not capable of replacing items made of conventional material. In Asia it was known as the "poor man's timber." This image is fostered by the tradition of using bamboo without preservatives and the fact that trained architects and carpenters lack experience with the material. In the developed world, there is a small market of environmentally conscious consumers interested in bamboo flooring and housing etc. However, Widenoja (2007) noted that the further development of the market is hampered by a lack of codes and standardization and doubts about the durability of the material. Despite this he sees a lot

of optimism that bamboo items are capable of replacing items made from conventional material.

Cindano and Omenda (2007) revealed that there exists a large and continuously growing local, national and international market for bamboo handicrafts, boards, fibre products, paper and pulp, different types of sticks, charcoal and intermediate products for further processing, such as slivers and splits. Bamboo poles are widely used for house construction in many countries, while bamboo shoots have become high value food exports for China, worth $150 million per annum. From the BMEs the study revealed that few bamboo items are made and they are all sold at a lucrative price.

The bamboo sector in Kenya is facing competition from international markets that have more experience and expertise. Odondo (2007) revealed that there is a lot of importation of bamboo items from Asia with China exporting 72% of bamboo items sold in formal retail markets. In addition, consumers and retailers alike do not yet have sufficient knowledge on the multitude of uses and applications of bamboo especially in the *jua kali* sector.

4.4 Contribution of Bamboo Micro enterprises to Environmental Conservation in Nairobi

Kenya may be classified as an important 'bamboo country' despite having only one native bamboo species. In the 1940's and 50's large tracts of bamboo forests were clear cut and replaced with exotic soft woods (Kigomo, 1988). By the late 1970s over-harvesting of natural stands of bamboo was threatening water catchments areas. Environmental strategies were needed, and the ban on bamboo harvesting was imposed in 1982. As much as the ban is currently an impediment to the development of the bamboo industry, it was at the time very essential and the only way to assure that the remaining bamboo is protected from depletion (Cindano and Omenda, 2006). The small remaining acreage of bamboo is also threatened due to the recent fires in the natural forests like Mau forest and determination to maintain the shamba system. In response KEFRI has advanced its initiatives of introducing exotic bamboo species by creating further awareness on its preservation and utilization.

The progress in the cultivation of exotic bamboos in Kenya has been slow but steady. Brias (2006) noted that farmers have been increasingly showing interest in bamboo and large companies are considering bamboo as a biomass alternative to timber species. Some of the bamboo nurseries in Nairobi are supplying seedlings to these companies. KEFRI's nurseries around the country are cultivating bamboos and nurseries in the private sector are scaling up their production of bamboo plants to meet future demand.

4.4.1 Bamboo Nurseries

Bamboo nurseries as a BME are the major source of bamboo seedlings for conservation purposes used in Nairobi. Three main nurseries exist which apply scientific nursery practices and produce bamboo seedlings in large scale mainly for sale. Two of them i.e. Bamboo and Tree Company Ltd and The Bamboo Trading Company Ltd are registered companies, and KEFRI Muguga which has a bamboo nursery as part of KEFRI's overall forestry research mission. Plate 11 shows bamboo seedlings in KEFRI Muguga's nursery. These bamboo nurseries are all located in the suburbs of the City. The bamboo and tree company not only propagates seedlings but also provides expertise on what bamboo species to use for what conservation or rehabilitation process. The company is working closely with KEFRI and other stakeholders in the Nairobi rivers rehabilitation project in enhancing the conservation status of the Nairobi Rivers and re afforestation of the river's riparian zones. Bystriakova (2003) and ICRAF (2004) recommended the use of bamboo for such projects as they have an extensive rhizome system found mainly in the top layers of soil, giving it soil stabilization function and securing hydrological functions of rivers. Bamboo trading company sells its seedlings in large scale to private companies within Kenya who are either practicing agroforestry e.g. Rea Vipingo Company Ltd or companies that want to propagate bamboo and later use it as a biomass source. It also provides seedlings to some of the city's seedling vendors in small scale. The company sells seedlings to the smaller bamboo nurseries traders who mainly work on the road sides of many residential areas who sell the seedlings to individuals.

In KEFRI the bamboo seedlings are mainly sold to conservation related projects that mainly want to use bamboo in afforestation and reafforestation. KEFRI propagates various species and varieties of bamboo and finds their suitability to various ecological

zones of Kenya as part of their awareness campaigns on bamboo (Kigomo, 1988). Bamboo nurseries by the roadside in Gigiri area on the other hand mainly supply bamboo seedling to individuals who plant bamboo for greening and beautification at a smaller scale.

Plate 11 Bamboo seedlings in a Nursery

4.4.2 Bamboo in environmental aesthetics

Bamboo nurseries (BME's) situated by road sides are a major source of bamboo seedlings used for beautification in Nairobi city. Around Nairobi, *Bambusa vulgaris Vitatta*' the yellow variety with green vertical stripes and *Bambusa vulgaris* the dark green variety is cultivated and used as an ornamental plant. In Ngong road to Karen area South of Nairobi (plate 12), bamboo clumps are seen standing in isolated patches. A number of home owners have planted *Bambusa vulgaris* in their compounds. Widenoja (2007) reported that the Bambusa *spp.* have been observed to be used in many areas for ornamental purposes. One person has planted bamboo by a swamp to stabilize the area, in other compounds it's ornamental or used for fencing. This bamboo when mature is

sold to retailers who make furniture and torches out of it. Around the industrial area off Mombasa road, a number of establishments are seen to have planted bamboo around their compounds, the reason being ornamental, reducing dust and noise effect. In Mamlaka area to Statehouse area, bamboo clumps are also observed by the road side, and in people's compounds. All these are individual's initiates to green their environment.

In Gigiri, some bamboos are sold by roadside vendors together with other ornamental plants. The sale of ornamental bamboos in Kenya is very recent, and a very limited number of plants are available. Vendors collect plants and propagate them by means of culm cuttings.

The plants are about 30-50 cm in height. Dwarf ornamental varieties are sold for KSh 300-500 per plant. The selling price of *Bambusa vulgaris* 'Vitatta' is KSh 200 per plant. Along the road in Gigiri (near the UN Complex), some large bamboos including *Dendrocalamus asper* are planted. The clumps appear healthy and are around 10 meters tall. The diameter of the bamboo culms more closely approximates those of bamboos growing in their natural range. The culms of *Dendrocalamus asper* in Gigiri were observed to have a diameter of about 15-20 cm.

For greening and beautifying the environment, Widenoja (2007) recommended bamboo as a low-cost yet effective material. From *Dendrocalamus giganteus* standing 20-30 m high to *Shibatea chinensis* which is just 0.2-0.3 m high, there are several bamboo species that could be used for the purpose. While it is the colouration or morphology of the culm that makes some species attractive. Widenoja (2007) further states that it's the foliage that makes others appealing. For example, *Sasa.fortunei, S. auricoma, S. pygmaea, Bambusa multiplex cv. fernLeaf, Indocalamus latifolius, I. herkiostii,* etc. are utilized for their leaves. Bamboo species with colour stripes or spots, square culm, nodes or internodes of peculiar shape, etc. are also chosen for ornamental use. Among these, the more famous include *Bambusa vulgaris cv. wamin, B. vulgaris cv. vittata, B. ventricosa, B. tuldoides cv. swollen internode, B. multiplex, Qingzhea tumidinoda, Phyllostach ys heteroc ycla, P. aurea, P. vivax flaureaocaulis, P. aureosulcata, Dendro-calamus latiflorus, Chimonobambusa szechluanensis var. flexuosa. Indosasa shibataedes, Neosinocalamus affinis cv. flavidorivens, Gigantochloa pseudoarundinacea* and *G.*

ligulata. Most of these species have not been introduced to Kenya as the bamboo sector is still young in Kenya. There are vast conservation aspects of bamboo that are yet to be explored and exploited.

Plate 12 A bamboo clump in a compound Mamlaka area Nairobi

4.4.3 Bamboo in restoration of the Nairobi river programme

The City of Nairobi is traversed by many small rivers which form tributaries of the Athi River, the main ones being Ngong, Nairobi and Mathare Rivers. The City has been subjected to serious environmental degradation mainly by the increasing urban population compounded by high poverty levels, demand for resources, unplanned development, and pervading ignorance of environmental issues, general apathy and institutional failures (GOK 2008). Currently, about fifty-six percent (56%) of the city residents live in 46 slums along the banks of the Nairobi Rivers. These informal settlements have encroached on the river reserve and have hardly any supporting sanitary facilities thereby causing considerable pollution to the Nairobi Rivers. Sewerage network in the city is grossly inadequate thereby causing considerable illegal discharges of sewage

into the rivers (GOK 2008) (See Figure 6).

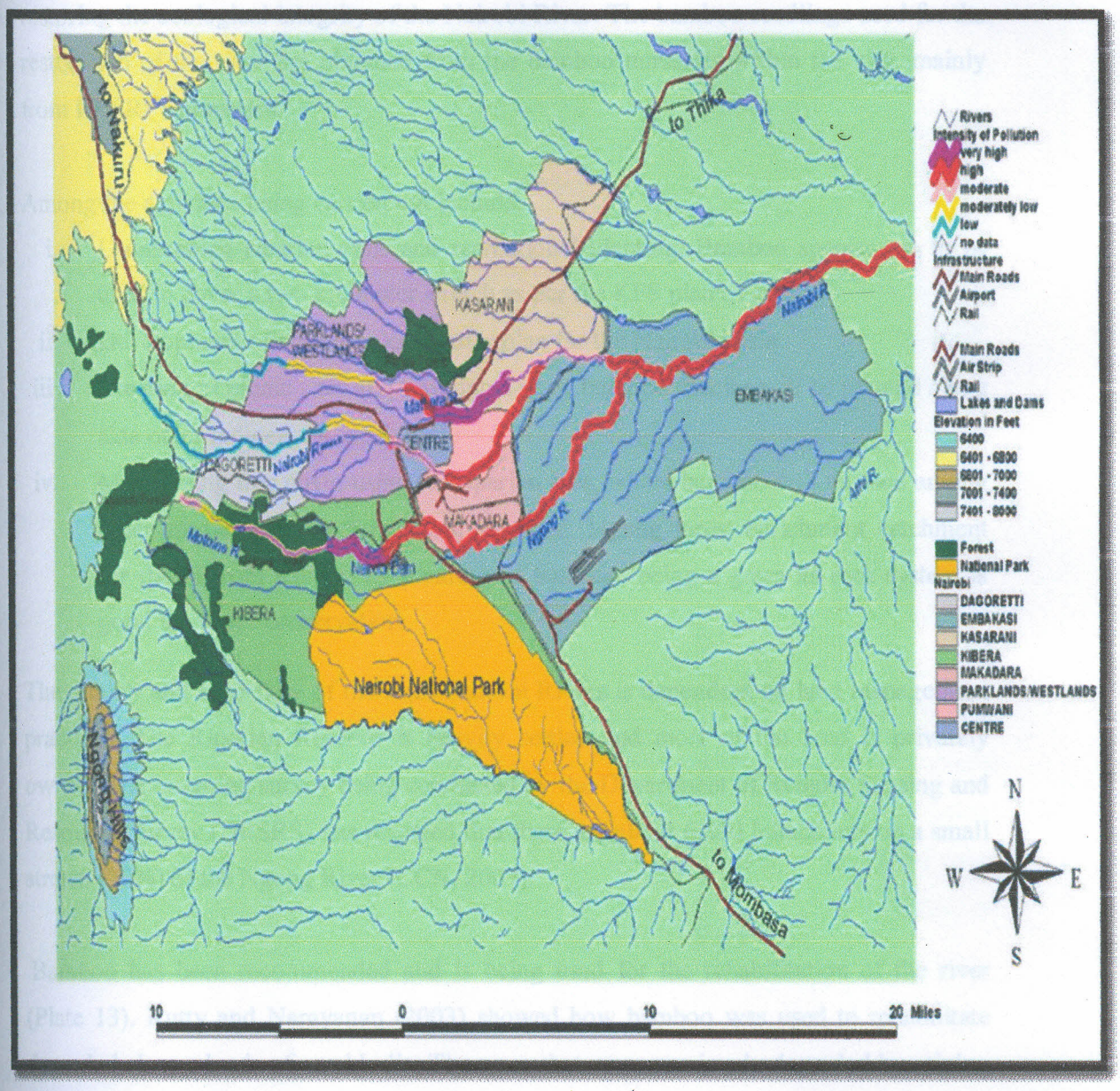

Figure 6 Intensity of Pollution of the Nairobi Rivers

(Source: GOK 2008)

The Nairobi Rivers are currently under rehabilitation programmes that have a number of phases; the most important one to this study is "The Enhancement of conservation status of the Nairobi Rivers". This project will include both restoration and awareness campaigns of the Rivers as they should provide a long term impact. Currently the rivers self cleansing capacity have far been exceeded. This component is aimed at gradually

restoring the ecological integrity of the Nairobi River. The bamboo seedlings used for the restoration of the river are obtained from the bamboo nurseries within the city, mainly from KEFRI's nurseries.

Among the activities being carried out include;

i. Landscaping riparian zone and recreational planting. Bamboo species are to be used to cover a two kilometer stretch as per the KFS plan of action.
ii. Development of conservation master plan for the Nairobi basin.
iii. Creation of picnic sites and ecological sites, bamboo species will be planted along side other indigenous species.
iv. Maximizing tree cover using the riparian area, where bamboo will be used among other species for re afforestation purposes. Ngong forest enrichment catchment for the Nairobi Rivers) by planting of bamboo, being a grass its root system is good for water conservation.

The quality and base-flow of the three Nairobi Rivers is dependent on land management practices. The Riparian Reserve is heavily settled and most of the land is privately owned. The on-going survey being conducted by the Department of Remote Sensing and Resource Survey (DRSRS) has revealed that there are about 6,800 inhabitants on a small stretch (20%) of the Ngong River (CCN, 2007).

Bamboo has been recommended and is being used for the rehabilitation of the river (Plate 13). Kutty and Narayanan (2003) showed how bamboo was used to rehabilitate degraded sloppy lands of rural India. The areas that were previously degraded by mining were restored to productive lands with a healthy ecosystem after years of bamboo afforestation. Bamboo's potential in doing the same to the degraded Nairobi Rivers is convincing, its results will however be have to be confirmed years from now. The landscaping of riparian zone of the Nairobi Rivers partly by bamboo seedlings provided by the BMEs will lead to absorption of heavy metals and hence cleanse the river. ICRAF (2004) verified its ability to clean sewage; therefore, its potential of cleaning of a polluted river is promising.

Plate 13 Bamboo on the reparian of Nairobi Rivers

Ngong forest enrichment (catchment for the Nairobi Rivers) by planting of bamboo will also enhance quick recovery of the water catchment as bamboo is a fast growing plant and ensure sustainable forest because it's a grass that will continuously reproduce. According to Kutty and Narayanan (2003) bamboo is often used for soil conservation and enrichment and watershed protection purposes. They further noted that the extensive rhizome system of the bamboos, found mainly in the top layers of soil, is one of the main reasons for its positive effect on soil stabilization and securing hydrological functions of catchments and rivers.

4.4.4 Nairobi Arboretum

The Nairobi Arboretum occupies a 30 hectare site of wooded landscape, an oasis close to the heart of the City. Vegetation in the arboretum is dominated by *Bambusa vulgaris* and *Dendrocalamus giganteus*. It is situated about 3 km from the city centre, adjacent to State House and bounded by Kirichwa Kubwa River. It was established in 1907 mainly as a site for eucalyptus provenance trials and was subsequently gazetted as a forest reserve in 1932. It now holds over 350 species of indigenous and exotic trees among them two bamboo species. Its diverse vegetation is also home to over 100 species of birds, a population of Sykes and monkeys, many butterflies and other small animals. It is one of

Nairobi's few remaining green spaces with shaded walk ways, picnic lawns and jogging trails. Since its founding, the arboretum has been and still is under the Kenya Forest Service - KFS. Management efforts of the arboretum declined in the between the 70's and 90's and it lost its splendor. However rehabilitation efforts have been going on and the arboretum is now a green heaven of bamboo in the middle of a chaotic city. Among the species of trees used are bamboo species; *Bambusa vulgaris* and *Dendrocalamus giganteus* (Plate 14). The bamboo in the arboretum is less than 10 years old. The bamboo seedlings used in the arboretum are obtained in KEFRI Muguga nurseries.

Plate 14 City dwellers getting pleasure from bamboo shade in style

Bamboo has been planted along the entire route where visitors take their nature walks, and culms have been used for fencing almost half of the arboretum. The forester in charge says the reason for this strategic planting is to create awareness on bamboo's significance both in ecosystems enhancement and the commercial use it can be put to. To reiterate on the importance of bamboo, at least three quarters of the seats and benches in the arboretum are made of bamboo and some are placed under bamboo shades. Many city dwellers come for recreation at the arboretum and find peace lying on the bamboo benches under the bamboo shades. Children coming for picnics play within large bamboo clumps, being brought up in the city, the bamboo clumps are an adventure to them. In the mornings and evenings many people also jog in the fresh air. The fallen leaves are also put together and form cushions one can find people sleeping in at the arboretum. Dust bins in the arboretum are also made of bamboo. Bamboo in the arboretum has been used to show its environmental restoration capacity as has been recommended by previous

studies like ICRAF (2004) and Widenoja (2007). At the same time bamboo is utilized in the arboretum to make the fence, seats and trash bins therefore exhibits its capability to be put into use for economical and social gains as seen in Kutty and Narayanan (2003) and Ongugo *et al.*, (2000).

4.4.5 Why the Use of bamboo in rehabilitation and conservation of the Environment

Bamboo is a versatile crop with many uses. It is the fastest growing woody plant on this planet. It has important direct and indirect economic and ecological benefits such as providing food (shoots), housing, furniture, artisan products and soil and water conservation. The flexibility of utilizing various sizes of bamboo culms gives it an advantage over investing in other woody plant species. Quicker and sustainable economic gains can be realized from bamboo especially in developing economies where communities are being drawn into joining forestry based microenterprises as an incentive to sustainable forestry.

Bamboo has been selected among the species of plants for rehabilitation of riparian reserves of the rivers of Nairobi and restoration of the Nairobi arboretum mainly due to its environmental friendliness, economic benefits to the community, carbon sequestering capability and its coast effectiveness (Figure 7).

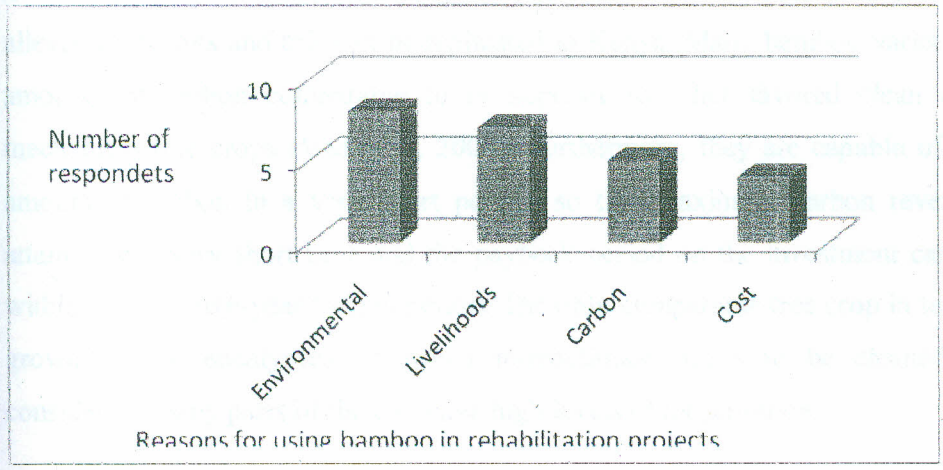

Figure 7 Reasons cited for using bamboo in rehabilitation projects

Modern bamboo management can produce high-yielding, renewable resources that do not require chemical fertilizers and do not deplete the soil (Madhab, 2003). The rhizome system of roots has even been shown to have water and soil erosion reduction capacities superior to many tree species, thus, environmental friendly. This makes bamboo ideal for planting at the riparian of the Nairobi rivers all the way to its catchment. Further, Hunter (2003) argued that many bamboo species are endangered or associated with endangered species, so forest with endangered bamboo species would be an important contribution to biodiversity preservation.

Bamboo is a versatile product that can be processed into finished or semi-finished products in the home in many cases (Xuhe, 2003). It is easier to process than timber because of its light weight. It can be grown on marginal land near or around houses such as residential areas of the city as well as in large stands. Bamboo experts interviewed during this study said that bamboo used in the conservation projects such as Rehabilitation of Nairobi river can be harvested by neighboring communities. These could be manufactured to usable products that can also be sold, thus, contribute to the development of neighboring communities. Widenoja (2007) stressed that bamboo processing can also be very efficient, with up to 90 percent of the biomass utilized at harvest, from the leaves to the rhizomes.

Bamboo projects in other countries have already been shown to have impressive poverty alleviation results and this can be replicated in Kenya. Many bamboo varieties sequester amounts of carbon comparable to or superior to other favored clean development mechanism tree crops (Widenoja, 2007). Furthermore, they are capable of storing that amount of carbon in a very short period, so that maximum carbon revenues can be attained in a very short time and the payback period on the investment can be reached within the first five-year trading period. The only comparable tree crop in terms of quick growth is the eucalyptus. Nairobi's microclimate needs to be cleaned constantly, considering many parts of the city have high levels of air pollution.

Bystriakova *et al.*, (2003) noted that upfront investment for establishing a bamboo forest or plantation is lower than for tree crops. Bamboo seedlings in Nairobi are equally

affordable can cost as low as Ks. 150. As unprocessed bamboo is still valued less than wood (and because it grows so quickly), the cost propagation materials is also cheaper than for favored tree species.

4.5 Factors that influence the sustainability of bamboo micro enterprises in the Nairobi City

Sustainable development was defined in the Brundtland Report in 1987 as "Development that meets the needs of the present generation without compromising the ability of the future generations to meet their own needs". The concept implies that the enlargement of human choices at any point would depend on environmental, social, economic, institutional and political, contexts. Thus sustainability encompasses more than environment. The BMEs operate within a complex environment, which is largely impossible to control and often difficult to predict. The business environment which is a combination of many factors presents a multitude of opportunities and threats for the BMEs. Bamboo experts, BME propriators and policy makers were asked on their opinions on the factors that affect the sustainability of BMEs in Nairobi city. Among the factors stated to influence the sustainability of the BMEs are; Environmental, socio-cultural, Economic, technological and political/legal factors (figure 8).

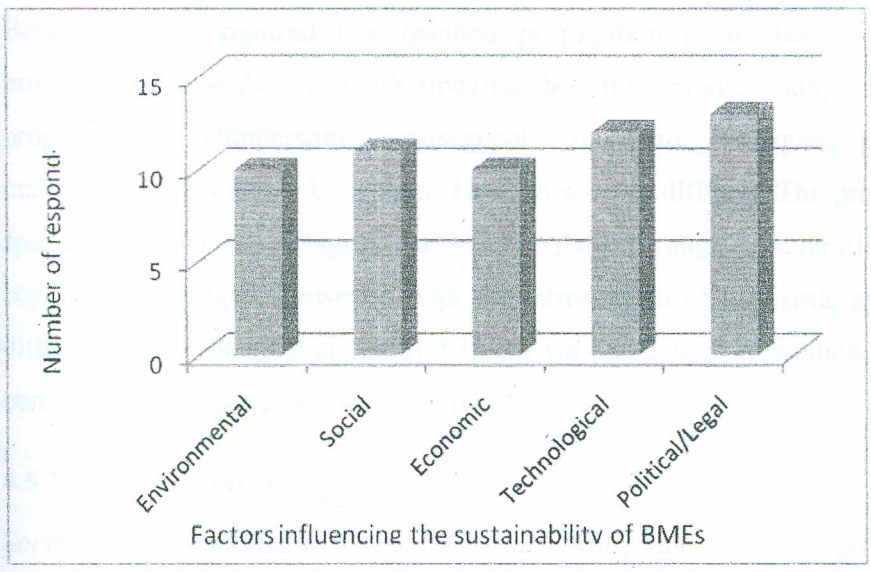

Figure 8 Factors affecting sustainability of BMEs in Nairobi city

4.5.1 Environmental

• *Environmental sustainability* deals with natural resources — exhaustible and renewable — and ecosystem services and the reproducibility of global ecosystems services and ecological resources. Environmental sustainability emphasizes the proper use of natural resources and regeneration of the ecosystem so that future generations have the same opportunities as the present ones.

Bamboo can be harvested sustainably, after a clump is five years old, harvesting culms annually from it only increases the vigor of the clump. Brias (2006) indicated that bamboo can be harvested from a clump for up to a hundred years. The BMEs that made bamboo furniture and artifacts had inconsistent supply of raw materials, especially the ones that bought bamboo from the timber yards. This is mainly because of the ban on bamboo harvesting and the supply of culms from farms is not sufficient. In Kenya, there is no bamboo resource data baseline, no inventory and therefore no monitoring system in place. Statz (2007) noted that Kenya's bamboo resource base is largely unknown, past and present uses are largely spontaneous and are generally not being properly recorded. This therefore inhibits efforts for planning and management for the bamboo resources. Nine respondents argued that Nairobi and Kenya in general has a good agro climatic environment that will favor the growth of bamboo and equally benefit from it. However, Brias (2006) recognized that bamboo propagation is another challenge in Kenya, propagation by seeds is difficult since bamboo flowers after many years yet vegetative propagation is cumbersome. Consequently there are inadequate planting materials, making planting outside indigenous bamboo sources difficult. The predominant bamboo species in Kenya has a highly restricted ecological range thus limiting its introduction beyond these ranges. However, with the introduction of 20 exotic species which suite different agro ecological zones by KEFRI, we can count on bamboo for environmental conservation and poverty alleviation purposes.

4.5.2 Socio-cultural

Socio-cultural sustainability reflects social norms, values and culture, social structures and social cohesion, which are conducive to ensuring enlargement of choices of all

segments of society in an equitable manner. If development is to be sustainable, it has to be owned by the entire society in terms of its philosophy. Such ownership will facilitate the commitment to, and understanding of the need for, not compromising the opportunities of future generations while undertaking development for the present time.

Bamboo is a native plant in Kenya that has for years had uses among Kenyans (Ongugo *et al.*, 2000). This can be confirmed by the fact that many tribes in Kenya can refer to bamboo in their local language for example *Mirangi* (Kikuyu), *Techani* (Pokot), *Tegek* (Kips.), *Tekek* (Sebei), *Modi* (Luo) and *Mianzi* (Kiswahili) Ongugo *et al,* (2000). For some cultures in Kenya planting bamboo is taboo, other cultures do not have a cultural inclination on bamboo while for other cultures it is associated with luck and prosperity. However, during the study, the respondents, despite their cultural background all viewed bamboo as an appropriate plant for environmental conservation and economic utilisation. Ten interviewees argued that since many Kenyan local communities used it in the past, it can easily be adapted again.

Presently, the socio-economic benefits of bamboo to the local, regional or national economy have proved to be largely negligible since the ban on cutting of bamboo in 1986 through a Presidential Directive (Cindano and Omenda, 2007). As a result of the imposition of Presidential ban on exploitation of bamboo, hardly any bamboo finds its way to the markets. Introducing bamboo nurseries, using bamboo in agro forestry practices in the suburbs of the city would restore bamboo stock and make it available again for use to the people who have always had use for it.

4.5.3 Economic

• *Economic sustainability* addresses economic production and distribution as well as reproduction of the population. Economic sustainability requires building of human capabilities in an equitable manner through universal access to basic social services, equal economic opportunities, fairness in access to productive resources, sustained economic growth, etc.

The BMEs are employing a number of residents in Nairobi at the same time providing good bamboo artifacts and handicraft for buyers. Bamboo could be utilized and thus employing many people, thus, boosting the economy, according to nine of the respondents five of whom were BME propriators and had seen this first hand. However, retailers and consumers alike are not yet sufficiently aware of the multitude of potential uses and applications that bamboo has for the typical cottage industries. A major bottleneck for the micro enterprises is the lack of capital to build up a stock of products; this was also detected by Statz (2007). Funding to upscale activities is not available from commercial banks, at least not at affordable rates; this is likely to remain a limiting factor even if the use of bamboo gets legally sanctioned and politically promoted, again. Poor capital endowment and access to credits makes most BME's live from hand to mouth. They lack financial reserves and are thus prevented cottage industries from up-scaling their bamboo income generating activities.

There is a market for bamboo handicrafts in Nairobi, this was observed at the city centre where most of the entrepreneurs interviewed said that the bamboo items sell faster than other items and they make more profits mainly because there are very few bamboo product producers. However when it comes to other fancy items like kitchenware, curtain blinders etc, and the products Kenyans make face competition from products made from Asia. Odondo, (2007) revealed that 72% of fancy bamboo items in formal retail outlets are imported from Asia. The Asians have been making these items for ages and have mastered the skills of doing so. Moreover, they have the industries and most of their export items are well finished unlike the products from Kenya.

4.5.4 Technological

The availability of adequate technologies and systems for absorbing the technology are crucial to the success of any project where imparting technical skills is regarded as the core deliverable. This is all the more significant in the case of the bamboo sector where technological backwardness has been seen to be a major hindrance to growth and improvements in productivity. The traditional bamboo artisans use only hand tools, mainly different types of knives. Power operated small machines and modern hand-tools that improve productivity by reducing processing time are alien to most artisans.

Processing in all BMEs sampled is done by the most basic equipment such as a hacksaw to cross-cut the internodes, knives (one for splitting, the other for finer works) and a file used to sharpen the Knives (See plate 15). Twelve of the interviewees argued stated that using the appropriate technology would enhance the bamboo product quality, as the sector is currently relying on very backward technology . A similar scenario was revealed by Brias, (2006) and Statz, (2007). Where the BME made furniture they also had a drill, hammers and handsaws. This determines the speed of their manufacturing and the quality of the product manufactured. The products made by the bamboo microenterprises in Kenya have a very poor finishing; they are selling very fast at the moment, probably because previously bamboo furniture did not exist and they are seen to be unique by their customers. The BMEs are selling their items especially bamboo furniture mainly because they are not facing competition from well finished bamboo furniture from Asia. However, the BMEs sampled do not make smaller fancy items such as decorating items, cutlery as they lack the technological capacity to do so. Technology is clearly an obstruction to innovation in the Nairobi's BMEs. The product range from the bamboo microenterprises is still very low. Fourty products were recorded to be made and sold in Nairobi during this study in comparison to the 1500 (Statz, 2007) products that have been recorded globally.

Plate 15 Basic tools used in the BMEs

4.5.5 Political/Legal

Political sustainability encompasses reproducibility of power structures and governance mechanisms, along with the evolution of institutions and the institutional framework that would carry out the tasks ensuring that the present generation maximizes its choices but not at the cost of opportunities for future generations.

In Kenya, the structures and mechanisms governing bamboo are a constraint in many ways to the potentials bamboo has. The continuing ban on harvesting bamboo is a disincentive to its local innovative use and processing into products that are capable of generating income. The interviewees all asserted that the bamboo ban was slowing progres that would have been made in the sector among other political/legal factors.

An estimated 98 % of the bamboo we have is from government forests (Cindano and Omenda, 2006). It is therefore not practical to make long term plans for the sector, as there is a ban on using its resource. Bamboo is classified as a minor forest product; it is thus suppressed in recognition and development. Its classification as a non timber forest product too made past forest policies to place it among the less forest development priorities making it uncommon. A study by Jiafu (2001) in China also argued that despite recognizing the importance of bamboo to rural communities by the government in China, its potential productivity and ecological processes have not been brought into full play. This is mainly because bamboo is regarded as a "poor man's timber" and in many cases used when there is no "better" alternative.

Interviews with bamboo experts and BME proprietors showed that the bamboo sector is not coordinated at many levels: There is no proper interdepartmental cooperation to formulate and implement a comprehensive bamboo promotion strategy. A similar weakness has been reported by Jiafu (2001) to be a weakness in the development of the bamboo and rattan in tropical china. Cindano and Omenda (2006) indicated that natural leader and coordinator of a bamboo promotion strategy would be KEFRI, the Forest Department (FD) and the Ministry of Trade and Industries. The stakeholders have also failed so far to organize an effective networking. As a result, the sector has for a long

time been uncoordinated and disorganized. This has influenced the inability of the bamboo microenterprises to be represented in participation on policy matters.

4.5.5.1 Existing bamboo governance and Institutional arrangements

A number of Acts/ government policies are currently in place that when well enforced will facilitate the realization of bamboo's potentials. Interviews with policy makers and bamboo experts acknowledged the following; the Forest Act 2005, EMCA 1999, water policy, national food policy, national energy policy and the vision 2030 (figure 9).

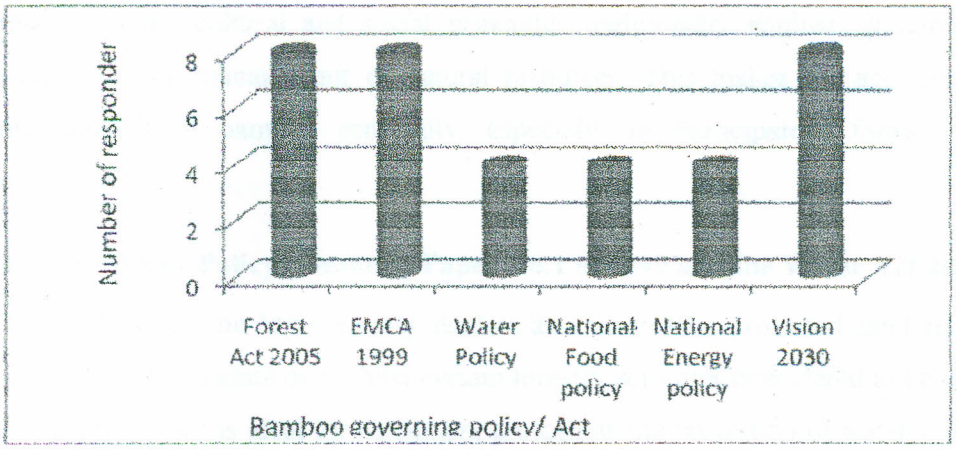

Figure 9 Existing bamboo governance policies/ Acts

4.5.5.2 The Forests Act (2005):

The important features of this Act that should boost the bamboo industry include: it recognizes bamboo as a tree in its definition provision. It stated that the terminology "Tree" included not only timber trees, but trees, shrubs, bushes of all kinds, seedlings, saplings and re-shoots of all ages, palms, bamboos, and any part of the tree. Poverty reduction, employment creation and improvement of livelihood through sustainable use, and prudent conservational management of forests and trees, promotion of the participation of the private sector, communities and other stakeholders in forest management, promotion of forest extension and promotion of forest research training and education to ensure a vibrant forestry sector all which should complement the BMEs. What is significant to this discourse is that In addition forest policies, Kenya has over 77

statutes that touch on forestry in one form or another (Figure 8). The following are some of the key ones:

4.5.5.3 Environmental Management and Co-ordination Act (EMCA) 1999

The EMCA was enacted to provide a framework for integrating environmental considerations into the country's overall economic and social development; and for harmonising the over 77 statutes relating to environmental management. The implementation of this Act is guided by the principal of public participation in the development of policies, plans and processes for environmental management. It also recognises the cultural and social principles traditionally applied by communities in Kenya for the management of natural resources. This makes the act relevant in the management of bamboo especially, especially to Participatory forest management initiatives.

4.5.5.4 Water Policy- Sessional Paper No.1 of 1999 and the Water Act 2002

Under this Act, the Minister may declare an area to be a protected catchment area and order, require, regulate or prohibit certain forestry activities considered to be not in public interest. This Act is ideal for catchment protection and protection of water sources within the forests such as the natural bamboo ecosystem range in the country.

4.5.5.5 Agriculture/National Food Policy – (Sessional Paper No.2 of 1994)

This Act promotes soil conservation and prevents the destruction of vegetation. It can help address the biggest threat to forest conservation i.e. short term shifting cultivation or the slash/burn agriculture, which is one of the main forces behind forest degradation and consequently reduced bamboo cover. The Ministry of Agriculture, in the recent past, has developed the Strategy for Revitalizing Agriculture (SRA), and a Policy on Agricultural Extension. These are significant policy frameworks that can be called upon to promote enforcement of the Forests Act (2005) in relation to soil conservation and food security.

4.5.5.6 National Energy Policy/Energy Act 2006

The policy ensures that the relevant ministries, NGOs and other organizations address environmental problems associated with the supply and use of energy (charcoal and fuel

wood). The Act in particular supports the promotion and development of renewable sources of energy, especially through agroforestry; and the conservation of energy through appropriate technologies. Bamboo can substitute for wood in many scenarios and among the appropriate technology that can be obtained is bamboo energy.

4.5.5.7 The Kenya vision 2030

The Kenya vision 2030 aims at making Kenya newly industrializing "middle income country providing high quality life for all its citizens by the year 2030". The vision was based on three pillars namely. The Economic Pillar which aims at improving the prosperity of all Kenyans through a transformation programme covering all regions of Kenya, with an average GNP growth of 10% per annum. The Social Pillar which seeks to build a just and cohesive society with a social equity in a clean and secure environment. Finally the Political Pillar which aims at realizing a democratic political system that nurtures issue-based politics respects the rule of law and protects all the rights and freedoms of individuals. The realization of the vision therefore would provide an enabling environment for the thriving of the bamboo sector.

5 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter gives the summary, conclusions and recommendations of the study. It is divided into three parts, the first part gives the summary of the findings, the second part gives the conclusions of the study and the third part gives the recommendations that would improve the BME sector.

5.2 Summary

The bamboo microenterprises (BMEs) consist of a few workers mostly less than ten, some specialize in specific activities while others multitask. Most of the BMEs did not have a secure source of bamboo culms. They source their raw material from bamboo depots, farms in neighboring towns and even residential compounds that have bamboo within the city with none of these sources being completely reliable. For most BMEs the bamboo products were made and sold from the same venue, some however sold their products in market centers. There is a market for the bamboo products in the city; this was indicated by the rate at which the few bamboo products produced were sold.

The BMEs in Nairobi have created employment to bamboo seedlings producers, bamboo hardware and bamboo artisans. The sector is broad and accommodates people with varying skills and education backgrounds. For example, the youth with artistic skills were mainly in bamboo utilization, i.e., handicraft work and designing; women were seen to be part timers in bamboo retailing and bamboo nursery maintenance/ gardening; and people with a post secondary school education were seen to juggle different activities in the BMEs such as designing, marketing and overall administration of the BMEs. The level of education of the BME workers mostly influenced the duties they had in a BME and, as a result, influenced their income i.e. their income rose with increase in education.

The study established that BMEs have a lot of potential for environmental conservation. Bamboo nurseries provide bamboo seedlings that are mainly used for city greening and beatification. They also have provided seedlings for conservation projects like the

There are positive and negative factors influencing the sustainability of BMEs. The introduction of bamboo species that suite different climates in Kenya are a boost to the sector. The economic significance of bamboo, its socio-cultural value and adaptability to different environments all strengthen the sector. The bamboo sector is however derailed by technological backwardness and the ban on bamboo harvesting which has slowed the development of the sector as an estimated 98% of bamboo is in gazzeted forests.

5.4 Recommendations

1) The BMEs need to be licensed and create an enabling environment by gradually establishing linkages and partnerships that will create a smooth chain flow of activities. This should ensure constant supply of bamboo culms to processors and also formalize the marketing arrangement for bamboo products.
2) Coordination among the BMEs which will improve marketing and as stakeholders can lobby for lifting of the bamboo ban and any issue which might come up in future.
3) BMEs need to be assisted in polishing their bamboo propagation, preservation and utilization skills; this can fall under KEFRI's awareness creation on bamboo. The people who are already working in the BME's can be trained further on improving the quality of their work or the BME's could be assisted with appropriate machines that will enhance increase the quality of bamboo items made. The youth in the urban areas could be trained on bamboo utilization and the youth in the rural areas on bamboo propagation.
4) There is need to sensitize women in bamboo related Income generating activities such as bamboo chopstick and toothpick making, weaving and curio making these will be especially beneficial to the women as they can earn money without interfering with their day to day chores.
5) Efforts need to be taken to promote the cultivation of bamboo species good for craft to provide a larger range of bamboo items and ensure sustainable supply of the same.

6) Shipping of bamboo from towns outside Nairobi to the bamboo yards in the city can be done to complement the small supply of bamboo from the natural forest and the city and thus ensure sustainability of the resource. The bamboo in conservation projects in Nairobi could be used as case examples and be replicated in other afforestation conservation projects in the country.
7) The Government needs to be proactive in tapping opportunities in the bamboo sector; it is a new addition to the SME sector in the country. It is unique in that it is a very eco friendly SME. This can be done by partnering with the private financial institutions to evolve special packages for development assistance.

Areas of further research

1) A quantitative study on the profit the BMEs are making should be done.
2) An Assessment on the viability and potential of BMEs in Environmental Conservation and poverty alleviation in a Kenyan rural setting.
3) A follow up study on bamboo's effectiveness in rehabilitation of rivers of Nairobi needs to be done.

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Appendix 1 Research tools

(A) Questions for proprietors

Introduction

Maseno University is carrying out a survey on the potential of micro enterprises in environmental conservation and alleviating urban poverty in Nairobi city. This questionnaire is directed towards getting an insight of bamboo micro enterprises from a proprietor's perspective. Your open and genuine responses will be highly appreciated and treated with confidentiality. The information obtained will be used only for academic purposes.

Instructions; please tick or fill gap where appropriate
All money is written in Ksh.

Interviewed by: Date of Interview:

GENERAL:

1) Name of Micro Enterprise_____
2) Address_____
   _____
3) Name of Key Informant
   _____Position_____
4) Age
5) Gender [M] [F]
6) When was this enterprise formed?