THE ROLE OF NON WOOD FOREST PRODUCTS IN IMPROVING LIVELIHOODS OF COMMUNITIES SURROUNDING JOZANI AND CHWAKA BAY NATIONAL PARK, ZANZIBAR

BY

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ABSTRACT

This study was conducted to asses the role of Non Wood Forest Products (NWFPs) in improving livelihoods of the communities surrounding Jozani and Chwaka Bay National Park in Zanzibar. The study aimed to document, asses the status and contribution of NWFPs, identify roles of user groups and constraints towards development of NWFPs in the study area. Six villages were selected based on accessibility to the forests and availability of NWFPs. Study was conducted in two phases: Phase one involved preliminary surveys and Participatory Rural Appraisals. Phase two was questionnaire surveys with households, key informants and field inventory. Data on PRA were analyzed with the help of local communities, while Statistical Package for Social Science (SPSS) was used for questionnaires. Revenue accrued from different sources was computed in MS Excel. A total of 88 and 26 NWFPs plant and animal species respectively were recorded. NWFPs contribute 27 % of household's food security, 32 % of income generation while 97 % of households rely for primary health care. The study revealed some constraints towards development of NWFPs. It is concluded that NWFPs contribute in improving livelihood of communities for subsistence, primary health care and income. The study also noted a decrease in NWFPs. It is concluded that gender roles has influence in collection, processing and marketing of NWFPs. It is recommended that information and training on NWFPs should be provided to the communities. Also utilization plan of NWFPs should be developed and collaboration between government and communities is needed to improve protection of the resoures.

DECLARATION

I, Nassor Said Mkarafuu, do hereby declare to the Senate of Sokoine University of Agriculture (SUA) that this dissertation is my original work and that it has not been submitted for a higher degree at any other University.

…….. ……

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The above declaration is confirmed

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DEDICATION

This dissertation is especially dedicated to my family.

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LIST OF ABBREVIATIONS AND ACRONYMS

DCCFF	-	Department for Commercial Crops, Fruits and Forestry
DFID	-	Department for International Development
DRC	-	Democratic Republic of Congo
FAO	-	Food and Agricultural Organization
GDP	-	Gross Domestic Product
GEF	-	Global Environmental Facilities

Ha	-	Hectare
IUCN	-	International Union for Conservation of Nature
JCBNP	-	Jozani and Chwaka Bay National Park
MNRT	-	Ministry of Natural Resources and Tourism
MOFEA	-	Ministry of Finance and Economic Affairs
NCDP	-	National Coconut Development Project
NWFPs	-	Non Wood Forest Products
PRA	-	Participatory Rapid Appraisal
SUA	-	Sokoine University of Agriculture
Tshs	-	Tanzanian shillings, equivalent to 0.0007 US $
UNEP	-	United Nation Environmental Programme
URT	-	United Republic of Tanzania
US $	-	United States Dollar, equivalent to 1 350 Tshs
ZFP	-	Zanzibar Forestry Plan

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background information

Non-Wood Forest Products (NWFPs) are defined as all goods of biological origin (both plants and animals) other than wood as well as services derived from forests and allied land uses (FAO, 2007a). The NWFPs range from animals to plants of different species, types and size. The NWFPs are responsible for the direct and indirect daily living of the macro and microorganism on the globe (Herman, 1995). Direct benefits include food (nuts, fruits, mushrooms, honey, gum, and game), fodder, fragrances for perfumes, ornamental pods and seeds, resin, oils, plants and animal products with medicinal values. Indirect benefits include watershed protection, climate regulation and carbon sequestration, soil protection and conservation functions.

Forests provide NWFPs which are important component of household nutrition and health care in Africa (Katerere, 1998). Despites the facts that the NWFPs are undervalued by policymakers and planners however, they provide food, fibers, fodder, and medicines products (Katerere, 1998). The policy makers value the forests in economic terms only when they are harvested. However, worldwide NWFPs are a traditional source of household income in rural areas (Neumann and Hirsch, 2000).

The basic important feature of NWFPs is the continuous flow of returns compared to timber where the returns are available at an interval of rotation period, and this feature can be used intelligently and strategically for conservation of forest

resources through proper forest management practices (Neumann and Hirsch, 2000). The products constitute an important source of livelihood for millions of people from forest communities in the world. Extraction, processing, consumption and sale of these NWFPs are crucial elements for communities' livelihoods development (Pimental *et al.*, 1997). Also NWFPs are important tools in addressing poverty issues for marginalized, forest dependant communities, by contributing to livelihood outcomes, including food security, well being and income (FAO, 1995; Falconer, 1997).

The NWFPs has been promoted as a contribution to the sustainable development of tropical forest resources through commercialization of the products (Arnold and Perez, 1998). The interest is based on earlier perceptions that forest exploitation for NWFPs can be more environmentally friendly than timber (Myers, 1988). There is a growing recognition worldwide on the income generation contribution made by many NWFPs to rural livelihoods (Perez *et al.*, 2004).

The NWFPs development in the country needs investments in industry for products development and marketing. These need to be promoted in order to utilize the full potential as well as to domesticate and commercialize the products with demand and improve the efficiency and profitability of forestry activities to promote the supply of forest products for national consumption (ZFP, 1996).

1.2 Problem statement and justification

The problem of poverty is facing many societies in the world, particularly third world countries. In Tanzania like most other third world countries, poverty as

measured by income, tends to be at worst in rural areas (World Bank, 1990), where the national account of Tanzania assumes that people in coastal regions have less than Tshs 100 000 per capita GDP at current prices (Hale, 2003).

Zanzibar is endowed with diversity of wood and NWFPs that have significant economic contributions to the community livelihood and national economy at large. The coastal and thickets forests provide numerous products and services necessary for community livelihood, which are also potential for commercial purposes (Zoltan, 1995).

In the communities' surrounding Jozani and Chwaka Bay National Park (JCBNP) in Zanzibar as other communities in the coastal areas, the income is low and the contribution of NWFPs to household food security and income is not known. The majority of rural people in the area depend on agriculture, which is at subsistence level (URT, 1997). In such situations NWFPs has been a vital source of subsistence and livelihood strategy in the area. According to (Kajembe, 1994; Makonda, 1997; Kessy, 1998; FAO, 2002; Lema, 2003) NWFPs can also be sold in local region or international markets to increase household income.

On the other hand the area of Jozani and Chwaka Bay National Park has a lot of NWFPs, which have a potential to contribute to improved livelihood of communities (Soud *et al.,* 2004). The area has abundant of NWFPs species but most of them have not been promoted and entered into national and international markets which need further studies. Some of social studies including Participatory Forest Management (Idd and Tamrin, 2006) and the nature and the role of local benefit

(GEF, 2004), the value of wood or forest products and their contribution to Zanzibar economy (Masoud 1990, Zoltan, 1995, Leskinen *et al.*, 1997) have been done, but the role that NWFPs play to communities' livelihood is inadequately documented.

It has been noted that, despite its greater role in provision of food and employment, NWFPs are viewed as secondary products and undervalued (Tewari, 1994). Furthermore, the author observed that economists tend to ignore NWFPs contribution since many of the products do not enter the market. Also, Blocknus (1993) expressed regret to manage and value timber resources only and neglect NWFPs as such approach may fail to maximize the actual value and contribution of the forest resources.

Although, there has been increasing awareness of the contribution of NWFPs to household in different parts of the world, still there is a need to undertake critical studies to determine contribution of NWFPs to the communities (Arnold and Perez, 1996). Therefore, this study was designed to assess the role of NWFPs in improving livelihood of communities surrounding Jozani and Chwaka Bay National Park in Zanzibar. Results from this study will contribute knowledge to the NWFPs database in Zanzibar and Tanzania as a whole, help in establishing priority list of NWFPs utilized in the area, form basis for developing harvesting and marketing strategies and develop utilization plans of the NWFPs. All these aims to improve the livelihood of people in the study area and Zanzibar as a whole.

1.3 Objectives

1.3.1 Overall objective

To assess the role of NWFPs in improving livelihood of communities surrounding Jozani and Chwaka Bay National Park in Zanzibar.

1.3.2 Specific objectives

(i) To identify and document available NWFPs and how they are used in the study area,

(ii) To assess the status of available NWFPs species in the study area,

(iii) To assess the contribution of NWFPs to food security, income and health care in the study area.

(iv) To identify the roles of different user groups in collection, processing and marketing of different NWFPs in the study area.

(v) To identify constraints towards development of NWFPs in the study area.

1.4 Research questions

(i) What types of NWFPs are found and used by communities around the study area?

(ii) What is the status of NWFPs availability in the study area?

(iii) In which ways can NWFPs contribute to food security and household income?

(iv) Who has the role of collecting, processing and marketing the NWFPs?

(v) What problems hinder the development of NWFPs in the study area?

1.5 Hypothesis of the study

H_A: Non wood forest products have significant contribution to livelihood of communities surrounding JCBNP.

H_O: Non wood forest products have no significant contribution to livelihood of communities surrounding JCBNP.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Forests in Zanzibar

Forests play an important role in the lives of the people of Zanzibar. They are important sources of food, fodder as well as shelters for water reserves and estuaries of fish and breeding areas (Leskinen *et al.*, 1997). Zanzibar has a total area of 2332 km^2 of which 52 % is covered by natural forests and 6 % is plantation forests while, 42 % is for agriculture and settlements. It is estimated that about 200 000 people in Zanzibar engage in forest activities every year (DCCFF, 2007) and the rural population living around these forest areas have been relying heavily on the use of material derived from these forests to improve their livelihoods and these forests make a particularly important contribution to the rural communities' livelihoods.

The forests of Zanzibar have areas of moist tropical forest, coastal evergreen thicket, swamp forest, open marsh and mangroves (DCCFF, 2007). Some of the main tree species dominated is *Polysphaeria parvifolia, Calophyllum inophyllum, Eugenia spp, Pandanus rabaensis, Vitex doniana, Elaeis guinensis, Anthogleista grandiflora, Bridelia micrantha, Ficus spp, Quassia undulate, Antiaris toxicaria, Bombax rhodognaphalon* and *Uapaca guinensis* (Leskinen *et al.*, 1997). Besides that, forest remnants are believed to have a wider list of wildlife such as flower plants, birds, reptiles and amphibians. However, these forests are homes to some species listed by the World Conservation Union (IUCN) as 'Critically Endangered' and found nowhere else in the world but Zanzibar. For example in Pemba the Flying Fox (*Pteropus voeltzkowi*), which are found in Ngezi forest. It is also home to the endangered Eastern Tree Hyrax (*Dendrohyrax validus*) and species of

amphibians and forest plants. It has a variety of endemic bird species, such as the Pemba Scops Owl, the Pemba Green Pigeon, the Pemba White Eye and sunbird. Also some species are found in Jozani and Chwaka Bay National Park in Zanzibar such as red colubus monkeys and endemic bird specie of *Fischers tourako fischeri*. Also, there are forest plantations dominated by species of *Pinus caribaea*, *Acacia auriculiformis, Casuarina equisitifolia* and *Eucalyptus spp* which have been established for the purpose of wood production to balance the gap between supply and demand in addition to environmental protection (DCCFF, 2007).

2.2 NWFPs and community dependency

Worldwide the community dependencies on NWFPs are either directly or as supplements of food, fodder, medicine and construction materials. There are other uses for NWFPs such as farm tools and implements, household baskets, mats, pillows, sponges and brooms (FAO, 1995; Arnold 1995). Furthermore, other services include fodder and pasture for grazing, water catchments, climate amelioration and carbon sequestration. In Southern Africa there are major rivers such as Zambezi, Kafue and Lualaba, Okavango, Ruaha, Rufiji and Ruvuma, Save and River Congo. These rivers have their headwaters in the major forest ecosystems of the region. Forests also regulate climate through the processes of the hydrological and carbon cycles. In Africa, NWFPs contribute substantially to livelihoods outcomes, in terms of food security, health and well being, and income and contribute significantly to national economic growth and international trade (Chikamai and Tchatat, 2004). Development of NWFPs is considered important to improve people's welfare and is linked to the economy of that society and environment is usually related to ecology (Nichols, 1991).

2.2.1 NWFPs as source of food

NWFPs contribute to household food security and family nutrition through different mechanisms. Rural communities use the products to meet a significant portion by supplementing family diet (Karki, 2001). These foods are often significant in providing essential vitamins, minerals, carbohydrates and protein. Rural households often turn to NWFPs resources in response to agricultural shortfalls and other contingencies (Tewari, 1994). These products might be collected for direct consumption or be sold to generate income for food purchasing. Edible nuts for example in Africa are often used by mankind for food, edible oils, spices, condiments or beverages. They have been an important food source from prehistoric times and are among the most nutritionally concentrated of human foods, high in protein, oil, energy, minerals and vitamins (FAO, 1995).

Some wild fruits are also used for the extraction of oil products. For example, the oil palm, *Elaeis guineensis* which is the largest single source of oleaginous products, the shea-butter tree, *Vitellaria paradoxa*, of the Sudan-Guinea zone and Raphia palm a species which seems to offer an equal or even greater potential for oil production, whose oil has only been commercialized and it produces a valuable fibre (FAO, 1995).

Wild animals are also important forest foods. The diverse of species consumed includes birds, and their eggs, insects, rodents, larger mammals and fish (FAO, 1991; Hamza, 1997). Animals and their products attract attention of a variety of people ranging from hunters to tourists and zoologists (Makonda, 1997).

Honey is the most important non wood forest product of beekeeping industry (Hamza, 1997), with several derived products includes wax, pollen, royal jelly and propolis. Usually bee products are renewable resources and with appropriate techniques, they can be exploited without detrimental effect to the environment. Honey forms a natural nutritious food for the rural and urban people, as well as medicine. Roots and tubers usually constitute a major food source in forest areas. Forest yams, which constitute the tubers of lianas, are consumed in Africa, Australia and Asia (FAO, 1995). Most of roots and tubers are obtained from wild plants and used as food (flour for porridge). However, tubers are very small in size and are too few to constitute a complete meal (FAO, 2000).

2.2.2 Traditional medicine

Traditional medical practices in Africa, like in many developing countries, are widespread and deep rooted. Most medicines are from plants with a majority coming from forests and allied ecosystems. More than 3.5 billion people in the developing world use plants for their primary health care with more than 35 000 species being used (Balick and Cox, 1997; van Seters, 1997). Approximately 3 000 plants in South Africa are used as medicines out of which 350 are commonly used and traded (van Wyk *et al.,* 1997).

Forest medicines form the base of the African traditional medicine in terms of socio-economic and socio-cultural heritage, servicing the majority of the population in Africa, coming a long way from the times of our ancestors. Traditional Medicine is the first-choice healthcare treatment for more than 80 % of Africans who suffer from simple and other common ailments (Marshal, 1999; Maximillian, 1998;

Chandrasekharan, 1993). WHO has estimated that up to 80 % of people in the developing world are dependant upon traditional medicines primarily because of their easy accessibility, wide affordability and cultural familiarity.

2.2.3 Fodder

In Africa, especially in arid and semi-arid areas, rural families keep domestic animals. Forests provide the pasture for grazing as well as fodder for stall-feeding (FAO, 1995). It may be interesting to mention here however, the case of the relation between milk production and the availability of green leaves of trees and shrubs in the ranges in arid and semi-arid areas. During the dry season in these areas, grasses are completely dry and do not contain any carotene, the nitrogen elements represent only 1 % of the dried matter; thus the only source of digestible nitrogenous matter comes from the leaves of trees and shrubs. It is therefore easy to imagine the importance of trees and shrubs in the ranges for these pastoral communities where milk is one of the most important staple foods (FAO, 1993).

However, fodder is one of the most important NWFPs in Africa. In Lesotho, Namibia, Swaziland, Zambia, Zimbabwe and South Africa major species providing fodder include *Adenium obesum* in the case of Swaziland, *Colophospermum mopane* for Namibia as well as *Acacia tortilis*, *Afzelia quanzensis*, and *Bauhinia thonningii* in Zimbabwe (FAO, 2001).

2.2.4 Ornamentals

Ornamentals are a prosperous new industry that has sprouted. The development of an export market for fern (*Rumohra adiantiformis*) has flourished into an industry earning over US$ 300 000 per annum, giving employment to about 250 - 300

people. However, the indigenous flowers and bulbs contribute approximately to 1 % of the total national value of agricultural production in South Africa (Maliehe, 1993).

2.2.5 NWFPs as sources of employment and income generation

NWFPs provide one of the good avenues for employment in many regions. Collection and sale of medicinal plants and other NWFPs alone are considered to be one of the biggest sources of seasonal employment. Forests contribute in improving the household economy through generation of income from sale and exchange of gathered and processed of these products (Taylor, 1999).

It has been observed that, households living in miombo woodlands in Tanzania derive more than 50 % of their cash incomes from selling forest products such as honey and wild fruits (Monela *et al.*, 2000). Nevertheless, Prasad (1999) found that small scale forest based enterprises, many of which rely on NWFPs, provide up to 50 % of income for about 25 % of Indian's rural labour force.

2.2.6 Watershed protection

Water plays not only a critical but distinct role in the ecological-economic process (Lant, 2004). Water is a raw material, a factor of production of a number of marketable commodities, some of which are themselves factors of production of other final goods. Due to its contribution to human health, treated potable water for domestic use is enormously valuable in producing human capital, whether it is delivered as a commodity by a private-sector firm, as a public service by a government-owned utility, or by some other institutional arrangement. Water in

estuaries, rivers, lakes, wetlands, soil, and other components of the hydrologic cycle is a, if not the, critical factor of production of ecosystem services. In fact, one could argue that without water no ecosystem services could be generated (Mitsch and Gosselink, 1993).

According to FAO (1992), the presence of forests and bushland helps to lower water tables, lessen the risks of salinization, and help to stabilize water supplies. Woody debris provides fish with habitat while leaves and decaying wood provide nutrients to a wide array of aquatic organisms.

2.2.7 Climate regulation and carbon sequestration

The significance of forests in climate change, especially their role as carbon sinks is gradually being recognized (Chikamai and Tchatat, 2004), despite too many scientific uncertainties associated with carbon sequestration by forests and land use changes fueled by lack of capacity to quantify such changes in most developing countries, including Africa. Evidence of global warming is well established (Hulme, 1996) and Africa is believed to be contributing up to 7 % of the green houses gases (Silveira, 1994).

2.3 Harvesting and post harvest handling of NWFPs

Harvesting is the activity linking resource management and resource utilization and thus influences resource sustainability. Harvesting of NWFPs of both wild and cultivated sources is different from wood harvest in terms of the use of tools and equipment, technology, pre-harvest preparations, post-harvest treatment and requirement of intermediate processing (FAO, 1996).

The harvesting techniques, including pre-harvest and post-harvest treatment, for the various NWFPs varies considerably for both wild and cultivated sources; ranges from destructive to non-destructive techniques and is of fundamental importance in guaranteeing the sustainability of the resource (FAO, 1996).

The harvesting procedures for many non-wood products are poor and undeveloped, thus wasteful, destructive and unsustainable. This is due to the fact that small volumes are involved for individual NWFPs in most cases, tending to decrease the attention devoted to their harvesting. The collectors are mostly unskilled and untrained in proper methods (Chandrasekharan, 1993). Inefficiency of appropriate processing, preservation and storage techniques limits their potential contribution to the household diet as some species may not be edible as such and as many forest foods, being perishable, can only be consumed for a limited period in the year (FAO, 1995).

2.4 Processing of NWFPs

NWFPs need to be processed before being utilized, sold and stored for future use. Processing add value to products, provides local employment and helps to increase the retention value in the country of origin. Processing and trade of NWFPs are often seasonal due in part to the seasonal availability of raw material and an acute need for cash and/or the availability of labour during slack agricultural work (FAO, 1995). The important processing methods of NWFPs are smoking, sun drying, grafting and production of beverage (Gumbo *et al.*, 1990).

2.5 Commercialization of NWFPs

Commercialization of NWFPs is often seen as a way to generate income for local communities while conserving biodiversity in an environmentally sound way (Belcher and Schreckenberg, 2007).

According to Belcher (1998) commercialization of NWFPs is important because it enables rural dwellers and poor urban households to diversify their source of incomes, which contribute to their food security and reduce their level of poverty; it increases the economic value of NWFPs thereby increasing the awareness and incentives for local communities to conserve forests. Despite the NWFPs having potential to become substantial sources of revenue, in many communities they are under exploited. For example, in some cases, people make considerable use of the products, but their commercial value is low (Brigham *et al.*, 1996). Also some of the gathered products have low value in rural areas due to high supply, competition amongst sellers, low price and low rural demand especially during the season of abundant production (Brigham *et al.*, 1996).

From the marketing point of view, markets comprise of their geographic location, end uses, customer needs and wants of the buyers. Geographically, markets for most of the internationally traded NWFPs are in industrialized countries in Europe, Japan, Oceania and North America. There are also large domestic markets both in the developing and industrialized regions (Anderson, 1989).

2.6 Gender and NWFPs activities

Men and women have different roles in utilizing the NWFPs. It has often been assumed that products which contribute through direct consumption are under the control of women while men collect products that generate income. However, evidence show that women are greatly involved in several forests based gathering and processing enterprises (FAO, 1991).

Marketing of NWFPs have also showed some different groups. For example most of honey sellers are men while the majority of women are mats and baskets makers. Kajembe *et al*. (2000) reported similar findings where most hunters and wood cavers were men. Also FAO (1991) reported that in Rufiji district, Tanzania, the majority of women were involved in low income generating activities such as mat and basket weaving, while men had the tendency to produce for market and women for domestic consumption, thus earning low returns.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Study site description

3.1.1 Location

The study was conducted in the villages surrounding Jozani and Chwaka Bay National Park (JCBNP) in Zanzibar – Makunduchi road which is about 35 km south-east of Zanzibar town in South Region. The area is situated at latitudes 3^0 20’ and 8^0 48’ and longitudes 29^0 05’ and 31^0 15’, with an altitude of 15 m above sea level (DCCFF, 2006). Six villages namely Kitogani, Charawe, Ukongoroni, Bwejuu, Cheju and Chwaka (Fig. 1) were studied, while NWFPs resource assessment was conducted in the dense thicket, evergreen bush and mangrove forests (Appendices 11, 12 & 13).

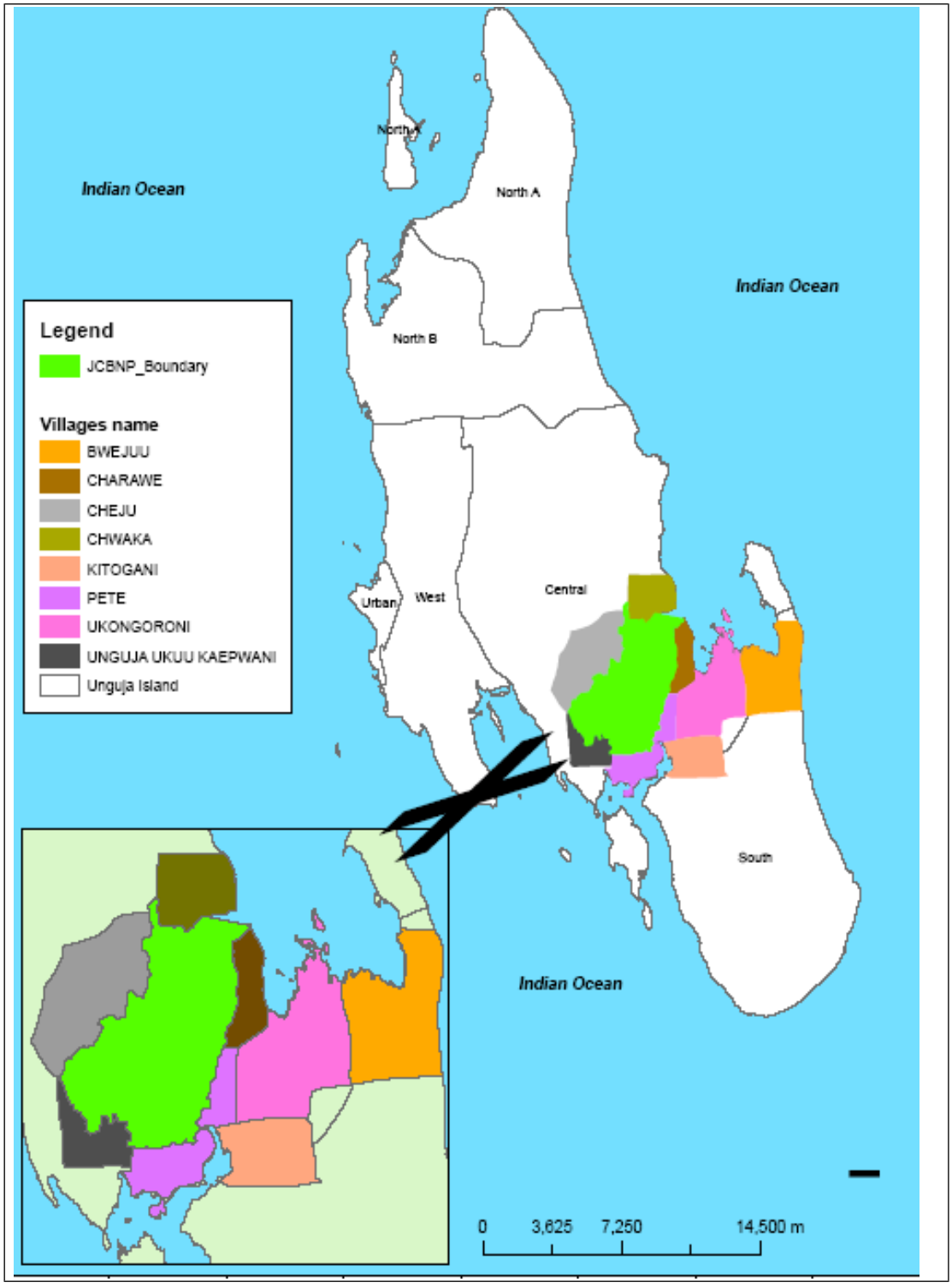

Figure 1: Map showing the location of the surveyed villages surrounding JCBNP

Source: DCCFF (2008)

3.1.2 Climate

The climate of the study area is tropical maritime, follows the monsoon winds and is dominated by a binomial rainfall pattern (NCDP, 1980). The main rain season (*masika*) occurs between March and June. The short rains (*vuli*), usually starts in October and ends in December. However, some inter-monsoonal precipitation takes place. The average rainfall is about 1500 mm per annum. Between February and March is the driest period of the year with about 20 mm of rainfall. The highest temperatures occur during the short dry season with a maximum mean of 33^{o} C and the minimum temperatures of 23.3^{o} C (Wirth *et al.*, 1988).

3.1.3 Vegetation

The vegetation of the area ranges from evergreen bush which is found on the western side, dense thicket vegetation is covered in north western part and mangrove forests found in the eastern part of JCBNP (DCCFF, 2006). However, biogeographically the flora of Jozani belongs to the Zanzibar - Inhambane regional centre of endemism (UNEP 2001), which extends from Somalia to Mozambique.

JCBNP contains a wide range of discrete vegetation communities, containing some rare and endemic species (Nahonyo *et al.,* 2002). Ground water forest occupies the central area, enclosed by coral rag forest and bushland. Well developed mangroves are situated to the eastern part, with less well developed mangroves around the village of Pete to the south.

The area covered by JCBNP is dominated by bushlands (31% by area); the western area, being at a slighter higher altitude, is dominated with lower bush with few or no large trees, whilst the eastern area is dominated with bushland with emergent

trees. The area between the bushlands forms a valley where Diospyros forest, ground water forest and salt marsh may be found (Nahonyo *et al.*, 2002).

3.1.4 Population

According to 2002 human census, the surveyed villages have a population of 10 866 and 2088 household (Table 1).

Table 1: Number of population and household in the surveyed villages

Village	Population	Number of households
Cheju	1577	342
Charawe	1060	143
Ukongoroni	1020	155
Chwaka	2912	587
Bwejuu	2848	691
Kitogani	1449	170
Total	**10 866**	**2 088**

Source: *Population Census (2002).*

3.1.5 Socio-economic activities

The major socio-economic activity in the area is agricultural related activities and about 75 % of the household were engaged in small scale subsistence farming (MOFEA, 2006). The main agricultural crops include rice, cassava, banana, yams, beans and maize. Others household activities include fishing which provides the main source of protein, but not every household have a fisherman. The activity is seasonal and traditional canoes with poor fishing gears are still used. Also beekeeping activities are practised in the study area. However, some of the villagers were engaged in off farm activities (small scale industries) and wood related forest activities.

3.1.6 Soil

The type of soils in the study area is varying widely ranging from deep rich fertile soil which comprises vegetation of evergreen bush. Also coral rag soil which characterized by a thin layer of soil pockets with coral out crops. Other type is the coastal limestone, which give rise to well drained, heavier texture soils (Beentje, 1990). However, the soil is rich, black and highly organic. This soil types ceases abruptly at the forest margin, giving way to broken coral rag with shallow pockets of light brown sandy soil (Pikkarainen, 1991).

3.2 Data collection methods

3.2.1 Source of data

Both primary and secondary data were used. Primary data was collected from social survey through households' questionnaire (Appendix 1), in addition, the data from market survey and NWFPs resource assessment in the forests, supplemented the primary information.

Secondary data were collected from different sources including reviewing relevant documents like journals and books, published and unpublished documents from Sokoine University of Agriculture (SUA) library and Department for Commercial Crops Fruits and Forestry in Zanzibar. The electronic databases such as CD – ROM and website were also explored. Also some information were obtained from districts forest office in Zanzibar. The aim was to review the researches which have been done to the interest of the current study, and identify gaps in information.

3.2.2 Sampling, unit, design and procedure

The sampling units taken were households and key informants for social survey as well as sample plots for NWFPs assessment in the forest. A cross-sectional design was used during data collection. According to Bailey (1994) such research design allows data to be collected at a single point in time without repetitions. The design uses minimum time and resources. The survey involved interviewing sampled respondents and discussions with the focused groups. The study was conducted in two phases.

The first phase involved a preliminary survey, in which Participatory Rural Appraisal (PRA) techniques were employed in the villages of Kitogani, Cheju and Bwejuu. During preliminary survey familiarization to the study area was also done whereby pre-testing of the questionnaires, group discussions and transect walk were done. Also the village economic activities were observed by the researcher. The second phase of the study based on questionnaire surveys with households and key informants.

3.2.3 Socio economic survey

Six out of nine villages surrounding JCBNP were selected for the survey. The selection of the villages based on accessibility to the forests and availability of NWFPs around the area. The villages involved were Cheju, Charawe, Ukongoroni, Chwaka, Bwejuu and Kitogani. Random sampling of households as a representative of the population was done from village registers. By using simple random sampling procedure, a sample size of thirty households was taken in each selected village as recommended by Bailey (1994).

A household was taken as a unit of analysis since Thomson and Metz (1997) have argued that all decision about production, collection and consumption are taken at household level. The household head was a target for the interview, but other members also based on age, education level and gender, were encouraged to supplement the information.

3.2.3.1 Questionnaire survey

The questionnaires were designed to facilitate both quantitative and qualitative information. Structured and semi-structured questionnaires with both closed and open-ended questions (Appendix 1) were employed for interviewing heads of households. In these questionnaires the respondents had to give their own views in open ended question and choose among the designed alternatives in close ended questions. Data collection was focused on different types of NWFPs, season for collection, collectors, uses and processes of NWFPs. Also, data included on socio economic variables such as gender, family size, occupation, marital status, age, education level of household head and contribution of NWFPs and agricultural product to food security. Other information was on availability and amount of NWFPs collected and used per year, marketing, constraints of NWFPs and measures to be taken to develop them. Nevertheless, the whole interview exercise was conducted in Kiswahili language.

In each selected and visited household, the contribution of NWFPs to households' food security was determined by computing the contribution of NWFPs to total household consumption in terms of weight and the total household food consumption comprising of agricultural crops. Moreover, the contribution of

NWFPs to household income was determined by computing the contribution of NWFPs to total household income and comprising the selling from other sources. Similarly, information from key informants was done by use of questionnaires (Appendix 2) where key informants such as village leaders and elders, extension officers and others NWFPs dealers were interviewed. Key informants were regarded as individuals who are accessible, willing to talk and have wide knowledge about the subject matter.

3.2.3.2 Participatory Rapid Appraisal (PRA)

PRA was done based on intensive, interactive learning and shared knowledge and flexibility under the study area. In this exercise NWFPs information was collected through free listing, transect walk, pair wise ranking, and group discussion. The participants were Village Committee members and other stakeholders dealing with utilization of NWFPs, divided into groups of men, women and youth as recommended by Duangsa (1996). The grouping was meant to capture both gender and reduce differences. The methods quickly generated information on how NWFPs contribute to household economy and hence improve the livelihood of rural community.

In free listing technique, group members had to list all NWFPs available in the forests, and that used in the village were listed by the respondents and compiled. For each species listed, the data on uses, collector, and season for collection were recorded. Transect walk was also done involving physical observation and identification of different useful and most preferred NWFPs around the study area. In this exercise, a purposeful selection of ten people with great knowledge on

different NWFPs as recommended by Martin (1995) together with the researcher conducted walk in the forest around each village.

In pair wise ranking a list of all NWFPs was made by participants used to rank NWFPs used in the villages in the order of preference. In this exercise, different NWFPs with their respective species were ranked according to their relative importance as perceived by villagers. These NWFPs were paired and compared against each other through discussion, and consensus among villagers themselves (Table 2).

Table 2: Results of pair wise ranking of NWFPs in JCBNP

Solution	R&t	S/f	W/v	B/m	V/t	Honey	M/c	Fruits	Score	Rank
R & t		S/f	W/v	B/m	V/t	Honey	M/c	Fruits	0	8
S/f	S/f		W/v	B/m	V/t	Honey	M/c	Fruits	1	7
W/v	W/v	W/v		B/m	V/t	Honey	M/c	Fruits	2	6
B/m	B/m	B/m	B/m		V/t	Honey	M/c	Fruits	3	5
V/t	V/t	V/t	V/t	V/t		Honey	M/c	Fruits	4	4
Honey	Honey	Honey	Honey	Honey	Honey		M/c	Fruits	5	3
M/c	M/c	M/c	M/c	M/c	M/c	M/c		Fruits	6	2
Fruits	Fruits	Fruits	Fruits	Fruits	Fruits	Fruits	Fruits		7	1

Note: R&t = root and tubers, S/f = sea food products, B/m = bush meat, V/t = vegetables and M/c = medicines. Score: 7 = high important, 0 = low important

3.2.3.3 Group discussion

In this exercise a group of men and women (N = 10) who have greater knowledge were involved in the discussion. The focussed groups' participants were of different ages, education level and marital status. The discussion based mainly on the availability, collection, consumption, marketing and processing of NWFPs. The information collected was documented aiming to compare information given by respondents during household questionnaire survey.

3.2.4 NWFPs resource assessment

The NWFPs resource assessment was done in the dense thicket, evergreen bush and mangrove forests of the surround study villages. The assessment involved the key researcher, one research assistant, a botanist and two experienced local plant identifiers from the study villages. In collection of NWFPs data, the transect lines was drawn on the map running from East to West with distance of 500 m from one transect to another. Clusters was located on the transect lines to cover the area and each cluster was square with sides of 200 m. At each corner of a cluster, a square sample plot measuring 10 m x 10 m was laid. In mangrove forest only one transect line was selected for data collection due to its low species variation, however, for other types of vegetation, data was collected in each transect line.

The species encountered in the plots was recorded using both vernacular and scientific names and their uses (Appendix 3). For plant species, diameter and number of stem per hectare were recorded. However, the sample of unidentified species was taken to the herbarium for further identification. Square sample plots of 10 m x 10 m were adopted because they are easy to lay out. The study by Hamza *et al*. (2004) used similar sample plots design in Mgori forest reserve in Singida Rural district, Tanzania. The square plot design is also recommended in the guideline for Participatory Forest Resources Assessment and Management Planning (MNRT, 2005). A sampling intensity of 0.025 % was used in dense thicket (2612 ha), evergreen bush forest (9548 ha) and mangrove forest (1751) where 65, 238, and 43 plots were sampled respectively (Appendices 11, 12 and 13). The sampling intensity was adopted due to available time and resources. The identification of

plant species was done by the help of long experience people who provided information on their vernacular names and use of the species concerned. However, some books of Williams (1949), Williams (1967), Beentje (1990), Ruffo, (1992) and Ruffo *et al.* (2002) were also referred to identify the species with their scientific names and their use as well. Similarly, numbers of available species and tree diameter of > 2cm were counted and recorded within a respected plot in order to assess the status of available NWFPs.

3.2.5 Market survey

The market survey (Appendix 4) was done in respect to market places and in the potential close points where NWFPs were sold. The aim was to identify NWFPs traded which contribute income to livelihoods. The survey also aimed to understand who are the people involved in the various stages of marketing, the trends on quantities of NWFPs sold, the species and prices of NWFPs and the constraints that hinder their marketing development.

3.3 Data analysis

Data were analysed qualitatively and quantitatively using the Statistical Package for Social Science (SPSS) and software tools.

3.3.1 Qualitative data analysis

Data collected through PRA were analysed with the help of communities and results communicated back. Content analysis was used to analyse qualitative data and information collected, such as different types of NWFPs, the status of products and problems facing NWFPs in the study area. In this exercise, the topic concerned was

discussed and the villagers gave information and analysed through dialogue against each other in relative with the topic mentioned and the last results comes through consensus between the villagers.

3.3.2 Quantitative data analysis

Data collected through questionnaire were coded and subjected to SPSS analysis tool to obtain descriptive information such as percentage of responses and their frequencies. Moreover inferential analysis was done using multiple regressions to find relationships between dependent variable and independent variables in terms of contribution of NWFPs to the income generation to the community livelihoods. The following regression equation was used:

$Yi = a + ß_i x_i + ß_2 x_2 + \ldots\ldots + ß_n x_n + e$

Where:

Yi = dependent variable mainly total income generation.

x_1 to x_n = explanatory or independent variables mainly NWFPs and other income generating activities such as farming, livestock keeping and off farming.

a = intercept, $ß_1$ to $ß_n$ = regression coefficient, e = Random variable (error) and

i = 1, 2, 3….n.

Likewise, food security in the study area was measured by taking the amount of NWFPs consumed on daily basis as an indicator to the contribution and were analyzed to obtain descriptive information such as percentage and summarized in the table. Similar technique was used by Hamza and Msalilwa (2004) in Mgori forest reserve, Singida, Tanzania.

Also, the species encountered in the resource assessment survey were grouped in to their local and botanical names, their uses and availability in stem/ha by counting the number of trees within the plot of known area and divide by plot size as reported by Philip (1983) and calculated as: N = n/a; where: (N) is number of stem per hectare; (n) is average number of trees counted in the plot and (a) is plot size. For each plant species in the plot, trees diameter and number of stem per hectare was calculated in the Ms Excel computer software tool to assess the status of available NWFPs species. The use value of different NWFPs species as reported by Martin (1995) was calculated as:

$UV_{is} = \sum U_{is}/n_i$: Where: UV_{is} is the use value attributed by particular species by informant; U_{is} is the use mentioned in each event by the informant; n_i is the number of event in which informant i gave information.

The overall use value $(UV_{is}) = \sum \underline{UV_{is}}$

N

Where N = total number of people interviewed about a particular NWFPs species.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 NWFPs and uses in the study area

4.1.1 Plant and animal species

A total of 88 and 26 NWFPs plant and animal species respectively have been recorded and identified in the study area (Appendix 5). The plant species fall within 48 families out of which Euphobiaceae (8 %) is dominant followed by Verbanaceae and Rubiaceae (7 %) respectively and Compositae (5 %). The number of plant species identified in JCBNP seems to be lower compared to what has been reported by other researchers in other parts of Tanzania and Africa. A study by Makonda (1997) for example identified 156 and 12 useful plant and animal species respectively in Geita district, Tanzania, higher than those reported in this study. Also, in the same country, Morogoro Rural district, Lema (2003) identified 120 and 26 useful plant and animal species with higher plant species, but similar number of animal species as those observed in the villages surrounding JCBNP. Higher numbers of plant and animal species have also been reported by Kagya (2002) in Meatu district with 104 useful plant and 10 animal species. Similarly, 92 useful plant and 13 animal species were identified by Mapolu (2003) in Tabora district, Tanzania.

Researchers from other African islands and other parts for example Okafor and Fernandes (1996) documented and identified 60 plant species in south eastern Nigeria. Also Olsson (2005) documented 500 and 280 plant and animal species respectively in southern Cameroon. While Joseph and Bassirou (2007) recorded and identified 97 plant species in Parc National Kabore Tambi, Bukina Faso.

Furthermore, Hobby *et al*. (2006) documented and identified 721 and 138 plants and birds species respectively in Comoro, while Mitchel *et al.* (2006) recorded 750 and 188 plants and animals species respectively in Mauritius. Similarly, Meidinger and MacKinnon (2006) documented and identified 250 and 38 plants and animals' species respectively in Seychelles. The variations in number of NWFPs documented exist probably due to different as in ethnobotanical knowledge as per locality and species diversity (Anderson, 2007).

4.1.2 Uses of NWFPs

4.1.2.1 As source of food

Wild fruits

Wild fruits are considered as important source of food for many rural communities. Results showed that wild fruit species are commonly utilized and contribute about 6 % of food security in the study area. The species used involved *Vitex doniana*, *Saba florida*, *Tamarindus indica*, *Adansonia digitata*, *Annona senegalensis*, *Terminalia cartapa*, *Syzygium cuminii*, *Psidium guajava*, *Sorrindeia madagascarensis* and *Flacourtia indica*.

Moreover, wild fruits are mainly used as snack rather than a primary source of food in most households. Fruits like *Vitex doniana*, *Syzigium cumunii*, *Psidium guajava* and *Flacourtia indica* were collected by children. Similar results are reported by Simwanza and Lungu (1998) in Zambia where wild fruits play an important role in supplementing food during hunger periods. In Rukwa region, Tanzania, Ramadhan *et al.* (1998) found that farmers use the dry pulp of *Parinari curatellifolia* and *Uapaca kirkiana* mixed with small portions of sorghum flowers to prepare stiff

porridge during famine period. It has been reported by Bashir and Jens (2004) that in Sudan about 40 plant species were used for food. Likewise, in Burkina Faso, Lamien *et al.* (1996) reported 30 NWFPs used as raw or cooked coming from 17 tree species of Savanna or traditional agroforestry. Additional further, in Sahelien belt about 800 edible wild fruits species, similarly in Nigeria there are more than 150 of edible wild fruits, while in Ghana there are over 200 species valued for their fruits as a source of food (Garcia *et al.*, 1997). Moreover, Timothy and Kokwaro (2008) recorded 69 wild fruits species used as source of food in Siaya district, Kenya.

Other researches have showed that in the context of recurrent epidemics, dietary supplementation with NWFPs may play an important role in community nutrition considering the growing evidence that malnutrition specifically depleted micronutrient status is a major underlying cause for the rapid progression to AIDS in Africa's HIV infected individuals (Enwonwu and Warren, 2001). According to FAO (1995), fruits from tree species such as *Adansonia digitata, Allanblackia spp., Parinari spp., Azanza garckeana, Uapaca kirkiana, Vitex spp., Strychnos cocculoides* and *Tamarindus indica* are a good source of food for most rural communities. In other countries for example in Namibia, Botswana and parts of South Africa, the Kalahari plant known as devil's claw (*Harpagophytum spp*) is usually found where livelihoods options are very limited and as such its extraction by local communities is an important survival strategy.

Wild vegetables

About 10 species of wild vegetables were identified in the study area which contributes about 1.1 % to food security. The species include *Physalis ixocarpa, Launea cornuta, Stachytapheta jamaicaensis, Sesuvium portulacastrum, Salada elegans, Emilia sagitata, Moringa oleifera, Amaranthus caudatus, Lobelia anceps* and Tui. Results from other areas in Africa and some parts of Tanzania show different number of wild vegetables species were recorded. For example Ogle and Grivetti (1985) identified 48 different species of wild vegetables in Swaziland, while Joseph and Bassirou (2007) identified 14 species in Bukina Faso. However, Mapolu (2003) observed 20 wild vegetable species in Tabora district, Kagya (2002) who identified 15 wild vegetable species in Meatu district, while Lema (2003) reported 23 wild vegetable species in Morogoro Rural district and Makonda (1997) recorded seven vegetable species in Geita.

Wild mushrooms

Two species of wild mushrooms were identified in the study area. However, about 99 % of the respondents mentioned that the species are toxic and they don't utilize any more. It was noted during the survey that those mushrooms species were not utilized in the study area. This was noted to be due to inadequate knowledge in utilization, or there are no diversity of edible mushroom species in the study area. Therefore, results imply that wild mushrooms are not among NWFPs used as source of food in the study area.

However, other findings from different parts of Tanzania and some countries in Africa show that wild mushrooms are utilized by many people. For example, Mapolu (2003) identified 20 edible wild mushrooms species in Tabora, while Lema

(2003) and Nyigili (2003) identified five and seven mushroom species in Morogoro Rural and Mbozi district respectively. Also, Temu and Chihongo (1998) documented 16 mushrooms species in Ruvuma region, Tanzania. Furthermore, FAO (2000) recorded and identified 34, 60 and 53 edible mushrooms species in Tanzania, Malawi and DRC respectively.

Roots and tubers

Two species of roots and tubers *Dioscorea zanzibarensis* and *Maranta arundinaceae* were recorded to be used as source of food which contributed 0.1 % to food security in the study area. Results indicated that only 2 % of the respondents are aware with the species. This might be due to in-availability and lack of knowledge in utilization. Different researchers have identified roots and tubers species in different parts of Tanzania. For example, a study by Mapolu (2003) reported five species of roots and tubers in Tabora region, while Nyigili (2003) identified four species of roots and tubers used in Mbozi district, while Paullo (2006) recorded two species in Kilwa district. In Africa regions similarly, Melaise and Parent (1985) identified more than 40 species of roots and tubers used in Upper Shaba in DRC while Kabuye (1986) identified 56 species of roots and tubers in Kenya used as source of food. According to FAO (1991) 33 species of roots and tubers were identified to be used as source of food in Natal, South Africa. Furthermore, it has been stated by FAO (2000) that, most of roots and tubers that are obtained from wild plants are used as food (flour for porridge). However, tubers are very small in size and are too few to constitute a complete meal. The herdsmen and hunters of some parts in Africa used as refreshment (water supply) and eat these raw in most cases.

Honey

Honey is a carbohydrate rich food, normally consumed as a side dish to accompany with other meals. Results from the study area revealed that honey consumption is about 2.2 kg per household per year in the study area (Table 12), where about 80 % of the respondents mentioned honey to be used as source of food. Different researchers have reported different results regarding honey utilization. For example in Mbozi district, about 7 kg of honey was reported to be consumed as source of food per household per year (Nyigili, 2003). In Kilwa district, about 56 % of respondents were found to consume about 15 kg per household per year as reported by Paullo (2006).

Furthermore, it has been stated by Kimbi *et al*. (1998) and Mwakatobe (2001) that, honey is used as a supplementary food for lactating mothers and as an appetizer at household level. Additional further, Krell (1996) commented that when pure honey or mixed with other ingredients it can be used to cure cough, ulcers, stomachaches, malaria and burns or scalds.

Wild animals

Results identified 12 animal species that can be used for food as meat in the study area (Table 3).

Table 3: Wild animals' species identified in JCBNP

Scientific name	Local name	Family
Cephalophus adersi	Paa nunga	Bovidae
Cephalophus monticola monticola	Paa chesi	Bovidae
Neotragus moschatus moschatus	Paa mwekundu	Bovidae
Cercopithecus mitis albugaris	Kimamweusi	Cercopithecidae
Civetictis ceveta	Ngawa	Viverridae
Cristomys gambianus cosensi	Buku	Seiuridae
Dendrohydrax validus neumani	Pelele	Noctunidae
Piliocolubus kirkii	Kimapunju	Cercopithecidae
Potomachoerus porcus	Nguruwe	Suidae
Python sebae	Chatu	Pythonidae
Achatina achatina	Koa/konokono	Achatinidae
Varanus niliticus	Kenge	Varanidae

The results conform to what Makonda (1997) observed, where about 12 wild animal species were reported to be used for food in Geita district. According to Kagya (2002) 10 wild animal species were reported to be used for food in Meatu district. The number being lower than what has been observed in JCBNP. Higher numbers of wild animals were reported by Mapolu (2003) in Tabora district where 13 animal species were documented. The study noted variations among the number of wild animals species documented by different researchers in different parts of Tanzania. This probably might be due to the fact that there are variations in condition of forests in different parts of Tanzania, hence causes the variation in number of wild animals from different parts. The statement also conforms to FAO (1998) who commented that wild animals vary greatly from one region to the next due to changes of the condition of the forests at a particular area.

Results indicated that only 2 % of the respondents are dealing with wild animal hunting for food. This is because out of 12 identified species, the study noted that only three species of wild animals included *Cephalophus adersi* (Paa nunga), *Cephalophus monticola monticola* (Paa chesi) *Neotragus moschatus moschatus* (Paa mwekundu) were mostly preferred by the all respondents for food while the

remaining species are used in minority at household particularly by some tribes originating outside Zanzibar.

However, it has been noted in JCBNP that some wild animal species like wild pigs, civets and blue monkeys are hunted and sold to tourist hotels and to some tribes from mainland Tanzania as source of food but the hunters themselves don't use. These results don't conform to the statements by Martin (1983) and Hamza (1997) who argued that bush meat is still the only reliable source of animal protein in many areas of the world. Other studies showed that in regions which are unsuitable for conventional animal husbandry, bush meat is often of immense importance. A study in the rainforests of southern Cameroon found more than 280 animal species in use (FAO, 1998). According to Lopez and Shanley (2004), in Central Africa alone, bush meat harvest is believed to total more than two million tones annually.

Birds

About 14 species of birds were identified and recorded in the study area to be used for food (Table 4).

Table 4: Birds species identified in JCBNP

Scientific name	Local name	Family
Accipiter tachiro	Kipanga	Accipitridae
Bubukus ibis	Yangeyange	Soricidae
Ciccaba woodfordi	Bundi	Strigidae
Cossypha natalensis	Kurumbizi	Muscicapidae
Dicrurus adsimilis	Kunzi	Dicruridae
Hypchira chalybeatu	Msese	Sylviomithidae
Streptopelia capicola	Huwa	Columbidae
Torkus alboterminatus	Kwembe	Gruidae
Tutor chalcospilos	Pugi	Alcedinidae
Canpethera cailliantii	Kigong'ota	Picidae
Guttera edouardi	Kororo	Numididae
Guttera pucherani	Kanga	Numididae
Sentropus superciliosus	Tipitipi	Cuculidae
Pyconotus barbatus	Shore	Turdidae

The study documented high number of birds species compared to those reported by other researchers in some parts of Tanzania. For example, Lema (2003) identified nine species of birds used for food in Morogoro Rural district, while Mapolu (2003) mentioned five commonly hunted bird species in Tabora region, while Paullo (2006) documented nine bird species to be used for food in Kilwa district, Tanzania. These results imply that probably the villages surrounding JCBNP are rich in bird's species due to good habitat for birds, but also these species are not commonly hunted.

However, the study revealed that the species of *Guttera pucherani* (Kanga), *Guttera edouardi* (Kororo) and *Streptopelia capicola* (Huwa) found in the study area are the most preferred and can be used by adults in the all household for meal, while the remaining species are mostly trapped and used by children for roasting as part time meal. The reason behind was pointed out to be due to small volume of birds which needs a high number of birds to complete a single meal in household.

Sea food products

Results documented some sea food products collected in the mangrove areas. They include sea shells, sea cones, crabs, shrimps and eels. About 5 % of the respondents agreed to be dealing with the collection and use of sea food products as source of food in the households. The study further noted that, most of the people dealing with these products are those living near the sea however; the key informant (a village leader) reported that other people who leave far away outside the villages are involved in collection of these resources for business. This implies that sea food products make a significant contribution to the communities' economy both in

terms of income and employment generation. Also it is an important supplement for animal protein to the majority of people in the islands of Zanzibar and therefore contributes to people's health and therefore improvement in human welfare.

4.1.2.2 As source of primary health care

A total of 62 species of plants were recorded and identified to be used as source of medicine for primary health care in the community around the study area (Appendix 6). The result implies that respondents in the study area have a wide knowledge on a number of useful medicinal plants, which contribute to the primary health care of their families. Results are in agreement with FAO (1995) who argued that indigenous people have developed sophisticated knowledge systems about the use of a vast variety of plants for medicinal purposes.

However, the number of medicinal plant species identified in JCBNP is lower compared to those observed by other researchers in other parts of Tanzania. A study carried out in Zaraninge forest reserve in Bagamoyo by Abdallah (2001) identified 159 medicinal plant species. Also Maximillian *et al*. (2001) observed 185 medicinal plant species in Kibaha district, while Paullo (2006) mentioned 139 species in Kilwa district. Similarly, in Geita district, about 77 plant species were identified by Makonda (1997) and 66 medicinal plant species observed by Kagya (2002) in Meatu district. Furthermore, Augustino (2002) documented 246 and 177 medicinal plant species in Morogoro and Iringa urban respectively, while in Morogoro rural district, 66 medicinal plant species were later recorded by Lema (2003). Additional further, lower numbers of medicinal plant species have also been reported by Luoga *et al.* (2000) who identified 35 species to be used as source of primary health care in

communities around Kitulangalo forest reserve in Morogoro, while 16 medicinal plant species were recorded in Kidabaga forest reserve in Iringa by Minja (1997). In tropical Africa, about 4 000 plant species are reported to be used as source of primary health care annually (FAO, 1995). While in China more than 1 000 varieties of natural medicines are produced as a source of primary health care of only 400 are cultivated (Wen, 2007). Similarly, about 2000 plant species were recorded as a source of primary health care in India for treatment of various disorders (Karki, 2001).

4.1.2.3 As Ornamental

A total of five plant species have been recorded and identified to be used for ornamental purposes in the study area (Table 5).

Table 5: Ornamental species identified in JCBNP

Scientific name	Local name	Family
Encaphalatus hilderbrandtii	Mgwede	Zamiaceae
Pshchotria bibracteata	Mkonge	Rubiaceae
Suregada zanzibarensis	Mdimumsitu	Euphobiaceae
Hoslundia opposita	Mnunu	Labiateae
Ficus capensis	Mkuyu	Moraceae

Other researchers have documented different figures in other parts in Tanzania. For example Paullo (2006) recorded four ornamental species in Kilwa district, while Makonda (1997) recorded 17 species in Geita district. However, the study noted that the uses of ornamental species differ from one area to another and from species to species due to people's perception and treatment of the species. For example, Ruffo *et al.* (2002) mentioned the species of *Stachytapheta jamaicaensis* (Kikwayakwaya) to be used as ornamental species in some parts in Tanzania, but none of the respondents in the study area regard the species as ornamental apart from being used as vegetable species.

4.1.2.4 As fish poison

Two plant species were recorded and identified to be used for fish poisoning. The identified species were *Saphora occidentalis* and *Piper guineese*. A number of fish poison species identified is lower compared to those recorded by Ruffo (1992) who found five species in Jozani forest reserve, Zanzibar. Other researchers in other parts in the world have reported different figures. For example Kent (2008) recorded 10 and 8 species in USA and South America respectively, while 6 species were recorded in Australia by Francis (2006). However, in tropical Africa, about 325 species have been reported to be used as fish poison (Neuwinger, 2004).

4.1.2.5 Ropes and twine

About four plant species were recorded and identified to be used for ropes and twine in the study area. The species include *Ancylobotrys petersiana*, *Synaptoleptis kirkii, Piper guineese* and *Saba florida*. Other studies in other parts of Tanzania showed different results. For example, Ruffo (1992) reported six species to be used for ropes and twine in Jozani forest reserve, Zanzibar, while Makonda (1997) reported four species in Geita. Similarly Lema (2003) and Nyigili (2003) identified 7 and 8 plant species used for ropes in Morogoro Rural and Mbozi district, respectively. According to FAO (2007b) 11 species were identified in Rufiji district, while 10 species were recorded and identified by Paullo (2006) in Kilwa district. The study revealed that there is low number of species to be used for rope and twine. This implies that forests in study areas probably are not richer on the species or might be due to low knowledge on the plant species to be used for ropes and twine.

4.1.2.6 Weaving materials

The species of *Phoenix reclinata* is the only one recorded and identified to be used for weaving in the study area. The species is used for making mats and baskets. Other researchers in other parts in Tanzania found different figures. For example Paullo (2006) recorded and identified three species to be used for weaving in Kilwa district, while Ruffo (1992) recorded and identified three species in Jozani forest reserve, Zanzibar. Also, in Morogoro rural district, seven species were identified by Lema (2003). The study noted the variation on the number of weaving materials in the study area and some parts in the country. This probably is due to the fact that the area is not richer on the species, due to ecological factors or other weaving species are not suitable.

4.2 The status of NWFPs in JCBNP

During field survey, different NWFPs were identified and recorded to determine the status of NWFPs. The survey covered vegetation that provides NWFPs, which have a potential to contribute to the improvement of livelihood of rural communities. These surveyed vegetations include dense thicket, evergreen bush and mangrove forests. The study revealed that the status of mangrove vegetation constitute of low species diversity where by only seven tree species have been identified and recorded (Appendix 7). These tree species are mostly used as medicine, fuel wood, poles and tool handles. However, the sea food products including fish, crabs, eels, shrims, sea shell and sea cones are collected from this type of vegetation. The status of dense thicket vegetation comprises of trees, shrubs, herbs and climbers where 46 plant species were identified and recorded (Appendix 8), while 41 plant species were identified and recorded in evergreen bush vegetation (Appendix 9).

However, the study revealed that there is an intermingle of some of plant species particularly in evergreen bush and dense thicket vegetation of which some of the species can be found in both type of vegetation. These are such as *Annona senegalensis, Bridelia micrantha, Vitex doniana, Sorindeia madagascarensis, Flueggea virosa, Casytha filiformis, Syzigium cuminii* and *Saba florida.*

4.2.1 Dense thicket vegetation

In this vegetation a mixture of species used as source of food, primary health care, building poles and fuel wood were observed. The dominant species included *Polysphaeria parvifolia* (498 stem/ha) followed by *Psychotria bibracteata* (204 stem/ha) and *Synoptoleptis kirkii* (197 stem/ha). The dominant average diameter at breast height (dbh) was observed for *Syzigium cuminii* (25.0 cm) followed by *Encaphalutos hilderbrantii* (21.2 cm) and *Bridelia micrantha* (13.3 cm). Furthermore, the study observed that large tree diameter species were few and have small number of stem per hectare and those species with small diameter were many having large number of stem per hectare.

Those species with small diameter were many having large number of stem per hectare in the study area. The reason behind these observations is probably due to the fact that most of large tree diameters have been harvested and then regeneration has taken place to form tree communities dominated with small diameter in the study area. The statement conform to Nahonyo *et al.* (2002) who observed very few large trees diameter (> 40 cm dbh) in JCBNP, which present mature forest due to high level of vegetation disturbance.

4.2.2 Mangrove vegetation

In this type of vegetation, the observed species include *Ceriopsis tagal*, *Rhizophora mucronata*, *Avicenia marina*, *Soneratia alba*, *Bruguiera gymnorhiza*, *Xylocarpus granatum* and *Heritiera littolaris*. The dominant species were *Rhizophora mucronata* (516 stem/ha) followed by *Ceriopsis tagal* (287 stem/ha) and *Bruguiera gymnorhiza* (131 stem/ha). The survey noted that the largest average diameter was for *Bruguiera gymnorhiza* (10.8 cm) followed by *Ceriopsis tagal* (10.4 cm) and *Avicenia marina* and *Xylocarpus granatum* (8.3 cm and 8.3 cm) respectively. Furthermore, the study noted that some of the species do produce dye, however communities around don't deal with the business, due to the fact that it is not common in the area, or they have not only inadequate knowledge on their utilization but also its market structure is not well convincing.

4.2.3 Evergreen bush vegetation

During the survey, the study noted that the dominant tree species was *Annona senegalensis* (309 stem/ha) followed by *Flueggea virosa* (210 stem/ha) and *Polysphaeria parvifolia* (195 stem/ha). The results showed that the average dominant diameter was for *Syzigium cuminii* (16.2 cm) followed by *Bridelia micrantha* (10.8 cm) and *Parinari curatelifolia* (10.7 cm). The survey also noted several herb species in this vegetation dominated by *Stachytapheta jamaicaensis*, *Sida acunata* and *Ocimum suave*. The specie of *Phoenix reclinata* was found only in this type vegetation. Results imply that the most species of fruits, vegetables and weaving material are mostly found in this area. The possible reason might be due to suites of ecological factors of the area in relation with the species. Also, low

disturbance rate which give the way for regeneration, hence increase species diversity.

4.2.4 Availability of NWFPs

About 97 % of the respondents argued that the current availability of NWFPs compared to the past is decreasing. Only 3 % of respondents reported the availability of NWFPs to be the same, while no one responded on an increased level. Communities complained that the forest has been destroyed due to shifting cultivation, forest fires, high demand for some products and population increase; hence they forced to walk longer distances to collect products while most of them are diminishing. Key informants argued that the decrease in availability of NWFPs is expected because formally the forests were controlled well and few people depended in the resources. It has been stated by Shaanker *et al*. (2001) that NWFPs support livelihood to communities living adjacent to the forests but with some ecological costs. The cost could range from resources decrease to changes in population dynamics and demography of harvested species. This implies that when population increases, the resources decrease due to harvesting pressure on the respected species if not well managed.

Fruits trees

Results showed that 95 % of the respondents mentioned 10 available fruits tree species used in the study area. *Annona senegalensis* was the most available followed by *Psychotria bibracteata* and *Saba florida* was mentioned to be least available (Table 6).

Table 6: Distribution of available fruit tree species in JCBNP

Scientific name	Local name	Number of species (Total %)
Annona senegalensis	Mtopetope	315 (50 %)
Flacourtia indica	Mgo	28 (4.4 %)
Psidium guajava	Mpera	21 (3.3 %)
Psychotria bibracteata	Mkonge	221 (35 %)
Saba florida	Mbungo	1 (0.2 %)
Sorindeia madagascarensis	Mpilipili doria	11 (1.7 %)
Syzigium cuminii	Mzambarau	8 (1.3 %)
Tamarindus indica	Mkwaju	2 (0.3 %)
Vanguera infausta	Mviru	2 (0.3 %)
Vitex doniana	Mfuu	21 (3.3 %)

The number of available wild fruits recorded in the study area is lower than those reported by other researchers in other parts of Tanzania and Africa. For example, 179 edible wild fruits were recorded to be available in miombo woodlands of Tanzania in Tabora, Iringa, and Rukwa regions as reported by Ramadhan *et al.* (1998). Likewise, Nyigili (2003) recorded 33 species of wild fruits to be available in Mbozi district, Tanzania. Moreover, Hamza and Msalilwa (2004) recorded eight species of wild fruits available around Mgori forest in Singida Rural district, Tanzania. Furthermore, Ogle and Grivetti (1985) identified 110 wild fruits available to be consumed in Swaziland.

Medicinal trees

About 95 % of the respondents mentioned 62 available medicinal tree species to be used in the study area (Appendix 6). The study noted that *Ocimum suave* was the most available followed by *Vernonia glabra* and *Bersama abbysynica* and *Caesalpinia voelkensii* were less available (Table 7).

Table 7: Distribution to some of the most available medicinal tree species in JCBNP

Scientific name	Local name	% (N)
Ocimum suave	Kivumbasi	42 (410)
Vernonia glabra	Dimi la ngo'mbe	18 (173)
Euclea schimpheri	Mdaa	8 (80)
Agathi santhemum	Mvumanyuki	3 (32)
Bersama abbysinica	Mwangwakwao	0.4 (4)
Suregada zanzibarensis	Mdimumsitu	15 (147)
Dalbegia vaccinifolia	Mvyongozi	3 (30)
Caesalpinia voelkensii	Mkomwe	0.4 (4)
Xylocarpus granatum	Mkomafi	5 (48)
Turraea floribunda	Mtamagoa	3 (33)

Note: Numbers in parenthesis are frequencies

Furthermore, the study noted that some of the medicinal plant species were mentioned by respondents, but were never found in the forest as larger trees but just growing around their homesteads, example *Phyllantus sp*. (Mtambaa na penu).

Ornamental trees

About 95 % of the respondents mentioned 5 available ornamental tree species in the study area. *Psychotria bibracteata* was the most available followed by *Suregada zanzibarensis* and *Hoslundia opposita* was less available (Table 8).

Table 8: Percentage distribution of ornamental tree species available in JCBNP

Scientific name	Local name	% (N)
Encaphalutos hilderbrandtii	Mgwede	10 (42)
Psychotria bibracteata	Mkonge	51 (221)
Suregada zanzibarensis	Mdimumsitu	34 (147)
Hoslundia opposita	Mnunu	0.6 (3)
Ficus capensis	Mkuyu	4 (18)

Note: Numbers in parenthesis are frequencies.

Apart from shade trees, the study noted also that most of the people in the study area have no habit of planting ornamental trees around their homesteads, but they identified the ornamental species because they see them planted in tourist hotels and in avenues around the town areas. According to Leskinen *et al*. (1997) observed that

most of the communities in Zanzibar tend to plant coconut trees and other fruits trees at homestead for domestic uses. This trend was also noted in the study area where most of the coconut trees, jack fruits trees and orange trees were planted around communities homestead. Gerean and Taplin (2007) recorded 80 ornamental species most of them in mainland Africa, where 30 species are endemic.

Fish poison

About 10 % of the respondents mentioned two species to be used as fish poison. These include *Saphora occidentalis* and *Piper guineese*. During inventory, these species were not found in the forest but are available around their vicinity. However, the study observed that these species are not allowed by government to be used in fishing. The reason behind could be due to the fact that the species were not found in the forest and they are few in numbers hence, it need to be reserved. Also, when the species are used in fishing it destroy the marine environment due to killing of all type of fish and no choice. The statement is also conform to Soud *et al.* (2004) who observed that due to conflict on resources use, other side of the community use fish poison and kill even small fish. A study done in Jozani forest reserve by Ruffo (1992) recorded *Erthrophleum suaveolens*, *Paulinia pinnata*, *Psiadia punctulata*, *Saphora tomento* and *Tephrosia vogeli* to be used as fish poison.

Ropes and twine

About 10 % of the respondents mentioned 4 available plant species used for ropes and twine in the study area. These included *Ancylobotrys petersiana*, *Synaptoleptis kirkii, Piper guineese* and *Saba florida*. Other researchers including Ruffo (1992) recorded 6 plant species used for ropes and twine in Jozani forest reserve, Zanzibar. Similarly, Makonda (1997) recorded 4 plant species in Geita district. During the

study it was noted that ropes and twine species are used for tying material during house construction and also for bundles of fuel wood in the forest.

Bush meat

About 95 % of the respondents mentioned 26 species of bush meat. The most used species with the majority and recorded to be available during inventory were *Cephalophus adersi*, *Cephalophus monticola monticola*, *Neotragus moschatus moschatus*, *Guttera pucherani*, *Guttera edourdi* and *Streptopelia capicola*. However, during discussion it was noted that the species of *Cephalophus adersi* is endemic and strictly prohibited for hunting, but some people do poaching. The results imply that the status of bush meat in the villages surrounding JCBNP is not convincing may be due to restriction in hunting. The limitation of the species use could be due to religion belief. The findings were also observed by Nahonyo *et al*. (2004). The authors reported that some communities enter the forest by hunting duikers by catching in nets and some times dogs are used and afterward enjoys the meat in their ceremonies and leave wild pigs in the forest due to religion beliefs.

Weaving material

About 97 % of the households surveyed used weaving materials. The materials were used for making mats and baskets. The recorded specie found during inventory is *Phoenix reclinata* only at a range of 6 stem/ha. A study done in Kilwa district by Paullo (2006) recorded three weaving species including *Phoenix reclinata*, *Hyphaene compressa* and *Oxytenanthera abyssinica* used as weaving material, while five plant species were available in Geita district as recorded by Makonda (1997) including *Phoenix reclinata*, *Cyperus papyrus*, *Eleucine indica*, *Gwewia bi*color and *Lannae spp*.

4.3 NWFPs Preference

During the study, the ranking was determined by each individual member to choose the items that he/she feels is more important, and all items were given score according to preferences. Scores of all respondents were added together to determine the wishes of the whole group. Results showed that in terms of preference, fruits (95 %) are the most preferred NWFPs by the community in the surveyed villages. This was followed by medicines (90 %), honey and vegetables (88 %) respectively bush meat (70 %), weaving material (51 %), sea food products (45 %) and root and tubers (16 %). These results depict characteristic of community preference on dependency of NWFPs uses in the study area (Table 9).

Table 9: Distribution of NWFPs in relative to preference in JCBNP

Products	% (N)	Rank
Fruits	95 (118)	1
Medicines	90 (111)	2
Honey	88 (109)	3
Vegetables	88 (109)	4
Bush meat	70 (87)	5
Weaving	51 (63)	6
Sea food products	45 (56)	7
Root and tubers	16 (20)	8

N= Frequency of response

However, the study noted that species preferences for the various NWFPs consumed in the study area confirm the importance of forests and associated species for the livelihood of the people. Also, the study noted that the preferences vary from place to place especially in relation to the abundance of preferred species for specific products Paullo, (2006).

4.4 NWFPs species in relative importance

Results have indicated that, when species were ranked by respondents in relative to their importance the highest scores was *Syzigium cuminii* followed by *Tamarindus indica*. *Agathi santhemum* was mentioned to be the least (Table 10). The study revealed that ranked species relative to their importance was based on multipurpose use and value of the species to the community. This implies that the ranked species confirm their importance associated to the livelihood of rural people.

Table 10: Distribution of NWFPs species in relative importance

Scientific name	Local name	% (N)	Rank of importance
Syzigium cuminii	Mzambarau	97 (120)	1
Tamarindus indica	Mkwaju	94 (117)	2
Vitex doniana	Mfuu	92 (115)	3
Psidium guajava	Mpera	90 (112)	4
Sorindeia madagascarensis	Mpilipilidoria	76 (95)	5
Monodora grandidieri	Mchofu	72 (90)	6
Ceriopsis tagal	Mkandaa mwekundu	70 (88)	7
Muraya koenigii	Mvuje	44 (55)	8
Pittosporum virrindiflorum	Mpande	32 (40)	9
Agathi santhemum	Mvumanyuki	28 (35)	10

Note : N = Frequency of responses

4.5 Useful NWFPs plant species

Use value results have indicated 10 plant species to be the most useful in the study area with *Pittosporum virridifolia* and *Suregada zanzibarensis* being the top most useful plant species (Table 11). Therefore, basing on this study it was noted that most useful NWFPs were fruits trees species where the communities use them on their daily lives.

Table 11: Most useful NWFPs plant species in JCBNP

Scientific name	Local name	Use value
Pittosporum virridiflorum	Mpande	4.0
Suregada zanzibarensis	Mdimumsitu	4.0
Syzigium cuminii	Mzambarau	3.0
Sorindeia madagascarensis	Mpilipilidoria	3.0
Psidium guajava	Mpera	3.0
Vitex doniana	Mfuu	3.0
Annona senegalensis	Mtopetope	2.8
Psychotria bibracteata	Mkonge	2.5
Soneratia alba	Mliana	2.0
Uapaca guinensis	Mchenzamwitu	2.0

During the survey, it was noted that the ranking of species depended upon the informants who judged the usefulness of the particular species due to the frequency of uses and the knowledge of informant regarding the species. This implies that the frequency of uses and the informant understanding of the respected species is the determinant factor of ranking, and some species might fall out or under ranked because they have few uses relative to the others.

4.6 Contribution of NWFPs to households

4.6.1 Contribution to food security

Results have revealed about 73 % of households depended on agricultural products for food security and NWFPs only contributed 27 %. Among the contribution of NWFPs, fish and fruits were noted to be high at 18.5 % and 5.7 % respectively, while roots and tubers were least in food security. The study revealed that only 4 % of the respondents were utilizing wild vegetables frequently. This response reflects that the utilization of fish is more important rather than wild vegetables in the study area (Table 12).

Table 12: Contribution of NWFPs to food security in JCBNP

Products	Average quantity consumed (kg) per household per year	% Contribution
Agricultural products	600	73.3
Wild fruits	47.1	5.7
Wild vegetables	8.8	1.1
Honey	2.2	0.3
Bush meat	5	0.6
Sea food	4	0.4
Fish	152	18.5
Roots & tubers	1.1	0.1
Total	**820.2**	**100**

Results from JCBNP indicated that, the contribution of NWFPs to household food security per year is lower compared to what has been reported by Falconer (1999) in Machakos district in Kenya. The author reported NWFPs to contribute 35 % of food security. However, different results have been reported by other researchers lower than the present study. For example Nyigili (2003) reported about 12.7 % contribution of food security in Mbozi district, while Hamza and Msalilwa (2004) reported about 13.9 % to the annual household diet in villages around Mgori forest reserve in Singida Rural district. These differences might be caused by the level of dependence on and type of forest resources available for food consumption in communities within a particular locality.

Wild fruits

Results from the study area revealed that wild fruits are not a major constituent of diet however; they are very important as supplementary source of food. It was noted that most fruits ripe during periods of food shortage (that is in periods before crops harvesting) so they contribute a bit to food security in the households. Some respondents in the study area utilized wild fruits as food first at day time before having a proper meal in the afternoon.

On average 47.1 kg of fruits seem to be consumed per household per year in the study area. The figure is lower than what Hamza and Msalilwa (2004) found where 116 kg of wild fruits in villages around Mgori forest reserve in Singida were consumed. Similarly, 90 kg of wild fruits are reported to be consumed in Mbozi district by Nyigili (2003). There is a variation in quantity consumption of wild fruits from one area to another. This might probably be caused by low fruit species richness in the study areas. Similar findings also were observed by Nahonyo *et al*. (2002) who commented that JCBNP vegetation habitat types contain low fruits species richness of not more than12 species.

The percentage of fruits consumed recorded in the study area accounted for 5.7 % of the annual household food consumption. The figure is higher than that reported by Nyigili (2003) who observed that wild fruits contributed 4.9 % of the annual household food consumption in Mbozi district. However, Hamza and Msalilwa (2004) reported that in villages around Mgori forest reserve in Singida Rural district, wild fruits contributed about 6.5 % to the annual household diet, a figure higher than what has been observed in this study.

Wild vegetables

The amount of wild vegetables consumed was 9 kg, which accounted for 1 % of the annual household food consumption. The figure is lower than what Nyigili (2003) reported (3 % of annual household food consumption) in Mbozi district. However, higher figure of vegetable consumption is recorded by Kajembe *et al.* (2000) in West Usambara, Tanzania, where wild green leafy vegetables are essential part of diet, which accounted for 81 % of all side meals in the area. Other studies showed

that in Tarime district, Mara Region, Tanzania, wild vegetables accounted 23 % of the total foods consumed during the months of June and July (Uiso and Johns, 1996). Hamza and Msalilwa (2004) in the villages around Mgori forest reserve in Singida Rural district found that vegetables accounted for 4 % of the annual household food consumption. It has been observed that in Tanzania, many wild vegetables have higher nutritive value than exotic vegetables commonly sold in markets. For instance, *Amaranthus spinosus*, *Bidens pilosa* and *Sesamum angolenses* are among the local vegetables which are rich in protein, fat and minerals (calcium and iron). Other local vegetables have calcium contents 1.5 – 3.2 times higher than those of the cabbage family species whose calcium content is the highest of all exotic vegetables (Ruffo *et al.*, 2002).

Other studies have been reported on wild vegetables with different arguments. For example in Southeast Asia, people eat the whole pods of *Parkia speciosa* either raw or cooked as vegetable (FAO, 1995). Also among the vegetables, *Gnetum* leaves from the species *G. africanum* and *G. bulcchozianum* are mostly used over the humid zone of West and Central Africa, from Angola to Ivory Coast (Tchatat *et al.*, 2002). In Swaziland about 48 species of wild plant leaves are consumed as vegetables and 50 % of the adults were reported to consume more than twice a week (Ogle and Grivetti, 1985).

Honey

Honey consumption contributed about 2.2 kg which accounted for 0.3 % of the annual household food consumption in JCBNP. This result is different to what has been reported by Nyigili (2003) in Mbozi district who observed that honey contributed 0.4 % to the annual household food security. However, the figure in the

study area is higher than what has been reported by Hamza and Msalilwa (2004). The authors observed that honey contributed 0.2 % to the household annual food consumption in the villages around Migori forest reserve in Singida Rural district. These differences might be caused by a high market for honey, which results into more sales than consumption at household level. Similar argument was noted by FAO (2007b) who argued that production of honey serves as a poverty reducer in rural areas of Tanzania where more honey is sold to the market. According to Moshi (2000) in Tabora region, an individual beekeeper seems to earn approximately US$ 1488 per annum from sales of honey due to market opportunities available for honey.

Bush meat

Bush meat from wild animals and some birds contributed about 5 kg which accounted for 0.6 % of the annual household food consumption (Table 12). The result of this study is different to what has been reported by Hamza and Msalilwa (2004) in Mgori forest reserve in Singida Rural district. The authors observed that bush meat from small animals and some birds contributed 3.3 % to the annual household food consumption. A lower figure has been reported by Nyigili (2003) where bush meat from small animals; rodents and birds contributed 0.2 % of the annual household food consumed in Mbozi district. According to FAO (1998) Wild animals' meat is not only a source of animal protein but also iron, vitamin A and B. Wild animal consumption varies greatly from region to region due to variations in conditions of the forests. Small animals like buck, genets, field mice, rock rabbit, porcupines, bush pigs and hares are the most important bush meat due their natural abundance and unrestricted hunting. For example in areas of Nigeria with no

reserve forests and population density, bush meat is reported to contribute food security only 7 % while areas near large forests reserves, bush meat provide up to 84 % of the total meat consumed (FAO, 1989). Likewise, in southern region of Nigeria, about 95 % of the populations have been found to consume wild meat while in Botswana per capita consumption of bush meat in some areas has been reported to be 248 g daily (Martin, 1983). Some ethnic groups in Cameroon eat more meat, primarily bushmeat (73 kg/capita/year) than the average person in France or elsewhere in the industrialized world, where 30 kg/capita/year are consumed (Chardonnet *et al.*, 1995).

Sea food products

These are the products collected from mangrove areas which include sea shells, sea cones, crabs, shrimps and eels. They are found to contribute about 4 kg which accounts for 0.4 % of the annual food consumption per household. The study observed that most of these products are consumed where there is a scarcity of fish in household as source of protein. Despite the fact that the sea food products contributes in food security, but regarded as supplement of animal protein to majority of the people in the islands of Zanzibar (Mmochi *et al.*, 1999).

However, the authors observed that fishermen spend relatively more time in fishing; hence to improve sea food probably will cover the gap of excess demand for fish in different coastal villages of Zanzibar by increasing supply especially during off seasons. This implies that the contribution of sea food products in food security is well recognized and such improvement is important to increase the source of protein in the households and more contribution to food security.

Fish

Fish is the main source of protein for households in the study area. The average contributions have been found to be 152 kg which accounted for 18.5 % annual food consumption per household (Table 12). The study noted that almost all households consume fish as the first choice source of protein in the all year round. This might be caused by presence of varieties of fish and its abundance in the study area through out the year. Similar findings were noted by Ngazy (2004) who commented that due to fish availability, people of Zanzibar consume fish at least in each one of the three meals of the day for all the days in a month. Also DFID (2005) reported that fish is the principal source of animal protein for the low-income families in Zanzibar. This implies that fish has a significant contribution in food security to the communities in the study area.

Roots and tubers

The average amount of wild roots and tubers consumed per household per year was 1.1 kg, which contributed about 0.1 % of the annual household food consumption (Table 12). The results is similar to what Nyigili (2003) revealed in Mbozi district. However, the study observed that wild roots and tubers are not famous to many respondents due to its low availability and knowledge of edibility. Other findings in Tanzania have shown that, the important species of roots and tubers includes *Ritchiea albersii* and *Dioscorea spp* used as source of food during periods of food insecurity (Ruffo *et al.,* 2002). Also roots of some species particularly *Mondia whiteii a*nd *Dostenia sp*. are used as spices (Guedje, 1998; van Dijk, 1999).

4.6.2 Contribution to income generation

Results have shown that the amounts of NWFPs collected and sold contributed to household income after selling in the markets. The results revealed that, the average household income per annum recorded in the study area was Tshs 838 500. This indicated that 68 % of income generation was from agricultural products and NWFPs contributed for 32 %. However the contribution of fishing (13.6 %), honey (5.0 %) and wild fruits (4 %) were more significant as the NWFPs, while livestock products was mentioned to be less significant in contribution of income (Table 13).

Table 13: Contribution of NWFPs to income generation in JCBNP

Products	Quantity sold per household	Unit price (Tshs)	Income (Tshs)	Contribution (%)
Agricultural crops (kg)	570	1000	570 000	68
Wild fruits (kg)	33	1 000	33 000	4
Wild vegetables (kg)	5	1 000	5 000	0.6
Honey (lts)	6	7 000	42 000	5
Bush meat (kg)	5	2 500	12 500	1.5
Products from mangrove (kg)	9	2 000	18 000	2.1
Weaving material (bunches)	35	300	10 500	1.3
Basket making (number)	2	5 000	10 000	1.1
Livestock products (kg)	5	500	2 500	0.3
Medicine (kg)	14	1 500	21 000	2.5
Fishing (kg)	38	3 000	114 000	13.6
Total			**838 500**	**100**

The results observed seems to be lower to what has been reported by Hamza and Msalilwa (2004) in Mgori forest reserve in Singida Rural district where NWFPs contributed about 35 % of the annual household income. Similarly, Monela *et al.* (2000) observed that, households living in Miombo woodlands generate more than 50 % of their cash incomes from selling forest products such as honey and wild fruits. Nevertheless, study results are higher than those reported by Kagya (2002),

who found that NWFPs contributed about 21 % of the annual household income in Meatu district. Nyigili (2003) also found NWFPs contributed 7.5 % of the annual household income in Mbozi district. Similarly, Shackleton *et al.* (2000) reported NWFPs to contribute an income of US $ 196 – 1114 per household per year in South Africa. There are variations in terms of results for contribution of NWFPs to income generation. These differences might probably be due to variation in economic returns to activities, the richness of natural resource stocks and unpredictable market changes that alter incomes from the products. The study noted that the incomes accrued from sales of NWFPs some times help households for buying food, school uniforms and clothing. Overall, the results entail that the revenue accrued from sales of NWFPs can improve the livelihood of people in the study area. The statement is also supported by Maximillian (1998); Taylor and Parratt (1999) that incomes from NWFPs play an important role in supplementing the household income and diversifying the rural economy.

4.6.3 Contribution to health care

The medicinal plants can be used by household members to treat different human diseases to keep household members healthy thus serve some money, which could have been used to buy medications and other household requirements. The results of this study revealed that about 97 % of the household use medicinal plant to supplement primary health care (Appendix 6).

However, it was further observed that there is a health centre in every village in the study area, but people still relied in traditional medicines for belief to be more appropriate for treatment of several diseases which have no solutions case by

conventional medicines in the health centre and some times those drugs are not available or people fail to afford payments.

About 62 medicinal plant species were identified which cure about 42 different diseases and ailment. This implies that the majority of respondents utilize medicinal plants for treating various diseases and other complications. However, Augustino (2002) reported about 246 and 177 medicinal plants in Morogoro and Iringa urban districts which cure about 72 and 57 diseases respectively. Also about 185 medicinal plants were documented by Maximillian *et al.* (2001) cure about 70 different diseases in Ruvu forest reserve, while FAO (2007) reported 56 medicinal plants in Rufiji district which cure more than 20 diseases and other complicated ailments. The result from the study area seems to vary from other researchers documents. This implies that the variation might be caused by the type of forest and the richness of the medicinal plant species found in each area. Also numbers of recorded medicinal plants might be caused by low knowledge of collectors i.e. they might be knowledgeable in few medicinal plants they use more frequently in their areas but the forests might have more medicinal plants than the number mentioned. Additional further, in Kilwa district, Tanzania, Paullo (2006) revealed about 97 % of the households relied on medicinal plants for their primary health care. Similar findings are reported by Abdallah (2001) where 98 % of mothers and their children relied heavily on medicinal plants for their health care needs in Bagamoyo district, Tanzania.

However, according to Chandrasekharan (1993) 75 % of the world population particularly in developing countries depends on traditional medicine. This implies

that medicinal plants play an important role in primary healthy care especially in areas where convectional medicine is not available. During informal discussion with traditional healer, Mr. Abu H. (*Personal communication*, 2008) he argued that human diseases like asthma, hernia, women diseases, children diseases and those cases related with spiritual believes are cured by plant medicines as appropriate method of treatment. He further reported that species of *Monodora grandidieri* (Mchofu) is a treatment of stomach and muscles. Apart the species being contributing to health care to treat diseases and other ailment, he further mentioned the species also are used by witch doctors and could be maneuvered in a way that the user apply a technique where people will fail to see him while staying in the same environment. This implies that plant medicinal species are being used for many households in primary health care, but also the species could be used for some few people in traditional belief. Hence, this adding more value in the uses of medicinal trees species.

4.7 Variables contributing to household income

Multiple regression analysis was done to determine the variables contributing to income of the households for improving their livelihood. Results showed significant at ($P < 0.05$) and $R^2 = 98$ %. This implies that the model fitted well by explaining 98 % of the independent variables (incomes from farming, employment, livestock's, NWFPs, forest related activities, business and fishing) on the dependent variable (total income). Furthermore, multicollinearity test was done to see if there were correlations among the independent variables. Results showed that there were no multicollinearity, since multicollinearity is evident when tolerance value is less than 0.01 and variance inflation factor (VIF) is above 10 (Appendix 10).

Furthermore, the result of each independent variable showed positive sign which means that these variables have contribution to households income for improving their livelihood. For example, the farming variable and NWFPs collection showed highest income contribution (0.523, $P < 0.05$) where the income from NWFPs and forest related activities were observed to be the least income contribution (0.078, $P < 0.05$). The results therefore, supported the alternative hypothesis that NWFPs have significant contribution to livelihood of communities surrounding JCBNP, though not higher than the farming income. This implies that the contribution of NWFPs at JCBNP at household level is subsistence. The results are in agreement with Leskinen *et al.* (1997) who observed that NWFPs are widely collected in Zanzibar and contribute significantly to socio economic well being of the communities.

4.8 Market of NWFPs

Results indicated 10 NWFPs food to be sold in market around the study area (Table 14). Results have revealed honey (Asali) being the most highly priced product followed by *Maranta arundinaceae* (Uwanga) and baobao fruits (Ubuyu) was mentioned to be low priced product among the NWFPs sold in the markets.

Table 14: Price distribution of sold NWFPs in markets around JCBNP

Sold products botanical name (unit)	Local name	Price (Tshs)
Syzigium cuminii (kg)	Mzambarau	1 000
Saba florida (kg)	Mbungo	1 600
Flacourtia indica (kg)	Ngo	1 000
Psidium guajava (kg)	Mpera	1 000
Sorindeia madagascarensis (kg)	Mpilipilidoria	1 000
Tamarindus indica (kg)	Mkwaju	800
Adansonia digitata (kg)	Mbuyu	600
Launea cornuta (kg)	Mchunga	2 000
Maranta arundinaceae (kg)	Uwanga	6 000
Honey (lt)	Asali	8 000

It has been noted that wild food products mainly change from season to season and from species to species Leskinen *et al*. (1997). The respondents (97 %) reported that wild fruits are available throughout the year; however has a tendency to alternate among the species. Despite this, there are varieties of fruits and only few were found in the market during survey. The study noted that the average daily income ranged from 10 000 – 30 000 (Tshs) and 5 000 – 15 000 (Tshs) for town and village market respectively. It was further noted that bush meat is not sold in the open market, probably due to the fact that most of the sellers seem to be not registered legally for the business. However, the price of 1 duiker (Paa) of 2 kg was noted to be about 5 000 (Tshs) while wild pig was sold to tourist hotels at a range of about 60 000 (Tshs).

However, other researchers like Dethier (1995) reported that hunters generated between US D 250 - 1 050 per year from selling bush meat near Dja reserve in Cameroon while, Ngnegueu and Fosto (1996) observed that individual hunter could generate as much as US D 650 per year from selling bush meat. For the case of medicinal plants market, the traditional medicinal plant sellers argued that the flow of medicinal plant species from the study villages has decreased for the past 10 years and the cost of the products is higher. Results have revealed that hermorhoidal medicines were at high price followed by massage oil and merge dose, while skin soap and headache were mentioned to have low price (Table 15).

Table 15: Price distribution for medicinal products in JCBNP

Products	Original plants/animals	Price
Massage oil (350 ml)	*Cocos nucifera and Syzigium aromatica*	2 500
Merge dose (350 ml)	*Senna siamea* and *Carica papaya*	2 500
Hermorhoidal (350 ml)	*Plectrunthus bulbatus* (Mpatakuva)	5 000
D/mix (350 ml)	*Senna siamea* and *Cinamomum zeylanicum*	2 000
Relaxer (100 gm)	*Ocimum suave* (Kivumbasi)	1 500
Skin soap (100 gm)	*Aloe vera* and *Syzigium aromatica* (Mkarafuu)	600
Headache (slab)	*Uapaca guinensis* (Mchenzamwitu)	600
Stomachache (root)	*Vernonia zanzibarensis* (Mtukutu)	1 000
Duikers skin (6 cm^2 piece)	Duikers (Paa)	600

It was further noted that some of the medicines for example *Agathi santhemum* (Mvumanyuki), *Monodora gradidieri* (Mchofu), *Makhamia zanzibarica* (Mtarawanda), *Caesalpinia voelkensii* (Mkomwe), *Clausena anisata* (Mwavikali) and *Murraya koenigii* (Mvuje) its prices ranged from 200 – 500 (Tshs) per tea spoon if crushed or per slab or root. The study also noted that some of medicinal plant products were manufactured locally with composition of different medicinal tree species. Among these include massage oil, merge dose, hermorhoidal (treatment of hemorrhoid), relaxer, skin soap and D/mix (treatment of pressure, ulcers, diabetes and gas). However, the sellers refused to reveal the composition of the manufactured products. This probably might be due to hiding the secret in traditional medicine to protect their business. Similar findings were also observed by (Augustino, 2002). The author observed selfishness among most traditional medicinal dealers due to avoid once of disclosing their information to others for fear of loosing markets/jobs.

The study has further noted that there is competition between traditional medicinal species to those imported from Arabian countries and Tanzania mainland which treats the same diseases and most of the customers prefer the Arabian medicines. This might be due to the notion by some customers who argued that Arabian

medicines are more active. It has been noted that the marketing chain involved the suppliers and the sellers of the products only. This probably might be due to the absence of special traditional medicines management regime which control the supply and reliability of the marketing structure of the products.

It was further noted that all medicinal plant sellers were men, however, during informal discussion with some key informants it was emphasized that, women have knowledge of utilizing traditional medicines but they are not the sellers of the products. This probably might be due to fact that most of women are not interested in selling traditional medicines according to culture and taboos. Similar findings are reported by Augustino (2002) in Morogoro urban district where women were not so much encouraged to practice traditional healing due to their low level of education as well as traditional culture and believe.

The study also noted some weakness in selling of medicinal plant species due to solely depends in local market and no exportation. Also, the study noted low effort to improve traditional medicines. This probably could be due to low awareness on the trade potential of NWFPs nationally and its contribution to generating income, and also absence of trade promotion tool of NWFPs. The result showed that the average daily income earned from sales of plant medicines ranged from 20 000 – 40 000 (Tshs). Different researchers in other parts of Tanzania have documented different results. For example, Abdallah (2001), Kagya (2002) and Hamza *et al*. (2004) observed that the household annual earning from sales of plant medicines was 600 000 in villages around Zaraninge forest reserve in Bagamoyo, 345 833 in Meatu district and 170 000 in villages around Mgori forest reserve, in Singida

Rural district, Tanzania respectively. Also Makonda (1992) found that sellers of traditional medicine in Geita had daily income ranging from 500 – 2 000.

The differences might be caused by the fact that income levels are not the same among the communities; hence influencing their abilities to pay for modern health services offered. Also, the trend of using the plant medicines and the types of diseases cured are differ from one community to another and this brings changes in utilization of the resources. Additional further, preferences vary from place to place especially in relation to the abundance of preferred medicinal plant species for specific treatment. Hence, the scarcity of the preferred species compels people to use other species; provided they save the same purpose e.g *Plectrunthus bulbatus* (Mpatakuva) and *Synaptoleptis kirkii* (Mbibikiu) (all cure stomach pain), hence this affect the trend in utilization of medicines Paullo (2006).

4.9 Roles of user groups in NWFPs

4.9.1 Gender and collection of NWFPs

Most men and women in the villages surrounding JCBNP were found to collect NWFPs (Table 16). The results indicated that both men and women share the same role in the collection of NWFPs in their vicinity. This observation was also reported by Kessy (1998) where collection of NWFPs between men and women were not specialized. However, the number of men (49 %) in the study area was mentioned to be high compared to women (23 %). During discussion with key informant, it was noted that men have greater role in collection of varieties of NWFPs throughout the year for their daily subsistence, primary health care and income generation. These products were collected from farmlands, fallow lands, and

forests. The most widely collected products were medicinal plants, wild fruits, bush meat and honey. However, women were noted to have a big role in the collection of the products which are mostly used for domestic purposes. This conform with Falconer (1997) who observed that most women in Africa are involved in collection of NWFPs more around the subsistence needs of the household. These include vegetables, weaving materials and sea food products. This trend is probably due to the fact that most of the NWFPs were available far away from home and in the forest where its accessibility is not easy and most of the women are not attracted. Secondly, the study noted that due to the culture and social life of people, most women are not much interested to deal with forest activities with a notion that are men activities and women are dealing with domestic tasks. However, the study further noted that about 28 % of the collectors of NWFPs involve both men and women in the households and normally for the products used in homestead for food and medicines.

Table 16: Percentage distribution of gender against collection of NWFPs in JCBNP

Respondents	Frequency	Percentage of response
Men	61	49 %
Women	28	23 %
Both (men & women)	35	28 %
Total	**124**	**100 %**

Other findings in some of African countries and other parts of Tanzania recorded different results. For example in Zimbabwe, it was reported that a significant difference across gender exists in terms of different resource collection (Campbell *et al.,* 1991). The authors reported that widows and widowers collect quite different products. Widows collect fruits while widowers rely on hunting and fishing.

Similarly, Lema (2003) and Kagya (2002) reported that male were responsible in hunting of wild animals and honey while women were largely involved in collection of wild vegetables and mushrooms which were for direct consumption in Morogoro Rural district and Meatu district respectively. The age group may also play an important role in collection of NWFPs. The results show that there is a significant difference in percentages of respondents by age categories. The study noted that age group distribution due to gender indicated that most men (30 %) and women (11 %) were in age group of 20 – 35 years (Table 17). This showed that the group is composed of youth who are active people, and can walk long distances in collection of NWFPs followed by age group of 46 - 60 which are active adults with a lot of experiences on NWFPs collection.

Table 17: Percentage distribution of age against collection of NWFPs in JCBNP

Age group (Years)	**Male % (N)**	**Female % (N)**
20 – 35	30 (51)	11 (20)
36 – 45	12 (21)	8 (13)
46 – 60	24 (41)	8 (13)
Above 61	7 (11)	(0)
Total	**73 (124)**	**27 (46)**

Note: Numbers in brackets are frequencies

The age of the collectors also affected the collection of forest products such as wild fruits, honey, bush meat, medicinal plants, and weaving materials. The statement was also conform to what reported by Paullo (2006) who observed that the collection of NWFPs increases gradually as age increases. Similarly, Ogle and Grivetti, (1985) argue that, in Swaziland, children collect and consume more species of wild fruits than adults and that adults regard most wild fruits as food for

children. The study noted that most of NWFPs are collected with young people compared to other age group. This implies that young people have an access to walk and find the products in the remote areas in the forests. Additional further, the age distribution of above 61 years is category of older people in the study area. The study noted that this category is more knowledgeable regarding NWFPs. Hence, the results implies that adults have a lot of experiences on sources of NWFPs and are able to distinguish between poisonous and non-poisonous species and even the uses of the products. The statement was also commented by Basnayake and Gunaratne (2002) who noted that the age of a person usually is a factor that can explain the level of production and efficiency. It influences experience, wealth and decision making of an individual.

Most men and women collectors of NWFPs interviewed were found to have different level of education in the study area. The results revealed that about 41 % and 13 % of men and women of NWFPs collectors respectively had secondary education followed by 21 % of men and 18 % of women had primary education. About 4 % and 0.5 % of men and women respectively had adult education which was mentioned to be the last level of education (Table 18).

Table 18: Percentage distribution of education level against collectors of NWFPs in JCBNP

	Education level			
Respondents	Adult education % (N)	Primary education % (N)	Secondary education % (N)	Higher education % (N)
Male	(4) 6	(21)36	(41)71	(6.5) 11
Female	(0.5)1	(11)18	(13)22	(3) 5
Total	**(4.5) 7**	**(32)54**	**(54) 93**	**(9.5) 16**

Note: N= Frequency

However, the study noted that the number of men collectors of NWFPs in the study area seems to have higher level of education compared to women. The same trend was also observed by other researchers, for example Vineeta (1997) in Augustino (2002) noted that women low level of education in general, together with combination of culture, social life and commitment to family are the factors that hinder women from education which could improve their knowledge. Furthermore, the study noted that those with high education level decreases significantly collection of NWFPs. This implies that literates had great chance of having other sources of livelihood and substitutes for NWFPs.

Despite the fact that the number of women collectors of NWFPs to be in low level of education compared to men, but the level of education in the study area was noted to be at middle level of education. This probably might be due to present of primary and secondary schools in each village which reduce the walking distance and hence encouraged most of young people to attend the school. Secondly, due to adult awareness in education, this committed to pay for school fees and other related cost to their kids. It has been reported by Maro, (1995) that primary education can foster human creativity, and hence been having relationship with farmers' readiness to integrate innovations into traditional systems of land use and management. Similarly, Mhinte (2000) reported that skills and education increase working efficiency and productivity, making households with more educated heads more entitled to income and food.

4.9.2 Gender and processing of NWFPs

The processing of NWFPs has showed gender differentiation for various products and methods used (Table 19). Women (47%) were noted to be more involved in processing of the products than men. During group discussion, it was noted that most women play important roles in processing of NWFPs. Results revealed that 19 % and 20 % respectively of most men and women interviewed preferred washing method of processing NWFPs. It was further noted that the method is mainly used for most of wild fruits. Moreover, 8 % and 17 % of men and women respectively use drying method of processing NWFPs. The study noted that most of the medicines, weaving materials and some vegetables were involved in this method.

Table 19: Percentage distribution of gender against processing of NWFPs in JCBNP

Processing method	Male % (N)	Female % (N)
Washing	19 (14)	20 (15)
Drying	8 (6)	17 (12)
Boiling and drying	26 (20)	10 (8)
Total	**53 (40)**	**47 (35)**

Note: N= Frequency

Additional further, the study noted that the boiling and drying method are used for processing some of sea food products and vegetables. The study noted that about 10 % of women use the method, however about 26 % of men respondent of not using the method. This probably due to the fact most of the processed products are used for domestic purposes, hence the process involve more women rather than men. The results are in agreement with Hamza and Msalilwa (2004) that women in Mgori forest reserve were more active in processing NWFPs than men. Similar findings of

Katani (1999) that women are extensively involved in processing enterprises compared to male counterparts.

4.9.3 Gender and marketing

Marketing of NWFPs have showed some gender dimensions. About 80 % of respondents, both men and women were observed to sell various NWFPs in the study area. However, the large number was noted to involve men compared to women (Table 20).

Table 20: Percentage distribution of gender role in marketing of NWFPs in JCBNP

Respondents	**(%) (N)**
Male	74 (73)
Female	26 (26)
Total	**100 (99)**

Note: N = Frequency

During group discussion with key informants, low number of women's role in marketing of NWFPs was noted probably women do not prefer to expose themselves infront of men. Also, due to difficulties in access of NWFPs, women were opting to deal with other small business hence leave men to deal with marketing of most of NWFPs. The study revealed that men are responsible for marketing of wild fruits, honey, medicines, fish and bush meat while women market sea food, vegetables, baskets and mats at home. The results implies that men are dealing with marketing of high income generating products, while the majority of women were involved in low income generating activities such as vegetables, mat and basket weaving. Where both men and women were involved, men had the tendency to produce for market and women for domestic consumption, thus earning

low returns. Kajembe *et al.* (2000) reported similar findings where most hunters and wood cavers were men. Similarly, Perez *et al.* (1999) in Cameroon noted that male traders concentrated on the largest, most lucrative products in marketing, while women tend to deal with the less attractive commodities. The results of age group distribution of respondents in marketing of NWFPs indicated that most of men were in age group of 40 – 60 years and women at the age of 20 – 35 years while above 61 years was mentioned to be less group in marketing of NWFP (Table 21). The results revealed that the age group of men composed of active adults with experience in NWFPs, while women composed of young people who are active in participating in marketing of NWFPs. All the NWFPs were sold by individual collectors and there were no organized marketing groups of all age distribution observed in the surveyed villages.

Table 21: Percentage distribution of age against marketing of NWFPs in JCBNP

Age group	**Male**	**Female**
	% (N)	**% (N)**
20 – 35	17 (21)	14 (18)
36 – 45	18 (23)	3 (4)
46 – 60	31 (39)	9.4 (12)
Above 61	5 (6)	3 (4)
Total	**71 (89)**	**29 (38)**

Note: N = Frequency

Additional further, the study noted that in all age groups, men are the most participating in marketing compared to women. This implies that men are the most sellers and distributors of NWFPs in the market. Most of interviewed were found to have education at different level. Men were found to have more education level compared to women (Table 22). However, most of the men were found to be in a level of secondary education, while women in primary education level.

Table 22: Percentage distribution of education level against marketing of NWFPs in JCBNP

Respondents	Education level			
	Adults % (N)	Primary % (N)	Secondary % (N)	Higher % (N)
Male	4 (5)	30 (33)	37 (47)	3 (4)
Female	1.6 (2)	15.7 (20)	11 (14)	1.6 (2)
Total	**5.6 (7)**	**41.7 (53)**	**48 (61)**	**4.7 (6)**

Note: Number in the parentheses is frequency of response

The study revealed that the respondents with higher education not much participating in marketing of NWFPs. This could be attribute by most of them have been engaged in other sectors of employment and their mind has focused in other channel of production, hence they could derive the life from other sources.

4.10 Constraints towards development of NWFPs

About 32 % of the respondents reported destruction of the forest as a major constraint towards development of NWFPs with a lack of awareness in protection on NWFPs being the least (Table 23).

Table 23: Percentage response on constraints towards development of NWFPs in JCBNP

Constraints	% Response (N)
Destruction of forest	32 (39)
No control in utilization and no community association to develop NWFPs	10 (12)
Less priority to politician and high competition in collection	9 (10)
No awareness in protection on NWFPs species	5 (6)
Few species are available and long distance to access NWFPs	11 (13)
Destruction of forest and competition among users	13 (16)
Destruction of forest, long distance to access and no control in utilization	7 (9)
Population increase, no research of NWFPs and destruction of forest	15 (19)

Note: N= Frequency of response

From the communities point of view, the main causes of forest destruction was due to the frequency of forest fires, fuel wood collection, poles cutting and shifting agriculture. During informal discussion with key informants, they insisted that the population is increasing rapidly while resources are diminishing and there is no research regarding improvement of a particular species of NWFPs. This implies that researches of NWFPs species are needed to cater the actual demand of the species to communities for improvement.

Despite the problem of forest destruction, competition among NWFPs users was noted as constraint by 13 % of the respondents. It was observed that this was due to fact that most users of NWFPs resources concentrate on the same area; hence diversification is limited. Also apart from villagers, there are some people outside the village who compete for the same NWFPs resources, for example in bush meat hunting, collection of mangrove products, wild fruits and weaving products. About 11 % of the respondents mentioned the problems of accessing few species with at a longer distance. During discussion, the study observed that several species of fruits, medicinal plants, vegetables and bush meat seem to have disappeared around the area and hence people are forced to walk not less than 2 km to access NWFPs. Similar observation was observed in Rufiji district by FAO (2007b) where villagers take long distance walk of up to 10 km to find NWFPs in the forests. Similarly, Paullo (2006) reported that in Kilwa district, the villagers walk at distance of up to 5 km to find NWFPs in their areas. This implies that in most areas NWFPs are not available around the home area and people walk long distance to access the products. The diminishing of NWFPs around home area indicates the difficulties of the communities to access the resources to improve income-generation. This could

be achieved by helping communities to organise themselves into economic groups and train them on how to establish conservation committee to rehabilitate the area.

Also the study observed that currently there is no control in utilization of NWFPs and lack of community associations to develop NWFPs. This problem was mentioned by 10 % of the respondents. The study noted that there is no limitation in the quantity required to be harvested in the forests per head, quality of the products and number of the people required to be in the forest at a time. This could lead over harvesting of NWFPs if not controlled and in turn result into deforestation and forest degradation. The problems of less priority to politicians and high competition in collection of NWFPs was also noted.

The study noted that communities have a notion that politicians do not regard NWFPs as resources which improve people's livelihoods and require being involved in the government plan. This implies that there is a gap in evaluation of forest product use and politicians which result into neglecting of the potential species to the community. And this might cause NWFPs resources not to be incorporated in the communities' initial plan, while the resources play an important role in supplementing the household income, stimulating and diversifying the rural economy and reducing risks on agricultural crops depending on rainfall, thus reducing poverty. About 5 % of the respondents mentioned the problem of unawareness of community in protection of NWFPs in the study area. The study noted that most of the people regard the forest as a government property and are not responsible in protection. The study also noted that most of the resources are abused by careless utilization.

It has been noted that some of the utilized species in the forest are in bad condition for being over barked and up-rooted for different purposes, for example *Makhamia zanzibarica* (Mtarawanda). Similar findings have been reported in Kenya by Gathaara and Kahuki (1997) who revealed that extraction of medicinal plants could be extremely destructive especially where bark and roots are needed. Similarly, Makonda *et al.* (2000) observed that drying patches of trees species following over exploitation of their roots and barks in Geita and Kilosa districts. These results imply that most of the community is not aware regarding the protection of NWFPs and this could lead the destruction of the products.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusions

The study documented about 88 and 26 Non Wood Forest Products plants and animal species respectively. The NWFPs found in the villages surrounding Jozani and Chwaka Bay National Park contribute 27 % to food security i.e only for subsistence, 32 % to income generation and 97 % rely on medicinal plant species for treatment of various diseases and ailments. The current availability of NWFPs is decreasing hence; indicates a need to increase the management of resources and training to the communities on the management of NWFPs for sustainable utilization in improving communities' livelihoods. The gender roles in collection, processing and marketing of NWFPs have influences to improve the livelihoods in the study area. The study also noted some constraints towards development of NWFPs in the area. The major constraints including forest destruction, less control in utilization of NWFPs and unawareness of communities in protection of NWFPs.

5.2 Recommendations

The following recommendations are made from this study:

- The use of NWFPs species to the community is very apparent, therefore communities should be provided with information based on NWFPs to raise their awareness. This will include the information on the valuable NWFPs species, its management and regeneration regime to be included in their plan.

- Communities should be trained to improve their utilization regarding NWFPs species particularly in such areas as conservation, processing, marketing and promotion of the products for sustainable development of the resources and hence livelihood improvement.

- There is a need to develop a utilization plan of different NWFPs in collaboration with Department responsible for Natural Resources and communitities should be supported to establish economic groups in boosting the products around their vicinity to improve their livelihoods through sustainable management of the resources.

- Due to work as separate entity, close collaboration between Department responsible with Natural Resources and communities is needed. This will help to reduce pressure in the exploitation of NWFPs hence to improve the protection of the resources.

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APPENDICES

Appendix 1: Households questionnaire on the role of NWFPs for the livelihood of communities around JCBNP.

1. Background information

Date of interview…….

Village…….Household No. (….)

Gender: Male (…)/Female (…)

Age of respondent…… (Years) Occupation:

…….

Marital status

i. Single (….)

ii. Married (….)

iii Widowed (….)

iv. Divorced (….)

Education level

i. Adult education (…)

ii. Primary education (…)

iii. Secondary education (…)

iv. Higher education (specify)...…….

Family size

	Male	Female
Below 15 yrs	…….	……
15 – 30 yrs	……..	……
31 - 60 yrs	……..	…….
Above 60 yrs	……..	……..

2. Information on utilization of NWFPs

a) Do you collect NWFPs (Yes/No)

if yes

b) What are the different types of NWFPs found in your village?

Types of NWFPs	Species	Local name
1.		
2.		

c) At which seasons are the NWFPs available for collection?

Types of NWFPs	Collection season	Remark

d) What is the status of NWFPs?

e) Can you explain the current situation of NWFPs availability compared to the past 10 years?

3. Who collects the NWFPs from the area? Why?

Types of NWFPs	Collectors	Remark
1.		
2.		

4. What are the uses of collected NWFPs?

Types of NWFPs	Uses	Remark
1.		
2.		

5. What cost do you incur during harvesting?

Type of NWFPs	Cost of harvesting	Remark
1.		
2.		

6 (a) What is your source of income?

(b) Can you give the estimation on how much you earning from your source of income?

Source of income	Estimated earning per year	Remark
1.		
2.		

(c) Can you mention the NWFPs contribution to income at your household?

Type of products	Income earning/yr (sh)
1.	
2.	

7 (a) Do you utilize medicinal tree species?

(b) If Yes, can you mention the most medicinal tree species utilized in this area?

8. Give information about marketing of NWFPs.

NWFPs type	Amount collected/yr	Amount sold per year	Marketing price/Unit	Remark
1.				
2.				

9 (a) Can you mention the collected and processed NWFPs?

b) Can you mention who process NWFPs?

c) Can you explain the method of processing NWFPs in your area?

10. Can you explain the quantity of NWFPs collected and how much consumed and contribute to household food security in your area?

Type of NWFPs	Quantity consumed/yr	Percent
1.		
2.		

11. Can you explain the agricultural products collected and how much consumed and contribute to household food security in your area?

Types of Agricultural products	Quantity consumed/yr	Percent
1.		
2.		

12. What are the problems facing the development of NWFPs in your area?

13. Can you suggest any measures that can be taken to develop NWFPs in your area?

Appendix 2: Key informants questionnaire on the role of NWFPs for the livelihood of communities around JCBNP

1. Background information

Village…….Key informant…….

Date of interview……

Gender: Male (…)/Female (…)

Age of respondent…… (Years) Occupation:

…….

Marital status ……

Education level

i. Adult education (…)

ii. Primary education (…)

iii. Secondary education (…)

iv. Higher education (specify)...

…….

2. Information on utilization of NWFPs

a) What are the different types of NWFPs found in your village?

Types of NWFPs	Species	Local name

b) Can you explain the season for collection of NWFPs?

Types of NWFPs	Season for collection	Remark

c) What is the status of NWFPs compared to the past 10 years?

3. Which user group collects the NWFPs? Why?

NWFPs	Collectors	Remark

4. What are the uses of collected NWFPs?

Type of NWFPs	Uses	Remark
1.		
2.		

5. Can you mention medicinal tree species utilized for primary health care?

6. Can you give the estimation of income contributed from these sources?

Source of income	Estimation per year

1.	
2.	

7 (a) Do people sell the NWFPs? (Yes/No). If yes which NWFPs are potential for providing income at household level?

b) Where the NWFPs are sold? Why?

8. Please give information about marketing of types of NWFPs in your area.

Type of NWFPs	Amount collected/yr	Amount sold per yr	Marketing price/Unit (Tshs)	Remark
1.				
2.				

9. Which collected NWFPs are processed?

10. Can you explain the user groups processing NWFPs in your area?

11. Can you explain the processing method used in your area?

12. Can you explain the quantity of NWFPs collected and how much consumed and contribute to household food security in your area?

Products	Quantity consumed/year (kg)	Percent
1.		
2.		

13. Can you explain the agricultural products collected and how much contribute to household food security in you area?

Products	Quantity consumed/yr (kg)	Percent
1.		
2.		

14. Are there any problems in development of NWFPs (Yes/No). If yes, which problems?

15. What measures can be taken to develop NWFPs in your area?

Appendix 3: NWFPs resource assessment from forest around JCBNP

Type of vegetation……

Date… …….

Cluster….	Species identified		Dbh (cm)	Stem/ha	Use	Part used
Plot no.1	Scientific name	Local name				
Plot no.2						
Plot no.3						
Plot no.4						

Appendix 4: Checklist for market survey on the role of NWFPs for the livelihood of communities around JCBNP.

Name of the market

place……..

Type of market …….

Date of interview……..

1. Can you explain the situation of NWFPs sold to the past?

2. Who are the people involved in the various stages of marketing?

3. Can you give the prices of different NWFPs?

Type of products	Price	Remark
1.		
2.		
3.		
4.		
5.		
6.		

4. Is there any competition on sold NWFPs at the market? YES/NO

   If yes, what aspect causes this competition?

5. If No, give the aspect, which will increase competition to the sold NWFPs in the market.

6. What are the constraints facing marketing of NWFPs?

7. What measures can be taken to improve the marketing situation of NWFPs?

Appendix 5: NWFPs recorded and botanically identified IN JCBNP with their parts used and use value

Scientific name	Local name	Family	Form	Use	Part use	Use value
Accipiter tachiro	Kipanga	Accipitridae	Bird	Food, medicinal	meat	0.5
Achatina achatina	Koa (Konokono)	Achatinidae	Snail	Food	meat	0.3
Adansonia digitata	Mbuyu	Bombacaceae	Tree	Food, fodder, rope, twine	Fruits, leaves, bark	1.5
Alangium salviifolium	Mnukamavi	Alangiaceae	Climber	Medicinal	leaves	1.5
Amaranthus caudatus	Mchicha mwiba	Amaranthaceae	Herb	Food, fodder	leaves	0.3
Ancylobotrys petersiana	Mtoe	Apocynaceae	Climber	Food, rope, twine, medicinal	Fruits, roots, leaves, stem	1.6
Annona senegalensis	Mtopetope	Annonaceae	Tree	Food, medicinal, ornamental, fuel wood, wooden spoon, clogs	Fruits, roots, flowers, stem	2.8
Avicenia marina	Mchu	Verbanaceae	Tree	Medicinal, fuel wood, poles, tool handle, charcoal	Bark, seeds, stem, branches	2.5
Bersama abyssinica	Mwangwakwao	Melianthaceaea	Tree	Medicinal, fuel wood, construction, wooden spoon, clogs	Bark, roots, stem	1.6
Bridelia micrantha	Mkarati	Euphobiaceaea	Tree	Medicinal, poles, fuel wood, charcoal, tool handle, wooden spoon	Bark, stem	3.0
Brugueira gymnorhiza	Mui	Rhizophoraceae	Tree	Medicinal, poles, tool handles, charcoal, fuel wood	Bark, seeds, stem, branches	2.0
Bubukus ibis	Yangeyange	Soricidae	Bird	Food	meat	0.5
Caesalpinia voelkensii	Mkomwe	Caesalpiniaceae	Climber	Medicinal, game	Roots, seeds	0.5
Campethera cailliautii	Kigong'ota	Picidae	bird	Food	meat	0.5
Carpolobia sp	Kikoko	Leguminaceae	Herb	Medicinal	leaves	1.5

Casytha filifomis	Mlangamia	Lauraceae	Climber	Medicinal	Leaves, tuber	0.3
Cephalophus adersi	Paa nunga	Bovidae	Animal	Food, drumming, knife cover, medicinal	Meat, skin, hoofs	2.5
Cephalophus monticola monticola	Paa chesi	Bovidae	Animal	Food	Meat	1.5
Cercopithecus mitis albugaris	Kima mweusi	Cercopithecidae	Animal	Food	Meat	0.3
Ceriopsis tagal	Mkandaa mwekundu	Rhizophoraceae	Tree	Medicinal, poles, fuel wood, charcoal, dye, pestle	Bark, seeds, stem, branches	2.5
Ciccaba woodfordi	Bundi	Strigidae	Bird	Medicinal	Claws	0.4
Civettictis cevetta	Ngawa	Viverridae	Animal	Food, medicinal	Meat, testis	0.3
Clausena anisata	Mwavikali	Rutaceae	Tree	Medicinal, fuel wood	Roots, stem, leaves	0.3
Clerodendrom sp	Kipepe	Verbanaceae	Herb	Medicinal	Roots, leaves	0.4
Cossypha natalensis	Kurumbizi	Muscicapidae	Bird	Food	meat	0.5
Crisetomys gambianus cosensi	Buku	Seiuridae	Animal	Food	Meat	0.3
Croton sylvaticus	Mshinduzi	Euphobiaceae	Tree	Medicinal, fuel wood, poles	Leaves, roots, stem, branches	1.0
Dalbegia vaccinifolia	Mvyongozi	Papilionaceae	Climber	Medicinal	Leaves	0.4
Datura spiciosa	Mranaha	Solanaceae	Herb	Medicinal	Leaves, roots	1.0
Dendrohydrax validus neumanni	Pelele	Noctuidae	Animal	Food	Meat	1.5
Dicrurus adsimilis	Kunzi	Dicruridae	Bird	Food	meat	0.5
Dioscorea zanzibarensis	Viazi vikuu mwitu	Dioscoreaceae	Climber	Food, ornamental	Tubers, whole	1.5
Dodonea viscosa	Mkeneta	Sapindaceae	Shrub	Medicinal, fuel wood	Leaves, stem, roots	1.5
Eel	Mkunga	Nuraenidae	Marine product	Food	Whole	1.5
Eleadendrom buchananii	Mwingajini	Celastraceae	Shrub	Medicinal	Roots, leaves	1.5
Emilia sagittata	Kilemba cha bwana	Compositae	Herb	Food, medicinal	Leaves, roots	0.5

Encephalartos hilderbrantii	Mgwede	Zamiaceae	Tree	Food, ornamental	Trunk, whole tree	1.0
Ethulia conizoides	Mbangiwazimu	Compositae	Herb	Medicinal	Leaves, roots, stem, fruits	0.6
Euclea rasimosa	Msiliza	Ebenaceae	Shrub	Medicinal, fuel wood, construction	Roots, stem	0.4
Euclea schimperi	Mdaa	Ebenaceae	Tree	Medicinal, fuel wood, construction, tooth brush	Roots, stem, branches	3.2
Eugenia capensis	Mkaaga	Myritaceae	Tree	Spices, medicinal, fuel wood, construction, wooden spoon	Leaves, stem	2.0
Euphobia nyikae	Mkweche	Euphobiaceae	Tree	Medicinal, fuel wood, poles	Leaves, roots, stem, branches	0.3
Ficus capensis	Mkuyu	Moraceae	Tree	Food, medicinal, ornamental	Fruits, bark, whole tree	1.0
Flacourtia indica	Mgo	Flacourtiaceae	Tree	Food, medicinal, fuel wood	Fruits, roots, stem	2.0
Flueggia virosa	Mkwamba	Euphorbiaceae	Shrub	Medicinal, fodder, fuel wood	Roots, leaves, stem	1.5
Guttera edouardi	Kororo	Numididae	Bird	Food	Meat	1.0
Guttera pucherani	Kanga	Numididae	Bird	Food	Meat	1.0
Harrisonia abyssinica	Kuche la simba	Simaroubaceae	Shrub	Medicinal, fuel wood	Leaves, stem	0.5
Heritiera littolaris	Msikundazi	Sterculiaceae	Tree	Medicinal, poles, fuel wood, charcoal, tool handle	Roots, stem, branches	2.0
Hoslundia opposite	Mnunu	Labiatae	Shrub	Medicinal, fuel wood, ornamental	Leaves, stem, flowers	1.0
Hypchira chalybeatu	Msese		Bird	Food	Meat	1.0
Lantana camara	Mlakunguru	Verbanaceae	Shrub	Food, medicinal, ornamental	Fruits, leaves, whole tree	0.3
Launea cornuta	Mchunga	Compositae	Herb	Food	leaves	1.0
Lippia javanica	Mpamba wake	Verbanaceae	Shrub	Medicinal, fuel	Leaves,	1.0

				wood	stem	
Lobelia anceps	Mchambale	Lobeliaceae	Herb	Food, medicinal	leaves	0.3
Makhamia	Mtarawanda	Verbanaceae	Tree	Medicinal,	Roots, stem	1.5
zanzibarica				wooden spoon,		
				clogs		
Mallotus	Mchakati	Euphobiaceae	Tree	Medicinal, fuel	Leaves,	1.0
oppositifolius				wood, poles,	bark, stem,	
				pestle	branches	
Maranta	Uwanga	Taccaceae	Herb	Food, medicinal	Tuber, stem	0.5
arundinaceae						
Mimisopsis	Mnyevuu	Sapotaceae	Tree	Medicinal,	Leaves,	1.0
fruticosa				timber,	roots, stem	
				construction		
Mimosa pigra	Kifauwongo	Mimocaceae	Herb	Medicinal	Leaves,	1.0
					roots	
Monodora	Mchofu	Annonaceae	Shrub	Medicinal, fuel	Roots, stem	3.0
grandidieri				wood, withies		
Moringa	Mronge	Moringaceae	Shrub	Food	leaves	0.3
oliefera						
Murraya	Mvuje	Loganiaceae	Herb	Medicinal	Leaves,	1.5
koenigii					stem	
Neotragus	Paa mwekundu	Bovidae	Animal	Food	Meat	1.5
moschatus						
moschatus						
Ocimum suave	Kivumbasi	Labiatae	Herb	Medicinal	leaves	1.0
Ocimum	Mtule	Labiatae	Herb	Medicinal	leaves	1.0
americanum						
Oldenia bonjeri	Mvumanyuki	Caesalpiniaceae	Shrub	Medicinal	Roots	1.0
Parinari	Mbura	Chrysobalanaceae	Tree	Food, fuel	Fruits, stem,	0.5
curatelifolia				wood, poles,	branches	
				tool handle		
Phoenix	Ukindu	Palmae	Tree	Food, weaving,	Fruits,	2.0
reclinata				thatching,	leaves,	
				ornamental	whole tree	
Phyllantus sp	Mtambaa na	Rubiaceae	Climber	Medicinal	Leaves,	0.5
	penu				stem	
Physalis	Mnavu	Solanaceae	Herb	Food	leaves	0.5
ixocarpa						
Piliocolubus	Kima punju	Cercopithecidae	Animal	Tourism	Whole	0.5
kirkii				attraction	animal	
Piper guineese	Mtambuu	Piperaceae	Climber	Medicinal, rope,	Leaves,	1.5
				fish poison	stem	
Pirtada	Chaza		Marine	Food,	Meat, shell	0.5
nargaritisesra			product	ornamental		
Pittosporum	Mpande	Rubiaceae	Tree	Medicinal, fuel	Roots, bark,	4.0
virridiflorum				wood,	seeds, stem	
				construction,		
				wooden spoon,		
				clogs		
Plectrunthus	Mpatakuva	Liliaceae	Herb	Medicinal	Leaves	1.5

bulbatus						
Polysphaera	Mlapaa	Rubiaceae	Tree	Food,	Food,	2.0
parvifolia				medicinal, fuel	leaves,	
				wood, tool	roots, stem	
				handle		
Potamochoerus	Nguruwe	Suidae	Animal	Food	meat	0.3
porcus						
Psidium guajava	Mpera	Myritaceae	Tree	Food,	Fruits,	3.0
				medicinal, fuel	leaves,	
				wood	roots, stem	
Psychotria	Mkonge	Rubiaceae	Tree	Food,	Fruits,	2.5
bibracteata				medicinal,	leaves,	
				poles, fuel	stem, whole	
				wood, tool	tree	
				handle,		
				ornamental		
Pyconotus	Shore	Turdidae	Bird	Food	meat	0.3
barbatus						
Python sebae	Chatu	Pythonidae	Snake	Food, medicinal	Meat, skin	0.3
Rhizophora	Mkoko	Rhizophoracea	Tree	Fuel wood,	Stem, bark,	2.0
mucronata	magondi			poles, tool	branches	
				handle,		
				charcoal, dye		
Rhoicissus	Mtongo	Vitaceae	climber	Drink, rope,	Stem, roots	1.5
revoilii				medicinal		
Rhus longipes	Mchengele	Anacadiaceae	Shrub	Food,	Fruits,	0.5
				medicinal, fuel	leaves,	
				wood	roots, bark,	
					stem	
Saba florida	Mbungo	Apocynaceae	Climber	Food,	Fruits,	2.0
				medicinal, rope,	leaves,	
				twine	roots, stem	
Salada elegans	Pwipwi	Compositae	Herb	Food	leaves	0.5
Saphora	Utupa	Papilinioceae	Herb	Fish poison	Leaves,	1.0
occidentalis					bark	
Scylla serata	Kaa	Crustaceae	Marine	Food		1.5
			product			
Senna	Mpingaume	Caesalpiniaceae	Shrub	Medicinal, fuel	Leaves,	1.5
petersiana				wood	roots, stem,	
					fruits	
Sentropus	Tipitipi	Cuculidae	Bird	Food	meat	0.5
superciliosus						
Sesuvium	Mboga ya	Aiozoaceae	Herb	Food, fodder	leaves	0.5
portulacastrum	pwani					
Shrims	Kamba	Crustaceae	Marine	Food	Whole	1.5
			product			
Sida acuminate	Kifagio	Malvaceae	Herb	Medicinal,	Leaves,	1.0
				sweeper	stem	
Smilax anceps	Mkwangashare	Smilaceae	Climber	Medicinal	Roots,	1.0

Soneratia alba	Mliana	Soneratiaceae	Tree	Dye, fuel wood, poles, tool handle, charcoal	leaves Bark, stem, branches	2.0
Sorrindeia madagascarensis	Mpilipilidoria	Anacadiaceae	tree	Food, medicinal, fuel wood, poles, charcoal, mortar	Fruits, bark, stem	3.0
Stachytapheta jamaicensis	Kikwayakwaya	Verbanaceae	Herb	Food, medicinal	leaves	1.0
Streptopelia capicola	Huwa	Columbidae	Bird	Food, ornamental	Meat, whole bird	1.0
Strychnos innocua	Mtonga	Loganiaceae	Tree	Food, medicinal, fuel wood	Fruits, leaves, roots, stem	1.5
Suregada zanzibarensis	Mdimumsitu	Euphobiaceae	Tree	Medicinal, fuel wood, poles, charcoal, ornamental	Leaves, stem, whole tree	4.0
Synaptolepsis kirkii	Mbibikiu	Thymelaeaceae	Climber	Food, medicinal, rope	Fruits, leaves, stem	1.5
Syzigium cumunii	Mzambarau	Myritaceae	Tree	Food, medicinal, timber, fuel wood, mortar	Fruits, bark, stem, branches	3.0
Tacca involucrate	Uwanga jike	Taccaceae	Herb	Medicinal	Tuber, stem	0.3
Tamaridus indica	Mkwaju	Caecalpinaceae	Tree	Food, medicinal, wooden spoon	Fruits, leaves, roots, stem	2.5
Tarrena pavettoides	Mlashore	Rubiaceae	Tree	Fruits, medicinal, fuel wood, ornamental	Fruits, leaves, stem, flowers	0.3
Terebralia talustris	Suka	Portamidididae	Marine product	Food	Meat	0.5
Terminalia cartapa	Mkungu	Combretaceae	Tree	Food, timber, fuel wood, ornamental	Fruits, stem, whole tree	2.0
Toddalia asiatica	Mdakakomba	Rutaceae	Climber	Medicinal	Leaves, bark	0.5
Torkus alboterminatus	Kwembe		Bird	Food	Meat	0.5
Turraea floribunda	Mtamagoa	Meliaceae	Tree	Medicinal, fuel wood, wooden spoon, tool handle, clogs, pestle	Leaves, roots, stem	1.0
Tutor	Pugi	Alcedinidae	Bird	Food	Meat	1.0

chalcospilos						
Uapaca guinensis	Mchenza mwitu	Euphobiaceaea	Tree	Medicinal, fuel wood, construction.	Bark, roots, stem	2.0
Unidentified	Tui (mahongo)	unidentified	Herb	Food	leaves	0.3
Vanguera infausta	Mviru	Rubiaceae	Shrub	Food, fuel wood, medicinal, wooden spoon, ornamental	Fruits, roots, stem, whole tree	2.0
Varanus niliticus	Kenge	Varanidae	Lizard	Food, medicinal	Meat, liver	0.5
Vernonia blabra	Dimi la ng'ombe	Compositae	Herb	Medicinal	Leaves	0.3
Vitex doniana	Mfuu	Verbanaceae	Tree	Food, fuel wood, timber, wooden spoon mortar	Fruits, roots, stem	3.0
Xylocarpus granatum	Mkomafi	Meliaceae	Tree	Medicinal, poles, fuel wood, charcoal, tool handle	Roots, seeds, stem	2.0
Zanthoxylum chalybeum	Mjafari	Rutaceae	Shrub	Medicinal, fuel wood, mortar, drum	Bark, roots, stem	2.0

Appendix 6: Medicinal species recorded and identified for primary health care service in the community around JCBNP

Scientific name	Local name	Diseases	Part used
Agathi santhemum	Mvumanyuki	Stomache for children	Roots
Alangium salviifolium	Mnukamavi	Headache, menstruation problem	Leaves, roots
Annona senegalensis	Mtopetope	Stomach, snake bite	Bark, roots
Bersama abbysinica	Mwangwakwao	Poisonous to stock	Leaves
Bridelia micrantha	Mkarati	Soothe sore eyes, stomach, gastric ulcers	Leaves, roots
Caesalpinia voelkensii	Mkomwe	Stomach, hernia	Roots, seeds
Carpobolia sp	Kikoko	Male weak sex stimulation	Roots
Ceriopsis tagal	Mkandaa mwekundu	Thrush	Heart wood
Clausena anisata	Mwavikali	Headache, devil cases,	Roots, leaves
Clerodendrom sp	Kipepe	Urination problem,	Roots
Cosytha filiformis	Mlangamia	Diarrhea, vomiting.	Leaves
Dalbegia vaccinifolia	Mvyongozi	Coughing	Roots
Datura spiosa	Mranaha	Asthma, boils	Flowers, leaves
Dodonea viscosa	Mkeng'eta	Coughing, snake bite	Fruits
Ereiosema psoraloides	Mbaazimwitu	Fish poison	Leaves
Euclea schimpheri	Mdaa	Anaemia, snake bite	Roots
Eugenia capensis	Mkaaga	Stomach	Leaves
Euphobia nyikae	Mkweche	Body swelling	Latex
Ficus capensis	Mkuyu	Delivery problems, asthma	Leaves
Flacourtia indica	Mgo	Indigestion, stomach, snake bite & infertility	Roots
Flaedendrom buchananii	Mwingajini	Urination problem, flue	Roots, leaves
Flueggea virosa	Mkwamba	Infertility, insect repellent	Roots, leaves
Hoslundia opposita	Mnunu	Flue	Leaves
Lantana camara	Mlakunguru	Coughing, toothache	Leaves
Lippia javanica	Mpambawake	Anaemic pregnant, vomiting	Leaves
Makhamia zanzibarica	Mtarawanda	Menstruation pain	Roots
Mallotus oppositifolius	Mtumbika	Vomiting	Roots
Mimosa pigra	Kifauwongo	Asthma, jaundice	Whole tree
Monodora grandidieri	Mchofu	Flue, headache, stomach	Roots, leaves
Murraya koenigii	Mvuje	Stomach pain, bad dreams	Leaves
Ocimum suave	Mtule	Coughing, rectum problem	Leaves, fruits juice
Ocimum suave	Kivumbasi	Body pain, headache	Leaves
Phyllantus sp	Mtambaa na penu	Malaria	Leaves

Piper guineese	Mtambuu	Toothache, aphrodisiac	Roots, leaves
Pittosporum virrindiflorum	Mpande	Vomiting, headache to pregnant	Bark, roots
Plectrunthus bulbatus	Mpatakuva	Stomach pain	Leaves
Psidium guajava	Mpera	Stomach, vomiting & diarrhea	Roots, leaves
Rhizophora mucronata	Mkoko magondi	Hernia	Leaves
Rhoicissus revoilii	Mtongo	Anemia, urination problem	Leaves
Rhus longipes	Mchengele	Diarrhea, gonorrhea	Fruits, leaves
Saba florida	Mbungo	Hypertension, rheumatism, women infertility	Leaves, roots
Saphora occidentalis	Utupa	Insecticide, fish poison	Leaves, stem
Senna petesiana	Mpingaume	Malaria, stomach	Roots
Smilax anceps	Mkwangashare	Menstruation pain, current wound	Roots, leaves
Sorindeia madagascarensis	Mpilipilidoria	TB, schistosomiasis, menstruation problems	Roots, bark
Stachytapheta jamaicaensis	Kikwayakwaya	Headache	Leaves
Strychnos innouca	Mtonga	Local insecticide	Leaves, fruits
Suregada zanzibarensis	Mdimimsitu	Stomach	Leaves, roots
Synaptoleptis kirkii	Mbibikiu	Stomach, snake bite	Roots
Syzigium cuminii	Mzambarau	Anaemia, gum & vomiting	Bark, leaves
Tamarindus indica	Mkwaju	Coughing	Leaves
Tarrena pavettoides	Mlashore	Body yellowing	Roots
Toddalia asiatica	Mdakakomba	Body weakness, flue	Roots, leaves
Turraea floribunda	Mtamagoa	Coughing, stop vomiting to pregnant	Roots
Uapaca guinensis	Mchenzamwitu	Stomach, ulcers, headache	Bark, roots
Unidentified	Jimbimwitu	Body weakness for children	Leaves
Vanguera infausta	Mviru	Intestinal worms, malaria	Roots, bark
Vernonia glabra	Dimi la ng'ombe	Stomach pain	Leaves, roots
Vernonia zanzibarensis	Mtukutu	Malaria, pimples, stomach	Leaves
Vitex doniana	Mfuu	Malaria	Bark
Xylocarpus granatum	Mkomafi	Stomach pain, hernia	Fruits
Zanthoxylum chalebeum	Mjafari	Malaria	Roots, leaves

Appendix 7: NWFPs tree species found in mangrove forest during inventory

Scientific name	**Local name**	**Dbh**	**Stem/ha**
Avicenia marina	Mchu	8.3	65
Bruguiera gymnorhiza	Mui	10.8	131
Ceriopsis tagal	Mkandaa mwekundu	10.4	287
Heritiera littolaris	Msikundazi	3	15
Rhizophora mucronata	Mkoko magondi	7.5	516
Soneratia alba	Mliana	7.8	69
Xylocarpus granatum	Mkomafi	8.3	48

Appendix 8: NWFPs tree species found in dense thicket forest during inventory

Scientific name	**Local name**	**Dbh**	**Stem/ha**
Ancylobotrys petersiana	Mtoe		22
Annona senegalensis	Mtopetope	3.5	6
Bersama abbysinica	Mwangwakwao		4
Bridelia micrantha	Mkarati	13.3	4
Caesalpinia voelkensii	Mkomwe	4	4
Carpolobia sp	Kikoko		4
Casytha filifomis	Mlangamia		4
Clerodendrom sp	Kipepe		14
Dalbegia vaccinifolia	Mvyongozi		30
Dodonea viscosa	Mkeng'eta		7
Encaphalutos hilderbrandtii	Mgwede	21.2	42
Ereiosema psoraloides	Mbaazimwitu		1
Euclea schimperi	Mdaa	3.2	80
Eugenia capensis	Mkaaga	4.1	81
Ficus capensis	Mkuyu	10.1	18
Flacourtia indica	Mgo	8.8	7
Flueggea virosa	Mkwamba	2	31
Harrisonia abbysinica	Kuche la simba		4
Hoslundia opposita	Mnunu		3
Mallotus oppositifolius	Mtumbika		1
Markhamia zanzibarica	Mtarawanda		5
Mimisopsis fruticosa	Mnyevuu	2.3	8
Mimosa pigra	Kifauwongo		3
Piper guineese	Mtambuu		1
Polysphaeria parvifolia	Mlapaa	2.7	498
Psychotria bibracteata	Mkonge	3.5	204
Rhoicissus revoilii	Mtongo	5.8	35
Rhus longipes	Mchengele		59
Saba florida	Mbungo		1
Saphora occidentalis	Utupa		1
Senna petersiana	Mpingaume	6.8	27
Sorindeia madagascarensis	Mpilipilidoria	10..3	7
Stachytapheta jamaicaensis	Kikwayakwaya		125
Strychnos innouca	Mtonga	12	4
Suregada zanzibarensis	Mdimumsitu	2.4	86
Synaptoleptis kirkii	Mbibikiu		197
Syzigium cuminii	Mzambarau	25	2
Tamarindus indica	Mkwaju	24	2
Tarrena pavettoides	Mlashore		18
Toddalia asiatica	Mdakakomba		15
Turraea floribunda	Mtamagoa		26
Unknown	Uyoga		4
Unknown	Kimaji		20
Unknown	Jimbimwitu		30
Vernonia zanzibarensis	Mtukutu		1
Vitex doniana	Mfuu	10.8	5

Appendix 9: NWFPs tree species found in evergreen bush forest during inventory

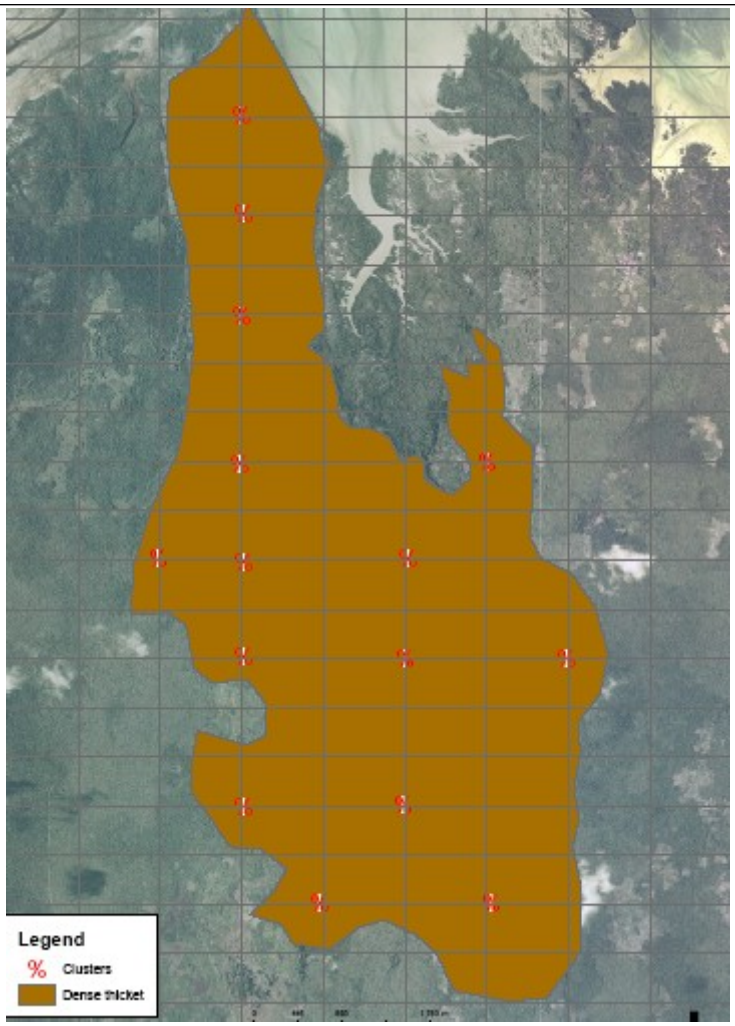
Scientific name	Local name	Dbh	Stem/ha
Agathi santhemum	Mvumanyuki		32
Albizia glaberrima	Mbura	13	1
Ancylobotrys petersiana	Mtoe		1
Annona senegalensis	Mtopetope	5.2	309
Bridelia micrantha	Mkarati	10.8	8
Casytha filifomis	Mlangamia		12
Clausena anisata	Mpambawake		16
Clerodendrom sp	Kipepe		50
Dodonea viscosa	Mbebeta		190
Ethulia conyzoides	Mbangiwazimu		19
Eugenia capensis	Mkaaga		11
Ficus capensis	Mkuyu	4.2	2
Flacourtia indica	Mgo	3.6	21
Flueggea virosa	Mkwamba		210
Hoslundia opposita	Malashore		88
Lantana camara	Mlakunguru		23
Ocimum suave	Kivumbasi		410
Parinari curatelifolia	Mbura	10.7	4
Phoenix reclinata	Ukindu	11	6
Polyspheria parvifolia	Mlapaa	2.6	195
Psidium guajava	Mpera	3.6	21
Psychotria bibracteata	Mkonge	8.1	17
Rhoicissus revolii	Mtongo		22
Rhus longipes	Mchengele	2	131
Saba florida	Mbungo		3
Sida acunata	Kifagio		490
Smilax anceps	Mkwangashare		8
Sorindeia madagascarensis	Mpilipilidoria	6.8	4
Stachytapheta jamaicaensis	Kikwayakwaya		708
Strychinos spinosa	Mtonga	5.1	8
Strychnos innocua	Mtonga	5.1	7
Suregada zanzibarensis	Mdimumsitu	2.4	61
Synatolepsis kirkii	Mbibikiu		70
Syzigium cuminii	Mzambarau	16.2	6
Turraea floribunda	Mtamagoa		7
Unknown	Kimaji		264
Unknown	Tui		50
Unknown	Jimbimwitu		112
Vanguera infausta	Mviru		2
Vernonia glabra	Dimi la ng’ombe		173
Vitex doniana	Mfuu	8.9	16

Appendix 10: Variables contributing to household income

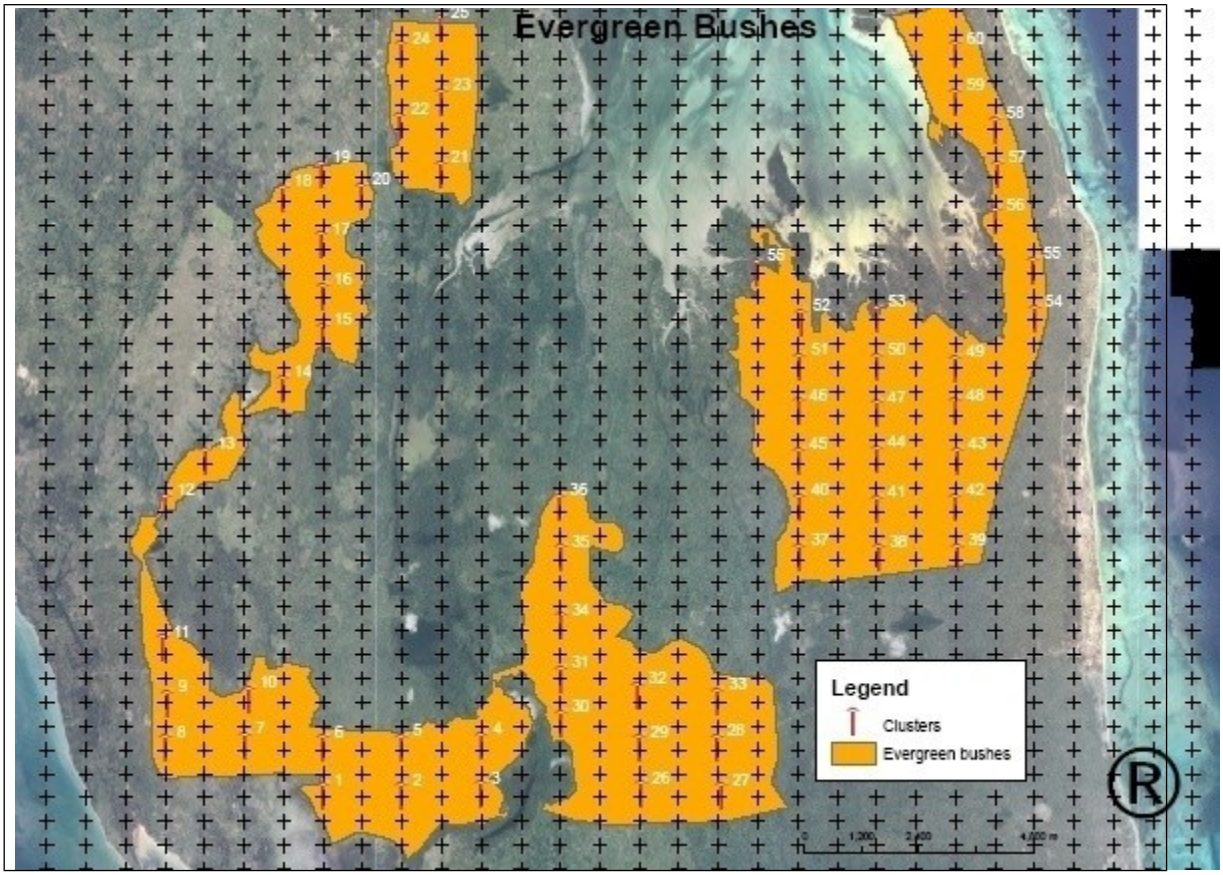
Independent variables	**Standardize coefficient**	**T - value**	**Significant**	**Collinearity statistics**	
	Beta			Tolerance	VIF
Constant		0.000	1.000		
Income from farming	0.270	1.07E+08	0.000	0.293	3.409
Income from employment	0.478	3.01E+08	0.000	0.748	1.336
Income from livestock	0.133	6654874	0.000	0.468	2.138
Income from NWFPs	0.342	1.39E+08	0.000	0.311	3.218
Income from forest related activities	0.244	1.13E+08	0.000	0.400	2.500
Income from NWFPs & farming	0.523	2.44E+08	0.000	0.409	2.442
Income from NWFPs & forest related activities	0.078	5484330	0.000	0.925	1.081
Income from farming & forest related activities	0.165	1.14E+08	0.000	0.899	1.113
Income from business	0.309	2.07E+08	0.000	0.841	1.190
Income from traditional healing	0.216	1.53E+08	0.000	0.947	1.056
Income from others activities	0.317	1.93E+08	0.000	0.696	1.436
Income from fishing	0.282	1.94E+08	0.000	0.893	1.119

$R^2 = 0.980$

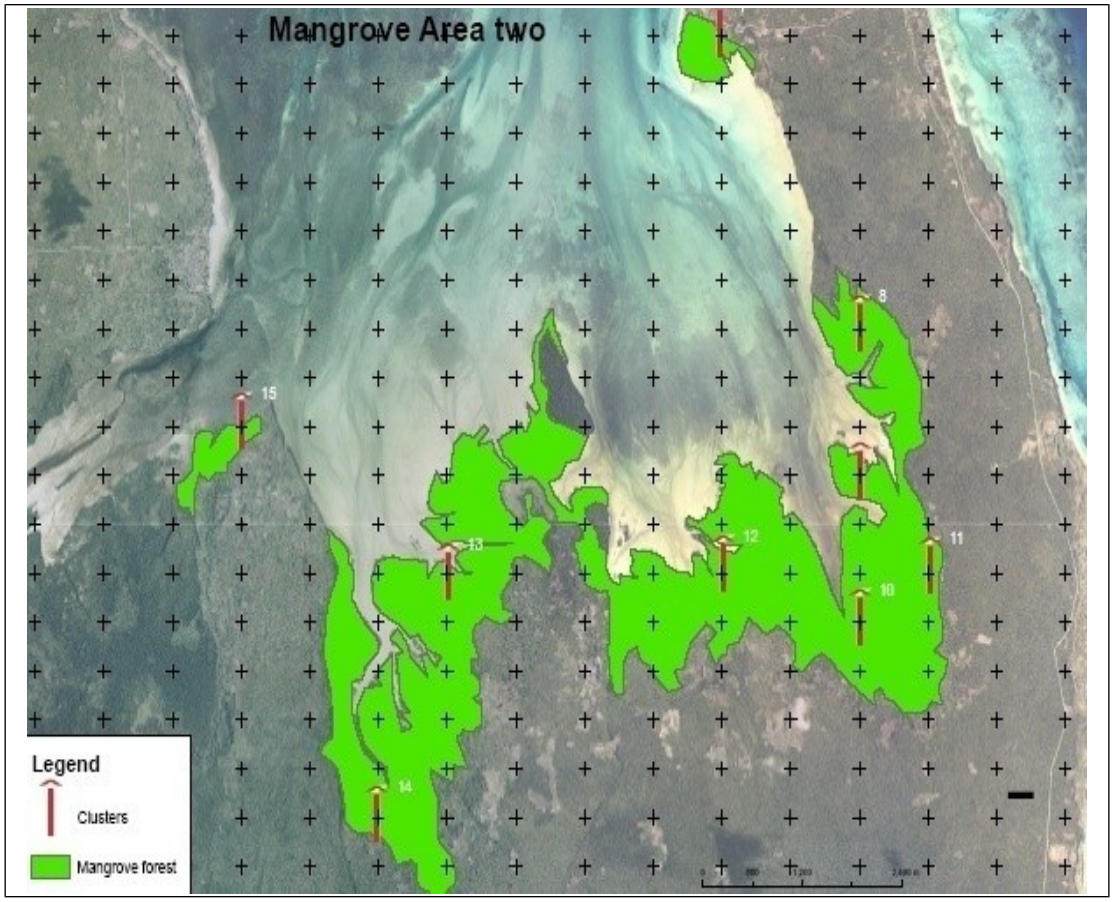
Appendix 11: A map showing resources inventory area in dense thicket forest



Appendix 12: A map showing resources inventory area in evergreen bush forest



Appendix 13: A map showing resources inventory area in mangrove forest


Mangrove Area two
15
8
13
12
11
10
14
Legend
Clusters
Mangrove forest