

CONTRIBUTION OF SELECTED INDIGENOUS FRUITS ON  
HOUSEHOLD INCOMES AND COPING WITH FOOD INSECURITY IN MWINGI -  
KENYA

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KM17/2427/09

A Research Thesis Submitted to the Graduate School in Partial Fulfillment for the  
Requirements of the Masters of Science Degree in Applied Agricultural Economics of  
Egerton University.

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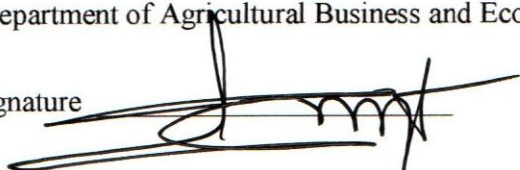
### Recommendation

This thesis has been submitted with our approval as university supervisors according to Egerton university regulations

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## **ABSTRACT**

With the changing climatic patterns, coping strategies to food insecurity is becoming of essence. Alternative dietary food supplement among communities in Arid and Semi Arid Lands (ASAL) is not a new phenomenon especially during dry seasons. Indigenous fruits are a major source of not only food but also income that most households utilize to cope with the looming food insecurity. Despite the role played by indigenous fruits in enhancing food security and rural incomes, this phenomenon has not been analyzed. The purpose of the study was to analyze the contribution of indigenous fruits to rural household incomes and in coping with food insecurity. To achieve this purpose, the study evaluated the factors that influence consumption of indigenous fruits arising from food shortage and then assessed the contribution of the indigenous fruits to the household income and coping with food insecurity in the area. The study was carried out in Nuu division, Mwingi District where a sample size of 120 households were interviewed using a structured questionnaire. Simple random sampling method was used. The logit, Gross Margin Analysis, correlations and t-tests were used for analysis. Data was processed using the STATA and SPSS packages. The results of the study indicated household size, education and income to be significant variables in influencing household decision to consume indigenous fruits in order to cope with food shortage with income and education having a negative influence and household size a positive influence. Consumption of indigenous fruits as a food insecurity coping strategy was found to contribute significantly to total household food insecurity coping strategies. Income from indigenous fruits was found to have a negative and significant relationship with livestock income and off-farm income and from the gross margins, income from indigenous fruits was the third contributor to household income.

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## **DEDICATION**

I dedicate this thesis to my parents and family who have continuously supported me financially and emotionally. Effortlessly and tirelessly encouraging and praying for me.

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May the Almighty God sufficiently and abundantly bless you all.

## LIST OF ACRONYMS

|               |                                         |
|---------------|-----------------------------------------|
| ASAL .....    | Arid and Semi-Arid Lands                |
| DDP .....     | District Development Plan               |
| FAO .....     | Food and Agricultural Organization      |
| FEWS NET..... | Famine Early Warning System Network     |
| GMA.....      | Gross Margin Analysis                   |
| GoK .....     | Government of Kenya                     |
| IFs.....      | Indigenous Fruits                       |
| Kgs:.....     | Kilograms                               |
| KES .....     | Kenyan Shillings                        |
| NTFPs .....   | Non Timber Forest Products              |
| SPSS .....    | Statistical Package for Social Sciences |
| WMS .....     | Welfare Monitoring Survey               |
| KNBS.....     | Kenya National Bureau of Statistics     |

## TABLE OF CONTENTS

|                                                                   |             |
|-------------------------------------------------------------------|-------------|
| <b>DECLARATION AND RECOMMENDATION .....</b>                       | <b>ii</b>   |
| <b>ABSTRACT .....</b>                                             | <b>iii</b>  |
| <b>COPY RIGHT .....</b>                                           | <b>iv</b>   |
| <b>DEDICATION .....</b>                                           | <b>v</b>    |
| <b>ACKNOWLEDGEMENTS .....</b>                                     | <b>vi</b>   |
| <b>LIST OF ACRONYMS.....</b>                                      | <b>vii</b>  |
| <b>TABLE OF CONTENTS.....</b>                                     | <b>viii</b> |
| <b>LIST OF TABLES .....</b>                                       | <b>x</b>    |
| <b>LIST OF FIGURES .....</b>                                      | <b>xi</b>   |
| <b>CHAPTER ONE .....</b>                                          | <b>1</b>    |
| <b>INTRODUCTION.....</b>                                          | <b>1</b>    |
| 1.1 Background Information.....                                   | 1           |
| 1.2 Statement of the problem.....                                 | 4           |
| 1.3 Objectives .....                                              | 5           |
| 1.4 Research Hypothesis .....                                     | 5           |
| 1.5 Justification of the study.....                               | 5           |
| 1.6 Scope and Limitations .....                                   | 6           |
| 1.7 Definition of Terms.....                                      | 6           |
| <b>CHAPTER TWO.....</b>                                           | <b>7</b>    |
| <b>LITERATURE REVIEW .....</b>                                    | <b>7</b>    |
| 2.1 Concept of food insecurity.....                               | 7           |
| 2.2 Consumption of indigenous fruits.....                         | 8           |
| 2.3 Nutritional value of IFs .....                                | 10          |
| 2.4 Commercialisation of IFs .....                                | 11          |
| 2.5 Economic Valuation of Non Timber Forest Products (NTFPs)..... | 13          |
| 2.6 Theoretical Framework .....                                   | 14          |
| 2.7 Conceptual Framework .....                                    | 15          |
| 3.1 Study area .....                                              | 17          |
| 3.2 Sampling procedure and sample size .....                      | 18          |
| 3.3 Data collection .....                                         | 19          |
| 3.4 Data analysis .....                                           | 19          |
| 3.5 Empirical Framework.....                                      | 19          |
| 3.5.1 Logit model.....                                            | 19          |



|                                                                                                          |           |
|----------------------------------------------------------------------------------------------------------|-----------|
| 3.5.2 Gross Margin Analysis .....                                                                        | 22        |
| <b>CHAPTER FOUR.....</b>                                                                                 | <b>24</b> |
| <b>RESULTS AND DISCUSSIONS.....</b>                                                                      | <b>24</b> |
| 4.1 Introduction.....                                                                                    | 24        |
| 4.2 Descriptive results .....                                                                            | 24        |
| 4.2.1 Gender of the Household heads.....                                                                 | 24        |
| 4.2.2 Age of respondents .....                                                                           | 24        |
| 4.2.3 Employment and income status of the respondents. ....                                              | 25        |
| 4.2.4 Education of the respondents .....                                                                 | 25        |
| 4.2.5 Household size of respondents.....                                                                 | 27        |
| 4.2.6 Consumption preference of Indigenous fruits.....                                                   | 27        |
| 4.2.7 Consumption Patterns of IFs among different age groups.....                                        | 28        |
| 4.2.8 Acquisition and use of indigenous fruits .....                                                     | 29        |
| 4.2.9 Sale of indigenous fruits .....                                                                    | 30        |
| 4.3 Empirical results.....                                                                               | 31        |
| 4.3.1 Socio economic factors influencing consumption of IFs due to food shortage. ....                   | 31        |
| 4.3.2 Contribution of indigenous fruits in coping with food insecurity .....                             | 34        |
| 4.3.3 Contribution of indigenous fruits to household income<br>as compared to other income sources. .... | 35        |
| <b>CHAPTER FIVE .....</b>                                                                                | <b>41</b> |
| <b>CONCLUSION AND RECOMMENDATIONS.....</b>                                                               | <b>41</b> |
| 5.1 Conclusion .....                                                                                     | 41        |
| 5.2 Policy recommendations.....                                                                          | 42        |
| 5.3 Suggestion for further research.....                                                                 | 43        |
| <b>REFERENCES .....</b>                                                                                  | <b>44</b> |
| <b>APPENDICES.....</b>                                                                                   | <b>50</b> |
| Appendix 1: Photographs of indigenous fruits.....                                                        | 50        |
| Appendix 2: Gross margins .....                                                                          | 52        |
| Appendix 3: Correlation matrix.....                                                                      | 55        |
| Appendix 4: Questionnaire.....                                                                           | 56        |



## LIST OF TABLES

|                                                                                            |    |
|--------------------------------------------------------------------------------------------|----|
| Table 2.1: Indigenous fruit consumption in Mwingi District, Kenya .....                    | 10 |
| Table 2.2: Nutritional composition of selected Indigenous Fruit species .....              | 11 |
| Table 3.1: Description of variables for the Logit model .....                              | 21 |
| Table 4.1: Gender status of respondents .....                                              | 27 |
| Table 4.2: Household head age category .....                                               | 28 |
| Table 4.3: Employment and income categories of respondents .....                           | 29 |
| Table 4.4: Consumption preferences of the different indigenous fruits .....                | 31 |
| Table 4.5: Acquisition and use of indigenous fruits .....                                  | 32 |
| Table 4.6: Sale of chocolate berry, tamarind and baobab indigenous fruits .....            | 33 |
| Table 4.7: Marketing of indigenous fruits .....                                            | 34 |
| Table 4.8: Logit estimates for consumption of indigenous fruits due to food shortage ..... | 35 |
| Table 4.9: Proportions of different coping strategies to food insecurity .....             | 38 |
| Table 4.10: One sample t-test results of food insecurity coping strategies .....           | 39 |
| Table 4.11: Off-farm income among the income classes .....                                 | 40 |
| Table 4.12: Gross Margins for the different income classes .....                           | 41 |
| Table 4.13: Income share of the income sources to total household income .....             | 42 |
| Table 4.14: Correlation estimates between income from IFs and other sources .....          | 43 |

## **LIST OF FIGURES**

|                                                                                           |    |
|-------------------------------------------------------------------------------------------|----|
| Figure 1.1: Conceptual framework .....                                                    | 16 |
| Figure 3.1: Map of the study area.....                                                    | 21 |
| Figure 4.1: Education levels of the household heads.....                                  | 29 |
| Figure 4.2: Household sizes of the sampled households.....                                | 30 |
| Figure 4.3: Consumption patterns of indigenous fruits among the different age groups..... | 32 |

## **CHAPTER ONE**

### **INTRODUCTION**

#### **1.1 Background Information**

In developing countries, food insecurity is one of the most pressing needs to be addressed. Worldwide, around 852 million people are chronically hungry due to extreme poverty, while up to 2 billion people lack food security intermittently due to varying degrees of poverty (FAO, 2004). Six million children die of hunger every year worldwide. The leading determinant of food insecurity in the sub-Sahara Africa is low levels of per capita food production due to poor weather and lack of effective agricultural policies (FAO, 2004).

The 2007 Economic Review of Agriculture indicates that 51% of the Kenyan population lacks adequate food. Food security which is closely linked to poverty is estimated to be 46% nationally (GoK, 2007). One of the GoK's coping strategies to food insecurity is maize importation since maize is the staple food in Kenya. In 2008, the GoK imported approximately 3 million bags of maize to cope with the food shortage (GoK, 2008). Although Kenya achieved self-sufficiency in the staple grain of maize in the year 2005-2007, this did not guarantee household food security since the government of Kenya continues to feed a section of the population that is chronically food insecure especially in ASAL areas like Mwingi district. On average, the government provides food for 1 million people per year (GoK, 2008). In rural Kenya, 60-80% of the population lacks adequate amounts of food for two to five months a year.

According to the WMS, Food insecurity remains worrisome in most parts of Mwingi with 65.5% of its population below the food poverty line and 58.5% of the households being food poor (GoK, 2008). The situation has been aggravated by changing patterns in recurrent droughts which are becoming more severe causing crop failures and livestock deaths. Substantial crop losses ranging between 60 - 80 percent have been reported in this area (GoK, 2008). Past records from the district show that there were predictable patterns for drought and rainfall. Out of five years, one year had good rains while the rest of the four years received unreliable rainfall. A worrying characteristic of the changing pattern is that rains come when least expected and farmers cannot plan their farm operations. Results from the 2010 short rains assessments indicated that households in this area were unlikely to sufficiently meet their food needs even though there was a decline in cereal prices due to low purchasing capacities after experiencing nearly five poor or failed seasons in succession (FEWSNET, 2010).



Poverty which is closely linked to food insecurity remains a deterrent to the survival of many not only in Kenya but also in other Sub-Saharan countries. Almost 50% of the populations live in one dollar per day in Sub Sahara Africa; the highest rate of extreme poverty in the world, with 32 of the 48 poorest countries located in this region (USAID, 2010). In Kenya, 50% of the population is absolute poor and three quarters of the poor live in rural areas (KNBS, 2002). It is also recorded that nearly all the other provinces had prevalence levels above 50% except central province which had the lowest incidence (31%). Eastern province which hosts Mwingi district is ranked the third in the poorest provinces after Nyanza, and Coast provinces (GoK, 2008). This is contributed majorly by the dry ukambani regions where Mwingi district is found. Mwingi district shows a very high prevalence of poverty which is estimated at 60%, with the poor residing in the driest divisions in the district namely Tsekuru, Kyuso, Ngomeni, Nguni and Nuu divisions. The other three: Migwani, Central, and Mui have least poverty (GoK, 2008).

During periods of drought, households either used their savings to purchase food or consumed other alternatives like the indigenous fruits. The government and the international community play a role in supplementing the food requirements of the households through food aids. Due to the recurrent crop failures and livestock losses, initiatives for integration of indigenous fruit trees in the farming systems can enhance contribution of IFs to food security besides income generation and ensuring short and long-term sustainability of agricultural production. Although IFs provide critical support to food security and rural incomes, this role has been ignored in the past because many of these resource values have not been captured in standard income consumption – expenditure surveys. These point to some flaws in standard estimates of rural welfare (Kajembe *et al.*, 2000).

Reliance upon indigenous fruit tree products as source of their diets especially during drought when there are food shortages is not a new phenomenon in Kenya especially within some of the nomad and pastoralist communities (Maundu *et al.*, 1999; Muok *et al.*, 2001). These products range from being used as food or food additives (seeds, leaves, fruits, roots, nuts, mushrooms, herbs, spices, aromatic plants), as plant materials (fibers, creepers and flowers), and plant derivatives (raffia, bamboo, rattan, cork and essential oils). All these products are essential to the livelihoods of most rural communities in the dry lands. Notably, indigenous fruits contribute to food security of the rural population by providing a vast array of food which supplies essential nutrients especially at times when other food sources are unavailable (Mithöfer *et al.*, 2003). The fruits act as an important source of vital nutrients and essential vitamins especially to the growing children who are prone to malnutrition. Baobab



fruits, for example, provide six times vitamin C compared to an orange and have calcium level higher than that of a cow's milk (Ondachi, 2001).

Not only do indigenous fruits provide food during the dry seasons, but they also act as a source of income for the households. Throughout the developing world, rural communities use a range of non-timber forest products (Shackleton *et al.*, 2002; Dovie, 2003; Fisher, 2004; McSweeney, 2005) which contribute to livelihoods through direct household provisioning, income generation and as a safety-net for consumption and income-smoothing (Angelsen *et al.*, 2003; Belcher *et al.*, 2005; McSweeney, 2005). Commercialization is becoming a common way in which the safety net function and value of NTFPs to rural households is manifest, and it appears to be growing. Greater proportions of poor households engage in commercialization than do wealthy households, and it represents a greater fraction of their total livelihood. Typically, they have low skills, education and limited employment opportunities. They have limited abilities to negotiate with buyers and officials and are price-takers (Shackleton *et al.*, 2002). Some households see trade in indigenous fruits as only a temporary activity whilst they seek or hope for permanent formal employment. Others trade in NTFPs as their primary livelihood activity, in which they take pride in being self-employed.

There are 400 species of indigenous fruit trees in the country. Approximately 57 indigenous fruit tree species in Mwingi District have been documented to be useful to the local community (Maundu *et al.*, 1999) with an increase in domestication of some of the major indigenous trees by the forestry department in the district being witnessed. The extent of consumption of these fruits varies from one species to another. The chocolate berry, baobab and tamarind non wood products are rated to be of high importance in the district because of their commercial value (Muok *et al.*, 2001). The indigenous trees have the ability to withstand and cope with unpredictable climatic patterns; they do not fail to produce even when the rain fails.

#### **The Chocolate berry (*Vitex payos*)**

*Vitex payos* also known as black plum is a tree with round leather-like leaves and fruits that resemble black olives. When ripe, the strong smelling black fruits are tasty, edible and mealy sweet with a pleasant taste, something like crumbled chocolate. The annual fruit production per tree is about 50 kg and is extensively traded locally (Maundu *et al.*, 1999). Chocolate berry is a species naturally occurring in hot, low, and semi-arid places. In zones that are more arid, it is found near rock outcrops (Maundu *et al.*, 1999). It grows from altitudes of 0-1600m, in areas with 650-850mm mean annual rainfall. In Mwingi, it is during

the period of March to May when the fruits are collected for consumption and sale in the local markets, largely because of food scarcity, and for provision of the needed cash income at the household level. Chocolate berry has numerous applications including use in traditional medicine. (Maundu *et al.*, 1999; Mbabu and Wekesa, 2004; Teklehaimanot, 2005).

### **Baobab (*Adansonia digitata*)**

The tree has mature leaves with up to 9 leaflets arranged like the fingers of a hand (digitate). The enormous, crinkled white flowers of the baobab last only a single day, and are pollinated by fruit bats. Some baobabs are reputed to be many thousands of years old. Baobabs store water inside the swollen trunk (up to 120,000 litres) to endure the harsh drought conditions. The baobab grows in well drained soils, deep rooted, drought resistant and prefers a high water table in agro-ecological zones II-VI, altitude 1-1000m.

The fruits can be eaten as dry powder, mixed into porridge or milk or they can be used to produce a cream of tartar used in the making of yoghurt. In various parts of East Africa, the dry fruit pulp is covered in a colored sugary coating and sold in packages as sweet and chilly candy called "mabuyu".

The seeds are mostly used as a thickener for soups, but may also be fermented into a seasoning, roasted for direct consumption, or pounded to extract vegetable oil. Fruit collection in Mwingi is between April-October.

### **The Tamarind (*Tamarindus indicus*)**

Tamarind is the brown, tart flesh from the pods of a tree in the pea and bean family. It grows to a height of 24-30 m. The fruits, flattish, beanlike, irregularly curved and bulged pods, are borne in great abundance along the new branches. The pods may be cinnamon-brown or grayish-brown externally.

The pulp is an important ingredient in some ice creams, chutneys, curries, sauces, jams, and marmalades. Ripe fruit of sweet varieties can be eaten fresh as a snack food, and ripe sour types are used for juices, syrups and sweets and for seasoning rice, meat and sea food dishes. The seeds can be ground and the flour used to bake cakes and breads. Dry weather is important during the period of fruit development. In Mwingi District, fruits collection occurs during August- November before the short rains.

## **1.2 Statement of the problem**

Mwingi district is an Arid and Semi Arid area faced with recurrent droughts and high levels of food insecurity and low incomes. Although a number of food insecurity coping strategies exist in the area, the levels of poverty and food insecurity keep on escalating. The study



therefore aimed to evaluate the contribution of indigenous fruits to household income and as a coping strategy to food insecurity in Mwingi district.

### **1.3 Objectives**

#### **General Objective.**

To evaluate the contribution of selected indigenous fruits to household food consumption, incomes, and as a coping strategy to food insecurity in Mwingi District.

#### **Specific Objectives**

1. To evaluate socio-economic factors influencing the decision of households to consume indigenous fruits due to food shortage.
2. To assess the contribution of the indigenous fruits in coping with food insecurity.
3. To analyze the contribution of indigenous fruits to household income as compared to other income sources.

### **1.4 Research Hypothesis**

1. Socio-economic factors have no significant influence on the consumption of indigenous fruits in order to cope with food shortage.
2. Contribution of indigenous fruits in coping with food insecurity is not significant.
3. There exists no significant relationship between income from indigenous fruits and other household income sources.

### **1.5 Justification of the study**

Eradicating extreme poverty and hunger is one of the most important Millennium Development Goals (MDGs). In order to achieve this goal, sustainable and diverse foods that can be supplemented in the diets need to be given attention. In ASAL areas like Mwingi district where there is wide natural occurrence of Indigenous trees, indigenous fruits are used as a source of food and income generation. An understanding of the significance of indigenous fruits to the communities will contribute substantially towards working out possible strategies for involving these communities in the management of indigenous trees. More specifically, this study will help policy makers in their effort to formulate policies and develop intervention mechanisms that are tailored to the specific need of the study area. Furthermore, this study will make further contribution to the body of knowledge and will be used as a source material for further studies.

## 1.6 Scope and Limitations

The study was limited to Nuu Division in Mwingi district. The scope of the study covered only the chocolate berry, baobab and tamarind Indigenous fruits where their direct use evaluated by the market value of the fruits was quantified. The study focused on the contribution of the indigenous fruits to household incomes and in coping with food insecurity. The reliability of the data is subject to the usual caveats that apply when information is based on recall. The study faced time constraint, and limitations with respect to financial resources. The recall method was used during data collection.

## 1.7 Definition of Terms

**Indigenous fruits** – edible fruits from native and mainly naturally occurring trees.

**Food insecurity** – exists when there is food shortage and household cannot access its daily food requirements.

**Household** - consists of all people who occupy a particular housing unit as their usual residence, or who live there at the time of the interview.

**Household Head** – the individual who generally provides the chief source of income for a household unit. He is the adult person, male or female, who is the decision maker in the household.

**Agro – Ecological Zones** - provide consolidated information on climate (including radiation, rainfall, temperature, and humidity) for the particular purpose of assessing the production potential of land for different types of (rain fed) agriculture.



## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.1 Concept of food insecurity**

Concepts of food insecurity are defined in different ways by International organizations and researchers. According to FAO, (1996) there are close to 200 definitions and 450 indicators of food security. In the World Food Conference of 1974 food security was defined as “availability at all times of adequate world food supplies of basic foodstuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices” (FAO, 1996). However, it was realized that this definition gave a very limited view of the food security problem. It is so because global food security could exist along side household and individual food insecurity. The most widely used definition of food security is the one forwarded by World Food Summit in 1996 ‘Food security exists when all people at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life’ (FAO, 1996). Food insecurity will therefore exist when all people at all times have no physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life’

Food insecurity concern may be due to either inadequate physical availability of food supplies, poor access among the population, or inadequate utilization of food (FAO, 1996). Food insecurity can be classified as chronic or transitory. Chronic food insecurity occurs when a household is persistently unable to meet the food requirements of its members over a long period of time. It, therefore, afflicts households that persistently lack the ability to either buy food or produce their own. On the other hand, transitory food insecurity refers to a temporary decline in a household's access to enough food. It can be due to crop failure, seasonal scarcities, temporary illness, unemployment, and instability in food prices, production, household income, or combination of these factors.

According to many researchers, the determinants of food insecurity are classified in to three groups within the framework of the general definition of food security, that is, food availability, access, and utilization (Seid, 2007; USAID, 2005; Frankenberger, 2002). Different researchers use diverse determinants of food security in their studies. A study conducted by Seid, (2007) to evaluate the determinants of food Insecurity in rural households in Amhara region in Ethiopia used food access indicator (income) as a food security determinant. Another study by Frankenberger, (2002) used the minimum calorie requirement



as a determinant to differentiate food secure and insecure household among the total sampled households. The major limitation with Food security studies is the inability to capture all the three determinants of food security (availability, Access, utilization) as a result most researchers focus on food access which is easier to evaluate. It's evident that indigenous fruits are an important source of food to the households, and therefore help to provide food security to rural households. (Maghembe *et al.*, 1998; Muok *et al.*, 2001). Akinnifesi *et al.*, (2006) reported that indigenous fruits are important in the Southern Africa development community (SADC) especially for marginalized groups in society. It has further been noted that indigenous fruits contribute on average about 42% of the natural food basket that rural households rely on in southern Africa (Akinnifesi *et al.*, 2006). Indigenous fruits are used by many communities prone to chronic food insecurity as a means of reducing their vulnerability to food insecurity and poverty as in the case of Mwingi district.

## **2.2 Consumption of indigenous fruits**

Indigenous fruits play an important role in the sustenance of livelihoods particularly in times of food scarcity. (Muok *et al.*, 2001; Tiisekwa *et al.*, 2004; Akinnifesi *et al.*, 2008). The consumptive use of the indigenous fruits has attracted much less attention than their commercial use. Many authors, while acknowledging the dietary and medical importance of indigenous fruits to the local populations, consider non-marketed indigenous fruits as food of the poor, a safety net, or reserve food in case of famine (Hedge *et al.*, 1996; Shackleton *et al.*, 2002; Senaratne *et al.*, 2003). Hence, they only include marketed NTFPs in their estimates of the economic role that the forests play in people's livelihood, ignoring those NTFPs that are directly consumed by the collectors themselves. For example, Narendran *et al.*, (2001), while acknowledging the dependence on fuel wood, fruits, greens, tubers, manure, and fodder, only used the marketed NTFPs to calculate the 'per capita household income. Yet, NTFPs play an important role in the sustenance of the gatherers who consume them.

Studies show that the level of utilization of such products as food materials is varied among different communities and regions in the country. Maundu *et al.*, (1999) observed that the consumption of IFs is minimal in the high potential agricultural areas especially Central Kenya due to great preference for modern agricultural crops. The pastoral communities on the other hand, greatly utilize indigenous species, which form up to 80% of the food consumed. Maundu *et al.*, (1996) noted that consumption of IFs depends on existing local knowledge and the economic focus of the people. He observed that some communities such as the Turkana in northern Kenya are well endowed with local knowledge in utilizing

indigenous fruits whereby they exploit over 149 species of edible trees in the ASAL areas (Muok *et al.*, 2001).

Extraction of NTFPs for consumption can under specific conditions help save the forest. According to a study by Delang, (2006), the amount of money per year that the household could save by consuming wild food plants was comparable to the average yearly cash expenditure of many households. This meant that if the respondents were not extracting wild food plants from the forest, they would need double as much cash incomes to maintain a comparable diet. This cash would have to be earned either by working for cash or growing cash crops. In which they would be forced to clear forestland.

Although previous studies acknowledge the role played by indigenous fruits and other NTFPs as a coping strategy to economic, social or bio-physical shocks which results to food shortages, (Shackleton *et al.*, 2002, Mithöfer *et al.*, 2003, Kalaba *et al.*, 2009), very little analysis has been done to the extent in which these products assist in coping with food insecurity has been done by previous researches.

A number of studies have been conducted on the consumption preferences of different edible IFs. A study conducted in Mwekera area in Zambia by Kalaba *et al.*, (2009), revealed that *Uapaca kirkiana*, *Anisophyllea boehmii* and *Parinari curatellifolia* were ranked respectively in order of importance by 97 per cent of the respondents who collect IFs in the area. Simitu *et al.*, (2008) also carried out a similar study among the different communities and regions in Kenya. He noted that, while *Balanites aegyptiaca* was the top ranking species in Baringo District because of its ability to provide food buffer during drought seasons as well as its multiple uses, *Vitex payos* and *Tamarindus indica* were the top ranked priority species in Kitui and Meru South Districts respectively, because of their commercial value. However the contribution that the consumption of the Indigenous fruits make on household food security was not evaluated.

Simitu *et al.*, (2008) noted that the average consumption of indigenous fruits per person per day was 19 g in Mwingi District, most of which was harvested from wild stands. Children formed the major consumers of indigenous fruits in the district.



**Table 2.1: Indigenous fruit consumption in Mwingi District, Kenya**

| Month          | Consumption in grams per person per day by age |             |             |            | Average     |
|----------------|------------------------------------------------|-------------|-------------|------------|-------------|
|                | <=9yrs                                         | 10-19yrs    | 20-49yrs    | >=50yrs    |             |
| January        | 6.6                                            | 7.1         | 5.4         | 6.4        | 6.4         |
| February       | 26.1                                           | 28.0        | 14.0        | 10.2       | 21.1        |
| March          | 35.2                                           | 36.4        | 26.4        | 11.6       | 29.7        |
| April          | 27.1                                           | 30.3        | 21.0        | 7.2        | 23.8        |
| May            | 11.4                                           | 10.6        | 6.2         | 6.3        | 9.0         |
| June           | 31.7                                           | 25.5        | 27.0        | 13.0       | 25.1        |
| July           | 33.6                                           | 26.5        | 29.4        | 12.6       | 26.5        |
| August         | 29.4                                           | 25.0        | 20.3        | 11.0       | 22.2        |
| September      | 18.3                                           | 13.7        | 10.3        | 9.6        | 12.8        |
| October        | 21.3                                           | 21.5        | 11.1        | 17.0       | 16.5        |
| November       | 19.6                                           | 22.4        | 11.4        | 7.3        | 16.7        |
| December       | 19.1                                           | 20.5        | 10.0        | 4.5        | 15.5        |
| <b>Average</b> | <b>23.6</b>                                    | <b>22.5</b> | <b>16.6</b> | <b>9.1</b> | <b>19.2</b> |

Source: Simitu *et al.*, (2008)

Studies suggest that a greater proportion of poor households utilize NTFPs more frequently and in greater quantities and, are more reliant on them than their wealthy counterparts (Narendran *et al.*, 2001; Shackleton and Shackleton, 2006). Very little has been done to evaluate how these varied consumption preferences of IFs within the different communities contribute to the household food security and welfare.

### 2.3 Nutritional value of IFs

Ondachi, (2001) carried out nutritional studies of selected indigenous fruits and compared the values obtained with nutritional components of commonly domesticated fruits. This study established that indigenous fruits have higher energy, protein and mineral content (rich sources of calcium). In addition, some of the species have high vitamin C content to comfortably meet the recommended daily requirement (60-89 mg). E.g. the vitamin C content in baobab is 170-150 mg/100 g which is six times higher than that in commercial fruits such as citrus (Ondachi, 2001). Another study by FAO, (1992) revealed that while vitamin C content of an orange is 57mg/100g, the fruit of the Baobab tree, *Adansonia digitata* has 360mg/100g and its leaves contain up to 13% protein.

**Table 2.2: Nutritional composition of selected Indigenous Fruit species**

| Species                      | DM   | Ash | Fat | Fibre | Protein | Total CHO | Reducing sugar | Vitamin c |
|------------------------------|------|-----|-----|-------|---------|-----------|----------------|-----------|
| <i>Strychnos cocculoides</i> | 25.1 | 5.4 | 1.3 | 1.9   | 0.6     | 90.8      | 36.9           | 135.3     |
| <i>Uapaca kirkiana</i>       | 29.5 | 5.4 | 2.4 | 14.9  | 7.0     | 70.2      | 98.6           | 430.8     |
| <i>Vitex payos</i>           | 28.0 | 5.6 | 0.5 | 6.6   | 2.0     | 80.8      | 93.7           | 107.5     |
| <i>Vitex mombassae</i>       | 32.1 | 5.1 | 1.5 | 12.3  | 3.9     | 77.2      | 24.7           | 427.7     |

Source: Ondachi, (2001)

## 2.4 Commercialisation of IFs

In the varied commercialization aspects, some studies have shed light on how proceeds from the sale of IFs help in poverty alleviation (Leakey, 2005; Poulton *et al.*, 2001; Ndoye *et al.*, 2006) while other studies have gone further to evaluate if harvesting and sale of IFs are economically profitable. In their study, Ayisso *et al.*, (2009) found out that the Net present values of fruit harvesting and almond processing activities are positive, with the highest value from fruit harvesting activity, they therefore concluded that almond fruit harvesting and selling was profitable. A similar conclusion was drawn by Paoli *et al.*, (2001) when they maintained that gaharu wood extraction from Gunung Palung in India was very profitable for collectors. On the contrary, some authors have underlined the non-profitable character of Non Timber Forest Products exploitation activities (Neumann *et al.*, 2000). In the cases they studied, NTFPs profitability is highly dependent on the relative levels of the different costs involved: labor, use of specialized technology for processing, advertisement and transportation. Ayisso *et al.*, (2009) found out that Market proximity was one of the most important factors in determining the profitability of NTFPs.

In Cameroon, NTFPs were found to make a greater contribution to middle-income groups (predominantly through trade), with wealthy and poor households benefiting to a lesser degree (Ambrose-Oji, 2003). Findings from South Africa show wealth to have less of an impact on proportion of households consuming NTFPs but to influence the procurement and sale, with a greater proportion of poorer households procuring NTFPs through self-collection and selling products on either a full-time or ad hoc basis (Shackleton and



Shackleton, 2006; Cocks *et al.*, 2008). Findings with respect to the influence of wealth on NTFPs commercialization are also mixed. Although poor household may sell NTFPs during times of need, middle to upper income households with access to capital, transport and markets and, with alternative fall-back options, can earn more from commercialization as a primary livelihood activity. (Kepe, 2002; Ambrose-Oji, 2003; Angelsen *et al.*, 2003). Fisher, (2004) suggests that incomes derived from NTFPs contribute towards reducing inter-household inequality more so than other income sources including waged labor, self employment and cash transfers. From the above it is clear that patterns of use and trade in NTFPs in relation to household wealth are variable across different studies.

Commercialization of IFs varies from one region to another. The widely traded indigenous fruits in Kenya are *Tamarindus indica* and *Adansonia digitata* (Muok, 2001; Maundu *et al.*, 1999; Muok *et al.*, 2001). Maundu *et al.*, (1999) still observed that *Syzygium guineense*, *Grewia tenax* and *Ximenia americana* were reportedly sold at local centers in Baringo District while *Vitex doniana* and *Ziziphus mauritiana* were observed in local market centers within Ukambani and coastal regions respectively.

Market studies that have been carried out in Kenya indicate that a number of indigenous fruits are sold in the local markets and major urban centres like Mombasa (Maundu *et al.*, 1999; Muok *et al.*, 2001). Such fruits include *Tamarindus indica*, *Adansonia digitata*, *Ximenia americana*, *Vitex doniana*, *Azanza garckeana*, *Berchemia discolor*, *Sclerocarya birrea*, *Ziziphus mauritiana* and *Syzygium guineense*. Muok *et al.*, (2001) noted that only a few indigenous fruits like *Tamarindus indica*, *Sclerocarya birrea* and *Adansonia digitata* were being processed on limited scale to produce commercial products. *Sclerocarya birrea* is used in Southern Africa to produce wine (Amarula) which is sold on the international market (Akinifessi *et al.*, 2008). Coloured *Adansonia digitata* fruits are sold in supermarkets such as Nakumatt (Muok *et al.*, 2001) and in local shops in many parts of Kenya like Mombasa, North Horr and Turkana District. Maundu *et al.*, (1999) observed that *Acacia nilotica* fruits are sold for use in production of dyes or as fodder for goats. Some Indigenous fruits are also exported like the *Tamarindus indica* fruits which are exported to Tanzania, Zanzibar and the Middle East (mostly Yemen). *Tamarindus indica* fruits are indicated to be in very high demand among the coastal communities and Muslims in general (Muok *et al.*, 2001).



## 2.5 Economic Valuation of Non Timber Forest Products (NTFPs)

Non-timber forest products (NTFPs) are plants or plant parts that have perceived economic or consumption value sufficient to encourage their collection and removal from the forest, excluding timber. About 150 types of NTFPs are significant in international trade. Indigenous fruits are classified as Edible (NTFPs) and are the most well-known and documented NTFPs (Adepoju *et al.*, 2007).

Three main types of measure can be used for NTFPs valuation; direct market price, indirect market price and lastly non-market estimates of values. The first two measures are based on estimate of exchange values where buyers and sellers exchange goods or service for money or other goods and services while the non market values estimate the willingness of buyers to purchase or pay for specific goods or services under defined conditions. Non market value estimates are not directly comparable with market based exchange values.

Appropriate method of valuation depends on the objective of the study. More recent studies have focused on use values or the actual harvest of goods estimated at current market prices (Hedge *et al.*, 1996; Caviglia *et al.*, 2005; Ezebillo *et al.*, 2010). The value of the NTFPs traded in the market is generally estimated based on the quantities traded and their market price. These studies are based on interviews with forest dwellers regarding their actual harvests. This method is only applicable for those products which are marketed.

In the case of indirect market price, we have assumptions regarding proxy market conditions and how buyers and sellers will behave under different circumstances, only a partial valuation can be undertaken. When market price data are not available, cost-based approaches are used. These estimates run the risk of being highly overvalued (Wunder, 2002).

The non market approach has been used in many studies where market prices or proxy market conditions cannot be established. In such cases the 'willingness to pay' approach has been widely used. Researchers obtain information on the value of an environmental benefit by posing direct questions to consumers about their willingness to pay for it (or their willingness to accept compensation for losing it). The contingent valuation model has been used by most authors (Price 2000; Delang *et al.*, 2006; Sattout *et al.*, 2007) to estimate the willingness to pay for environmental goods.

For instance, the contingent valuation method was applied by Sattout, (2007) to obtain the Willingness to Pay (WTP) for a scenario to conserve cedar forests in Lebanon; to promote

sustainable activities and to explore the degree of importance of their attributes, bequest and existence values as perceived by the Lebanese population.

Another study by Shackleton *et al.*, (2002) on the importance of NTFPs in rural livelihood security focused on the extent of use and value of NTFPs at a broad scale, they valued their NTFPs collected in two ways;

- (1) By using ‘direct use value’ which was based on the farm gate prices, input cost was also considered. This method of valuation acknowledges cost-benefit analysis.
- (2) NTFPs were valued based on their contribution to livelihood (indirect use value) i.e. by assisting household to cope in times of adversity manifested at sudden changes in the economic and social or biophysical environment e.g. flood, death of head of household etc. Here the “direct use value” of NTFPs used during period of adversity does not adequately reflect their true value because it does not account for emergency insurance component of use during the times of hardship. In these situations, the changed or increased use of NTFPs is typically a coping strategy, with the products providing a safety net for the household. However, the authors assumed that all the NTFPs are tradable, this may not be true. For non traded NTFPs, non-market prices are supposed to be used. The study will be richer, if the authors had separated the NTFPs between Traded and non-traded before estimating their financial value. This study captured the direct use of indigenous fruits where the market prices and costs were used as a benchmark. This method was suitable because the indigenous fruits under study are marketed and so the market conditions can be easily captured.

2.6 Theoretical Framework ✓

Households are assumed to maximize expected utility according to a von Neuman Morgenstern utility function defined over wealth (W). We assumed that there is a wide natural occurrence of indigenous trees and those households who exploit this potential of utilizing indigenous fruits either for food or income will be well-off in terms of incomes and coping with food insecurity. We also assumed that the decision to utilize indigenous fruits was predicated on higher expected utility. Suppose that  $U_j$  and  $U_k$  represent a household’s utility for two choices; decision to utilize or not to, which are denoted by  $Y_j$  and  $Y_k$  respectively. The linear random utility model could then be specified as:

$$U_j = \beta_j X_i + \epsilon_j \text{ and } U_k = \beta_k X_i + \epsilon_k \dots\dots\dots (2.1)$$

where  $U_j$  and  $U_k$  are perceived utilities of utilizing indigenous fruits and not utilizing indigenous fruits, choices  $j$  and  $k$ , respectively,  $X_i$  is the vector of explanatory variables that influence the perceived desirability of each choice,  $\beta_j$  and  $\beta_k$  are utility shifters, and  $\epsilon_j$  and



$\varepsilon_k$  are error terms assumed to be independently and identically distributed (iid) (Greene, 2000). In the case of indigenous fruits, if a household decided to use option  $j$ , it follows that the perceived utility or benefit from option  $j$  is greater than the utility from other options (say  $k$ ) depicted as:

$$U_j > U_k \dots\dots\dots (2.2)$$

The probability that a household will choose to utilize indigenous fruits, i.e. choose method  $j$  instead of  $k$  could then be defined as:

$$\begin{aligned} P(Y=1|X) &= P(U_j > U_k) \\ P(\beta_j'X_i + \varepsilon_j - \beta_k'X_i - \varepsilon_k > 0|X) \\ P(\beta_j'X_i - \beta_k'X_i + \varepsilon_j - \varepsilon_k > 0|X) \\ P(X^*X_i + \varepsilon^* > 0|X) &= F(\beta^*X_i) \end{aligned} \tag{2.3}$$

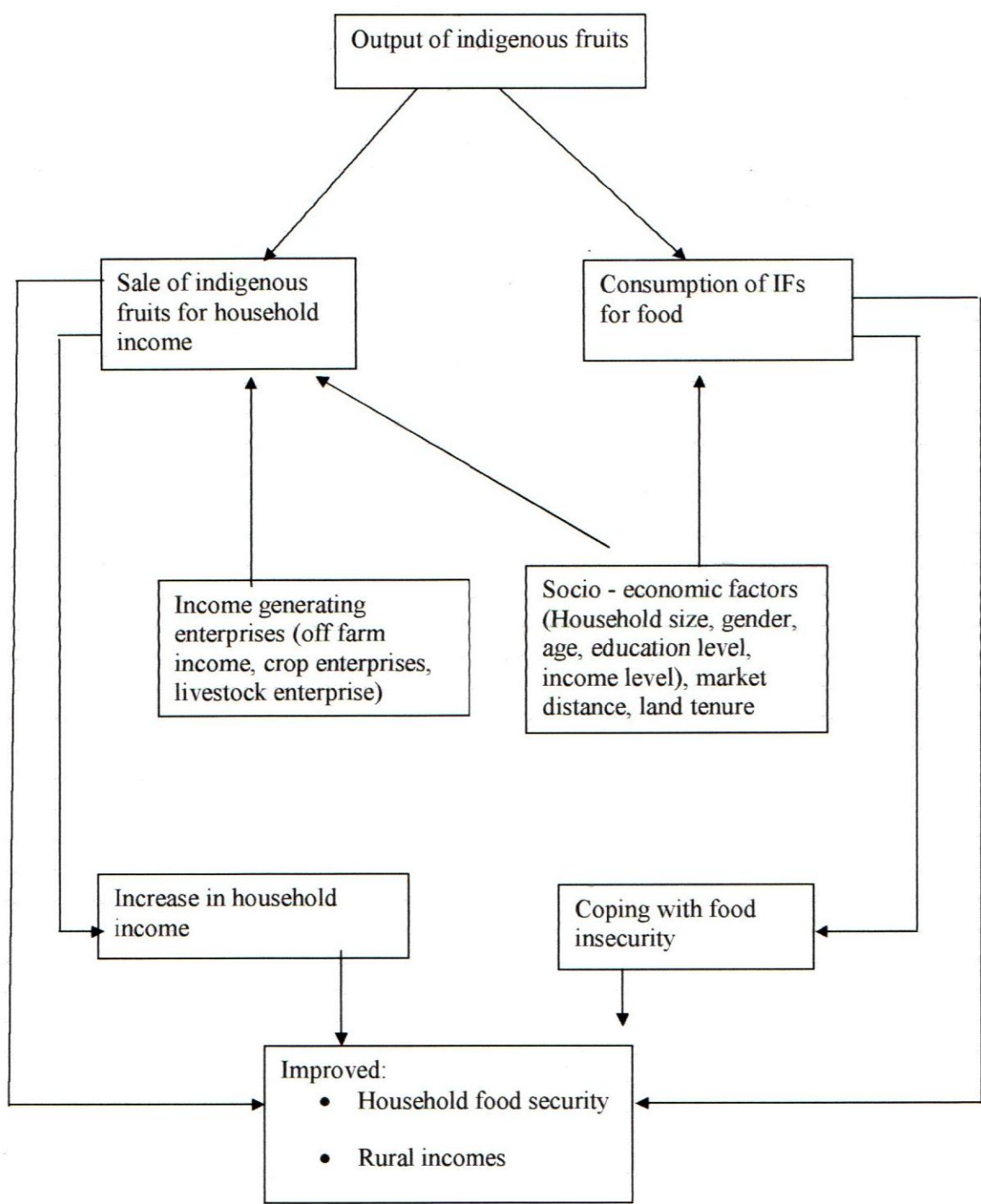
Where,  $P$  is a probability function,  $U_{ij}$ ,  $U_{ik}$ , and  $X_i$  are as defined above,  $\varepsilon^* = \varepsilon_j - \varepsilon_k$  is a random disturbance term,  $\beta_j^* = (\beta_j' - \beta_k')$  is a vector of unknown parameters that can be interpreted as a net influence of the vector of independent variables influencing utilization, and  $F(\beta^*X_i)$  is a cumulative distribution function of  $\varepsilon^*$  evaluated at  $\beta^*X_i$ . The exact distribution of  $F$  depends on the distribution of the random disturbance term,  $\varepsilon^*$ . Depending on the assumed distribution that the random disturbance term follows, several qualitative choice models can be estimated (Greene, 2000). Any household decision on the alternative choices is underpinned by this theoretical framework.

### 2.7 Conceptual Framework

The conceptual framework outlines the conceptualized interrelationships in the study, the key variables involved and how they are interrelated. The output of indigenous fruits which is the dependent variable can be utilized either for sale or for consumption. Household decision to consume indigenous fruits in order to cope with food insecurity will be influenced by socio-economic factors like the size of the household, income levels, age of the household head. This decision will also be influenced by market conditions and the prices which represent the independent variables. A decision to trade in indigenous fruits will also be influenced socioeconomic factors and incomes from other income sources (livestock, crop, off farm income). Through the sale of indigenous fruits, the income of the household is expected to increase. Consumption of indigenous fruits on the other hand is expected to contribute to a



household ability to cope with food insecurity. These will ultimately contribute to household food security and rural incomes.



Source: Author's

**Figure 2.1: Conceptual framework**

## **CHAPTER THREE**

### **METHODOLOGY**

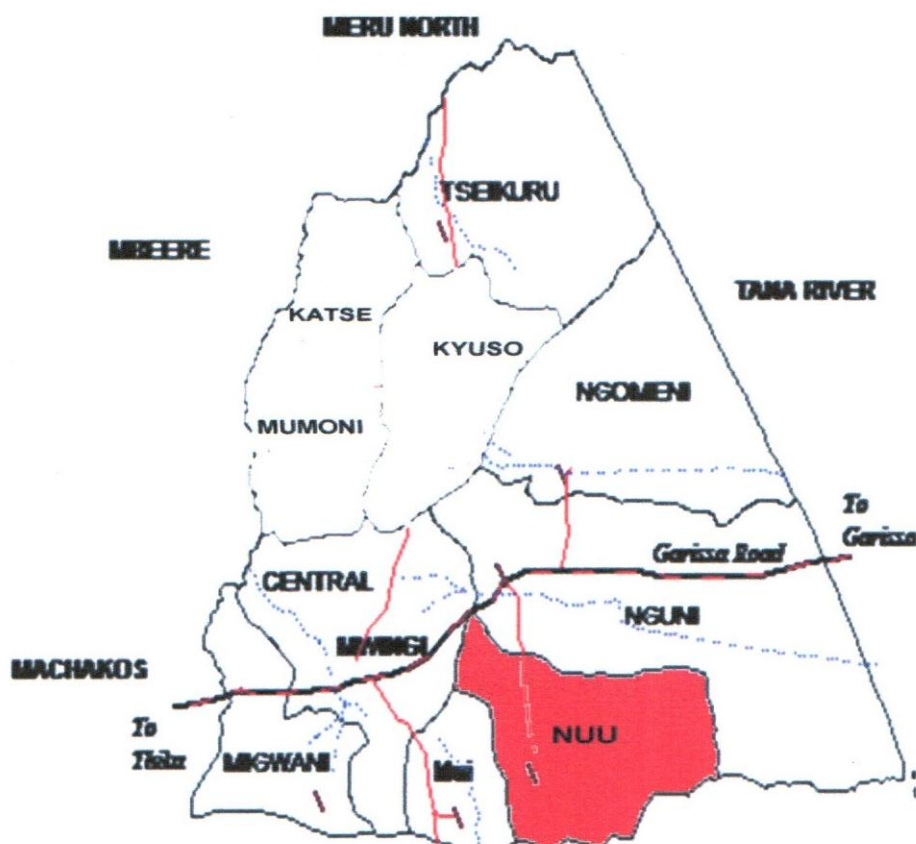
#### **3.1 Study area**

Located in Eastern province, Kitui County, Mwingi District borders Kitui to the south, Mbeere and Machakos Districts to the West and Tana River to the East. The climate is hot and dry for the greater part of the year and falls under two climatic zones; semi arid and arid. Nuu division, the actual site of the study is classified as an arid area. Temperatures are high throughout the year with maximum ranging from 28°C – 34°C. The DDP indicates that the district has two rainy seasons between March – May (long rains) and October – December (short rains) with the rest of the year remaining dry. Mean annual rainfall ranges from 400mm to 800 mm and is highly erratic between years with the short rains being more reliable than the long rains (GoK, 2008).

Mwingi District has 65.5% of its population below the food poverty line while 58.5% of the households in Mwingi District are food poor. Consequently, 62% and 66.5% of the people and households in the district, respectively, are in absolute poverty (GoK, 2008). Poverty levels and food insecurity have been aggravated by recurrent droughts causing severe crop failures and animal deaths, resulting in food shortages.

The main crops grown in the district are maize, sorghum, bulrush millet, beans, cowpeas, green grams, cassava, and sweet potatoes, which are grown at subsistence level of small-scale farming. Livestock farming remain the major economic activity in the district with about 90% of the area being suitable for extensive livestock production. The main livestock kept include beef cattle, goats, poultry, and bees. Livestock products from the district include chicken meat, mutton and goat meat, eggs, hides, skin and honey.





**Figure 3.1: Map of the study area**

*Source: GoK, (2008)*

### 3.2 Sampling procedure and sample size

The Multi-stage sampling technique was used for the survey where the target population was the households in Mwingi District. Nuu Division was purposively selected out of the eight Divisions in Mwingi District because it has a widespread natural occurrence of indigenous fruit trees under study. Two locations out of the four in Nuu division were then selected using simple random sampling. From the two selected locations, 60 households from each location were then selected using simple random sampling.

The formulae for the sample size was based on the coefficient of variation which states that in most surveys or experiments, coefficient of variation of at most 30% are usually acceptable Nassiuma, (2000). An acceptable coefficient of variation of 25% was used for the study. A standard error of 0.02 was used. The population was estimated to be 8000 households (GoK, 2008). The formula for determining the sample size according to Nassiuma, (2000) is given below:

$$n = \frac{NC^2}{C^2 + (N-1)e^2}$$

Where: **n**= sample size, **N**= population, **C**= coefficient of variation and **e**= standard error

$$n = \frac{8000 \times (0.22)^2}{(0.22)^2 + (8000-1)(0.02)^2} = 120$$

### 3.3 Data collection

Primary data was collected and used in the analysis. Primary data for this study was collected using a structured questionnaire. Pre-testing of the questionnaire was undertaken in a randomly selected village outside the sample frame, Kwatei village in Nu division. The information collected by the questionnaires was for the period of one year from December 2009 to November 2010. Data on socio economic characteristics, household income sources, consumption and marketing of indigenous fruits were collected. Secondary data was collected from existing and relevant literature and publications. Vital information was also collected from the Ministry of Agriculture, Ministry of Environment and Natural Resources and World Agro forestry Center.

### 3.4 Data analysis

Data was analyzed using descriptive statistics to assess the contribution of indigenous fruits in coping with food insecurity in the study area. The logit model was used to assess the socio- economic factors influencing consumption of indigenous fruits in order to cope with food shortage. The Gross Margin Analysis was used to compute the on farm household incomes from which the contributions of the different sources of income to total household income were evaluated. T-tests and Pearson's bivariate correlation were used for hypothesis testing. SPSS and STATA 9 softwares were used for data analysis.

### 3.5 Empirical Framework.

#### 3.5.1 Logit model

To evaluate objective 1; socio economic factors influencing the decision of households to consume indigenous fruits in order to cope with food shortage, the analysis relied on the use of qualitative choice models. The linear probability model, the probit model, and the Logit model are alternative specifications of qualitative choice models. Logit and probit analyses, however, are preferred to the linear probability model when qualitative choice models are to be estimated since the latter suffers from a number of deficiencies. The variance of the disturbance term of the model is heteroskedastic and, therefore, the standard



errors of the ordinary least squares parameter estimates are biased. Further, the disturbance term is not normally distributed, thus classical hypothesis tests, such as the t-ratios are inappropriate (McFadden, 1981). The use of logit, which gives the maximum likelihood estimates, overcome most of the problems associated with linear probability models and provides estimators that are asymptotically consistent, efficient and Gaussian so that the analogue of the regression t-test can be applied.

Conceptually, the following is the general behavioral model used to examine the factors influencing the household’s decision to consume indigenous fruits in order to cope with food shortage:

$$P_i = f (Z_i) \dots\dots\dots \text{Equation 2}$$

$$f (Z_i) = f (X_{ji}, \beta_j) \dots\dots\dots \text{Equation 3}$$

Where:

$P_i$  = the probability that a household will consume indigenous fruits in order to cope with food shortage (the binary variable,  $P_i = 1$  for coping with food shortage and  $P_i = 0$  for other reasons)

$Z_i$  = Estimated variable or index for the  $i^{\text{th}}$  observation

$f (Z_i)$  = the cumulative logistic function

$i = 1, 2 \dots, m$  are observations on the variables. (They are defined in Table 1 for this analysis,  $m$  being the sample size 120)

$X_{ji}$  = the  $j^{\text{th}}$  explanatory variable for the  $i^{\text{th}}$  observation,  $j = 1, 2 \dots n$

$\beta_j$  = A parameter,  $j = 0, 1 \dots n$

$j = 0, 1 \dots, n$  where  $n$  is the total number of explanatory variables.

The logit model assumes the underlying theoretical index,  $Z_i$  which is a random variable that predicts the probability of a household to consume indigenous fruits in order to cope with food shortage. The  $Z_i$  is determined by a set of explanatory variables  $X$  which are education, gender, employment, household size, income levels and marital status.

The probability that an  $i^{\text{th}}$  household will consume indigenous fruits in order to cope with food shortage can be expressed as in equation 4

$$P_i (1) = \frac{e^{Z_i}}{1+ e^{Z_i}} \dots\dots\dots \text{Equation 4}$$

The probability that an  $i^{\text{th}}$  household will consume indigenous fruits for other reasons is given by equation 5

$$P_i (0) = \frac{1}{1+ e^{Z_i}} \dots\dots\dots \text{Equation 5}$$

$e$  represents the base of natural logarithms (approximately equal to 2.7 18)

The model can be further expressed as below;

$$p = \beta_0 + \beta_1 (MARITSTAT) + \beta_2 (GEND) + \beta_3 (EMPL) + B_4 (AGE) + \beta_5 (HHSIZE) + \beta_6 (INC) + \beta_7 EDUC + \varepsilon$$

Where, *P* represents the dependent variable: equal to 1 if the individual consumes indigenous fruits to cope with food shortage and 0 otherwise.

**Table 3.1: Description of variables for the Logit model**

| Variable                            | Description                                       | Unit of measurement                         | Expected sign |
|-------------------------------------|---------------------------------------------------|---------------------------------------------|---------------|
| <b><u>Dependent variable</u></b>    |                                                   |                                             |               |
| Consumption of IFs                  | Household consumes for food shortage or otherwise | 1 = consumes for food shortage, 0 otherwise |               |
| <b><u>Independent variables</u></b> |                                                   |                                             |               |
| Abbreviation                        | Variable Name                                     | Unit of Measurement                         |               |
| HHINC                               | Household Income level                            | Amount (Kshs.)                              | -ve           |
| HHSIZ                               | Household size                                    | Number                                      | +ve           |
| EDUC                                | Education level                                   | Number of years                             | -ve           |
| AGEHH                               | Age of Household head                             | Number of years                             | -ve           |
| EMPL                                | Formal employment                                 | Dummy (1=Yes, 0= No)                        | -ve           |
| GEND                                | Gender of house hold head                         | Dummy(1=Male , 0=Female)                    | (+ve or -ve)  |
| MARIT                               | Marital status of household head                  | Dummy (1=married, 0=Not married)            | (+ve or -ve)  |

The second objective was addressed by descriptive statistics. Using a Likert type scale ranging from 0- 4, the different food insecurity coping strategies were ranked by respondents as used never used (0), used rarely (1), occasionally (2), frequently (3) or always (4). These strategies included skipping meals, consumption of indigenous fruits, consumption of wild animals, relying on food aid, food rationing, food for work and borrowing food. A score for each strategy was then generated by summing up the responses of all the households in that particular strategy. The proportion that consumption of indigenous fruits makes out of the total coping strategies to food insecurity was then computed. This proportion was tested using a one-sample t-test to assess if the contribution is significant.



### 3.5.2 Gross Margin Analysis

The Gross Margin Analysis was used to address the third objective of estimating the contribution of indigenous fruits to the total household income. This was done by identifying and estimating the different on farm activities that are a source of income to the households. To estimate the values of the different income generating activities, the direct and indirect approaches to valuation can be used. The direct approach entails estimation of the price of the products which are sold in the market. The indirect market price approach is often used for products that are not directly traded in the market. Their values can be derived from their contribution to other production processes or their impact on the prices of other commodities. For this study, the direct approach was used where the IFs will be valued at their market price. Willingness to pay can be used but it is difficult to capture and may also be biased (Tietenberg, 1996). The Gross margin was calculated from the net incomes of the agricultural crops, livestock, off farm income and the IFs. The contribution of each production activity towards the household income was established via gross margin calculation (Equation (1) and (2)) for each production activity. The gross margin is defined as gross income net off direct variable cost (FAO, 1985).

$$GM_i = R_i - VC_i - wL_i \dots\dots\dots (1)$$

Where,

$R_i$  = revenue (cash and in-kind from the sale and use of products) from the  $i^{th}$  activity

$VC_i$  = variable cost (cash and in-kind) from the  $i^{th}$  activity

$wL_i$  = Cost of hiring labor and work parties from the  $i^{th}$  activity

Five major sources of income were captured; crops income, livestock income, income from indigenous fruits and off farm income. Products from livestock keeping which include milk, eggs, meat, manure, hides and skin were also captured. The operational costs for the crop enterprises included expenses for seeds, fertilizers, manure, pesticides, draught power, transport and hired labor. Direct variable costs of livestock keeping included expenses for medical treatments, feeds and hired labor.

Off-farm income was defined in net terms, that is, net of any costs incurred related to a person's engagement in an activity. Off-farm income was generated by summing up the incomes from the off-farm activities. These include income from salaries and wages, small-scale non-farm market production, business activities, rent and net remittances. Net remittances were generated by summing the transfers received during the year and subtracting transfers remitted out.

In order to identify the relationship that existed between incomes from indigenous fruits and other household income sources, a Pearson's bivariate correlation was used. The incomes for the four enterprises (crops, livestock, and indigenous fruits) were run on SPSS to identify the association (correlation) that existed between them. A correlation matrix was generated by the program.



## CHAPTER FOUR

### RESULTS AND DISCUSSIONS

#### 4.1 Introduction

This chapter outlines the findings in two sections: Section one outlines the descriptive results on socio economic characteristics. Section two outlines the empirical results on identified variables that influence consumption of indigenous fruits in order to cope with food shortage and the contribution the indigenous fruits have on household income and in coping with food insecurity.

#### 4.2 Descriptive results

The descriptive statistics presented under this section are socio-economic characteristics of the respondents (gender, age, employment status, education level of the household head and household size), consumption of indigenous fruits and sale of the different indigenous fruits.

##### 4.2.1 Gender of the Household heads.

The majority (73.3%) of the sampled households were male headed while female headed households constituted only 26.7%. While all the households consumed indigenous fruits, it is only 60% and 81% of the male and female headed households respectively who were involved in the sale of indigenous fruits (table 4.1). More female headed households participated in the sale of indigenous than their male counterpart. These results concur to studies carried out by Shackleton *et al.*, (2006) and Ayisso *et al.*, (2009). This could be explained by the fact that collection and sale of indigenous fruits is less labor intensive and therefore favorable to women.

**Table 4.1: Gender status of respondents**

| Gender | Frequency | Sellers (%) | Non- sellers (%) | Total |
|--------|-----------|-------------|------------------|-------|
| Male   | 88        | 60          | 40               | 100   |
| Female | 32        | 81          | 19               | 100   |
| Total  | 120       |             |                  |       |

##### 4.2.2 Age of respondents

Results on table 4.2 summarize the age distribution of the household heads involved in indigenous fruits. Interestingly, male household heads tended to be younger with 40% in the 40-49 age bracket while female household heads were evenly distributed in age from 30

years and above. This indicates that it is only the middle aged and older people with vast experience about their environment who find meaning in indigenous fruits.

**Table 4.2: Household head age category**

| Age category | Frequency | Male (%) | Female (%) |
|--------------|-----------|----------|------------|
| Below 20     | 3         | 2        | 3          |
| 20-29        | 6         | 6        | 1          |
| 30-39        | 27        | 21       | 24         |
| 40-49        | 42        | 40       | 25         |
| 50-59        | 30        | 25       | 25         |
| 60 and above | 12        | 6        | 22         |
| Total        | 120       | 100      | 100        |

**4.2.3 Employment and income status of the respondents.**

The results in table 4.3 show that most of the sampled household heads are full time farmers (58.3%) and low income earners (57%). The pensioners were the least (8.3%) among all the employment categories while the high income earners comprised the minority (18.8%) among the three income classes. The greater proportion are full time farmers and low income earners, with limited agricultural possibilities, this would suggest exploring ways of exploiting comparative advantage like involvement in the sale of indigenous fruits.

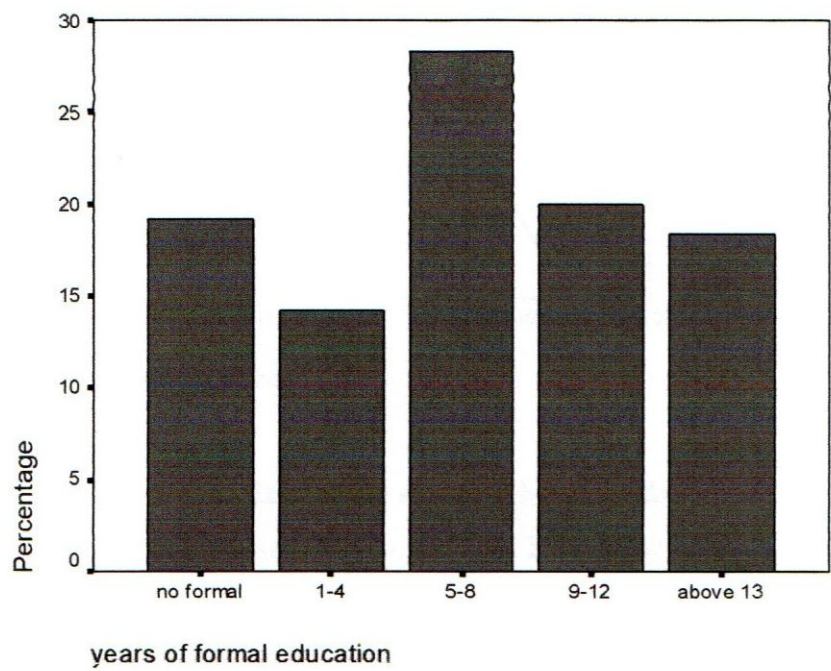
**Table 4.3: Employment and income categories of respondents**

| Employment categories | Sample (%) | Income status | Sample (%) |
|-----------------------|------------|---------------|------------|
| Full time farmer      | 58.3       | Low income    | 57.0       |
| Formally employed     | 19.2       | Middle income | 24.2       |
| Pensioner             | 8.3        | High income   | 18.8       |
| Self-employment       | 14.2       |               |            |
| Total                 | 100        | Total         | 100        |

**4.2.4 Education of the respondents**

Results in Figure 4.1 indicate that 28% of households had attained 5-8 years of education. However, there was still a bigger proportion (19%) had acquired no formal

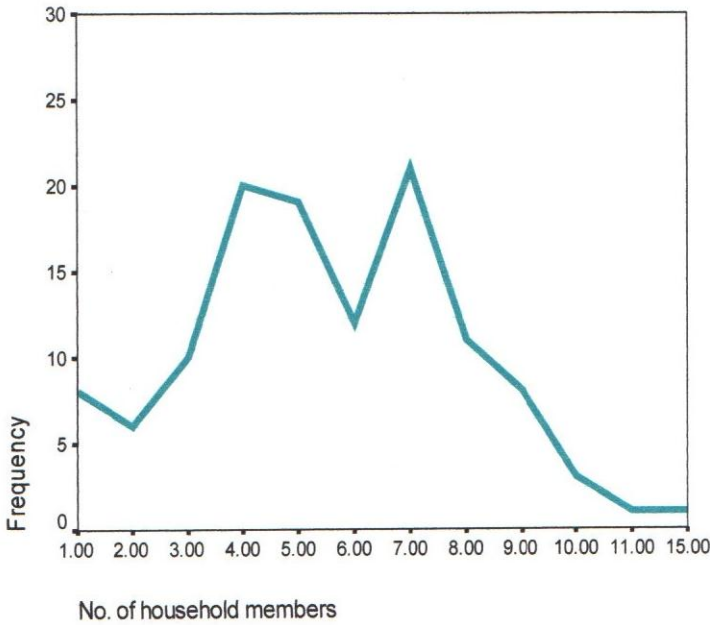
education and could therefore be classified as illiterate. The proportion that attained 9-12 years of education comprised 20% while above 13 years was 18%. It is apparent that the proportion with tertiary education is only 18%. This implies that possibilities of acquiring alternative sources of income from formal employment amongst many households is negligible, as a result, opting for other income sources like trading in indigenous fruits.



**Figure 4.1: Education levels of the household**



### 4.2.5 Household size of respondents



**Figure 4.2: Household sizes of the sampled households**

The average household size is 5.5. This shows that most households have large families which increase the food expenditure among the households. This could force these household to look for alternative income sources or food sources like indigenous fruits.

### 4.2.6 Consumption preference of Indigenous fruits

All the sampled households were found to consume indigenous fruits, which supports the results of Ramadhani, (2002) and Mithöfer, (2005). The preferences to the type of indigenous fruits are as summarized in table 4.4. Preference to the type of indigenous fruits for consumption varied from one household to another and from one region to another, mainly as a result of availability, taste and taboos.

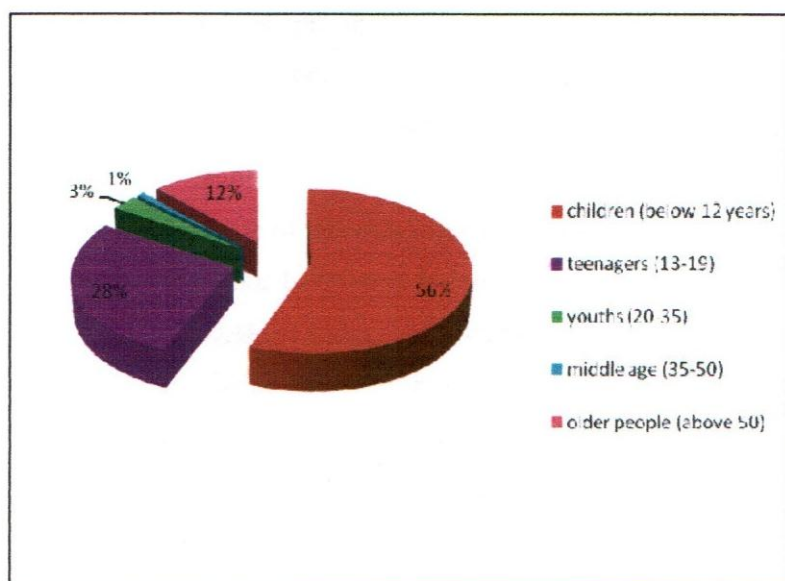
**Table 4.4: Consumption preferences of the different indigenous fruits**

| Indigenous fruits | Sample (%) | Yumbu (%) | Mutyangome (%) |
|-------------------|------------|-----------|----------------|
| Baobab            | 37         | 8         | 67             |
| Chocolate berry   | 50         | 77        | 23             |
| Tamarind          | 13         | 15        | 10             |
| Total             | 100        | 100       | 100            |

In Mutyangome location, for instance, majority (67%) of the respondents preferred baobab while in Yumbu location majority (77%) preferred chocolate berry. Generally, the most preferred indigenous fruit for consumption in both locations is chocolate berry with 50% of the respondents preferring it. Chocolate berry is most preferred for consumption because of its sweet taste and the filling effect it has on the stomach once eaten. The least preferred is tamarind with only 13% of the households because of its sour taste and is therefore mainly used as a food additive. The preference to baobab was 37% of the households.

#### **4.2.7 Consumption Patterns of IFs among different age groups**

Consumption of the indigenous fruits in both locations was noted across members of all ages in the households as shown in figure 4.3. However, children were the most popular consumers of indigenous fruits comprising 56%, followed by teenagers (28%), and these results support the findings by Mithöfer, (2005). This could be explained by the ease of collection of the fruits from forest when grazing livestock since children and teenagers are the ones who mainly graze livestock. The middle age group was the least consumer of indigenous fruits comprising only 1%; this could be explained by lack of ease of accessibility to the fruits by the middle aged people who are usually busy to be engaged in collection of indigenous fruits for consumption.



**Figure 4.3: Consumption patterns of indigenous fruits among the different age groups**

#### 4.2.8 Acquisition and use of indigenous fruits

Table 4.5, shows that most of the households collected indigenous fruits from the forest (40%), with children identified as the frequent collectors of indigenous fruits for the households. Some, however, collected the fruits from the farms (25%) and these households were mainly those who owned land communally as a family. Communal land ownership in the area encourages the preservation of the indigenous trees and as such, a larger number of the indigenous fruit trees can be found in communally owned land than in self-owned land. Borrowing of indigenous fruits for consumption was rarely (8%) done. However, some households (19%) received indigenous fruits from relatives and friends as gifts.

**Table 4.5: Acquisition and use of indigenous fruits**

| Method of acquisition      | %   | Use           | %   |
|----------------------------|-----|---------------|-----|
| Collection from forest     | 40  | Snack         | 48  |
| Collection from farms      | 25  | Food additive | 25  |
| Purchasing from the market | 18  | Food          | 23  |
| Borrowing from neighbors   | 8   | Medicine      | 4   |
| Gifts                      | 19  |               |     |
| Total                      | 100 | Total         | 100 |

Indigenous fruits are not a substitute for the staple food in the study area, but they are part of a basket of natural resources, which can supplement staple food during periods of food shortages. As indicated in table 4.5, 48% of the households would decide to consume the three indigenous fruits as a snack, 25% as food additive 23% as food and only a few (4%)



preferring to consume indigenous fruits for medicinal purposes. However, with respect to the three indigenous fruits, Chocolate Berry was mainly consumed as food, baobab consumed as food and snack and tamarind used mainly as food additive. It was however noted that in Yumbu location more households consumed indigenous fruits for food than in Mutyangome location because of the widespread availability of chocolate berry in the location which is the major indigenous fruits used as food.

**4.2.9Sale of indigenous fruits**

Results in table 4.6, show that the highly commercialized indigenous fruit was baobab (55%). This is because it is not only sold in the local market like chocolate berry but also in distant markets like in Garissa and Mombasa. Chocolate berry is highly perishable and as a result, it is only sold in the local markets and consumed at the household level. That is why, out of all the households who sell indigenous fruits, it is only 38% who were involved in the sale of chocolate berry fruits. The remaining households (39%) sold tamarind fruits.

**Table 4.6: Sale of chocolate berry, tamarind and baobab indigenous fruits.**

|                 | All sampled<br>households (%) | Mutyangome (%) | Yumbu (%) |
|-----------------|-------------------------------|----------------|-----------|
| Chocolate berry | 18                            | 19             | 39        |
| Baobab          | 55                            | 49             | 26        |
| Tamarind        | 27                            | 32             | 35        |
| Total           | 100                           | 100            | 100       |

In the two locations, however, there was a pronounced difference in the highly commercialized indigenous fruitsdepending on availability. In Mutyangome location, majority (49%) sold baobab with the least selling (19%) selling chocolate berry. In Yumbu location on the other hand, majority(39) sold chocolate berry with the least (26%) selling baobab. On average in both locations, baobab was the most (55%) sold indigenous fruit.

Table 4.7 shows the markets and the challenges faced by households in marketing indigenous fruits. Among the households who sold indigenous fruits, 40% noted poor sales due to low demand and seasonality as the major challenge in marketing indigenous fruits. Majority (80%) of the households sold the indigenous fruits in the local markets with only 5% selling in distant markets.

**Table 4.7: marketing of indigenous fruits**

| Challenges in marketing | %   | Markets       | %   |
|-------------------------|-----|---------------|-----|
| Unstable prices         | 15  | Local         | 80  |
| Poor sales              | 46  | Nearest urban | 15  |
| Lack of market          | 32  | Distant urban | 5   |
| Poor infrastructure     | 7   |               |     |
| Total                   | 100 |               | 100 |

### 4.3 Empirical results.

#### 4.3.1 Socio economic factors influencing consumption of IFs due to food shortage.

The logit model was used to evaluate the socio- economic factors that influence consumption of indigenous fruits due to food shortage. The dependent variable is a dummy variable with two categories of choices, 1 if the household consumes indigenous fruits because of food shortage and 0 if the household consumes indigenous fruits for other reasons.

The variables used in the model were generated from literature review, theoretical information and through correlation matrices. The results of the correlation matrices generated are given as appendix 3. Where correlation between two variables was above 0.6, one variable was to be dropped; this was not without considering the importance of a variable in the context of household consumption as generated from literature. The generated correlation matrices did not show any correlation among the variables. They all had a value of less than 0.6. All the variables were therefore included in the model.

Household size is an important variable when it comes to household decision to consume indigenous fruits due to food shortage. It is expected that large families will opt to consume indigenous fruits during food shortage because of the high costs required to sufficiently meet their food needs.

Education of the household head was also included in the model as an important socio-economic factor influencing consumption of indigenous fruits in order to cope with food insecurity. It was expected that households with highly educated heads were less likely to consume indigenous fruits due to food shortage than the less educated ones. The more educated heads are mainly formally employed and therefore have alternative sources of income to purchase food when it is inadequate.



**Table 4.8: Logit estimates for consumption of indigenous fruits due to food shortage**

| Variables                       | Coefficient   | Standard error | z                              | p >  z |
|---------------------------------|---------------|----------------|--------------------------------|--------|
| Gender                          | 0.6239593     | 1.129522       | 0.55                           | 0.581  |
| Age                             | -0.3529088    | 0.3591462      | -0.98                          | 0.326  |
| Marital status                  | -0.0776705    | 0.6407332      | -0.12                          | 0.904  |
| Education                       | -0.811003**   | 0.3518431      | -2.31                          | 0.021  |
| HHsize                          | 0.4958085 *   | 0.1245367      | 1.34                           | 0.091  |
| Employment                      | -0.6470913**  | 0.2552568      | -2.54                          | 0.011  |
| Income                          | -0.8934208*** | 0.3430541      | -3.57                          | 0.000  |
| Constant                        | 6.900955      | 2.571553       | 2.68                           | 0.007  |
| LRchi <sup>2</sup> (7) = 107.82 |               |                | Log likelihood = -29.002231    |        |
| Prob> chi2 = 0.0000             |               |                | Pseudo R <sup>2</sup> = 0.6502 |        |
| Number of obs = 120             |               |                |                                |        |

\*\*\* Significant at the 0.01 level, \*\* significant at the 0.05 level, \* significant at the 0.10 level

Results in table 4.8, show that education of the household head, household size, employment of the household head and household income levels were found to significantly influence the decision of a household to consume indigenous fruits for the purpose of coping with food shortages. Other socio- economic factors like gender of the household head, age, and marital status were not significant. As expected, household size was positively associated with the decision to consume indigenous fruits for the reason of food shortage; on the other hand, age, education, employment and income were negatively associated with the decision to consume indigenous fruits because of food shortage. Gender and marital status which were not predicted priori were found to be positively and negatively, respectively, associated with consumption of indigenous fruits for the purpose of coping with food shortage.



Education as expected had a negative influence in the consumption of indigenous fruits in order to cope with food shortage. A year increase in education increased the likelihood of a household not consuming indigenous fruits because of food shortage by 81% and this was significant at 95% confidence level. These results agree with studies carried out by, Gunatilake, (1998); Adhikari *et al.*, (2004) and Mamoet *et al.*, (2007) who found out that a higher level of formal schooling is associated with less collection and dependency on NTFPs. A higher level of education provides a wider range of employment opportunities and as a result alternative sources of income. The hypothesis that socio-economic factors have no significant influence on household decision to consume indigenous fruits in order to cope with food shortage was rejected at 95% confidence level.

Income level was found to be a significant variable that determines the decision of a household to consume indigenous fruits due to food shortage; this was at 99% confidence level. The results indicate that, as total household income increases the likelihood of a household to consume indigenous fruits in order to cope with food shortage decreases by 89%. Households with high incomes have the purchasing power to buy food. These households can afford to buy foodstuff which are usually highly priced when food is scarce. On the other hand, low income earners have to make do with indigenous fruits which they can collect from the forest or buy at a very low price. These results agree with those of a study in Brazilian Amazon which found out that household wealth had a negative and significant relationship with forest dependency. This indicates that households with more diverse income sources are less dependent on forest resource extraction (Caviglia and Sills, 2005). The hypothesis was therefore rejected at 99% confidence level.

Form of employment of the household head was another significant variable that negatively influenced the decision of a household to consume indigenous fruits in order to cope with food shortage. As the household head acquires employment, the probability that the household will consume indigenous fruits due to food shortage decreases. For every unit increase in the form of employment the decision to consume indigenous fruits due to food shortage increased by 65% at 95% confidence level. The hypothesis was therefore rejected at 95% confidence level.

An increase of one member in the family would increase the likelihood of the household consuming indigenous fruits to be able to cope with food shortage by 50% at 90% significant level. Individuals from larger families may find it difficult to access alternative sources of subsistence, and thus become dependent on indigenous fruits during times of food shortage. These results are consistent with those of other studies in Ethiopia and Burkina

Faso where dependency on NTFPs was found to be significantly positively related to household size. (Mamo, *et al.*, 2007; Lingani, *et al.*, 2009). These results facilitated the rejection of the null hypothesis at 90% confidence level.

### 4.3.2 Contribution of indigenous fruits in coping with food insecurity

The different strategies of coping with food insecurity were identified and ranked by the respondents. These strategies included skipping meals, eating wild animals, eating indigenous fruits, borrowing food, relying on food aid, food rationing and food for work. These strategies were ranked by the respondents with respect to how often they utilize the strategy to cope with food insecurity using a five - point Likert type scale. The proportion that indigenous fruits make to the total food insecurity coping strategies was then calculated. The results tabulated in table 4.9 indicate the means, standard deviation, scores and proportions of the different coping strategies to food insecurity. The score for each coping strategy was computed by summing up the responses in that particular strategy.

**Table 4.9: Proportions of different coping strategies to food insecurity**

| Coping strategies        | Score | Mean   | S.D    | proportions(%) |
|--------------------------|-------|--------|--------|----------------|
| Skipping meals           | 256   | 2.1333 | 0.8294 | 14             |
| Eating wild animals      | 168   | 1.4000 | 0.5710 | 10             |
| Eating indigenous fruits | 323   | 2.6917 | 0.8075 | 18             |
| Borrowing food           | 215   | 1.7917 | 0.7206 | 12             |
| Relying on food aid      | 230   | 1.9167 | 0.7841 | 13             |
| Food ration              | 332   | 2.7667 | 0.8863 | 19             |
| Food for work            | 225   | 2.1500 | 0.8759 | 14             |

On average, food rationing is the commonly used strategy to cope with food insecurity in the study area; it contributed 19% to the total coping strategies and a score of 332. Eating indigenous fruits took the second biggest share (18%) in its contribution to coping with food insecurity and has a score of 323. Most households utilize this strategy because even when there is severe crop failure, the fruits never fail to produce, others claim that they were introduced in to this coping strategy by their parents and it has thus become a part of them. Eating wild animals on the other hand was the least contributor to food insecurity coping strategy (10%) because of the strict ban by the Kenya Wildlife Society on poaching of wild animals.



To identify if the contribution of indigenous fruits in coping with food insecurity was significant, a one- sample t- test was used on the proportions of the different strategies and the results are as tabulated in table 4.10

**Table 4.10: One sample t-test results of food insecurity coping strategies.**

| Test value = 2.0  |            |       |                         |         |
|-------------------|------------|-------|-------------------------|---------|
| Coping strategies | t          | Sig.  | 95% Confidence Interval |         |
|                   |            |       | Lower                   | Upper   |
| Skipping meals    | -4.843***  | 0.000 | -0.5166                 | -0.2167 |
| Wild animal       | -21.103*** | 0.000 | -1.2032                 | -0.9968 |
| Indigenous fruits | 2.600***   | 0.010 | 0.0457                  | 0.3376  |
| Borrowing food    | -10.768*** | 0.000 | -0.8386                 | -0.5781 |
| Food aid          | -8.149***  | 0.000 | -0.7251                 | -0.4416 |
| Food ration       | 3.296***   | 0.001 | 0.1065                  | 0.4269  |
| Food for work     | -4.377***  | 0.000 | -0.5083                 | -0.1917 |

\*\*\* Significant at the 0.01 level

The results of the one sample t-test show that the contribution of all the strategies indicated above are significant in coping with food insecurity amongst the households and this is plausible because the proportions (Table 4.9) occupied by any of them are somewhat clustered. All the strategies were significant at 99% confidence level. The hypothesis that indigenous fruits do not contribute significantly to coping with food insecurity among households in Nuu division was therefore rejected. At 99% confidence level the study concluded that consumption of indigenous fruits contribute significantly to coping with household food insecurity.

#### **4.3.3 Contribution of indigenous fruits to household income as compared to other income sources.**

The major household income sources identified by the study were; livestock, crops, indigenous fruits and off-farm. The incomes from livestock, crops and indigenous fruits were generated using the gross margin analysis. Off farm income was generated by summing up



the different off farm activities, these included remittances, salaries and wages, rent income and business income.

#### 4.3.1.1 Off-farm income

Table 4.11 shows a summary of income from off-farm activities including salaries and wages, business income, rent income and remittances among the different income classes.

**Table 4.11: off-farm income among the income classes.**

Figures in 000' KES

| Income source      | Amount of income |         |         |          |
|--------------------|------------------|---------|---------|----------|
|                    | Low              | Middle  | High    | Total    |
| Salaries and wages | 284.5            | 2,800.9 | 6,265   | 9,350.4  |
| Business           | 500.5            | 2,740   | 860     | 4100.5   |
| Rent               | 50               | 110     | 450     | 610      |
| Remittances        | 156              | 252.5   | 242.4   | 1750.9   |
| Total              | 2,091            | 5,903.4 | 7,817.4 | 15,811.8 |

As shown in table 4.11, the total off-farm income was Kshs. 15,811,800 where salaries and wages contributed KES 9,350,400; Business KES 4,100,500; rent KES 610,000, and Remittances KES 1,750,900.

#### 4.3.1.2 on farm income

The gross margins were calculated by subtracting the variable cost from the total revenue for each enterprise. These enterprises on the farm include crops, livestock, and indigenous fruits (see appendix 2 for the gross margins). The total gross margins for the different enterprises were computed by summing up all the sampled households' income for the respective enterprise. Table 4.12 summarizes the gross margins of the different enterprises for the three income groups.

**Table 4.12: Gross Margins for the different income classes**

Figures in 000' KES

| Income class  | Gross Margins |           |                   |           |
|---------------|---------------|-----------|-------------------|-----------|
|               | Crops         | Livestock | Indigenous fruits | Total     |
| Low income    | 483.66        | 612.37    | 1,221.46          | 2,317.49  |
| Middle income | 505.73        | 641.376   | 556.11            | 1,703.216 |
| High income   | 311.29        | 1,455.716 | 14.87             | 1,907.876 |
| Total         | 1,300.68      | 2,709.462 | 1,928.44          | 5,928.582 |

Livestock enterprise had the highest total gross margin (KES.2, 709,462) followed by indigenous fruits (KES 1,918,440) with crops enterprise having the least (KES1, 300,680). This could be explained by the fact that though most households harvested after the short rains, the harvests were hardly enough to sell, therefore, most households kept the grains for household consumption. As a result of poor harvests experienced by most households, livestock farming has become the major farming activity which supplies major income to most households. A higher gross margin from indigenous fruits was noted from the low income earners (KES1, 221,460) with the high income earners recording a gross margin of only KES 140,870 from indigenous fruits. This could be explained by the alternative sources of income by the high income earners. The middle income earner is the most diversified group when it comes to income sources. In the study area most of the middle income earners run small businesses and involve themselves in keeping of livestock which they sale when need arises. However, still some of them participate in the sale of indigenous fruits especially in distant markets. The middle income recorded a gross margin of KES556, 110 from indigenous fruits.

These findings agree with studies from South Africa by Shackleton and Shackleton, (2006) and Cocks *et al.*, (2008), which show income as an influence to procurement and sale, with a greater proportion of low income households procuring NTFPs through self-collection and selling products on either a full-time or ad hoc basis. However, they contradict with a study carried out by Ambrose-Oji, (2003) in Cameroon, which found NTFPs to make a greater contribution to middle-income groups (predominantly through trade), with wealthy and poor households benefiting to a lesser degree.

Table 4.13 summarizes the contribution of the different income sources to household income. The income share is the proportion of each enterprise's income to the total household income.



**Table 4.13: income share of the income sources to total household income**

Figures in 000' KES

| Enterprise        | Income     | Mutyangome          |           | Yumbu               |        | Average<br>income share<br>(%) |
|-------------------|------------|---------------------|-----------|---------------------|--------|--------------------------------|
|                   |            | Income share<br>(%) | income    | Income share<br>(%) | income |                                |
| Crops             | 951.41     | 6.8                 | 349.27    | 4.4                 |        | 5.6                            |
| Livestock         | 994.746    | 7.1                 | 1,714.716 | 21.8                |        | 14.5                           |
| Indigenous fruits | 1,322.72   | 9.7                 | 595.72    | 7.6                 |        | 8.6                            |
| Off- farm         | 10,603.6   | 76.4                | 5,208.2   | 66.2                |        | 71.3                           |
| Total             | 13,872.476 | 100                 | 7,867.906 | 100                 |        | 100                            |

In both locations, off-farm income contributed majorly to the total household income among the respondents with Mutyangome location having a gross margin of KES 10, 603,600 and Yumbu KES 5, 208,200 as illustrated in table 4.13. Livestock farming was the major farming activity among many household in both locations. However the livestock gross margins in Yumbu were notably higher (KES 1, 714,716) because the location is nearer to the major market in the district and therefore creating an ease in the sale of livestock. The gross margin for indigenous fruits in Mutyangome was more than double that of Yumbu. This could be explained by the fact that chocolate berry is the major indigenous fruit in Yumbu location; because of its perishability, it is mainly used for household consumption and local market sales.

The proportion of each enterprise's gross margin out of the total income was calculated. As shown in table 4.13 above, Off-farm income was the major contributor to total household (71.3%) with Mutyangome recording a higher off-farm income share (76.4%) than Yumbu (66.2%). Surprisingly, in Mutyangome location, indigenous fruits' enterprise was the second largest contributor (9.7%) to total household income after off-farm income. On average in both locations, indigenous fruits contributed 8.9% to the total household income among the sampled households ranking it third after off-farm income (71.3%) and livestock (14.5%). These results differ in magnitude from those of other studies who found that income from NTFP for rural households in the Brazilian Amazon accounted for 25% of annual income (Caviglia and Sills, 2005). Pethiyaet *al.*, (2003) also reported that 28% of income of forest dwellers in Madhya Pradesh and Andhra Pradesh in India came from NTFP. This

On average, the crops enterprise contributed the least (5.6%) to total household income. Most respondents claimed to harvest very little or sometimes even nothing because of the unreliable rainfall. As a result, the little harvest is seldom sold, unless on rare occasions when emergencies arise.

To evaluate if there exists any significant relationship between income from indigenous fruits and other household income sources, the Pearson's bivariate correlation was used where the correlation between income from indigenous fruits and other household incomes were computed. The results are as indicated in table 4.14.

**Table 4.14: correlation estimates between income from IFs and other sources.**

| Enterprise      | Correlation coefficient | Sig. (2-tailed) |
|-----------------|-------------------------|-----------------|
| Crop            | 0.402                   | 0.078           |
| Livestock-0.238 |                         | 0.009***        |
| Off-farm        | -0.259                  | 0.004***        |

\*\*\* Correlation is significant at the 0.01 level (2-tailed).

As expected, there was a significant negative correlation between income from indigenous fruits and off-farm income of 26% at 99% confidence level. Indicating that, an increase in off-farm income will cause a decrease in income from indigenous fruits. This could be attributed by the fact that income from indigenous fruits is mainly generated by the low income earners who have little or no off-farm income. The biggest proportion of the off-farm income comes from the formally employed who are the high income earners in the study area and least involve themselves in the sale of indigenous fruits.

Livestock income also had a negative significant relationship with income from indigenous fruits of 24% at 99% confidence level. Indicating that, an increase in income from livestock enterprise will also cause a decrease in income from indigenous fruits. Most low income earners have no or very few livestock because of high costs involved in acquisition of livestock, as a result, they tend to rely more on sale of indigenous fruits. Livestock income is on the other hand higher among the high and middle income earners.

Income from crops had a positive and insignificant relationship with income from indigenous fruits. The recurrent crop failures in the region make the wealthier counterparts to resent crop production for commercial purposes; because of the high opportunity costs of labor associated with crop production in the region.



The relationship between income from indigenous fruits and other sources of income exhibited a distinct curvilinear form which when transformed to a log-linear fit gives a higher coefficient of correlation. This supports the results of Godoy *et al.*, (1997) and Angelsen *et al.*, (1999) who found out that the relationship between farm income and NTFP extraction resembled an inverted U-shape which is a non- linear relationship.

The hypothesis that there exists no significant relationship between income from indigenous fruits and other income sources was therefore rejected. Off-farm income and income from livestock enterprise had a significant negative relationship with income from indigenous fruits at 99% confidence level.

## **CHAPTER FIVE**

### **CONCLUSION AND RECOMMENDATIONS**

#### **5.1 Conclusion**

The study aimed to; assess the factors that influence consumption of indigenous fruits in order to cope with food shortage, evaluate the contribution of baobab, chocolate berry and tamarind indigenous fruits on household income and in coping with food insecurity.

Indigenous fruits were found to be widely used by rural households in Mwingi District for both direct household provisioning and income generation, with low income households using and benefiting more from these products than the high income earners. Although trade in indigenous fruits is seasonal, households take advantage of the opportunity it presents due to the increasing harsh climatic and economic conditions. For example the price of the staple food, maize meal, has more than doubled in the last two years denying most households the purchasing power to acquire basic needs especially women, who indicated that they had to find means of earning additional cash to pay for their basic food needs.

The study therefore concluded that socio-economic factors are very important in determining household decision to consume indigenous fruits in order to cope with food shortage. The findings identified income, education, household size and form of employment as significant factors that influence a household decision to consume indigenous fruits in order to cope with food insecurity. Alternative sources of income provided households with purchasing power to acquire food in times of food shortage. Education on the other hand was essential in provision of opportunities for formal employment and ultimately alternative income sources. A bigger household size on the other hand created more demand for food pushing the household to consume indigenous fruits to cope with food shortage.

According to the study findings, indigenous fruits contributed substantially to household income although trade was mainly orientated at local village markets and a few distant markets like Garissa and Mombasa. In one of the locations, however, income from indigenous fruits was found to be the second major contributor after off-farm income. Dependency on indigenous fruits was less among households with more diversified income sources. The low income earners were found to rely more on income from indigenous fruits; as a result, the gross margins of indigenous fruits were higher among the low income earners and least among the high income earners



More households were found to be involved in the sale of indigenous fruits with baobab fruits being the most highly traded indigenous fruits. Leasing of indigenous fruit trees was also noted, this was another alternative way of generating income from the indigenous fruits. While as many collected indigenous fruits from forests and farms, others decided to lease the fruit trees. Although baobab was the major traded indigenous fruit, most people preferred chocolate berry for consumption with children being the major consumers.

More than half of the sampled households consumed indigenous fruits in order to cope with food shortage. Consumption of indigenous fruits was ranked second after food rationing as being the most frequently used strategy in coping with food shortage. Since the area is dry and experiences frequent food shortage, contribution of indigenous fruits was found to be very significant in assisting households cope with food insecurity. Indigenous fruits were therefore found to be a coping strategy that provides safety or emergency net when food availability is threatened in the households.

## **5.2 Policy recommendations**

At a macro-level, the role and value of indigenous fruits in the livelihoods of communities living in harsh climatic conditions needs to be communicated to planners and decision-makers. Thus, policies and projects need to build upon this diversity of livelihood strategies and the abilities of rural households in dry land areas to utilize indigenous fruits to cope with the looming food shortages.

Consumption of indigenous fruits was found to be a significant contributor to food insecurity coping strategies, management of the indigenous fruits in order to produce more fruits need to be encouraged among the communities in the study area.

The gross margins from indigenous fruits were higher among the low income earners, since the low income earners are the majority in the study area, policies that will encourage domestication of indigenous fruits trees in order to increase production need to be put in place. Most fruits are collected from the naturally occurring trees, with the threat of land clearance for agriculture and human settlement; these trees could face extinction if not domesticated.

The government and other stakeholders need to increase the market reach of the traders. They need to identify that trade in indigenous fruits generates economic implications not only to individual traders but to the country's economy. There is need therefore to link fruit sellers with both regional and international markets.

### **5.3 Suggestion for further research**

There is need to include other Non-Timber Forest Products in the subsequent researches like tubers, fuel wood, leaves, stems and other products . These researches can capture the contribution both in cash and-in-kind. This will give a clear picture of the magnitude that indigenous fruit trees have on livelihoods of rural households.

Economic valuation of the non-marketed fruits can also be done in further research especially those fruits that are consumed by the gatherers themselves and other household members. This will help give the true income of the gatherers, and estimate the amount of extra cash that they would need if they could no longer collect the fruits. It will also give the extra amount of cash that household will require to acquire food if they were not consuming indigenous fruits.



## REFERENCES

- Adepoju, A. A., Salau, A. S., (2007). Economic valuation of non-timber Forest products (NTFPs). *MPRA Paper*, 2689.
- Adhikari, B., Di Falco, S., Lovett, J.C., (2004). Household characteristics and forest dependency: evidence from common property forest management in Nepal. *Ecological Economics* 48, 245–257.
- Akinnifesi F.K., Kwesiga F., Mhango, J., Chilanga T., Mkonda A., Kadu C.A.C., Kadzere I., Mithofer D., Saka J.D.K., Sileshi, G., Ramadhani T., Dhliwayo P., (2006). Towards the development of Miombo fruit trees as commercial tree crops in southern Africa. *Forests, Trees and Livelihoods* 16: 103–112.
- Akinnifesi, F.K., Sileshi G., Ajayi, O.C., Chirwa, P.W., Kwesiga, F., Harawa, R., (2008). Contributions of agroforestry research and development to livelihood of smallholder farmers in Southern Africa: *Agricultural Journal*, 3(1): 76-88.
- Ambrose-Oji, B., (2003). The contribution of NTFPs to the livelihoods of the ‘forest poor’: evidence from the tropical forest zone of south-west Cameroon. *International Forestry Review* 5, 106–117.
- Angelsen, A., Kaimowitz, D., (1999). Rethinking the causes of deforestation: lessons from economic models. *The World Bank Research Observer* 14, 73–98.
- Angelsen, A., Wunder, S., (2003). Exploring the forest-poverty link: key concepts, issues and research implications. CIFOR Occasional Paper No. 40. Centre for International Forestry Research (CIFOR), Bogor, Indonesia.
- Ayisso, C. A., Sinsin, B., Gbidi, A. A., Dossou, G., Damme, P., (2009). Sustainable use of non-timber forest products: Impact of fruit harvesting on *Pentadesmabutyratea* regeneration and financial analysis of its products trade in Benin Forest. *Ecology and Management* 257, 1930–1938.
- Belcher, B., Ruiz-Perez, M., Achdiawan, R., (2005). Global patterns and trends in the use and management of commercial NTFPs: implications for livelihoods and conservation. *World Development* 33, 1435–1452.
- Caviglia, J.L., Sills, E.O., (2005). Land use and income diversification: comparing traditional and colonist populations in the Brazilian Amazon. *Agricultural Economics* 32, 221–237.

- Cocks, M.L., Bangay, L., Shackleton, C.M., Wiersum, K.F., (2008). Rich man–poor man: inter-household and community factors influencing the use of wild plant resources amongst households in South Africa. *Int'l Journal Sustainable Dev. World Ecology* 15, 1–13.
- Delang, O.C., (2006). The economic rationale for the consumption of wild food plants by subsistence farmers. *Journal of Ecological Economics* 59, 64–73.
- Dovie, D.B.K., (2003). Rural economy and livelihoods from the non-timber forest products trade. Compromising sustainability in southern Africa? *International Journal of Sustainable Development and World Ecology* 10, 247–262.
- Ezebilo, E. E., Mattsson, L., (2010). Contribution of non-timber forest products to livelihoods of communities in southeast Nigeria. *International Journal of Sustainable Development & World Ecology* 17: 3, 231 – 235.
- FAO, (1985). Farm management glossary. *Agricultural Services Bulletin*, FAO, Rome, 221 pp.
- FAO, (1992). Report of the International Expert Consultation on Non-Wood Forest Products. Non-Wood Forest Products. FAO, Rome - Italy. [www.fao.org](http://www.fao.org). Accessed on 8<sup>th</sup> September, 2010.
- FAO, (1996). *Rome Declaration on World Food Security*. [www.fao.org/docrep](http://www.fao.org/docrep). Accessed on 25<sup>th</sup> July, 2010.
- FAO, (2004). Forestry Outlook Study for Africa: Sub-regional Report — Southern Africa. [www.fao.org](http://www.fao.org). Accessed on 12<sup>th</sup> August, 2010.
- FEWSNET, (2010). *Status of food insecurity in Kenya*. <http://www.fews.net>. Accessed on 5<sup>th</sup> March, 2010.
- Fisher, M., (2004). Household welfare and forest dependence in Southern Malawi. *Journal of Environment and Development Economics* 9, 135–154.
- Frankenberger, R., Maxwell, T., (2002). Household Food Security: Concepts, Indicators, Measurements: A Technical Review. New York and Rome: UNICEF and IFAD.
- Godoy, R., O'Neill, K., Groff, S., Kostishack, P., Cubas, A., Demmer, J., McSweeney, K., verman, J., Wilkie, D., Brokaw, N., Martinez, M., (1997). Household determinants of deforestation by Amerindians in Honduras. *World Development* 25, 977–987.
- GoK, (2008). *Mwingi District Development Plan*, 2002–2008.
- GoK, (2007). *Economic Review of Agriculture*. [www.foodsecurityportal.org/kenya](http://www.foodsecurityportal.org/kenya). Accessed on 5<sup>th</sup> March, 2010.
- GoK, (2008). *Welfare Monitoring Survey*. [www.humanityunitedagainstopoverty.org/kenya](http://www.humanityunitedagainstopoverty.org/kenya). Accessed on 17<sup>th</sup>, April 2010.



- Greene, W.H., (2000). *Econometric Analysis*, 4th edition. Macmillan Publishers, New York. 1004 pp.
- Gunatilake, H., (1998). The role of rural development in protecting tropical rainforests: evidence from Sri Lanka. *Journal of Environmental Management* 53, 273– 292.
- Hegde, Ravi, Suryaprakash, S., Achoth, Lalith., Bawa, K. S., (1996). Contribution to Rural Income in 'Extraction of Non-Timber Forest Products in the Forests of Biligiri Rangan Hills, India'. *Economic Botany* 50 (3):243-252.
- Kajembe G.C., Mwenduwa M.I., Mgoo J.S., Ramadhani H. (2000). Potentials of Non Wood Forest Products in Household Food Security in Tanzania: The Role of Gender based Local Knowledge, occasional paper series No. 8, CASS/PLAAS.
- Kalaba, F., Chirwa, W., Prozesky, H., (2009). Contribution of indigenous fruit trees in livelihoods and conservation of natural resources. *Journal of horticulture and forestry*, vol. 1(1) pp 001- 006.
- Kepe, T., (2002). Grassland vegetation and rural livelihoods: a case study of resource value and social dynamics on the wild coast, South Africa. Ph.D. thesis, University of the Western Cape, Cape Town.
- KNBS, (2002). *Poverty statistics in Kenya*. [www.ruralpovertyportal.org/Kenya](http://www.ruralpovertyportal.org/Kenya). Accessed on 23rd February, 2011.
- Leakey, R., (2005). Domestication potential of Marula (*Sclerocarya birrea* sub species Caffra) in South Africa and Namibia: multiple trait selection. *Agro forestry System* 64, pg 51– 59.
- Lingani, P. C., Tigabu M., Savadogo, P., Oden, C., Ouadba, J. M., (2009). Determinants of access to forest products in southern Burkina Faso. *Forest Policy and Economics* 11, 516–524.
- Maghembe JA, Simons AJ, Kwesiga F, Rarieya M (1998). Selecting indigenous fruit trees for domestication in southern Africa: Priority setting with farmers in Malawi, Tanzania, Zambia and Zimbabwe. International Centre for Research in Agroforestry, Nairobi, Kenya.
- Mamo, G., Sjaastad, E., Vedeld, P., (2007). Economic dependence on forest resources: a case from Dendi District, Ethiopia. *Forest Policy and Economics* 9, 916–927.
- Maundu, P.M., Ngugi, G.W., Kabuye, C.H.S., (1999). *Traditional Food Plants of Kenya*. National Museums of Kenya, English Press Ltd. Nairobi, Kenya. 270 pp

- Mbabu, P., Wekesa L., (2004). Review and appraisal on the status of indigenous fruits in Eastern Africa. A report prepared for IPGRI-SAFORGEN in the Framework of AFREA/FORNESSA. Kenya Forestry Research Institute, Nairobi, Kenya, pp. 35–58.
- McFadden, D. (1981). *Econometric models of probabilistic choice*. In C.F. Manski and D.McFadden (eds.), *Structural Analysis of Discrete Data with Econometric Application*. Cambridge, Massachusetts: MIT Press. Pp. 198-272
- McSweeney, K., (2005). Natural insurance, forest access and compounded misfortune: forest resources in smallholder coping strategies before and after hurricane Mitch, northeastern Honduras. *World Development* 33, 1453–1471.
- Mithöfer, D., (2005). Economics of indigenous fruit tree crops in Zimbabwe. PhD thesis, Department of Economics and Business Administration, University of Hannover, Germany.
- Mithöfer, D., Saka J.D.K., Sileshi G, Ramadhani T, Dhliwayo P., (2003). Towards the development of Miombo fruit trees as commercial tree crops in southern Africa. *Forests, Trees and Livelihoods* 16, 103-121
- Muok, B.O., Owuor, B., Dawson, I., Were, J., (2001). The potential of indigenous fruit trees; result of a study in Kitui District, Kenya. *Agroforestry today* 12, 13-15
- Narendran, K., Murthy, I.K., Suresh, H.S., Dattaraja, H.S., Ravindranath, N.H., Sukumar, R., (2001). Non-timber forest products extraction, utilization and valuation: a case study from the Nilgiri biosphere reserve, Southern India. *Economic Botany* 55 (4), 528–538.
- Ndoye, O., Tieguhong, J.C., (2006). Forest resources and rural livelihoods: the conflict between timber and non-timber forest products in the Congo Basin. *Scandinavian Journal of Forest Research* 19, 36–44
- Neumann, E.P., Hirsch, E., (2000). *Commercialization of Non-Timber Forest Products: Review and Analysis of Research*. Centre for International Forestry Research CIFOR. Bogor, Indonesia, 176 pp.
- Ondachi, P., (2001). Nutritional composition of some indigenous fruits in drylands. In *Proceedings of the Regional Social Forestry Extension Seminar for Semi-arid and Arid areas*.
- Paoli, G.D., Peart, D.R., Leighton, M., Samsuodin, I., (2001). An ecological and economic assessment of the non-timber forest product Gaharu wood in Gunung Palung National Park, West Kalimantan, Indonesia. *Conservation Biology* 15, 1721–1732.



- Pethiya B. P., Surayya T., (2003). Assessing the impact of microfinance as a tool for adoption of appropriate technology and conserving the environment. Bhopal: India Institute of Forest Management.
- Poulton C. and Poole N. (2001). Poverty and fruit tree research. FRP Issues and options paper No. 6.
- Price, C. (2000). Valuation of unpriced products: contingent valuation, cost benefit analysis and participatory democracy. *Land Use Policy* 17, 187-196.
- Ramadhani, T., (2002). Marketing of indigenous fruits in Zimbabwe. Socioeconomic Studies on Rural Development, Vol 129. University of Hanover:
- Sattout, E.J., Talhouk, S.N., Caligaria, P.D., (2007). Economic value of cedar relics in Lebanon: An application of contingent valuation method for conservation. *Ecological Economics* 61, 315-322.
- Seid F. F., (2007). Food Insecurity and its Determinants in Rural Households in Amhara Region. Unpublished master thesis, Addis Ababa University
- Senaratne, A., Abeygunawardena, P., Jayatilake, W., (2003). Changing role of non-timber forest products (NTFP) in rural household economy: the case of Sinharaja world heritage site in Sri Lanka. *Environmental Management* 32(5), 559-571.
- Shackleton, C.M., Shackleton, S.E., (2006). Household wealth status and natural resource use in the Kat River valley, South Africa. *Journal of Ecological Economics* 57, 306-317.
- Shackleton, C.M., Shackleton, S.E., Ntshudu, M., Ntzebeza, J., (2002). The role and value of savanna non-timber forest products to rural households in the Kat River Valley, South Africa. *Journal of Tropical Forest Products* 8, 45-65.
- Simitu P., Jamnadass R., Kindt R, Kungu J., Kimiywe J., (2008). Consumption of Dryland Indigenous Fruits to Improve Livelihoods. The Case of Mwingi District, Kenya. A report prepared by ICRAF, Nairobi, Kenya.
- Teklehaimanot, Z., (2005). Exploiting the potential of indigenous agroforestry trees: *Parkia biglobosa* and *Vitellaria paradoxa* in sub-Saharan Africa. *Journal of Agroforestry System* 61, 207-220.
- Tietenberg, T., (1996). *Environmental and Natural Resource Economics*. Harper Collins College Publishers. New York, USA, 614 pp.
- Tiisekwa, B.P., Ndabikunze, B.K., Samson G., Juma, M., (2004). Suitability of some indigenous tree fruits for manufacturing juices and jams in Tanzania. *World Agroforestry centre (ICRAF)*, Nairobi, Kenya, pp. 331-335.
- USAID, (2005). *Food Security Report*. [www.usaid.gov](http://www.usaid.gov). Accessed on 5<sup>th</sup> March, 2010.

USAID, (2010). *Poverty prevalence in Sub Sahara Africa*. [www.worldhunger.org](http://www.worldhunger.org). Accessed on 5<sup>th</sup> March, 2010.

Wunder S. (2002). Poverty alleviation and tropical forest – what scope for synergies. *World Development* 29, 1817–1833.



## APPENDICES

### Appendix 1: Photographs of indigenous fruits



*Vitex paysonii* (Chocolate berry/ Black plum)



*Tamarindus indica* (tamarind)



***Adansoniadigitata* (Baobab) tree and fruits**

*Source:* Simituet *al.*, (2008)



## Appendix 2: Gross margins

| crop enterprise | livestock enterprise | indigenous fruits |
|-----------------|----------------------|-------------------|
| 28600           | 44340                | 5400              |
| 17150           | 15900                | 2800              |
| 38750           | 15650                | 4950              |
| 38500           | 42250                | 700               |
| 19000           | 0                    | 16800             |
| 14250           | 0                    | 5800              |
| 21500           | 12000                | 12800             |
| 17750           | 0                    | 4400              |
| 0               | 118000               | 0                 |
| 0               | 20000                | 4000              |
| 0               | 0                    | 4800              |
| 900             | 0                    | 17100             |
| 40600           | 0                    | 0                 |
| 39250           | 0                    | 5100              |
| 42500           | 235500               | 0                 |
| 0               | 0                    | 0                 |
| 0               | 0                    | 0                 |
| 8000            | 0                    | 3000              |
| 0               | 97000                | 0                 |
| 4800            | 0                    | 5700              |
| 0               | 14960                | 5100              |
| 46000           | 20000                | 0                 |
| 0               | 0                    | 0                 |
| 0               | 54000                | 0                 |
| 0               | 0                    | 0                 |
| 91500           | 0                    | 0                 |
| 54000           | 12500                | 0                 |
| 34500           | 24000                | 0                 |
| 31750           | 13756                | 40000             |
| 13000           | 0                    | 35200             |
| 3000            | 0                    | 8000              |
| 0               | 0                    | 0                 |
| 3000            | 9800                 | 0                 |
| 3800            | 21000                | 24000             |
| 0               | 0                    | 0                 |
| 1800            | 7500                 | 4000              |
| 0               | 0                    | 22000             |
| 7800            | 0                    | 38000             |
| 15750           | 0                    | 5800              |
| 0               | 0                    | 0                 |
| 16000           | 0                    | 1200              |
| 0               | 0                    | 0                 |
| 5200            | 19800                | 600               |
| 0               | 0                    | 18000             |

| Crops enterprise | Livestock enterprise | Indigenous fruits |
|------------------|----------------------|-------------------|
| 61750            | 1600                 | 28000             |
| 750              | 0                    | 7000              |
| 0                | 0                    | 38900             |
| 0                | 0                    | 0                 |
| 380              | 1200                 | 46000             |
| 0                | 0                    | 58900             |
| 9000             | 0                    | 21000             |
| 6500             | 0                    | 710000            |
| 0                | 0                    | 45870             |
| 32670            | 0                    | 0                 |
| 88000            | 116000               | 38900             |
| 43560            | 0                    | 49800             |
| 0                | 0                    | 16500             |
| 0                | 75800                | 0                 |
| 50150            | 2190                 | 55800             |
| 70550            | 5660                 | 7900              |
| 20000            | 14940                | 25500             |
| 0                | 9000                 | 0                 |
| 17950            | 123000               | 0                 |
| 2800             | 6000                 | 2720              |
| 10600            | 80250                | 600               |
| 2800             | 16900                | 1800              |
| 6000             | 13500                | 1600              |
| 12000            | 10500                | 9000              |
| 8700             | 65700                | 1800              |
| 6000             | 4000                 | 2240              |
| 6000             | 15500                | 3120              |
| 2800             | 250                  | 1600              |
| 11550            | 39700                | 0                 |
| 13600            | 16500                | 2800              |
| 2000             | 14870                | 4200              |
| 16500            | 105400               | 5550              |
| 6150             | 83700                | 0                 |
| 1600             | 12200                | 2120              |
| 1600             | 23570                | 7000              |
| 4800             | 9600                 | 1000              |
| 4200             | 11500                | 3600              |
| 24000            | 11840                | 11700             |
| 4800             | 5500                 | 10000             |
| 4800             | 89000                | 2000              |
| 23800            | 52000                | 0                 |
| 1900             | 20320                | 640               |
| 7740             | 147400               | 0                 |



| Crops enterprise | Livestock enterprise | Indigenous fruits |
|------------------|----------------------|-------------------|
| 3850             | 38316                | 0                 |
| 0                | 71600                | 3400              |
| 6400             | 7900                 | 41000             |
| 20000            | 0                    | 5000              |
| 6200             | 17600                | 0                 |
| 7000             | 0                    | 7000              |
| 3000             | 24000                | 0                 |
| 11000            | 36650                | 6400              |
| 7800             | 11100                | 10000             |
| 0                | 0                    | 15000             |
| 0                | 54950                | 0                 |
| 0                | 0                    | 0                 |
| 0                | 44500                | 4500              |
| 0                | 0                    | 3000              |
| 1150             | 0                    | 1950              |
| 700              | 4900                 | 5000              |
| 7950             | 0                    | 2500              |
| 4000             | 28000                | 10000             |
| 6320             | 3200                 | 5390              |
| 21000            | 2100                 | 10580             |
| 22000            | 45900                | 8600              |
| 8000             | 0                    | 10800             |
| 23000            | 98000                | 0                 |
| 3500             | 28200                | 32000             |
| 0                | 0                    | 0                 |
| 66420            | 9900                 | 4570              |
| 9000             | 42700                | 0                 |
| 0                | 93000                | 0                 |
| 8800             | 15700                | 5300              |
| 0                | 0                    | 0                 |
| 17240            | 9400                 | 45000             |
| 20400            | 18800                | 3790              |
| 15750            | 0                    | 0                 |

### Appendix 3: Correlation matrix

|            | Constant | GENDER | AGE   | MARSTAT | EDUC  | HHSIZE | EMPLOYMENT | INCOME |
|------------|----------|--------|-------|---------|-------|--------|------------|--------|
| Constant   | 1.000    | -.282  | -.632 | -.175   | -.674 | -.077  | -.055      | -.262  |
| GENDER     | -.282    | 1.000  | -.027 | -.559   | .144  | .137   | .034       | -.079  |
| AGE        | -.632    | -.027  | 1.000 | -.083   | .449  | -.265  | -.148      | .135   |
| MARSTAT    | -.175    | -.559  | -.083 | 1.000   | -.090 | .054   | -.045      | -.010  |
| EDUC       | -.674    | .144   | .449  | -.090   | 1.000 | -.250  | -.007      | .168   |
| HHSIZE     | -.077    | .137   | -.265 | .054    | -.250 | 1.000  | .023       | -.207  |
| EMPLOYMENT | -.055    | .034   | -.148 | -.045   | -.007 | .023   | 1.000      | -.168  |
| INCOME     | -.262    | -.079  | .135  | -.010   | .168  | -.207  | -.168      | 1.000  |



**Appendix 4: Questionnaire**

Questionnaire No. ....

This study is being carried out by a student pursuing a Master of Science degree from Egerton University. The questionnaire is aimed at gathering information on the utilization of indigenous fruits and how it impacts on the household welfare: food security and incomes. I, therefore kindly request you to feel free to answer the questions asked because the information will strictly be used for academic purposes and the necessary confidentiality will be maintained.

**1. BACKGROUND INFORMATION**

Date.....

Name of Interviewer.....

Name of location .....

Name of village.....

Name of respondent (Optional) .....

**2. SOCIOECONOMIC CHARACTERISTICS**

a) Sex of the household head      ☐ Male                      ☐ Female

b) Age (years) of household head

☐ Below 20      ☐ 20-30      ☐ 30-40      ☐ 40-50      ☐ 50-60      ☐ above 60

c) What is the marital status of the household head?

☐ Single      ☐ Married      ☐ widowed      ☐ Divorced

d) Number of years of the household head in formal education?

☐ No formal education      ☐ 1-4      ☐ 5-8      ☐ 9-12      ☐ above 13

e) Indicate the number of people in the household who fall in the following age brackets

| Age bracket    | No. of people |
|----------------|---------------|
| Below 10 years |               |
| 10-20 years    |               |
| 21-30 years    |               |
| 31-40 years    |               |
| 41-50 years    |               |
| 51-60 years    |               |
| Above 60 years |               |

f) What is your employment status? (Mark as appropriate)

|                   |  |
|-------------------|--|
| Full time farmer  |  |
| Formally employed |  |
| Pensioner         |  |
| Unemployed        |  |
| Others (Specify)  |  |

g) Status of the family income in Kshs. Per month

☐ Low income earners (1,000-5,000)    ☐ Medium income earners (5,000-15,000)  
☐ High income earners (above 15,000)

h) What is the form of land tenure?

☐ Ownership                      lease ☐                      communal ☐

i) If the form of land tenure is leasing for how many months did you lease from December 2009 to December 2010 and how much did you pay as rent per month??

.....

## 2) UTILISATION OF INDIGENOUS FRUITS

a) Do you utilize indigenous fruits?

☐ Yes                                      ☐ No

b) For what purpose do you utilize the following indigenous fruits?

- Baobab (*chamba*) consumption ☐                      Sale ☐                      others ☐ (specify)
- Tamarind (*nzumula*) ☐ consumption                      ☐ Sale                      ☐ others (specify)
- Chocolate berry (*muu*) ☐ consumption                      ☐ Sale                      ☐ others (specify)

c) Rank the following indigenous fruits in order of preference of consumption

☐ Baobab (*wamba*)                      ☐ Chocolate berry (*muu*)                      ☐ Tamarind (*nzumula*)  
☐ Others (specify) .....

.....

f) Who mainly consumes the indigenous fruits?

☐ Children (below 12 years)    ☐ teenagers (13-19 years)    ☐ youths (20-30 years)  
☐ Middle age (35-50 years)    ☐ older people (above 50 years)

g) Where do you get the indigenous fruits for consumption? (Tick where applicable)

Purchasing from the market ☐  
Collecting from the farm ☐

- Collecting from the forest ☐
- Borrowing from neighbors ☐
- Others (specify) ☐ .....
- .....

### 3) COPING WITH FOOD SHORTAGES

a) What are the reasons for consuming the indigenous fruits? Rank them in order of importance

- Affordability ☐
- Availability ☐
- Food shortage ☐
- Taste ☐
- Taboos ☐
- Nutrition ☐
- Others (specify) ☐

b) Which months do you mainly consume the following indigenous fruits?

| Name of the fruits | Months |
|--------------------|--------|
| Baobab             |        |
| Tamarind           |        |
| Chocolate berry    |        |

c) For what uses do you consume the indigenous fruits for? Rank them according to importance

- ☐ As food supplement
- ☐ As a snack
- ☐ For medicinal purposes
- ☐ As a food additive
- ☐ Others (specify)

d) Which periods of the year do you experience severe food shortage?

- ☐ January-April ☐ May- August ☐ September - December

e) During the above mentioned period how do you cope with the food shortage?

- Skipping meals ☐ Always ☐ Frequently ☐ Occasionally ☐ Rarely ☐ Never
- Eating wild animals ☐ Always ☐ Frequently ☐ Occasionally ☐ Rarely ☐ Never



Eating indigenous fruits ☐ always ☐ frequently ☐ occasionally ☐ rarely ☐ never

Borrowing food ☐ always ☐ frequently ☐ occasionally ☐ rarely ☐ never

Relying on food aid ☐ always ☐ frequently ☐ occasionally ☐ rarely ☐ never

Food rationing ☐ always ☐ frequently ☐ occasionally ☐ rarely ☐ never

Food for work always ☐ frequently ☐ occasionally ☐ rarely ☐ never ☐

Others (specify)

..... always ☐ frequently ☐ occasionally ☐ rarely ☐ never ☐

..... always ☐ frequently ☐ occasionally ☐ rarely ☐ never ☐

### 3. MARKETING

a) Where do you sell the following indigenous fruits?

Baobab (*chamba*) ☐ Local market ☐ nearest urban market ☐ distant urban market

Tamarind (*nzumula*) ☐ Local market ☐ nearest urban market ☐ distant urban market

Chocolate B. (*muu*) ☐ Local market ☐ nearest urban market ☐ distant urban market

b) What are the problems relating to indigenous fruits marketing?

☐ Unstable prices ☐ poor sales (demand, seasonality) ☐ lack of market

☐ Poor infrastructure ☐ others (specify)

c) How do you sell the fruits?

i. Baobab (*chamba*) ☐ Processed ☐ unprocessed

ii. Tamarind (*nzumula*) ☐ Processed ☐ unprocessed

iii. Chocolate berry (*muu*) ☐ Processed ☐ unprocessed

d) Who mainly sells the fruits?

☐ Husband ☐ wife ☐ hired labor ☐ children ☐ others (specify)

e) What is the distance to the market in Kms?

f) What is the distance to the forest?

#### 4. HOUSEHOLD INCOME SOURCES

a) What are the sources of income for the family?

- Sale of crops ☐
- Sale of honey ☐
- Sale of indigenous fruits ☐
- Pensions and remittances ☐
- Employment income ☐

#### Crop enterprises

| REVENUE |        |            | COSTS |            |            |              |                 |             |
|---------|--------|------------|-------|------------|------------|--------------|-----------------|-------------|
| Name    | Output | Price/unit | Seeds | fertilizer | pesticides | Hired labour | Transport costs | Other Costs |
|         |        |            |       |            |            |              |                 |             |
|         |        |            |       |            |            |              |                 |             |
|         |        |            |       |            |            |              |                 |             |
|         |        |            |       |            |            |              |                 |             |
|         |        |            |       |            |            |              |                 |             |

#### d) Livestock enterprise

| REVENUE |          |             | COSTS          |       |                 |              |               |             |
|---------|----------|-------------|----------------|-------|-----------------|--------------|---------------|-------------|
| Name    | Qty sold | Price /unit | Purchase price | feeds | Transport costs | Hired labour | Medical costs | Other Costs |
|         |          |             |                |       |                 |              |               |             |
|         |          |             |                |       |                 |              |               |             |
|         |          |             |                |       |                 |              |               |             |
|         |          |             |                |       |                 |              |               |             |

e) What livestock products did you sell between the periods of Dec. 2009 – Nov. 2010?

- ☐ Eggs      ☐ Hides and skin      ☐ Milk      ☐ Honey      ☐ Others (specify)

f) Indicate the quantity sold and the price for each product in (e)

| Name of the livestock product | Quantity sold | Price/ unit |
|-------------------------------|---------------|-------------|
|                               |               |             |
|                               |               |             |
|                               |               |             |
|                               |               |             |

g) Did you incur any costs when selling the above products?

☐ Yes

☐ No

h) Please indicate the costs incurred and their amounts

| Costs | Amount |
|-------|--------|
|       |        |
|       |        |
|       |        |

#### i) Indigenous Fruits

| Name                           | Quantity<br>(kgs) | Price/<br>unit | Seeds | Hired<br>Labour | Transport<br>costs | Other<br>costs |
|--------------------------------|-------------------|----------------|-------|-----------------|--------------------|----------------|
| Baobab ( <i>chamba</i> )       |                   |                |       |                 |                    |                |
| Tamarind ( <i>nzumala</i> )    |                   |                |       |                 |                    |                |
| Chocolate berry ( <i>muu</i> ) |                   |                |       |                 |                    |                |

#### j) Off farm income

a) Did you receive any transfer amount from relatives?

☐ Yes

☐ No

b) If yes, indicate the amount received from December 2009 to November 2010

.....

c) Did you run any business as from December 2009-November 2010?

☐ Yes

☐ No

d) If yes, how much did you earn? .....

e) Did you receive any amount as rent as from December 2009-November 2010?

☐ Yes

☐ No

f) If yes, how much? .....



g) Did you receive any salary or wages apart from the farm income from December 2009-  
November 2010?

☐ Yes

☐ No

h) If yes, how much? .....

i) Indicate any other sources of income for the family and the amount

**Source**

**Amount**

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