FARMERS' KNOWLEDGE, ATTITUDE AND PRACTICE TOWARDS AFRICAN INDIGENOUS VEGETABLES IN KENYA

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Farmers' Knowledge, Attitude and Practice towards African Indigenous Vegetables in Kenya

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DECLARATION

This thesis is my original work and to my knowledge has not been presented for the award of a degree in any other university.

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This thesis has been submitted for examination with our approval as University and ICIPE supervisors.

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DEDICATION

"This Thesis is dedicated to my Late Father and Mother for their Unswerving Support and Encouragement in my Education and for teaching me Virtues of Resilience, Hard Work, Excellence, Humility, Honesty and Integrity at tender age; and to my Beloved Wife and Cherished Children for their Love, Support, Understanding, Patience and Prayers in my Absence during my Study Period".

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LIST OF ABBREVIATIONS AND ACRONYMS

AIVs	African Indigenous Vegetables
ASAL	Arid and Semi-Arid Land
CI	Confidence Interval
DAP	Diammonium Phosphate
FAO	Food and Agriculture Organization of the United Nations
FFS	Farmer Field School
FGDs	Focus Group Discussions
GDP	Gross Domestic Product
GPS	Global Positioning System
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome
ICIPE	International Centre of Insect Physiology and Ecology
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IDAF	Integrated Development of Artisanal Fisheries
JKUAT	Jomo Kenyatta University of Agriculture and Technology
KALRO	Kenya Agriculture and Livestock Research Organization
KAP	Knowledge, Attitude and Practice
M.A.S.L	Meter Above Sea Level
NPK	Nitrogen Phosphorus and Potassium
SD	Standard Deviation
WHO	World Health Organization

ABSTRACT

Food and nutrition insecurity has been a major challenge in Sub-Saharan Africa (SSA). With land frontier closing, farmers in SSA must intensify and diversify food production to alleviate food and nutrition insecurity. In the face of climate change, African Indigenous Vegetables (AIVs) can offer opportunities to diversify production systems and improve food, nutrition and income security in many countries of SSA. Despite their potential, the importance of AIVs in alleviating food, nutrition and economic insecurity are not fully exploited in Kenya. Further until recently there is less research and development efforts and limited information on farmers' knowledge, attitude and perceptions about AIVs. The objective of this study was to assess the knowledge, attitude and practice among AIVs farmers in three counties (Busia, Nyamira and Machakos) of Kenya and analyzed the critical factors influencing KAP. The study was carried out on 600 farm households. The formula by Cochran was used to estimate the sample size. A multi-stage sampling procedure was used to select counties, villages and smallholder AIVs growers. Counties were selected purposively based on their different agro-ecological characteristics. These counties are; Nyamira (the Agro-Alpine Zone), Busia (the Medium Potential zone) and Machakos (the Semi-Arid zone). Villages were randomly selected from these three counties. Lists of AIVs farmers were prepared with assistance of village leaders and farmers randomly selected for interview. Farmers were interviewed on their farms. Knowledge and attitude were assessed on a 3 and 5 point Likert scale, respectively while closed and open-ended questions were used to evaluate the practice. Data analysis was performed using the statistical package STATA version 12. Data were analysed using descriptive statistics and multinomial logit (MNL) regression. The study revealed that the respondents know the value and benefits of African Indigenous Vegetables but this knowledge still needs to be improved so as to impact on best farming practices. Besides, their attitude towards AIVs is positive. Despite the good knowledge and positive attitude, majority of farmers are using traditional method of farming. There is a need to ensuring access to technologies and providing information and training in order to change current indigenous vegetable production methods. The MNL regression analysis showed that as expected, most socio-demographic variables and farm characteristics like gender, education, profession, years of experience in farming, land tenure and total land owned by farmers had significant positive effect on farmers' KAP. These findings should be considered during research development and promotion of AIVs.

CHAPTER ONE
1.0 INTRODUCTION

1.1 Background information

Food and nutrition insecurity has been a major challenge in Sub-Saharan Africa (SSA) (Fanzo, 2012). With land frontier closing, farmers in SSA must intensify and diversify food production to alleviate food and nutrition insecurity. In the face of climate change, African Indigenous Vegetables (AIVs) can offer opportunities to diversify production systems and improve food, nutrition and income security in many countries of SSA (Agriculture for impact 2013). AIVs have been part of the food systems in SSA for generations (Muhanji *et al*., 2011). AIVs are known for their importance in providing nutritious food, both in rural and urban areas (Ngugi *et al*., 2007).

Also, it is widely accepted that AIVs are important resources to overcome the nutritional gaps and to support rural and urban livelihoods of populations in SSA (Chweya & Eyzaguirre, 1999). They play a highly significant role in the food security of the underprivileged in both urban and rural settings (Schippers, 1997). Despite their potential, the importance of AIVs in alleviating food, nutrition and economic insecurity are not fully exploited in Kenya (Abukutsa-Onyango, 2007). Further until recently there is less research and development efforts and limited information on farmers' knowledge, attitude and perceptions about AIVs.

1.2 Statement of the Problem

In her research, Abukutsa-Onyango (2014) states that "Of the people living in sub-Saharan Africa, 30% are obese, and this pandemic is increasing at 40% every 10 years". Some 44% of the diabetes burden, 23% of the heart disease burden and 41% of the cancer burden are attributed to obesity. If obesity is not controlled, obesity-related cardiovascular complications will be the leading cause of death in sub-Saharan Africa by the year 2020 (Dalal *et al*., 2011; Staggers-Hakim, 2012). Research shows that physical activity has many proven benefits, but may not be key to curbing the obesity epidemic. Key causes of obesity have been reported to be the consumption of foods rich in fats and extracted sugars coupled with consuming inadequate amounts of vegetables and fruits (Dalal *et al*., 2011).

For instance, the recommended consumption of vegetables and fruits by World Health Organization (WHO) is 73 kg/person/year (FAO/WHO, 2004). In Africa, the average regional vegetable and fruit consumption is estimated to be about 30 kg/person/year, which is less than half the WHO-recommended amount. Vegetables are important components of a healthy diet, and if consumed daily in sufficient amount they could curb major ailments and contribute to household food security.

Sustainable vegetable farming is a relatively high risk, high cost per acre business requiring intensive management (Frank & Roland, 2011). Successful vegetable growers manage capital, and marketing competently. Growers design and implement systems of culture which include crop and variety selection, crop rotation, soil fertilization, land selection, tillage, integrated pest management (insect, disease and weed control), transplant production and/or use, seedbed preparation, seeding, irrigation, windbreak management, pollination (bee management), harvesting, handling and packaging and sales. Vegetable production differs from other crop production enterprises. These crops are perishable in nature, must be free from blemishes, and have narrow market windows. Consequently, cultural operations must be accomplished in a more precise and timely manner to deliver high quality products to markets on schedule (Frank *et al*., 2009).

The use of wild food forms part of the safety net that rural people use to cope with poverty, disaster and livelihood stress. During periods of drought, or when the breadwinner in the household becomes unemployed, affected rural households intensify their collection and consumption of wild food. Social disturbances can also lead to increased use of wild food. In poor rural communities consumption of wild food is particularly important for women and children. Use of wild food is also enhanced by remoteness because households in remote rural areas have limited access to fresh produce markets. Urban households use leafy vegetable collected from the wild less than rural households, because they lack access to sites where these vegetables grow naturally (Jansen *et al*., 2007).

Previous reports indicate that AIVs contain high levels of minerals especially calcium, iron and phosphorus (Chweya & Nameus, 1997). African Leafy Vegetables have been documented to have high nutritive value with high contents of Vitamin A and C, minerals and supplemental proteins; most of such vegetables have been reported to have medicinal properties (Abukutsa-Onyango, 2010). AIVs are well adapted to harsh climatic conditions and disease infestation and

are easier to grow in comparison to their exotic counterparts. AIVs can produce seed under tropical conditions unlike the exotic vegetables. They have a short growth period with most of them being vegetables ready for harvesting within 3-4 weeks, and respond very well to organic fertilizers. Most of them have an in-built ability to withstand and tolerate some biotic and abiotic stresses. They can also flourish under sustainable and environmental friendly cropping conditions like intercropping and use of organics. AIVs have considerable potential as cash income earners, enabling the poorest people in the rural communities to earn a living especially women farmers.

There has been a substantive, long-term underinvestment in research and development of the horticultural sector in Africa with particular reference to AIVs which are naturally high in nutritious vitamins and minerals (Afari-Sefa *et al*., 2012). AIVs have not been fully exploited for food, nutrition and economic security in an endeavour to alleviate poverty in Kenya and the Lake Victoria region (Abukutsa-Onyango, 2007). Both past and present experiences reveal that household food insecurity is a serious recurrent problem for Kenyan smallholders for whom hunger periods and/or nutritional deficiencies are frequent (Figueroa et al., 2009). The nutritional potential of AIVs is relatively unexploited (Chelang'a et al., 2013) and there is a dearth of knowledge as to whether AIVs offer an alternative pathway to addressing poverty for the most vulnerable people in the rural areas of Kenya. Further until recently there is less research and development efforts and limited information on farmers' knowledge, attitude and perceptions about AIVs.

Numerous reports indicate that the popularity of many AIV species is declining across the Sub-Saharan African continent (Vorster et al., 2007; Vuyiswa et al., 2012; Nekesa & Meso, 1997; Smith & Eyzaguirre, 2007). In Kenya, although the area devoted to AIV production and income generated from AIVs has shown an increasing trend, the current status of production of AIVs is low compared to their exotic counterparts.

Table 1.1: Industry Performance by Category, 2011-2013

	2011			**2012**			**2013**			**%**
	Area (Ha)	Quantity (MT)	Value(Ksh)	Area (Ha)	Quantity (MT)	Value(Ksh)	Area (Ha)	Quantity (MT)	Value(Ksh)	**share by value**
Exotic vegetables	219,431	3,218,429	1,111,790,320	216,108	3,221,225	52,134,985,917	252,651	4,202,393	65,992,794,954	37
Fruits	131,467	2,266,861	773,162,198	148,295	2,405,750	40,633,144,688	159,666	2,728,273	48,913,451,055	28
Flowers	3,349	121,891,436	44,506,056,083	5,086	123,510,784	42,872,537,453	6,239	124,858,139	46,333,368,752	26
Nuts	65,177	133,544	5,776,017,714	67,597	152,224	7,349,496,827	81,568	204,338	7,415,729,104	4
MAPs	12,942	80,980	160,686,400	14,882	85,885	303,044,004	17,732	95,307	4,538,970,850	3
Indigenous vegetables	31,354	132,614	2,437,075,543	36,133	168,153	3,538,456,172	85,550	176,736	3,579,241,367	2
Asian vegetables	1,239	13,627	352,338,935	1,397	17,727	1,220,482,162	1,932	18,139	539,287,917	0
Totals	464,959	127,737,491	55,117,127,193	489,498	129,561,748	148,052,147,223	605,338	132,283,325	177,312,843,999	100

Source: Ministry of Agriculture, 2013

About 85,550ha of farm land was allocated to AIVs in 2013 with yield in metric tons of 176,736 MT and the total domestic value amounted to Kenya Shillings (KSH) 3.579 billion (USD 41.4 million) (Central Bank of Kenya, Exchange rates of 31/12/2013). Area allocated to exotic vegetable production in 2013 was 252,651ha with yield in metric tons of 4,202,393MTand the total revenues amounted to Kenya Shillings (KSH) 65.992billion (USD 763.755 million). Of the total value of vegetables, AIVs, exotic vegetables and Asian vegetables account for 5%, 94% and 1% respectively (Alberto 2015).

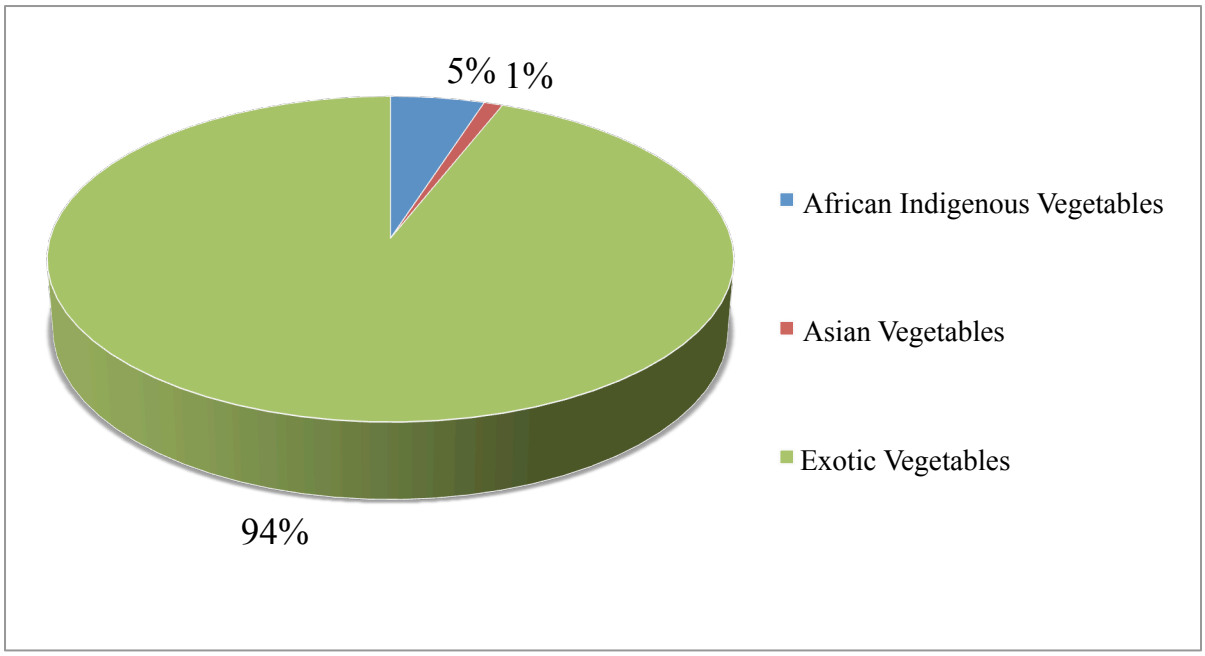

Figure 1.1: Share of African Indigenous Vegetables in horticulture production by value in Kenya (Source: KALRO, 2013)

Understanding the cause of low performance of AIVs in country's horticultural sector and economy is therefore important.

1.3 Objectives of the Study

1.3.1 Overall Objective of the Study

The general objective of this study was to investigate the knowledge, perception or attitude, and practices (KAP) of AIVs growers in Busia, Nyamira and Machakos counties of Kenya.

1.3.2 Specific Objectives

The specific objectives of this study were as follows:

1. To assess the knowledge, attitude and practices of AIVs growers in Busia, Nyamira and Machakos Counties.

2. To analyse factors influencing farmer's knowledge, attitude and practices in AIVs production.

1.4 Justification of the study

Low productivity and performance of AIVs in Kenyan horticultural sector is a threat to food security and nutritional balance and wellbeing in both rural and urban populations. AIVs are recognized as vital dietary components due to their perceived health promoting and protecting attributes and their potential value for increasing income as well. To sustain production, there is need to ensure that smallholder farmers understand AIVs benefits and position in the horticultural value chain. Are smallholder farmers able to maintain their position within the horticultural value chain? To understand these implications, there is need for agricultural researchers to turn their focus to solve the problems facing AIVs farmers and ensure that their findings are making impacts both in the farms and markets. This requires assessing the level of awareness, identification of opportunities and constraints facing AIVs farmers and their influence on production.

The understanding of farmers KAP will guide researchers and policy makers in developing technologies and formulation of policies aimed at improving the performance of AIVs production in order to impact positively on farmers' livelihoods.

1.5 Scope of the study

This research targeted farmers of AIVs in Busia, Nyamira and Machakos counties, Kenya. These three sites fall into three different agro-ecological zones of Kenya ranging from the Agro-Alpine zone (Nyamira), Medium Potential zone (Busia) and Semi-Arid zone (Machakos).

1.6 Limitation of the study

The study faced the limitation of enough funding as per the time of plan when research was to be carried out in rural areas where the road network was poor. Hence, Focus Group Discussions were not organized and research opted for non structured interviews with focal persons in each region.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 KAP

KAP stands for Knowledge, Attitude and Practice. It is used to investigate human behaviour concerning a topic:

- What the respondents know about it (K)
- How the respondents feel about it (A)
- What the respondents do about it (P)

(IDAF, 1994)

According to Wood & Tsu (2008), a KAP survey is a representative study of a specific population to collect information on what is known, believed and done in relation to a particular topic. The KAP survey was developed in the 50's and was originally designed to research family planning in the Third World. These sample surveys were very popular during the fifties and sixties: several hundred KAP studies were carried out in several dozen countries (Bulmer & Warwick, 1998).

In literature three different objectives of KAP studies can be found. The first objective is to assess KAP towards a concept. The second objective is to use it for problem identification and intervention planning. Thirdly KAP studies can be used as an evaluation tool (Vandamme, 2009). KAP surveys can be used as a tool for problem identification and intervention planning.
In a paper by Swanson *et al*. (1994) the Strategic Extension Campaign (SEC) methodology programme is explained. This program states to employ a primary analysis, based on a participatory needs assessment for problem identification of the target audience, for the development of appropriate intervention strategies and tactics to increase agricultural productivity. The SEC programme follows a system approach: it starts with a farmer's Knowledge, Attitude, and Practice (KAP) survey whose results are used as planning inputs and benchmark-baseline. Moreover a KAP survey is generally used to identify and describe critical elements, negative attitudes and reasons for non-adoption of a recommended technology.

2.2 Types and qualities of knowledge

In literature on learning and instruction, knowledge plays a pivotal role and is attributed a wide variety of properties and qualities. Among the examples encountered are generic (or

general) and domain specific knowledge, concrete and abstract knowledge, formal and informal knowledge, declarative and proceduralised knowledge, conceptual and procedural knowledge, elaborated and compiled knowledge, unstructured and (highly) structured knowledge, tacit or inert knowledge, strategic knowledge, knowledge acquisition, situated knowledge, and meta-knowledge (Ton de Jona *et al*., 1996).

2.2.1 Types of knowledge

Frequent attempts have been made to give a systematic description of knowledge. Some attempts have been based on cognitive theories, whereas others have been formulated to serve as a basis for instructional design theory. Still another approach is to characterize knowledge from an epistemological point of view. This implies that elements of knowledge base are characterized by the function they fulfill in the performance of a target task (Ton de Jona *et al*., 1996).

Ton de Jona *et al*. (996) distinguish four types of knowledge:

- **Situational knowledge** is the knowledge about situations as they typically appear in a particular domain. Knowledge of problem situations enables the solver to sift relevant features out of the problem statement (selective perception) and, if necessary, to supplement information in the statement. It may serve to create a representation of the problem from which, if the organization of knowledge is adequate, additional knowledge (conceptual, procedural) can be invoked.
- **Conceptual knowledge** is static knowledge about facts, concepts and principles that apply within a certain domain. Conceptual knowledge functions as additional information that problem solvers add to the problem and that they use to perform the solution.
- **Procedural knowledge** contains actions or manipulations that are valid within a domain. Procedural knowledge helps the problem solver make transitions from one problem state to another. It can have a specific, domain-bound (strong) character, or it can be more general (weak).
- **Strategic knowledge** helps students organize their problem-solving process by directing which stages they should go through to reach a solution. A strategy can be seen as a general plan of action in which a sequence of solution activities is laid down. Elements of knowledge belonging to the first three types are specific, applicable to certain types of

problems in a domain, whereas the last type, strategic knowledge, is applied to wider variety of types of problems within a domain (Ton de Jona *et al*., 1996).

2.2.2 Qualities of knowledge

A large number of concepts are used to describe qualities of knowledge: Generic, abstract, informal, elaborated, and structured, are but a few examples. Some qualities refer to relations between knowledge types, whereas others to types as such (Ton de Jona *et al*., 1996).

2.3 Formation of attitudes

How are attitudes formed? Attitude formation is a result of learning, modeling others, and our direct experiences with people and situations. Attitudes influence our decisions, guide our behavior, and impact what we selectively remember (not always the same as what we hear). Attitudes come in different strengths, and like most things that are learned or influenced through experience, they can be measured and they can be changed (Allport, 1935).

2.3.1 Attitude measurement

Perhaps the most straightforward way of finding out about someone's attitudes would be to ask them. However, attitudes are related to self-image and social acceptance (i.e. attitude functions). In order to preserve a positive self-image, people's responses may be affected by social desirability. They may not well tell about their true attitudes, but answer in a way that they feel socially acceptable. Given this problem, various methods of measuring attitudes have been developed. However, all of them have limitations. In particular the different measures focus on different components of attitudes – cognitive, affective and behavioral – and as we know, these components do not necessarily coincide (http://www.simplypsychology.org/attitude-measurement.html accessed on 18/12/2014). Attitude measurement can be divided into two basic categories:

- **Direct Measurement** (likert scale and semantic differential);
- **Indirect Measurement** (projective techniques).

A. Likert scale

Various kinds of rating scales have been developed to measure attitudes directly (i.e. the person knows their attitude is being studied). The most widely used is the Likert Scale.

Likert (1932) developed the principle of measuring attitudes by asking people to respond to a series of statements about a topic, in terms of the extent to which they agree with them, and so tapping into the cognitive and affective components of attitudes.

Likert-type or frequency scales use fixed choice response formats and are designed to measure attitudes or opinions (Bowling, 1997; Burns & Grove, 1997). These ordinal scales measure levels of agreement/disagreement.

A Likert-type scale assumes that the strength/intensity of experience is linear, i.e. on a continuum from strongly agree to strongly disagree, and makes the assumption that attitudes can be measured. Respondents may be offered a choice of five to seven or even nine pre-coded responses with the neutral point being *neither agree nor disagree*.

In its final form, the Likert Scale is a five (or seven) point scale which is used to allow the individual to express how much they agree or disagree with a particular statement. Each of the five (or seven) responses would have a numerical value which would be used to measure the attitude under investigation (http://www.simplypsychology.org/likert-scale.html accessed on 18/12/2014).

❖ **Data analysis from Likert Scale**

A way to analyze data from Likert Scale:

- ✓ Summarize using a median or a mode (not a mean); the mode is probably the most suitable for easy interpretation.
- ✓ Display the distribution of observations in a bar chart (it can't be a histogram, because the data is not continuous).

Critical Evaluation

Likert Scales have the **advantage** that they do not expect a simple yes / no answer from the respondent, but rather allow for degrees of opinion, and even no opinion at all. Therefore quantitative data is obtained, which means that the data can be analyzed with relative ease.

However, like all surveys, the validity of Likert Scale attitude measurement can be compromised due to **social desirability.** This means that individuals may lie to put themselves in a positive light. For example, if a Likert scale was measuring discrimination, who would admit to being racist? ((http://www.simplypsychology.org/likert-scale.html accessed on 18/12/2014).

Offering **anonymity** on self-administered questionnaires should further reduce social pressure, and thus may likewise reduce social desirability bias. Paulhus (1984) found that more desirable personality characteristics were reported when people were asked to write their names, addresses and telephone numbers on their questionnaire than when they told not to put identifying information on the questionnaire.

B. Semantic differential

The semantic differential technique of Osgood *et al*. (1957) asks a person to rate an issue or topic on a standard set of **bipolar adjectives** (i.e. with opposite meanings), each representing a **seven point scale.** This is a direct method of attitude measurement and produces quantitative data. To prepare a semantic differential scale, you must first think of a number of words with opposite meanings that are applicable to describing the subject of the test.

For example, participants are given a word, for example 'car', and presented with a variety of adjectives to describe it. Respondents tick to indicate how they feel about what is being measured (Osgood *et al*. (1957).

Semantic differential is widely used in advertising and marketing research, from questionnaires to interviews and focus groups. The versatility of uses with the bipolar adjectives and the simplicity of understanding them have made it ideal for consumer questionnaires and interviews (http://www.simplypsychology.pwp.blueyonder.co.uk/ accessed on 18/12/2014).

The semantic differential technique reveals information on three basic dimensions of attitudes: evaluation, potency (i.e. strength) and activity.

- **Evaluation** *is concerned with whether a person thinks positively or negatively about the attitude topic (e.g. dirty – clean, and ugly - beautiful).*
- **Potency** *is concerned with how powerful the topic is for the person (e.g. cruel – kind, and strong - week).*
- **Activity** *is concerned with whether the topic is seen as active or passive (e.g. active – passive).*

Using this information we can see if a person's feeling (evaluation) towards an object is consistent with their behavior. For example, a place might like the taste of chocolate (evaluative) but not eat it often (activity). The evaluation dimension has been most used by social psychologists as a measure of a person's attitude, because this dimension reflects the affective aspect of an attitude.

- **Evaluation of Direct Methods**

An attitude scale is designed to provide a valid, or accurate, measure of an individual's social attitude. However, as anyone who has every "faked" attitude scales knows there are shortcomings in these self report scales of attitudes. There are various problems that affect the validity of attitude scales. However, the most common problem is that of social desirability. Socially desirability refers to the tendency for people to give "socially desirable" to the questionnaire items. People are often motivated to give replies that make them appear "well adjusted", unprejudiced, open minded and democratic. Self report scales that measure attitudes towards race, religion, sex etc. are heavily affected by socially desirability bias.

Respondents who harbor a negative attitude towards a particular group may not wish be admitted to the experimenter (or to themselves) that they have these feelings. Consequently, responses on attitude scales are not always 100% valid (http://www.simplypsychology.org/attitude-measurement.html accessed on 18/12/2014).

C. Projective Techniques/indirect measurement

To avoid the problem of social desirability, various indirect measures of attitudes have been used. Either people are unaware of what is being measured (which has ethical problems) or they are unable consciously to affect what is being measured (http://www.simplypsychology.org/attitude-measurement.html accessed on 18/12/2014).

Indirect methods typically involve the use of a projective test. A **projective test** involves presenting a person with an ambiguous (i.e. unclear) or incomplete stimulus (e.g. picture or words). The stimulus requires interpretation from the person. Therefore, the person's attitude is inferred from their interpretation of the ambiguous or incomplete stimulus.

The assumption about these measures of attitudes is that the person will "project" his or her views, opinions or attitudes into the ambiguous situation, thus revealing the attitudes the person holds. However, indirect methods only provide general information and do not offer a precise measurement of attitude strength since it is qualitative rather than quantitative. This method of attitude measurement is not objective or scientific which is a big criticism (http://www.simplypsychology.org/attitude-measurement.html accessed on 18/12/2014).

- **Evaluation of Indirect Methods**

The major criticism of indirect methods is their lack of objectivity. Such methods are unscientific and do not objectively measure attitudes in the same way as a Likert scale. There is

also the ethical problem of deception as often the person does not know that their attitude is actually being studied when using indirect methods. The advantages of such indirect techniques of attitude measurement are that they are less likely to produce socially desirable responses, the person is unlikely to guess what is being measured and behavior should be natural and reliable (http://www.simplypsychology.org/attitude-measurement.html accessed on 18/12/2014).

2.4 Cultural practices in vegetable farming

Sustainable vegetable farming is a relatively high risk, high cost per acre business requiring intensive management. Successful vegetable growers manage capital, and marketing competently. Growers design and implement systems of culture which include crop and variety selection, crop rotation, soil fertilization, land selection, tillage, integrated pest management (insect, disease and weed control), transplant production and/or use, seedbed preparation, seeding, irrigation, windbreak management, pollination (bee management), harvesting, handling and packaging and sales. Vegetable production differs from other crop production enterprises.

These crops are perishable in nature, must be free from blemishes, and have narrow market windows. Consequently, cultural operations must be accomplished in a more precise and timely manner to deliver high quality products to markets on schedule (Frank *et al*., 2009).

2.5 Consumption practices of AIVs

For most species the young growth points and tender leaves are the plant parts that are used in the preparation of vegetable dishes. Petioles and in some cases young tender stems are also included, but old, hard stems are discarded (Vorster *et al*., 2002).

The leaves and other selected plant parts are prepared as potherbs or as relishes, primarily to accompany maize porridge and sorghum. The leafy vegetable dishes may be prepared from a single species or from a combination of different species. Other ingredients, such as tomatoes, onions, peanut flour and spices may be added to enhance their taste. Cooking methods vary from thorough boiling, which may include the replacement of the first cooking water with fresh water in the case of bitter-tasting species, such as *Solanum retroflexum* (Van Averbeke & Juma, 2006a), to steaming involving the use of very small quantities of water and short cooking times, as in the case of pumpkin leaves and flowers. According to Vorster *et al*. (2005), the recipes used

to prepare the different leafy vegetables tend to be fairly homogeneous within particular cultural groups limiting culinary diversity.

The use of wild food forms part of the safety net that rural people use to cope with poverty, disaster and livelihood stress (Rose & Guillarmod, 1974; Rubaihayo, 1997; Shackleton *et al*., 2000). During periods of drought, or when the breadwinner in the household becomes unemployed, affected rural households intensify their collection and consumption of wild food. Social disturbances can also lead to increased use of wild food (Shackleton *et al*., 1999; Dovie *et al*., 2002; Shackleton, 2003).

In poor rural communities consumption of wild food is particularly important for women and children (Shackleton et al., 2002, Vorster & Jansen, 2005). Use of wild food is also enhanced by remoteness because households in remote rural areas have limited access to fresh produce markets (Jansen & Vorster, 2005; Hart &Vorster, 2006; Dovie et al., 2002; Shackleton, 2003). Urban households use leafy vegetable collected from the wild less than rural households, because they lack access to sites where these vegetables grow naturally.

Despite the growing popularity of AIVs and their potential values for increasing nutrition, food security and income not much research has been conducted to address the issues involving their production, storage and marketing (Alberto L., 2015).

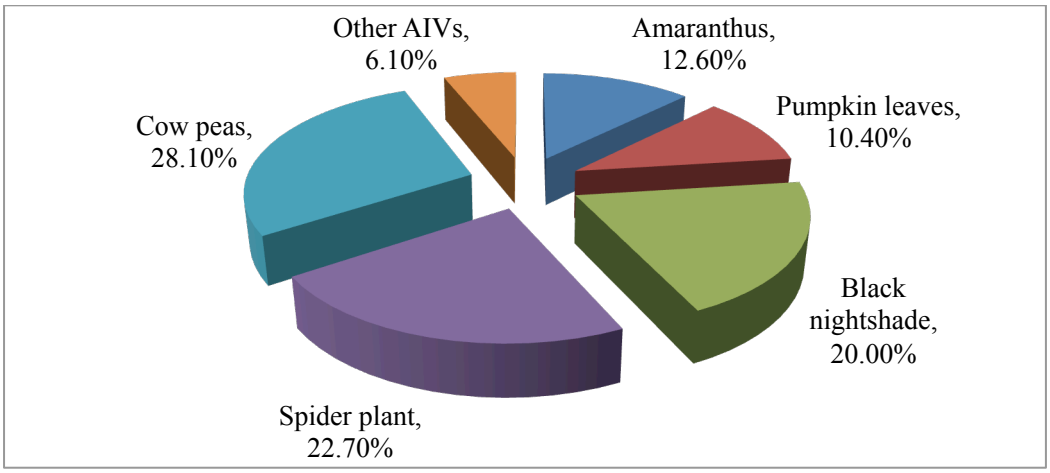

Figure 2.2: Data for top six indigenous vegetables in Kenya (Source: KALRO, 2012)

Supermarkets and grocery shops are also now selling indigenous vegetables, and the former Kenya Agricultural Research Institute (KARI) now renamed the Kenya Agriculture and Livestock Research Organisation (KALRO), and several seed companies are now focusing on developing and selling quality indigenous vegetable seeds (Alberto L., 2015). These initiatives

demonstrate that something is being done to move these crops from neglected, orphaned or underutilised vegetables by developing seed systems that although currently are weak, do exist in certain parts of the country.

2.6 Value, health benefits, agronomic advantages and economic potential of African Indigenous Vegetables

2.6.1 Nutritive value

African Indigenous Vegetables contain high levels of minerals especially calcium, iron and phosphorus. They also contain significant amounts of vitamins and proteins (Mnzava, 1997). In most cases the mineral and vitamin contents is equivalent to or higher than that found in popular exotic vegetables like cabbage. On average 100 g of fresh vegetable contain levels of calcium, iron and vitamins that would provide 100% of the daily requirement and 40% for the proteins (Abukutsa-Onyango, 2003). AIVs have high nutritive value with high contents of Vitamin A and C, minerals and supplemental proteins (Wenga et al., 2003).

2.6.2 Medicinal value and health benefits

AIVs have medicinal properties as they are usually bitter and some have been known to heal stomach-related ailments (Olembo et al., 1995). Most of such vegetables have been reported to have medicinal properties (Kokwaro, 1993; Olembo et al., 1995) for instance spiderplant has been reported to aid constipation and facilitate birth while African nightshades has been reported to cure stomachache. Nonetheless, limited information available on the mode of preparation suggests that the presence of undesirable chemical compounds in these potential crops cannot be overruled (Abukutsa-Onyango, 2010).

2.6.3 Agronomic advantages

AIVs are well adapted to harsh climatic conditions and disease infestation and are easier to grow in comparison to their exotic counterparts (Grubben, 2004). AIVs can produce seed under tropical conditions unlike the exotic vegetables. They have a short growth period with most of them being vegetables ready for harvesting within 3-4 weeks, and respond very well to organic fertilizers. Most of them have an in-built ability to withstand and tolerate some biotic and abiotic

stresses. They can also flourish under sustainable and environmental friendly cropping conditions like intercropping and use of organics. Furthermore, because most of them have not been intensively selected, they have wide genetic bases, which will be important in sourcing for new genotypes and/or genes for adaptation to climate change (Abukutsa-Onyango, 2010).

2.6.4 Income generation and employment opportunities

African Indigenous Vegetables have considerable potential as cash income earners, enabling the poorest people in the rural communities to earn a living (Schippers, 2000). Socio-economic survey on traditional vegetables conducted in various parts of Africa particularly in Central, Western and Eastern Africa (Abukutsa-Onyango, 2002; Schippers 2000) revealed that AIVs are important commodities in household food security. They provide employment opportunities and generate income for the rural population. There appears to be a high demand of AIVs in cities and major towns, making the intensive production in and around the towns and trading of the same important sources of household income for the urban poor and the unemployed (Abukutsa-Onyango, 2002; Schippers, 2000).

2.7 Cropping systems, climate, and soils in Kenya

Farms in Kenya range from small-scale subsistence family operations to large-scale mechanized enterprises with crops and/or livestock. Kenya's total land area is about 587,000 km^2, of which 576,076 km^2 consists of land and 11,230 km^2 is covered by water. Of total land area, 18% has a high to medium agricultural potential. The rest is arid and semi-arid land (ASAL) and, therefore, of low agricultural potential (Sombroek et al., 1982). Kenya has six agro-ecological zones as given in Table 2.2.

Table 2.2: Agro-ecological zones of Kenya

Zone		Approx. area (km^2)	% Total
I.	Agro-Alpine	800	0.1
II.	High Potential	53,000	9.2
III.	Medium Potential	53,000	9.2
IV.	Semi-Arid	48,200	8.5
V.	Arid	300,000	52.9
VI.	Very Arid	112,000	19.8
Rest (waters, etc)		15,600	2.6

Source: Sombroek et al., 1982.

Of total ASAL area of 48 million ha, 24 million ha is only useful for nomadic pastoralism; the rest can support some commercial ranching and irrigated agriculture but with added

technological input. Over 7 million people live in and derive their livelihoods from ASAL areas; the remaining population lives in the high to medium agricultural potential land areas or in cities. In a country where 80% of the population depends on agriculture, the high and medium potential areas have been split up into to small-scale farms of up to 0.5 – 10 ha. For example, 81% of the small-scale farmers occupy holdings of less than 2 ha. Considering that the population growth rate is 3.2%, pressure on the land is continuously reducing the capacity to sustain food production and cash crop-farming.

Kenya has a wide range of soil types, which is caused by large variation in geology (parent material), relief and climate. Soil types vary from sandy to clay, shallow to very deep, and from low to high fertility. However, many soil types have serious limitations such as salinity, sodicity, acidity, fertility and drainage problems. The major soil types used in agriculture are ferralsols, vertisols, acrisols, lixisols, luvisols and nitisols (Sombroek et al., 1982).

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 The Study Area

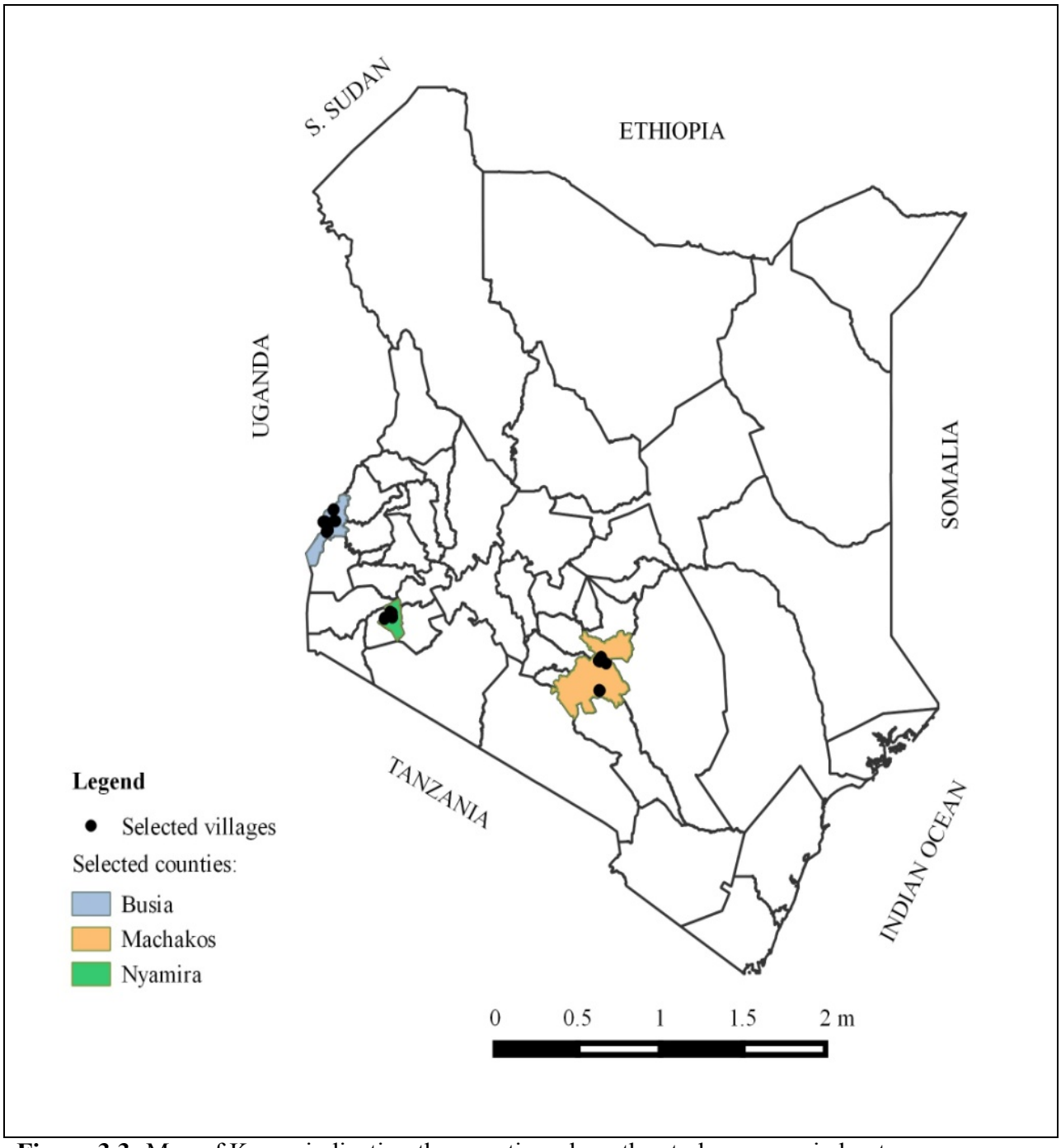

Figure 3.3: Map of Kenya indicating the counties where the study was carried out.

This research was carried out in rural areas of Busia, Nyamira and Machakos counties. These sites fall into three different agro-ecological zones of Kenya ranging from the Agro-Alpine zone (Nyamira), Medium Potential zone (Busia) and Semi-Arid zone (Machakos).

Busia County is located in Western Kenya between $0^0$43'N and $34^0$15'E. Most parts of Busia County fall within the Lake Victoria Basin. The altitude is undulating and rises from about 1,130m above sea level at the shores of Lake Victoria to a maximum of about 1,500m in the Samia and North Teso Hills. Busia is counted among the least 10 populated counties of Kenya with a total population of 743,946 people ((male: 232,075 (48%); female: 256,000 (52%)) (Kenya census, 2009). The economy of Busia County is mainly driven by agriculture related activities. In Kenya, this sector directly contributes 24% of the Gross Domestic Product (GDP) and 27% of GDP across its value chains. In Busia County, agriculture, fisheries and livestock directly and indirectly, engages more than 80% of its people and therefore residents depend on it for their daily living and livelihood support (Kenya census, 2009).

Nyamira County is located in the former Nyanza Province between $0^0$75'S and $35^0$00'E. It borders the following counties; Bomet to the East, Narok to the South, Kisii to the West, Homa Bay to the North, and Kericho to the North East. It covers an area of 899.3 Km^2. Temperatures range from a mean annual minimum of 10.1°C to a mean maximum of 28.7°C, with rainfall amounts of between 600mm and 2,300mm per annum(Kenya census, 2009). Nyamira has a population of 598,252 (Male-48%, Female-52%), population density of 665 people per Km^2, national percentage of 1.55%, annual growth rate of 2.4%, age distribution of 0-14 years (44.1%), 15-64 years (52.4%), 65+years (3.5%) and the number of households of 131,039 (Kenya Census, 2009). Nyamira County is an agricultural based economy as 90% of the residents derive their livelihoods from various on-farms and off-farm agricultural activities. Agriculture is the mainstay of Nyamira economy and its performance greatly influences the overall economic performance. It contributes directly 25 % of the GDP and a further 27 % through links with the manufacturing, distribution and other services related to the sector. Given its importance, the performance of the sector is therefore reflected in the performance of the whole economy. The development of agriculture is also important for poverty reduction since most of the vulnerable groups like the landless, and subsistence farmers, also depend on agriculture as their main source of livelihoods. Growth in the sector is therefore expected to have a greater impact on a larger section of the population than any other sector. The development of

the sector is therefore important for the development of the economy as a whole (Kenya census, 2009).

Machakos County was the first capital city of Kenya but now, it is an administrative county in Kenya. Machakos County borders Nairobi and Kiambu counties to the West, Embu to the North, Kitui to the East, Makueni to the South, Kajiado to the South West, and Murang'a and Kirinyaga to the North West. Machakos County stretches from latitudes 0º 45'S to 1º 31'S and longitudes 36° 45'E to 37° 45'E. The county has an altitude of 1000 - 1600 meters above sea level. Machakos is among the most 10 populated counties of Kenya; it has a total population of 1,098,584 people, 264,500 households and covers an area of 6,208 SQ. KM. The Population density is 177 persons per SQ. KM. The Akamba people are the dominant habitants of Machakos County (Kenya Census 2009). The local climate is semi-arid with a hilly terrain covering most parts of the county. Subsistence agriculture is practiced with Maize and drought-resistant crops such as sorghum and millet being grown. However, the County also plays host to the open air market concept with major market days where large amounts of produce are traded. Fruits, vegetables and other food stuffs like maize and beans are sold in these markets (Kenya census, 2009).

3.2 Sampling procedure

In order to generate sufficient information of the knowledge, attitude and practices regarding AIVs among farmers in Busia, Nyamira and Machakos Counties, a multi-stage sampling method was employed to select counties, villages and smallholder AIV growers respectively. The formula by Cochran (1977) shown below was used to estimate the sample size:

$$n= \frac{Z^2}{d^2} pq$$

Where: n= Sample size, Z= normal curve distribution (1.96 which corresponds to 95% confidence interval), p = proportion of AIVs growers (given as 0.5 when the exact proportion of the farmers is not known), q = proportion of non AIVs growers (1-p), d= margin error set at 95% (given as 0.05).

$$n= \frac{1.96^2}{0.05^2} 0.5 * 0.5$$

n= 384

For the purposes of the study, a sample size of 600 was used (200 from each site), though the minimum sample size obtained was 538. This minimum sample size of 538 was obtained after calculation according to Israel (1992), who proposed this formula to compensate for people that will not be contacted (10%) and also another 30% for non-response.

A multi-stage sampling procedure was used to select counties, villages and smallholder AIVs growers. Counties were selected purposively based on their different agro-ecological characteristics. Villages were randomly selected from the three counties. Lists of AIVs farmers were prepared with assistance of village leaders and farmers randomly selected for interview. Farmers were interviewed on their farms. The household head or other responsible person in the household aged at least 21 years was eligible to be interviewed. Only one person per household, whether male or female, was interviewed.

3.3 Data collection

Data collection was conducted during the period of June to July 2015. The study utilized primary data collected among smallholder farmers.

The study adopted a survey design for collecting primary data in respect to farmers' socioeconomic characteristics, and KAP of smallholder AIVs producers in Busia, Nyamira and Machakos Counties. A semi-structured questionnaire designed was used to collect data on farmers' socioeconomic characteristics, farmers' knowledge on AIVs attributes, farmers' attitude towards AIVs, and farmers' practices. Research experts at the International Centre of Insect Physiology and Ecology (ICIPE) in Nairobi, Kenya reviewed the questionnaire; after which it was subjected to a pre-test on 20 households in Machakos before administration to respondents in its final form. The pre-test intended to capture any problems in the questionnaire, in order to eliminate them and to ensure adequate record of the required data. Enumerators fluent in the English and local languages were trained to administer the questionnaire. They asked the questions in local languages, and recorded the responses in English. Questionnaires and filled forms were checked every day for the purpose of quality control.

The questionnaire used in the study consisted of five sections that included: (i) geographical coordinates; (ii) household characteristics and demography; (iii) knowledge about AIVs; (iv) attitudes towards AIVs and (v) practices in AIVs farming. Likert scale was adopted to record the responses utilized to evaluate knowledge and attitude while closed and open-ended questions

were used to assess their farming practices. Additional information was obtained using non-directive interviews with key informants such as local/village leaders, agriculture extension officers, traders of AIVs in open markets, farmer groups such as Bahari Horticulture Group in Machakos (affiliated to ICIPE) and observations on the ground.

Knowledge, attitude and practice are the primary outcome variables in this study. Knowledge was measured on a 3-scale Likert statement (1= don't know; 2= false; 3= true). For each question, a positive response (true) was awarded with one point while a negative response (false) or "don't know" a zero point. A knowledge score for each sampled farmer was computed by summing the number of positive answers out of 9 questions. Farmers' attitude towards AIVs was measured on 5-scale statements (1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = Agree; 5 = strongly agree) (Likert, 1932). Those who agreed or strongly agreed to the statements were considered to have a positive attitude while the rest were considered to have a negative attitude. Practice was measured using 8-item binary questions (yes/no questions). One point was awarded for each correct practice mentioned, and zero otherwise. A practice score for each household was computed by summing the number of correct responses out of the eight questions.

3.4 Data Analysis

Responses were coded for easy entry and analysis. The coded answers were entered into Microsoft Excel 2007, cleaned and then imported to the statistical package STATA version 12 analysis. Results were presented as descriptive statistics and an econometric model was estimated to identify the factors influencing farmers' KAP.

3.4.1 Descriptive statistics

Descriptive statistics included means, percentages, frequencies and standard deviation. Pearson chi-squared test was then applied to establish whether farmers' KAP were significantly different across study zones.

In addition, Principal Component Analysis (PCA) was used to generate the composite indices for Knowledge score, Attitude score, Practice score and a composite of the three denoted as KAPscore (Knowledge, Attitude and Practice scores) (Krishnan, 2010). Nine (9) knowledge questions, seven (7) attitude and eight (8) practice questions were used in the computation for the indices. A regression model was fitted to determine association between farmers' socio-economic characteristics and KAP. Variation inflation factors (VIFs) were used to check

multicollinearity among predictor variables, where as *modus operandi*, a value greater than 10 may warrant further examination (Myers, 1990). Marginal effects were computed to present and explain the results of significant predictor variables. The multinomial goodness-of-fit (mgof) diagnosis was carried out for the model to check whether or not the model predictors describe sufficiently the observed data. The null hypothesis for goodness-of-fit is to be rejected if the p-value of the chi-squared test statistics is less than a given significance level α (Cressie & Timothy, 1984). A p-value of less than 0.05 was considered significant for all statistical analyses.

3.4.2 Econometric model

Econometric analysis was used to test the key factors influencing KAP among AIVs farmers. The regression results indicate the degree to which specific farm and household characteristics variables influence farmers' KAP. When the choice variables are more than one and cardinal in nature, the appropriate discrete choice models are either multinomial or multiprobit models (Mohammad, 2007). This study used multinomial logit (MNL) model to analyse factors influencing farmers' KAP as the test for independence of errors terms are rejected against use of multiprobit model (Sosina et al., 2009). In order to describe the MNL model, let y denote a random variable taking on the values [1,2….j] for KAP outcomes j (here j represents 3 outcomes, knowledge, attitude and practice), a positive integer, and let ***x*** stand for a set of explanatory variables. In this case, y denotes KAP of a given farmer. We assume that each farmer faces a set of discrete, mutually exclusive outcomes of KAP which are conditioned by a set of explanatory variables ***x.*** The model to be estimated will enable the researcher to assess how changes in explanatory variables ***x*** affect the response variable (KAP) denoted as p (y= j/ *x*), j= 1, 2…J. The question is how, *caeteris paribus*, changes in the elements of ***x*** affect the response probabilities. Let *x* be 1 x k vector with 1st element unity. The MNL model response probabilities are of the form:

$$P(y=j\backslash X) = \frac{\exp(x\beta_j)}{1+\sum_{k-1}^{j}\exp(x\beta_k),\ j=1,\cdots,J} \qquad (1)$$

Where β_j is k x 1, j= 1…….J.

To obtain unbiased and consistent parameter estimates of the MNL model in equation-1 above the assumption of Independence of Irrelevant Alternatives (IIA) must hold. Simply stated, the

IIA assumption requires that the probability of having a particular level of KAP outcomes by a given respondent needs to be independent from the probability of having another level of KAP outcome (that is, Pj/Pk is independent of the remaining probabilities). The parameter estimates of the MNL model provide only the direction of the effect of the independent variables on the dependent variable, but estimates do not represent the actual magnitude of change nor probabilities (Greene, 2000). In order to allow interpretation of the effects of explanatory variables on the probabilities, we have to estimate marginal effects. Differentiating equation-1 partially with respect to the explanatory variables provides marginal effects of the explanatory variables given in the form:

$$\frac{\partial \mathrm{P_j}}{\partial \mathrm{X_k}} = P_j \left(\beta_{jk} - \sum_{j=1}^{j-1} P_j \ \beta_{jk}\right) \qquad (2)$$

The marginal effects or marginal probabilities are functions of the probability itself and measure the expected change in probability of a particular KAP outcome reached with respect to a unit change in a given independent variable from the mean.

3.4.3 Choice of explanatory variables used in the model

The explanatory variables hypothesized to have a relationship with the dependent variable and their expected signs are presented in table (3.3). Those variables were generated from literature review, theoretical information and through correlation matrices. They were those variables (farmers' socioeconomic characteristics) which are hypothesized to have associations with the farmers' KAP.

Table 3.3: Description of variables and their expected signs

Variable	**Description**	**Variable type**	**Expected signs**
Gender	1 if male, 0 if female	Dummy	+-
Education	1 if literate, 0 if illiterate	Dummy	+
Main occupation	1 if farming, 0 otherwise	Dummy	+
Farming experience	Farming experience in years	Discrete	+
Age	Age of respondent in years	Continuous	+
Household size	Household size in number counts	Discrete	+
Land tenure	1 if owned, 0 if rented	Dummy	+
Total land	1 if large farmer; 2 if medium famers; 3 if small farmer	Categorical	+
Ploughing tools	1 if hoe; 2 if ox; 3 if tractor	Categorical	+

The results of the correlation matrices generated are given as Appendix 1, where correlation between two variables was above 0.6, one variable was dropped. This was not without considering the importance of a variable in the context of the horticultural sub-sector as generated from literature, for example, gender of the household head and his/her marital status.

Gender of the household is an important variable in the horticultural industry. The industry is mainly associated with women and children since it is labour intensive hence inclusion of this variable in the model. Horticultural farming just like most of buyer-driven commodity chains is labour-intensive, with women frequently comprising the majority of these workers (Dolan and Sutherland, 2003). It was therefore expected that the female headed household had high probability of implication in AIVs knowledge, attitude and farming practices. Gender and marital status had high correlation; hence, marital status was dropped from the model though important in predicting farmers' KAP.

Educated farmers are found to be able to process information and search for appropriate technologies to alleviate their production and marketing constraints than uneducated farmers (Feder and Slade, 1994). It is believed that education gives farmers the ability to perceive, interpret and respond to new information much faster and adopt new technology than their counterparts without education.

The size of the family was also included in the model as an important factor that would positively influence farmers' KAP, especially in good practices. A large family is expected to supply sufficient labour as demanded in the horticultural production hence high probability of implication in KAP.

Area under AIVs production was used as it was expected to positively impact farmers' KAP especially in farming practices and yield. It was expected that the larger the area under AIVs production, the higher the new technology adoption and the higher the gross income.

Experience in AIVs production is expected to influence farmers' KAP. It was expected that farmers who have long experience in AIVs production are willing to increase knowledge and expand production with an aim of improving their earnings from farming.

It was also expected that farmers who practice farming as primary activity are assumed to increase knowledge and expand production of AIVs.

CHAPTER FOUR

4.0 RESEARCH FINDINGS AND DISCUSSIONS

4.1 Household characteristics

Table 4.4: Descriptive statistics: Socio-economic characteristics

Characteristics	**Sites**			
	Busia	**Nyamira**	**Machakos**	**Total**
Gender	**200(33.33%)**	**200(33.33%)**	**200(33.33%)**	**600(100%)**
Male	167(27.83%)	162(27%)	157(26.17%)	486(81%)
Female	33(5.50%)	38(6.33%)	43(7.17%)	114(19%)
Marital status	**200(33.33%)**	**200(33.33%)**	**200(33.33%)**	**600(100%)**
Married	156(26%)	159(26.50%)	151(25.17%)	466(77.67%)
Not married	44(7.33%)	41(6.83%)	49(8.17%)	134(22.33%)
Education	**200(33.33%)**	**200(33.33%)**	**200(33.33%)**	**600(100%)**
No formal education	16(2.67%)	18(3%)	22(3.67%)	56(9.33%)
Primary school	109(18.17%)	102(17%)	100(16.67%)	311(51.83%)
Professional training	10(1.67%)	15(2.50%)	10(1.67%)	35(5.83%)
Secondary school	55(9.17%)	57(9.50%)	59(9.83%)	171(28.50%)
University	10(1.67%)	8(1.33%)	9(1.50%)	27(4.50%)
Occupation	**200(33.33%)**	**200(33.33%)**	**200(33.33%)**	**600(100%)**
Farming	112(18.67%)	111(18.50%)	116(19.33%)	339(56.50%)
Salaried employment	28(4.67%)	25(4.17%)	28(4.67%)	81(13.50%)
Business	26(4.33%)	32(5.33%)	32(5.33%)	90(15%)
Casual worker on-farm	3(0.50%)	4(0.67%)	6(1%)	13(2.17%)
Casual worker off-farm	31(5.17%)	28(4.67%)	18(3%)	77(12.83%)
Farming experience	**200(33.33%)**	**200(33.33%)**	**200(33.33%)**	**600(100%)**
0-5 years	62(10.33%)	54(9%)	58(9.67%)	174(29%)
6-10 years	41(6.83%)	31(5.17%)	41(6.83%)	113(18.83%)
11-15 years	30(5%)	37(6.17%)	20(3.33%)	87(14.50%)
16-20 years	26(4.33%)	36(6%)	31(5.17%)	93(15.50%)
>20 years	41(6.83%)	42(7%)	50(8.33%)	133(22.17%)
Age	**Mean=48.4**	**Mean=47.1**	**Mean=45.7**	**Mean=47.0**
Household size	**Mean=5.6**	**Mean=5.4**	**Mean=5.5**	**Mean=5.5**
Land tenure	**200(33.33%)**	**200(33.33%)**	**200(33.33%)**	**600(100%)**
Land owned	191(31.83%)	192(32%)	190(31.67%)	573(95.50%)
Land rented	9(1.50%)	8(1.33%)	10(1.67%)	27(4.50%)
Total land owned	**200(33.33%)**	**200(33.33%)**	**200(33.33%)**	**600(100%)**
Larger farmer (farm > 5 ha)	1(0.17%)	2(0.33%)	2(0.33%)	5(0.83%)
Medium farmer (farm >2&<=5ha)	32(5.33%)	27(4.50%)	33(5.50%)	92(15.33%)
Small farmer (farm <=2ha)	167(27.83%)	171(28.50%)	165(27.50%)	503(83.83%)
Ploughing tools	**200(33.33%)**	**200(33.33%)**	**200(33.33%)**	**600(100%)**
Hoe	184(30.67%)	187(31.17%)	192(32%)	563(93.83%)
Ox-plough cultivation	13(2.17%)	13(2.17%)	8(1.33%)	34(5.67%)
Tractor	3(0.50%)	0(0%)	0(0%)	3(0.50%)

Table 3.4 describes the characteristics of sampled households. Out of 600 farmers who were interviewed, 19% were females while the rest were males. Slightly more than three-quarters (77.67%) of sample households were married. With regard to education of farmers; (9.33%) were illiterate; (51.83%) had attained some primary education; (28.50%) attained secondary school; (5.83%) attended professional schools; while only (4.50%) attended university. Farming was the main activity reported by 56.50% of respondents followed by 15% in business, paid employment (13.50%), off-farm casual workers (12.83%), and lastly on-farm casual workers (2.17%). Slightly more than a quarter of sampled farmers (29%) had experience of less than 5 years in AIVs production. The age of AIVs farmers ranged from 21 years to 98 years with mean age of 47 years. The average household size was 5.55. Majority (95.50%) of sampled farmers owned land. About 83.83% of sampled farmers were small farmers owning farm less than/equal to 2ha. Most of them used hoe for land tillage (93.83%) while less than 1% used tractors.

4.2 Farmers' Knowledge towards African Indigenous Vegetables

Table 5.4: Farmers' knowledge of AIVs

	Responses			
	Don't know	**False**	**True**	**Total**
AIVs Nutritive value				
AIVs contain essential vitamins & minerals, protein and calories	14(2.33%)	0(0%)	586(97.67%)	600(100%)
High protein & vitamin in AIVs can eliminate deficiencies among children, pregnant women & the poor	56(9.33%)	2(0.33%)	542(90.33%)	600(100%)
AIVs are nature's food	34(5.67%)	5(0.83%)	561(93.50%)	600(100%)
AIVs overcooking destroys essential phytochemicals which are beneficial in low doses	101(16.83%)	56(9.33%)	443(73.83%)	600(100%)
AIVs medicinal value and health benefits				
AIVs have health healing properties	50(8.33%)	6(1%)	544(90.67%)	600(100%)
AIVs agronomic advantages				
AIVs are adapted to harsh climatic conditions & disease infestation	32(5.33%)	58(9.67%)	510(85%)	600(100%)
AIVs are easier to grow in comparison to the exotic vegetables	13(2.17%)	15(2.50%)	572(95.33%)	600(100%)
AIVs economic importance				
AIVs are important commodities in household food security	5(0.83%)	2(0.33%)	593(98.83%)	600(100%)
AIVs provide employment & generate income in families	40(6.67%)	23(3.83%)	537(89.50%)	600(100%)

Table 4.4 presents results on farmers' knowledge towards AIVs. When asked about attributes of AIVs, 97% of respondents agreed that AIVs are rich in vitamins and 90% agreed that AIVs can improve health conditions of vulnerable people. About 90% agreed that AIVs contain healing properties. On average 85% agreed that AIVs are resistant to harsh weather condition and disease infestation, while 95% believe that AIVs are easier to grow in comparison to the exotic vegetables.

All the nine statements were individually answered correctly by more than three-quarter of the respondents so that it can be concluded that the respondents know the value and benefits of African Indigenous Vegetables.

Table 6.4: Knowledge by site of study

	Sites			
	Busia	Nyamira	Machakos	Total
Knowledge	0.94	0.965	0.92	0.941

The knowledge score was 94% indicating high knowledge among AIVs farmers in the surveyed areas. Findings by site showed that Nyamira was scored statistically higher for knowledge with mean score of 96%, followed by Busia with mean score of 94% and lastly Machakos with mean score of 92%.

Table 7.4: Pair-wise comparisons of mean knowledge using Duncan's adjustment

Variable	**(I)Site (J)Site**	**Mean Difference (I-J)**	**Std. Err.**	**t**	**P>|t|**
Knowledge					
	Nyamira Vs Busia	0.025	0.023	1.07	0.286
	Machakos Vs Busia	-0.02	0.023	-0.85	0.394
	Machakos Vs Nyamira	-0.045	0.023	-1.92	0.069

Comparing the three sites of research, the mean knowledge were significantly different between Machakos and Nyamira (p=0.069), but not between Nyamira and Busia (p=0.286) and Machakos and Busia (p=0.394).

4.3 Farmers' attitude towards African Indigenous Vegetables

Attitudes towards AIVs was measured using Likert's rating scale statements (1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = Agree; 5 = strongly agree).

Table 8.4: Farmers' attitude towards AIVS

	Statements					
	Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**	**Total**
AIVs farming is women activity	195 (32.50%)	119(19.83%)	38(6.33%)	135(22.50%)	113(18.83%)	600(100%)
AIVs is poor people's food/food of the older generation	197(32.83%)	299(49.83%)	50(8.33%)	42(7%)	12(2%)	600(100%)
AIVs consumption may cause health problems	348(58%)	218(36.33%)	26(4.33%)	7(1.17%)	1(0.17%)	600(100%)
AIVs are not grown/handled in cleaner way	189(31.50%)	295(49.17%)	95(15.83%)	19(3.17%)	2(0.33%)	600(100%)
AIVs are unfashionable/not trendy	186(31%)	294(49%)	55(9.17%)	46(7.67%)	19(3.17%)	600(100%)
AIVs are time consuming to process/prepare	152(25.33%)	231(38.50%)	64(10.67%)	60(10%)	93(15.50%)	600(100%)
AIVs taste, appearance, quality are not good	401(66.83%)	133(22.17%)	27(4.50%)	12(2%)	27(4.50%)	600(100%)

Majority of respondents (32.50%) strongly disagreed to the statement that AIVs farming is women activity. Almost half of respondents (49.83%) disagreed to the statement that AIVs is poor people's food or food of the older generation. More than half (58%) of respondents strongly disagreed to the statement that AIVs consumption may cause health problems. 49.17% of respondents disagreed to the statement that AIVs are not grown or handled in cleaner way. 49% disagreed to the statement that AIVs are unfashionable and not trendy. 38.50% disagreed to the statement that AIVs are time consuming to process and to prepare. Almost three-quarter (66.83%) of respondents strongly disagreed to the statement that AIVs taste, appearance, quality are not good.

Majority of respondents disagreed or strongly disagreed to the all seven negative statements. This shows that the respondent farmers have positive attitude or perception on African Indigenous Vegetables.

Table 9.4: Attitude by site

	Sites			
	Busia	Nyamira	Machakos	Total
Attitude	0.815	0.86	0.835	0.836

The attitude score was 83% indicating positive attitude of farmers towards AIVs in the surveyed areas. Findings by site showed that Nyamira was scored statistically higher with mean score of 86%, followed by Machakos with mean score of 83% and lastly Busia with mean score of 81%.

Table 10.4: Pair-wise comparisons of mean knowledge using Duncan's adjustment

Variable	**(I)Site (J)Site**	**Mean Difference (I-J)**	**Std. Err.**	**t**	**P>|t|**
Attitude					
	Nyamira Vs Busia	0.045	0.037	1.22	0.255
	Machakos Vs Busia	0.02	0.037	0.54	0.589
	Machakos Vs Nyamira	-0.025	0.037	-0.68	0.500

Comparing the three sites of research, there was no significant difference in attitude among AIVs farmers.

4.4 Practice in AIVs Production

Farmers' practice in the AIVs production was evaluated to identify the gaps in good agricultural practices of AIVs as baseline for future interventions in the sector.

4.4.1 Some African Indigenous Vegetables grown in regions under study

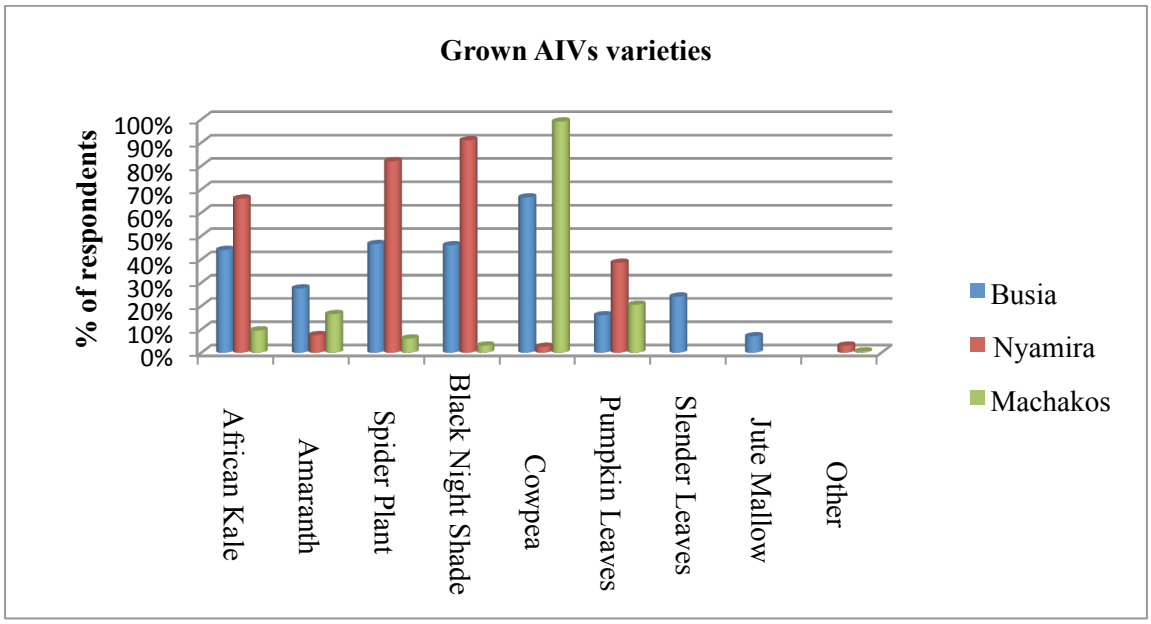

Figure 4.4: Different AIVs varieties by region

African Kale, spider plant, black night shade and pumpkin leaves are mostly grown in Nyamira. Amaranth, slender leaves and jute mallow are mostly grown in Busia while Machakos is leading in cowpeas. Other varieties that farmers grow include climbing vine and Ngwalo.

4.4.2 Average household AIV production in areas of study

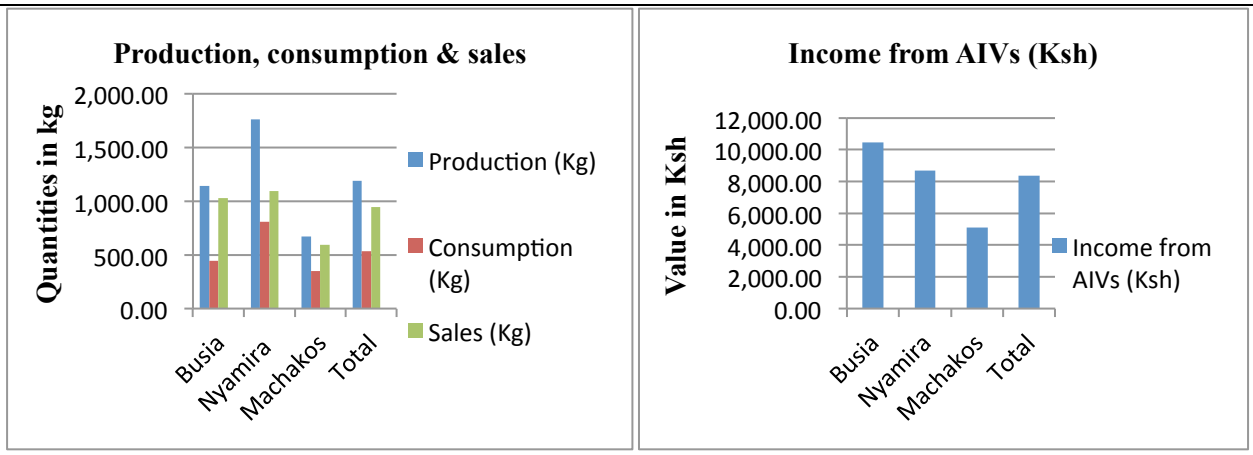

Figure 5.4: Average household AIVs production

On average household in the three counties produced 1,191.8kg of AIVs during the preceding harvest season; Nyamira coming ahead (1,761.5kg) of Busia (1,140.4kg) and Machakos (673.5kg). The average amount of AIVs consumed by household was 533.5kg while the average amount of AIVs sold was 947kg. The average gross income from AIVs sale was Ksh 8,347.47 (USD 85.77) (Central Bank of Kenya, Exchange rates of 15/06/2015).

4.4.2 Farmers' farming practices in the surveyed sites

Table 11.4: Farm characteristics

Characteristics	**Sites**			
	Busia	**Nyamira**	**Machakos**	**Total**
Cropping systems	**200(33.33%)**	**200(33.33%)**	**200(33.33%)**	**600(100%)**
Pure stand	139(23.17%)	145(24.17%)	155(25.83%)	439 (73.17%)
Intercropping	61(10.17%)	55(9.17%)	45(7.50%)	161 (26.83%)
Area under AIVs	**200(33.33)**	**200(33.33)**	**200(33.33)**	**600(100%)**
<=10%	88(14.67%)	99(16.50%)	89(14.83%)	276 (46%)
11-20%	58(9.67%)	64(10.67%)	63(10.50%)	185(30.83%)
21-30%	32(5.33%)	20(3.33%)	30(5%)	82(13.67%)
31-40%	14(2.33%)	8(1.33%)	4(0.67%)	26(4.33%)
41-50%	4(0.67%)	8(1.33%)	9(1.50%)	21(3.50%)
>50%	4(0.67%)	1(0.17%	5(0.83%)	10 (1.67%)
Farming inputs	**200(33.33%)**	**200(33.33%)**	**200(33.33%)**	**600(100%)**
Improved seeds	66(11%)	59(9.83%)	60(10%)	185(30.83%)
Inorganic fertilizers	26(4.33%)	49(8.17%)	25(4.17%)	100(16.67%)
Organic fertilizers	88(14.67%)	89(14.83%)	103(17.17%)	280(46.67%)
Pesticides	1(0.17%)	1(0.17%)	3(0.50%)	5(0.83%)
None	19(3.17%)	2(0.33%)	9(1.50%)	30(5%)
Fertilizers	**200(33.33%)**	**200(33.33%)**	**200(33.33%)**	**600(100%)**
NPK	9(1.50%)	13(2.17%)	9(1.50%)	31(5.17%)
DAP	34(5.67%)	63(10.50%)	25(4.17%)	122(20.33%)
Urea	3(0.50%)	3(0.50%)	1(0.17%)	7(1.17%)
Compost manure	48(8%)	31(5.17%)	46(7.67%)	125(20.83%)
Fallow practices	0(0%)	0(0%)	0(0%)	0(0%)
Farm yard manure	84(14%)	87(14.50%)	108(18%)	279(46.50%)
Green manure	0(0%)	0(0%)	0(0%)	0(0%)
None	22(3.67%)	3(0.50%)	11(1.83%)	36(6%)
Pest control	**200(33.33%)**	**200(33.33%)**	**200(33.33%)**	**600(100%)**
Insecticide	103(17.17%)	169(28.17%)	155(25.83%)	427(71.17%)
Fungicide	1(0.17%)	0(0%)	1(0.17%)	2(0.33%)
Traditional product (ash)	15(2.50%)	1(0.17%)	2(0.33%)	18(3%)
None	81(13.50%)	30(5%)	42(7%)	153(25.50%)
Pesticide name	**200(33.33%)**	**200(33.33%)**	**200(33.33%)**	**600(100%)**
Dimethoate	0(0%)	0(0.17%)	0(0%)	1(0.17%)
Cypermethrin	18(3%)	12(2%)	9(1.50%)	39(6.50%)
Thiodan	2(0.33%)	6(1%)	3(0.50%)	11(1.83%)

Dithane	0(0%)	6(1%)	5(0.83%)	11(1.83%)
Ridomil	20(3.33%)	12(2%)	20(3.33%)	52(8.67%)
Copper oxychloride	0(0%)	0(0%)	1(0.17%)	1(0.17%)
Other	160(26.67%)	163(27.17%)	162(27%)	485(80.83%)
Methods of harvesting	**200(33.33%)**	**200(33.33%)**	**200(33.33%)**	**600(100%)**
Uprooting the crop	13(2.17%)	2(0.33%)	35(5.83%)	50(8.33%)
Harvesting leaves	72(12%)	82(13.67%)	55(9.17%)	209(34.83%)
Harvest leaves & stem tops	115(19.17%)	116(19.33%)	110(18.33%)	341(56.83%)
Harvest handling	**200(33.33%)**	**200(33.33%)**	**200(33.33%)**	**600(100%)**
Cleaning	95(15.83%)	103(17.17%)	115(19.17%)	313(52.17%)
Washing	96(16%)	47(7.83%)	42(7%)	185(30.83%)
Grading/sorting to remove poor material	2(0.33%)	34(5.67%)	37(6.17%)	73(12.17%)
Shredding	1(0.17%)	1(0.17%)	1(0.17%)	3(0.50%)
Produce held in shaded area awaiting packing	6(1%)	15(2.50%)	5(0.83%)	26(4.33%)
Processing techniques	**200(33.33%)**	**200(33.33%)**	**200(33.33%)**	**600(100%)**
Simple sun-drying	1(0.17%)	1(0.17%)	0(0%)	2(0.33%)
Sun-drying & grinding into powder	2(0.33%)	4(0.67%)	1(0.17%)	7(1.17%)
None	197(32.83%)	195(32.50%)	199(33.17%)	591(98.50%)
Extension training on AIVs	**200(33.33%)**	**200(33.33%)**	**200(33.33%)**	**600(100%)**
Yes	53(8.83%)	52(8.67%)	62(10.33%)	167(27.83%)
No	147(24.50%)	148(24.67%)	138(23%)	433(72.17%)
Will to attend training on AIVs	**200(33.33%)**	**200(33.33%)**	**200(33.33%)**	**600(100%)**
Yes	178(29.67%)	178(29.67)	24(4%)	532(88.67%)
No	22(3.67%)	22(3.67%)	176(29.33%)	68(11.33%)

Table 11.4 shows that about three-quarters (73.17%) of all sampled farmers produced AIVs in pure stand. Almost half (46%) of all the respondents allocated less than 10% of their land to AIVs production. About 47% of farmers used organic manure in the production of AIVs. A small number of farmers 16.67% and 30.83% used inorganic fertilizer and improved seeds, respectively while 5% did not use any input. Close to half of sampled farmers (46.50%) used farm yard manure, 20.83% used compost manure, 20.33% used DAP, 5.17% used NPK, 1.17% used Urea while 6% did not apply fertilizers. Slightly more than half of sampled farmers (56.33%) controlled weeds mechanically by digging but majority (71.17%) used insecticide to control pests in their farms. Common insecticide brands used were: Dimethoate (0.17%), Cypermethrin (6.50%), Thiodan (1.83%), Dithane (1.83%), Ridomil (8.67%) and Copper oxychloride (0.17%). A large number of farmers (80.83%) used other brands of insecticides

namely: Diazol, Duduthrin, Rocket, Ambush, Karate-Zeon, Dodadim, OswalBestox pc 50, Tropical, Agrinet, Actellic, Nano-silver, Easygrow, Cyclone 505ec, Alphamethrin 10ec, Atom ec25, Tornado 900sp, Twiga Ace 20sl, Chariot, Actara 25wg, Thunder, Ametix, Baytone, Plantone 4.5sl, Pyrenone, Karate 5ec. Close to 3% of respondents used traditional products (ash). More than half of respondents (56.83%) harvest leaves and stem tops while 52.17% handle produce by cleaning. Only (1.17%) of respondents add value on the produce through processing by sun-drying and grinding technique. About 27.83% received extension training on AIVs while 88.67% were willing to go for such training. Farmers and key informants pointed out the need for training in aspects such as; marketing of vegetables, planting materials and land preparation, pest and disease control, water irrigation, AIVs nutrition value, AIVs varieties, fertilizer, postharvest practices, record keeping, greenhouse usage, nursery preparation, AIVs marketing, preservation and processing technologies, homemade fertilizers, types of spray and soil analysis.

4.4.3 Other farm practices

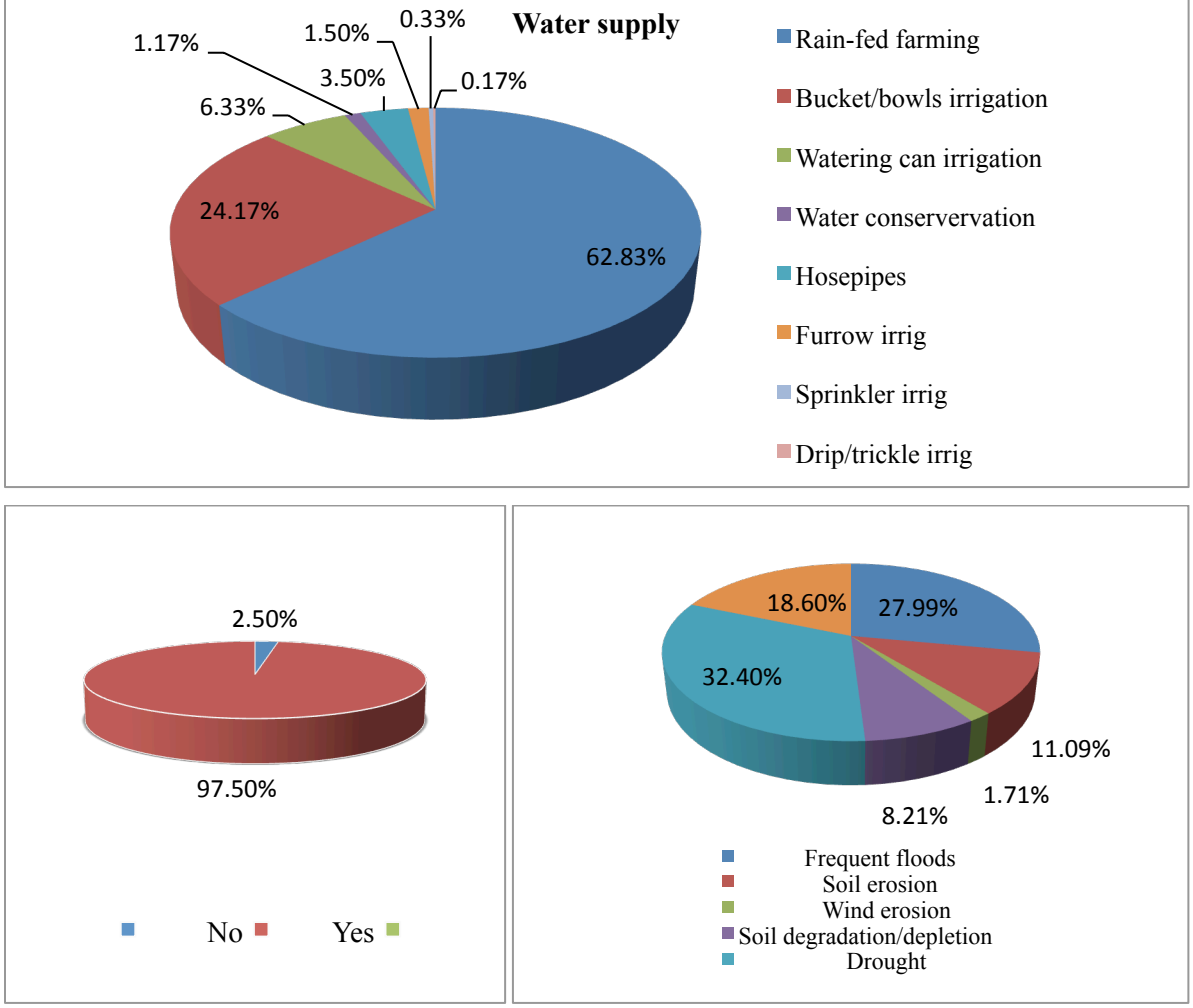

Figure 6.4: Water supply and climate effect on AIVs production

Majority of farmers (62.83%) rely on rain-fed farming in the production of AIVs. Irrigation using complex combinations of equipments and techniques is still at lower level (less than 1%). Almost all the farmers (97.50%) have experienced the effect of climate change in their farming activities. Negative effects were drought (32.40%), frequent floods (27.99%), plant diseases (18.60%), soil erosion (11.09%), soil degradation/depletion (8.21%), and wind erosion (1.71%).

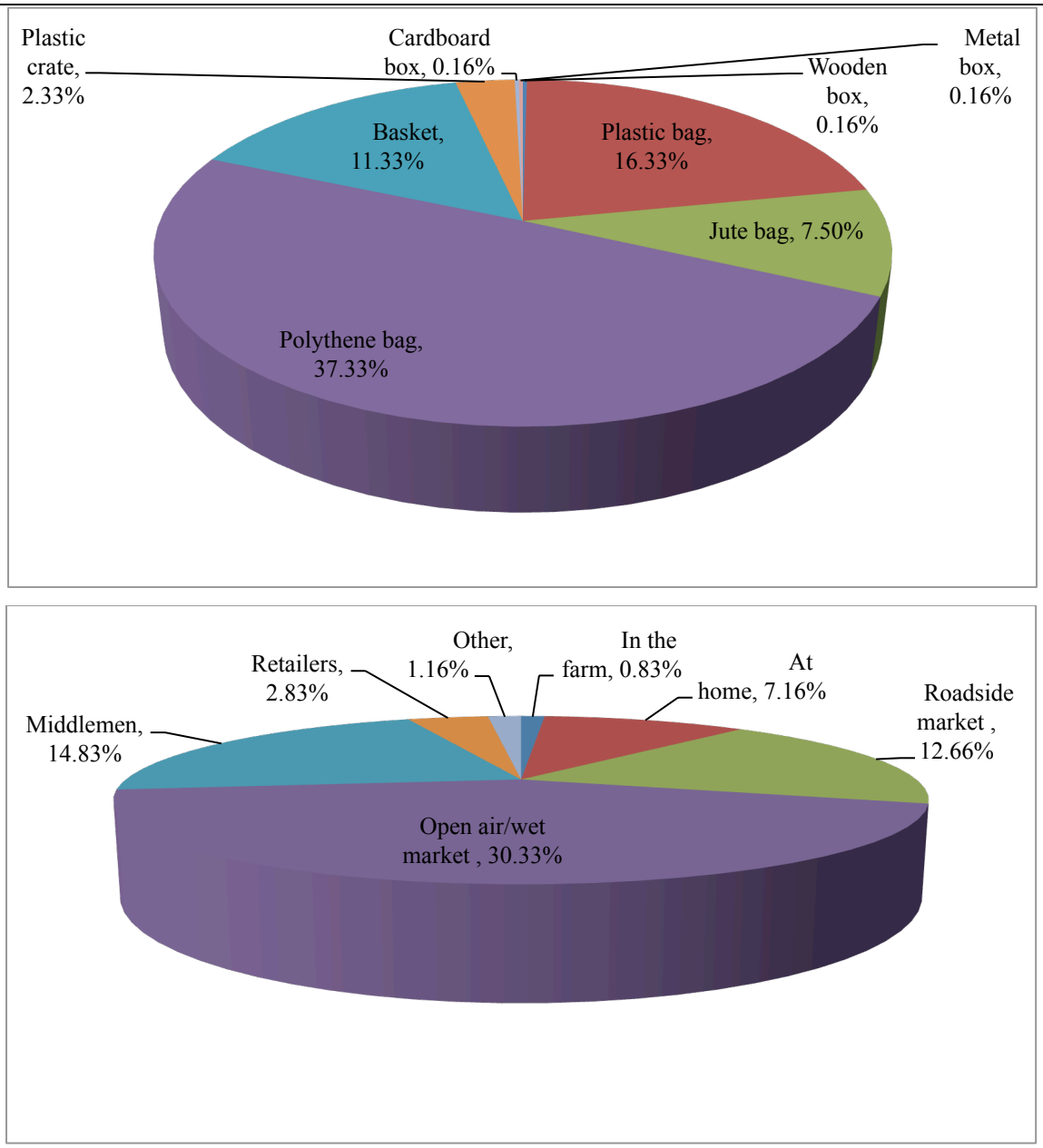

Figure 7.4: Mode of packaging and produce outlet

Majority of AIVs farmers package their produce in polythene bags (37.33%) and sell their produce in open air/wet market (30.33%).

Findings show that majority of AIVs farmers still use or practice traditional methods of farming and that using complex combinations of equipments and techniques is still at lower level.

4.5 Assessment of factors influencing farmers' KAP

4.5.1 Multinomial logistic (MNL) model results

Table 14.4 presents the multinomial regression results with KAP and the dependent variables. As expected, most socio-demographic variables and farm characteristics like gender, education, profession, years of experience in farming, land tenure and total land owned by farmers had significant positive effect on farmers' knowledge, attitude and practices. However, age and family size were not significantly associated with farmers' KAP. Regarding the use of tools in land preparation, use of hoe and ox had significant positive influence on KAP whereas use of tractor positively influences farming practices. Marginal effects in the fitted regression model imply that a unit change in predictor variables would increase the probability of having higher knowledge, attitude and adopting good agricultural practices.

Table 12.4: Multinomial logistic regression results

Variables	Knowledge				Attitude				Practice			
	Marginal effects	Std. Err.	z	p>z	Marginal effects	Std. Err.	z	p>z	Marginal effects	Std. Err.	z	p>z
Gender												
Female	0.335	0.050	6.68	0.000	0.404	0.051	7.81	0.000	0.260	0.046	5.65	0.000
Male	0.339	0.022	14.86	0.000	0.299	0.021	13.74	0.000	0.360	0.023	15.53	0.000
Education												
No formal education	0.227	0.059	3.80	0.000	0.441	0.071	6.14	0.000	0.330	0.069	4.75	0.000
Primary school	0.348	0.028	12.39	0.000	0.328	0.027	11.85	0.000	0.323	0.027	11.60	0.000
Professional training	0.492	0.086	5.67	0.000	0.189	0.066	2.84	0.004	0.318	0.078	4.05	0.000
Secondary school	0.341	0.038	8.87	0.000	0.298	0.036	8.23	0.000	0.360	0.039	9.21	0.000
University	0.309	0.089	3.44	0.001	0.286	0.100	2.86	0.004	0.404	0.107	3.77	0.000
Main occupation												
Farming	0.336	0.027	12.20	0.000	0.299	0.027	10.99	0.000	0.363	0.028	12.84	0.000
Salaried employment	0.383	0.060	6.30	0.000	0.364	0.064	5.67	0.000	0.252	0.052	4.82	0.000
Business	0.357	0.053	6.66	0.000	0.356	0.052	6.77	0.000	0.285	0.049	5.78	0.000
Casual worker on-farm	0.214	0.116	1.84	0.066	0.310	0.129	2.40	0.016	0.474	0.139	3.40	0.001
Casual worker off-farm	0.308	0.055	5.56	0.000	0.304	0.054	5.56	0.000	0.386	0.058	6.60	0.000
Farming experience												
0-5 years	0.336	0.037	9.00	0.000	0.361	0.038	9.47	0.000	0.302	0.036	8.26	0.000
6-10 years	0.349	0.045	7.68	0.000	0.322	0.045	7.07	0.000	0.328	0.045	7.28	0.000
11-15 years	0.287	0.051	5.62	0.000	0.371	0.053	6.98	0.000	0.340	0.052	6.45	0.000
16-20 years	0.347	0.051	6.75	0.000	0.249	0.047	5.24	0.000	0.402	0.053	7.53	0.000
>20 years	0.363	0.045	8.07	0.000	0.279	0.039	7.09	0.000	0.356	0.044	7.93	0.000
Age		0.007	0.12	0.908		0.006	-1.01	0.313		0.007	-0.12	0.908
Household size		0.044	-1.12	0.262		0.042	-0.28	0.782		0.044	1.12	0.262
Land tenure												
Land owned	0.343	0.020	16.73	0.000	0.315	0.019	15.98	0.000	0.341	0.020	16.71	0.000
Land rented	0.289	0.091	3.15	0.002	0.385	0.092	4.15	0.000	0.325	0.092	3.52	0.000
Total land												
Large farmer	0.414	0.205	2.01	0.044	0.203	0.192	1.06	0.290	0.382	0.228	1.67	0.094
Medium farmer	0.402	0.054	7.44	0.000	0.324	0.051	6.26	0.000	0.273	0.047	5.71	0.000

Small farmer	0.328	0.021	15.21	0.000	0.318	0.021	15.10	0.000	0.353	0.021	16.06	0.000
Ploughing tools												
Hoe	0.328	0.020	16.13	0.000	0.336	0.020	16.35	0.000	0.334	0.020	16.36	0.000
Ox-plough cultivation	0.420	0.086	4.86	0.000	0.273	0.083	3.26	0.001	0.306	0.077	3.96	0.000
Tractor	0.409	0.290	1.41	0.158	0.000	0.000	1.63	0.102	0.590	0.290	2.03	0.042
Constant		1.148	0.19	0.851		1.483	0.54	0.588		1.148	-0.19	0.851

Wald chi2(40) = 519.87 Log likelihood = -642.07972 Number of observations= 600
Prob > chi2 = 0.0000 Pseudo R2 = 0.0259

All the independent variables had variance inflation factors (VIF) less than 1.24 indicating absence of serious multicollinearity. The multinomial goodness-of-fit (mgof) test yielded a chi-square value of 0 .0467 on 1.9906 degrees of freedom, and a p-value of 0.9894 suggesting that our model fits reasonably well.

4.6 Identification of trend in AIVs production

Figure 8.4 shows the results from the analysis of target of farmers for the next 5 years.

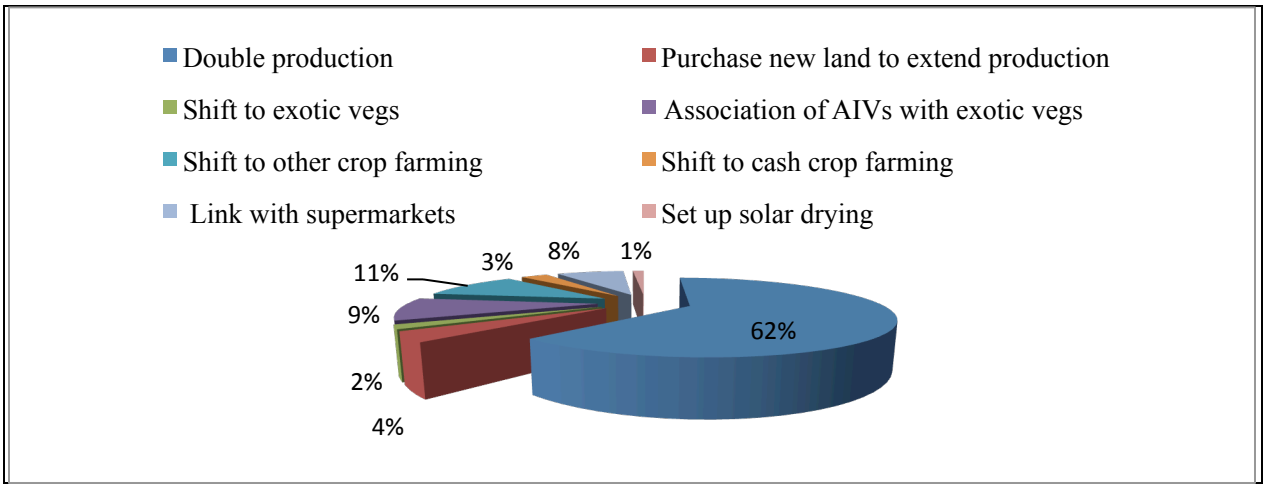

Figure 8.4: Trend in AIVs production

Majority of farmers (62%) intend to double production of AIVs.

4.7 Major constraints to production of African Indigenous Vegetables

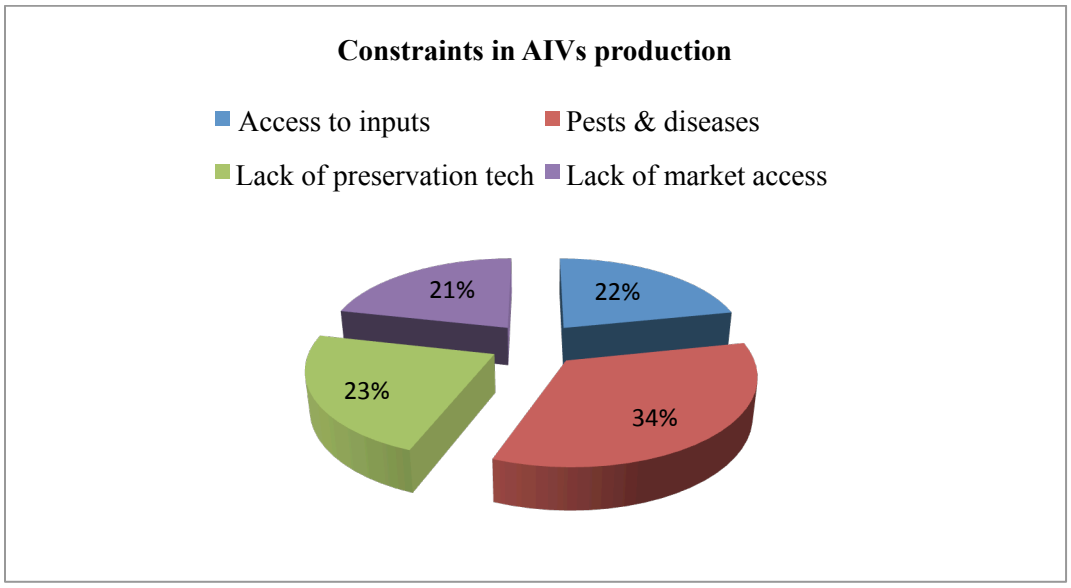

Figure 9.4: Constraints in AIVs production

When asked about constraints encountered in the production of AIVs, a considerable number (40.82%) mentioned lack of access to inputs as hindrance to crop intensification of AIVs, another 63.78% pointed out pests and diseases in crops as a serious issue in AIVs production, while 40.31% cited the lack of market access, and 42.52 % the lack of preservation and processing technologies. On top of this, information collected from oral interviews with

farmers revealed further barriers to crop intensification of AIVs namely low prices during high seasons, costly labour, soil depletion, drought, rodents, land fragmentation, lack of training, lack of protective gears (e.g. germ boots), poor quality seeds, robbers, devastation by domestic animals, disturbance by birds, poor roads, cold snow, frost, water shortage.

4.8 Recommendable ways of promoting the production of AIVs

The farmers were asked to suggest the way forward to improve the production and utilization of AIVs in Kenya. Various suggestions from farmers are shown in figure 8.4.

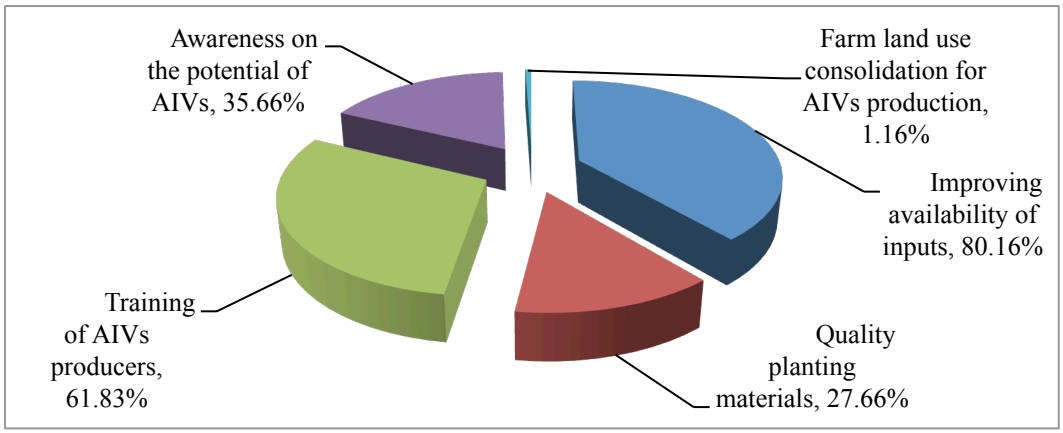

Figure 10.4: Views of farmers on improving production and utilization of AIVs

The proposals included: improving availability of inputs (80.16%), training of AIVs producers (61.83%), awareness on the potential of AIVs (35.66%), quality planting materials (27.66%), and farm land use consolidation for AIVs production (1.16%). Other ways suggested by farmers and key informants include: avail market, access to finance, improve access to water for irrigation, forming AIV farmers association/forum, catalyze extension services, help access to information, irrigation facility, water pumps, water boreholes supply, dealing with frost, and build AIVs market channels. Another key point raised by farmers and key informants was training.

Suggested areas of training included: marketing of vegetables, planting materials and land preparation, training on pest and disease control, water irrigation in AIVs production, AIVs nutrition value, AIVs varieties, fertilizer application; postharvest practices, record keeping, greenhouse usage, nursery preparation, awareness of potential AIV market, preservation and processing technologies, homemade fertilizers, types of spray and soil analysis.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

This study aimed at assessing the knowledge, attitude and practice (KAP) of African Indigenous Vegetables among smallholder farmers in Kenya and investigated the factors influencing KAP among those farmers. Further the study investigated the trend in AIVs production; identified constraints associated with production of AIVs and suggested recommendable ways to curbing these constraints in order to improve the production and utilization of AIVs in Kenya.

All the nine statements were individually answered correctly by more than three-quarter of the respondents so that it can be concluded that the respondents know the value and benefits of African Indigenous Vegetables. This knowledge still needs to be improved so as to impact on best farming practices. Besides, their attitude towards AIVs is positive. In terms of practices, majority of farmers were small land holders. For example in Nyamira where land is largely fragmented, AIVs are grown around homesteads while in Machakos and some parts of Busia, crops cover relatively bigger areas. Findings showed low use of best practices in AIVs farming, they are still dependent on conventional practices especially to control pests and diseases, inputs use and land tillage. They integrated a variety of techniques, mostly traditional modes of AIVs production. About 94.83% of respondents apply inputs though they more rely on organic manure. The study by Svotwa et al. (2009) emphasizes that farmers use organic farming as a less costly strategy. Although the majority used pesticides, as also confirmed in several researches such as Obopile et al. (2007) and (Abang et al. 2014), they did not have a good knowledge of pesticide handling. Close to 3% of respondents used traditional methods of pests and diseases control such as ash. In our findings, similar to findings of Elizabeth and Zira (2009), it was reported that most AIVs farmers were aware of extension services, and recognized the usefulness of extension services. However, most were never visited by the extension services providers, which likely resulted in farmers' inability to identify pests and diseases of vegetables, poor pest management skills, lack of good knowledge of the use of chemical pesticides (Abang et al. 2014), and inability to mention the name of a chemical.

The empirical analysis of factors influencing farmers' KAP revealed that most socio-demographic variables and farm characteristics like gender, education, profession, years of experience in farming, land tenure and total land owned by farmers had significant positive effect on farmers' knowledge, attitude and practices. However, age and family size were not significantly associated with farmers' KAP. Regarding the use of tools in land preparation, use of hoe and ox had significant positive influence on KAP whereas use of tractor positively influences farming practices.

5.2 Conclusion

This study provides baseline information regarding knowledge, attitude and practice gaps among AIVs farmers in different regions subject to the study. This study showed that the profile of farmers may affect adoption of new technologies in AIVs production. The level of experience and knowledge of farmers regarding AIVs attributes and technologies such as improved seeds, fertilizers, and pest control strategies that have been available for decades should be exploited to boost AIVs production in Kenya. Modern types of pest control strategies would however require high levels of expertise from farmers and extensionists in order to be implemented more effectively.

5.3 Recommendations

The current study and others quoted herein do not only point out socio-economic factors that may affect knowledge and adoption of new technologies in AIVs farming. The study proposes the following in order to improve the level of farmers' knowledge, attitude and practices and address constraints associated with the production, utilization and consumption of AIVs with reference to findings in Busia, Nyamira and Machakos Counties, Kenya.

a) Improving availability of inputs (seeds and fertilizers). Farmers expressed concern about high cost of inputs in the AIVs production. The Government should subsidize the agriculture of AIVs to reposition them in the horticultural sector as major contributor to both food and nutritional security and in the context of market-oriented agriculture.
b) Training of AIVs producers. The only knowledge available among farmers is local knowledge of AIVs attributes. There is need of farmer training in basic technologies used in modern agriculture, particularly AIVs. Suggested areas of training include: marketing of

vegetables, training on pest and disease control, water irrigation in AIVs production, fertilizer application, postharvest practices, greenhouse usage, nursery preparation, awareness of potential AIVs market, spacing during planting, preservation and processing technologies, types of spray and soil analysis, among others.

c) Farm land use consolidation for AIVs production. Land use consolidation would encompass initiatives like land-husbandry, irrigation and mechanization infrastructure development to bring more land under production of AIVs, avoid dependency on rain-fed farming system and use of farm power in the context of a market-oriented agriculture. Land use consolidation as a driving component of crop intensification may contribute to mitigate hunger and poverty in rural areas of Kenya.
d) Avail proximity advisory services to farmers. Extension services can bridge the information gap and provide an even stronger impact. Extension officers and agronomists should be recruited to work in villages and then to mobilize farmers for growing the priority crops adapted to respective zones. The same services may contribute in mobilizing farmers to form cooperatives or other farmer groups.
e) Promote the Farmer Field School (FFS) as an agriculture participatory extension approach to promote the production of AIVs and other priority crops. The Government should set up FFS groups in agricultural production in a bid to increase productivity of AIVs. The complementary role of the private sector in development of FFS is an important factor in this process. FFS may help in expansion of technical knowledge, integrating research in the field as well as continuously looking for innovations in agriculture.

5.4 Suggestions for further research

Farmers expressed concern about insect infestation on their AIVs crops in some parts of the surveyed areas. There is need to conduct research in pest control to investigate those insects. There is also a need to explore why farmers are knowledgeable about AIVs but don't apply this knowledge to improve AIVs production.

REFERENCES

Abang, A. F., Kouamé, C. M., Abang, M, Hanna, R. & Fotso, A. K. (2014). Assessing Vegetable Farmer Knowledge of Diseases and Insect Pests of Vegetable and Management Practices Under Tropical Conditions, *International Journal of Vegetable Science*, 20(3): 240-253.

Abukutsa, M. O. O. (2010). African Indigenous Vegetables in Kenya: Strategic Repositioning in the Horticulture Sector. Second Inaugural Lecture of the Jomo Kenyatta University of Agriculture and Technology, Friday, 30th April 2010.

Abukutsa, M. O. O. (2003). Unexploited potential of Indigenous African Vegetables in Western Kenya, *Maseno Journal of Education Arts and Science* 4(1): 103-122.

Abukutsa, M. O. O. (2014). Strategic Repositioning African Indigenous Vegetables and Fruits with Nutrition, Economic and Climate Change Resilience Potential, in *Novel Plant Bioresources: Applications in Food, Medicine and Cosmetics* (Eds. John Wiley & Sons Ltd), West Sussex, UK: 361-369.

Abukutsa, M. O. O. (2007). The diversity of cultivated African leafy vegetables in three communities in Western Kenya. *Afr. J. Food Agr. Dev.*, **7**(3): 1-15.

Afari-Sefa, V., Tenkouano, A., Ojiewo, C. O., Keatinge, J. D. H., & Hughes, J. D. A. (2012). Vegetable breeding in Africa: constraints, complexity and contributions toward achieving food and nutritional security. *Food Security*, 4:115–127.

Alberto, L. (2015). Promoting local vegetables R&D to benefit smallholders. Available via http://www.scidev.net/sub-saharan-africa/farming/feature/local-vegetables-r-d.html#sthash.sgAEdweg.dpuf Accessed on 06/02/2016.

Allport, G. W. (1935). *Attitudes*, Murchison C. (Ed.), Handbook of social psychology (pp. 798-844), Worcester, MA, Clark University Press.

Bulmer, M. & Warwick, D. P. (1998). Social research in developing countries: surveys and consensus in the third world, UCL press.

Central Bank of Kenya (2013). Foreign Exchange Rates (Exchange rates of 31/12/2013). https://www.centralbank.go.ke/index.php/rate-and-statistics.

Chelang'a, P. K., Obare, G. A., & Kimenju, S. C. (2013). Analysis of urban consumers' willingness to pay a premium for African Leafy Vegetables (ALVs) in Kenya: a case of Eldoret Town. *Food Security,* 5: 591-595.

Chweya, J. A. & Eyzaguirre, P. B. (1999). The biodiversity of traditional leafy vegetables. International Plant Genetic Resources Institute, Rome.

Chweya, J. A. & Mnzava, N. A. (1997). Cat's whiskers. Cleome gynandra L. Promoting the conservation and use of underutilized and neglected crops. 11. Institute of Plant Genetics and Crop Plant Research, Gatersleben/International Plant Genetic Resources Institute, Rome, Italy.

Cochran, W. G. (1997). *Sampling Techniques*, 2nd Ed., New York: John Wiley and Sons, Inc.

Cressie, N. & Timothy, R. C. (1984). Multinomial Goodness-of-Fit Tests. *Journal of the Royal Statistical Society*. Series B (Methodological), 46, **3**: 440-464.

Dalal, S., Baunza, J. J., & Volmink, J. (2011). Non-communicable diseases in sub-Saharan Africa, what we know. *International Journal of Epidemiology*, 40, 885-901.

Dolan, C. & Sutherland, K. (2003). Gender and Employment in the Kenya Horticulture Value Chain. Discussion Paper 8. Department for International Development's Globalization and Poverty Research Programme. University of East Anglia, U.K.

Dovie, D. B. K, Shacklton, C. M. & Witkowsk, E.T.F. (2002). Direct-use values of woodland resources consumed and traded in a South African village. *International Journal for Sustainable Development*. World Ecology 9: 269-283.

Elizabeth, S. & D. Zira (2009). Awareness and effectiveness of vegetable technology information packages by vegetable farmers in Adamawa State, Nigeria. *Journal of Agriculture Research,* 4(2):65–70.

Fanzo, J. (2012). The nutrition challenge in Sub-Saharan Africa: Working paper. United Nations Development Programme, Regional Bureau for Africa, WP 2012-012.

Food & Agriculture Organization of the United Nations (2004). Fruit and vegetables for health, Report of a joint FAO/WHO workshop, 1-3 September, Kobe, Japan.

Feder, G. & Slade, R. (1994). The acquisition of information and the adoption of new technology. *American Journal of Agricultural Economics,* 66 (2):312-320.

Figueroa, B. M., Tittonell, P., Giller, K. E., & Ohiokpehai, O. (2009). The contribution of traditional vegetables to household food security in two communities of Vihiga and Migori districts, Kenya. In *Acta Horticulturae* (Ed. ISHS), 57-64.

Frank, J. D. (Emeritus), Joseph, G. M. & Sam, C. (2009). *The Texas Vegetable Growers Handbook*, 4th Edition. Texas A&M University, Horticultural and Forestry Sciences Building, College Station, Texas.

Grubben, G. J. (2004). Plant Resources of Tropical Africa. PROTA, Wageningen, Netherlands. Vegetables; p. 667. (Series 2).

Hart, T. G. B. & Vorster, H. J. (2006). Indigenous Knowledge on the South African Landscape Potentials for Agricultural Development. Urban, Rural and Economic Development Programme. Occasional paper N 1. HSRC Press, Cape Town, South Africa.

Integrated Development of Artisanal Fisheries (1994). Program for integrated development of artisanal fisheries in West-Africa, IDAF Technical report N° 60 ftp://ftp.fao.org/docrep/fao/006/AD342E/AD342E00.pdf.

Israel, G. D. (1992). *Sampling the Evidence of Extension Program Impact*, Program Evaluation and Organizational Development, IFAS, Univ. of Florida, PEOD-5, October.

Jansen, W. S. & Vorster, H. J. (2005). The utilization of traditional leafy vegetables. 6th International Food Data Conference, 14-16 September 2005, University of Pretoria, Pretoria, South Africa. Unpublished. Available from ARC-VOPI, Pretoria, South Africa.

Jansen, W. S., Averbeke, W., Slabbert, R., Faber, M., Jaarsveld, P., Heerden, I., Wenhold, F. & Oelofse, A. (2007). African leafy vegetables in South Africa, Water SA (on-line), Vol. 33, No 3 (Special Edition).

Juma, C. (2011). The new harvest, Agricultural innovation in Africa, Oxford University Press.

Kenya National Bureau of Statistics (2009). The 2009 Kenya Population and Housing Census.

Kokwaro, J. O. (1993). Medicinal Plants of East Africa, Second Edition, Kenya Literature Bureau, Nairobi.

Krishnan, V. (2010). Constructing an area-based socioeconomic index: A Principal Components Analysis Approach, ECmap: 20-22.

Likert, R. (1932). A technique for the measurement of attitudes, Arch Psychol., 22 (140):1–55.

Ministry of Agriculture (2013). National Horticulture: Validated Report, 2013, Nairobi, Kenya.

Mnzava, N. A. (1997). Vegetable crop diversification and the place of traditional species. In: Guarino L.editor 1997, *Traditional African vegetables. Promoting the conservation and use of Underutilized and neglected crops*. 16. Institute of Plant Genetic and Crop Plant Research, Gatersleben/International Plant Genetic Resources Institute, Rome, Italy.

Mohammad, A. K. (2007). Factors affecting employment choices in Rural Northwest Pakistan. University of Kassel-Witzenhausen and University of Gottingen. Conference on International Agricultural Research for Development. October 2007.

Muhanji, G., Roothaert, R. L., Webo, C. & Mwangi, S. (2011). African indigenous vegetable enterprises and market access for small-scale farmers in East Africa. *International Journal of Agricultural Sustainability*, 9:1, 194-202.

Myers, R. H. (1990). Classical and modern regression with applications. 2nd edition Boston: PWS and Kent Publishing Company, Inc., 63,221–222.

Nekesa, P. & Meso, B. (1997). Traditional African vegetables in Kenya: production, marketing and utilization. In: *Traditional African Vegetables*. Promoting the conservation and use of underutilized and neglected crops. 16. Institute of Plant Genetic and Crop Plant Research, Gatersleben International Plant Genetic Resources Institute, Rome, Italy: 98-103.

Ngugi, I. K., Gitau, R. & Nyoro, J. K. (2007). Access to high value markets by smallholder farmers of African indigenous vegetables in Kenya. Regoverning Markets Innovative Practice series, IIED, London.

Obopile, M., Munthali, D. C. & Matilo, B. (2007).Farmers' knowledge, perceptions and management of vegetable pests and diseases in Botswana. Department of Crop Science and Production, Botswana College of Agr., Gaborone, Botswana.

Olembo, N. K., Stephen, S. F. & Edah, S. N. 1995. Medicinal and Agricultural plants of Ikolomani Division Kakamega District. Development Partners. Nairobi.

Osgood, C. E., Suci, G. & Tannenbaum, P. (1957). *The measurement of meaning,* Urbana, IL: University of Illinois Press, USA.

Paulhus, D. L. (1984). Two-component models of socially desirable responding. *Journal of personality and social psychology, 46(3):* 598-609.

Rose, E. F. & Guillarmod, A. J. (1974). Plants gathered as foodstuffs by the Transkeian peoples. Suid-Afrikaanse Mediese Tydskrif 861: 688-1690.

Rubaihayo, E. B. (1997). Conservation and use of traditional vegetables in Uganda. In: Guarino L (ed.) *Traditional African Vegetables*. IPGRI, Rome: 104-116.

Schippers, R. R. (1997). Domestication of indigenous vegetables for sub-Saharan Africa: a strategy paper, in: Schippers, R. and Budds, L. (eds), African Indigenous Vegetables Workshop Proceedings, Limbe, Cameroon, 13–18 January 1997: 125–135.

Schippers, R. R. (2000). African Indigenous Vegetables. An Overview of the Cultivated Species. Natural Resources Institute/ACP-EU Technical Centre for Agricultural and Rural Cooperation, Chatham, UK.

Shackleton, C. M., Netshiluvhi, T. R., Shackleton, S. E., Geach, B. S., Ballance, A. & Fairbanks, D. F. K. (1999). Direct use values of woodland resources from three rural villages. Unpublished Report No. ENV-P-I 98210. Pretoria: CSIR.

Shackleton, S., Shackleton, C. & Cousins, B. (2000). Revaluing the communal lands of southern Africa: a new understanding of rural livelihoods. *Natural Resource Perspectives,* 62: 1-4.

Shackleton, C. M, Shackleton, S. E, Netshiluvhi, T. R, Geach, B.S, Balance, A. & Fairbanks D. F. K. (2002). Use patterns and value of savannah resources in three rural villages. *Econ. Bot.*56(2): 130-146.

Shackleton, C. M. (2003). The prevalence of use and value of wild edible herbs in South Africa. South African Journal of Science 99 (January/February): 23-25.

Shackleton, C. M., Margaret, W. P. & Axel, W. D. (2009). African Indigenous Vegetables in urban Agriculture, Earthscan/Dustan House, London, UK.

Smith, I. F. & Eyzaguirre, P. (2007). African Leafy Vegetables: Their Role in the WHO's Global Fruit and Vegetable Initiative. *African Journal of Food Agriculture Nutrition and Development*, 7 (3):1-17.

Sombroek, W. G., Braun, H. M. H. & Pouw, B. J. A. (1982). Exploratory Soil Map and Agro-Climatic Zone Map of Kenya, 1980, Scale: 1:1'000'000, Exploratory Soil Survey Report No. E1, Kenya Soil Survey Ministry of Agriculture - National Agricultural Laboratories, Nairobi, Kenya.

Sosina, B., Holden, S. & Barrett, B. C. (2009). Activity Choice in Rural Non-farm Employment (RNFE): Survival versus accumulative strategy.

Staggers-Hakim, R. (2012). The impact of globalization on the prevalence of obesity: trends and health implications in sub-Saharan Africa, in *Global Awareness Society International 21st Annual Conference*, New York.

Svotwa, E., Baipai, R. & Jiyane J. (2009). Organic farming in the small holder farming sector of ZIMBABWE. *Journal of Organic Systems*, 4 (1) http://www.organic-systems.org/journal/Vol_4(1)/pdf/08-14_Svotwa-et-al.pdf

Swanson, B. B, R. & Sofranko, A. (1994). Improving agricultural extension, FAO http://www.fao.org/docrep/W5830E/w5830e00.htm.

Ton de Jona (1996). Types and Qualities of Knowledge, Lawrence Erlbaum Associates, Inc., AE Enschede, The Netherlands.

Vandamme, E. (2009). Concepts and challenges in the use of Knowledge-Attitude-Practice surveys: Literature review. Department of Animal Health, Institute of Tropical Medicine, Antwerpen, Belgium, Unpublished.

Van Averbeke, W. & Juma, K. A. (2006). The cultivation of Solanum retroflexum Dun in Vhembe, Limpopo Province, South Africa. Proc. Int. Symp. on the Nutritional Value and Water Use of Indigenous Crops for Improved Livelihoods. 19-20 September 2006.

Vorster, I. H. J., Jansen, R. W., Van Zijl, J. J. B. & Venter, L. S. (2007). The importance of traditional leafy vegetables in South Africa. *African Journal of Food, Agriculture, Nutrition and Development*, 7(4):1-13.

Vorster, H. J., Jansen, W. S, Venter, S. L. & Van Zijl, J. J. B. (2005). (Re)-creating awareness of traditional leafy vegetables in communities. Regional workshop on African Leafy Vegetables for Improved Nutrition. Paper presented at Regional Workshop on African Leafy Vegetables for Improved Nutrition, 6-9 December 2005, IPGRI, Nairobi, Kenya (Available from ARC-VOPI, Pretoria, South Africa).

Vuyiswa, T., Phefumula, N. & Nomalungelo, G. (2012). People's perceptions on indigenous leafy vegetables: A case study of Mantusini Location of the Port St Johns Local Municipality, in the Eastern Cape, South Africa. Paper presented at the conference "Towards Carnegie III", University of Cape Town from 3-7 September 2012.

Wenga, G. R., Gordon, M. H. & Walker, A. F. (2003). Effects of enhanced consumption of fruit and vegetables on plasma antioxidant status and oxidative resistance of LDL in smokers supplemented with fish oil. *European Journal of Clinical Nutrition* **57**: 1303–1310.

Wood, S. & Tsu, V. (2008). Advocacy, communication and social mobilization for TB control: a guide to developing knowledge, attitude and practice surveys, WHO Library Cataloguing-in-Publication Data.

APPENDIX 1: CORRELATION MATRICES (n= 600)

	Gender	Marital status	Education	Main occupation	Farming experience	Age	Family size	Land tenure	Total land	Ploughing tools
Gender	1.0000									
Marital status	0.8522	1.0000								
Education	0.2867	0.2822	1.0000							
Main occupation	0.2992	0.2683	0.0956	1.0000						
Farming experience	-0.2195	-0.2104	-0.1832	-0.2448	1.0000					
Age	-0.0664	-0.0619	-0.0950	0.0394	0.0693	1.0000				
Family size	0.0675	0.0655	0.0273	0.0615	0.0388	0.1104	1.0000			
Land tenure	0.0027	0.0006	-0.0006	0.1244	-0.0178	0.0442	-0.0366	1.0000		
Total land	-0.0575	-0.0381	0.0276	0.0881	-0.1320	-0.0502	0.0827	0.0929	1.0000	
Ploughing tools	0.0885	0.0437	-0.0044	0.0331	0.0799	0.0522	0.0527	-0.0239	-0.0656	1.0000

APPENDIX 2: QUESTIONNAIRE (QUESTIONS FOR FARMERS)

My name is Donatien Ntawuruhunga, I am an Msc Student in Research Methods at Jomo Kenyatta University of Agriculture and Technology (JKUAT). I am doing a survey for African Indigenous Vegetables (AIVs) production in Kenya. Your household has been randomly selected for the interview. The information you provide will be useful in project planning for AIVs production and promotion in Kenya.

We request that you answer to questions as accurately and honestly as possible so that our findings and future activities are then based on addressing the real AIVs farming situation and problems faced by farmers like yourself. Your contribution will be highly appreciated.

Part 1: Interview Background

1.1 Survey details

Date of Interview	……/……/…….
Name of Enumerator	
Questionnaire Number	
County[1]	
Constituency	
Ward	
Village	
Name of Respondent & Telephone Number	
GPS coordinates (Latitude S, Longitude E)	
Elevation (m.a.s.l)	
Interview start-time	
Interview end-time	

1.2 Social and Demographic Status of Respondents

1.2.1. Gender of household head

	Gender (*see code*)
Male	
Female	

Gender: 1=Male 0=Female

[1] M= Machakos, N= Nyamira, B= Busia

1.2.2. Age of household head

……..years old

1.2.3. Relation of respondent to household head

	Tick appropriate
1. Self	
2. Spouse	
3. Son/daughter	
4. Other (specify)……..	

1.2.4. Marital status of household head

	Tick appropriate
1. Single	
2. Married	
3. Separated	
4. Divorced	
5. Widow/widower	

1.2.5. Education characteristics of household head

	Tick appropriate
1. No formal education	
2. Primary school education	
3. Professional training school education	
4. Secondary school education	
5. Higher education/university/college	

1.2.6. Main occupation of household head

	Tick appropriate
1.Farming (crop +livestock)	
2.Salaried employment	
3.Business	
4.Casual labourer on-farm	
5.Casual labourer off-farm	

1.2.7. Household composition

Number of Male	Number	Number of Female	Number
Less than 5 years		Less than 5 years	
6-15 years		6-15 years	
16-25 years		16-25 years	
26-35 years		26-35 years	
36-45 years		36-45 years	
46-55 years		46-55 years	
Above 55 years		Above 55 years	

Part 2: Verification/testing of Farmers' Knowledge about the Value, Health benefits and Potential of AIVs.

2.1.Knowledge on AIVs Nutritive Value

Please rate the following questions in regard to your understanding about the nutritive value of African Indigenous Vegetables.

		True (3)	False (2)	Don't know (1)
1	AIVs contain essential vitamins, particularly A, B and C, and minerals (such as calcium and iron) as well as supplementary protein and calories			
2	The high protein and vitamin contents in AIVs can eliminate deficiencies among children, pregnant women and the poor			
3	AIVs are nature's food and it is that naturalness in them that makes them healthy and nutritious			
4	AIVs overcooking destroys most of the essential phytochemicals especially the phenolic compounds which are beneficial in low doses			

2.2.Knowledge on AIVs Medicinal Value and Health Benefits.

Please rate the following questions in regard to your understanding about the medicinal value and health benefits of African Indigenous Vegetables.

	True (3)	False (2)	Don't know(1)
AIVs have health healing properties			

2.3.Knowledge on Agronomic Advantages of African Indigenous Vegetables

Please rate the following questions in regard to your understanding about the agronomic advantages of African Indigenous Vegetables.

		True (3)	False (2)	Don't know (1)
1.	AIVs are well adapted to harsh climatic conditions and disease infestation			
2.	AIVs are easier to grow in comparison to their exotic			

	counterparts			

2.4.Knowledge on economic importance of African Indigenous Vegetables.

Please rate the following questions in regard to your understanding about income generation and employment opportunities from African Indigenous Vegetables.

		True(3)	False (2)	Don't know (1)
1.	AIVs are important commodities in household food security			
2.	AIVs provide employment opportunities and generate income for the rural population			

Part 3: Portraying Farmers' Attitudes against African Indigenous Vegetables

1. **Please rate the following questions in regard to your degree of appreciation/perception about African Indigenous Vegetables' value, health benefit, agronomic advantages and economic importance.**

		Strongly agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly disagree (1)
1.	AIVs farming is a women's activities/business					
2.	AIVs is poor people's food, traditional lifestyle, and food of the older generation					
3.	AIVs consumption may cause health problems					
4.	AIVs are not grown and handled in a cleaner way					
5.	AIVs are unfashionable and not trendy compared to fast foods like French fries					
6.	AIVs are time consuming to process and to prepare compared to "modern					

	foods"					

2. Please rate your degree of preference of AIVs versus exotic vegetables.

		Strongly agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly disagree (1)
1.	The taste, appearance and quality of AIVs foods are not as good as that of modern foods					
2.	AIVs are cheap to produce and maintain compared to "modern foods"					

3. Please rate the frequency of AIVs consumption in your household.

	Always (5)	Often (4)	Sometimes (3)	Seldom (2)	Never (1)
How often do you eat AIVs in your household?					

4. Please rate your acceptability of attributes of AIVs recipes.

		Extremely acceptable (5)	Acceptable (4)	Neutral (3)	Unacceptable (2)	Extremely unacceptable (1)
1	Colour					
2	Smell					
3	Texture					
4	Taste					

5. Please rate your consumption intent in regard to AIVs recipes.

	I would eat it every day (7)	I would eat it very often (twice a week)	I would eat it frequently (once a week) (5)	I would eat it now and then/occasionally (once a month) (4)	I would eat it if available but would not go out of my way	I would eat it when no other food is available	I will never eat it (1)

		(6)			(3)	(2)	
Food action rating scale							

6. Please rate the barriers of AIVs consumption.

		Rank (*See code*)
1.	Lack of knowledge and skills in AIVs preparation and nutrition information	
2.	Lack of knowledge transfer between generations for younger generation's beliefs and pickiness	
3.	Urbanization and modernization have changed eating habits and induced a lack of the interest regarding AIVs knowledge by the youth	
4.	Lack of knowledge transfer from research institutions on AIVs nutritional benefits	
5.	Other (specify)…….	

Rank: 3= Most serious 2= Fairly serious 1= Least serious

Part 4: Investigation of AIV Farmers' Practices.

1. **What is your land tenure status? Please tick that appropriate.**

	Land tenure system	Tick appropriate
1.	Land owned	
2.	Land rented	
3.	Other (Specify)……..	

2. **Through which means did you acquire land? Please tick that appropriate.**

	Means of obtaining land	Tick appropriate
1.	Inheritance from parents	
2.	Purchased	
3.	Gift	
4.	Other (Specify)……..	

3. **What is your land area under crop production (hectares)? Please tick that appropriate.**

	Total land holding in hectares	Thick appropriate
1.	Larger farmer (farm greater than 5 hectares)	
2.	Medium farmer (farm greater than 2 and less than/equal to 5 ha)	
3.	Small farmer/Marginal farmer (farm less than/equal to 2ha)	

4. **Please estimate the space occupied by AIV production in your farm land. Tick that appropriate.**

	Proportion of land size occupied by AIVs crop	Tick appropriate
1.	≤ 10%	
2.	11-20%	
3.	21-30%	
4.	31-40%	
5.	41-50%	
6.	≥ 50%	

5. **What cropping system applied in your farming activities? Please tick appropriate.**

	Cropping practices	Tick appropriate
1.	Pure stand	
2.	Intercropping	

6. **Provide the names of African Indigenous Vegetables you grow and rank them in order of importance?**

Rank	AIV Name	Production over last season (kg)	Total consumed over last season (kg)	Sales over last season (kg)	Revenue over last season (KES)
1.					
2.					
3.					

7. **Why do you grow AIVs? Please tick that appropriate.**

	Main reason for cultivation	Tick appropriate
1.	Auto-consumption	
2.	Contract grower	
3.	Available market	
4.	Other (specify)……..	

8. **How many years have you been growing AIVs?**

Years of experience	Tick appropriate
0-5 years	
6-10 years	
11-15 years	
16-20 years	
>20 years	

9. **At what period of the year do you grow AIVs? Please tick that appropriate.**

	Farming period	Tick appropriate
1.	Farming in dry season	
2.	Farming under rain-fed conditions	
3.	Both	

10. **Please list tillage tools used for land preparation in the production of AIVs. Please tick *all* that apply.**

	Land preparation tools	Tick appropriate
1.	Axe	

2.	Hoe	
3.	Machete	
4.	Wheel barrow	
5.	Ox-plough cultivation	
6.	Tractor	
7.	Other (specify)……..	

11. Do you apply inputs in AIVs production? 1= Yes 0= No

12. Please tick *all* that apply.

	Inputs used	Tick appropriate
1.	Improved seeds	
2.	Inorganic fertilizer	
3.	Organic fertilizer	
4.	Pesticides	
5.	None	

13. If fertilizer is among inputs you apply, what kind of fertilizer do you use in AIVs cultivation?

	Type of fertilizer	Tick *all* that apply	Type of fertilizer	Tick *all* that apply
1.	NPK		4.Fallow practices	
2.	DAP		5. Farm yard manure	
3.	Urea		6. Green manure	
4.	Compost manure		7.Other (Specify)……	

14. If pest control is among your farming activities, what kind of pesticide do you use in AIVs cultivation?

	Type of pesticide	Tick *all* that apply	Pesticide name	Tick *all* that apply
1.	*Insecticide*		1. *Dimethoate*	
2.	*Fungicide*		2. *Cypermethrin*	
3.	*Traditional product*		3. *Thiodan*	
4.	*None*		4. *Dithane*	
			5. *Ridomil*	
			6. *Copper oxychloride*	

	7. *Don't apply pesticide*	

15. If you don't apply pesticide, give reasons.

	Reasons	Tick appropriate
1.	Spray cause health problems	
2.	Spray is harmful to environment	
3.	Lack of knowledge on the use of pesticides	
4.	Pesticides are costly	
5.	Other (Specify)……	

16. Do you buy the inputs? 1= Yes 0= No

17. If Yes, from where do you buy them? Please tick *all* that apply.

	Source of supply	Tick appropriate
1.	Agro-chemical dealers	
2.	Market	
3.	Other (specify)……..	

18. If No, how do you get them? Please tick appropriate.

	Source of supply	Tick appropriate
1.	Other farmers	
2.	Cooperatives	
3.	NGOs	
4.	Government subsidies	
5.	Other (specify)……	

19. Which water supply system do you apply in AIVs production? Please tick *all* that appropriate.

	Form of water supply in farming	Tick appropriate
1.	Rain-fed farming	
2.	Bucket/bowls irrigation	
3.	Watering can irrigation	
4.	Water conservation methods	
5.	Hosepipes	
6.	Furrow irrigation	

7.	Sprinkler irrigation	
8.	Drip or trickle irrigation	

20. Does climate change affect your activities of AIVs production? 1=Yes 0= No

21. If yes, what is the effect of climate change on your produce? Please tick *all* that apply.

	Climate change effect	Tick appropriate
1.	Frequent floods	
2.	Soil erosion	
3.	Wind erosion	
4.	Soil degradation/depletion	
5.	Drought	
6.	Plant diseases	

22. Which weed control technique do you apply for ridding your garden of these problematic plants? Please tick appropriate.

	Weeding techniques applied	Tick appropriate
1.	Mulch technique	
2.	Cover crop technique	
3.	Weeds pulling technique	
4.	Weeds digging technique	
5.	Weeds chopping technique	
6.	Garden edge trimming	
7.	Closing ranks (plants closer together)	
8.	Cut them off at the pass (encourage weeds to grow before you plant your garden)	
9.	Other (specify)…….	

23. Which main methods do you use for AIVs harvesting? Please tick appropriate.

	Types/methods of AIVs harvesting	Tick appropriate
1.	Uprooting the crop	
2.	Harvesting of leaves	
3.	Harvesting of leaves and stem tops	
4.	Other (specify)…….	

24. At what point of the day do you harvest AIVs? Please tick appropriate.

	Harvesting period	Tick appropriate
1.	Harvest during the cool part of the day (just after sunrise)	
2.	Harvest during the cool part of the day (just after sunset)	
3.	Both after sunrise and sunset	

25. How do you handle your harvest? Please tick *all* that apply.

	Harvest handling	Tick appropriate
1.	Cleaning	
2.	Washing	
3.	Grading/sorting to remove poor material	
4.	Shredding	
5.	Produce held in a shaded area while awaiting packing	

26. How do you package your AIVs product? Please tick that appropriate.

	Mode of packaging	Tick appropriate
1.	Plastic bag	
2.	Jute bag	
3.	Polythene bag	
4.	Basket	
5.	Plastic crate	
6.	Cardboard box	
7.	Metal box	
8.	Glass box	
9.	Wooden box	
10.	Other (specify)…….	

27. Do you sell processed AIVs? 1= Yes 0= No

28. If yes, what processing/preservation techniques do you apply to AIV product? Please tick that appropriate.

	Processing techniques applied to AIVs	Tick appropriate
1.	Simple sun-drying	

2.	Sun-drying & grinding into powder	
3.	Blanching/solar drying technology	
4.	Other (specify)…….	

29. Which main transport facility used in your AIVs product? Please tick appropriate.

	Transport facility	Tick appropriate
1.	Head	
2.	Wheelbarrow/mkokoteni	
3.	Animal	
4.	Bicycle	
5.	Motorbike	
6.	Van/pickup	
7.	Lorry	
8.	Matatu/bus	
9.	No transport needed (middlemen collect)	
10.	Other (specify)……	

30. Do you employ permanent and casual workers in your farm? 1= Yes 0= No

31. If Yes, how many permanent and casual workers employed in your farm?

	Category of workers	Number of workers	Monthly pay (KES)
1.	Permanent employees		
2.	Casual workers		

32. Where do you sell your harvest? Please tick that appropriate.

	Farm fresh produce outlet	Tick appropriate
1.	In the field	
2.	At home	
3.	Roadside markets	
4.	Open air/wet markets	
5.	Supermarkets	
6.	Cooperatives	
7.	Processors/industry	
8.	Middlemen	

9.	Retailers	
10.	Other (specify)……..	

33. Please state how far from your home is: 1. Nearest market; 2. Nearest Agrovet shop.

	Place	Distance (KM)
1.	Nearest market	
2.	Nearest Agrovet shop	

34. Have you ever experienced problems in AIVs production? 1= Yes 0= No

35. If Yes, what main constraints do you experience in AIVs production? Please tick *all* that apply.

	Type of constraint	Rank (*See code*)
1.	Access to farm inputs	
2.	Pests and diseases	
3.	Lack of preservation and processing technologies	
4.	Lack of market access	
5.	Other (specify)……	

Rank: 1= Most serious 2= Fairly serious 3= Least serious

36. Have you received any training on vegetables production in general and AIVs in particular? 1= Yes 0= No

37. If No, are you willing to attend a farmers' training? 1= Yes 0= No

A. If Yes, in what particular area? _____

B. If No, what is the reason? _____

38. What is your target in the AIVs production in the future 5 years? Please tick *ALL* that apply.

	Target	Tick all that apply
1.	Double production quantities	
2.	Purchase new land to extend production	
3.	Shift to exotic vegetables	
4.	Association of AIVs with exotic vegetables	
5.	Shift to other crop farming	
6.	Shift to cash crop farming	

7.	Set up agro-processing unit for AIVs (solar drying)	
8.	Open link with supermarkets to supply AIVs	

39. Suggest the way forward to improve the production and utilization of AIVs in Kenya. Please tick *ALL* that apply.

	Suggestions to improve AIVs production	Tick all that apply
1.	Improving availability of inputs	
2.	Quality planting materials	
3.	Training of AIVs producers	
4.	Awareness on the potential of AIVs	
5.	Farm Land use consolidation for AIV production	
6.	Other (specify)……..	

Thank you!

Enumerator's signature: ……..