

FROM CONSERVATION TO COMMERCIALISATION: AFRICAN INDIGENOUS VEGETABLES IN ARUA, DISTRICT OF UGANDA

ALENI COMFORT

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Faculty of Life Sciences

Albrecht Daniel Thaer-Institute of Agricultural and Horticultural Sciences

From conservation to commercialisation: African Indigenous Vegetables in Arua, District of Uganda

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Submitted by: Aleni, Comfort

1st Examiner (Supervisor): Prof. Dr. rer. nat. habil. Bokelmann, Wolfgang (Albrecht Daniel Thaer-Institute,Humboldt University Berlin)

2nd Examiner: Dr. Hartmann, Marco (Program Green Innovation Centres, Deutsche Gesselschaft fur Internationale Zusammenarbeit GmbH, GIZ)

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Dedication

This Thesis is dedicated to my lovely husband Mr. Thomas Hartmann and

my brother Yoti Moses who have always stood by me as well as

my friend Mr. Steffen Kogel-Linser

who has always helped me and believed that I could do it.

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Abstract

Despite the rich content of nutrients they possess, the consumption of African indigenous vegetables showed a decline due to the introduction of exotic vegetables such as cabbages. Several factors have compounded the popularity of the African indigenous vegetables, to name some: poor seed distribution, post-harvest handling and marketing. On the other hand, Agro-bio diversification has been shown to improve livelihoods, and African indigenous vegetables are a good candidate because of their agronomical advantages.

In the study undergone in Arua District in the West Nile region of Uganda, I intended to evaluate the potential of utilization of some selected African indigenous vegetables and to provide an integrated framework for their governance from conservation to commercialisation. The respondents were predominantly female above 60 years of age with no or low level of education.

Using the two analytical techniques, a framework of integrated approaches from conservation to commercialisation of the indigenous vegetable model and bubble maps I was able to realize and analyze the strengths and constrains its commercialisation. The constrains are mainly poor infrastructure, lack of inputs and financial capital, lack of knowledge on how to introduce a product to the market, lack of government support; absence of policies that support the development of Indigenous leaf vegetables and their marketing as well as negative belief against these vegetables.

I recommend awareness campaigns to raise the profile of such vegetables to incorporate them into mainstream agriculture. The hitherto neglected stakeholders like youths and agricultural extension workers should also be incorporated. I also realize the need to involve private stakeholders especially processing companies to help fulfil product control and process control aspects of the vegetables' value chain integration as outlined in the framework.

Finally more research is still needed to ascertain the alternative benefits of African Indigenous vegetable consumption to further boost the economic potentials.

CHAPTER ONE:

INTRODUCTION

1. Background

African Indigenous Vegetables (AIVs) have always ensured food security at the household level. A number of factors including negative perception, poor quality seed, and lack of technical packages, poor marketing and high perishability have however conspired against the sustainable development of good agricultural practices, efficient seed delivery system, breeding, conservation, processing, value addition, product development and commercialisation of AIVs. Kiremere et al. (2006) and Abukutsa (2010) have pointed it out that the collection and conservation of AIVs from the wild, as well as their consumption and domestication have been on the decline due to the introduction of temperate crops like cabbage. While these temperate crop brands have been well packaged to enjoy positive public perception, their production, value addition and consumption processes have also been well integrated into the African marketing systems to boost their preferences and economic potentials.

AIVs can be defined as vegetables whose primary or secondary center of origin is known to be in Africa (Schippers, 2000). They have been grown and utilized traditionally by many African communities and possess several advantages and potentials that have not been fully exploited (Schippers, 2000). They have high nutritive value. They contain high levels of minerals especially Calcium, Iron and Phosphorus (Abukutsa, 2010). They also contain significant amounts of vitamins and proteins (Mnzava, 1997). In most cases the mineral and vitamin contents are equivalent to or higher than that found in popular exotic vegetables like cabbage (Onyango, 2010). For example, per 100g of fresh weight edible portion of amaranths (an AIV) and cabbage (an exotic vegetable), the nutrition content of protein, Calcium, Iron and Vitamin C in amaranths far supersede that of cabbage (Maundu et al., 1999; Onyango, 2003).

1.1 Problem statement

AIVs have values such as high micronutrient content, medicinal properties, several agronomic advantages (Venter et al., 2004; Kimiywe et al., 2007). These vegetables often seem to grow easily, resist pests and diseases, and have acceptable taste. To date, AIVs are still collected in the wild, with a number of them under-cultivated for household consumption.

Given the advantages and potential values of AIVs and the constraints that curtail their optimal production and utilization, there is the need for a framework of integration that governs and ensures sustainable processes from their conservation to commercialisation. Over the years, farmers failed to increase their income opportunities as they are reluctant to go into large scale cultivation in this sector because they have limited information on AIV commercialisation potentials, agronomic practices and postharvest handling, that assure availability of food all year round.

Most communities are also not aware of all the nutritional and health benefits that AIVs can provide. According to Gockowski et al. (2003) and Madisa et al. (1997) the commercialisation of AIV can provide food security to vulnerable citizens and can be used as the source of household income, since they are the ones who are active in the production of these farm products. Thus the aim of this study is to investigate the conservation, production, marketing and values of utilization of selected AIVs and to provide an integrated framework for their commercialisation.

1.2 Major objective of the study

Major objective of the study is investigating values of utilization of some selected AIVs and to provide an integrated framework for their governance from conservation to commercialisation, which, will enhance rural livelihoods and ensure sustainable food security.

The specific objectives of the study therefore are to:

I. Identify the perceived values of utilization and economic potentials of AIVs in the rural areas of Arua district.

II. Assess different types of marketing channels of AIVs in the district.

III. Investigate constraints faced by farmers in commercialising AIVs

IV. Provide a framework of integration for the commercialisation of AIVs in the district.

1.3 Research questions

I. What are the values of utilization and economic potentials of AIVs in the rural areas of Arua district?

II. What are the existing market channels (if there are any) of AIVs?

III. What constrains are faced by farmers in the commercialisation of AIVs in the district?

IV. What institutional framework best govern AIVs from conservation to commercialisation?

1.4 Significance of the study

Several agricultural experiments have indicated that AIVs have values and economic potentials that can contribute significantly to rural development (Schippers, 2000; Onyango, 2003; Kiremere et al., 2006). There is also an assumption that there is a market for AIVs, so it is essential to promote them by investigating their values of utilization and economic potentials and also by adopting an institutional framework that governs processes from their conservation to commercialisation. The information generated will be useful to policy makers and farmers since it will outline the values of utilization, commercial potentials and an efficient system for the acquisition, production, marketing and consumption of AIVs. Policy makers will be able to develop policies that improve and promote the potential production and commercialisation of AIVs. The study will also help highlight other production and marketing systems towards the transformation from subsistence to commercial production of AIVs in Arua district.

CHAPTER TWO:

LITRATURE REVIEW

2. Literature Review

2.1 African Indigenous Vegetables (AIVs)

African Indigenous Vegetables (AIVs) have played an important role in farming and consumption systems across Africa throughout history. Their ease to grow and minimal external input requirement make them particularly suitable for resource-poor farmers, unlike most exotic vegetables (Opole et al., 1991). They are also an integral component of many traditional dishes. However, in addition to the promotion of Green Revolution high-yielding varieties which takeover many local landraces (Thies, 2000), modernization and the progression of the market economy in Africa (Weinberger and Lumpkin, 2007) implies that scientific agronomic research and development has changed its preference to exotic crops which are practical for export. As a result it has assumed the meaning that AIVs are grown by subsistence farmers only as 'hunger food' that people consume in times of need and drought (Humphry et al., 1993), or as a safety net during social unrest and war (Smith et al., 1996a, 1996b), or as important part to dietary requirements of isolated communities (Grivetti and Ogle, 2000).

In a sense of deeper awareness of the multi interactions between agriculture and environment, the limitations of the Green Revolution, concern about rapid climate change, the realization of the need for a highly diversified diet, rich in vegetables and fruit, for good health, and a shift from top-down to community-driven rural development, these neglected and underutilized species have begun to attract considerable interest for their multiple underused benefits in terms of nutritional and food security, income generation and medicinal value, suitability for low-input systems and for marginal environments.

Investment in research and development covering production to commercialised chains for AIVs could leverage the distinct advantages that exotic crops have over these less frequently studied crops. The revival of the use of indigenous AIVs within communities in Africa will ensure a focus on the conservation of these crops added to the availability of diverse genetic material for future needs.

2.2 Conservation of AIVs

AIVs are normally collected from the wild assumed as “weeds” in agricultural and disturbed spaces for millennia (Jansen van Rensburg et al., 2007) and there is long history of these crops being tolerated and nurtured in agricultural lands and homestead plots (Vainia-Mattila, 2000; Keller, 2004; Jansen van Rensburg et al., 2004, 2007). A number estimated to reach 115 in dicates the indigenous African food-plant species excluding the 150 known AIV currently consumed in the world (Adebooye et al., 2004). To name some of the main regions which consume such plants: Ethiopian highlands, the Sahelian transitional zone, the delta of Niger River and the humid forest zone of West and Central Africa (Kiambi and Atta-krah, 2003).

Moreover it is of high probability that a fair proportion of species are not to be found anywhere else in the world (Endemism) but in Africa (Kiambi and Atta-krah, 2003). Endemism in Tropical Africa at the general level has been estimated to be 45% (Sayer et al., 1992). The countries of West and Central Africa sub-regions have identified a large number of underutilized species that are important to the livelihoods of local population (FAO 1998). According to Adebooye et al. (2003) an expanded list of twenty-four indigenous leaf vegetables are utilized in the daily meal in southwest Nigeria only. Several other species have been listed by Okafor (1978, 1983) in Nigeria, (Abbiw 1990) in Ghana, (Chweya 1997) in Kenya, (Rubaihayo 1997) in Uganda, (Seck et al., 1997) in Senegal and (Okigbo 1977) for the entire tropical Africa. The Plant Resources of Tropical Africa (PROTA) studied to be approximately 30,000 plant species for Tropical Africa of which only 6,376 (21%) are consumed by habitants of the various regions in Africa (PROTA, 2004).

In 2004 103 authors and 46 co-authors cooperated to the publication of The Plant Resources of Tropical Africa on detailed cultivation practices for 280 African indigenous leaf vegetables.

Table 1: A summary of the number of useful species and endemism in seven selected African countries

Country	Size (km²)	Used plants	Endemism
Cape Verde	4,033	774	92
Gambia	11,300	974	3
Ghana	238,539	3,600	43
Guinea-Bissau	28,000	1000	12
Liberia	111,370	2,200	unknown
Nigeria	923,768	4,614	205
Sierra-Leone	71,620	2,090	74 and 1 genus

Sources: IUCN (1997), Okali and Fasheun (1997), Tuffour (1994) and Sayer et al. (1992).

Plant resources are basic ingredients for biotechnological research (Adeboye et al., 2004). Lewis (1985) stated that an adequate gene resource conservation program is as important to genetic engineering as a series library is to the whole human knowledge. Germplasm collection of indigenous leaf vegetables, fruits and spices, their wild relatives and landraces are essential if biotechnology is to move ahead (Witt, 1995). Perrino (1992) confirmed two reasons as of why biotechnologists need germplasm collections. First, because they are not able to invent genes, they need models to synthesize them. And second, biotechnology will continue to depend heavily on naturally occurring genes in their experiments to influence the future. Gene banks therefore are of huge importance to the gene hunters and to biotechnology in general (Adebooye et al., 2004).

Africa's plant diversity, in general, is being seriously degenerated as a result of multiplicity of environmental, political and socioeconomic factors (Adeboye et al., 2004). With the realization of the threat to plant diversity in Africa the first step in the conservation effort should be a mission of collecting samples of the available useful indigenous plants as a matter of urgency. It is imperative therefore that the diversity within the gene pools, including the wild relatives are adequately collected, conserved and used in the broadening of the genetic base in crop improvement programs. Africa is rich in a wide diversity of indigenous useful plants and there is a dire need for greater investment in their conservation and sustainable utilization in order to broaden the base of agriculture and improve food security.

Shackleton et al. (2009) showed that poor conservation of certain AIV species or varieties is one of the main concerns. While in the cultivated species the major loss is at varietal level, for wild species the main concern is loss of their habitats and overexploitation (e.g. *Gnetum africanum*), leading to diminished populations that are not viable and even local extinctions. It's been suggested that research on easy and cheap technologies of cultivating the plants should be an issue of first order. Their study showed as well that species such as *Chrotalaria brevidens* and *C. ochroleuca*, are increasingly becoming rare in the wild with the current population is being generally maintained by farmers. Rare farmers' varieties (landraces) are encountered in many cultivated species, including the bottle gourd and watermelon. Ex situ conservation, mainly in gene banks, coupled with specific strategies of in situ conservation and the promotion of use are needed for many of these rare farmer varieties with restricted distribution.

On conservation through use, Maundu and Morimoto (2008) clarified that even though there is a huge diversity of AIVs, only limited numbers of species have widespread use in the continent and its regions. Species or varieties that are not important to a community would be more likely to be neglected and forgotten in favor of useful ones. Many AIV species and varieties can thus be saved if some values are inculcated to them by the communities. Declining use of less common AIVs is likely to lead to loss of knowledge and, finally, loss of the species or variety. Awareness of the value could contribute to conservation.

Many of the minor underutilized species, particularly those of African origin, however, have to be subjected to research, improvement and promotion for more widespread consumption (Shackleton et al., 2009). Shackleton et al stated that simple selection work can often result in an enormous improvement of desired characteristics such as leaf size and hence yields. Works carried out in the past have shown that selection alone could considerably improve the leaf size and other characteristics of AIVs within a relatively short period of time.

The introduction of exotic vegetable varieties in Africa is generally believed to contribute to the decline in the production and consumption of African indigenous vegetables (Smith and Eyzaguirre, 2007). However, some literature states that declining use of traditional vegetables is due to declining availability (Adedoyin and Taylor, 2000; Okeno et al., 2003), while others argue that traditional vegetables are readily available, especially during the rainy season, but remain

among the least consumed foods (Maziya-Dixon et al., 2004). Thus, conserving traditional plants themselves is only one part of the story: While it is important to maintain traditional knowledge of the advantages of these crops, it is also important to use, prepare, store and consume them in short, conservation through usage.

2.3 Production and marketing of AIVs

According to investigations by Shackleton et al. (2009) there are many production systems of AIVs between two cities in Uganda whose differentiating attributes include location, size, proximity to homestead, commercial or subsistence, nature and quantity of inputs, and whether the crops are planted in mixed or pure stands. Different combinations of these attributes result in a wide array of production systems, both within countries and between them. The table below shows considerable regional differences in AIV production systems between two cities in Uganda.

Table 2: Regional differences in AIV production systems between Kampala and Mbale cities in Uganda

AIV	*Kampala (n = 94)*					*Mbale (n = 74)*			
	Field	*Home garden*	*Inter-cropped*	*Pure stand*	*Mix-cropped*	*Field*	*Home garden*	*Inter-cropped*	*Pure stand*
African eggplant	66.2	10.8	13.8	4.3	2.1	44.0	25.6	2.7	74.3
Ethiopian mustards	55.4	9.5	10.6	9.6	1.1	4.4	24.4	6.7	55.4
Amaranthus	29.7	23.0	46.8	17.0	2.1	54.4	30.0	2.7	50.0
Cowpea	21.6	5.4	4.36	1.1	–	48.9	23.3	2.7	28.4
African nightshade	8.1	4.1	–	–	–	–	–	–	12.2
Spider plant	8.1	5.4	15.1	7.5	7.5	7.8	30.0	–	13.5

Source: IndigenoVeg survey data, 2006

Source: IndigenoVeg survey data (2006).

Compared to production as an intercropped or pure stand, approximately one third of AIVs are intercropped, while two-thirds are cultivated in pure stands, with 67% of all plots using sowing rather than broadcasting in Tanzania (Weinberger and Msuya, 2004).

On the other hand, in rural areas of the continent subsistence AIV cultivation generally follows an extensive cropping fashion in association with staples or tree crops. AIVs are planted between and around other staple crops such as maize, cassava, etc. (Shackleton et al., 2000). Van Rensburg et al. (2007) showed that AIVs are harvested from the wild, or from cultivated fields where some of them grow as weeds. This study indicated that the production of AIVs have a history that has been directly associated with women and their traditional livelihood activities. Production and marketing is undergone mainly by women. However, as soon as cash generation potential of the crop increases, men become more involved (Jansen van Rensburg et al., 2007; Shackleton et al., 2009) which is true with many other natural resources. These studies also highlighted that in remote rural areas the use of this AIVs is still common with a decline in availability particularly in urban areas.

The positive role of AIVs in nutrition supply and employment both in production and marketing among urban and semi-urban households has been scrutinized. For example in Cameroon, AIVs contribute a visible share of essential nutrients for the urban people who are in need. Price analysis showed that a decline in supply during the dry season, which is a food security concern for the very poor. It is estimated that over 32000 households are to be engaged in producing and marketing AIVs under readily accessible entry conditions.

Three production methods were disclosed in the area:

A. an intensive system within the urban limits,
B. a semi intensive style in the urban periphery,
C. an extensive style also in the urban periphery.

According to the results of the studies, it has been showed that the biggest number of producers were women employing an extensive mixed crop system (Gockowski et al., 2003).

In South Africa Vorster (2007) studied the role and the production of AIVs in three rural communities. The outcomes showed that AIVs production is mainly female oriented, and these vegetables are mostly produced for household consumption. Marketing of these products was minimal and the revenue generated subsidized household income.

AIVs were commonly intercropped with maize and some are uncultivated just harvested from maize and fallow land. Because of bio-physical and socio-economic factors a difference in production was found between three villages.

Nevertheless, the demand for AIVs in Tanzania, Botswana and Zambia (Lyatuu et al., 2009) has been observed to significantly increase. On the other hand AIVs are at risk of being diminished in these countries, as farmers are replacing them with improved varieties. The lack of seed and information about their performance, input requirements and marketing can be stated as reasons. It was as well showed that AIVs marketing are characterized by inadequate government intervention. The challenges that farmers are facing are lack of reliable market information, market advisory service providers and lack of pricing mechanism. Farmers sell their products just to cover their cost of living, rather than considering their production cost, supply and demand conditions. High perishable nature of AIVs creates a major challenge in distribution and marketing.

In the rural areas there are a variety of edible plants consumed. In the Limpopo and KwaZulu-Natal provinces in South Africa, for example, the most consumed leafy vegetables by households were found to be amaranth (*Amaranthus spp*), spider plant (*Cleome gynandra*), and wild watermelon (*Citrullus lanatus*) and blackjack (*Bidens spinosa*), which were consumed individually or mixed with other leaves. Rural households got most of their leafy vegetables from the wild while the urban households bought from informal market (Faber et al., 2010).

According to Madisa and Tshamekang (1997) Botswana indigenous vegetables are mostly imported from South Africa. They also indicated that exotic vegetables demand high inputs for production and nutritional quality and yields are often low compared to indigenous vegetables of equal or better nutritional status could perform better under cultivation with relatively low input levels. Indigenous vegetables market is still disorganized; they are cheaper than exotic imports and thus affordable by an average citizen. Dried AIVs showed economic potential on the local market, because of their easiness to produce and production is by traditional methods. They are popular and marketable even in urban areas. They can be stored for a long time and are easy to transport. AIVs have a good economic potential as they can be sold fresh or dried, which means that the producer does not lose the produce.

Women play a major role in marketing of AIVs. According to Buabeng et al. (2002) on the role of women in marketing of indigenous vegetables: opportunities and challenges, Kumasi, Ghana, women (99.5%) were the main retailers and also served as middlemen from production points. The study also identified major challenges on marketing to be the lack of storage facilities, poor market structures, unreliable market arrangements, and transportation. Findings from the study suggest that there are good opportunities to take greater advantage of AIVs as valuable local food resources.

According to Nekesa and Meso (1997) traditional vegetables provide an important economic mainstay for rural Kenyan livelihood especially women. Production, handling and marketing were mostly done by women; only one man was involved out of the 20 vendors and 20 farmers contacted during the survey. The farmers harvest, pack and transfer the vegetables to the buying point nearest to their farms, usually by a roadside. Vendors from urban areas buy and transport vegetables to strategic wholesale urban markets while their counterparts in the retail sector purchase and transfer the vegetables to strategic retail points. One woman producing traditional African vegetables provides employment to wholesaler and a retailer and made a profit of well over 75 percent.

Added to the aforementioned obstacles, several international agreements have an influence on the commercialisation of indigenous vegetables. Yet, legislation and regulations with regard to indigenous knowledge systems are not yet executed. This worsens the challenge to work on indigenous plants. The study also indicated that some of indigenous plants are only useful to fill small niche markets; others have the potential to become new products for consumers. It also indicates possible aspects which could enhance commercialisation of the products. As an example are given technology, market information, entrepreneurial and business skills training, social awareness, environmental awareness, and access to finance (Reinten and Coetzee, 2002).

Participation in markets for indigenous vegetables for small farmers and other participants determines if they benefit from, whether in domestic markets or for high-value market segments, depends to a large extent upon how the market is organized. Shackleton et al. (2009) investigated the relative benefits of small farmers and other actors in the value chains of AIVs. They found out for poor farmers to have market access and even market competition, intermediaries and

retailers to livelihoods, one must understand what stakeholders are involved in the supply chains, what their roles and interests are, and what barriers to entry there are, hence the objective of their research was to provide an overview and status assessment of the marketing of AIVs in a multi-country survey of seven countries considered to be the representative regions of sub-Saharan Africa (SSA) in the production, marketing and consumption of AIVs. The outcome of the survey shows that the production, handling and marketing of AIVs are activities of considerable size and value in the countries studies, and that AIVs comprise a lucrative market worth billions of US dollars across sub-Saharan Africa. The marketing and production of these vegetables also provide employment and livelihoods to millions of farmers and other participants. Data available from the survey also show that the farm share in the retail price is comparatively high for indigenous vegetables, sometimes higher than for exotic vegetables.

2.4 Socio-economic attributes of AIV farmers

Few authors have highlighted the economic importance of AIVs for income generation and livelihoods (High and Shackleton, 2000; Gockowski et al., 2003; Weinberger and Msuya, 2004; Ngugi et al., 2007). They all indicate the role AIVs play in the economy of rural livelihood and highlight that these are crops that are being marketed, rather than serving as subsistence crops only. To consider wholesaling and marketing supply chain of AIVs, (Gockowski et al., 2003) investigated the importance of leafy AIVs for urban and sub-urban livelihoods in Yaoundé (Cameroon). Their result turns out to show a high level of participation by women in AIV marketing because of the low starting capital in the business, allowing even the poorest households to participate. In this study, while earnings per product were found to be significantly higher for exotic vegetables than for traditional leafy vegetables, it was also found that there was no significant difference in gross margins between retailers of exotic and traditional leafy vegetables. In this study, the low elasticity for this group of food items in higher expenditure classes indicated that demand for these vegetables may decline as incomes increase.

However, other examples from South-East Asia show that indigenous vegetables have the potential for commercial exploitation (Weinberger, 2007). Urban supermarkets in this region increasingly stock a wide variety of indigenous vegetables for affluent consumers.

With a focus on a socio-economic a survey has been conducted by Mahyao et al. (2006) in Côte d'Ivoire to show the value chain of AIVs in the two biggest cities (Abidjan and Yamoussoukro) of the country, it was found that rural markets of Yamoussoukro constitute suppliers of AIVs to secondary urban markets (93%) where the vegetables are commercialised.

In Abidjan, AIVs were commercialised on principal urban markets (66%). Women dominate the markets supply chains significantly (100% at Yamoussoukro and 97.5% at Abidjan). Major participants in the chains are the producer-retailers, the wholesaler-retailers and the retailers. These traders were young and are of different social background, and majority of traders were illiterate (76% at Yamoussoukro and 67% at Abidjan). Urban markets supply chains of indigenous leafy vegetables (AIVs) are socially and economically important in the country.

In Nairobi, a descriptive cross-sectional survey has been undergone by Kimiywe et al. (2007). The survey subjects included populations from all socio-economic strata and income levels. Consumption and usage of AIV was found to be significantly influenced by Ethnic origin. On the other hand household income and education level and choice or use of AIVs had shown no significant relationship among themselves. More than 60% of the respondents reported that the vegetables had a medicinal value associated to them and some were said to cure more than one disease.

AIVs have considerable potential in generating cash, helping the poorest people in the rural communities to make a living (Schippers, 2000; Onyango, 2003). Socio-economic survey on traditional vegetables conducted in various parts of Africa (Schippers 2000; Onyango, 2002) revealed that indigenous vegetables are important commodities in household in order to maintain food security. They not only provide employment opportunities but also generate income for the rural population. The high demand of these indigenous vegetables in cities and major towns, makes 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. Over 70% of the traded vegetables in rural markets were indigenous vegetables while in bigger towns it was about 10%. However, there was generally a poor marketing system in some of the countries. (Abukutsa-Onyango, 2002; Schippers, 2000).

Moreover, AIVs have good monetary returns in some instances. For example, a study held by Adebooye and Opabode (2000) shows that *Solanecio biafrae*, an indigenous leaf vegetable in south-west Nigeria, is several times more expensive than the routinely cultivated species, especially during the dry season. Experience has also shown that other AIVs such as *Telfairia occidentalis*, *Celosia argentea*, *Amaranthus cruentus and Solanum macrocarpon* are also sold at high prices during the dry season in south-west Nigeria. Abukutsa-Onyango (2003) showed that AIVs offer a significant opportunity for the poor people in western Kenya to earn a living because AIV production can be done with little capital investment.

A survey conducted by IndigenoVeg in 2006 shows that urban and sub-urban AIV production is perpetuated by vulnerable groups, often migrants who came to cities in search of jobs in the secondary or tertiary sector, but had engaged in AIV production in the absence of better options. AIV production thus provides employment opportunities and income for those who are outside the formal sector. The average revenue from the three most important AIVs were found to exceed US dollar 540 for the Abidjan wholesalers and US dollar 200 for Kampala farmers. They are suitable for the resource poor since they are easy to grow and require minimal external inputs to do well (MATF, 2006).

2.5 Opportunities and constraints in commercialisation

Enhancing commercialisation of AIVs may negatively influence weaker actors along the chain, such as the young, the uneducated and women according to the research carried out by Shackleton et al. (2009). Their data shows that in urban centers, where land is scarce and expensive, the share of men in production and trading is higher than would be expected. Urbanization appears to lead to a displacement of small-scale farmers by wealthy urban residents and (usually male) immigrants to cities. The latter often enter commercial AIV production since this requires little start-up capital. They conclude that more research is however needed to understand how commercialisation of indigenous vegetables will affect the livelihoods of AIV value chain actors, especially within a spatial context, considering the role of increasing urbanization. Such research could provide the basis for the development of improved market coordination mechanisms, including for improved coordination and information.

A study by Gebreselassie and Ludi (2007) stated that commercialisation of AIVs in the African small family farms can play a key role in the value chain especially at international level. The results indicated that commercialisation process reinforces the production of staple food crops and provides opportunity for further diversification of agriculture in the areas under consideration. The level of commercialisation consistently increased with the size of farm which indicates the positive role of capital accumulation in the form of farm land in fueling the commercialisation process. The study shows that diversification into high-value horticultural crops is one potential avenue for commercialisation of small scale farmers while assisting farm households to improve their income.

In recent years, there has been a boom in the consumption of AIVs. For example Shiundu and Oniang'o (2007) found that the market share of AIVs in comparison with other vegetable species has been in progress, in the urban markets and increased consumption in rural areas too. However issues of quality control, reliability and pricing remain critical to the future success of AIVs farming. Women have been closely associated with cultivation and selling of AIVs; however, studies have shown that whenever a crop begins to appreciate in the market and starts fetching higher income, men tend to push their way into the trade.

According to Abukutsa (2007) major obstacles the production of AIVs has to face in Western Kenya are poor seed quality, pests and diseases, drought, poor marketing channels, transport to markets, lack of agronomic and utilization packages are among the major constraints that hinder optimal production of AIVs. Seed quality is normally affected by the agronomic practices used, the time of harvest and seed processing procedures.

Generally AIVs have a potential to improve the daily diets of the urban as well as the rural households. However the challenges need to be addressed. In Nairobi, in particular, constrains included poor physical infrastructural development in terms of road network, storage facilities and actual physical trading space (Irungu, 2007). Other factors included unfavorable policies for production and marketing, lack of capacity to regulate in supply, lack of product differentiation and value addition, lack of credit and other forms of support to traders.

2.6 Values of utilization of AIVs

A number of studies have shown that utilization of AIVs is highly valuable mainly in its nutrition aspect. AIVs contain high levels of minerals especially Calcium, Iron and Phosphorus. They also contain significant amounts of vitamins and proteins (Mnzava, 1997). On average 100g 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 are therefore a valuable source of nutrition in rural areas where they contribute substantially to protein, mineral and vitamin intake (Mnzava, 1997). They are compatible to use with starchy staples and represent cheap but quality nutrient source to the poor sector of the population in both urban and rural areas where malnutrition is widespread. In case of mineral nutrients such as calcium, iron and zinc the bioavailability is however not assured as certain phyto chemicals like phytates bind them making them unavailable (Makokha and Ombwara, 2005). There is need for studies on bioavailability of such micronutrients.

There exists a wide variation in nutrient content in tropical AIVs. Yang et al. (2007) carried out studies on 120 vegetable species mostly native to tropical and subtropical zones, they disclosed the presence of vitamins, minerals, polyphenols and oxalate. However, palatability of these high-nutrient AIVs is a concern because of their high dry matter and crude fiber content, although, the high dry matter could be an advantage to preserve the nutritional values of dried vegetables because shorter processing time is required, thus reducing nutrient losses.

An exceptional high iron content of AIVs has been reported (Grubben and Denton, 2004). Iron contamination in African plant foods from soil and food processing facilities were also reported (Bothwell et al., 1979; Hallberg and Bjorn-Rasmussen, 1981; Abebe et al., 2007). Contaminant iron could significantly elevate total iron content of plant foods more than ten times higher than plant intrinsic iron. Calcium contamination from soil was also reported for vegetables containing exceptionally high calcium content (Abebe et al., 2007). The bioavailability of iron and calcium remains uncertain because of contaminants (Derman et al., 1982; Harvey et al., 2000; Hooda et al., 2004; Teucher et al., 2004). Studies investigating the iron and calcium contents of AIVs should therefore be carried out under conditions that avoid contamination.

Nutrient densities among AIVs are found to be highly variable (Yang et al., 2006, 2007). On average, indigenous and adopted vegetables are more nutritious than exotic. In particular, values for antioxidant activity were high for indigenous vegetables. Among species, AIVs show a wider content range for most micronutrients. The wide range of nutrient contents indicates that there is great potential to increase nutrient supply by incorporating nutrient dense vegetables within diets. Among the AIVs currently consumed in East Africa and West Africa cowpea leaves (*Vigna unguiculata*), baobab leaves (*Adansonia digitata*), amaranth (*Amaranthus viridis*), spider plant (*Cleome gynandra*), jute mallow (*Corchorus olitorius*), moringa leaves (*Moringa oleifera*), African nightshade (*Solanum scabrum*), cassava leaves (*Manihot esculenta*), pumpkin leaves (*Cucurbita spp*.) and sweet potato leaves (*Ipomoea batatas*) are nutritious and relatively high in β-carotene and iron content (Weinberger and Swai, 2006; Grubben and Denton, 2004). These AIVs deserve greater promotion for household consumption.

Moreover, AIVs have traditionally been used for medicinal purposes. Several studies have been done on the perceived nutraceutical properties. This is mainly attributed to their bitter tastes. Most of such vegetables have been reported to have health and medicinal properties and some have been known to heal stomach-related ailments (Kokwaro, 1993; Olembo et al., 1995). For instance, spider plant has been reported to aid constipation and facilitate birth while African nightshades have been reported to cure stomachache.

Limited information is available on the way of preparation of AIVs suggests that the presence of undesirable chemical compounds in these crops cannot be overseen. Most of the indigenous vegetables have been reported to contain anti-nutrient factors. Due to these limitations, successful commercial exploitation of AIVs, need to be studied (Onyango, 2010).

A different aspect that could be exploited is phyto-chemicals or Nutraceuticals which are biologically active, non-nutrient compounds that provide health benefits. These phytochemicals help promote optimal health by lowering risk of occurrence of chronic diseases like cancer. Some of the phytochemicals are namely antioxidants, scavenge for and bind free radicals that occur in the body which could cause cancer and other ailments if left unchecked. Further investigation need to be done to elucidate the medicinal properties of these AIVs.

Considering the user, utilization can be enhanced visibly by increasing awareness of the benefits of AIVs – particularly their health benefits. Nutritional profiles are thus crucial in promotion (Shackleton et. al., 2009). For African vegetables, such profiles are scanty and often limited to a few nutrients – hence the need for more complete nutritional profiles is high. It is also important for consumers to access recipes that they can test and improve upon to fit their own cultural context. Their study results suggested the need for documentation of local AIV recipes and wide dissemination of information. It is also called for concerted efforts by local and international research and development organizations, as well as by relevant government agencies to promote local AIVs. Additionally, this should be supported by research and the right policies. Government departments and ministries responsible for food, health and agriculture need to spearhead the development and implementation of relevant policies that recognize the potential role that AIVs can play in enhancing nutrition, health and general livelihoods. Policies should also recognize the need to conserve the diversity of AIVs by promoting different diets and methods of preparation in order to avoid loss of varieties as a result of a few species or varieties dominating the markets and dishes.

There are a number of agronomic advantages of AIVs that could enhance their value of utilization over their exotic counterparts. A study by Onyango (2010) shows AIVs are more suitable to harsh climatic conditions and disease infestation and are easier to be cultivated in comparison to exotic breeds. They 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 inbuilt ability to withstand and tolerate some biotic and abiotic stresses. They also flourish under sustainable and environmental friendly cropping conditions like intercropping. Furthermore, because most of them have not been intensively selected, they have wide genetic bases, which is important in sourcing new genotypes and/or genes for climate change adaptation.

CHAPTER THREE:

RESEARCH & METHODOLOGY

3. Research & Methodology

3.1 Geographical description & population of study area

Arua District, referred to as the West Nile District lies between longitude 3^0 30'E and 31^0 30'E and latitude 2^0 30'N and 3^0 50'N in the Northwestern part of Uganda. It is bordered by the Republic of Sudan in the North West, Yumbe District in the North East, Democratic Republic of Congo in the West, Nebbi District in the South, and Amuru District in the East. Figure 1 below shows the location of Arua district in Uganda. Arua Town, the Administrative and Commercial Headquarters of the district is 520 kilometers away from Kampala, Uganda's Capital City. The district covers a total area of 5419.64 km^2. The land area is 5207.91. Of which about 87% is arable.

Figure 1: Location of Arua District in Uganda



Source: http://3.bp.blogspot.com/-Z71QXejbk_I/UFWQ2UXVBlI/AAAAAAAAGd8/C2I6XuZ-vjw/s1600/map_uganda.jpg (accessed on 08/09/2017).

Arua District comprises 7 Counties, 36 Sub-counties (including the divisions in the urban councils and the newly created sub-counties), 232 parishes (LCIIs) and 2058 villages (LCIs). The district has two Urban Councils namely, Arua Municipal Council and Koboko Town Council. The District has a bi-modal rainfall pattern with light rains between April and October. The wettest months are normally August and September which receive 120mm/month. The average total rainfall is 1250mm. The mean monthly evaporation ranges from 130mm - 180mm. In the dry season (December -March) temperatures remains high throughout.

According to the District State of Environment Report (2004), Arua had a total population of 855,055 on September 2002. Over a period of about 12 years (January 1991 to September 2002), there was an increase of about 316,908 (about 60%) from 538,147 (excluding Yumbe District, then Aringa County in Arua District) to 855,055 in 2002. This was the highest inter-censual increase ever recorded in the District. Table 3 shows the population of the district from 1980 to 2002

Table 3: Arua District population 1980 - 2002

Year	**1980**	**1991**	**2002**
Population	394.303	538.147	855.055

Source: Office of the District Planner – Arua (2004).

3.1.1 Gender composition of the population

The gender composition of a population is useful for understanding the past trends of population change. The gender ratio defined as the number of males per 100 females is an index for comparing the numerical balance between the two genders in different population groups irrespective of the size, location and time reference. Overall, there are 409,203 males compared to 455,852 females giving a gender ratio 91.8 males per 100 females. Table 4 shows male and female population by sub-county

Table 4: Arua District male and female population by sub-county

County	Sub County	Male	Female	Total
Arua Municipality	Arua Hill	7,581	7,856	15,437
	Olli River	15,221	15,225	30,446
Ayivu	Adumi	19,307	21,960	41,267
	Aroi	9,128	10,090	19,218
	Dadamu	12,420	13,426	25,846
	Manibe	11,096	12,450	23,546
	Oluko	13,551	14,827	28,378
	Pajulu	16,749	18,324	35,073
Koboko	Koboko Town Council	14,561	14,882	29,443
	Kuluba	8,894	8,765	17,630
	Lobule	18,283	18,509	36,792
	Ludara	9,226	9,404	18,630
	Midia	14,170	14,910	29,080
Madi-Okollo	Offaka	8,639	93,998	18,037
	Ogoko	6,630	7,167	13,797
	Okollo	5,790	6,251	12,041
	Rhino Camp	7,682	8,264	15,946
	Rigbo	14,170	14,810	29,009
	Ullepi	3,200	3,460	6,660
Maracha	Yivu	9,310	10,548	19,858
	Nyadri	10,194	11,495	21,689
	Oleba	10,868	12,200	23,068
	Oluvu	11,500	13,304	24,804
	Tara	7,580	8,237	15,817
	Oluffe	8,094	9,111	17,205
	Kijomoro	13,211	14,936	28,147
Terego	Aii-vu	14,510	15,231	29,741
	Bileafe	7,226	7,434	14,660
	Katrini	13,357	14,621	27,975
	Udupi	19,394	19,265	38,659
	Omogo	15,214	16,335	31,549
	Uriama	8,439	8,727	17,166
Vurra	Ajia	9,311	10,284	19,595
	Arivu	7,704	8,542	16,246
	Logiri	11,528	12,479	24,007
	Vurra	15,439	23,125	38,564
District Total		**409,203**	**445,852**	**855,055**

Source: Office of the Planner - Arua (2004).

3.1.2 Household population

In demographic terms, a household is defined as a group of persons that normally live and eat together (Uganda Bureau of statistics, 2014). According to 2002 Census, out of the total population of the district (855,055), 98.6% (843,378) were living in the households while the remaining were institutional population. Total number of household in the district was 153,701. The mean household size (summary measure that gives the number of residents per household, obtained as the ration of the total household population to the number of households in the area was 5.5. This is quite close to the previous censuses and shows that the mean household size in Arua has been fairly stable over the past four decades (Arua District Local Government, 2012; Uganda Bureau of Statistics, 2014).

3.1.3 Functional age groups

A very high proportion of the district population is in the young age group.23% of the total population are children aged between 0-5 years; 22% are aged between 6-13 years (primary school going age); 54% are aged between 0-17 years. Secondary school population (14-17 years) constitutes 9% of the total population. The productive age group (15-64 years) is 51% of the total population. Only 2.5% are aged 65 years and above (Arua District Local Government, 2012).

The age structure implies that a significant proportion of the population is dependent. This exerts a heavy burden on the few productive members of the population because they have to look after a number of other people, a fact that hampers the rate of investment in the productive sectors.

3.2 The economy

Like many Ugandan districts, the economy of Arua is dependent on agriculture and employs over 80% of the total population. Fertile soils and suitable climatic conditions combine to support the cultivation of a number of crops in most parts of the district. Agriculture is mainly subsistence (79.9%) and takes place on small holdings of approximately two acres using mainly simple farming tools (hoes, pangas and harrowing sticks). Only 0.5% of the population is engaged in commercial agriculture. Family members constitute the single most important source of labor. (Arua District Local Government, 2012).

Both food and cash crops are grown. The major food crops include cassava, beans, groundnuts, simsim, millet and maize. Tobacco is the major cash crop and is the main source of livelihood for the majority of the population in the district. It is grown mainly in the fertile highlands. Cotton used to be grown in the lower and drier plains but due to marketing problems, it has been abandoned. Efforts are however underway to revamp cotton production. There is also an insignificant growing of coffee, which is done mainly in the temperate areas along the borders of Arua and Nebbi district. There is renewed interest in the promotion of coffee production in many areas of the district now.

Other important economic activities in the district include formal employment, which employs about 9% of the population, petty and formal trade, which employs 3.8% and 0.7% respectively and cottage industry that employs 2.3%. The remaining proportion of the population depends on family support and other miscellaneous activities. (Arua District Local Government, 2004).

3.3 Land tenure

Typical land holdings in the district vary generally from ½ to 3 acres per household (with exceptions of up to 4 acres) and more than half of the farmers would like to cultivate more land. This situation varies significantly; farmers in the less populated county of Madi Okollo usually have bigger plots than farmers elsewhere in the District (Arua District Local Government, 2004).

Land in the District is held under four tenure systems, namely customary land tenure, leasehold system, communal land tenure system and rent. These are briefly discussed below:

Customary land tenure

Land acquisition under customary tenure is usually through inheritance. A father allocates Land to his sons who in turn assign it to their wives to cultivate. According to the law, women can inherit property (and thus also land), although in the patriarchal societies in the District this is virtually never the case, so women tend to be excluded from having control over this basic resource.

Leasehold system

Land can be leased (to a maximum of 500 acres) from the state and this currently is done by very few farmers. In case, land to be leased is held under customary land tenure system by some individuals, these previous owners with customary claims are compensated before leasing it to the new owner.

Communal land tenure system

This land tenure system is gradually disappearing due to increase in population size. It is common in counties of Madi- Okollo and Terego where the number of livestock is higher than elsewhere. Communal land is used mainly for grazing livestock.

Rent

This is still new and it is found in central parts of the District. Land is rented to people who would like to cultivate more land than they have. The size of the land and the prices to be offered are negotiable. After the expiry date of the rent, the land will revert to the previous owner.

Agriculture, followed by livestock and forestry are the major land use in Arua district. 96 % of the households depend on subsistence farming as their principal source of livelihood. The sector provides employment to over 80 % of the active rural population.

Agricultural land occupies about 85 % of the total district area. However, land put under cultivation is about 40 % of the total agricultural land. Table 5 depicts major crops and average yields in the district in the year 2003/2004.

Table 5: Major crops and production in Arua 2003/2004

S/N	**Crop**	**Farm Yield/Acre**	**Farm Average Acre**	**Total Acre on average**	**Total (Mt)/H**	**No: of farmers involved**
1	Cotton	300	0.3	1352.75	405826	1036
2	Tobacco	900	0.25	-	-	Over 17 000
3	Coffee	2000	0.65(150 trees)	1205.5	3380	7377
4	Groundnuts	500Kg -620 kg	0.7	768505	19212	153701
5	Onions	2020kg	0.25	426	1201.32	1704
6	Tomatoes	600 kg	0.25	3458.3	20749.6	23055
7	Rice	600kg	0.4	7952	47920	1998
8	Chilly	100kg	0.125	38.375	38.375	307
9	Passion fruit	30 000kg	0.125	43.125	1293750	3450
10	Pineapple	250 000kg	0.25	1913.25	47831.25	7653
11	Potatoes	3000kg	0.25	8925	2677.5	3570
12	Cassava	3500kg	1	153701	53795.35	153701
13	Beans	350kg	0.5	768505	26897.68	153701
14	Sorghum	300kg	0.25	38425.25	11527.58	148320
15	Millet	250kg	0.125	2881.875	720.469	23055
16	Maize	400-600kg	0.4	77705	46623	194.26
17	Simsim	400kg	0.4	8050	2450	17128
18	Cow peas	240kg	0.25	803.333	1928	3213
19	Pigeon peas	160kg	0.25	5133	8212	2053
20	S/potatoes	3000kg	0.25	11378	34134	153701
21	Citrus	70 000kg	0.25	4995.25	34966.75	19981

Source: Arua District Local Government (2004).

3.4 Occupation

Arua district has not experienced much economic growth. Subsistence farming is generally the main occupation. Most of the industries are small-scale industries that are operating using small generators and therefore their production output is still very low.

Majority of the industries are food processing plants with exception of two; Arua Foam industries and the Cotton Ginnery at Rhino Camp. Other industries in the district include the Bee natural products, and a number of grain milling factories and Metal Fabricators. The industrial sector so far offers low employment opportunities in the district. According to UPPAP (2002) cottage industry employed 2.3% of the working population. West Nile Distilling Factory which used to produce 7 Hills Vodka and employed over 100 people was unfortunately burnt at the end of January 2005 (UPPAP, 2002).

3.5 Data collection

The study used qualitative cross-sectional data. This design was chosen because it saves time, is not costly and is also useful for descriptive purposes. Primary data was collected through interviews using structured questionaires. The selection of AIV farmers within the study area was done using stratified random sampling procedure with the strata being gender. The list of AIV producers was obtained from the district offices of the Department of Agriculture in Arua. The AIV farmers were stratified according to gender to make sure that male and female headed households were represented. Disproportionate random sampling procedure was used to select individual households.

Consumers were interviewed so as to get their perception about the values of utilization of AIVs, to find out if they knew all the benefits that AIVs provide and if they can buy it from retail shops. The sampling of consumers was done using purposive sampling procedure, selecting only consumers of AIVs. Consumers who were not involved in the production were selected.

Consumers were sampled from rural and urban areas, and rural consumers came from the same areas where the data on production were collected and the urban consumers were selected from one urban area within the Arua district. The selection of the study areas within the district was highly influenced by the knowledge about known areas where AIVs are commonly produced and consumed. Elderly people were regarded as primary sources in the study, especially women. The sample size was 20 households producers and 10 consumers of AIVs in the district.

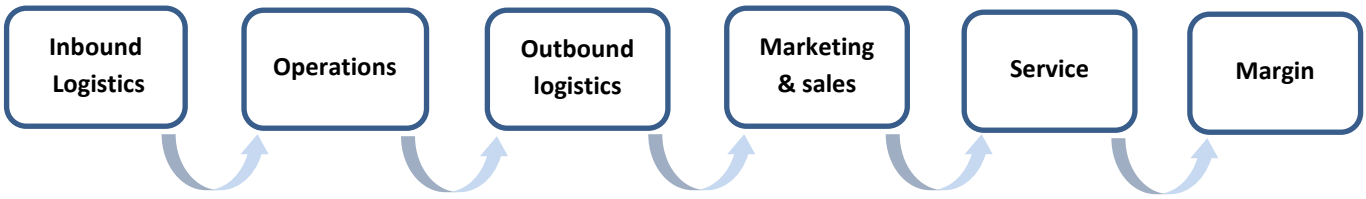
3.6 Data analysis

Responses from the interview were entered and analyzed using Microsoft Windows-Excel (Microsoft TM). With the analysis involving use of descriptive statistics according to the objectives stated. This involved use of percentages, bar graphs, pie charts and bubble maps.

3.6.1 Value chain analysis conceptual framework

The conceptual framework of the study adopts a broad value chain analysis. It's a systematic approach that characterizes the various stages of a given product from conception through the various market stages to final consumption, including the identification of the value added at each node of the market chain (Kaplinsky and Morris, 2001). Porter developed the value chain as tool for identifying the value of each step in the production process (**Figure 2).** Apart from the spectrum of activities involved from production, processing, distribution retailing and consumption, I also placed emphasis on linkages among actors. (Nangole et al., 2011). I used the value chain analysis as a descriptive tool to map the potential areas of intervention to commercialise African indigenous vegetables. As a descriptive tool it allows for consideration of both the macro and micro aspects involved in the production and exchange activities. It also allows us to understand the environment in which the farmers operate, identify key relationships amongst the actors and gain greater visibility of the risks and constrains in which the farmers operate (VSO ICS, 2015). Value chain analysis also offers insights that would not be revealed in studies focused on individual economic agents or particular agricultural policy or management framework. I could then have informed strategies to optimize the commercialisation of the Indigenous vegetables. The mapping of the value chain involved identification of actors, opportunities and constrains towards commercialisation.

Figure 2: Porter's Generic Value Chain



Source: Adapted from Nangole et al. (2011).

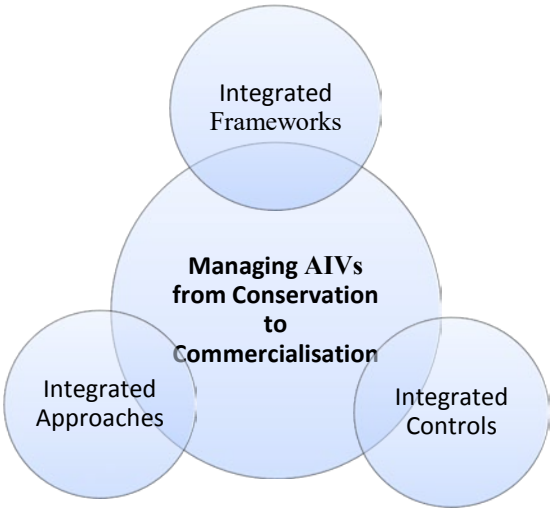
Following the value chain analysis we realize that the link that can be upgraded to realize the commercialisation of AIVs is the provision of quality seeds and improving supply chain to increase production and enhance profitability for the small scale producers.
Nevertheless, the value analysis approach need to be combined with more analytical methods as it is only descriptive and also enable comparisons across agricultural products.

3.6.2 Framework of integration model

This study aimed to develop a framework of integration for managing African indigenous vegetables from conservation to commercialisation. The study focused on a system of integration of activities throughout the value chain of AIVs. The purpose is to observe relationships involving order between sets of activities from conservation, production, marketing, and commercialisation of AIVs in the study area. Specifically the observation process was designed to find out:

a) Whether there is an integrated framework for conservation of AIVs.
b) Whether there is an integrated approach towards production and marketing of AIVs.
c) Whether there is an integrated control for commercialising AIVs (see figure 3 below).

Figure 3: Theoretical framework of integration model for managing AIVs

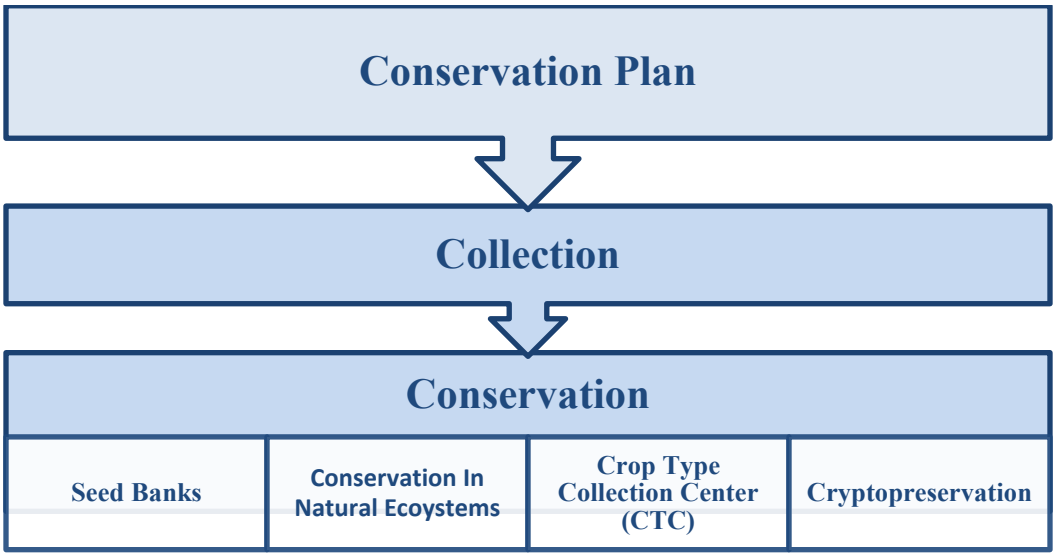


Source: Adapted from Adebooye et al. (2004).

The theoretical framework of integration model sought to focus on

I. Identifying similarities rather than differences in collection-conservation plans for AIVs. Based on the study by Adebayo et al. (2004), a simple conservation plan for indigenous leafy vegetables should include the following as represented in the figure below:

Figure 4: Conservation plan model



Source: Adebooye et al. (2004).

II. Qualities and quantities of AIVs produced in the study area rather than quantities alone.

III. Cohesive ways of AIVs production rather than disparate ways

IV. Integrated policy making rather than fragmented frameworks

V. Integrated control of production policy implementation rather than separate control

VI. Integrated rather than disparate approach to problem solving

VII. Meeting customers' needs through collaboration rather than by duplication and overlap

3.7 Data Presentation

Bubble chart is used to assess the marketing channels of AIVs. It helped to show the share of each market and the potential of markets that can be explored in future for AIVs. It indicated the competitiveness and prospect for diversification of supply by farmers for African Indigenous Vegetables. Bubble size was proportionate to the share of each market for AIVs.

CHAPTER FOUR:
RESULTS & DISCUSSION

4. Results & Discussion

4.1 Household socio-economic characteristics of AIV farmers

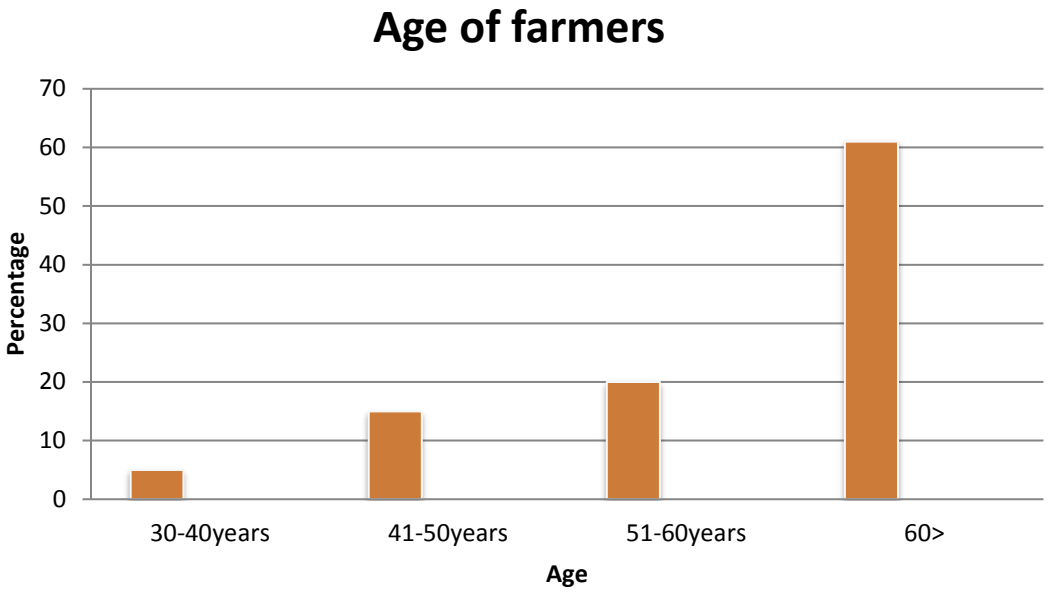
The study involved 20 respondents. In the findings, 90% were females and only 10% were male. In the male headed production, females were, however, not left out because they serve as helping hands especially in harvesting and drying of produce.

In the African context women dominate the cultivation of indigenous leafy vegetables as compared to men, leading to the crops being considered as “women crops”. Men seemed to be interested in livestock farming as it is perceived to be a store of wealth. Figure 5 below shows the age distribution of AIV farmers in the study area, majority (60%) of farmers were older than 60 years, followed by those who range between 51-60 years who form 20%, 41-50 years were 15% and 30-40 years were only 5%. This indicates that in the study area older farmers were the major producers of AIVs; probably younger generations were engaged in some other economic activities other than agriculture.

The age of the farmers plays a very significant role in farming, as experience helps in decision making. Young farmers are eager to create wealth and prefer exotic vegetables which have higher economic value. Majority of farmers of AIVs were pensioners, who relied mostly on government pension fund. These farmers had lot of experience in producing the vegetables; they grow up farming these crops.

Other studies e.g. (Oladele, 2011) showed that age distribution was very important for all agricultural productions. Although experience in farming was very important and it comes with years of practice, yet fairly young farmers are needed on farm because agricultural production is labor intensive. More production activities could be engaged by young farmers, hence, enhanced productivity.

Figure 5: Age distribution of farmers



Source: Author's research work.

Table 6 below indicates that in the study area most farmers (42%) had primary education, 38% had no formal education, 17% had secondary education and only 3% had a tertiary qualification. The high percentage of farmers with low levels of education was due to the ancient believe of Africans that women were not supposed to attend school, as their exclusive roles are confined only to the kitchen, which to a greater extent affected production and marketing decisions.

Approximately 57% of farmers interviewed were married, 15% single and 27% widowed. The younger farmer is thirty eight years old while the older is ninety years old. Farmers mainly rely on pension as source of income and they have to support their grandchildren, whom they stayed with. They stayed with these grandchildren because their parents were working and some because the parents had passed away. On average the number of people in the household was six, giving farmers a pool of additional labour from family members. Approximately all AIV producers hold locally recognized customary land rights; they have a yearly payment that they made to the chief for the possession of the land. Their scale of production on average was 1.29 hectares, with most of them devoting only 0.75 hectare to AIVs production.

Table 6: Socio economic status of AIV farmers

			N=20		
Gender				Female	Male
				90%	10%
Age		35-40years	41-50years	51-60years	>60years
		5%	15%	20%	60%
Marital status		Single	Married	Widowed	Divorced
		15%	57%	27%	1%
Educational level		Non-formal education	Primary	Secondary	Tertiary
		38%	42%	17%	3%
Source of Income	Own salary	Farming	Pension	Social grant	Hawking
	7%	4%	67%	6%	16%
Number of dependents		1	6-Feb	11-Jul	16-Dec
		9%	81%	9%	1%

Source: Author's research work.

Results also showed that all farmers had no access to credits; this was due to lack of collateral. Some concede that there is no need to acquire credit as they mainly farm for household consumption. Figure 6 below show that only five percent (5%) of farmers belonged to an organization and being part of an organization could help them in accessing information about new production technologies. Even with the 5% that belong to an organization and two percent (2%) were promoting AIVs in their organization.

Figure 6: Membership of farmers to farmer organization



Source: Author's research work.

4.2 AIVs production system

AIV farming system in the study area mostly depends on locally available resources and farmers used their indigenous knowledge. This was due to their socio-economic characteristics. These farmers did not fully explore the range of farming innovations and practices that had been developed over the years.

The production of AIVs was very simple and often requiring very little inputs save for occasional farm yard manure application (Abukutsa-Onyango et al., 2007). In the study area, the type of production system being used to produce AIVs is the extensive mixed crop system: intercropping system, no farmer practiced mono-cropping. The AIVs in each farm were intercropped with other crops such as maize watermelon, groundnut, sugar bean and pumpkin. This made their management very limited. In another paper Abukutsa-Onyango (2007) stated several intercropping advantages. These include having diversity of crops in a given season, optimal utilization of resources like nutrients, water and light especially if the intercrops have different growth patterns.

Intercrops can be planted with crops that have different maturity dates. Farmers in the three communities have indigenous knowledge that agrees with the established fact that intercropping is advantageous. The environmental conditions and soil type prove to determine AIVs that could be produced in the study area.

Table 7 below indicates the three crops on which the study has focused. They were amaranths (*Amaranthus spp*), spider plant (*Cleome gynandra*) and cowpea (*Vigna Unguiculata).* In the study area farmers also mentioned some AIVs that they were producing; the most common one is the pumpkin leaves. Two of the crops (Amaranth and spider plant) were not mostly cultivated and harvested from maize fields. They were from fields where manure is used extensively. Only cowpea was cultivated from maize fields, and most farmers consider it to be profitable.

Table 7: Table of AIVs considered in the study

Scientific names	Common names	Local names
Amaranthus spp	amaranths	Dodo
Cleome gynandra	spider plant	Nakati
Vigna Unguiculata	cowpea	Kao

Source: Adapted from E.B Rubaihayo (2002).

Reliance on rain-fed production of AIVs has been one of the major obstacles in expanding production (Shiundu, 2007). African indigenous vegetable production is rain-fed; depends on rainfall for watering the crops. This make the supply not reliable because there will be more products in the rainy season and less in the dry season. Sowing was mainly done by broadcast; most farmers used seeds obtained from older plants, dried and stored in a bottle or plastic bag mixed with ashes and others store them in the fridge until being planted during summer after the rains.

However, there was a limited number of farmers who buy seeds and others used both seeds from the last season and buy. There seem to be doubts with the quality of seeds; because even those who buy, most of them do from their neighbors.

Uncultivated crops self-seed but in rare cases farmers go find the seeds and broadcast in their fields. These have disadvantages as seed production could be less which leads to fewer plants the next season, which will mean less production.

Manure was commonly applied, with the use of fertilizer and other agrochemicals being very limited. Farmers used different types of manure, but the most used was the cattle and chicken respectively. One of the reasons for the use of manure was that it was easily availability especially the cattle manure. However, most farmers believed that chicken manure has much value. Farmers highlighted some reasons with regard to their limited use of agrochemicals: The main ones were the lack of finances and their negative impact on soil. All farmers in the study area had no electricity in their farms; some do not even have it in their homes.

More than 90% of AIV producers did not own vehicle, but even those who owned one, were not in good conditions and the vehicles were mostly controlled by husbands who were not that interested in farming AIVs but some were using animals such as donkeys as a means of transport. They used both part-time and unpaid family members as labour. The part-time laborers used were mostly very poor people from either the community or the neighboring country who charge very little for labour or receive farm produce as substitute for cash. The produce used mostly as substitute payment was the maize, and it depends on the level of production. Those who had older kids and relatives relied more on unpaid family members for labour assistance. The production system of AIVs was closely related to local indigenous knowledge system.

4.3 Value of utilization and economic importance of cultivating AIVs

Although most farmers currently regarded AIVs as secondary to other crops, they however agreed that the contribution of AIVs to their households cannot be over-emphasized. AIVs have a range of contributions to the rural community livelihoods, both direct and indirect.

All the respondents indicated that the consumption of these vegetables provided nutritional and health benefits while their sales supplemented or complemented family income. AIV sales provided income that was vital in substantial seasonal gaps, and in helping the farming community to respond to odd expenses.

They also had a role as crops that people fall back on in times of crop failure because of their survival attributes. In addition to the values mentioned above, some farmers have also indicated that they cultivate AIVs because of their contribution to nutrient recycling and soil fertility.

In the study area farming is regarded as part of the culture of the people: They grew up feeding off the land, they were thought to produce and consume AIVs. Most people do not take farming as a business, but just as source of food. Ethnicity had a very strong influence on the type of AIV produced and consumed. Farmers also mentioned that AIVs help with food security as there are easily available and have a high nutritional content. Dried AIVs come in handy in dry season when there is a shortage of food. These products were regarded as having a good taste, good for fresh skin, prolonging life, good eye sight and prevent illness. Farmers used AIVs as their part of strategy to alleviate poverty in rural communities. The promotion of *amaranthus spp*. is important because of its large nutritional advantage, both from the point of view of supplying pro-vitamin A, and also for its nutraceutical benefit (Dlamini, 2010). Farmers also perceive AIVs as important in improving the quality of soil; they stated that these crops help soil fertility. AIVs had a short growing period, easy to cultivate, especially as they were grown as intercrops, they need no extra labour, finances and other inputs. They are adaptable to local conditions, can be able to survive harsh environmental conditions and have a high resistance towards insect and disease. These observations agree with Kimiywe et al., (2007) who concluded that dietary diversity of African indigenous vegetables in addition to providing essential nutrients presumably offers broad benefits to health.

Farmers also mentioned the advantage of dried AIVs product; it helps during dry season when there was shortage of food. The study focused on, two AIVs semi-cultivated (amaranth and spider plant) and a cultivated (cowpea). Cowpea was perceived as the best and profitable crop and it had a long shelf life even when it's not dried. Respondents mentioned that, determination is required to cultivate the two semi-cultivated crops as some farmers notice no benefit of cultivating something that grows in abundance in the wild. Importance of AIVs in rural areas shows that increasing yield will assist in enhancing livelihood of many household, both in rural and urban areas.

4.4 Under-utilization of AIVs

Notwithstanding the values of AIVs outlined above, it was generally accepted that they were being under-utilized. Farmers suggested that the underutilizations of AIVs was because of its seasonality, making them to be available fresh only in one season.

Others said it was because people had a negative perception about these products, especially "black diamonds" (middle income earners) who were the targeted customers of many products. Black diamonds previously took these crops to be food for the poor and having low status but on the other hand this group is starting to be conscious about their diet.

This was also noted by (Stevens et al., 2008), who observed that a barrier to AIV utilization was that the youth had a negative view towards AIVs. This may be qualified by the change in food culture pushing people to leave their old and traditional food culture and adopt a modern food culture. About four percent complained about too much work related to processing the produce.

Also the loss of indigenous knowledge contributed to the underutilizations of AIVs. The older generation who is the custodians pass-on without transferring the knowledge to younger generation. These led to less production of these crops since they didn't know much about AIVs.

In some cases younger people regard some AIVs as weed. There were evidences of lack of seeds of some crops, and over-harvesting. This study therefore supports the findings of Shiundu and Oniang'o (2007) who also stated that AIVs remain under-exploited and under-utilized due to various constraints, including processing, distribution and marketing, as well as nutrition information.

4.5 Implication of under-utilizing AIVs

4.5.1 Food insecurity

AIVs were the easily available vegetables especially to rural communities, helping them to have enough food. They were abundant in rainy season but were also preserved by drying them for dry season. The underutilizations of these crops poses a threat to food security in terms of food supply.

According to Kwenin (2011) AIVs are important commodities for poor households because their prices are relatively affordable as compared to other food items.

4.5.2 Reduced income

Indigenous vegetables are reported to play a very important role in income generation through the sale of surplus produce (Schippers, 2000). The underutilizations of these crops don't allow farmers to supplement their income in order for them to improve their standard of living.

4.5.3 Health

Vegetables are important source of nutrients that help maintain good health and prevent diseases. A great number of AIVs have long been known and reported to have health protecting properties and uses (Kwenin, 2011; Okeno et al., 2003).

4.6 Farmers' perception to AIVs

AIVs were generally perceived to be the best crop and the rescuing crop during hard times. These crops have an advantage of possessing desirable agronomic and organoleptic traits.

Table 8 indicates how farmers in the study area rate AIVs in terms of their traits as compared to exotic crops. Many farmers perceive AIVs as drought tolerant and mature early. More than 50% of farmers indicated that AIVs are excellent and they also found them to be very resistant to nematodes. Input costs are indicated to be low about 57% of farmers and 32% indicated that costs are good and excellent respectively.

Farmers perceived production of AIVs to be easy, as they don't need too much management. AIVs were also perceived to have a good texture, highly storable, and an attractive color.

Table 8: Perception comparison of AIV crops to exotic crops

	Bad	Fine	Good	Excellent
Nutritious	0%	0%	9%	91%
Taste	0%	0%	26%	74%
Freshness	0%	14%	52%	34%
Storability	0%	4%	38%	58%
Colour	2%	20%	34%	44%
Texture	2%	17%	43%	38%
Easy to produce	0%	10%	55%	35%
Input costs	0%	12%	55%	33%
Bunch size	0%	33%	55%	12%
Maturity	0%	14%	62%	24%
Drought tolerance	3%	7%	46%	44%

Source: Author's research work.

4.7 Processing techniques

In the study area producers used two local traditional knowledge of post-harvest processing (preservation) of the AIVs. These were sun-drying after being cooked and sun-drying raw leaves. Women were the principal agent of processing AIVs, the processing help with post-harvest preservation to maintain supply throughout the year since AIVs are perishable and were only abundant during rainy season but scarce the rest of the year.

In the first method, the water was pre boiled and then washed leaves were put into the pot. The leaves were boiled till there was no or little water remaining, then when the leaves were half cooked and left to cool. The blanched leaves were spread thinly (or if not it will spoil and take time to dry) on a corrugated iron-sheet out on the open surface directly in the sun. For complete dry products it takes two to three days on sunny days but can go up to five days if the weather is not good.

In the Second method, they were drying raw leaves by placing them on a corrugated iron-sheet out on the open surface directly in the sun. For leaves to be completely dried, it took two to three days.

According to Smith and Eyzaguirre (2007) although drying is one solution to the problem of perishability, it does not satisfy the needs of a large population of consumers, particularly urban dwellers. Some consumers also preferred freshly harvested leaves. Thus there is a need to improve the drying methods that are currently being used taking into account hygienic considerations as well as nutrient degradation and loss. Farmers should incorporate the use of modern methods and equipment.

4.8 Production constraints

AIVs production has been shown to be important in so many ways but there seem to be constraints in their production. Water scarcity was a major constraint since the production depends on rain-fed and the area receive small summer rainfall. The rainfall pattern is erratic and severe droughts are experienced about once every eight years (Thomas, 2002). Farmers lack financial resource to reinvest in their farming activities and this hinder growth. Farmers were unable to acquire all the necessary inputs needed and the one that will help them improve their production. Farmers also struggle with infrastructure, they didn't have proper infrastructure like storage, irrigation system etc. There were also signs of inefficient and unsustainable usage of available inputs. The constraints were taking its toll because extension services were apparently concentrated on commercial exotic crops.

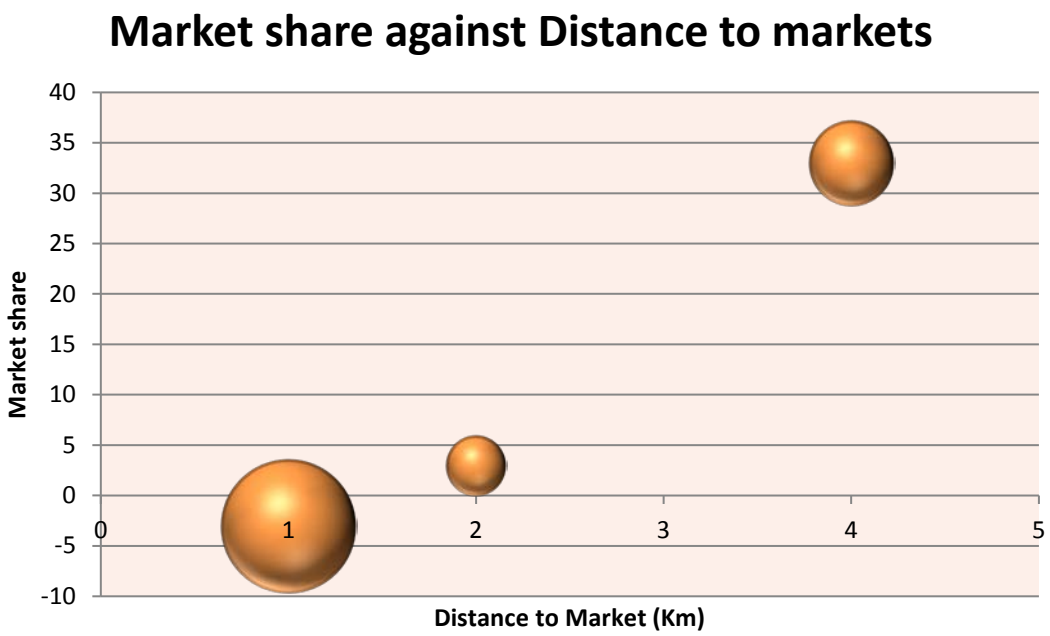
4.9 Marketing of AIVs

AIVs have long been regarded as minor crops and thus have attracted little marketing attention, in favor of major crops and cash crops (Lyatuu et al., 2009). These vegetables were recognized as subsistence crops. The marketing of AIVs is very limited, most farmers produce for their own consumption with little produce reaching the informal market. Women are the major agents involved in the marketing of AIVs.

Results from the study area indicated that 50% of farmers sell their products whereas 50% do not. The ones, who were not selling, mostly shared their produce with relatives, orphans and poor community members who did not own a land or farm. Those who sell their produce usually sell between 50% to 60% of the total produce. Income from these sales helps to supplement the family income and put them in a position to fulfill some of their basic needs.

Farmers sold their products to three output market; locally, neighboring villages, and in town. This information is represented below in (figure 7).

Figure 7: The market, market share and distance to the market of vegetable traders



Source: Author's research work.

Figure 7 outlines AIVs market results from the study area, the Bubbles represent markets whereby 1 was the local market, 2 neighbouring villages, 3 supermarkets and 4 town market. From the results it was clear that local market has a bigger market share of about 73%, followed by town market with 20%, neighboring village share was 7%. There was no evidence that AIVs reach the supermarket. Most farmers sold their produce locally because of lack of market information and lack of resource to reach other markets. The reason neighboring village market absorb small percentage was because they were also producing AIVs.

The distance to different output markets vary, results indicate that a majority of local consumers buy from the farmer's house with few farmers selling door to door or in pension points. Distance to a neighboring village on average was about 6km, the largest selling point being pension points and shopping centers.

The average distance to town output market was 35km; mostly farmers who utilized this market are the one who worked in town especially as hawkers. Respondents who were not working in town faced high transaction costs in marketing their products in town; these made them not to market in town. Transaction costs influenced marketing decisions as noted in the northern communal areas of Namibia by Du toit et al. (2010); and Bruyn et al. (2001). It showed that a number of transaction cost variables had a significant effect on the proportion of meat sold and thus indirectly on the choice of marketing channels. The lack of exploitation of the town marketing channels opened an opportunity for middlemen who were hawking in town. These middlemen helped move the produce from the hands of the farmer to town at the same time giving them a share of income but there seem to be allegations that these middlemen benefit way more than farmers.

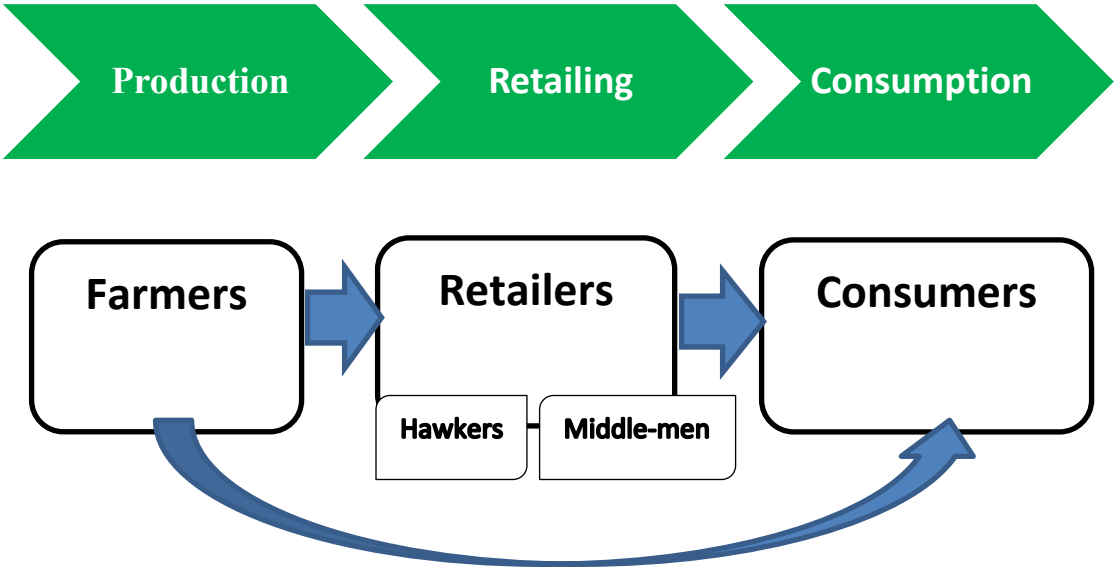
As in most studies, I found that females were the ones mainly undertaking AIVs marketing and other allied activities. AIVs were sold as both fresh and dry products. Most farmers sell both fresh and dry, with a little percentage that only sell their product as fresh or dry only.

The study found that prices ranged between 2000.00 and 2500.00 Ugandan shilling (1USdollar=2500UgShs) with dry products fetching a higher price as compared to fresh product. This made an economic sense since there has been a value added by processing and packaging. Among the farmers no one really knows who set the price and what were the standards used to set it but in each area prices were found to be unique. Farmer's price setting was based on the market, with few setting their price as dictated by buyers. Buyers who mostly dictated the price were the ones who were acting as middlemen between the farmer and consumers. Prices they set were disadvantaging farmers but on the other hand they were helping farmers to sell their produce.

Farmers found this price setting system to be important, since it gives some form of guarantee that their produce would be sold as the price is uniform for everyone. But their challenge was that there was no institution controlling the price, which makes some farmers to be easily manipulated in changing their prices and the fact that all products are sold at the same price regardless of variations in their quality.

Farmers were not utilizing all the available marketing channels, if they were exploiting available options they will increase efficiency in business hence raise the total generated income and improve competence thus increasing the market share. Farmers had two routes that they used to supply their product to customers

Figure 8: Simplified supply chain of AIV



Source: Author's research work.

Farmers supplied their produce direct to consumers; this selling route is mostly to rural consumers but with an exception of little percentage to urban consumers. On this route farmers supplied both fresh and processed (dried) produce. This marketing channel has its own advantages as there were no marketing costs involved.

The other channel is the one where farmers supplied hawkers; even with this channel they supplied both fresh and dried products. Middlemen in this case hawkers, added value to the fresh product by drying it. With these route hawkers sell to the final consumer. Middlemen tend to get more money than farmers themselves because of high prices they charge as they sell in areas were AIVs were scarce.

Potential markets

In the country there is an increasing trend of supermarket chains in the food system and consumer preferences for quality and easy to prepare food. The emergence and growth of the middle class is the most powerful marketing trend in the country, the advantage of AIVs to be absorbed by this market is considerably tremendous as most of them grow up consuming these crops. Urban and sub-urban consumers should be the target since they do not have the land where they can plant and in these areas there is a rising health conscious and high willingness to experiment.

4.10 Consumer perception to AIVs

4.10.1 Consumer socio-economic and intake level of AIVs

The socio-economic conditions of household influenced the consumption and perception towards AIVs.92% of respondents (consumers) were females; this was because they were the ones who mostly cook in the household. Large number of respondents was between the ages of 41-50 years, whom most had formal education with some having up to tertiary education. Consumers interviewed were both from rural and urban areas of the Arua district.

The average number of people living in a household was 6, with the average of two people working. The main source of income for rural consumers was found to be a social grant, and in the urban areas it was found to be salary. The socio-economic conditions of rural consumers indicated that the introduction of AIVs in the main stream will really help them improve their standard of living.

AIVs were consumed in both urban and rural areas and played a vital role to their diet. Households preferred different types of AIVs but most consumed all AIVs considered in the study, these products were consumed in their fresh and dried state. These crops were mostly consumed in rainy season when they were abundant, but dried were available in dry season. Consumers were buying these products from hawkers and directly from farmers.95% of respondents indicated that they would be very interested in buying the products from retailers, the reason being that retailers are hygienic, easily accessible and they will be assured of constant supply. Then these will force farmers to supply high quality and enough AIVs.

4.10.2 Attitude of consumers towards AIVs

Generally consumers know AIVs but the young generation considers the crops to be of low status. The main reason for young people to perceive the crop the way they do was because of the way parents cook it. To young people AIVs are just bitter vegetables that are not even. Attitude of respondents who were consumers of AIV was shocking, since they value AIVs but seemed to be shy about the crops. A large number about 80% of respondents do not serve AIVs to visitors, they only serve when visitor asked for it especially the ones from urban areas. Most people also do not serve these crops because it associated with poverty. AIVs were never served in special occasions as they believe that during ceremonies people are supposed to eat meat. Consumers love the taste of AIV, because of its uniqueness. Not all family members were consuming AIVs; it was mostly preferred by women and older males. Most kids ate only if they do not have other relish to eat and adults were not teaching their kids on how to cook these crops. Approximately 99% of respondents highlighted that currently there are less varieties of AIVs as compared to older days, suggesting that it might be because of climate change, loss of interest in farming and migration to urban areas.

4.10.3 Local preparing/cooking technique

Preparation methods have an influence on both safety and how younger generation perceives the product. Cooking methods from all the villages proved to be similar, different methods come with age difference. When preparing, they pre-boil little water in a pot then put leaves while the water is boiling. Leaves are boiled with no/little water remaining after cooking. Ingredients that they add were tomatoes, salt and onion and sometimes peanut butter, the young generation sometimes add soup and cooking oil. Older generations do not add soup and cooking oil; as they explained that when you add these ingredients you take away the indigenous flavor, making it to taste like exotic crops. The reason they pre-boil water was to distil, to fasten the cooking process and make it tastier. Spider flower was cooked with lot of water in order to mask/reduce the bitterness. At times they mixed spider flower and Amaranth.

AIVs were usually eaten with maize meal porridge, at times together with meat. There is a need to introduce more recipes so as to make the AIVs more attractive.

4.10.4 Traits preferred by consumers

Crop appearance to some extend determines how consumers perceive it. AIV consumers are of no exception. They preferred dark big green leaves, which show freshness of the product. Consumers perceived AIV to be healthier because of less use of agrochemicals.

CHAPTER FIVE:

SUMMARY, CONCLUSION & RECOMMENDATION

5. Summary, Conclusions and Recommendation

This chapter summarizes the main findings of the study and concludes on the basis of the findings derived from the empirical results. It provides an integrated framework for conservation to commercialisation of the AIVs and also gives recommendations on how the potential of these crops can be exploited.

5.1 Summary

The aim of the study was to analyze the production and commercialisation potential of indigenous leafy vegetables in the Arua district in the West Nile region of Uganda. The study had four objectives:

a. Identifying the perceived values of utilization and economic potentials of AIVs in the rural areas of the district
b. Investigate constraints faced by farmers in commercialising AIVs in the district.
c. Assess different types of marketing channels of AIVs
d. Provide a framework of integration for the commercialisation of AIVs

To answer the objectives, the study used two analytical techniques, which were a framework of integrated approaches for conservation to commercialisation of AIV model and bubble Map. Results of the study indicate that the majority (90%) of AIVs farmers were females and were old age pension group. Most respondents had no or low formal level of education. The average household size in the study area is six and most respondents were married.

There were several constraints faced by farmers towards production and commercialisation of AIVs but the most outstanding were

A. Water scarcity that bring threat into consistent supply
B. Lack of financial resource that restricts farmers from purchasing the required inputs
C. Lack of proper infrastructure
D. Lack of knowledge on how to introduce their produce into the market
E. Lack of government support
F. Absence of policies that support the development of ILVs and their marketing.

In addition to these constraints, farmers also never saw or believe that these crops could fit in the main-stream food system, although they know its benefits.

5.2 Conclusions

The study had four research hypotheses:

The first one stated that there were significant values of utilization and economic potentials of AIVs in the rural areas of Arua district. Results of the study support this hypothesis because several values of utilization and economic potentials were identified as factors necessitating the conservation, production and consumption of the AIVs in the study area.

The second hypothesis stated that there were constraints faced by farmers in commercialising AIVs. In support to this hypothesis results indicated that there were constraints affecting farmers for commercialising AIVs in the study area.

The third hypothesis stated that there were no known structured marketing channels for AIVs in the rural areas of Arua district. Results from the study support the hypothesis as it was found that only informal market channels exist for these crops.

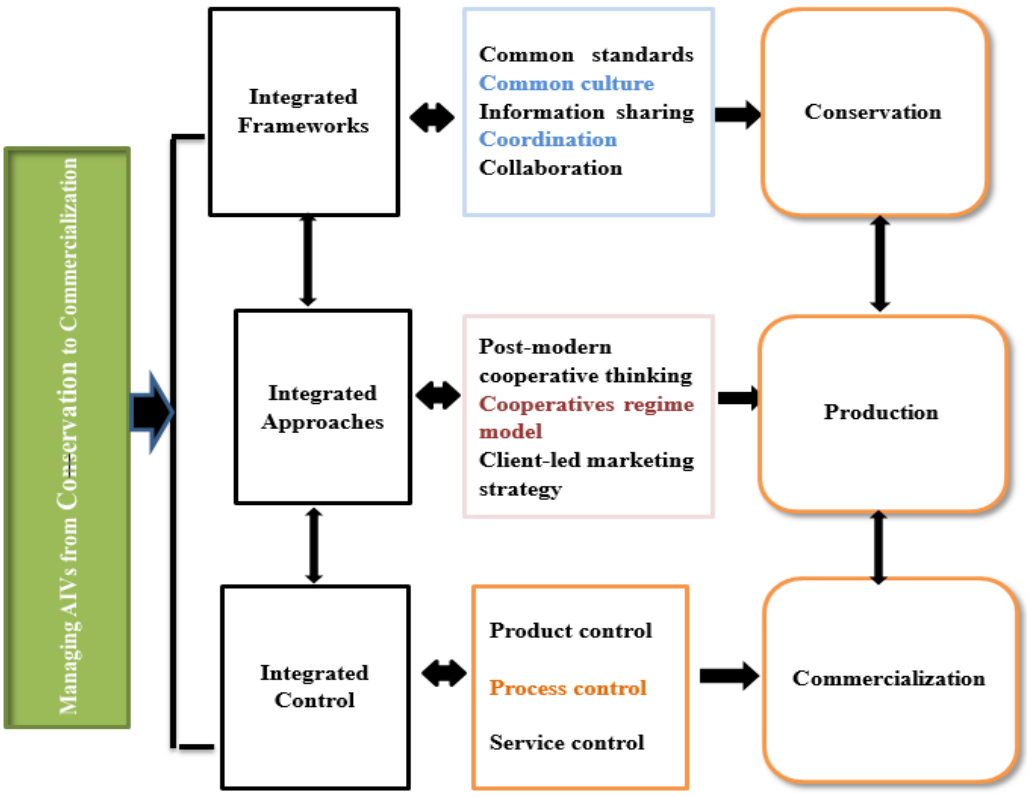
The fourth hypothesis stated that there was no known framework of integration for AIVs from their conservation to commercialisation. The results of this study support the hypothesis as it was found that were no cohesive policies and processes on the value chain of AIVs but rather than desperate and fragmented arrangements.

In general, the study can conclude that there is a potential for commercialising AIV but there is a lot of work to be done in assisting farmers since their socio-economic status and lack of institutional arrangements negatively affect the full exploitation of these crops.

5.3 Recommendation

Based on the findings of this study, it is recommended that science, modern technology and indigenous knowledge should be integrated. To improve the productivity of AIVs there is a need to introduce things such as improved seed, fertilizers but at the same time consideration of the knowledge and resources the farmers have is also important. The integration of modern and indigenous techniques will allow rural people to improve production and participate in the main stream (structured) agriculture market systems. The study therefore proposes the following framework of integration to govern the value chain of AIVs from conservation to commercialisation that could enhance the competitiveness and enable effective participation in the structured market systems.

Figure 9: Framework for managing AIVs from conservation to commercialisation



Source: Author's research work.

The study also recommends an awareness campaign on the benefit of AIVs in both rural and urban communities. The main focus of the campaign should be to change the perception of people towards AIVs so that they can start consuming them. This will raise the demand of these crops helping it to enter main stream food systems. Young people have negative perception about these crops need to be educated about all the benefits of the crops. Also farmers need to know all the benefits associated with these crops, particularly in terms of their agronomic advantages, nutritional value and so on, so that they can sell the crops with confident and enthusiasm. Awareness creation strategies should incorporate recruitment of youth into agriculture.

During the course of the research it was noted that indigenous crop producing farmers were not given much attention by extension officers. This calls for government to spread their services even to farmers producing indigenous vegetables, it will help a lot in improving the production as extension officers do frequent visit and they understand the local environment. We also encourage the formation of local well oriented formal institutions that will also discuss issues surrounding indigenous vegetables and promote the spirit of entrepreneurship among farmers. This will help farmers to be well organized and treat their farming as business ventures so as to improve their livelihoods as well as feeding the nation.

More stakeholders should be involved particularly processing companies to help fulfil product control and process control aspects of AIVs' value chain integration as outlined in the framework. Proper processing will help maintain nutrient content, help eliminate losses due to spoilage and make these crops more attractive leading to it becoming a brand. Other stakeholders could be people who will come up with different recipes for preparing food out of these crops. Value addition to the vegetables will help to introduce an appealing product into the market; products that create demand rather than it being forced onto consumers. Furthermore, additional research is needed in areas of finding alternative uses of these indigenous vegetables.

Finally, the study recommends the commercialisation of AIVs as they have great potential. They prove to have values of enormous importance to both producers and consumers. The crops are bound to help the communities in the study area to improve their financial, economic and social status. Market channels particularly those connecting to urban areas should be developed for these products where they are highly demanded.

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APPENDIX 1:

SAMPLE FIELD QUESTIONNAIRES:

Producer perspective

Appendix 1: Sample field questionnaires: Producer perspective

Research Topic: From conservation to commercialisation: African Indigenous Vegetables (AIVs) in the Arua district of Uganda.

Hi, my name is Aleni Comfort. I am a Master (Integrated Natural Resource Management) student at Humboldt University of Berlin. I am conducting a research and the topic of my research is as stated above. I would really appreciate if you could spend the next 30 minutes responding to the questions. Feel free not to answer any question that you are not comfortable with and you can ask any question. The information exchanged between us is going to be used to compile a M.Sc. research report.

Interview date …… 2017

Interview/questionnaire no …….

Interviewer's name …….

Name of village …….

Village Head …….

Respondent's name ……..

House no ……

Initial time ……

Ending time ……....

Part one: General social characteristics of the respondent

1. Respondent's name and surname ……

2. Gender

Male	Female

3. Marital status

Single	Married	Widowed	Divorced

4. Number of people in the household?.....

5. What is your highest educational level?

Primary	Secondary	Tertiary	Vocational qualification

6. Source of income

Own Salary	Remittance	Social grant	Others(Specify)

7. Age of household head

<35years	36-40years	42-50 years	51-60years	>60

8. Number of dependents…….

Part two: Conservation/Production of AIVs

1. How big is your land/farm? .....…….acres
2. What is the size of the land devoted to African Indigenous Vegetables (AIVs)?…….…….acres
3. What types of Indigenous African Indigenous do you produce?

Amaranths (Lerotho)	Spider Plant (Thepe)	Cowpea(Monawa)	Others (Specify)

4. a) Do you use seeds? Yes……. No……..
   b) If yes, where do you get them?

Buy	From last Season	Buy and use from last season

5. What other types of major crops do you produce?
   i. ……
   ii. ……
   iii. ……
   iv. ……

6. For how long have you been producing African Indigenous Vegetables?

<10	11-20yrs	21-30 years	31-40years	40-50years	60>

7. What was the reason for you to start producing AIVs?

   .....

   .....

8. a) In your opinion do you think these vegetables are under-utilized? Yes……No…..

b) If yes what reasons account for this?

Seasonality of Crop	People don't buy	Expensive	Food for poor	Others (Specify)

9. Which production system do you use?

Intensive	Semi-Intensive	Extensive

10. a) Do you use manure? Yes……No…….

b) If yes, how many kilograms per acre? .....

c) Where do you get the manure?

Buy	From own Kraal	From Neighbors	Others(Specify)

d) If you buy, how much is the cost per kilogram? ……

11. a) Do you use fertiliser? Yes…….No……

b) If yes how kilograms of fertilizer per acre? …….

c) Where do you get the fertiliser?

Local Shops	From Town	Donation(Specify)	Others(Specify)

d) How much do you pay per kilogram of fertilizer? .....(Ushs)

12. What is your water source?

Borehole	Dam	River	Rainwater	Others(Specify)

13. How do you irrigate your crops?

Rainwater	Furrows	Canal	Horse pipe	Irrigation System	Go Fetch	Others (Specify)

14. Do you have labour assistance and what type? Yes……No……

Type of labour	Full time	Part Time	Unpaid family labour

15. What is the cost of using a tractor on an acre of land? .....(Ushs)

16. How many kilograms of AIVs do you produce per season in Kgs?

Amaranths	Spiderplant	Cowpea	Others(specify)

Part three: Marketing of AIVs

1. Do you sell the produce? Yes……No……..

2. a) Where do you sell most of your produce?

In the local Village	Neighbouring Village	Nearest Shopping centre	Town

b) How do you sell your produce?

Fresh	Dry	Fresh and Dry

3. How much is a kilogram of AIV?

	Cowpeas	Amaranths	Spiderflower	Others(Specify
Fresh				
Dry				

4. How is your price set?

Market Driven	Dictated by Buyers	Through negotiations	Others(Specify

5. How important is the system you use to set the price? ……
……

6. How do you market your AIVs?

Advertisement	Word of Mouth	Street selling	Others(Specify)

7. How much AIVs do you consume at home and how much is sold in the market?

	Amaranths	Cowpeas	Spider plant
Home(Kg)			
Market(Kg)			

8. Which of the AIVs is profitable?

Amaranths	Cowpeas	Spiderplant

9. How do you dry your produce?

……

……

……

……

10. How long can a dried product be stored?

	Amaranths	Cowpea	Spiderplant
Time (months)			

11. How many kilograms of AIVs do you sell per season?……(kg)

12. Which of the AIVs sells most? ...…….

13. What is the distance to the output market?

	Local Village	Neighbouring Village	Supermarket	Town
Distance(Km)				

14. In your opinion why do you think producing AIVs for consumption is important?

……

……

……

15. a) Do you think it's possible to commercialise AIVs? Yes……No……

b) If yes, give reasons

…….....

.....

.....

.....

.....

.....

.....

.....

.....

Part four: Socio-Economic characteristics related to African Indigenous Vegetables (AIVs) production

1. Do you have ownership of the land you farm on? Yes……No…….
2. Is your farm fenced? Yes…….. No…….
3. Is the land devoted to AIVs increasing or decreasing over the years? Yes….No…..
4. What is the reason for the above situation?

   .....

   .....

   .....
5. a) Do you receive extension services regarding AIVs? Yes……..No…….

   b) If yes, how do you rate the service?

Bad	Good	Excellent

6. Are you employed elsewhere other than farming? Yes…….No……
7. Do you own a vehicle? Yes…….No……..
8. Do you have electricity on the farm? Yes…….No…….
9. Do you have access to credits? Yes…….No……..

10. What's your perception of African Indigenous Vegetables as compared to exotics?

	Bad	Good	Very Good	Excellent
Drought Tolerance				
Maturity				
Bunch size				
Performance in poor soils				
Resistance to Nematodes				
Input costs				
Easy to produce				
Texture				
Colour				
Storability				
Freshness				
Taste				
Nutrition value				
Others(Specify)				

11. Do you belong to any farmers group? Yes……No……

12. Do you promote the production of AIVs in the group? Yes…….No……

13. Number of years in farming? ……..……

14. Can you tell us about the major challenges that you face in producing AIVs?

……
……
……
……
……
…….

15. How have AIVs production contributed to your income generation?

Not significant	Significant	Very	Highly significant

APPENDIX 2:

SAMPLE FIELD QUESTIONNAIRES:

Consumer perspective

Appendix 2: Sample field questionnaires: Consumer perspective

Consumer Research Topic: From conservation to commercialisation: African Indigenous Vegetables (AIVs) in the Arua district of Uganda.

Hi, my name is Aleni Comfort. I am a Master (Integrated Natural Resource Management) student of Humboldt University in Berlin. I am conducting a research on the topic stated above. I would really appreciate if you could spend the next 30 minutes responding to the questions. Feel free not to answer any question that you are not comfortable with and you can ask any question. The information exchanged between us is going to be used to compile a M.Sc. research report.

Interview date …… 2017

Interview/questionnaire no …….

Interviewer's name …….

Name of Area …….

Initial time ……

Ending time ……...

Consumer Perspective

1. Respondent's name and surname? …….
2. Gender?

Male	Female

3. Where do you stay, is it rural or urban area?

Rural area	Urban Area

4. Number of people in the household?
……..

5. Highest school qualification?

No formal Education	Primary	Secondary	Tertiary	Vocational qualification	Others

6. Source of income for the household head?

Own salary	Remittance	Farming	Social grant	Others(Specify)

7. Age of household head

<35 years	36-40 years	41-50 years	51-60 years	>60

8. How many people are working in the household?
…….....

9. How many times do you consume AIVs in a week?
…….....

10. Does the frequency of consumption decreased or increased over the years?
……

11. Which AIV do you consume?

Amaranths(Thepe)	Spider Plant	Cowpea	Others(Specify)

12. What are the traits of the best AIVs?

…….....

.....

.....

13. a) What is your perception of AIVs?

……

……

b). Do you offer AIVs when visitors come to your home and what is your reason?

……

……

c). Do you consume AIVs at special occasions and why? Yes/No……

……

……

d) Do you like the taste of AIVs and why? Yes/No……...

……

……

e) Are AIVs an important contribution to the diet when there is food shortage?

Yes/No…….

f) Do adult males in your household eat AIVs? Yes/No……

g) Generally, do your children like eating AIVs? Yes/No …….

h) Are you teaching your children how to prepare AIVs? Yes/No ……..

g) Are fewer varieties of AIVs to be found nowadays than 10-20 years back and what

might be the cause? Yes/No ……

……

……

14. How do you prepare your AIVs?

……..……

……..

15. Would you like to buy AIVs from retailers and why?

    Yes/No…….....

    ……..……

    ……..

16. Can identify some contributions the consumption of AIV is making to your household or your community?

    ……..……

    ……..

Declaration

I hereby declare that the present thesis has not been submitted as a part of any other examination procedure and has been independently written. All passages, including those from the internet, which were used directly or in modified form, especially those sources using text, graphs, charts or pictures, are indicated as such. I realize that an infringement of these principles, which would amount to either an attempt of deception or deceit, will lead to the institution of proceedings against myself.

10.08.2017, ……...……
Comfort Aleni