The Effect of Market Development On-farm Conservation of Diversity of African Leafy Vegetables around Nairobi

Charity Irungu (Corresponding Author)
St Paul's University
Private Bag - 00217, Limuru, Kenya
Email: cirungu@spu.ac.ke, Phone: +254 20 2020505/10

Mburu J.
University of Nairobi,
P. O. Box 29053 - Nairobi, Kenya

Maundu P
Grum M.

Bioversity International, Sub-Saharan Africa Office
c/o ICRAF, P.O. Box 30677, 00100 Nairobi, Kenya

Hoeschle-Zeledon I.
Global Facilitation Unit of the Underutilized Species
Via dei Tre Denari 472/A, 00057 Maccarese
Rome, Italy

Abstract

Production and marketing of African Leafy Vegetables (ALVs) has increased tremendously around Nairobi. ALVs contribute to food and nutritional security. They also have a public value that includes maintenance of traditions and cultures, and contributing to sustainable development, specifically in biodiversity conservation alongside other ecosystem benefits. However, little economic analysis has been conducted to assess how market development affects on-farm conservation of ALVs biodiversity. This paper seeks to analyse the ALVs species demanded in the Nairobi market and the effect of market development on on-farm biodiversity of ALVs around Nairobi? The study uses both qualitative and quantitative empirical data. Results indicate that consumers demand particular ALVs species due to the nutritive aspects associated with them. However, the effect of market development on on-farm diversity ALVs species is mixed. While market development in terms of gross sales has no significant effect, spatial dimension of market development reduces intra-diversity of ALVs.

Key words – African Vegetables, Biodiversity, Kenya, Market Development, On-farm conservation, Underutilized species

1. Introduction

Production of African Leafy Vegetables (ALVs) has been expanding and becoming increasingly commercialized especially within Nairobi and its outskirts. The priority species marketed within and around Nairobi include various subspecies of the African nightshades *(Solanum* spp.*),* leafy amaranth *(Amaranthus* spp.*),* spider plant *(Cleone gynandra),* cowpeas *(Vigna unguiculata),* Ethiopian kale (*Brassica carinata*), *Crotalaria ochroleuca* and *C. Brevidens (mitoo), Cucurbita ficifolia,* jute plant *(Corchorus olitorius)* and pumpkin leaves (*Cucurbita maxima and C. moschata).* Production, marketing and consumption of these vegetables has potential social, economic and health benefits including contribution to food security, as a source of livelihood and a good source of essential nutrients. They are known to be especially rich in micronutrients such as vitamins (especially A and C), minerals and certain essential amino acids such as lysine (Imungi & Porter 1983; Imungi 2002). ALVs have also been associated with management of various diseases including HIV/AIDS, diabetes, high blood pressure and other common ailments. Besides these private value attributes, ALVs also have a public value as their continued production and use contribute to cultural enrichment and biodiversity conservation. The development of ALV market within Nairobi and other major urban centres could be considered a milestone in the re-introduction of underutilized local food crops for food security as well as for on-farm biodiversity conservation. From direct observation and recent studies (Kimiywe, Waudo, & Mbithe, 2006), there seems to be an increase in both demand and supply of ALVs within Nairobi markets. However, it has not been clearly established which key varieties are demanded by the consumers and for what reasons.

Further, given that commercialization of these vegetables has begun to take prominence, it is worth establishing whether their heightened demand in Nairobi has any policy implications on on-farm biodiversity. Past studies have shown that on-farm conservation of crop genetic resources can easily be enhanced through provision of markets for traditional crops such as ALVs (Meng, Taylor, & Brush, 1998). However, increased consumer demand of certain specific ALV species could also lead to loss of on-farm biodiversity. Other studies have empirically demonstrated that farmers are likely to specialize in the few varieties demanded by the market leading to low level of diversity or uniformity of crop varieties conserved on-farm (Smalle & Bellon, 1999; Mburu & Wale, 2006). It is therefore important to make more and thorough investigations on this ambiguous role of markets on on-farm conservation of crop genetic resources. Thus the objectives of this paper are to identify key ALV species demanded by the market in Nairobi, examine reasons for their demand, and determine the effect of market development, among other factors, on on-farm biodiversity of ALVs around Nairobi. In the following sections the conceptual framework guiding the study is presented followed by a discussion of the empirical methods, main findings and some conclusions and policy implications.

2. Conceptual Framework

ALVs fall under the category of underutilised species. And, just like other underutilised species, ALVs fulfil three conditions that are internationally accepted; are locally available but globally rare, scientific information and knowledge on them is scant, and their current use is limited relative to their economic potential (Gruère, Giuliani, & Smale, 2006). For many years, the use and hence the commercialisation of ALVs remained low despite their potential economic use. Commercialization of ALVs like for other underutilised crops, is affected by the current observed and potential economic value as well as socio-economic and policy problems of their external environment. The observed and potential value of a species has been characterised according to whether private or public, level of competition, existing knowledge gap and according to spatial or temporal dimensions (Gruère, et al, 2006).

The private value of ALVs, i.e. the value to the user, is shown by its ability to generate income to the user, ability to meet the users' household needs for food, medicine, and socio-cultural obligations, as well as its ability to be used occasionally as a general household risk management option. Continued growing of ALVs and the emerging markets would seem to suggest that they are increasingly being perceived as relatively profitable in comparison to other alternative uses of land or trading in other commodities. For the former, it shows the value of the crops is appreciating, hence the increasing supply of the ALVs. For the latter, it would then seem that the marketing systems are becoming more efficient and hence encourage further trading in ALVs. On the public value, the cultivation of ALV species has continued to contribute to agricultural biodiversity. Exploitation of ALV species on a commercial level is however likely to lead to a situation where the preferred species and subspecies will be promoted to the neglect of the ones which are less preferred in the market. Thus the question arises: what is the implication of increased ALV demand and subsequent market development for on-farm conservation of these species as commercialisation increases? It can therefore be hypothesized that the exploitation of ALVs for income generation (for private value) and the resultant commercialization threatens on-farm biodiversity.

The Institutional Analysis and Development (IAD) framework (Ostrom, 1998) can be applied to study ALV market development and on-farm biodiversity as one of its outcomes. This approach helps to develop hypotheses about market actors' behaviour and outcomes from changes in some exogenous variables and to analyze factors affecting interrelationships between institutions, actors and their activities and resources. Dorward (2001) adapted the IAD approach and market development framework for quantitative analysis of factors determining contractual forms and terms found in specific markets. Drawing on this framework ALV market development is hypothesized to be influenced by stakeholders' (suppliers and partners) characteristics, products' characteristics and the prevailing institutional, socio-economic, physical and infrastructural conditions. The interaction of these actors and factors affect the market efficiency, product volumes, level of market integration, level of transaction costs and level of crop diversity. In this paper we are interested in the effect of market development on the level of crop diversity.

The framework is divided into three main interrelated components: first, the external environment consisting of institutional, socio-economic and physical/infrastructure factors. These factors are exogenous and assumed to be out of control of the suppliers, supermarkets and organizations involved in the promotion of consumption of ALVs. For instance, depending on the country, the existing national policies may hinder or facilitate the use and production of ALVs. Presence or absence of storage facilities and the associated technological advancement may also be critical to reduction of waste and deterioration of quality. Lack of credit, poor infrastructure, and lack of market information may all curtail the ability of the market actors in the value chain to improve or increase the supplies.

The second component is the action domain which consists of the main actors or stakeholders, their activities (including the product or resource) and interactions or interrelationships, and where social and economic exchange takes place. The main actors are categorized as state agencies and ministries, suppliers, supermarkets, NGOs, international organizations while the minor ones include ALV transporters, county councils management, etc. is not considered in ALV trade. Here, among others the product attributes which include perishability, seasonality, assets specificity, quality/value, volumes and price, storage, processing, and value addition are considered. For brevity, only a few attributes are explained here. For example, for the ALVs attributes, it is considered that they are highly perishable, and therefore the handling and haul conditions may affect their quality and hence price. Asset specificity is also high when one invests in ALVs since there are few other commodities with similar characteristics.

The third component of the framework is the outcome. The question addressed here is: what is the performance of the activities of the various actors given their interactions or institutions and the prevailing conditions of the external environment? It is hypothesized that outcomes related to marketing of ALVs would include ALV market spatial growth and growth in terms of turnover , reduced on-farm diversity, increased market efficiency, increased incomes for suppliers, increased market integration, and reduced transaction costs and risks. In this study only the effect on crop biodiversity is investigated as the ALV market develops.

3. Research Methods

3.1The Study Area

The study was conducted within Nairobi and its peri-urban areas between August and September 2006. Nairobi is the capital city as well as the largest city in Kenya and as such all the ethnic backgrounds are represented. Food eaten in the city comes from across the republic and this extends also to ALVs. Some of the production areas of these ALVs are near Nairobi, e.g., Ngong, Limuru and Githunguri, whereas others are more than 100 km away. The latter include Transmara, Kisii, Nakuru, Machakos, Makueni and some pockets in Western and Nyanza Kenya (Mburu & Wale, 2006). Nairobi has ten large markets where ALVs are traded in large quantities. In addition, there are several estate markets that serve residential areas as well as small groceries, kiosks and local evening vendors all which stock varying amounts of ALVs**.** Gikomba market serves as the main wholesale market for ALVs within Nairobi. Other large and important ALV markets include: Wakulima, Githurai, Kangemi, Toi, Kawangware, Ngara, City Park, Korogocho, and Dagoretti. Many of these markets provide significant wholesale services besides retail. Those in the peri-urban include Gitaru, Wangige, Ngong, Kiserian, Ongata rongai and Ruiru. These mainly serve as producer markets, whereby farmers in the neighbourhood areas bring their produce and middlemen from other markets in the city come to buy and take to Nairobi urban markets. They therefore serve as an important source of most ALVs marketed and consumed in and around Nairobi. Most supermarkets chains like Uchumi, Nakumatt, Tuskermattress and Ukwala, as well as other smaller estate supermarkets are also important outlets for the ALVs especially for the working upper and middle class who have little time to visit the open air and seemingly congested Nairobi City Council markets.

3.2 Sampling and Data Collection

The study targeted suppliers marketing ALVs in Nairobi and in the peri-urban markets. Both qualitative and quantitative data was generated and used in the analysis. Qualitative data was generated from discussions and detailed interviews with consumers and suppliers, and key stakeholders involved in the marketing of the ALVs from both public and private sectors. Quantitative data was generated through administration of a semi-structured questionnaire to 97 randomly sampled suppliers from a total of 30 market outlets. This data included dates for starting to trade, production volumes for different time periods, cultivated and traded ALV species, socio-economic variables, respondents' perceptions, etc. The sampling procedure involved sampling first markets and then suppliers actively participating in the actual marketing of ALVs. To eliminate small and *ad hoc* trading venues from the quantitative analysis, only formal (licensed) markets which had at least five suppliers were considered for sampling. All the licensed markets were selected for the study. And after further consideration of costs and the relatively short time taken for wholesale activities in some markets, we settled on sampling randomly 20% of the actors in each of the selected markets. Thus a probability proportional-to-size systematic random sampling was done.

To generate the sampling frame in each market, a head count of market suppliers of ALVs was conducted. For the wholesale markets this was done just after starting the marketing activity, sometimes 4 am in the morning. The head count was then authenticated or validated by key informants, regular ALV suppliers and licensing officers or '*Askaris*' by asking them to confirm the number of suppliers who normally frequent a particular market. This number included those absent at the time of head count but were frequent suppliers of the particular market.

This method of establishing the sampling frame was done due to the fact that it was not possible to establish in advance the total population, hence lack of a predetermined sampling frame. For the purpose of the study, markets were categorized as either wholesale or retail. A market place could have both retail and wholesale markets. Dividing markets this way was necessitated by their different characteristics and those of participating suppliers. Suppliers in wholesale markets sold their wares on wholesale basis to retailers, while the retailers usually sold directly to consumers. The wholesalers usually traded very early in the morning and within a limited period of time while the retailers sat the whole day and retailed. Following this categorization, a total of 12 wholesale and 18 retail markets were found in the study area and included in the sample. The sampled market suppliers covered five marketing channel levels: producer wholesalers (% of the sample), first and second level wholesalers (%), producer retailers (%) and retailers (%).

The supermarkets were regarded as retail markets for ALVs. Among the major supermarkets in Nairobi, only the suppliers of Uchumi, who were farmers or producer wholesalers, were included in the sample, as the others were found to have complicated supply chains involving at least two intermediaries, making it difficult to identify farmers. Uchumi supermarket chain was sourcing its supplies from individual producers or producer groups who are listed and personally known to the chain. Its personnel even visited the farms to ensure that quality standard in production and harvesting were maintained. Thus it was easy to randomly sample from the list of the suppliers (farmers) linked to this supermarket chain who included individual farmers, both large and small, and several groups supplying ALVs under Farm Concern International. As with the other markets, a 20% sample was taken from the direct individual Uchumi suppliers and another 20% of individual farmers was randomly selected from suppliers operating in groups.

A few limitations are eminent from the sampling design employed in this study. First, the '20% selection criterion' had the disadvantage that formal markets with less than five actors were disqualified from the quantitative analysis and probably these would have provided more variation in the dataset. However, during the preliminary survey it was found such markets were very few. Second, due to time and financial constraints the quantitative analysis was confined to market suppliers, leaving out some producers who were likely to be selling ALVs from their own farms. This implies that only producers who participate in the marketing activities by selling their ALVs in market places (physical markets) were included. The consumers are also not included in the quantitative analysis since it is almost impossible to generate a random sample of this group of actors, given the time and finances allocated to the study. The study relied on secondary sources to generate data related to these two categories of actors.

4. Results and Discussion

4.1 Categorization of market suppliers and their attributes

In this study, the market suppliers were divided into four categories, namely, producer-wholesalers, producer-retailers, trader-wholesalers (first and second levels) and retailers. As indicated in Section three a market was conceptualised as having the three main actors, namely; producers, other suppliers or middlemen and consumers. Most suppliers preferred trading in a particular market as opposed to moving from market to market. Almost two thirds of the suppliers were more or less permanent in the same markets while the others were either mobile suppliers (6.2%) or occasional suppliers (mainly peri-urban producers) usually on market days or during specific seasons (29.9%). Producers who market their produce beyond the farm-gate fall into two categories: those who sell in bulk to other wholesalers or retailers and those who choose to retail direct to consumers. Most producers sold wholesale to other suppliers in order to get time to do other activities and minimize transaction costs. Only a few producers (3%) chose to retail and even then, only on market days in their nearest market centres (Table 4.1). About 38% of the sample suppliers were producer-wholesalers. In an effort to maximise profits from their ALVs and minimize costs and risks, these producers chose to bring their produce directly to the markets. As Table 4.3 indicates most of these suppliers are more involved in the peri-urban markets and also receive external support to enable them market their ALVs.

This rationality behaviour of producer-wholesalers is a key factor enabling this key group of market actors to benefit from ALV trade. The producer-wholesalers make savings from losses due to perishability and other costs that they would incur during harvesting and transportation of the produce and waiting at the markets. This may explain why only 3% of producer- retailers participate in the market. Nevertheless, if producers' opportunity cost of time is not considered, their profit margin is lower than when the ALVs are retailed directly to consumers. An accurate estimation of the profit that goes to the producer-wholesalers has therefore to account for benefits or returns from the other activities performed by this group after the ALV wholesale business is over. The trader-wholesalers were classified into first level and second level as shown in Table 4.1. The first level wholesalers (about 21% of the sample) get their produce direct from the producers in the growing areas and wholesale to other suppliers in the market.

The second level wholesalers actually buy on wholesale from the first level wholesalers and sell on wholesale at the same market. Only a few (1%) chose the latter as the profit margin is low. Some would wholesale at the second level just a little in the morning and retail the rest in the course of the day. Thus even though there are many 'early morning' second level wholesalers, most of them were classified as trader-retailers. The trader-wholesalers live in Nairobi or in far rural areas such as Limuru and Kisii, and are better endowed with financial capital than any other category of suppliers. They avoid risks such as losses due to perishability by buying and selling in bulk within a period of 18-24 hours. The trader-wholesalers enable the producers to save on costs of transportation and market fees and transaction costs of trading in the market. In some cases the farmers took their produce to the nearest markets, from where these first level trader-wholesalers would buy them. In other cases these wholesalers would go to the farms and even harvest the ALVs for themselves. In both cases, the wholesalers are driven by profit maximisation and choose the option that best suits them. Retailing to the consumers was mainly done by the trader-retailers who comprised 37% of the sampled market suppliers. This group of suppliers normally remains in one place and sell ALVs the whole day. The trader-retailers are well endowed with financial capital though not to the level of wholesalers. Most of the retailers live near the retail markets. Often they own temporary stalls in the council markets and in some cases have employed assistants.

4.2 Development of ALV market within Nairobi: a historical perspective

There was evidence that ALVs have been traded in Nairobi even before 1970 (Figure 4.1). However, the amounts traded remained relatively low and market development seemed to have picked between 2001 and 2006 after a drastic fall in 1981-1990 period. Most of the markets embarked trading in ALVs after 1991 with a good number of them (35.3%) having started in the period 2001 and 2006. About half (50%) of individual suppliers also started trading in ALVs around or before 2001, with 2004 being the year when most suppliers started selling ALVs. Prior to 2000, the ALVs trade was exclusively conducted in the city council markets albeit at a lower scale than in 2006 as only 38.1% of the suppliers were involved. The increase in trade volumes after 2000 was mainly due to the opening of supermarket outlets which started stocking mainly African nightshade and the involvement of farmers' groups in growing and selling ALVs within Nairobi. Even upmarket groceries were found stocking ALVs by the time of conducting this study.

According to the survey results, the oldest places where the ALVs were traded included all areas but were mainly concentrated in low class urban settlements. These include areas such as Kangemi where ALV trade started as early as 1960, Gikomba, and Wangige, where it started in 1972and 1974 respectively (Table 4.1). Other older markets included Ngara and Kisii bus-stage where ALV trade started in 1980 and 1986 respectively. At first, these ALVs would be brought from the growing areas for specific clientele which included the people who come from the growing areas. Kangemi is home mainly to people from Western Kenya (Adeka, Imbumi, & Maundu, 2005), while Gikomba is close to the city's country bus park therefore guaranteeing easy access for the suppliers from upcountry. Kisii bus-stage is a peculiar market as this is where the buses from Kisii park. Suppliers from Kisii and Transmara Districts would bring these vegetables and sell to others and a market eventually developed at the area. The buyers would also mainly be of the Kisii ethnic group but dwelling in the city. The early trading in ALVs within Nairobi is therefore localised and coincided with areas largely inhabited or regularly visited by people originally from major growing areas. It is therefore possible to link earlier ALVs' market development to patterns of settlement in Nairobi of particular ethnic groups that had indigenous knowledge on nutritional importance of ALVs.

4.3 Market development for different ALV species and subspecies

The study results showed that between 1996 and 2006, the number of species traded increased from seven to twelve. This presented an increase of 71.4% and a demonstration that species diversity in the market was increasing as market for ALV developed. The first three ALVs to be traded included African nightshade, leafy amaranth, and spider plant. Others included cowpeas leaves, *mitoo (Crotala*ria *ochroleuca* and *C. brevidens),* and Ethiopian kales (Table 4.2). It can also be seen in Table 4.2 that most of the markets had their 'first born' ALV as the African nightshade. To-date African nightshade is also the most common ALV in the Nairobi urban markets, followed by the amaranths. All the ALV species are sold in the markets in bunches. It was found that the total number of bunches sold between 2001 and 2006 increased by 164%. Most of these ALV species were sold at the city council markets since the supermarkets do not handle large quantities. For example, Uchumi supermarkets sold about 2500 bunches of ALVs daily (17,500 bunches per week) in September 2006. Alongside the increase in volumes sold, it was found that the percentage increase in gross sales is much greater since in some cases the prices also had changed. However, after thorough investigation it was found that it is the packaged quantities that have reduced whereas the prices have remained the same for the last decade.

This is also evident during period of scarcity. Instead of suppliers increasing the price per bundle they tie few vegetable leaves or stems to reduce the weight per bundle. The weekly turnover of ALVs in gross value in Kshs for 2006 and 2001 are shown in Table 4.3. The increase of gross sales between these periods was 213%. These results imply that in a week ALVs worth Ksh.7 million are consumed in Nairobi. About 80% of the market share was provided by four ALV species: African nightshade, Amaranth, cowpeas and spider plant. This implied that consumers prefer mainly these species though the diversity supplied to the market is high. The reasons behind the preference for these species (and their subspecies) are provided later in this section. Supply is abundant during the rainy season when demand is lowest. This is partly due to the fact that those with kitchen gardens have their supplies met from home. Bunches and bundles at this time are much bigger and the varieties to choose from are more. During the dry season, only a few producers with access to irrigation water grow the vegetables. Thus there is high demand during this time making vegetables more costly since they are not readily available. NGOs and other partners have been encouraging farmers where possible to engage in staggered and scheduled production to ensure they have the ALVs all year round. This is however not possible or is being done at a very limited scale due to scarcity of irrigation water. There were even cases, e.g., in Githunguri, where farmers would fetch water from a stream manually to water the vegetables.

Most ALV species have two or more traded sub-species. Table 4.4 summarises the most popular subspecies in terms of daily market share in gross sales in the study area. Although the species diversity has increased in the markets, about 60% of the market share is provided by five subspecies: broad and small leafed African nightshades (32%), green-stem broad leafed Amaranth (10%), purple stemmed Spider plant (9%), and broad leafed cowpea (7%). From the qualitative interviews, it was gathered that broad leaf African nightshade is preferred more than other subspecies because it is less bitter. In addition it is easier to prepare due to the size of the leaves (washing and destalking). African nightshade on the whole is considered to have high nutritive and medicinal values. Accordingly African nightshade is used traditionally to cure and manage such ailments as stomach-ache, bladder inflammations, kidney inflammations, fever and skin problems by many communities although the specific ailments differ from community to community. Since almost all communities have a tradition of consuming African night shade, this also contributes to its popularity in the markets. Amaranth in general is considered tender and milder than most of the other ALVs species in Nairobi market. The species is widely considered rich in iron and is mixed with the other bitter such as Spider plant, African night shade, and *Launaea cornuta* to enhance taste.

The green-stem broad leafed sub-species in particular is liked more due to its mild taste making it tasty even to children, while the broadleaves makes it easier to prepare. Amaranth is also common in most communities. The purple stemmed Spider plant is the most common in the Nairobi markets. Spider plant is attractive to many consumers because it is considered medicinal, in particular it is considered high in iron and hence it is recommended to the women before and after child birth, to initiates and to invalids just recovering from an illness. It is also associated with the treatment of constipation, diarrhoea, intestinal worms, and even birth facilitation. It also has a strong cultural significance amongst the Kisiis of Western Kenya as it is considered a ceremonial dish during weddings, initiations and burials, and it is given to important visitors as a sign of respect. Milk is usually added by many communities to manage the bitterness. Alternatively it is mixed with other vegetables. The broad leafed cowpea is preferred by consumers since it much tender and cooks faster compared to the narrow leafed usually grown in medium to dry potential areas. Cowpeas in general are compatible with many traditional or cultural diets of many dwellers of Nairobi. It also quite abundant as it is cultivated all over Kenya. These results are corroborated by past research by Mbugua, et al, (2004) and Maundu, Ngugi, and Kabuye (1999).

4.4 Effect of market development on on-farm conservation of biodiversity

Although the count diversity of ALV species and subspecies traded in the market increased with increased market development, this may not be the case at the farm levels. Farmers are likely to grow a few varieties that fetch them higher incomes. Thus it can therefore be hypothesised that as market and commercialisation of ALVs progresses, there is likely to be selective production of popular species and sub species to the neglect of others leading to reduced crop biodiversity. An econometric model was developed to determine effect of market development and other factors on ALV biodiversity. This model uses the 2006 count of species and subspecies or count index as the dependent variable. This is because its data requirement suited a study of this nature, and secondly, since data collection was not done at the farm level, it was difficult to estimate underlying population distributions, e.g. in terms of area, which can enable derivation of other indices. It has been generally argued in literature that diversity outcome is dependent on farm, household and market characteristics (Wale 2004). Thus a generalised regression equation would be: diversity = f (farm characteristics, household characteristics and market characteristics).

Market development in this case is regarded as one of the market characteristics. Since the dependent variable in the above equation is a count variable, Poisson regression for a count choices model is used (Cameron and Trivedi 1998). Two regression models were conducted: one with the count of species (inter-diversity) and the other with the count of subspecies (intra-diversity). Both models were run with producer-suppliers only (see Table 4.1) since the focus is on determinants of on-farm biodiversity at the time of conducting the study. There is therefore sample selection bias since farmers from ALVs producing areas who do not participate in the trade in Nairobi and its environs are not included in the analysis. The concern for this bias is minimized by the fact that the analysis is conducted from the perspective of trading ALVs and not conservation of biodiversity. In other words, the study is concerned about on-farm diversity of traded ALVs and not all cultivated ALVs.

The explanatory variables used in the regression analysis and their hypothesised signs are shown in Table 4.5. For the market development, the increase in gross values of ALVs for the period 2001-2006 and distance from the market were used as a proxies. This is justified by the fact that gross sales and market access can only increase if ALV market is developing. As hypothesised earlier, market development is likely to be negatively associated with ALV diversity. It was however difficult to place a priori sign for the variable 'SUPPORT' since external support was provided by different organisations which had diverse objectives. Some, like the non-governmental organizations, would favour cultivation of species and subspecies demanded by the market while others like research organizations favoured cultivation of many species and subspecies in order to conserve agro-biodiversity. According to the model results in Table 4.6, the household characteristics showed the expected signs. Particularly, the negative influence on intra and inter biodiversity by GENDER is significant, implying that women involvement in the trade favours ALV on-farm conservation. The other important household characteristic is EDULEVEL which had a positive and significant influence on the number of species and subspecies grown. This factor, by contributing to the producers' human capital, most likely enhances the ability to grasp faster new production techniques and to seek any market information on ALV varieties, and generally to better coordinate farm activities even when more species and subspecies are involved.

The proxies for market development, GROSS_INCR and DISTANCE, which is a measure of market access, have the expected negative signs. Thus though market development in terms of gross sales in Nairobi and its environs is negatively linked to efforts to conserve both inter- and intra-species, it is difficult to say that it significantly reduces on-farm diversity. This implies that at the moment ALV market development in gross sales is not a factor of policy relevance in the conservation on-farm diversity. Growth of gross sales is however normally positively correlated with increased market access (DISTANCE variable), which is a measure of spatial dimension of development of markets. This factor has a significance influence on intra-diversity. Thus as expected an increase of market access (decrease in DISTANCE) reduces the numbers of subspecies conserved on-farm. This result suggest that producers trading further from market outlets tend to keep more subspecies in their farms more than those trading from nearby markets. This might be mainly because producer-traders trading in far markets do not get adequate information on ALV subspecies demanded by the markets. Conversely, producer-traders cultivating ALVs in farms nearer Nairobi and its environs are probably assured of market and hence tend to concentrate on those species that are on demand in order to capture higher profit margins.

5 Conclusions and Policy Suggestions

This study shows that although ALV market in Nairobi has existed since the 1960s, rapid growth has only been realised since the late 1990s. With increasing market development, suppliers trade in many species and subspecies. Diversity of ALVs in the market is therefore appreciably high. However, only four species and – five sub-species are consumed in large volumes, providing 80% and 60% of the market share respectively. These species include African nightshade, amaranth, cowpeas and spider plant, while the subspecies are broad and small leafed African nightshades, green-stem broad leafed Amaranth, purple stemmed Spider plant and broad leafed cowpea. Both these species and subspecies are preferred mainly due to their nutritive values and compatibility with cultural diets of Nairobi dwellers. The effect of market development, as measured by increase in gross sales, on on-farm diversity of ALVs is negative as expected but it is not significant. Thus, this study cannot authoritatively conclude that ALV growth in gross sales in Nairobi and peri-urban areas has any significant effect on on-farm biodiversity at the moment. However, considering that this factor has been found to affect on-farm conservation of crop genetic resources negatively in many other areas (Mburu and Wale, 2006), the negative influence cannot be ignored and might be something to watch as the market progresses. Market access which is directly related to market development in terms of gross sales also showed the expected influence which particularly had a significant influence on intra-diversity. It was found that increased access to market reduces the number of subspecies grown in the farms.

This implies that as market develops spatially, only fewer subspecies that are demanded by the market will be grown. The policy implication of this factor is that it would be easier to conserve ALV diversity in areas that are far from markets. Such areas would then be the targets for promotional campaigns of organizations favouring on-farm conservation ALV diversity. Policy implications on the role of gender and education which were also found to influence on-farm diversity of ALVs deserve mention. The significant results of these variables imply that to spur ALVs trade and at the same time conserve on-farm diversity there will be need for policy makers and other stakeholders to encourage more participation of women and increased investment in education.

Acknowledgement

Thanks to the Global Facilitation Unit (GFU) for Underutilized Species, Rome, for initiating and funding this study. This paper was originally prepared for the European Association of Agricultural Economics.

6 References

Adeka, R., Imbumi, M. & Maundu P. M. (2005). Foods of the Nairobi People: A picture book of foods found in Nairobi Markets, IPGRI, Nairobi

Cameron, A. C. & Trivedi P. K. (1998). *Regression analyses of count data*. University Press, Cambridge

Dorward, A. R. (2001). The effects of transaction costs, power and risk on contractual arrangements: a conceptual framework for quantitative analysis. *Journal of Agricultural Economics 52(2): 59-74*

Gruère, G., Giuliani, A. & Smale, M. (2006). Marketing Underutilized Plant Species for the Benefit of the Poor: A conceptual framework, EPT Discussion Paper 154, IFPRI, Washington, D.C.

Imungi, J. K. (2002). The brighter side of phenolic compounds abundance in African leafy vegetables in IPGRI Newsletter for sub-Saharan Africa, Issue No. 17

Imungi, J. K. & Porter, N. N. (1983). Nutrient content of raw and cooked cowpea leaves. *Journal of Food Science 48:1252-1254*

Kimiywe, J., Waudo, J. & Mbithe, D. (2006). Reducing hidden hunger and malnutrition through traditional foods, IPGRI Newsletter for sub-Saharan Africa. Issue No. 21

Maundu, P., Ngugi, G. & Kabuye, C. (1999). *Traditional food plants of Kenya*, National Museums of Kenya, Nairobi

Mbugua, G. W., et al. (2004). Awareness creation and farmer-participatory prioritisation of African Leafy Vegetables. A project report by KARI, Thika for the IPGRI African Leafy Vegetables Programme, Nairobi

Mburu, J. & Wale, E. (2006). Local organizations involved in conserving crop genetic resources in Ethiopia and Kenya: Conditions for their Emergence and Success in Ethiopia and Kenya, *Genetic Resources and Crop Evolution Journal 53: 613-629*

Meng, E. C. H., Taylor, J. E. & Brush, S. B. (1998). Implications for the conservation of wheat landraces in Turkey from a household model of varietal choice. In: Smale, M. (ed) *Farmers, Gene Banks and Crop Breeding: Economic Analyses of Diversity in Wheat, Maize, and Rice, (PP 127 – 142) CIMMYT and Kluwer Academic publishers*

Ostrom, E., (1998). 'The Institutional Analysis and Development Approach' In: Loehman and Kilgour (eds), *Designing Institutions for Environment and Natural Resource Management (pp 68 – 90)*, Cheltenham, Edward Elgar.

Smale, M. & Bellon, M. R. (1999). A conceptual framework for valuing on-farm genetic resources. In: Wood D. (ed) *Agro-biodiversity: Characterisation, Utilisation, and Management, (PP 387-408)* New York, CABI Publishing

Wale, E (2004) The economics of on-farm conservation of crop diversity in Ethiopia: incentives, attribute preferences and opportunity costs of maintaining local varieties of crops. Dissertation, University of Bonn

Table 4.1: Categories of ALV market suppliers and their market locations

Category of suppliers	% in the sample	Location of market (%)	
		Urban	Peri-urban/rural
Producer-wholesalers	38.1	40.5	59.5
Producer-retailers	3.1		100.0
Trader-wholesalers 1st level	20.6	50.0	50.0
Trader-wholesalers 2nd level	1.0		100.0
Trader-retailers	37.1	58.3	41.7
n = 97	100.0	47.4	52.6

Table 4.2: The first ALVs traded in various Nairobi markets

Name of Market	First ALVs to be traded	Year
1. Kangemi Retail	African nightshade	1960
2. Kangemi Wholesale	Leafy amaranth, cowpeas	1968
3. Gikomba Wholesale	African nightshade, cowpeas, m*itoo*	1972
4. Ngara Retail	African nightshade	1980
5. Wangige Wholesale	African nightshade, Ethiopian Kales	1974
6. Kisii bus-stage Retail	African nightshade, leafy amaranth	1986
7. City park retail	Leafy amaranth, cowpeas, m*itoo*	1991
8. Toi Retail	African nightshade	1994
9. Ngong Retail	African nightshade	1998
10. Githurai Wholesale	Cowpeas	2001

Table 4.3: Weekly gross sales*

Species	Weekly gross value in Kshs	
	Year 2006	Year 2001
African nightshade	448,736.8	217,299.9
Leafy amaranth	262,946.4	167,752.7
Cowpeas	209,103.3	67,515.5
Spider plant	173,831.1	109,854.7
Ethiopian kales	87,642.6	24,457.7
Kahurura	57,209.3	16,124.0
Pumpkin leaves	49,027.7	12,918.02
Mitoo	43,053.1	27,744.5
Jute plant	35,589.8	5,750.0
Common comfrey	1,0614	682.5
Vine spinach	4360	.
Total for sample	1,382,114	650,099.5
Projected population totals	6,910,571	3,250,498

* Quantities in bunches per week * prices provided

Table 4.4: The importance of the various subspecies in the Nairobi market in 2006

Species	**Subspecies**	**Daily market share within the species (%)**	**Daily market share within the entire ALV market (%)**	**Popularity Ranking in the entire ALV market**
African nightshade	Broad leaf	65.11	20.83	1
African Nightshade	Small leaf	34.89	11.16	2
Amaranth	Green-stem broad leaf	53.33	10.28	3
Spider plant	Purple stem	89.52	9.25	4
Cowpeas	Broad leaf	76.50	6.61	5
Mitoo	Small leaf	60.55	4.92	6
Ethiopian Kale	Green stem	64.78	4.51	7
Vine spinach	-	-	3.87	8
Kahurura	-	-	3.80	9
Amaranth	Green-stem small leaf	18.46	3.56	10
Mitoo	Broad leaf	39.45	3.21	11
Jute plant	Broad leaf	97.72	3.18	12
Amaranth	Red-stem broad leaf	15.99	3.08	13
Ethiopian kale	Purple leaf	35.22	2.45	14
Amaranth	Red-stem small leaf	12.22	2.35	15
Pumpkin leaves	-	-	2.17	16
Cowpeas	Narrow leaf	23.50	2.03	17
Common comfrey	-	-	1.21	18
Spider plant	Green stem	10.48	1.08	19
Stinging Nettle	-	-	0.38	20
Jute plant	Small leaf	2.28	0.07	21

Table 4.5: Descriptive statistics and explanations of the model variables

Variables	Meaning	Mean	Std. Dev	A priori sign
Species	Number of ALVs species grown by the producer	3.45	1.78	
Subspeci	Number of ALVs subspecies grown by the producer	3.83	2.31	
Gender	Dummy for the sex of respondent (=1 if male and 0 if female)	0.38	0.49	+
Experien	Experience of trading in ALVs in years	6.74	5.92	-
Tot_Acre	Total farm size in acres	1.43	1.85	+
Support	Dummy for receiving support from outside to market ALVS (=1 if support received; otherwise =0)	0.6	0.50	??
Edulevel	Education level of the trader in years	9.95	3.40	+
Distance	Distance in Kms from the source of ALVs to market	27.2	23.5	-
Gross_INCR	Increase of gross value in Ksh of traded vegetables from 2001 to 2006	6569	5326	-

Table 4.6: Determinants of on-farm biodiversity of ALVs traded in Nairobi

	SPECIES		SUBSPECIES	
Explanatory variables	Coefficient	t-statistic	Coefficient	t-statistic
Constant	0.7851	2.408**	0.9455	3.066***
GENDER	-0.4715	-2.003**	-0.4728	-2.485**
EXPERIEN	0.00002289	0.048	0.0001215	0.7974
TOT_ACRE	-0.009093	-0.197	-0.009266	0.8342
SUPPORT	-0.06452	-0.332	-0.1814	-0.992
EDUC	0.05112	1.717*	0.05244	1.864*
DISTANCE	0.005772	1.513	0.005954	1.663*
GROSS_INCR	-0.0000017	-0.494	-0.0000096	-0.611
No. of observations	= 40		No. of observations	= 40
Wald Chi^2	= 27.80		Wald Chi^2	= 42.28
Pseudo R^2	= 0.2257		Pseudo R^2	= 0.22
Log pseudo- likelihood	= -78.77		Log pseudo-likelihood	= -86.82

*,**,*** significant at 10%, 5% and 1% respectively

Figure 4.1: Period when ALV trade started in the Nairobi markets