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An analysis of socioeconomic factors affecting avocado production in saline and flooded areas around Lake Victoria Basin of Western Kenya

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Avocado (*Persia americana*) a very important crop worldwide nutritionally and economically. In Kenya avocado does not thrive well in soils with high salinity, flooded or waterlogged areas. Survey was conducted around Lake Victoria Basin in Kenya to establish socioeconomic factors and flooding that affects its production. A sample of 400 households was interviewed using structured questionnaire, focus group discussions and key informants. Data were collected and analysed using Statistical Package for Social Scientists. Objectives were to find how flood, human capital and other socioeconomic factors such as gender, age, farmer education affects avocado production in areas with saline soils and floods among other factors namely Busia, Muhoroni, Nyando and Rachuonyo counties in Kenya. Results indicated that the major impediments were water logging (76.2%), flooding (73.0%), soil fertility (62.5%) and soil salinity (42.9%), to agricultural development and affect the crop production. Farmers had limited access to information on avocado production and marketing 31.3%, and sourced information from fellow farmers. Majority of farmers owned indigenous or non-certified avocado trees; low fruits market prices also discouraged its production. Therefore, farmers should be sensitized on the impacts of climate change on agriculture, encourage majority of them to take samples of their plots for soil analysis. 65.5% expressed soil fertility problems in their farms yet 95.5% of them had not taken their plots for soil analysis. Increasing of human capital, farmer education, and extension services may contribute to farmer's abilities to adopt new technologies for increased avocado production in these areas and may positively contribute to improved livelihood through nutrition, income generation of the stakeholders. Farmers should be encouraged to plant certified avocado seedlings tolerant to water logging and salinity.

Key words: Avocado, climate change, Lake Victoria, Kenya, strategies.

INTRODUCTION

Avocado (*Persea Americana)* is generally cultivated in tropical and sub-tropical regions from 40°N and 40°S. The fruit has remarkably high nutritional values and contains 15 to 30% oil, similar in composition to olive oil, eleven vitamins (Vit A, B6, B12, K, C, E, Folacin, Niacin, etc.) and fourteen minerals. Its calorific value is exceptionally high, 123 to 387 gmcal /100 g edible avocado and has low sugar content (Bergh, 1991; Currier, 1991; Gaillard and Gregory, 1995; HCDA, 2010). They are eaten fresh, in salads with lemon juice, salt, etc.

Avocado is a complete food in terms of protein, containing nine essential amino acids. It can almost substitute butter and meat and is called in many countries as poor man's butter. The avocado fruit was once a luxury food reserved for the tables of royalty but is today enjoyed around the world by people from all walks of life. Avocado is one of the most nutritive fruits known. Further it has several uses; as a natural cosmetic, with advantage in rapid skin penetration and as a superior natural sunscreen (Bose and Mitra, 1996). Compared with almond, corn, olive and soybean oils, avocado oil has the highest skin penetration rate (Currier, 1991; Swisher, 1998; HCDA, 2010). Avocado oil is easily digestible and can have beneficial effects on the digestive system. The oil is largely unsaturated and as the sugar content is low (about 3%), the fruit can be recommended as a high-energy food for diabetics.

Most countries where agriculture drives their economies in terms of employment, foreign exchange, subsistence and contributes to Gross Domestic Product (G.D.P) are adversely affected by the climate change affecting food security and incomes of the people. Other effects of climate change are incidences of diseases such as malaria, genetic erosion, biodiversity loss and ecosystems disturbance among others. (Robinson, 2004).

Economic importance of Avocado

Avocado's world production of 3.2 million tones (FAO, 2004) makes it an important fruit crop internationally. Its main producers are North America and Central America whose production constitutes 80% of the world production. Other countries produce the remaining 20%. Currently, Avocado represents about 17% of the total horticultural exports from Kenya. In the year 2003 total Avocado exports from Kenya was approximately 39% of total Avocado's annual production of 70,000 tones (Griesbach, 2005).

Although Avocado is important in Kenya its production is limited by waterlogging or flooding and in poorly drained soils which encourages Avocado root rot (*Phytophthora cinnamon*). This is the most serious disease in nearly all avocado producing areas of the world (HCDA, 2010). In Kenya every effort has been made to rectify the situation by uprooting or treatment of affected trees. Hot water and fungicide treatment of seeds for propagation purposes is highly recommended and grafting on phytophthora-tolerant and/or resistant rootstocks have been included as control options. Flooding limits gaseous exchange in the soil because it affects oxygen availability Oxygen has a slow diffusion rate in water than air. Consequently, in a poorly drained or flooded soil the main factor causing root damage is lack of adequate oxygen for normal root respiration (Drew, 1977; Kramer and Boyer, 1995). Other accompanying changes are the increase in the ethylene precursor, ACC, (I-carboxylic,I-aminocyclopropane) (Kramer and Boyer, 1995).

Objectives of this study to carry a survey on avocado production and utilization in five Counties around the Lake Victoria Basin and assess the livelihood contexts, strategies and outcomes of small holder farmers in avocado production systems. To consider socioeconomic factors with special emphasis on flooding common in some parts of the counties, human capital and its implications in Nyando, Muhoroni, Rachuonyo, Bunyala and Samia. The outputs are useful future information that can be scaled up in any new areas with similar characteristics such as saline and water-logging where tolerant Avocado varieties may be recommended.

Conceptual framework approach

This study applied the Sustainable Livelihood Approach (Figure 1). The Sustainable Livelihoods Approach (SLA) has been developed to help understand and analyze the livelihoods of the poor. In addition to improving the understanding of livelihoods, the approach can be used in planning new development activities and assessing the contribution to livelihood sustainability made by existing activities (DFID, 2000). Sustainable livelihoods approach offers a conceptual framework for understanding causes of poverty, analyzing relationships between relevant factors at micro, intermediate and macro-levels and prioritizing interventions. The approach explicitly requires going beyond sectorial barriers, to look at more of the context in which people live (DFID, 2000; Ashley and Diana, 1999; Ashley, 2000). There are variations on the SLA, emphasizing different aspects with many common elements. The SLA considers five assets or types of capital namely natural, human, financial, physical and social. It also integrates vulnerability contexts and livelihood strategies and was, therefore, used in this study to understand the livelihood support system of local households.

Livelihood assets

Swisher (1998) indicated five assets or types of capital available to people namely natural, human, financial,

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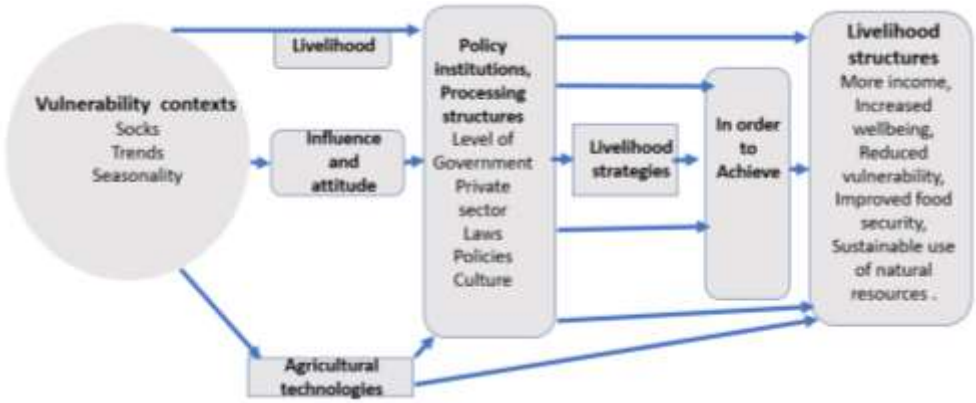

Figure 1. Sustainable livelihood framework (Adapted from DFID, 2000),

physical and social. These five forms of capital have different characteristics. People, according to the livelihoods approach, rely for their success on the value of services flowing from the total capital stock. Different households with different access to livelihood assets are affected by the diversity of assets, quantity and balance between assets. It is, therefore, worth investigating accessibility, quantity and balance of assets as benchmark information against which progress in the future can be measured from the changes brought about by the deployment of new innovations.

Natural capital

Natural capital refers to the biophysical elements such as water, air, soil, sunshine, woodlands and minerals the basic conditions for human existence. And it is the most fundamental of the core forms of capital namely manufactured, human and natural since it provides the basic conditions for human existence such as fertile soils, forests, productive land and seas, good quality freshwater and clean air (EU, 2013). A conceptual framework (Figure 1) involving interactions between socioeconomic and ecosystems in natural capital. Natural capital sets the limits for socioeconomic systems and is both limited and vulnerable (EU, 2013) was applied in this study.to exhaust information on ecosystem services to human wellbeing. The ecosystem services such as; biomass, water and fiber, regulating and maintenance services such as soil formation, pests and disease control and cultural services such as physical, intellectual, spiritual and symbolic interactions with ecosystems or landscapes (EU, 2013).These types of services are enhanced by supporting services such as nutrient cycling and are provided at a range of scales from global-climate regulation to local-flood protection. These are naturally occurring assets that are largely renewable. In this study, household land size and land under cultivation of fruits were analyzed to explore other livelihood contexts and outcomes as reported.

Human capital

Human capital is perhaps the most important livelihood support factor (Ashley, 2000). It is the people who are both the object and subject of development. Since this study was on smallholder farmers, their knowledge about agriculture, technology available, sources and levels of accessibility were investigated. Investigation was, of necessity, carried out on farmers' exposure to agricultural extension.

Financial capital

Financial capital is the medium of exchange and, therefore, central to the functioning of a market economy. Its availability is critical to the successful utilization of the other factors or assets. The main analyzes in this section were farmers' exposure to financial services such as savings and access to cash credit.

Physical capital

Physical capital refers to man-made assets such as productive assets, housing quality and consumer durables. An analysis was done on the number and status of productive assets within the households.

Social capital

Social capital according to Ashley (2000) is the productive capital making possible the achievement of certain ends that would not be attained in its absence. In the Sustainable Livelihood Approach (SLA), social capital

entails the social networks and associations to which people belong. In this context, social capital is taken to mean the social resources upon which people draw in seeking to achieve their livelihood outcomes, such as networks, and connectedness that increase their trust and ability to cooperate, or membership to groups and their systems of rules, norms and sanctions. Social capital attributes were analyzed descriptively through simple statistics (frequencies). Attributes that were analyzed included: group belongingness in terms of group typology and mandate.

Vulnerability concept and livelihood strategies

Under SLA, people's livelihoods and availability of assets are fundamentally affected by critical trends (such as population, resource, technology, national and international economic, shocks (such as human health shocks, natural shocks, economic shocks, conflicts and crop/livestock health shocks), and seasonality of prices, production, health and employment opportunities) (Ashley and Diana, 1999; Ashley, 2000). In general, people tend to have limited or no control on the vulnerability contexts. The factors (trends, shocks and seasonality) that make up the vulnerability contexts impact directly on people's asset status and the options open to them in pursuit of beneficial livelihood outcomes. Local households' vulnerability to climate change and livelihood strategies and outcomes were analyzed.

MATERIALS AND METHODS

Study locations

The study covered four Counties around the Lake Victoria Basin, namely: Nyando, Muhoroni, Rachuonyo and Busia based on their edaphic and climatic conditions such as salinity and water-logging commonly affecting some parts of the named counties. In these areas screening avocado rootstocks for tolerance to salinity and water-logging adaptable to these conditions would increase the production of avocado as a food security crop and income generation would be of importance.

Nyando and Muhoroni Counties; Nyando and Muhoroni Counties are in Nyanza region of Kenya covering Upper Nyakach, Lower Nyakach, Nyando, Miwani and Muhoroni. Much of the area lies in the Kano Plains that is predominantly black cotton clay soils with moderate fertility and poor drainage. The rest of the County has sandy clay loam soils derived from igneous rocks. Altitude range 1100 to 1800 m, annual precipitation 600 to 1630 mm, bi-modal rainfall pattern and exhibit wide variation in distribution. Kano Plains in Nyando is prone to flooding and water overflow that has caused extensive erosion in its lower parts resulting in huge galleys (GoK, 1999).

Rachuonyo county

The County has a population of 307,126 and an area of 945 Km². with four sub Counties namely East Karachuonyo, Kabondo, Kasipul and Rachuonyo (GoK, 1999)

Busia county (Bunyala)

Bunyala in Busia County has a total population of 58,773 lies to the north of Lake Victoria near the Kenya-Uganda border. Rainfall is bi-modal per annum. The major season occurs in March to May while the minor season occurs in October to December. The period June to July is generally dry unlike other areas in western Kenya, which observe a major rainfall peak during the period. The months of January and February are also generally dry though occasional wet conditions may occur especially in January (GoK, 1999).

Sampling method

Four Counties (Muhoroni, Nyando, Rachuonyo, Bunyala) were purposively sampled based on their edaphic and climatic (salinity and water-logging) conditions. Two divisions were selected from each county for the study. Further, one administrative sub-location was selected from each of the selected divisions. Two villages were randomly sampled from each sub-location, from a list of all the villages in the selected sub-locations. The same procedure was used for selecting sample villages in all the three counties. The listing of villages was done during reconnaissance survey by the research team and FEWs (Frontline Extension Workers) through the assistance of the area assistant chiefs that availed the lists of all the households in each village from which sample households were selected for the study.

Sample size

Four steps were used to select the sample population. The first step involved developing a list of all villages in the selected sub-locations. The second step involved sampling four sample villages from the list developed. The third step involved making a list of all households in the sampled villages. The fourth step involved selecting the sample households from the village lists. Thus, using the 'lottery technique, four villages were randomly sampled from each county. Using systematic sampling technique, 25 households were selected from each village for the survey. Thus, one household was selected randomly from among the first five households in each village through the 'lottery technique'. The next and subsequent households were then selected based on the interval established. An appropriate sampling interval (I) was calculated by dividing the total village household size (N) by the required sample size (n) as follows:

$I = {}^{N}/n$

Where, I = the interval; N = the total village household population and n = the sample size.

All households were assigned sequential numbers from 1……..n for each County based on the village lists. If the first random household was, for example, 5, and the interval was 2 then the next 2nd household on the list of households was selected along with every following 2nd household until the required sample of 400 households was obtained.

Data collected and analysis

The collected data included; livelihood contexts, avocado production levels, vulnerability, capital assets from smallholder

farmers by means of a structured questionnaire, Focus Group Discussion (FGD) where two FGDs per each county comprising of 20 participants were captured and Key Informant Interviews (KII) using a checklist. The structured questionnaire was administered by Field Extension Workers (FEWs) from local county Agricultural Offices and Research Assistants. The data was cleaned prior to analysis and subjected to Statistical Package for Social Scientists (SPSS) outputs interpreted and reported. The purpose of these tools was to assess farmers' opinion on: avocado production and livelihood contexts. Information collected through these tools were used for triangulation purposes, that is, cross-checking it with information that was collected through the structured questionnaire.

RESULTS AND DISCUSSION

Socio-economic and demographic characteristics of respondents

Demographic and socio-economic characteristics play a key role in determining the livelihoods of rural people. Variables such as age and education greatly influence how people perceive, use and dispose of assets (Usman et al., 2013). Normally, aged household heads are expected to have accumulated wealth of experience on various aspects of life. A farmer's experience, for instance, can generate or erode confidence. With more experience, a farmer can become more or less averse to agricultural risks by adopting new technologies and improved agricultural practices (Usman et al., 2013). All these falls under human capital whose results as reported and discussed below.

Human capital

Human capital represents the skills, knowledge, ability to labor and good health that together enable people to pursue different livelihood strategies and achieve their livelihood objectives (DFID, 2000). At the household level, it varies according to variables such as household size, skill levels, leadership potential and health status. Human capital appears to be a decisive factor in making use of other types of assets. Therefore, changes in human capital have to be seen not only as isolated effects, but as a supportive factor of the other assets. Human capital has been reported to increase agricultural productivity in Senegal (Ndouri, 2017), while in Iran (Mehdi, 2012), reported that experience and education increases agricultural productivity, additional year of education squared reduced level of inefficiency while additional years of experience squared increases famer's income (Jules and Fondo, 2012). In this paper physical capital, age, financial capital and membership to cooperatives were considered because they affect human capital since they interact with each other.

Age

Age can have a positive or negative effect on a farmer's decision to adopt technologies. An aged farmer, for example, may avoid a technology that is more labor involving. In China an increase in age lowered agricultural, similarly, in Nigeria majority of older farmers reduced scope and time hours in farming operations (Usman et al., 2013). Thus, age may reduce technical efficiency in crop productivity. Majority of the respondents interviewed were aged 41 and above. However, analysis across the counties indicated that Nyando County had the highest number of respondents, 76.2%, while Rachuonyo had the lowest, 56.3% (Table 1). During the study period most farmers were in the age groups of 31 to 40 years and greater than 60 years.

Level of education

Exposure to education increases a farmer's ability to obtain, process and use information relevant to adoption of improved technologies and hence, increase yields and influence wealth (Usman et al., 2013). A mean of 60.4%, of the framers, had completed primary level education. Muhoroni County had the highest at 72.5%, while Nyando County had the lowest at 51.4% (Table 1). In Kenya primary level of education is sufficient for farming but more education is even better (Usman et al., 2013).

Physical capital in relation to human capital

Physical capital comprises the basic infrastructure required to support livelihoods in a given environment (rural or urban). These basic infrastructures include adequate water supply, sanitation, environmentally friendly sources of energy, secure shelter, access to transportation and communication facilities (Asif et al., 2015) increases agricultural productivity and output since it determines agricultural production decisions (Moser, 1998; Putman, 1993; Bebbington, 1999) and also affects marketing of produce (Winters, 2000).

Mobile phones as a tool for change

Mobile ownership was considered as proxy indicator for household socio-economic status. The ownership of a mobile phone has nowadays become and essential household item in Kenya and lack of it in the household means that the household will struggling to acquire one. Mobile phones can facilitate flow of information along value chains among stakeholders from agricultural extension officers. They can also be used to manage livelihood shocks such as livestock deaths or harvesting problems (Aker and Mbiti, 2010; Sen and Chaudhery, 2011) or for savings, insurance services and for marketing (Sen and Chaudhery, 2011). Almost, 71.2% of the farmers owns, at least owned a mobile phone.

Table 1. Gender, education and age of respondents.

Characteristic		Number of respondents (%)					
		Muhoroni (%) (N=80)	Nyando (%) (N=80)	Rachuonyo (%) (N=80)	Bunyala East (%) (N=80)	Bunyala (%) West (N=80)	All counties (%) (N=400)
Gender	Male	72.5	71.2	71.2	66.2	58.8	68.0
	Female	27.5	28.8	28.8	33.8	41.2	32.0
Age (Years))	<18	1.2	Nil	3.8	Nil	Nil	1.2
	19-30	15.0	7.5	10.0	16.2	8.8	11.4
	31-40	23.8	16.2	30.0	25.0	21.2	23.1
	41-50	15.0	25.0	22.5	15.0	23.8	19.9
	51-60	20.0	20.0	13.8	21.2	10.0	17.1
	> 61	25.0	31.2	20.0	22.5	36.2	27.3
Schooling	None	13.8	20.0	8.8	23.8	17.5	16.9
	Primary	72.5	51.4	52.5	55.0	71.4	60.4
	Secondary	12.4	23.7	33.7	21.2	9.9	20.0
	College	Nil	3.8	5.0	Nil	1.2	0.5
	University	1.2	1.2	Nil	Nil	Nil	0.4

Therefore, passing information may be faster, this may be a good channel for change and may increase adoption of technology

Agricultural extension services

This study specifically focused on human capital in relation to agricultural activities. In this section, human capital was analyzed from the perspective of agricultural extension, decision-making on key household enterprises and time allocation by key household members to the enterprises. Extension is an important parameter of human capital. The extensive ownership of mobile phones in the study areas is a boost to the flow of agricultural information from agricultural extension officers as discussed earlier under physical capital. Both government and private sector extension services help farmers to access new technologies and demonstrations on how to apply the various guidelines (Thabitt and Suleiman, 2015; Usman et al., 2013; Akkad, 1990; Ndour, 2017). In addition, extension providers play an important role in monitoring and evaluation of these new technologies. Agricultural extension services play a major role in building the knowledge stock of farming communities (Jules and Fondo, 2012; Ouma et al., 2018). They help farmers to translate results into improvement in livelihoods. In Ethiopia Agricultural extension has helped farmers replace their local crop landraces with improved varieties thus increasing crop yields and food security (Biratu, 2008) while in Argentina it has resulted in increases in Grape yield, productivity and quality (Pedro et al., 2008). In Kenya it has been similarly reported that it increases yields but this depends on factors such as availability of labour, farmers' level of education, types of crops grown, farmers' experience, farm management abilities of the farmer and agroecological characteristics of the farm.

Visits by extension agents to farmers and farmers' participation in field days, seminars and/or agricultural shows are cost effective ways of reaching out with the new agricultural practices or technologies to a large number of farmers. The study revealed that agricultural extension contacts increases yields and incomes for farmers and particularly for farmers near cities where the officers stay, farm inputs available for purchase, younger farmers who are active and educated in addition to high incomes. The study revealed that overall 55.1% of the respondents' farmers indicated that they never sought extension advice for crops and livestock production, specifically, Bunyala East had 81.2%, and conversely, Nyando County had 60%, sought extension service. The main source of extension services was the public sector while in Rachuonyo County where private sector was the major source of extension services as "service providers". Some the reasons for not accessing extension services were reported as that the extension services were not available (Table 2). Thus, any undertaking on fruit production and especially, avocado production should address the issue of extension. By the farmers indicating that they sought advice from the public sector indicates that they have confidence in the sector and therefore any extension services should be channeled through the public sector. Some farmers would expect extension services to reach them as they fear that if the call for them there might pay for the services rendered. However, extension reforms are taking place in many countries to enable private agencies to be hired by farmers for the task (Rivera, 1996; Rivera et al., 2000; Carner, 1998; Feder et al., 1999).

Table 2. Sourcing of extension services.

Service type		Number of respondents					
		Muhoroni (%) (N=80)	**Nyando (%) (N=80)**	**Rachuonyo (%) (N=80)**	**Bunyala East (%) (N=80)**	**Bunyala West (%) (N=80)**	**All Counties (%) (N=400)**
Sought extension service	Yes	46.2	60.0	45.0	18.8	55.0	44.9
	No	53.8	40.0	55.0	81.2	45.0	55.1
Source of extension	Public extension agent	15.0	15.0	12.5	6.2	45.0	18.4
	Private extension agent	1.2	35.0	1.2	7.5	2.5	9.9
	Neighbor/farmer	13.8	Nil	7.5	2.5	2.5	5.2
	ASK show	2.5	3.8	1.2	1.2	1.2	2.0
	Input dealer	1.2	Nil	11.2	1.2	Nil	3.0
	Radio/TV	Nil	2.5	1.2	Nil	Nil	0.5
	Family/friend	1.2	1.2	Nil	2.5	3.8	1.7
	Farmer organization/Cooperative	2.5	Nil	2.5	Nil	2.5	1.5
	Field days/Demos	1.2	Nil	1.2	Nil	Nil	0.5
	NGO agent	10.0	1.2	6.2	Nil	Nil	3.5
	Research organization	Nil	Nil	Nil	1.2	Nil	0.2
	Other	Nil	Nil	1.2	Nil	Nil	0.2
Reasons for not seeking advice	Long distance	20.0	12.5	3.8	21.2	8.8	13.2
	Expensive	8.8	8.8	Nil	5.0	15.0	7.4
	Time consuming	Nil	1.2	1.2	3.8	Nil	1.2
	Extension agent not available	17.5	10.0	18.8	12.5	15.0	14.9
	Don’t need extension services	5.0	10.0	20.0	35.0	1.2	14.1
	Other	7.5	Nil	8.8	2.5	Nil	4.0

Payment for extension services

In the rapidly changing world, with demands on few resources, the provision of free extension services is becoming impracticable thereby necessitating cost-sharing in extension services with the farmers. The results indicated that 64.5% of the respondents were not paying for extension services with Rachuonyo topping the list with 80% followed by Muhoroni, 76%. The willingness to pay for extension service, were as follows: 56.1% said no. Bunyala East topped this list at 71.2% followed by Muhoroni at 65.0% of the respondents indicating that they would not be willing to pay for extension services. Willingness to pay for extension services appeared to have been affected by factors such as availability of skilled extension staff, farm productivity, size of farm, crop type; some crops such as fruits and vegetables are high value crops and can help the famer pay for extension services (Onoh et al., 2012). Other factors which may have influenced these results include cost of extension services, economic benefits, access of government extension services, subsistence farming, quality of extension services (Uddin et al., 2016), farm size, farmer’s level of education, can help the famer pay for extension services (Onoh et al., 2012). However, 66.2% of the respondents in Rachuonyo were willing to pay for extension service.

Table 3. Payment for extension services.

Service		Number of respondents					
		Muhoroni (%) (N=80)	Nyando (%) (N=80)	Rachuonyo (%) (N=80)	Bunyala East (%) (N=80)	Bunyala West (%) (N=80)	All counties (%) (N=400)
Paying for extension	Yes	3.8	47.5	7.5	3.8	1.2	12.9
	No	76.2	41.2	80.0	62.5	62.5	64.5
Willing to pay for extension for a fee	Yes	30.0	66.2	46.2	28.8	33.8	41.2
	No	65.0	32.5	52.5	71.2	60.0	56.1
Reasons for non-payment for extension service	Cannot afford	30.0	13.8	36.2	51.2	53.8	37.0

Conversely, the farmers gave various reasons why they would not be willing to pay for service. Topping the list was the feeling that the farmers cannot afford to pay for extension service. Yet others felt that it is the responsibility of the government to provide extension services (Table 3). The several implications were that was difficult to sell extension services as a cost-sharing venture in Rachuonyo and Muhoroni Counties and that any intervention aimed at scaling up extension services either on fruit production or any farming venture should aim at reversing the thinking that farmers cannot afford to pay for the services and/or that it is the responsibility of the government.

Decision making on agricultural production

Maize is as a staple crop grown by the farmers both for food and cash income in the survey areas. Avocado was studied as a fruit crop mainly for cash production. Decisions making of various crops in the farm by the farmers were influenced by age, farming experience, type of agricultural land, ecology, extension programs, attitude of cooperative society members, agricultural knowledge, level of full-time activity, professionalism, farm size, social status, knowledge, attitudes and social association (Mehdi, 2012). Other factor affects include labour availability and cost, market price, availability and cost of inputs, crop requirements and pests and diseases (Madhu and Chandargi, 2004). Gender roles in the household decision-making process are important in a baseline study before a new technology is deployed in an area. An understanding of the role of household members in making decisions about the utilization of resources guides the design of appropriate strategies, for the introduction of a new technology. Household members decide on the disposal of benefits from agriculture is important in order to predict who among the household members, the new technology would benefit most. Results from the survey indicated that most decisions on maize and fruit production were made by head of the household as indicated by 44.4 and 38.0% of the respondents respectively. Bunyala West had majority of the decisions on the two crops made by the head of the household as indicated by 76.5 and 77.5% for maize and fruit production, respectively (Table 4). Any intervention, therefore, aimed at decisions on crop production should address the issue of household headship as this dictate which enterprise the household would give priority.

Similar to maize and fruit production, the farmers indicated that it was the head of the household who made decisions on maize and fruit marketing as indicated by 26.3% for both maize and fruits respectively (Table 4). Factors which may affect marketing decisions are farmer attitudes, age and education of the farmer. A relatively young, educated and innovative farmer sells at farmer's markets while the older, less educated farmer sells at traditional markets. Other factors were farming experience, farming traditions in the family, farm size, number of

Table 4. Decision making on production of maize and fruits.

Crop		Number of respondents					
		Muhoroni (%) (N=80)	Nyando (%) (N=80)	Rachuonyo (%) (N=80)	Bunyala East (%) (N=80)	Bunyala West (%) (N=80)	All Counties (%) (N=400)
Maize production	Head	37.5	41.2	28.8	42.5	76.2	44.4
	Spouse	11.2	23.8	15.0	11.2	13.8	15.6
	Male children	1.2	3.8	Nil	1.2	Nil	1.2
	Female children	Nil	Nil	1.2	Nil	Nil	0.2
	Head and spouse	47.5	26.2	41.2	41.2	10.0	33.3
	Head/Spouse/Children	1.2	Nil	3.8	1.2	Nil	1.2
	Household non-member	Nil	1.2	Nil	Nil	Nil	0.5
Fruit production	Head	32.5	32.5	17.5	32.8	77.5	38.0
	Spouse	10.0	6.2	11.2	10.0	13.8	10.4
	Male children	1.2	3.8	Nil	7.5	Nil	2.5
	Female children	Nil	Nil	Nil	Nil	Nil	Nil
	Head and spouse	46.2	3.8	31.2	36.2	8.8	25.1
	Head/Spouse/Children	6.2	Nil	1.2	10.0	Nil	3.5
	Household non-member	Nil	Nil	Nil	Nil	Nil	0.2

products, higher price motivation, plans to continue farming, plans to develop farm infrastructure, external supports and cooperatives (Ouma et al., 2018). Other factors are market price, scale of operation, distance to the market, farm mechanization, institutional and agricultural markets ,access to finance, investment and infrastructure services, speed of payment, farmers age (Nwachukwi, 2013), market information, credit availability, availability of cooperatives, expertise on grades and standards, contractual agreements, availability of social capital and market infrastructure, communication infrastructure. For fruits such as Avocado the decision making depends on orchard characteristics, variety, fruit maturity, quality attributes. There are other crops in the farm which also influence decision making namely rice, groundnuts, sweet potatoes, tomatoes, vegetables, millet/sorghum (Nwachukwi, 2013). Where both male and female participate equally in decision making in a house hold a higher production were realized especially in a high valued crop such melon (Mohammad and Abdulquaris, 2012) that the involvement of both sexes in various field activities may be specific but they are complimentary as also confirmed for maize and beans in this study.

Households decision making on fruit and maize enterprises marketing

The decision making on fruit and maize enterprises marketing lies on the head of the household who makes decisions on how to market maize and fruits (Table 5). However, other family members can market in absence of household head.

Decision making on use of income from maize and fruits

When it came to the issue of use of income, the results further still indicated that it was the head of the household who made decisions on how to use income from sale of maize and fruits as indicated by 44.4 and 38.0% of the respondents, respectively. In both cases, Bunyala West was leading that it was the head of the household who made decisions on use of income from maize and fruits (Table 6).

Table 5. Households decision making on fruit and maize enterprises marketing.

N (Number of respondents)		Number of respondents					
Enterprise		**Muhoroni (%) (N=80)**	**Nyando (%) (N=80)**	**Rachuonyo (%) (N=80)**	**Bunyala East (%) (N=80)**	**Bunyala West (%) (N=80)**	**All Counties (%) (N=400)**
Maize marketing	Head	17.5	1.2	16.2	33.8	63.8	26.3
	Spouse	12.5	1.2	13.8	12.5	25.0	12.9
	Male children	2.5	Nil	Nil	3.8	Nil	1.2
	Female children	Nil	Nil	Nil	Nil	Nil	Nil
	Head and spouse	18.8	1.2	20.0	45.0	10.0	18.9
	Head/Spouse/Children	2.5	Nil	Nil	2.5	1.2	1.2
	Household non-member	1.2	Nil	Nil	Nil	Nil	0.5
Fruit marketing	Head	16.2	20.0	7.5	22.5	65.0	26.3
	Spouse	12.5	12.5	15.0	13.8	25.0	15.4
	Male children	2.5	2.5	Nil	10.0	Nil	3.0
	Female children	Nil	Nil	Nil	Nil	Nil	Nil
	Head and spouse	16.2	1.2	21.2	41.2	8.8	17.6
	Head/Spouse/Children	6.2	Nil	1.2	8.8	1.2	3.5
	Household non-member	1.2	1.2	Nil	Nil	Nil	0.7

Time allocation to household enterprises by household members

The household is the level at which most resource allocation decisions are made. Division of roles, time and responsibilities among different family members occurs naturally among men, women, youth and the elderly.

Allocation of labour varies if farm income is uncertain for reasons of farm product price variability and uncertain rainfall (Mishra and Godwin, 1997). Like any other resource in the household, time is not equally distributed across members. Time allocation is highly influenced by farm characteristics, individual member characteristics and market access (Ellis, 1993). Farm size is negatively related to amount of time allocated to off-farm activities since farmers undertake them due to constraints in getting access to farming land (Reardon, 1997). Usually, there are significant differences not just along gender lines but also by age, social status, wealth, etc. Time allocated to household (Table 6) activities can range from 24 h to days spent in various activities over a year. How much time one devotes to certain activities in the household may imply the importance the person attaches to the activity or its necessity as compared to farming. Family members may allocate their time budget between self-employment on their piece of land and local agricultural labour market (Escobal, 2001). Participation in farm activities may be influenced by labour availability and cost and economic status of the family (Madhu and Chandargi, 2004; Escobal, 2001). Some household members may not work off farm due to their low education, advanced age, gender and customs (Udry et al., 1995). Rural household members are motivated to enter non-farm sector due to factors such as risk in farming or lack of insurance. Under the assumption of perfect labour market farmers may not participate in the off-farm labour even if the reservation wage rate is less than the marginal value of labour (Blundell and Meghir, 1987). The actual participation of farmers in off-farm activities depends on the incentive and capacity to participate (Reardon, 1997), variables that raise the value of marginal product of labour

Table 6. Decision making on use of income from maize and fruits enterprises.

Crop		Number of respondents					
		Muhoroni (%) (N=80)	Nyando (%) (N=80)	Rachuonyo (%) (N=80)	Bunyala East (%) (N=80)	Bunyala West (%) (N=80)	All Counties (%) (N=400)
Use of income from maize	Head	15.0	3.8	16.2	33.8	63.8	44.4
	Spouse	2.5	Nil	13.8	12.5	25.0	15.6
	Male children	2.5	Nil	Nil	3.8	Nil	1.2
	Female children	Nil	Nil	Nil	Nil	Nil	.2
	Head and spouse	15.0	1.2	20.0	45.0	10.0	33.3
	Head/Spouse/Children	17.5	Nil	Nil	2.5	1.2	1.2
	Household non-member	2.5	Nil	Nil	Nil	Nil	.5
Use of income from fruits	Head	13.8	31.2	10.0	32.5	67.5	38.0
	Spouse	1.2	6.2	8.8	5.0	8.8	10.4
	Male children	2.5	Nil	Nil	1.2	Nil	2.5
	Female children	Nil	Nil	Nil	Nil	Nil	Nil
	Head and spouse	12.5	1.2	26.2	40.0	11.2	25.1
	Head/Spouse/Children	22.5	Nil	1.2	16.2	10.0	3.5
	Household non-member	2.5	Nil	Nil	2.5	2.5	0.2

in off-farm employment increase the probability and level of participation in off-farm. Therefore, family members whose real opportunity cost of time is lower than marginal productivity of labour work on the farm and vice versa (Reardon, 1997). Attention was given to the household head and their spouse as the key household members. The findings indicated that both the head of the household and spouse hadalmost similar time allocation to household farming activities as indicated by 42.4 and 38.7% of the respondents, respectively (Table 6). This agrees with past findings reported on effect of gender on time allocation. Males however been reported to increase chances of working off-farm but reduces time in farm activities (Abdullai and Delgado, 1999; Newman and Canagarajah, 2000) but contrasts with most scholars who reported that growth in non-farm activities would benefit women (Newman and Canagarajah, 2000).

Time allocation to household members

Time allocation on the scale of 100% to farming activities scored dismally across the head and the spouse (Table 7). This shows that the families were involved in off-farm activities due to their low economic status due to may be to poor crop yields or produce prices (Mishra and Godwin, 1997; Rose, 2001; Bandyopadhyay et al., 2012). The present study findings disagree with those of Adeyonu (2012) who reported that male allocated more time to farming than off-farm activities while female allocated more time to farming during rainy seasons than dry seasons. In Uganda it has been reported that education and road access positively affected time allocation to off-farm employment (Bagamba, et al., 2007). The age groups of the famers in the counties appear to have been middle aged since they are likely to work off-farm compared to young and old due to their higher education levels (Newman and Canagarajah, 2000).

Household membership to cooperative organizations

In this sturdy, the focus was on farmers' membership to cooperative organizations. Results

Table 7. Time allocation to household members.

N (Number of respondents)		Number of respondents					
Household		**Muhoroni (%) (N=80)**	**Nyando (%) (N=80)**	**Rachuonyo (%) (N=80)**	**Bunyala East (%) (N=80)**	**Bunyala West (%) (N=80)**	**All Counties (%) (N=400)**
Time allocation by household head	0	12.5	2.5	11.2	8.8	12.5	10.2
	25	50.0	60.0	20.0	56.2	27.5	42.4
	50	Nil	Nil	Nil	Nil	Nil	Nil
	75	27.5	32.5	47.5	27.5	37.5	34.2
	100	10.0	5.0	18.8	6.2	22.5	12.4
Time allocation by spouse	0	5.0	2.5	3.8	1.2	11.2	5.0
	25	42.5	51.2	18.8	45.0	35.0	38.7
	50	Nil	Nil	Nil	Nil	Nil	Nil
	75	28.8	18.8	40.0	26.2	27.5	28.3
	100	23.8	21.2	31.2	26.2	26.2	25.6

Table 8. Household membership to co-operatives.

Cooperative type	Number of respondents					
	Muhoroni (%) (N=80)	**Nyando(%) (N=80)**	**Rachuonyo (%) (N=80)**	**Bunyala East (%) (N=80)**	**Bunyala West (%) (N=80)**	**All Counties (%) (N=400)**
Producer cooperative	22.5	3.8	3.8	3.8	1.2	6.9
Multi-purpose cooperative	6.2	2.5	2.5	Nil	1.2	2.5
Savings and credit cooperative	10.0	15.0	10.0	3.8	5.0	8.9
Informal self-help groups	28.8	12.5	40.0	11.2	3.8	18.9
Out grower company	Nil	1.2	Nil	Nil	Nil	0.2
Other cooperative	1.2	1.2	Nil	Nil	1.2	0.7

revealed that the responses were evenly spread out across different associations including; informal self-help groups, (18.9%), savings and credit cooperatives, (8.9%) and producer cooperative (6.9%) among other associations (Table 8). Across all the Counties there was poor enrolment in cooperatives. This may have been due to their low education and lack of coordination and efficient distribution of resources to members (Abdullai and Delgado, 1999; Arcas-Lario and Hernadez Espallardo, 2003). Membership to cooperatives has been reported to be positively affected by farmer's level of education, communication, log of gross income and farm size. Small farmers are expected to join cooperatives than large farmers for input services (Karh and Celik, 2006). It is most probable that the farmers in these counties had low education, low gross income and poor awareness but were small scale farmers who needed this membership (Ouma et al., 2018). Factors such as age, farming

experience, type of agriculture, agricultural land area and area of cultivated land, social status, knowledge and attitudes, facilities, attitudes of the cooperatives also could have led to this poor membership to cooperatives (Mehdi, 2012).

Conclusion

Farmers had limited access to information on avocado production and marketing as 31.3%, sourced information from fellow farmers, lack of certified avocado seedlings. Sensitizing farmers on the importance of knowing the soil fertility status of their farms by sampling their soils and taking to soil laboratory for analysis for appropriate recommendation of the required amendments would enhance profitable production. Increase in human capital, farmer education and extension services contribute positively to farmer's abilities to adopt new technologies. In water logging and salinity areas planting tolerant certified avocado seedlings are beneficial to farmers.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interest.

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REFERENCES

Abdullai A, Delgado C (1999). Determinants of non-farm earnings of farm-based husbands and wives in Northern Ghana. American Journal of Agricultural Economics 81:117-130.

Adeyonu AG (2012). Gender dimensions of time allocation of rural farming households in S.W. Nigeria. Research Journal of Social Science 4:269-276.

Aker JC, Mbiti M (2010). Mobile phones and economic development in Africa. The Journal of Economic Perspectives 24(3):207-232.

Arcas-Lario N, Hernandez Espallardo M (2003). Coordination and performance of Spanish second-level agricultural cooperatives. The impact of relationship characteristics. European Review of Agricultural Economics 30(4):487-507.

Ashley C (2000). Applying livelihood approaches to natural resources management. Experiences in Namibia and Kenya, ODI Working Paper 134, ODI, London.

Ashley C, Diana C (1999). Sustainable Livelihoods. Lessons from early experience. DFID, 1999.

Bagamba F, Burger K, Kuyvenhoven A (2007). Determinants of small holder farmer labour allocation decisions in Uganda. Paper presented at the 106th seminar of EAAE. 25-27 October 2007, Montpeller, France.

Bandyopadhyay S, Skoufias E (2012). Rainfall variability. Occupational choice and welfare in rural Bangladesh. World Bank Policy Research Paper No. 6134

Bebbington A (1999). Capitals and capabilities: A framework for analysing peasant viability, rural livelihoods and poverty reduction strategies. World Development 26:1:1-19.

Bergh BO (1991). The avocado and human nutrition I. Some health aspects of the avocado proceedings. Proceedings of the World Avocado Congress II (WAC 91). University of California, California pp. 25-35.

Biratu GK (2008). Agricultural extension and its impact on food crop diversity and the livelihood of farmers in Guduru, Ethiopia. MSc. Thesis. Norwegian University of Life Sciences.

Blundell R, Meghir C (1987). Bivariate alternatives to the tobit model. Journal of Econometrics 34:179-200.

Bose TK, Mitra SK (1996). Fruits: Tropical and Sub-tropical. Naya Prokash, Social Sciences, Agriculture and Horticulture, 206 Bidhan Sarani, Calcutta 700006, India.

Carner D (1998). Changing private and public roles in agricultural service provision. London, ODI, Natural Resources Group.

Currier W (1991). New variety introduction. US condition. Proceedings of the World Avocado Congress II (WAC 91). University of California, California, pp. 609-613.

DFID (2000). Sustainable Livelihoods Guidance Sheets. DFID. London. UK.

Drew M (1977). Oxygen deficiencies and root metabolism: injury and acclimatization under hypoxia and anoxia. Annual Review of Plant Physiology and Plant Molecular Biology 48:233-250.

Ellis F (1993). Peasant economics farm households and agrarian development. Cambridge University press, Cambridge. https://www.worldcat.org/title/peasant-economics-farm-households-and-agrarian-development/oclc/709580893

Escobal T (2001). The determinants of non-farm income diversification in rural Peru. World Development 29:497-508.

EU (2013). European Union. Mapping and assessment of ecosystems and their services.-Second report.

Feder G, Willet A, Zijp W (1999). Agricultural extension: generic challenges and some ingredients for solutions. Washington DC World Bank Policy Working Paper 2129.

Gaillard JP, Gregory J (1995). Avocado the tropical agriculture. Technical Centre for Africa (CTA). Macmillan Education Ltd, London, UK, pp. 94-110.

GoK (1999). Government of Kenya National Bureau of Statistics. Population Census. Kenya Bureau of Statistics Nairobi, Kenya.

Griesbach J (2005). Avocado growing in Kenya. World Agroforestry Centre (ICRAF). Kul Graphics Ltd. Nairobi, Kenya.

Horticultural Crops Development Authority (HCDA) (2010). Horticultural Crops Development Authority Serving the horticulture industry 5:6. Marketing NEWSLETTER June 2010 edition.

Jules MN, Fondo S (2012). The effects of human capital on agricultural productivity and farmer's income in Cameroon. International Business Research 5(4):20-25.

Karh AB, Celik Y (2006). Factors affecting farmer's decision to enter agricultural cooperatives using random utility model in the South Eastern Anatolian region of Turkey. Journal of Agriculture and Rural Development in the Tropics and Subtropics 107(2):115-127.

Kramer P, Boyer J (1995). Water relations of plants and soils. Academic Press, San Diego California 4(8):240-244.

Madhu SK, Chandargi DM (2004). Factors influencing decision making of farmers in non-farm and farm activities. Kamataka Journal of Agricultural Science 17(2):355-357.

Mehdi SJ (2012). Factors affecting sustainability of agriculture production system in Iran Annals of Biological Research 3(90):4578-4583.

Mishra AK, Godwin BK (1997). Farm income variability and the supply of off-farm labour. American Journal of Agricultural Economics 79:880-887.

Moser CON (1998). The asset vulnerability framework; reassessing urban poverty reduction strategies. World Development 26(1):1-19.

Nwachukwi M (2013). Analysis of gender participation in agriculture food crop production activities. Ph.D. Thesis. University of Nigeria, Nsukka.

Ndour CT (2017). Effects of human capital on agricultural productivity in Senegal. World Scientific News 64:34-38.

Newman C, Canagarajah RS (2000). Gender, poverty and non-farm employment in Ghana and Uganda. World Bank Policy Research Unit. World Bank. Washington.

Onoh PA, Asiabaka CC, Edna M, Eze CC (2012). Determinants of farmers' willingness to pay for agricultural extension services in South East Nigeria. Nigeria Agricultural Journal 43(1):1-10.

Ouma G, Odhiambo GD, Musyimi D, Kwach J (2018). Livelihood assessment of avocado growing in western Kenya and its socioeconomic implications using agricultural extension services. International Journal of Agricultural Extension, pp. 2311-8547.

Pedro C, Maffioli A, Ubfali D (2008). Impact of agricultural extension services: The case of grape production in Argentina.Inter-American Development Bank. Office of evaluation and oversight. Working Paper: OVE/WP-05/08 JUNE 2008.

Putman R (1993). Making democracy work; civic traditions in Modern Italy. Princeton University, Press. https://en.wikipedia.org/wiki/Making_Democracy_Work

Reardon T (1997). Using evidence of household income diversification to inform study of the rural non-farm labour market in Africa. World Development 25:735-747.

Rivera WM (1996). Agricultural extension transition. Worldwide: structural, financial and managerial strategies for improving agricultural extension: Public Administration and Development 16:151-161.

Rivera WM, Zip Willem A, Gory A, Vin L, Crowdeand JA (2000). Contracting for extension: review of emerging practices of agricultural knowledge and information systems. Good Practice Note. World Bank Washington DC.

Robinson GM (2004). Geographies of agriculture: Globalisation, restructuring and sustainability, Harlow, Pearson/Prentice Hall. https://www.taylorfrancis.com/books/9781315839509

Sen S, Chaudhery V (2011). Information communications technologies application for agricultural risk management: ICT in Agricultural Source Book, World Bank, Washington, DC. https://elibrary.worldbank.org/doi/abs/10.1596/978-1-4648-1002-2_Module10

Swisher HE (1998). Avocado oil: From food use to skin care. Journal of Ornamental Oil Chemistry Society 65:1704-1706.

Thabitt AH, Suleiman E (2015). Economic analysis of factors affecting crop production in South Sudan. APRN. Journal of Science and Technology 5:5

Uddin E, Qijie G, Maman-Ur-Rashid MD (2016). Crop Farmers' Willingness to Pay for Agricultural Extension Services in Bangladesh: Cases of Selected Villages in Two Important Agro-ecological Zones. Journal of Agricultural Extension and Education 22:1.

Udry C, Alderman JH Haddal I (1995). Gender differences in farm productivity implications for household efficiency and agricultural policy. Food Policy 20:407-423.

Usman I, Taiwo AB, Haratu D, Abubaker AM (2013). Socio-economic factors affecting groundnut production in Sabongari Local Government of Kaduna State, Nigeria. International Journal of Food and Agricultural Economics 1(1):41-48.

Winters LA (2000). Trade liberalization and poverty. Working Paper No.7 Poverty Research. University of Sussex.