

International Journal of

Agriculture

(IJA)

AN EVALUATION OF THE FACTORS INFLUENCING VEGETABLE COMMERCIALIZATION IN KENYA

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AN EVALUATION OF THE FACTORS INFLUENCING VEGETABLE COMMERCIALIZATION IN KENYA

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Abstract

Purpose: The purpose of the study was to establish factors that influence vegetable commercialization among smallholder farmers of fresh vegetables in Kenya. The present study defined commercialization against farmer characteristics including portion of land committed to vegetable farming, share of household income generated from it, and the producers' perception that the vegetables they consumed at the farm were produced or procured without any substantial cost.

Methodology: The researcher adopted a cross-sectional survey design to randomly recruit a sample of crop farmers (n=118) from Kirinyaga and Kiambu counties in Kenya. Data on agrochemical use, crop diversity and scale as well as logistical issues regarding proximity to markets and social status of the crop farmers were collected using a researcher-administered questionnaire in a one-on-one interview. These data were initially entered on MS Excel spread sheets for cleaning and later transferred to Minitab (Ver 12) for statistical analyses. Principal component analysis (PCA) was used to isolate crucial commercialization factors responsible for varying agrochemical use behaviours among crop farmers and later presented in scree plots.

Results/Findings: The study revealed that commercialization of tomatoes and kale was real in different areas of study which was influenced by structural and socio-demographic factors. From the study findings, structural policies to promote horticulture and high value crop production had a positive impact on production of vegetables while wildlife conservation and livestock development resulted to human-wildlife conflicts due to agrochemical abuse. Various socio-demographic factors that influence commercialization of vegetables included: household size, farm size, proportion of land used for vegetable production and household income. It emerged that household size (Eigen value EV=3.63), income (EV=2.61) and farm size (EV=1.27) accounted for 68.4% of variability in agrochemical abuse. This finding also explains their marginalization from county government extension services and high costs of market access.

Unique contribution to theories, practice and policy: The study finds that vegetable farmers' perception of commercialization leaned more towards increasing production in response to consumer demand and not necessarily to raise household food supplies. Farmers dedicated over two thirds (66.67%) of their land to vegetable farming to support their livelihood (97.1%, SE= 1.30). Commercialization of vegetable farming was influenced by the level of education (SE=3.68). The study found out that that access to ICT equipment, particularly mobile phones, were the prime means via which farming techniques and agribusiness practices were learnt or improved (V= 0.196 Pearson, p=0.11).

Key words: *Commercialization, Vegetable, Agrochemicals*

1.0 INTRODUCTION

Agricultural commercialization refers to the orientation of individual farm enterprises or optimization of to input and output markets coupled with decision making component (von Braun & Kennedy, 1994; Pingali, 1997) with the aim of increasing productivity and profits. Therefore, smallholder commercialization encompasses going beyond the food self-sufficiency goal by adopting productivity enhancers and offloading the surplus to the market (Kiriathi, Kassim and Kimanya, 2016). In addition, the increased productivity from commercialization results to household income growth which is an indicator of increased purchasing power and improved welfare which contributes to changes in food consumption patterns among producers (Dorsey, 1999; Seale *et al.*, 2003; Moti *et al.*, 2009, Kirimi *et al.*, 2013). Gross domestic product (GDP) growth originating from agriculture has been acknowledged to have higher positive impact (2-4 times) on incomes of extremely poor category compared to growth from other sectors (AGRA, 2014), therefore vital for development of developing economies (Thorbecke, 1970; Diao *et al.*, 2007; Cervantes-Godoy & Dewbr, 2010). Literature indicates that agricultural commercialization is vital in the structuring and transformative aspects of an economy (von Braun 1995; Pingali & Rosegrant, 1995; Timmer 1997; Pender & Alemu, 2007; Moti *et al.*, 2009) especially in the developing ones. Cervantes-Godoy and Dewbr (2010) point out that economic growth especially agricultural related is fueled by among other factors access to input and output market; a basis for agricultural commercialization. Sharma *et al.* (2015) recognizes that agricultural commercialization is driven by demand and supply forces with the changing food consumption trends as well as production regimes in a locality, economic growth, demographic changes, technology, urbanization and modernization of agricultural food markets.

Commercialization addresses the increasing challenges in deficient soil fertility, pest and disease prevalence on one hand and need to increase agricultural productivity and income returns on the other hand, thus necessitating the use of agrochemicals. Further to this, in effort to meet the specific demand attributes (cosmetic quality) such as color, outlook (spotlessness), size, shape, texture and taste by target consumers, farmers have resulted to use of agrochemicals (Thrupp *et al.*, 1995; Okello & Swinton, 2010). The use of external inputs is further legitimized by the need to increase production in order to meet the increasing food demand for the surging population and the changing population structure. This trend compliments the 'green revolution' movement which has been advocating for crop varietal development and input use as a basis for agricultural development since 1950s (The Royal Society, 2009). The use of external inputs has been lauded as a basis for embracing science in agricultural commercialization and as a result reaping the ensuing benefits (The Royal Society, 2009).

The world population is expected to expand by about a billion people by 2030 and another 2 billion by 2050 (Bjørndal *et al.*, 2014). This demographic expansion is anticipated to be most pronounced in Africa (Mubila, 2012; Bremner, 2012). Specifically, the Sub-Saharan Africa (SSA) region, currently the poorest in the world, will contribute 46% of the world's total births by 2050. Kenya, a developing country, located within the Eastern part of the SSA and whose population was estimated to be 43.35 million in 2013 (World Bank, 2016) is projected to reach 60 million by 2030 and 77 million by 2050 (GoK, 2012). Out of the estimated total population of

40.91 million in 2010 for Kenya, approximately 20.1 million people (49%) were categorized as poor (KIPPRA, 2013) where almost 80% of the overall population depend on agriculture for its livelihood. Whether it is from a global or national perspective, these population changes present a challenge and an opportunity in provision of adequate, nutritious and safe food. Putting up the required structures to ensure food demand is met may be a challenge but availing these foods present an opportunity for increased returns in food supply chains.

There is a general agreement that the increasing population is an indicator of growing food demand (Regmi *et al.*, 2001; Hui & Wen, 2007; Bjørndal *et al.*, 2014). As a result, an increase in food production by at least 50% will be required globally by 2050 (The Royal Society, 2009). The anticipated changes in the structure of the population especially age, sex, income, level of education and urban/rural orientation across the globe will complicate the future consumption patterns and food needs (Bjørndal *et al.*, 2014)

In Kenya, food production falls way below consumption and will need to increase by 75% from 2015 levels in order to match consumption in by 2030 (Welborn, 2018). Kenya's agricultural sector, the eighth biggest in Africa by volume, has attempted to keep pace with consumption since the late 1990s. Nonetheless, the contrast between sustenance free market activities stayed under two metric tons until 2009 (ISS, 2018). Furthermore, as indicated by the International Futures (IFs) forecasting framework housed at the Frederick S Pardee Center for International Futures at the University of Denver, the gap between consumption and production is anticipated to broaden going ahead (ISS, 2018). IFs forecasts that consumption in Kenya will surpass production by about 20 million metric tons by 2040. This implies imports would need to meet 25% of rural interest.

Findings by Food and Agricultural Organization and World Water Council gauge that by 2050, the world will require 60% more food to sustain its growing population (Valin *et al.*, 2014). In Kenya, the force of the issue is all reflected in the government's choice to incorporate food security in its "Big Four Agenda"; Enhancing Manufacturing, Food Security and Nutrition, Universal Health Coverage and Affordable Housing which spells out the government's need zones priorities (GoK, 2019). Here, farming backing up to 75% of the population and produces all the nation's sustenance necessities.

Commercialization of agricultural produce and especially vegetables through improved participation in output markets has been supported as one of the best approach to address low agricultural output that has led to high levels food insecurity in developing countries such as Kenya (Ngenoh *et al.*, 2019; Abdullah *et al.*, 2019; Olwande & Mathenge, 2011; Wickramasinghe, 2015). In addition, the market liberalization policies that were widely promoted in Kenya in the 1990s under structural adjustment programs (SAPs) were generally meant to encourage agricultural commercialization. Covertly, however, these liberalization policies also aimed at opening up new economic hotspots. This outcome has not been impressive.

As of today, many rural producers continue to practice the traditional survival agriculture and consequently unable to realize full potential from commercialization prospects presented by the liberalized markets (Pinder & Wood, 2003). Equally, for many years, local agricultural markets

in Kenya were profoundly protected against cheap imports and a time government has been supporting producer output prices through parastatals (FAO, 2015).

The market liberalization policies are aimed at protecting the welfare of the producer and the country at large. Conversely, owing to the international food crisis of 2006 and 2008 and subsequent post-election violence, food prices went up sharply with poor households being worst hit. Although the food prices have dropped since 2009, they still remain higher compared to the period before the crisis and predictions point to that there is a likelihood that they will remain so for the next 20 years (IFAD, 2011). Up to now, considerable amount of the production are in response to these higher food prices (IFAD, 2011).

1.2. Statement of the Problem

Outspoken authors on vegetable commercialization in Kenya argue that it could improve the livelihoods of corresponding farmers and improve the economy of the country by first responding to household demands for food. This view resonates well with local needs to combat poverty and hunger in the region and has therefore become increasingly popular among policymakers and civil society agencies. Theoretically, the view also fits well within the utility maximization theory (UMT).

However, authors also admit that this conclusion was reached in the absence of data and a poor understanding of the factors that compel farmers to commercialize vegetable farming. Strangely, researchers continue to interpret these producer patterns against structural and demographic characteristics such as level of education or proximity to markets. The risk has been the creation of a smoke-screen around real concerns of farmers such as access to capital and extension services, wildlife depredation or even more controversial, the privatization of seed and agrochemicals by big multinationals.

This study casts the farmers' choice to adopt and practice vegetable commercialization within the utility maximization theory (UMT) and finds significant faults in its principal aim of increasing production and income. This is portrayed as short-sighted and capable of endangering the farmer's long-term household food supplies. The proposed logic argues that commercialization compromises agrochemical ethics and could thus undermine the safety and acceptability of farmers' produce in the market. Finally, the researcher disputes the relationship between the farmer's livelihood and their ability to address the food security of marginalized groups in the society.

Unlike the export markets, domestic markets have not been keen to ascertain the safety of local foods, particularly, fresh vegetable targeting domestic consumers (Gitonga *et al.*, 2010). As a result, levels of pesticide residues capable of harming human health have been detected in fresh vegetables such as tomatoes destined for local markets (Kiriathi, Kassim and Kimanya, 2016). There have also been allegations to suggest that fresh produce that fails to satisfy export market demands is diverted back to the domestic food supply chains. In addition, the country's consumer welfare watchdog has not been outspoken in order to initiate debate and policy action in relation to the booming agricultural commercialization especially vegetables as far as agribusiness ethics compliance by fresh food producers (Muriithi & Matz, 2014).

1.3. Research Objective.

- i. The study sought to determine the factors influencing vegetable commercialization in Kenya

2.0 LITERATURE REVIEW

2.1 Theoretical Framework

2.1.1 Utility Maximization Theory

Several theories have been advanced to describe consumer behavior towards aspects of vegetable commercialization, agribusiness ethics and chemical safety of foods. However, their limitation is their inability to offer an integrated explanation that combines commercialization factors from the producer and consumer as well as, ethics and safety. For this reason, the researcher adopts the Utility Maximization Theory (UMT).

According to the theory, consumers are increasingly choosing among alternative goods within their limited incomes (Chernov & Hamilton, 2009) with the aim of spending each last cent on products that yield the highest marginal utility (or satisfaction) possible (Stigler, 1950). Utility theory bases its beliefs upon individuals' preferences. It explains behavior of individuals based on the premise people can consistently rank order their choices depending upon their preferences. Each individual will show different preferences, which appear to be hard-wired within each individual.

Studies on vegetable commercialization attribute its advent and popularity on government and donor efforts to increase production and offer a means to alleviate poverty among small farm-holders (Gebru *et al.*, 2019) in rural areas. In a sense, therefore, commercialization could be seen as a push-pull affair aided by the entire market with the aim of maximizing product penetration (quantity and quality).

Given that poverty is multidimensional, its alleviation through commercialization could consider much more than direct costs of production including other livelihood needs such as healthcare. The socioeconomic burden of disease due to agrochemicals is already incredible enough to erode the benefits of commercialization (Dewbr, 2010). Globally, for instance, more than 350,000 people globally suffer acute poisoning due to herbicide and insecticide (Ko *et al.*, 2018) and this costs Kenyan farmers about 47% of their household income (Macharia, 2015). Interestingly and despite the intensive use of agrochemicals, commercialization in the horticulture industry has been shown to increase household income and asset value for Kenyan farmers (Muriithi and Matz, 2014) and contribute to poverty alleviation. This underscores the significance of strict safety regulations particularly for export market and urban supermarkets. Otherwise, the burden of agrochemicals undermines the industry's contribution to alleviate poverty and in turn hinders commercialization. In the context of UMT, agrochemical safety presents an objective rationale for vegetable producers to maximize satisfaction for consumers.

2.2 Research Gaps: Critical Review of Literature

Empirical literature to appreciate the inadequate production market participation in post food-price crisis era is still very few. Most of them were based on output market participation of one or just a few selected crops especially cereals yet smallholder commercialization involves largely vegetables including the indigenous vegetables (Jaleta, 2009). In terms of policies in Kenya, The National Food Safety Policy and the National Food Nutrition and Security Policy ignore consumer sensitization and involvement (Oloo, 2010). An empowered consumer will raise the red flag in the event of suspected contamination. Tough policies and regulations should scrutinize and authorize different actors in the value chain and provide the consumer with the vital information for proper decision making.

Literature shows substantial research on food demand (Regmi *et al.*, 2001), agricultural commercialization across the globe (von Braun & Kennedy, 1995; Mahaliyanaarachchi & Bandara, 2006), in Thailand (Tipraqsa & Schreinemachers, 2009), SSA (Nindi, 1993; Govereh *et al.*, 1999; Berhanu *et al.*, 2006; Pender & Alemu, 2007; Moti *et al.*, 2009; Zhou *et al.*, 2013; Tirkaso, 2013), in Kenya (Chiputwa & Qaim, 2014; Muriithi & Matz, 2014; Woolverton & Neven, 2014). Available literature shows that there is scarcity of knowledge on vital connection of components in the agri-food supply chain such as consumer food demand, agricultural commercialization, and agribusiness ethics in commercialization and food safety. Researchers have largely failed to establish the link among these vital components across food supply chains. This study sought to build on the existing literature to fill in the research gaps by establishing the link among these components in the regenerative vegetable supply chain while focusing on the effect of vegetable commercialization on agribusiness regulatory compliance and food safety, an area that has been minimally researched on.

3.0 RESEARCH METHODOLOGY

3.1 Research Design

The study adopted a mixed methods approach. The descriptive design describes the state of affairs as it exists at present (Kothari, 2004).

3.2 Target Population

The target population consisted of all households in Nairobi, Kiambu and Kirinyaga counties. The accessible population comprised of 1,405,092 household units and is summarized in Table below:

County	Population
Nairobi (Westlands)	860,464
Kirinyaga	134,719
Kiambu	409,909
Totals	1,405,092

Source: (KNBS, 2013)

3.3 Sample Size

A total of 384 households in the three counties were interviewed. The following formula was adopted in calculating the sample size (Delice, 2002).

$$n = \frac{NZ^2 \times 0.25}{d^2 \times (N - 1) + (Z^2 + 0.25)}$$

Where, n=sample size

N= Target population

d= precision level normally expressed in terms of 0.05

Z= number of Standard Deviation (SD) units of the sampling distribution correct to desired confidence level

N=1,405,092

d=0.05

Z=1.96

$$\frac{1405092 \times 1.96^2 \times 0.25}{0.05^2 \times (1405092-1) + (1.96^2 + 0.25)}$$

n=384 households units

The sample size for each county was then allocated in proportion to the population of each county as shown below:

Kiambu County (Producers)

$$\frac{409909}{1405092} * 384 = 112$$

Kirinyaga County (Producers)

$$\frac{134,719}{1405092} * 384 = 36$$

Nairobi County (Consumers)

$$\frac{860,464}{1405092} * 384 = 235$$

3.3.1 Sampling Procedure and Technique.

The study used three main sampling techniques; judgment sampling stratified sampling and simple random sampling which are both non-probabilistic and probabilistic in nature. The study applied judgment sampling to select Kirinyaga, Kiambu and Nairobi Counties. Kothari and Gaarg (2019) have already explained how judgment sampling could be used when the study has to be biased in selection towards preferred criteria. The Economic Survey 2019 lists Kirinyaga County among the leading tomato producing counties in Kenya while Kiambu is a major source of African Kales (Sukuma wiki). Nairobi County is a main market for produce.

3.4 Data Collection Tools

Self-administered questionnaires and personal interview schedules were used during data collection, applying both open-ended and closed-ended questions. Kothari and Gaarg (2019) explained how closed-ended questions helped in standardizing responses while open-ended questions described the researchers' conclusions.

3.5 Data Analysis and Presentation

The analysis sought to test factors that predict the adoption (presence or absence) of vegetable commercialization in the study area. The following binary logit model was adopted from Jong *et al* (2019) to explain the influence of these factors on commercialization:

$$\pi_{ij}(x_i) = \frac{\exp(\alpha_j + \beta' x_i)}{1 + \sum_{h=1}^{J-1} \exp(\alpha_h + \beta' x_i)}$$

Where: y_{ij} denote the presence ($y_{ij} = 1$) or absence ($y_{ij} = 0$) of multinomial outcomes j , $j = 1, \dots, J$, for observation i , $i = 1, \dots, N$; $(\beta_{j1}, \dots, \beta_{jR})'$ denotes the coefficients for the j^{th} linear predictor, except its intercept α_j . For the reference outcome, $\pi_{ij}(x_i) = 1 / (1 + \sum_{h=1}^{J-1} \exp(\alpha_h + \beta' x_i))$.

The table below outlines some of the consumer and producer factors that have been shown in literature to influence vegetable commercialization. The multinomial regression model would help sift through to identify factors that were significant (have p-values below 0.05) and relevant (have a coefficient of determination above 0.1) in vegetable commercialization

4.0 RESULT AND DISCUSSION

4.1 Is vegetable commercialization real?

The initial challenge for the study was to prove a case for commercialization. This was achieved in the following four ways, firstly, by evaluating the sources from which consumers purchased their vegetables in which case commercialization was implied if a majority of consumers purchased rather than produced the vegetables they needed. Secondly, commercialization was implied if a farmer committed a significant portion of land to vegetable farming or secured a sizeable share of household income from it. Thirdly, there was commercialization if the farmer drew a substantial amount of household income from vegetable income. Fourth and lastly, commercialization was implied if the producers perceived that the vegetables they consumed at the farm were produced or procured without any substantial cost. This was used as a benchmark for drawing comparisons with the other forms of commercialization.

4.2 What factors influence vegetable commercialization in the study area?

Ready market or demand

Under the first criterion, the study found that about 98.72% of the consumers sampled reported consuming both kales and tomatoes regularly. This ranged from once every day for 36.6% of respondents, to about twice or thrice every day for 30.64% of respondents, respectively. Only

1.28% of respondents consumed kales alone but none consumed tomatoes alone. Very few (0.43%) reported not consuming vegetables in a given week.

All respondents acknowledged sourcing their vegetables from the market out of which a majority (76.6%) relied on nearby traders, supermarkets (9.36%), county markets (0.43%) or a combination of all sources (13.62%). Demand was, therefore, deemed a crucial factor influencing vegetable commercialization in the study area and about half (49.36%) of respondent consumers felt that this demand was growing. However, 42.55% felt that it remained normal and even fewer (8.09%) felt that it was declining.

Access to land

A majority of farmers were seen to utilize a substantial share of their land with the aim of maximizing income from vegetable farming. For instance, about 50% of crop farmers were utilizing between 66.67% - 100% of the total land for vegetable farming. Similarly, the data returned very high mean farm utilization for vegetable farming of about 81.86% (SE=2.88).

Easy source of livelihood or household income

A substantial share of farmers depended on the income they drew from vegetable farming for livelihood needs. At least 97.1% of farmers reported that revenues from vegetable farming contributed 100% of their household income. The mean contribution of vegetable revenues to household income was 98.19% (SE = 1.30) and to only 1.45% and 2.9% of the farmers interviewed did vegetable revenue contribute less than 25% and 50% of household income, respectively. Female farmers were slightly more dependent (mean household contribution = 98.53%, SE=1.47) on vegetable revenues for livelihood than their male counterparts (mean household income = 97.86%, SE=2.14). Likewise, widows and unmarried farmers were more dependent on vegetable income (mean household contribution = 100%, SE=0.00) compared to their married counterparts (mean household contribution = 97.02%, SE=2.12).

On average, farmers in Kiambu County reported a slightly higher dependency on vegetable revenues for livelihood at about 99.303 (SE=0.492 Min=60% Max=100%) compared to their counterparts in Kirinyaga at about 96.71% (SE=2.34 Min=25% Max=100%). This could hint to some persistent traces of subsistence farming. For instance, about 98.198% of Kiambu farmers reported 100% dependency compared to 94.737% in Kirinyaga. Dependency was also influenced by the choice of vegetables grown. Farmers who grew kales were more likely (99.029%) to wholly depend on its revenues for household income, and livelihood as well, compared to those who grew both kales and tomato (93.103%) or those who only grew tomato (94.118%).

Level of education caused unexpected variation in the farmers' dependence on vegetable income. For instance, persons without any formal education, those with primary education and strangely those with college or university education reported 100% dependence on vegetable income (SE=0.00). It is farmers with secondary education that reported slightly less dependence of 94.79% (SE=3.68).

Access to information and information technology

Factors relating to information access appeared to vary dependence on vegetable incomes. These included information technology in which case farmers relying on computers and mobile phones to access farming information appeared most dependent (mean vegetable contribution = 100%, SE=0.00) compared to those relying on mobile phones only (97.66%, SE=2.34) or those with none (98.48%, SE=1.52). Nevertheless, ownership of or access to these ICT equipment could infer other underlying factors such as access to capital and the caliber of agribusiness practiced more than the influence of information alone.

Household demands for vegetables

To test whether farmers perceived their access of vegetables as being a substantial cost to livelihood, the researcher conducted a correlation test between household income and percentage of land utilized for vegetable farming. This was done against the assumption that farmers utilizing less land would do so because alternative sources of income enabled them to procure vegetables without any pressure on household income. The tests returned a correlation coefficient (R) of 0.196 (Pearson, $p=0.11$) suggesting that a farmer's acquisition of vegetables was not hinged on household income and vegetable intensification.

Gross influence of factors

For a more rounded evaluation of factors influencing commercialization, the researcher employed Principal Component Analysis (PCA) targeting both household and farming characteristics outlined above. The characteristics were household size (HH-Size), household income (HH-Income), farm size, size of vegetable land in raw acres (VegLand) or as a percentage of total land (VegLand%), a farmer's experience (Experience), capital requirements per acre (Capital Req), number of agrochemicals used in a farming season (ACNo) and charges to market facilities. The results are given in the Eigen analysis below.

Table 1: Eigen analysis of factors influencing vegetable commercialization

<i>Variable</i>	<i>Eigen Value</i>	<i>Proportion</i>	<i>Cumulative</i>
HH-Size	3.2291	0.294	0.294
HH Income	1.9164	0.174	0.468
Farm size	1.1812	0.107	0.575
Veg Land	1.1442	0.104	0.679
VegLand%	0.9487	0.086	0.765
Experience	0.8617	0.078	0.844
Monthly income	0.7266	0.066	0.910
VegShare	0.5845	0.053	0.963
Capital Req	0.3778	0.034	0.997
ACNo	0.0292	0.003	1.000
Charges to access market facilities	0.0007	0.000	1.000

As indicated on the table 1 above, only four factors achieved the cut-off Eigen value of 1.00 (Oshlyansky, Cairns & Thimbleby, 2007) and above, namely HH Size, HH-Income, Farm size

and share of vegetable land. However, none of these factors achieved the cut-off loading factor of at least 0.30 to be considered statistically significant (Ibid).

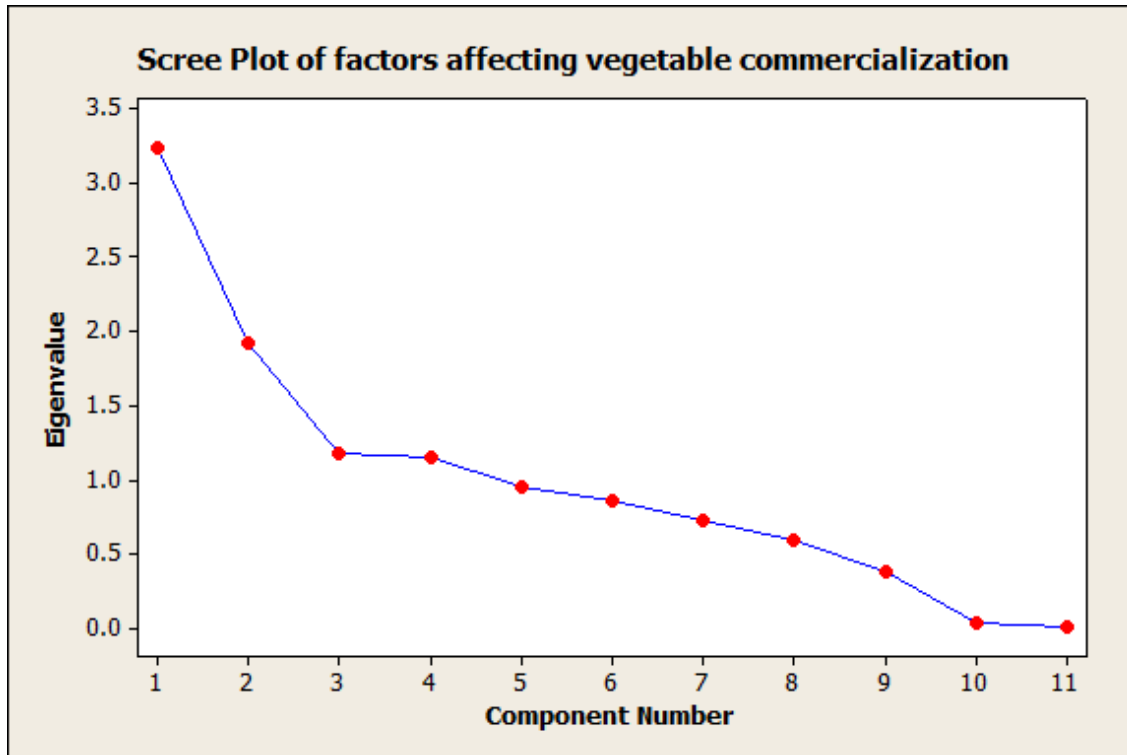


Figure 1: A scree plot of factors influencing vegetable commercialization

5.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of the study findings

The study revealed a great deal of commercialization for tomatoes and kales in the study areas aided by both structural and demographic factors. Inasmuch as structural policies to promote horticulture and high-value crop production in poverty alleviation and food security, some programs hindered this in key tomato and kale production zones for wildlife conservation and livestock development resulting in human-wildlife conflicts and alienation from extension services and a sharp rise in agrochemical abuse. Household and demographic characteristics particularly household size, farm size, proportion of vegetable land as a percentage of total land and share of household income derived from vegetable farming.

The study revealed that over four fifths (98.72%) of the buyers were consuming both kales and tomatoes regularly with over three fifths (67.24%) of the buyers consuming twice or thrice every day. Majority (76.6%) of the respondents sourced their vegetables either from the nearby traders, supermarkets and county markets and while other (23.4%) visited a combination of all sources. The study found out that demand was crucial factor influencing vegetable commercialization in

the study area, which was rising over time. Majority of farmers were seen to utilize a substantial share of their land with the aim of maximizing income from vegetable farming. About half of the crop farmers were making use over three quarters (66.67% - 100%) of their land for vegetable farming (SE=2.88). Vegetable farming was viewed as a source of livelihood as well as income (97.1%) for the framers that had increased due to increased demand of vegetal in varied areas (SE= 1.30).

Women farmers were slightly more dependent (mean household contribution = 98.53%, SE=1.47) on vegetable revenues for livelihood than their male counterparts (mean household income = 97.86%, SE=2.14). More importantly, Kiambu County farmers (99.30%) depended more on vegetable farming (SE=0.492 Min=60% Max=100%) in relation to Kirinyaga county farmer (SE=2.34 Min=25% Max=100%) which was influenced by the type of vegetable grown and its marketability. Level of education was a determinant factor on the dependence on vegetable income for people with college and university education depended more on the vegetable farming income which was impacted by their understanding of benefits of agriculture compared to those with secondary education and below who lowery dependent on vegetable farming (SE=3.68).

Majorly farmers relied on computers and mobile phones to access farming information on farming techniques and varied pest control mechanism. Therefore, the access to these ICT equipment could ease the access to capital and the competence of agribusiness practiced more than the influence of information alone. Farmer's acquisition of vegetables was not significant influencer of household income and vegetable intensification ($V = 0.196$ Pearson, $p=0.11$). Eigen analysis showed that HH Size, HH-Income, Farm size and share of vegetable land influenced vegetable commercialization (3.2291, 1.9164, 1.1812 and 1.1442) respectively.

5.2 Conclusion of the study

There was high (98.72) consumption of tomatoes and kale which were obtained from the nearby traders, supermarkets and county markets. The study concluded that demand was determinant of vegetable commercialization in the study are over 3 years. More production was crucial to meet the demand of customers. Famers used over three quarters (66.67%) of their land for vegetable farming providing for their livelihood (97.1%, SE= 1.30). the study concludes that commercialization of vegetable was influenced by demand and household land used for vegetable production.

Commercialization of vegetable farming was influenced by the level of education SE=3.68). The varied farming techniques were learned through mobile phones and computers. The study concludes that the access to ICT equipment improved the competence of agribusiness practices ($V = 0.196$ Pearson, $p=0.11$).

5.3 Recommendation

The paper attempted to understand factors influencing commercialization of vegetable farming in Kenya, despite the contributions to the existing literature and theory more work needs to be done to provide more knowledge on the commercialization of vegetable farming. In order to provide

more insights on the subject the study gives various recommendations. The study was limited to three counties. There is therefore need for a similar study to be conducted in the other 43 counties to provide a comparison and variation of factors influencing commercialization of vegetable farming in Kenya. The paper calls for a multi-stakeholder approach to the challenge facing commercialization of vegetables by focusing on public awareness campaigns on consumption of tomatoes and kales utilizing social media and involving civil society groups, public health and environmental regulators.

5.3.1 Recommendations for Policy

The study findings portrayed a weakness in the adherence and compliance to agribusiness practices. To enhance adherence and compliance there is a need to enact a policy that will ensure the implementation and adherence of the agribusiness to facilitate practice.

5.3.2 Recommendations for Practice

There is need to have regular visits to the agro vets by the government officers to verify the authenticity and credibility of the pesticides sold to the farmers

The government needs to provide incentive for provision of sustainable pest control solutions to the famers including bio control as well as bio-pesticides.

5.3.3 Recommendations for Further Research

The study attempted to understand commercialization of vegetable farming on agribusiness ethics compliance and food safety. Despite the contributions to the existing literature, more work need to be done to provide more knowledge on the commercialization of vegetable farming. In order to provide more insights on the subject the study gives various recommendations.

Second, further research needs to be done to understand the perception of community members on the application of agrichemical in the farming of vegetables in the three counties and elsewhere in the country. This would aid in understanding issues awareness and knowledge of side effects of agrichemical on human health and willingness to pay for organically produced vegetables as well as sustainable farming.

Lastly, further research needs to be conducted to understand the involvement of farmers in the formulation of policies and agribusiness practices rules in order to gain knowledge on the level of acceptance of these polices among farmers in Kenya.

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