

DETERMINANTS OF FOOD CROP DIVERSIFICATION AMONG SMALLHOLDER MAIZE FARMERS FOR ENHANCED FOOD SECURITY IN BOMET COUNTY, KENYA

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Abstract: Food crop production by smallholder farmers has encountered various challenges of which climate change (CC), pests and diseases are the most important. Global quest for enhancement of food security and reduction of poverty is evident as it is enshrined in policy statements such as the Green Revolution, Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs). Overreliance on one type of food crop worsens the impact of CC on food security. Practicing diversification through production and utilization of alternative food crops is one of the key climate-smart strategies to mitigate risks from CC, pests and diseases. This study explored diversification in the food crop subsector, an area that has not been ventured by other researchers who majorly focused on diversification to the horticulture subsector. This has therefore bridged the information gap in this area thus providing information necessary for decision making, planning and development of strategies towards self food sufficiency in the county and beyond. This study used cross-sectional survey and descriptive research designs. Stratified random sampling was used to sample three hundred and forty one (341) smallholder maize farmers in Sotik, Bomet East and Chepalungu Sub-counties from a target population of three thousand and ninety four (3094) maize farmers. Fifteen (15) ward extension officers were also targeted. Primary data was collected using a questionnaire for the maize farmers while an interview schedule was used for the extension staff. Secondary information was also obtained from the Agriculture directorate in the county. The pattern of diversification was deduced from the tabulated records of food crops grown in the area of study within the cropping year in consideration of the three previous years of production. Results from the study indicated that the maize farmers were moderately diversified on food production with a CDI of 0.4974. Socio-economic factors that influence food crop diversification included civil status of the household head, Age, Experience in farming and farm size. Gender on the other hand had a negative impact meaning female farmers were more diversified in food crop production than male farmers.

Keywords: Diversification, Crop Diversification, Socio-economic factors.

1. BACKGROUND INFORMATION

Over time, the world has been grappling with hunger and poverty. Every time these subjects arise, agricultural sector performance is viewed as a strategy to food security, economic growth and poverty reduction. In this regard, many countries in the world have strategized to eradicate poverty and hunger through agriculture as documented in many global

policy statements on hunger and poverty eradication. For example, the Green Revolution which was introduced in the 1960's to deal with issues of malnutrition in the developing world (Sebby, 2010). This was a response technologically to a world-wide food scarcity which was a threat in the time after the Second World War According to Fitzgerald & Parai (1996) (cited in Sebby2010), the Green Revolution improved farming practices in many parts of the tropical and sub-tropical regions where the primary food crops were rice, wheat and maize. The technology employed the use of improved high-yielding varieties of seeds as well as chemical fertilizers. The green revolution has been credited with increasing yields in many places where it was embraced though resulting to unequal benefits across regions and groups (Sebby, 2010).

In recognizing that agriculture is key to her development towards global goals of ending hunger and poverty, Africa developed a comprehensive policy framework for transformation of the sector; Comprehensive Africa Agriculture Development Programme (CAADP) also known as Maputo declaration, 2003. This is a policy framework for Africa geared towards transformation agricultural, creation of wealth, food and nutrition security, economic development and prosperity for all. Reforms in the sector are advocated for in the framework, important ones being a growth of 6% annually in Agricultural GDP and at least 10% allocation from the public expenditure to agriculture sector. Africa acknowledges that enhanced performance of the agricultural sector is strategic to economic development and poverty reduction by directly contributing to job creation, increasing opportunities for women and youth, enhancing food and nutrition security and resilience (UN- OSAA 2015). The Chief Executive Officer (CEO) for the NEPAD agency, Dr. Ibrahim Assane Mayaki, articulates it clearly when he remarked that agriculture is everybody's concern and that national independence is anchored on its development because it liberates countries from the scourge of food insecurity which is the key role in defaming their sovereignty. In addition, he acknowledged agriculture as a significant driver of economic growth whose power is also accredited by economists and political leaders since it is the sector that has enormous potential for reduction poverty and inequality (NEPAD, 2003).

Agriculture is the spine of the Kenyan economy and currently contributes 26 percent of the National GDP directly and another 25 percent indirectly. The sector is not only the driver of Kenya's economy but also the means of livelihood for the majority of Kenyan people (GOK, 2010). The country is a signatory to global and continental policy framework for development. In this regard, Kenya developed a blue print, Kenya Vision 2030, which begun in 2008 and ends in the year 2030. The objective of this blue print is to transform Kenya into a newly industrialized, middle income country providing high quality of life to all its citizens by the year 2030 (GOK, 2010). Under this blue print, Agricultural development is recognized as one of the Key sectors to contribute to a 10 per cent annual economic growth under the economic pillar. In this regard, Kenya's Agricultural Development Strategy (ASDS) was developed to position the sector as the key driver in delivering to the achievement of the vision's goals. The government also developed the Kenya Comprehensive Africa Agriculture Development Programme (Compact) which commits Kenya to vision, principles and strategy fundamentals of CAADP-NEPAD. ASDS and CAADP Compact acknowledges the agricultural sector as a potential engine for national economic growth and also as a critical component at household and community levels, thereby producing benefits for the entire economy (GOK, 2010)

Following the enactment of the new constitution in 2010, most of the agricultural sector's functions were decentralized to the County governments as specified in schedule 4 which is the development of agricultural policy and veterinary policy. Counties are therefore expected to drive the double digit growth envisioned in the Kenya Vision 2030 in addition to ensuring food and nutritional security, in collaboration with the national government (KIPPRA, 2016).

In Bomet County, agriculture is one of the key sectors targeted to bring out development in the County as documented in the County Integrated Development Plan (CIDP). Poverty and food insecurity however still remains a foremost challenge in the County (County Government of Bomet, 2013). Agriculture can alleviate poverty by enhancing food security, creating employment and generating income to the County's population.

1.1 Statement of the Problem

In Bomet County, maize production has faced various challenges including unreliable rainfall patterns, MLND and FAW infestation. Despite the favorable climatic conditions to various alternative food crops such as sorghum, finger millet, Irish potatoes, sweet potatoes and beans, Poverty and food insecurity levels in the county are still unacceptably high. Wakibi, Gichuhi & Kabira, (2015) on their report, food security score for Kenya, showed that Bomet County is 16.3%

food insecure. Furthermore, there is seasonality in food availability in the county raising food insecurity further to 23% during low seasons of food availability, rendering 60% of female headed and youth headed households food insecure between January and April annually.

Diversification to alternative food crops which are drought tolerant, tolerant to pests and have high resistance to diseases is one of the key strategies of minimizing poverty and food insecurity. The potential of food crop diversification however has not been fully exploited in the county. Furthermore, most of the studies focus on diversification in terms of movement from cereal crops or cash crops to production of horticultural crops that are normally referred to as High Value Crops (HVC). None of these studies has focused on diversification within the food crops sub-sector hence there is no study that has been undertaken to establish its determinants or ascertain its extent and pattern in the county. Finally, with the scourge of MLND and FAW infestation on the county's staple food and the adverse effects of CC, there is need to understand diversification within the food crops sub-sector. This study will therefore provide useful information to facilitate proper development of food security strategies to safeguard the county's population from the vicious cycle of food insecurity. Other stakeholders and regions with similar challenges will also find outcomes of this study valuable. This study sought to determine the extent of diversification of food crops by smallholder maize farmers and to identify the socio-economic factors influencing food crop diversification by smallholder maize farmers in Bomet County

2. CROP DIVERSIFICATION

The concept of crop diversification at different levels expresses diverse connotations to different people (Ojo, Ojo, Odine & Oganji, 2014). Ellis, (2011) cited in Ojo *et al*, (2014), defines diversification of as the process whereby rural households develop a variety of activities and assets to existence geared towards improving their living standards. Diversification of crops can be defined as reallocation of resources, especially cultivated land at the access of farmers to accommodate a wide-range of cropping pattern (Mandal & Bezbaruah, 2013). Emrys & Ngau, (1991), in the same study, two types of diversification are identified, namely; farm diversification (crop diversification) and farm income diversification (diversification of activities). Farm diversification comprises of variation of agricultural portfolios within the farm while diversification of activities involves varying the income generating portfolios within and outside the farm. Crop diversification involves the production of different varieties of crops of related or different species in an area rotationally and or by intercropping (Makate, Wang', Makate & Mango, 2016). This study focused on establishing the significant determinants of diversification of selected food crops among smallholder maize farmers in Bomet County. The selected food crops were maize, sorghum, finger millet, Irish potatoes and sweet potatoes. Allocation of land by smallholder farmers among these selected crops was established.

2.1 Levels of Diversification

According to Otsuka (1998) and Golleti (1999) cited in Hamad (2010), agricultural diversification occurs at three levels; micro, regional and macro levels. At the micro level, the individual household diversifies for the purpose of strengthening their income sources. This level involves both horizontal diversification which is an expansion towards new agricultural commodities and vertical diversification involving movement into non-farm activities like marketing, storage and processing. This can also happen at regional level, where similar agricultural activities are undertaken by an area with comparative advantage. At the macro-level, diversification entails a structural shift from agriculture into non-agricultural activities, in either rural or urban areas.

Diversification refers both to the number of economic activities an economic unit is involved in and the distribution of those activities' in the total economic unit of activity (Kimenju & Tschirley, 2011). To this study, diversification was based on the micro-level (household) which is the individual smallholder maize farmer household that practice diversification to heighten food security and increase income sources.

2.2 Importance of Diversification

Recent evidence points out to climate change among the leading threats to development in the continent of African (Makate *et al*, 2016). Climate change seriously affects agriculture among other sectors. Seasonality, escalated drought frequency, increased temperatures and erratic precipitation patterns and intensity are the extreme weather conditions affecting agriculture also in Kenya. Falling crop yields, increased risks in agricultural, dwindling soil fertility and degradation of the environmental also continue to frustrate collective efforts to enhance food security, increase income

and nutritional security particularly in smallholder farming. With these concerns, a real transformation of the agriculture sector more so in worst hit regions is inevitable (Makate *et al*, 2016). A meaningful and acceptable transformation will be required so as to improve livelihoods and decrease environment degradation (Nyamisi, Amwata, Hove, Kinyangi & Wamukoya, 2014).

Climate-smart agriculture (CSA) has been recognized by Climate change adaptation research in agriculture among the sustainable agricultural practices (SAPs) to help households manage the harmful impact of CC and inconsistency in farming systems by the smallholders (Makate *et al*, 2016). CSA operates under the following three principals: first is tackle climate related risks while enhancing food security, improving income as well as ensuring nutrition security. The CSA should also enhance productivity and livelihood improvement. Finally, the technology should be appropriate in the particular areas they are practiced.

Crop diversification through rotation and intercropping is one of such climate-smart techniques identified. Although diversification of crop production is not a completely new practice, CC impact in agriculture has given it popularity. Adopting the technology could significantly bring down risks linked to agricultural production by improving productivity, income, food and nutritional security among smallholder farmers (Makate *et al*, 2016). According to Joshi, (2005) cited in Makate *et al*, (2016), diversification is among the most ecologically viable, efficient and practical strategies of minimizing uncertainties in agriculture particularly with the small scale farmers. Crop diversification also boosts farm spatial and biodiversity thus enhancing resilience (Makate *et al*, 2016). Lin, (2011) indicates that soil fertility is improved through crop diversification. It also aid in pests and diseases control, facilitates yield stability, improves nutritional diversity as well as health improvement. Crop diversification is also a dominant substitute to chemical use in soil fertility conservation and control pests. Diversified cropping systems generally, are more agronomically stable and resilient due to decreased weed and insect, reduced requirement of nitrogen fertilizers (when leguminous crops are incorporated), reduced erosion due to cover crops use, and increased productivity (Lin, 2011; Makate *et al*, 2016). Moreover, Makate *et al*, (2016) indicate that crop diversified systems provide conducive environment for beneficial insects hence reducing the amount of pests by making the host crops less conspicuous for attack by pests. Crop diversification also contributes to local biodiversity more so when indigenous crop varieties are grow. Lin, (2011) also indicates that proper management of soils helps maximise use of water by plants thereby improving overall crop yields. Crop diversification therefore contributes in one way or another to all the three principles of CSA through improvement of productivity, livelihood and resilience of agricultural systems including reduced carbon dioxide emission. This study considered crop diversification on the selected food crops among the smallholder maize farmers, namely maize, sorghum, finger millet, Irish potatoes, sweet potatoes and beans.

2.3 Selected Crops for Diversification

This section looks at the selected crops for diversification to enhance food security in Bomet County. Apart from maize, other crops grown for food in the County include: Irish potato, sweet potato, finger millet, sorghum and beans.

2.3.1 Irish Potatoes

Irish potato, *Solanum tuberosum*, is one of the most important food crops in the world coming fourth after wheat, rice and maize. A record production of 320 million tons was attained globally in 2007. It is a significant source of food as well as employment and income in developing countries where production has almost doubled since 1991, with an equivalent increase in consumption (Menza, Girmay & Woldeyes, 2014). Potato, commonly referred to as Irish potato comes second in significance in Kenya following maize. It is also very significant to the country's economy. Nearly 1 million tons of tubers were produced by about 500,000 smallholder farmers from 100,000 ha of land. Kenya's production makes up 0.3% of the world's overall output and 6.5% of Africa's (MOA, 2006). The Kenyan government's major policy objective is to reduce poverty and Irish potato is eyed as one of the significant sub-sectors to deliver on the agenda. Production of this crop in Kenya is expected to grow further and could replace maize as the number one food crop since the latter is threatened by climate change, pests and diseases such as FAW and MLND. In addition, Irish potato is fast maturing compared to maize hence can bridge the gap during shortage of the staple grain. KEPHIS, acknowledges the crop as having a high prospective to tackle food insecurity, create employment and enhance farm incomes in Kenya due to its high productivity per unit area and its versatility in consumption. According to County Agriculture department annual reports, 2017, area under Irish potato production in 2017 was 2899 Ha producing 43,485MTs.

2.3.2 Sweet Potatoes

Sweet potato, *Ipomea batatas*, has the third highest production level after cassava and yams. It is also among the most widely grown tuber crop among smallholder farmers in Sub-Sahara Africa (SSA) (Kaguongo, Ortmann, Wale, Dorroch & Low, 2010). Its importance as an attractive income generation is rising in Kenya (Odendo *et al*, 2002). According to Nungo, Ndolo, Kapinga & Agili (2017) in Odendo *et al*, (2002), its popularity in Kenya has increased since it is able to produce good yields even under harsh climatic and soil conditions and minimal use of external inputs.

Sweet potato has more other advantages compared to maize. Furthermore, the flexibility of this crop in mixed farming systems enhances household food security therefore it is a significant livelihood strategy to the rural households (MOA & GTZ, 1998). Other than its fast maturity, Sweet potato is also drought resistant, flexible in harvesting time as well as improving maize yield in a crop rotation system compared to continuous maize production.

Sweet potato is consumed as a snack either boiled or roasted and a few instances in raw form (Nungo *et al*, 2007). Nutritionally, sweet potato is an excellent source of vitamin A, especially the orange fleshed varieties (Odendo and Ndolo, 2002). As per MOA and GTZ sweet potato yields more protein and calories per unit area than either maize or Irish Potatoes. The average yield is 10 tons per hectare (MOA & GTZ, 1998). According to the department of agriculture in Bomet County, production and productivity of the crop was boosted in 2014 by the sourcing 400,000 vines of the orange fleshed varieties (Kenspot 1, 3, 4 and 5, Vitaa and Kapode) from KALRO. From this, several bulking plots were established across the County. The County also facilitated the County cooperative union to establish a value addition plant where the sweet potato is ground to flour for baking. The area under the crop in 2017 was 1077 hectares which yielded 17,980 MT. Sweet potatoes are generally an easy crop to farm due to their low capital intensity and applicability on small tracts of land.

2.3.3 Finger millet

Farmers of the semi-arid tropics including the sub-tropics grow finger millet, *Eleusine coracana*, as one of their staple food crops for subsistence (Thilakarathna & Onyango, 2016). The local farmers highly value it for its ability to produce in harsh agro-climatic environments where cereal crops like maize fail. Ecologically, it requires an annual rainfall of 500-1000mm that is well distributed and preferably well-drained fertile sandy to loamy soils at a pH of between 5 and 7. The crop is however adapted to a varied range of soil conditions (Thilakarathna, 2015).

Nutritionally, finger millet plays a vital role in the subsistence farmers' dietary requirements and habits. Important minerals and nutrients are obtained from foods cooked from the grain, particularly by expectant women, breast feeding mothers and children (Mitaru, Karugia & Munene, 1993). Finger millet is also superior to the commonly promoted rice and even wheat with 3-5 times protein, minerals and vitamins content (Bhohale, 2013). Finger millet is also drought tolerant, disease resistant, effective in suppressing weeds and has long shelf-life (MOA, 2010). The grain can ensure food supply throughout the year even during crop failure as it can resist storage pests for even ten years longer than other cereals hence popularly known as 'famine crop' (Mgonja *et al*, 2007).

Millet is important for various securities such as food, fodder, fiber, nutrition, health, environment and livelihood at very low costs making it an important guardian of agricultural security. Its flour is usually utilized in Bomet County for making ugali purely or mixing with maize flour and making porridge especially for children, nursing mothers or sick people.

2.3.4 Sorghum

Farmers of Africa and Asia arid and semi-arid lands (ASALs) grow sorghum, *Sorghum bicolor*, for rural food security. According to Taylor, (2010), sorghum is still basically a subsistent food crop. The crop has however been proven to be the finest substitute to barley for brewing of beer hence increasingly becoming part of a successful food and beverage industry. Sorghum is a traditional crop produced in several parts of the country for subsistence use.

Driven by the need to stabilize food security in the Kenya, there is a new interest in revitalizing production of drought tolerant crops like sorghum (Chepng'etich, 2015). Sorghum was included as one of the crops to be promoted under the orphaned crops programme whose aim was to diversify sources of food through promotion of indigenous crops that are drought tolerant (Malinga, 2009). In 2017, its production in Bomet County stood at 442ha yielding 5,432 bags. The crop is utilized by mixing with maize and ground to make flour for ugali or porridge.

2.3.4 Beans

Common bean, *Phaseolus vulgaris*, is extensively grown as a key staple food in both Eastern and Southern Africa (Birachi, Ochieng', Wozemba, Buraduma, Niyuhire & Ochieg', 2011). The crop can yield up to 10 bags by 90kgs from an acre of land (KARI, 2008). Beans are one of the key sources of plant proteins and are strategic in alleviation of malnutrition. It is largely grown for subsistence and mostly intercropped with maize. Unlike maize, they have a high potential to spur economic growth of a region since they fetch more income within a short period of time (Kariuki, 2014). Beans are also incorporated in intensive agricultural production system as a rotational crop due to their wide adaptability. They are tolerant to shades and fix nitrogen thereby improving soil nutrition (Kariuki, 2014).

In Bomet County, it is usually consumed as a stew with carbohydrates like rice, maize (ugali) or boiled with maize (githeri). Production area in the county stood at 31,857Ha with a yield of 238,668 bags by 90kgs in 2017.

3. RESEARCH DESIGN.

This study adopted a cross-sectional survey and descriptive research designs to determine the extent of diversification and also identify the factors of diversification for farmers in Bomet County. The two designs are more appropriate because they give a provision for comparison of the research findings. Furthermore, they are exploratory and allow the researchers to collect, sum up, evaluate, analyze, present and interpret the data in a simpler and more understandable manner (Kothari, 2008). This research was conducted in the County of Bomet, one of the 47 Counties in the republic Kenya with Bomet Town being her headquarters. The county borders four counties, which are Kericho to the North, Nakuru to the North-east Narok to the East and South, and Nyamira to the West. It is located between latitudes of 0° 29' and 1° 03' south and longitudes of 35° 05' and 35° 35' east, occupying an area of 2037.4 Km².

This study targeted three thousand and ninety four (3094) smallholder maize farmers in Sotik, Bomet East and Chepalungu sub-counties of Bomet County (NCPB, 2017). This is the active population of youth and adults at age 30 years to 65 years. The population between 15 to 65 years in the county constitute 50.3% of the total population and among this, age 15 to 29 constitute 28.7%. The average farm size of the target population is 1.5ha. Fifteen (15) agricultural extension staff from the wards were also targeted as the key informants for the study.

Stratified random sampling was adopted to select 341 maize farmers from 3094 registered maize farmers from the three sub-counties. This procedure is the most appropriate because it combines both stratified sampling which is essential in calculating the sample per sub-county and simple random sampling which is used when picking the particular farmers to be interviewed. The key informants were purposively picked, one from each of the five wards in the three selected sub-counties.

Two instruments, structured questionnaire and an interview schedule, were adopted by this study to collect primary data. To collection data from three hundred and forty one (341) smallholder maize farmers, a structured questionnaire was used. The tool was segmented into five sections according to the objectives of the study. Section (A) had introduction section and collected data on the socio-economic characteristics of the household. The second section (B) collected data on the extent of food crop diversification. The third section (C) had questions on institutional factors while the fourth section (D) contained questions on market related factors. Finally, the fifth section (E) collected information on the food crop types produced within the year.

4. FINDINGS OF THE STUDY

4.1 Extent of Food Crop Diversification

The extent of food crop diversification among smallholder maize farmers in Bomet County was established using Crop Diversification Index (CDI). This is an index showing concentration with a straight forward relationship to diversification whereby its zero value shows specialization while an incline towards one indicates an intensifying level of diversification. The total number of farmers who did not diversify were 26, with a CDI of zero (0) making up 7.6% of the total sample. These are the farmers who produced maize alone as a food crop throughout the year. 92.4% (315 in number) of the smallholder maize farmers diversified on food crop production at different levels with a CDI of between 0.1 and 0.78. The farmers who practiced low diversification at a CDI of 0.1 to 0.44 were 20.5%. These farmers majorly grew maize in the first season and beans in the second season with very sparse production of the other food crops along the range. Those at 0.45 to 0.54 were 29.6% and they grew maize and beans in the first and the second season and had a moderate distribution

of the other food crops within the two cropping seasons. The highly diversified group with a CDI of between 0.51 and 0.78 were the highest at 42.3% with a good distribution of the various food crops under study throughout the cropping seasons. The mean CDI was 0.4974, indicating that the smallholder maize farmers of the county were moderately diversified. These results are presented in Table 1. Other researchers on extent of crop diversification like Sichoongwe *et al* (2014) established that diversification of smallholder farmers in Zambia was low.

Table 1: Extent of food crop diversification by smallholder maize farmers in Bomet County

Category	Level of CDI	Number of farmers	Percentage of farmers
None diversifiers	0	26	7.6
Low diversifiers	0.17 – 0.44	70	20.5
Moderate diversifiers	0.45 - 0.54	101	29.6
High diversifiers	0.51 -0.78	144	42.3

Source; Study Data, 2019

4.2 Determinants of Food Crop Diversification

The determinants of diversification of food crop were analysed using Tobit regression model. The results of Tobit regression models on table 4.2 indicate that food crop diversification among smallholder maize farmers in Bomet County was determined by civil status of the household head, age, experience in farming and size of land. This study also reveals that gender, education level of the household head, size of the household, agriculture as a primary occupation and membership to a farmers' group does not positively influence diversification of food crops among the smallholder farmers in Bomet County. Tobit regression results on socio-economic determinants are presented in Table 2

Table 2: Tobit Regression for determinants of food crop diversification farmers in Bomet County

Tobit regression		Number of obs = 341		LR chi2(9) = 7.14	
Log likelihood = 15.770057				Prob > chi2 = 0.6221	
				Pseudo R2 = -0.2928	
CDI	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
GENDER	-.0096869	.02831	-0.34	0.732	-.0653765 .0460026
CIVSTAT	.0127069	.0171516	0.74	0.459	-.0210326 .0464464
AGE	.0156069	.0122045	1.28	0.202	-.0084011 .0396148
HHSZE	-.0091275	.018952	-0.48	0.630	-.0464087 .0281536
EXP	.0038996	.016654	0.23	0.815	-.0288611 .0366604
EDUCTN	-.0146504	.0128493	-1.14	0.255	-.0399266 .0106258
PROCCHH	-.0006866	.0124725	-0.06	0.956	-.0252217 .0238485
LNDSTZ	.0020187	.0117216	0.17	0.863	-.0210393 .0250766
HHMBFGRP	-.0293342	.0228285	-1.28	0.200	-.074241 .0155726
_cons	.5291865	.0852307	6.21	0.000	.3615262 .6968469
/sigma	.2001359	.0082692			.1838692 .2164026
Obs. summary:		26 left-censored observations at CDI<=0			
		312 uncensored observations			
		3 right-censored observations at CDI>=.78			

Source; Study Data, 2019

NB: CDI as the Dependent Variable

The positive determinants are discussed as follows;

The majority of the respondents, 78.6 %, were married while the single, divorced and separated were 21.4 %. Civil status of the smallholder maize farmer had a positive influence on food crop diversification. A married man or woman probably has more resources due to extra contribution by the spouse. Ideas, skills and labour contribution to food crop production for married farmers are better than their counterpart single farmers. Preferences of the types of food crops to be grown are also diverse hence high chances of diversifying. In addition, since a larger number of these maize farmers (77.1%) have agriculture as their primary occupation, both spouses are available for farming activities and focus on it since it is their main source of income hence high diversity on food crops produced.

The average age of the respondents was between 36 and 45 years. This had a positive influence on diversification of the kind of food crops cultivated by maize farmers in the county. This finding is contrary to that of Kumar *et al*, 2012, Huang *et al*, 2014, Shabhaz *et al*, 2017 and Ojo *et al*, 2013 who established that age negatively influences diversification. According to this study, older farmers are usually patient with food crops that have longer growing periods like maize, millet and sorghum. The young farmers prefer quicker food crops such as Irish potatoes and beans. In addition, older farmers are more skilled in producing traditional food crops more than the young people. Furthermore, older people have a high preference for the traditional food crops such as finger millet, sorghum and sweet potatoes other than maize compared to the young people.

The average experience of the maize farmers in agriculture was over 10 years at 67%. This determinant also had a positive influence on food crop diversification by smallholder maize farmers. This is in line with the explanation on age that older people have more skills in producing the selected food crops especially maize and the traditional food crops than the younger people. This is in line with the findings of Aheibam 2017, Dube 2016, Ojo *et al*, 2013 and Kinyua *et al*, 2013.

The average land size for maize farmers was between 2.5 to 5 ha. This had a positive influence on diversification of food crop production among the maize farmers in the County. Bigger land space makes it possible for a farmer to produce more food crops other than maize hence diversify. These findings on the effect of land size on diversification are similar to the findings of Mithiya *et al*, (2018), Huang *et al*, (2014), Shabhaz *et al*, (2017), Ojo *et al*, 2013, Rahman & Chima, (2015), Mussema *et al*,(2013), Sichoongwe, (2014), and Kinyua *et al*, (2013).

This study however reveals that household head's gender did not positively influence the diversification of food crops by farmers similar to the outcomes from Kumar *et al*, (2012), but against Kinyua *et al*, (2013). Female farmers however were more diversified in food crops production compared to male farmers. Household size also had no positive influence on diversification which is against Kumar *et al*, (2012). Majority of larger households' composition could be children who are in school and could not be participating in farming activities. Education level likewise did not have positive influence on diversification, against findings of Kumar *et al*, 2012, Aheibam, 2017, Mithiya *et al* 2018, Shabhaz *et al* 2017 and Dube 2016 but similar to findings of Huang *et al*, 2014 and Ogutu & Obare, 2015. In this study, the more the number of years one spent in education, the more the likelihood that the person is formally employed and does not fully rely on farming as a source of food or income. More learned farmers could also prefer growing the horticultural crops rather than the traditional food crops since they have more resources and skills and are willing to take more risks. Agriculture as a primary occupation also did not positively influence food crop diversification which is against the findings of Kumar *et al*, 2012. Equally, membership to a farmers' group does not positively influence diversification of food crops among the smallholder farmers in Bomet County which is against the findings of Dube *et al*, (2016).

Other factors that were established to influence food crop diversification are market related factors. Tobit analysis revealed that access to loan positively determined diversification of food crops among maize farmers in Bomet County. Perceived availability of market for the food crops however did not positively impact on diversification except for Potatoes. Perceived market availability for the crop positively determined its inclusion production by the smallholder maize farmers probably because the crop is mainly produced for commercial purposes rather than for subsistence.

5. CONCLUSIONS AND RECOMMENDATIONS

The study established that smallholder maize farmers in Bomet County were moderately diversified being influenced by different factors. Civil status of the household head, age, and experience in farming, farm size and gender are the socio-economic determinants of diversification. This study hereby acknowledges that a critical consideration of the factors

influencing diversification matters greatly whenever food security strategies are put in place. This will foster sustainability in food security due to proper use of the land harnessing the good climatic conditions for food crop production throughout the year.

The study recommends that promotion of the food crops be done among the young and educated farmers. This will increase productivity of the crops since young farmers are energetic and with improved education levels, they understand the extension messages well and implement them correctly. There is also need to improve market access for food crops by improving road networks and facilitating for market linkage. The county government should prioritise improvement of access roads and facilitate the farmers groups on contract farming and other forms of collective marketing to improve farmers' income. This will encourage production of the food crops hence sustainable food security within the county and beyond. This study proposes further research on efficiency in food crops diversification.

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