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Evaluation of Socio-Economic Characteristics Influencing Choice of Technologies in Maize Production Systems in Kabiyet Division, Nandi County, Kenya

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Abstract: ***The adoption and diffusion of soil fertility management technologies among smallholder farmers in Kenya lags behind scientific and technological advances thus reducing crop productivity. The main purpose of this study was to evaluate the socio-economic characteristics that influence the choice of technologies in maize production systems in Kabiyet Division, Nandi County. This study adopted a descriptive survey method. The sampling frame was drawn from 6,505 households. 100 households were selected by multi-sage cluster sampling from six locations of the study area. Interviews, questionnaires and observation were used to collect data. The study utilized descriptive methods of data analysis which entailed the use of measures of central tendencies such as frequencies and percentages. Qualitative data was summarized and interpreted in line with the research objectives and questions. Results of data analysis were presented in form of figures and tables. The study findings showed that men were the decision makers in implementation of maize production technologies. It was recommended therefore that there was need for agricultural field days to be organized more in the study area to enable maize farmers to obtain more soil management technologies for maize production. It is expected that the study findings will be of importance to maize farmers in Kabiyet division, The Ministry of agriculture and other relevant ministries in identifying strategies of soil management technologies.***

Keywords: Evaluation; Socio-Economic; Characteristics; Technologies; Maize Production

1. Introduction

Most of the economies in Sub-Saharan Africa largely depend on agriculture for food and income provision. In this region, more than 50% of the populations rely on agriculture for their livelihood and the sector contributes more than 30% of the Gross Domestic Product (GDP) (Van Straaten, 2002). Soil fertility decline and land degradation are critical constraints to agricultural development in the region. The focus of efforts to solve these problems has been on increased food production through a series of interventions. A recent innovation was the application of the Green Revolution, which, however, eluded most African land managers due to its capital-intensive nature and lack of political will. Plant nutrient deficiency, poor soil management, poor soil conservation management, poor land tenure systems and inadequate extension infrastructure are among the major causes of poor land productivity in Sub-Saharan Africa (SSA) (Gachene & Kimaru, 2003). Land degradation is widespread in the region and has been on the increase despite the awareness of its effects.

Traditionally, increase in agricultural output has been achieved through the expansion of cultivated area. Little of the best arable lands left today must be divided among the farming populations which continue to expand. Such an approach has led to widespread degradation of land (Lynam & Blackie, 1994). According to Flintan (2003), in the past, environmental and soil fertility decline were addressed through shifting cultivation, mainly by men-dominated initiatives. In some instances women played little or no role and were therefore marginalised (Flintan, 2003) while in other instances the whole of the agricultural economy depended on female labour. At the same time, due to an increase in population pressure, some traditional practices of natural resource management became obsolete and untenable. This has culminated in environmental degradation, nutrient depletion, hunger, and widespread poverty. Alternative profitable and sustainable ways must, therefore, be found quickly to restore lost soil fertility and natural resource productivity.

The utilisation and viability of agricultural technologies are influenced by political, social, economic and institutional constraints. Any decision to adopt technology would be based not only on profitability but also on potential tangible social and cultural benefits. According to Doss and Morris (2001), farmers will adopt technologies if they do not seriously disrupt existing farming systems, jeopardise their subsistence, or introduce additional strains on already constrained and limited resources. Gender aspects are not considered and the resulting constraints on the adoption of technologies across gender are ignored. This study therefore seeks to analyse the role played by types of technologies, characteristics of farmers, and gender differences as it relates to choice and profitability of technologies.

Agriculture remains the backbone of the Kenyan economy. It is the single most important sector in the economy, contributing approximately 25% of the GDP, and employing 75% of the national labour force (Republic of Kenya, 2005). Over 80% of the Kenyan population live in the rural areas and derive their livelihoods, directly or indirectly from agriculture. Given its importance, the performance of the sector is therefore reflected in the performance of the whole

economy. The development of agriculture is also important for poverty reduction since most of the vulnerable groups like pastoralists, the landless, and subsistence farmers, also depend on agriculture as their main source of livelihoods. Growth in the sector is therefore expected to have a greater impact on a larger section of the population than any other sector. The development of the sector is therefore important for the development of the economy as a whole.

The increasing complexities of environmental problems are likely to increase the necessities of new agricultural technologies that can be used to minimize the potential contribution of negative environmental consequences of agricultural production. Climate change poses threats, but the effect is still difficult to predict. Climate change will affect crop and livestock yields worldwide, which will lead to change in food and fiber consumption, prices of agricultural commodities, and farm income (USDA, 2014). According to the Agricultural Resources and Environmental Indicators (AREI) many technologies that have been developed have the potential not only to increase farm productivity, but also to reduce the environmental and resource costs associated with agricultural production such as land and water by increasing yields with the same or fewer inputs and technologies. Besides, agriculture can provide many public goods and services or externalities like land conservation, maintenance of landscape structure, biodiversity preservation , nutrient recycling and loss reduction and so on (Boody *et al.*, 2005).

Technical change in the form of adoption of improved agricultural production technologies has been reported to have positive impacts on agricultural productivity growth in the developing world (Nin *et al.*, 2003). Promotion of technical change through the generation of agricultural technologies by research and their dissemination to end users plays a critical role in boosting agricultural productivity in developing countries (Mapila, 2011). The availability of modern agricultural production technologies to end users, and the capacities of end users to adopt and utilise these technologies are also critical. This study investigated the socio-economic characteristics that influence the choice of technologies in maize production systems in Kabiyet Division, Nandi County.

2. Statement of the Problem

Kenya has had a long history of successful agricultural research and the subsequent release of new crop varieties and innovative technologies. Despite this, the country continues to suffer from deficits in main food staples, such as maize, wheat and rice (KARI, 2008). There are various technologies that have been introduced by Ministry of Agriculture and other service providers like KARI. However, levels of technology adoption are low, and farmers' yields are about 50 percent or less of their potential. Since farmers' needs and objectives are diverse and always changing, diversities need to be considered in technology development processes to a greater extent than has hitherto been the case. Much work has been done on manure use and management in maize production in Kabiyet (MOA, 2012) but only limited studies have been carried out on evaluation of gender and social perspectives in choice of soil fertility management technologies for maize production in the division. The study sought to investigate the socio-economic characteristics that influences the choice of technologies in maize production systems in Kabiyet Division, Nandi County

3. Literature Review

A study on factors influencing adoption by Ransom et al. (2003) on the hills of Nepal revealed that, a significant and positive relationship exists between years of use of fertilizer, off-farm income, contact with extension and adoption. Researches on agricultural innovations show that, farmers" different personal characteristics lead some to adopt innovations more readily than others (KARI, 2002). It appears that, future growth in maize production in Kenya would have to depend mainly on yield gains, made possible by widespread use of technologies that promote maize production such as use of improved germplasm contained in hybrid maize varieties available in the Kenyan seed market (KARI, 2002).

The FAO has recognized that, globally, "Gender inequalities in land rights are pervasive. Not only do women have lower access to land than men. They are often also restricted to so called secondary land rights, meaning that they hold these rights through male family members. Women thus risk losing entitlements in case of divorce, widowhood or their husband's migration. Evidence also shows that women's land parcels are generally of smaller size and lower quality" than men's (FAO, 2010). Single women or those whose marriages are not formally recognized also typically have more tenuous rights to land. While women's land and property rights are vital to development, the reality remains that in many parts of the world these rights are often not shared equally between men and women, and are routinely violated, denied, and given insufficient protection and enforcement. The obstacles which prevent women from effectively enjoying these rights equally with men are complex, and at times context specific. They range from inadequate legal standards and implementation of laws, to discriminatory social norms, attitudes, and programs at the national, regional and local levels which taken together result in wide discrepancies in practice between development outcomes for men and women (Gomez & Tran, 2012).

Conley and Udry (2003) model on the adoption of pineapple production practices in Ghana found that social learning is important in the spread of the new technologies. Foster and Rosezweig (1995) find that own experience and neighbor's experiences with high yielding varieties in India significantly increased the profitability from these varieties. Considerable more work is needed in this area to understand how the use of technologies spread.

Gender specialists have demonstrated that whether a farmer is a man or a woman is not, in and of itself, the most important factor affecting adoption of agricultural technologies (Doss, 1999). Controlling for farmers' access to productive resources, wealth, education, or marital status may eliminate gender differences in adoption rates, also modulating gender differences in adoption impacts. For

example, Doss and Morris (2001) demonstrated that gender-linked differences in the rates of adoption of modern maize varieties and chemical fertilizer in Ghana resulted from gender-linked differences in access to complementary inputs such as land, labor, extension and market extension services. Quisumbing and Pandolfelli (2009) noted that few studies have examined socio-economic differences among women when analyzing decision-making, such as technology adoption.

A study of Macharia *et al*., (2010) examined the profitability of soil fertility and management practices in small-scale maize-based production systems in the Central Province of Kenya. The researchers found that the household head was the main decision-maker in households they interviewed, deciding which crops to grow, which soil and fertility management practices to use, when to obtain a loan, and the strategic direction of development on the farm. Male-headed households differed from female-headed households in terms of their initiatives and innovations. As has been repeatedly demonstrated in Kenya, the education household heads was a critical factor in the choice of development initiatives, which new farming techniques they adopted, and the changes made in farming enterprises. The authors noted, however, that wives generally decided on the maize varieties grown.

In their analysis of fertilizer use on maize in Zambia, Ricker-Gilbert, Jayne, and Chirwa (2011) found that the gender of the household head had no effect on maize yields, although hybrid seed use, nitrogen use, use of animal or mechanical power were important factors. Also in Zambia, Kimhi (2006) found a negative relationship between female headship and area allocated to maize as well as maize yields, when controlling for a smaller maize plot sizes. In a sample of households interviewed in selected districts of major maize-producing zones, Langyintuo and Mungoma (2008) found that gender of household had no effect on either the likelihood of hybrid use or the area share allocated to hybrid seed. The lack of statistical significance held across households when they were grouped by wealth index into poorly- and well-endowed segments. Salasya *et al*. (2007) evaluated the factors influencing the adoption of stress-tolerant maize in Western Kenya, finding that the dummy for gender of household head was not statistically significant in the probit equation. In the Coastal Lowlands of Kenya, Wekesa *et al.* (2003) also found that the gender of the household head was of no significance in the decision to grow maize hybrids. Ouma *et al* (2002) found that gender was a significant determinant of adoption if hybrid seed and basal fertilizer in Embu District in Kenya. So were, however, manure use, hiring of labor, and extension where all of which are likely to be associated with gender of household head. Other variables, such as age and education of household head, farm size, credit and education were not found to be statistically significant.

Much empirical adoption literature focuses on farm size as the first and probably the most important determinant (*Daku, 2002;* Nkonya *et al*, 1997; and Doss and Morris, 2001). A study by Gabre-Madhin and Haggblade, (2001) found that large commercial farmers adopted new high-yielding maize varieties more rapidly than small farm holders. Koundouri *et al, (*2002) argue that farmers' decision to adopt a new technology is affected by risk factors which are related to production risk and how the new technology can change the amount of production and profitability of the farmers. Particularly, farmers with poor farming practices and use of traditional agricultural appliances are afraid of taking risks to adopt new ways of farming practices. Kosarek *et al.,* (2001) also found that farmers' decision to adopt hybrid maize was determined by the expected returns (profitability) of the technology, the availability of hybrid seed, and risks associated with the expected outcomes of the new technology.

Factors like the total land area and the total number of animals will affect farm household's production decisions of rice. The study showed that the animal asset and the percentage of rice areas have the largest impact on a household's profit (Yan Liang, 2006). According to Kassie *et al,* (2009) adoption decisions can also be significantly influenced by land rights and the future security of tenure among farmers. The rapid adoption of GMHT crops were explained by the economic benefits results from higher yields or reduced costs, production efficiency and flexibility and simplification of conservation tillage (Dill *et al.,*2008).

Doss, (2007) also stated that; it is useful to collect information whether or not farmers have ever used improved technologies before in order to understand and introduce new technologies. In addition, Koundouri *et al,* (2006) also wrote that farmer's information about the new technology plays a significant role in deciding to adopt the improved agricultural technology. The extent to which farmers learn from each other and the influence of social network can also play a vital role in accepting and disseminating new technologies to a large population. The main source of information for farmers is other farmers because information is easily available and it is not too costly to utilize it (Gershon *et al, 2004*). This is confirmed by a survey data which showed that farmers cite other farmers as their main source of information regarding agricultural practices (Rees *et al,* 2000).

Furthermore, access to funds including credit is expected to increase the probability of adoption. For instance, it has been reported that most small scale farmers in the country are unable to afford basic production technologies such as fertilisers and other agrochemicals resulting in low crop yields due to poverty and limited access to credit (Ministry of Food and Agriculture, Ghana, 2010). This study investigated the socio-economic factors influencing the choice of technologies in maize production systems in Kabiyet Division, Nandi County, Kenya.

4. Methodology

This study adopted a descriptive survey design. This design is appropriate for data collection in large areas. According to Aggarwal (2008) descriptive research is devoted to the gathering of information about prevailing conditions or situations for the purpose of description and interpretation.A descriptive design was selected because of its high degree of representativeness and the ease in which a researcher could obtain the participants' opinion (Polit & Beck 2004). The

sampling frame was drawn from 6,505 households in the division as shown in Table 1.

Table 1: Households in Kabiyet Division

Location	Household numbers	Sub-Location	Household Numbers	Sample size
Kabiyet	1947	Cheptuiyet	293	30
Kamasia	854	Kamasia	127	13
Lolkeringet	1854	Chemnoet	289	29
Kebulonik	1850	Rubet	277	28
Total	6,505		986	100

The sampling technique to be used in this study was multi-sage cluster sampling. The division was taken as a cluster with six locations and 18 sub-locations. The locations have three sub-locations while others have 2 or four sub-locations. One sub-location in each sub-cluster (location) was selected by simple random sampling technique. Ten percent (10%) of households in each sub-location were selected by simple random sampling technique as per the population proportion where the first household was picked by simple random sampling technique followed systematic random sampling where every 10^{th} household was selected. The choice of 10% was based on recommendations by Mugenda and Mugenda (2003). A total of 100 households were selected in the study giving 1.5 percent of the total population. Neuman (2000) argues that for large populations small sampling ratios (1 percent) are possible and can be very accurate and therefore 1.5 percent of the population was considered adequate.

The instruments used for collection of data relevant to this study were interview schedules, questionnaires and observations. The study utilized descriptive methods of data analysis. This entailed the use of measures of central tendencies such as frequencies and percentages. Quantitative data was analyzed using frequencies and percentages while qualitative data was summarized and interpreted in line with the research objectives and questions. Results of data analysis were presented in form of Figures and Tables.

5. Results

The study sought to evaluate the socio-economic characteristics that influence the choice of technologies in maize production systems in Kabiyet Division. The respondents were requested to indicate the persons who do the actual tilling of land for maize production. The results are presented in Table 2.

Table 2: Persons Responsible for Land Tilling for Maize Cultivation

Persons	Frequency	Percent
Men	44	46.3
Women	13	13.7
Youth	27	28.4
Others	11	11.6
Total	**95**	**100.0**

Table 2 showed that 44(46.3%) respondents indicated that men were responsible for the tilling of land for maize production. However youths (28.4%) also contributed a larger percentage for those responsible for land tillage followed by women (13.7%). This implies that men and youth contribute a larger percentage of labour for land tillage in maize production. This pointed out that women have access to land but are not so much involved in tilling for maize production purposes.

Further, it emerged that 67.4% of the respondents reported that men were responsible for the costs incurred for technologies used in maize production while 1.1% reported that the government met the technology transfer costs. This implies that men were more involved in technology acquisition in maize production as compared to other groups as shown in Table 3.

Table 3: Groups who Meet Costs Associated with Technology Acquisition in Maize Production

Group	Frequency	Percent
Men	64	67.4
Women	22	23.2
Youth	8	8.4
Government	1	1.1
Total	**95**	**100.0**

This shows that men are the dominant group in Technology adoption for maize production in the study area. In addition, the respondents were asked to rate their level of agreement on a five point likert scale items in the questionnaire on socio-economic characteristics that influence the adoption of technologies associated with maize production. The items were scored and their means tabulated. The results are presented in Table 4.

Table 4: Socio-Economic Characteristics that Influence the Choice of Technologies in Maize Production Systems

Socio-economic characteristic	Mean	Std. Deviation
Primary occupation of the farmers	4.5	.80
Annual income of the farmers	4.3	.91
Household size of the farmers	2.6	1.32
Membership of farmers' group of the farmers	2.8	1.24
Educational attainment of the farmers	3.4	1.42
Age of the farmers	3.0	1.67
Farm size of the farmers	3.8	1.42
Availability of credit facilities enables farmers to easily acquire agricultural technologies	3.5	1.46
Participation in agricultural project activities enables farmers to easily acquire agricultural technologies	4.2	1.04

Table 4 showed that household size, membership of farmers' group and age of the farmer did not influence the adoption of agricultural technologies for maize production. These factors were found to have a mean of less than 3.0. However, primary occupation of the farmers, annual income, educational attainment, farm size, availability of credit facilities and participation in agricultural project activities were considered by the farmers to be the factors that influence the adoption of agricultural technologies for maize production. These factors had a mean of over 3.5. Primary occupation, annual income and farmers' participation in agricultural project activities were found to be the prime factors influencing the adoption of soil fertility management technologies for maize production in Nandi County. This is consistent with Nepal and Thapa, (2009) who argued that at

the younger age, farmers may not be able to adopt modern agricultural production technologies, especially capital intensive ones because of the fact that they might not have adequate resources to do so. Further, it concurs with Gabre-Madhin and Haggblade, (2001) who found out that large commercial farmers adopted new high-yielding maize varieties more rapidly than small farm holders. The study finding further supports and earlier research by Friis-Hansen and Duveskog (2012) which found out that income had a positive and significant relationship with adoption of agricultural technologies.

On interviewing the SCAO, it was found out that women and youth were vulnerable because they don't have finance to acquire the required input and soil fertility management technologies to enhance maize production thus affecting productivity of maize and management of soil in the study area. It further emerged from the interview that culturally most men were the main land owners and therefore women and youth had low access to land hence minimum modification on the soil fertility management technologies.

6. Discussions

The study found out that men and youth contribute a larger percentage of labour for land tillage in maize production. This pointed out that women have access to land but are not so much involved in tilling for maize production purposes. This is in line with Swiss Agency for Development and Cooperation (SDC) (2015) report which indicated that women had access but not control over new post-harvest technologies in maize production in Nakuru, Naivasha and Embu Districts. World Development Report (World Bank 2007), pointed out that farming is a key pathway out of poverty for women and that women's prospects for taking this path improve when they have better access to resources. Because of their limited access to essential production resources, such as land, labor, and inputs, women's role in crop agriculture is often restricted to producing subsistence food crops with low potential to generate income. The prospects for women to expand their incomes through alternatives such as seasonal migration or labor markets outside agriculture are limited. Women's mobility is usually more constrained by social and cultural norms, and women play a central role in raising and caring for children.

In addition, men were found to be the dominant group in Technology adoption for maize production in the study area. While technological implications of the different spheres of operation exist, logically, one can assume from these gender differences that the adoption, adaptation, allocation and utilization of the various technologies, are directly related to the different activities in the production cycle (Wekesa, *et al.,* 2003).

The study indicated that primary occupation, annual income and farmers' participation in agricultural project activities were found to be the prime factors influencing the adoption of soil fertility management technologies for maize production in Nandi County. Studies by Ouma *et al*., (2002) found out that variables such as age and education of household head, farm size, credit and education were not associated to adoption of agricultural technologies. However, Weir and Knight (2000) found out that, in Ethiopia, household-level education affects whether a farmer is an early or late adopter, but is less important in determining whether or not the farmer ever uses fertilizer.

The study finding supports an earlier research by Friis-Hansen and Duveskog (2012) which found out that income had a positive and significant relationship with adoption of agricultural technologies. Furthermore Davis *et al.* (2012) showed that group members had no significantly higher crops yields than nonmembers in Uganda, while in both Kenya and Tanzania, group members had recorded significant higher yields and household incomes. This study showed that being a member of a particular agricultural group influenced the adoption of soil management technologies for maize production. Further, Mwaura (2014) farmers who had access to extension andcredit services reported higher yields ofmaize due to adoption of agricultural technologies.

7. Conclusion and Recommendations

The study further concluded that men and youth contributed a larger percentage of labour for land tillage in maize production. This pointed out that women have access to land but are not so much involved in tilling for maize production purposes. In addition, men were found to be the dominant group in Technology adoption for maize production in the study area. Farmers' Primary occupation, annual income and farmers' participation in agricultural project activities are the prime factors influencing the adoption of soil fertility management technologies for maize production in Nandi County.

Men were found to be the major decision makers in the implementation of maize production technologies. Therefore there is need for the women and the youth to be more involved in the acquisition of soil management technologies for maize production.

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