

# Determinants of Commercial Mixed Farming on Small Farms in Kenya

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## Abstract

Agriculture is a topic of concern for rural development programs in Kenya because of the high poverty incidents among farmers. Fundamentally, smallholder agriculture contributes substantially to total agricultural production and total employment. Despite the fact that Kenyan farmers largely practice mixed farming, some are unable to act commercially and consequently, unable to improve their livelihoods. This paper therefore aims at establishing the entrepreneurial indicators of farming activities that lead to improved rural livelihoods. Cross-sectional survey of 388 small farms in Thika was carried out to investigate the determinants of commercial mixed farming. Linear probability model, logit and probit models were used to estimate the determinants of commercial mixed farming. The results show that the size of the farm, gender of the farmer, availability of electricity supply and running water on the farm are the main determinants of mixed farming. This study suggests that policies be put in place to discourage partitioning of farm land into uneconomical sizes. It also recommend that rural electrification and training programs on best farming practices be intensified in the rural areas to enable farmers to act commercially.

**Key words:** Commercial Mixed Farming, Farm Characteristics, Entrepreneurship, Logit and Probit models

## 1. Introduction

Commercial mixed farming is an economic activity characterized by growing a variety of crops and/or keeping of livestock. The agricultural sector in Kenya comprises of crop farming, forestry, livestock, and fish farming. Agricultural sector in the developed countries is an entrepreneurial undertaking because farmers act commercially (Makaya, 2007; Carter, 1999; and Ntale, 2013); while in Africa the situation is slightly different as most African nations tend to either neglect or fail to avail the necessary resources to farmers on small farms who are the backbone of African agro-economies (Mburu and Massimos, 2005). Ntale (2013) argues that persistent low investment in agricultural research and extension is a limiting factor to the potential of the agricultural sector in Africa. The agricultural sector therefore needs to be strengthened to improve the standard of living of the people and food security in the African countries (UNDP, 2005). Fouracre (2001) explained that entrepreneurial activities of farmers do not only increase agricultural production that leads to better livelihoods, but also to the wealth of the nation. Although agriculture has the potential to alleviate poverty, Rantamaki-Lahtinen (2008) argued that a detailed understanding of the determinants of commercial farming that can lead to better livelihoods was missing. Food and Agriculture Organization (FAO) (2002) and United Nations Development Programme (UNDP) (2005) assert that 25% of African countries do not get enough food to eat. UNDP (2005) report stated that even Kenya which is among the most developed agricultural sector in Africa, undernourishment and poverty was still a problem.

Aina (2007) explains that the problems facing agriculture in Africa are enormous given that a large number of inhabitants are involved in smallholder farming on small farms ranging from 0.5 hectare to about 4 hectares. Smallholder agriculture contributes 75% of total agricultural production and about 51% of total employment in Kenya. Furthermore, agriculture as a means of rural livelihood is a major concern for rural development programs because of the high poverty levels among small landholders (Alila and Atieno, 2006). FAO (2002) report states that over 50 percent of the Kenyan population lives below the poverty line, therefore improvement of livelihoods in Kenya is a matter of primary concern. The report goes on to state that over 80 percent of the Kenyan population lives in the rural areas and the majority of the residents are poor farmers.

Waikwa (1999) hypothesized that small farmers are poor because they are overburdened by smallholder agriculture which is not economically viable. Alila and Atieno (2006) observed that households in Kenya are usually poor because of the large families depending on small farms. They further said that farmers in rural areas have no sufficient land or have subdivided land into units that are not economically viable, worse still; most farmers on small farms are involved in farming practices that have negative impact on the environment. Terichow (2009) observed that climatic change has a negative effect on farmers in Kenya, and the people that are most at risk of

increased drought and other extreme climatic conditions are the poor farmers who have limited access to resources to help them cope with increased disasters. Ntale (2013) observed that farmers on small farms in Thika area are deeply involved in crop and animal farming regardless of the scale. They grow horticulture like pineapple, mangoes, avocados, passion fruits, and flowers. Coffee, tea, pineapples and macadamia are the main cash crops grown in the area while the main food crops are maize, beans, Irish-potatoes and pigeon peas.

Ochango (2007) argues that the current doubt about the viability of farming on small farms needs to be overcome and there is evidence to show that if farmers are unable to perform commercially they will be ignored on the value supply chain. Haggblade (2011) asserts that smallholders are able to participate in viable agricultural activities if they practice entrepreneurial agriculture. However, attempts have been made by the Kenyan government, African Union, and the World at large to improve the livelihoods of the farmers, but the impact is yet to be felt. UNDP (2012) argues that action needs to be taken to boost food security in Africa by integrating four interrelated areas, namely: agricultural productivity, nutrition, access to food, and empowerment of the rural poor. It asserts that increasing agricultural productivity in entrepreneurial ways can boost food production and economic opportunities, thereby improving the farmers' livelihoods. This paper attempts to answer the question that, what enables small farmers to participate in commercial mixed farming?

## 2. Literature Review

According to UNDP (2012) report, more than one in four of 856 million people in world are undernourished; it further states that Sub-Saharan Africa remains the world's most food-insecure region. Currently, at least 15 million people are at risk in the Sahel alone - across the semi-arid belt from Senegal to Chad; and an equal number in the Horn of Africa remain vulnerable after 2011 food crisis in Djibouti, Ethiopia, Kenya, and Somalia. Barret et al, (2001) discovered that in rural Africa, farmers on small farms and with limited capital are less capable to act commercially than the rich large scale farmers. Ndemo (2005) observes that the land available to the Maasai community of Kenya is decreasing in size due to the sub-division going on and therefore, no longer tenable to own large herds of livestock. Although, the economic situation may dictate livelihood diversification, many people from this community are resistant to diversify their livelihood due to their cultures. Furthermore, those who have diversified still have a divided mind between their livestock and their crop farming. Given a choice, they would rather retain their traditional economic system instead of diversifying into other economic activities.

Onduru et al. (2002) ranked sources of income for farmers in Kenya as agriculture, followed by livestock, then cash remittances from friends & relatives, and non-agricultural businesses. Alila and Atieno (2006) established that 84% of Kenya is classified as arid or semi arid lands (ASALs) and therefore unsuitable for rain-based agriculture. They suggested that better livelihoods for smallholder agriculture will have to come from intensification of improved inputs, and commercialization of agriculture. They further said that there is insufficient appreciation of entrepreneurial farming as most researches tend to focus on inputs that are uneconomical to small farmers. This has led to lack of well defined guidelines for both policy makers and farmers.

Chapman and Tripp (2004) argue that the type of economic diversification where the small-scale farmers look for work on other farms result in a decline in the effective management of the small farms. This is because the necessary labour and attention from the farmer is no longer available on the farm as required. Bryceson (2000) observed that farmers with small-land holdings have resorted to renting or selling their farm land to larger-scale farmers and look for employment elsewhere for their livelihoods. Chapman and Tripp (2004) explain that in the situation where men look for employment away from their own farms, women tend to take on a wide range of farm work in order to maintain the food production for survival. This has resulted into economic empowerment of women and improvement in the standard of living of many families (Ellis, 1999).

TechnoServe (1997), and Ministry of Agriculture, Livestock Development and Marketing (1996) report indicate that horticulture, especially fruit and vegetables, maize and dairy commodities were the subsectors identified by government and development agencies as areas with the greatest potential for improving income of farmers. Carter (2001) says that past studies show that promotion of on-farm and off-farm linkages, especially those focusing on commercialization of farming, has enormous potential to create employment and to further diversify sources of labour income. Many small farmers are becoming increasingly commercialized by growing high-value non-traditional crops such as fruits and vegetables for the fresh export and processing markets. Vegetable production is currently the most important commercial horticultural enterprise among small farmers, especially those with very small farms of less than or equal to 2 acres (World Bank, 1994; Kimenyi, 1995; & Ntale, 2013).

Vision 2030 puts a lot of emphasis on the commercialization of agriculture as agricultural development is a critical factor to poverty reduction and in achieving food security (Republic of Kenya, 2007). Atieno and Allila (2006) acknowledge that Kenyan government investment in agriculture has grown tremendously in the last 5 years and the government is ready to embrace innovative approaches to agriculture to solve the problem of poverty. To demonstrate the seriousness of the matter, the government of Kenya is a signatory to the Maputo agreement that ushered in the African Union's Comprehensive Africa Agriculture Development Programme (CAADP) (NEPAD,

2005). The Maputo declaration calls for signatories to invest at least 10% of the national budgets in agriculture. Furthermore, Ntale (2013) acknowledges that the government is working closely with programme of rural outreach for financial innovation and technology (PROFIT) to empower the farmers to act commercially. Kimenyi (1995) estimates that about 80% of fresh export vegetables are grown on small farms, which are sold to middlemen before they are exported. She further says that some of the vegetables are processed and sold in domestic or export markets. Besides providing income directly to farmers that cultivate the crops, commercialization of farming has the potential to generate farm employment and improvement of rural livelihood in general (Haggblade and Hazell, 1989).

### Smallholder Agriculture in Thika

Thika is an agricultural area and small-scale farming therein is a microcosm of smallholder agriculture in Kenya and therefore an ideal sample area of study (Kinyanjui, 2007). Rurigi (2007) observes that dairy cattle, goats, sheep, rabbits, pigs and poultry are some of the main animals on the farms in Thika. Nevertheless, the fish farming industry is growing steadily in the district with a very great potential to improve the lives of many people, however it is still largely underutilized. The Kenyan government is actively promoting aquaculture by introducing small scale fish farming in Thika district like in many other districts for the purpose of food security and increase income diversification on small farms (Republic of Kenya, 2008). The intensive agricultural economic activities have affected the Thika River catchment areas by diminishing the forest cover at a very high rate. This is a matter that deserves attention as far as sustainable livelihood is concerned because activities that undermine the natural resources go against the tenets of sustainable livelihood as stipulated by Department for International Development (DFID) (1999). Kagira (2007) recommends planting of trees and agro-forestry to increase the forest cover of the water catchment areas.

Nduguti (2007) advises farmers on small farms to go for professional training on poultry keeping form and register common interest groups in order to affiliate themselves to national bodies like Kenya Poultry Farmers Association (KEPOFA), Kenya National Federation of agricultural Producers (KENFAP) and Savings and Credit Co-operatives (SACCOs). He goes on to say that the government should improve infrastructure to enhance accessibility in delivery of inputs and reduce losses due to breakage of eggs during transportation. She should also build and equip a diagnostic laboratory in Thika town, establish and enforce maintenance of high quality standards of poultry feed. Rurigi (2007) observed that small-scale coffee farmers have abandoned their farms due the mismanagement of Kenya Plantations and Planters Co-operative Union (KPCU) which was supposed to give them technical farming advice. Nduguti (2007) suggested that financial and insurance companies should lend and insure micro and small poultry enterprises.

### 3. Materials and Methods

Data was collected from a cross-sectional survey of small farmers from Thika area of Murang'a and Kiambu counties of Kenya. A multistage sampling technique was used to identify the districts for the 1<sup>st</sup> stage, divisions for the 2<sup>nd</sup> stage, locations for the 3<sup>rd</sup> stage, and sub-locations for the 4<sup>th</sup> stage. Line transect sampling technique was used to identify the farms. Descriptive statistics is used to estimate the proportions of the determinants of commercial mixed farming. Linear Probability Model (LPM), logit and probit models are used to estimate the determinants of commercial mixed farming. Litondo (2013) used the same models to estimate the determinants of possession of mobile phones. Literature tells us that commercial mixed farming is based on farm characteristics (Ntale, 2013; and Carter, 1999), personal & social characteristics (Ket De Vries, 1985; Ellis and Mdoe, 2003) and motivating factors (Ntale, 2013; Alila and Atieno, 2006). The study was guided by the assumption that a set of farm characteristics is a function of commercial mixed farming, moderated by personal & social factors and motivating factors. Specifically, a farmer's decision to act commercially was estimated using the following models:

Linear Probability Model (LPM)

$$P_i = bX + u_i \quad (1)$$

Logit model

$$P_i = \frac{1}{1 + e^{-Z_i}} \quad (2)$$

Probit model

$$P_i = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{Z_i} e^{-\frac{1}{2}z^2} dz \quad (3)$$

Where  $P_i$  is the probability of farmer  $i$  acting commercially,  $e$  is a natural number ( $\approx 2.718$ ),  $\pi$  is a mathematical constant ( $\approx 3.141$ ),  $Z_i$  is the logit or probit index of farmer  $i$ ; the logit or probit index  $Z_i$  is the measure of benefits that a farmer  $i$  perceives in acting commercially. As  $Z_i$  becomes infinitely large ( $+\infty$ ), the more the probability

that a farmer  $i$  will act commercially. The estimating model for the determinants of commercial mixed farming is:

$$CMF_i = \beta_0 + \beta_1 F + \beta_2 PS + \beta_3 M + e \quad (4)$$

$$Z_i = \beta_0 + \beta_1 F + \beta_2 PS + \beta_3 M + e \quad (5)$$

Where  $CMF_i$  is commercial mixed farming,  $F$  is farm characteristics,  $PS$  is personal and social characteristics,  $M$  is motivating factors,  $Z_i$  is the logit index as explained above,  $\beta$  is a vector of coefficients of the explanatory variables and  $e$  is a random error term. LPM is estimated by Ordinary Least Squares (OLS) and logit & probit models by Maximum Likelihood Estimates (MLE). The three models are used together for the purpose of testing the robustness of the estimated model parameters. The coefficient of determination is denoted by  $R^2$  in LPM and pseudo  $R^2$  in logit and probit models as shown in the table below.

#### 4. Results and Discussions

Descriptive statistics is used to estimate the extent of commercial mixed farming while predictor models are used to measure the effect of farm characteristics on commercial mixed farming controlled by motivating factors, and personal & social characteristics.

##### 4.1 Descriptive Statistics

The results indicate that 88% of farmers on small farms in Thika practice mixed farming and earn an average income of Ksh.10,000.00 per month ranging from Ksh. 500.00 to Ksh.1,000.0, this show a very big disparity in the incomes of farmers. Commercial mixed farming does not seem to benefit many farmers; this could be because some farms are too small to do any meaningful mixed farming. 32% of the farmers had less than 1 acre of farm land while only 9% had farms with sizes ranging from 5 to 10 acres. The average size of farms in this area was 1.77 acres. The study finding is very close to Aina (2007) estimation that small farms in Africa are approximately 1.8 acres. This indicates a very big difference in land ownership with some farmers owning pieces of land which are too small for any meaningful agriculture. This could be an explanation why commercially mixed has not improved the livelihoods of farmers in small farms. The results support Alila and Atieno (2006) suggestion that the Kenyan government should come up with land policy on partitioning of farm land. Unregulated partitioning of farm land is contributing to poverty among the farmers. At least every farm has an employee, the supply of electricity varied among farmers, whereby in some locations, 29% of the respondents had electricity, while in others only 8% had electricity. 53% have access to running water while the average education level of the small scale farmers in Thika was 8 years of schooling with an average age of 49 years. The study shows that there is a very high correlation between the size of farm land and commercial mixed farming.

##### 4.2 Estimation Results

The estimates results of determinants of commercial mixed farming are shown in the table below. Linear Probability Model (LPM), logit and probit models in the table indicate that the major determinants for mixed farming are electricity, running water and farm size.

**Determinants of commercial mixed farming  
 (Absolute *t* Statistics in parentheses)**

Variables	Model parameter estimates (marginal effects)					
	LPM		Logit		Probit	
<i>Farm Characteristics</i>						
Electricity (1 = available)	.1066 (2.91)	.0652 (1.65)	.0781 (3.13)	.0422 (1.60)	.0863 (2.79)	.0478 (1.46)
Running water (1 = available)	-.1040 (3.04)	-.1180 (3.18)	-.0823 (2.85)	-.0862 (2.94)	-.0902 (2.92)	-.0903 (2.90)
Farm size (in acres)	.1257 (4.74)	.1168 (4.12)	.1111 (4.93)	.1030 (4.50)	.1240 (4.58)	.1197 (4.25)
Distance to the market (in km)	-.0026 (0.72)	-.0044 (1.11)	-.0030 (0.96)	-.0034 (1.04)	-.0029 (0.87)	-.0036 (0.99)
<i>Personal and social characteristics</i>						
Years of schooling		.0077 (1.61)		.0064 (1.74)		.0061 (1.50)
Gender (1 = male)		-.0740 (2.16)		-.0591 (2.18)		-.0713 (2.33)
Age		.0017 (1.19)		.0010 (1.00)		.0011 (0.93)
<i>Motivating factors (dummies)</i>						
Desire for financial security		.1967 (2.48)		.1301 (1.25)		.1470 (1.77)
Desire for food security		.1486 (1.86)		.0944 (1.04)		.1105 (1.40)
Cost of farming		.0110 (0.29)		.0098 (0.32)		.0022 (0.06)
Unfavourable government Regulations		-.0413 (1.07)		-.0444 (1.38)		-.0517 (1.44)
Access to loan		.0315 (0.81)		.0240 (0.87)		.0274 (0.86)
Insurance availability		.0127 (0.31)		.0093 (0.31)		.0149 (0.44)
Existence of business opportunity		.0254 (0.60)		.0162 (0.47)		.0178 (0.48)
Desire for independence		.0344 (0.72)		.0173 (0.48)		.0077 (0.20)
Desire for achievement		-.0004 (0.01)		.0076 (0.17)		.0114 (0.23)
Desire for social status		.0044 (0.10)		.0112 (0.35)		.0165 (0.46)
Weather conditions		-.0470 (0.81)		-.0364 (1.27)		-.0411 (0.97)
Constant	.6914 (11.99)	.2936 (2.36)				
$R^2$	0.0778	0.1153				
Pseudo $R^2$			0.1254	0.2088	0.1287	0.2055
<i>F</i> -Statistics ( <i>p</i> -value)	9.17 (0.0000)	3.80 (0.0000)				
$\chi^2$ -Statistics ( <i>p</i> -value)			36.43 (0.0000)	60.63 (0.0000)	37.36 (0.0000)	59.69 (0.0000)
Observations	388	388	388	388	388	388

Source: Ntale (2013)

OLS results show that a 1 acre increase in the farm size increases the probability of mixed farming by 12.6% ( $t = 4.74$ ) while the marginal effect for logit model is 11.1% ( $z = 4.93$ ) and that of the probit model is 12.6% ( $z = 4.74$ ). These results make sense because mixed farming requires big size of farm land to accommodate a variety of farming activities. Availability of running water reduces the chance of a farmer practicing commercial mixed

farming by 10.4% ( $t = 3.04$ ) in the OLS and in the logit and probit models by 8.2% ( $z = 2.85$ ) and by 9.02% ( $z = 2.92$ ) respectively. One would have expected running water to be used extensively in commercial mixed farming.

However, one of the reasons could be that smallholder agriculture in Kenya is rain fed, or farmers are not allowed to use running water for irrigation, instead use other sources of water such as boreholes, dams, rivers and harvested water. Running water is used for domestic use and it is against the rural water board regulation to use running water for irrigation. The OLS results indicate that having the supply of electricity on the farm increases the probability of mixed farming by 10.7% ( $t = 2.91$ ) while the marginal effect for the logit model is 7.8% ( $z = 3.13$ ) and that for probit model is 8.6% ( $z = 2.79$ ). These results make sense because rural electrification is an essential element of the infrastructure development and exploitation of natural resources. All the instrumental variables jointly explain 7.79% of the variations of commercial mixed farming as  $R^2 = 0.0778$ . The  $p$ -values of  $F$ -statistics and the  $\chi^2$  statistics are zero; therefore, the hypothesis that running water, electricity supply, farm size, and distance to the market together have no effect on commercial mixed farming is rejected.

After controlling for other explanatory variables, farm size is still a strong determinant of commercial mixed farming. In the LPM a one acre increase in the farm size increases the probability of mixed farming by 11.70% ( $t = 4.12$ ) and in the logit model by 10.3% ( $z = 4.50$ ), and in the probit model by 11.97% ( $z = 4.25$ ). This justifies the above results that the size of the farm is important determinant of mixed farming. Partitioning of farm land into very small pieces reduces food production and makes farmers vulnerable (FAO, 2002; Allila & Atieno, 2006; and Ntale & Litondo, 2013). The Kenyan government has ambitious plan of putting at least a million acres of land under irrigation. This initiative of commercial farming is to boost food security in the country. This undertaking ought to be emulated by farmers in order to improve their livelihoods.

The OLS estimates show that being a woman increases the probability of commercial mixed farming by 7.4% ( $t = 2.16$ ), in the logit model by 5.90% ( $z = 2.18$ ) while in the probit model by 7.12% ( $z = 2.33$ ). This could be a case of feminization of agriculture as observed by Chapman and Tripp (2004) that when men look for employment from elsewhere other than their own farms, women tend to participate in a wide range of farm activities for survival and desire for food security. Traditionally women are the home makers and expected to provide food for their families. Ntale (2013) explains that most of the staple food production comes from the small farms whereby the majority of the farmers are women. Desire for financial security also comes out an indicator of commercial mixed farming in the LPM and probit model. The OLS estimates show that the desire for financial security increases the probability of commercial mixed farming by 19.67% ( $t = 2.48$ ). McClelland (1961) argues that desire for financial security is one of the motivating factors for high need for achievement which is an element of entrepreneurship. Fouracre (2001) further says that entrepreneurial agriculture leads to financial security.

The  $R^2$  of the LPM is 0.115% meaning that 11.5% of the variations of mixed farming are explained by the independent variables. The Pseudo  $R^2$  of the logit and probit models are 20.88% and 20.55% respectively. The  $p$ -values of  $F$  - statistic and  $\chi^2$  - statistic are equal to zero. This shows that the joint effect of the independent variables is not equal to zero, therefore the null hypothesis that farm characteristics, personal & social characteristics, and motivating factors have no effect on mixed farming is rejected. This study finding concurs with Carter (2001) who said that farm characteristics play a very big role in commercial mixed farming.

## 5. Conclusion and Recommendations

The study discovered that all farmers are involved in mixed farming and 88% are acting commercially. Although the farmers said that they are selling their agricultural produce for commercial purposes, this does not seem to translate into reasonable income that could improve their standard of living. A few farmers who have farm land of at least 5 acres are the ones who have reasonable income to improve their livelihoods. This implies that commercial farming is economically viable if a farmer has a reasonable piece of land. The research confirms that reasonable sizes of farm land enable small farmers to cultivate a variety of crops like maize, beans, pineapples, coffee and tea. They also enable farmers to keep different types of livestock like cattle, sheep and goats. The study indicates that the bigger the farm sizes the more likely the farmers are in getting involved in commercial mixed farming. The government should come up with a policy to restrict the uneconomical partitioning of farm land to encourage farmers to act commercially. The study shows that the supply of electricity on the farms is very essential in commercial farming. Therefore rural electrification should be intensified to enable farmers to act commercially. Desire for financial security was found to have a big influence on commercial mixed farming. The study recommends that farmers should be sensitized to actively participate in commercial mixed farming for

financial security. The study suggests that, what is needed in commercial mixed farming is a more creative way of agricultural production which can rapidly change the current realities on the ground, and that the African union should take a lead in sharing of ideas about how best to achieve food security across the continent as it has been mandated by the African political leadership. The Kenyan leadership should give more priority to agriculture to end hunger and poverty in the country. A more holistic approach should be taken to fight hunger and poverty by involving all the stakeholders in the agricultural sector including the private sector, farmers' groups, and civil society to come up with solutions on how to increase agricultural production. The government should work closely with the International Fund for Agricultural Development (IFAD) to implement a programme of rural outreach for financial innovation and technology (PROFIT). Food security would be achieved by the development and dissemination of improved varieties of food staples like maize, cassava, sorghum, beans, and pigeon pea.

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