Distribution and Duration-Based Crop Diversification Strategies and Household Living Standards among Smallholder Farmers in Kenya

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Abstract: Agriculture is the most important sector in Kenya. The main economic importance of crop diversification is contribution to living standards and risk management. Crop farming in Mathira East District is characterized by different forms of diversification. The main objective of this study was to contribute to the understanding of the importance of crop diversification in meeting the household's goal of improved standards of living. The mean-variance (E-V) approach and random utility theories were used to guide the study. Data was collected from150 smallholder farmers using a structured questionnaire. Ordered probit model was used to determine the influence of crop diversification on standard of living. This study arrived at the finding that households standard of living was influenced by distribution and duration-based diversification. This study recommends that in order for farmers to improve their standards of living through farming, diversification should be undertaken in such a way that there is more emphasis to at least one particular crop which the farmer has competitive advantage in its production as well as failure to neglect short season crops such as most horticultural crops. The government should provide a conducive environment for farmers to improve their levels of education and household average income per month since these factors may help to boost diversified agriculture that lead to improved standard of living. Farmers should be supported on how to take advantage of diversification in improving their standards of living. This may be achieved if necessary infrastructure (irrigation, credit access, improved information access and good road network) can be put in place.
Keywords: Agriculture, endeavour, Crop farming, diversification

INTRODUCTION

A number of research studies have successfully identified the potential of diversification to contribute to better performance in agriculture by smallholder farmers in Kenya. Kimura and colleagues [1] noted that risk management strategies through properly managed diversification can help boost agriculture and hence uplift farmers' standards of living. Additionally, due to limited availability of high potential land, it has been envisaged that increasing agricultural production will have to come from diversification [2]. Promoting and supporting diversification opportunities is an integral part of most agricultural strategies in Kenya.

In 2008, Kenya launched Vision 2030 as the country's long-term economic blueprint to guide the development process. Vision 2030's objective is to transform Kenya into a middle income country providing a high quality of life to all its citizens by 2030. Based on Vision 2030, the agricultural sector has developed the Agricultural Sector Development Strategy (ASDS) that envisages a food-secure and prosperous nation. The overall objective of the ASDS is to achieve an agricultural growth rate of 7 per cent per year over the next 5 years through various means, among them being promotion and support of diversification opportunities. The United Nations Food and Agriculture Organization (FAO) is Kenyan development partner that has been on the forefront in promoting diversification opportunities among smallholder farmers [3].

Since agriculture is rampant with risk, farmers in most parts of the country choose to diversify. This makes households with multiple income sources to experience less variability in total income than a specialized household [4]. Consequently, risk management in crop farming involves choosing among alternative cropping strategies that reduce the effects of risks. Mathira East District has a variety of crops grown, ranging from food to cash crops [5]. These crops have varying durations of maturity. The most important food crops grown in the district include maize, beans, peas, potatoes, sweet potatoes, sorghum, millet and barley. Distributive diversification (balance between crops) and crops duration diversification (spread/balance in expected crop durations) are very common. Many researchers have argued that the main economic goals behind diversification relate to income enhancement and hence improved standards of living [6] and reduction of risk [7]. The decision of diversification by a farmer is considered to be one of the major economic decisions that have strong bearing on his welfare [8].

In the recent past, despite the widespread campaign meant to encourage smallholder farmers into specialized and commercial farming, evidence shows that most farmers in Mathira East District continue to be diversified. Though one of the major goals of diversification is improvement of the standards of living, it is not known if their involvement in crop diversification enables them to improve their living standards. None of the key strategies has been evaluated to pinpoint their ability to improve living standards to the household and yet they are used repeatedly. This study sought to evaluate the influence of distribution and duration-based crop diversification strategies on household living standards.

METHODOLOGY

The study area, the Mathira East District, is in Nyeri County where many farmers are diversified. Due to intense land subdivision, distribution and duration based crop diversification are farming strategies commonly practiced in the area. It has an area of about 129 Square Kilometers [9]. The district mainly has red volcanic soils suitable for food crops such as maize, beans, peas, sorghum and potatoes. The district has a population of 81,126 persons. The district has some sizeable portions of areas that are vulnerable to drought. The rainfall pattern in the District is bimodal.

There are 5,792 smallholder crop farmers in Mathira East District. Using the sample size determination formula proposed by Nassiuma [10] and the Cochran's correction formula as proposed by Cochran [11], a sample size of 150 smallholder farmers was used. The main data collection instrument was a household questionnaire directed at households' heads. An important aspect of the household questionnaires was its ambition to capture information on demographic characteristics of respondents, their engagement in on-farm crop diversification and production risks faced. The study further used secondary data where necessary while reviewing the literature and discussing results. The Statistical Package for Social Scientists (SPSS) version 17.0 and STATA software was employed in the analysis. The @Risk software was employed in performing quantitative (stochastic) risk analysis using Monte Carlo simulation using minimal data such as the minimum, most likely, and maximum values of certain incidences.

Ordered probit model was used to analyze the influence of distributive and duration-based crop diversification strategies on household standard of living. The model was preferred since the dependent variable is multiple and ordered. According to Greene [12], in the formulation of the ordered probit model, the observed responses are represented by a variable Y_i which denotes the perceived standard of living as a result of crop diversification given by farmer i and takes on j different values which are naturally ordered, in this case 5 values (j = 0, 1, 2,3,4).

However, these observed values are assumed to be derived from some unobservable latent variable.

$$Y_i^* = X_i\beta + \varepsilon_i \quad \text{--(1)}$$

where X_i represents the observable individual specific factors on which data will be collected, β is a vector of parameters to be estimated and ε_i is the stochastic disturbance term whose distribution is estimated to be normal. The values for observed choice outcome Y_i are assumed to be related to the latent variable Y_i^* as follows:

Y = 0 (Extremely worse) if $Y^* \leq \mu_o$
Y = 1 (Worse) if $\mu_0 < Y^* \leq \mu_1$
Y = 2 (Average) if $\mu_1 < Y^* \leq \mu_2$
Y = 3 (Good) if $\mu_2 < Y^* \leq \mu_3$
Y = 4 (Very good) if $\mu_3 < Y^* \leq \mu_4$ --- ---------- (2)

Where μ_i is unknown threshold parameter to be estimated for outcome *i* that separates the adjacent boundary values and is estimated together with the βs. The estimated μ follows the order $\mu_0 < \mu_1 < \mu_2 < \mu_3 < \mu_4$.
The probability of each observed outcome falling in a given category is given as:

Prob [y = 0 or Extremely worse] = $\varphi(-\beta'X)$--(3)
Prob [y = 1 or Worse] = $\varphi[\mu_1 - \beta'X] - \varphi(-\beta'X)$--(4)
Prob [y = 2 or Average] = $\varphi[\mu_2 - \beta'X] - \varphi(\mu_1 - \beta'X)$--(5)
Prob [y = 3 or Good] = $\varphi[\mu_3 - \beta'X] - \varphi(\mu_3 - \beta'X)$--(6)
Prob [y = 4 or Very good] = $1 - \varphi(\mu_3 - \beta'X)$--(7)

Where φ is the cumulative density function of μ_i. Using maximum likelihood estimates technique, the values for the parameters βs will be estimated.

RESULTS AND DISCUSSION

This section presents results of Ordered Probit Regression Model, which show the influence of distributive and duration-based crop diversification strategies on household living standards. Arbitrary indices to proxy living standards were used. The final index was constructed as the average of indicator variables for whether a household possessed certain assets, kind of building materials used in the dwelling structure, availability of drinking water, sanitation and the type of energy used. The index was then translated into meaningful ordered categories (extremely worse, worse, average, good and very good). Asset ownership was views in terms of livestock, land, businesses, transportation tools and other assets. The kind of building materials used for the dwelling structure was assessed in terms of type of roofing, walls and floor. Sanitation was viewed in terms of toilet facilities and main method of garbage disposal in the household while the type of energy used considered the cooking and lighting fuels. The results on various indicators used as proxies for the standards of living are shown in Appendix 1. The figure below shows a summary of respondents' standards of living.
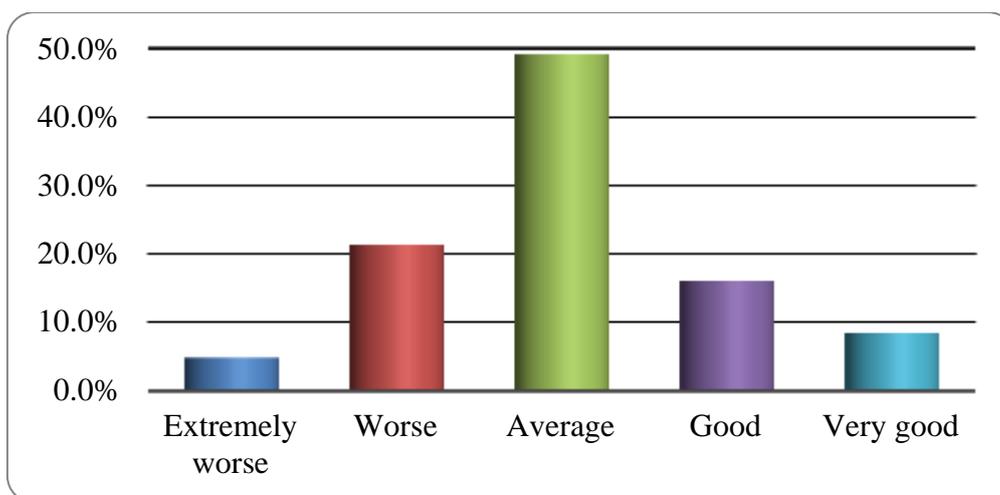
Fig-1: Respondents' standards of living

Majority of the households had average standard of living as represented by 49.2% of the total responses. About 21.4% of the households had worse standard of living. Other households had good (16.1%), very good (8.5%) and extremely worse (4.8%) standards of living. The ordered probit model was used because the dependent variable and the values of each category have a meaningful sequential order.

Table-1: The Maximum Likelihood Estimates of the Ordered Probit Model

Variable	Coefficient estimates	Standard Error	Z-value	P>|z|
Distribution-based diversification (DISDIVER)	-0.292**	0.121	-2.42	0.016
Duration-based diversification (DURDIVER)	0.092**	0.042	2.17	0.030
Gender of the household head (GENDER)	0.088	0.211	0.42	0.675
Marital status of the household head (MARITAL)	0.140	0.093	1.51	0.131
Age (AGE)	0.043	0.087	0.49	0.623
Education (EDUC)	0.367***	0.099	3.69	0.001
Household income (per month) (INCOME)	0.277***	0.087	3.18	0.001
Land size (LAND)	0.095**	0.042	2.26	0.024
Household size (HHSIZE)	0.051	0.087	0.59	0.555
/cut1	0.525	0.046		
/cut2	0.531	0.068		
/cut3	0.645	0.066		
/cut4	0.843	0.086		

Log likelihood =-143.015; LR Chi2 (9) = 176.25; Prob>χ^2= 0.000, Pseudo R^2=0.381; N = 150
*** Sig at P<0.10, ** Sig at P<0.05, * Sig at P<0.01

The households' standard of living depends on a number of factors. Table 1 shows the maximum likelihood estimates of the parameters of Ordered Probit regression model characterizing the relationship between households' standards of living and independent variables. From the model, five variables were found to be statistically significant. These are distribution-based diversification (with negative sign), duration-based diversification (with positive sign), household head education (with positive sign) and land size (with positive sign).

Results in Table 1 reveal that two coefficients were significant at 1% and three coefficients significant at 5%. The log likelihood for the fitted model was -143.01 and the log likelihood chi-squared value of 176.25 indicating that all parameters are jointly significant at 5%. Pseudo R^2 of 0.38 was also above the statistical threshold of 20% confirming that the household's standard of living was well attributed to the independent variables considered in the model.

Distributive-based diversification was observed to have a significant and negative relationship with the level of standards of living at 5% level. The negative signs on distributive-based diversification (DISDIVER) variables imply that the standards of living decrease when that strategy is used. This therefore suggests that the manner in which farmers distribute their land to the crops grown is an important variable influencing the standards of living of the household. The lack of more emphasis to at least one particular crop which the farmer has competitive advantage in its production only encourages subsistence farming, reduced commercialization and eventually greater possibilities of encouraging family poverty.

Duration-based diversification has a significant relationship with the level of standards of living at 5% level. The positive signs on duration-based diversification (DURDIVER) variables imply that the standards of living increase with increase with this strategy. This situation is attributed to the fact that growing short-season crops (and often, high value crops) increase the farmers likelihood of benefiting from agriculture. This implies that farmers who have the means (irrigation facilities, capital and adequate land) and know-how of conducting commercial agriculture involving short season crops should do so as this may earn them more profits. This is consistent with Mehta [13] who noted that most horticultural crops are high value crops and shift from staple crops to horticultural crops was seen as commercial diversification in Bangalore, India.

Education was observed to have a significant and positive relationship with the level of standards of living at 1% level. The positive sign on the level of education (EDUC) variable might be attributed to the high level of knowledge and experience on improved farm practices acquired by the educated household heads that enables them to benefit most from agriculture. This helps them to engage in various crop diversification strategies in a more profitable way and thereby raising the standards of living of their households. This observation is consistent to Dinh [14] who noted that a household head's education positively affects the participation of farm households in the adoption and transfer of advanced technologies and eventually improving the household standards of living through farming.

Household income per month (INCOME) has a significant and positive relationship with the level of living standards. The variable is significant at 1% level. The surplus income may be reinvested in agriculture thereby providing reliable capital that may significantly boost their farming activities, especially through better management of distribution and duration-based diversification strategies. This may eventually improve their living standards. Furthermore, households with more income per month may easily afford to grow short season crops such as horticultural crops that require a huge capital investments (in irrigation facilities), more inputs (hired labour, fertilizer and pesticides), which may be expensive for farmers with low incomes.

The coefficient of farm size (LAND) was positive and significant at 5% level, indicating that farmers with larger farm size had higher living standards as compared to farmers with small farm size. This can be due to the fact that large farms expand the farmers' production possibility curves and thus making them able to carry out several economic activities at profitable levels and eventually raising their standards of living. Additionally, farmers with more land are highly likely to be less risk averse. This implies that they can afford to be more specialized towards one profit making type of crop (less distribution diversification) even if it is could be a short-season crop (greater duration based diversification).This agrees with Mehta [15] finding that higher allocation of land in favour of high value crops like fruits and vegetables is desirable from the point of view of not only raising the farm income and productivity of the farmers but also to create high employment. .

CONCLUSIONS AND RECOMMENDATIONS
The households' standard of living was influenced by distribution-based diversification but more diversification was associated with less living

standards. Duration-based diversification improved the level of living standards since it implies a shift to high value crops. In order for farmers to improve their standards of living through farming, diversification (distribution-based and duration-based) should be undertaken in a careful manner in such a way that there is more emphasis to at least one particular crop which the farmer has competitive advantage in its production as well as failure to neglect short season crops such as most horticultural crops.

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