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Degree of Output Market Participation by Male and Female Rice Farmers': A Case for Ahero Irrigation Scheme, Kenya

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Abstract

Agricultural commercialization has a potential to increase farming households' income and standard of living. This study assessed the degree of rice commercialization and the determinants of commercialization of rice farmers in Ahero Irrigation Scheme, Kenya. Stratified and probability proportionate to size sampling were used to select 221 rice farmers. A Household Commercialization Index (HCI) was computed to estimate the degree of commercialization and then modeled as a function of explanatory variables. Informed by the Chow test, three regressions were estimated; male, female and the whole sample. The HCI were 0.77, 0.79 and 0.78 for male, female and whole sample respectively. Household size, off-farm income generating activities, household income, rice price and pesticides usage were significant determinants of rice commercialization. The recommended policy options are to advice and train farmers on pesticides use and the government to have a planned exit from agriculture by introducing attractive off-farm income generating activities.

Keywords: Smallholder farmers, commercialization, rice, Kenya, gender

JEL codes:

1. Introduction

Agriculture is the cornerstone of Kenya's economy, to which it contributes 26% of the Gross Domestic Product (GDP) directly and 25% indirectly (Republic of Kenya, 2010). Kenya's population growth of 2.5% per annum requires a shift from low productivity to intensive agricultural production that is commercially oriented (Republic of Kenya, 2012). Rising urban food demand and diversification of diets calls for increased agricultural commercialization (Pingali et al., 2006).

Kenya's Agriculture Sector Development Strategy (ASDS) 2010-2020 recognizes that development and growth of the agricultural sector are hinged on increasing productivity, commercialization and competitiveness of agricultural commodities and enterprises (Republic of Kenya, 2010). Furthermore, the Kenya Vision 2030 has identified agriculture as an important sector to increase economic growth, through transformation to an innovative and commercially oriented sector (Republic of Kenya, 2007). To achieve significant contributions to economic growth, the agriculture sector needs to be commercialized to enable smallholder farmers participate in markets (Jagwe et al., 2010).

Agricultural commercialization is the transition from subsistence farming to market oriented production (KIPPRA, 2007; Omiti et al., 2009) and use of high quality inputs (Omiti et al., 2007). Pradhan et al. (2010) defines agricultural commercialization as the process of increasing the proportion of agricultural produce that is sold by farmers. Agricultural commercialization goes beyond marketing of agricultural produce and focus on product choice and input use decisions that are based on profit maximization objectives (Pingali and Rosegrant, 1995; Pingali, 1997).

Agricultural commercialization can be input or output oriented, characterized by increase in marketable surplus or increase in use of purchased inputs in the output and input dimensions respectively, or both (Jaleta, 2009; Martey et al., 2012). The main drivers of commercialization are population growth which creates high demand for food, high opportunity cost for family labour, urbanization, technological progress (KIPPRA, 2007; Okezie et al. 2012), globalization and rising per capita incomes (Omiti et al., 2007).

Output market participation by smallholder farmers is expected to increase their incomes and improve their welfare (Jagwe et al., 2010; KIPPRA, 2007). Otieno et al., (2009) argues that

promotion of market orientation among smallholder farmers in developing countries is important for development of value chains that are effective in food supply. One of the policies in the Strategy for Revitalization of Agriculture (SRA) for economic growth is enhancement of market orientation of smallholder farmers (Republic of Kenya, 2005). Marketing has been identified as the main activity in the agricultural commodity value chain (Otieno et al., 2009) which is critical in improving productivity and commercialization (Republic of Kenya, 2010). At the farm level, which is the beginning of the market chain, production must be high enough to attract enough market participants to ensure efficient distribution (Enete and Igbokwe, 2009).

Pingali and Rosegrant (1995) classified food production systems into subsistence, semi-commercial and commercial systems. The authors classify rice production as semi-commercial system. This is particularly true for rice production in Ahero Irrigation Scheme in Kenya where some of the rice produced is consumed by the farm households while inputs are purchased. Rice is among the most important cereals in Kenya, ranked third after maize and wheat (Export Processing Zones Authority, 2005; Republic of Kenya, 2008; Kamau, 2013). Although rice is ranked third in terms of consumption and production, its consumption has been steadily increasing at a rate of 12% compared to 4% and 1% for wheat and maize respectively (Republic of Kenya 2008). Kenya's rice per capita consumption has increased by about 32%, from 5.8kg/capita/year in 2004 to 7.6kg/capita/year in 2009 (Omondi and Shikuku, 2013).

Some authors attribute this to the changing eating habits among Kenyans (Emongór et al., 2009). About 80% of rice production in Kenya is under government established irrigation schemes while 20% is grown under rain fed conditions (Republic of Kenya 2008). However, domestic rice production has not kept pace with the rising demand and the deficit is met through imports (Chemonics International Inc., 2010). Despite the huge deficit ranging between 75%-85% (Chemonics International Inc., 2010), demand for rice is expected to increase in future. Promotion of rice production and consumption is expected to reduce over-reliance on maize as the main food staple hence increasing farmers' income and ensuring food security (European Cooperative for Rural Development, 2012).

In an effort to bridge the demand-supply gap, the Kenyan government initiated the National Rice Development Strategy (NRDS) 2008-2018 which will ensure increased production from 75,000 MT/year to 178,580 MT/year by 2018 (Republic of Kenya, 2008). About 300,000

smallholder farmers in Kenya depend on rice farming for their livelihood (European Cooperative for Rural Development, 2012), hence underscoring its importance. Although the efforts appear attractive, farmers' participation in rice market is an important area to consider for the strategy to succeed.

There is ample evidence indicating that there are gender differences in agriculture, in terms of access to production inputs such as land, labour, fertilizer and certified seed, extension services, education and productivity. Women play an important role in agricultural production, providing about 80% of the labour force in food production and 50% in cash crop production (African Development Bank, 2007). Women disproportionately work for longer hours compared to their male counterparts (Kabutha and Kiara, 2008; Republic of Kenya, 2010) and in addition, perform household chores and take care of the young and sick family members (African Development Bank, 2007) which may hinder their market participation. Although there is considerable literature on gender- agricultural productivity- technology adoption nexus in Sub Saharan Africa which constrain women productivity, gender gaps in agricultural commercialization has received far less rigorous empirical attention.

The study therefore assessed the degree of commercialization of male and female rice farmers and the factors conditioning the degree of commercialization. The decision to pool or separate data for site specific or groups' analysis is often subjective (Otieno et al., 2009). For example, Oladeebo and Fajuyigbe (2007) in a study of technical efficiency of men and women rice farmers in Benin estimated two production functions for male and female farmers without testing for equality of coefficients of the two regressions. Alene et al., (2008) also pooled data from eight districts in Western Kenya without conducting a test to justify the pooling.

However, this study estimated male and female regressions, justified by the Chow test, which indicated that the sample could be separated into male and female sub samples. The test indicated that the coefficients in male farmers' and female farmers' regressions were significantly different. The study analysed the degree of commercialization of smallholder male and female rice farmers in Ahero Irrigation Scheme, Kenya, through application of Chow test (Chow, 1960) for sample differences. The specific objectives of the study were:

I. To estimate and compare the degree of rice commercialization between male and female rice farmers in Ahero Irrigation Scheme, Kenya

II. To analyse the factors that influence the degree of commercialization of male and female rice farmers in Ahero Irrigation Scheme, Kenya

The study provides insights for developing policies that target improvement of rural households' welfare through improved market participation and consequently income improvement. Such policies would ensure reduction of extreme poverty and hunger which constitute the Millennium Development Goal 1(MDG 1). Furthermore, the study conducts a gender analysis on the degree of commercialization and the different determinants of commercialization among the two genders. The study further assessed input commercialization which is mostly neglected in agricultural commercialization studies. For example, Gebreselassie and Sharp (2008), Otieno et al. (2009), Enete and Igbokwe (2009) focused only on output commercialization. To the best of the author's knowledge, no previous study has been conducted to estimate the degree of rice commercialization in Kenya.

This paper is organized as follows. Section 1 provided the introduction while the method used is presented in section 2. Section 3 presents results and discussions while section 4 presents conclusions.

2. Methodology

2.1.Study area and the data

The study was conducted in Ahero Irrigation Scheme in Nyando District, Kisumu County, Kenya in April 2012. The scheme, which is managed jointly by the National Irrigation Board (NIB) and farmers, is located in Kisumu County, in the outskirts of Kisumu city. Rice is the main crop cultivated in the scheme under irrigation.

A pretested household questionnaire was used to collect primary data from rice farmers. A list of all the farmers in the scheme was used as the sampling frame. Using the 12 blocks as strata, 8 blocks were randomly selected. Probability proportionate to size sampling was then performed to select a sample of 221 farmers. The data collected was on input use, volume of outputs, input and output prices as well as socioeconomic variables.

2.2.Empirical model

To estimate the degree of commercialization, a Household Commercialization Index (HCI) was computed. HCI is the ratio of output sold to the total output produced. A value of zero

would indicate a household that is completely subsistence while values close to one indicate households that are more market oriented. HCI was computed as follows:

$$HCI = \frac{Quantity\ of\ rice\ sold}{Total\ quantity\ of\ rice\ harvested}$$

Commercialization Index has been used by several authors in estimating the intensity of market participation (Strasberg et al., 1999; Burke et al., 2007; Gebreselassie and Sharp, 2008; Otieno et al., 2009; Jaleta et al., 2009; Omiti et al., 2009; Martey et al., 2012; Mpogole et al., 2012; Agwu et al., 2012; Nmadu et al., 2012; Asuming-Brempong et al., 2013).

The HCI was modelled as a function of explanatory variables which have been hypothesised to influence the quantity of output sold. A linear regression was estimated as follows.

$$HCI_i = \beta_0 + \sum_{K=1}^{9} \beta_i x_i + \varepsilon_i$$

Where HCI_i is the ratio of rice sold to total rice harvested; β_0 is the intercept; β_i is a vector of parameters to be estimated; x_i is a vector of explanatory variables (described in Table 1) and ε is the error term.

Table 1: Description of variables used in the regression model

2.3.Chow test

Chow test was employed to determine whether it was appropriate to pool or separate the models into male and female models. Two models, for male (Equation 1) and female (Equation 2) sub samples were specified as follows:

$$Y_m = \beta_m X_m + \varepsilon_m \qquad \{1\}$$

$$Y_f = \beta_f X_f + \varepsilon_f \qquad \{2\}$$

Where Y_m and Y_f are vectors of the dependent variable; X_i (i=m, f for male and female subsamples respectively) is a vector of explanatory variables; β_i are the parameters to be estimated. The null hypothesis tested was that the coefficients are equal for male and female sub samples (Equation 3)

$$H_0 = \beta_m = \beta_f \qquad \{3\}$$

Three separate models were estimated, one for the whole sample; and two for male and female sub-samples. The Chow test was computed as follows:

$$F^* = \frac{RSS_w - (RSS_m + RSS_f)}{(RSS_m + RSS_f)} * \frac{(T - 2K)}{K}$$

Where F* is the test statistic.

RSSw = Residual sum of squares for the whole sample.

RSS_m = Residual sum of squares for the male sub-sample.

RSS_f = Residual sum of squares for the female sub-sample.

T = Total number of observations in the whole sample.

K = Number of regressors (including the intercept term) in each unrestricted sub- sample regression.

2*K* = Number of regressors in both unrestricted sub sample regressions (Whole sample).

Table 2: Computation of Chow test

The results of Chow test are presented in Table 2. The test statistic (F*) is 2.39 which is greater than the respective F statistic (1.99) at 5% level of significance. The null hypothesis was therefore rejected and it was concluded that the male and female sub samples were significantly different. Consequently, separate models were estimated for the male and female farmers. For comparison purposes, a whole sample regression was also estimated.

3. Results and discussion

3.1.Descriptive statistics

The descriptive statistics of the sampled rice farmers is presented in Table 3. The statistics include comparison of socioeconomic factors among male and female farmers, as well as the characteristics of all the sampled rice farmers.

Table 3: Descriptive statistics for testing for differences in means between male and female rice farmers

Male farmers comprised about 70% of the sample. Years of formal education of the household head, household size, participation in off farm income activities, land size

cultivated, credit access and the amount of rice harvested varied significantly between male and female farmers. Specifically, male farmers had about 3 years more of formal education compared to female farmers. The male headed households on average comprised of 6 persons while female headed households comprised of 5 persons. About 45% of male farmers participated in off farm income generating activities compared to 27% of female farmers. Male farmers also owned 0.49 acres of land more compared to female farmers. Land is a significant input for agriculture and its size greatly determines the amount of output. Male farmers harvested about 79 kg per acre of rice more compared to female farmers.

There were no significant differences in age and experience of the household head, annual household income, access to extension advice, use of insecticides/fungicides, percentage of output sold and price of paddy between male and female farmers. However, the effect of these variables on the degree of commercialization (percentage of output sold) may be different because of the effect of other exogenous variables like education and off farm income, which vary between male and female farmers.

3.2.Differences in means in input use between male and female rice farmers

Table 4 represents the test of differences in means of input use by rice growers in Ahero Irrigation Scheme. This can be interpreted as input commercialization because all the inputs are purchased except for family labour, whose use is minimal considering that rice farming is labour intensive.

Table 4: Test for differences in means of input use intensity and input prices among male and female farmers

There were no significant differences in the quantities of seed, fertilizer, chemicals and labour costs between male and female farmers. On average, farmers planted 25kg of rice seed per acre and applied about 86kg of fertilizer per acre. The chemical cost on average was Ksh.494 per acre while labour cost, which constituted the largest proportion of total cost was Ksh. 24,313 per acre. There was no significance difference in fertilizer price which is about Ksh. 46 per kg. However, there were significant differences in the price of seed. Male farmers bought rice seed at a cost which was Ksh. 5 per kg less compared to female farmers.

3.3.Proportions of rice sold by male and female rice farmers

The distribution of percentage of rice sold by male and female farmers is presented in Table 5. As indicated in Table 5 rice farmers are generally commercially oriented.

Table 5: Distribution of the percentage of paddy sold by male and female farmers

About 21% of male farmers sold less than 60% of their producer. However, about 34% of male farmers sold more than 90% of their produce. On the other hand, about 17% of female farmers sold less than 60% of their produce with 27% selling more than 90% of the paddy harvested.

3.4.Determinants of the degree of rice commercialization among male and female farmers

Table 6 represents the results of linear regressions.

Table 6: Determinants of the degree of rice commercialization among male and female farmers

The results demonstrate that participation in off farm income generating activities negatively influences the degree of commercialization for both male and female farmers. Similar findings were obtained by Otieno et al., (2009) and Omiti et al., (2009). In addition, credit access, paddy price and use of insecticides/fungicides positively influenced the degree of rice commercialization among male farmers. The findings corroborate findings from similar studies (Alene et al., 2008; Enete and Igbokwe, 2009; Omiti et. al., 2009; Mathenge et al., 2010; Martey et. al., 2012) that price positively influence the amount of output sold. Martey et al., (2012) found a positive coefficient for credit though not significant. A positive relationship between access to credit and output commercialization was also obtained by (Mathenge et al., 2010). Use of insecticides/fungicides contributes to increased yield, consequently contributing to increased sales. Insecticides/fungicides help in abating yield loss due to destructive insects/fungi.

On the other hand, household size and annual household income significantly influenced the degree of output commercialization among female farmers. Specifically, household size negatively influenced the amount of dry paddy sold. Households with higher number of persons demand more output for consumption and food security, hence selling relatively

smaller amounts. Similar findings were obtained by Otieno et al., (2009) and Agwu et al., (2012). Household income positively influenced the amount of paddy sold. Households earning higher incomes sold more output compared to households earning less income. This finding corroborates that of Agwu et al., (2012).

Overall, participation in activities that earn off farm income, annual household income, credit access, output price and use of insecticides/fungicides determined the degree of output commercialization.

4. Conclusions and recommendations

There is need to improve the degree of commercialization among rice farmers, in order to increase their incomes as well as reduce the rice import bill. To achieve this, productivity must be increased such that farmers have adequate quantities to sell and for household consumption. Credit access and use of insecticides/fungicides have the potential to increase farmers' commercialization. The use of insecticides/fungicides reduces yield loss to insects and fungal diseases hence increasing commercialization. Farmers should be trained and advised on insecticides/fungicides use.

Since participation in off farm income generating activities reduces the degree of commercialization, there is need for the government to have a planned exit from agriculture. This underpins the importance of developing attractive off farm income generating activities that will motivate exit from farming of the less productive and landless citizens. The direction of change should be towards a more diversified rural economy with a variety of livelihood sources and increased returns from agriculture.

Price motivates farmers to participate more in output markets. However, policies that target increase in price to increase the degree of commercialization for an important staple such as rice will only benefit farmers in the short run but have negative effects to buyers. Furthermore, since Kenya is a net importer of rice, increasing price to benefit producers will lead to Kenyan farmers being uncompetitive with other countries importing rice to Kenya. Therefore, it is recommended that other non-price incentives such as use of insecticides/fungicides, improving credit access and household incomes be used as a motivating factor for output commercialization. Reduction of input prices such as seed,

chemicals and fertilizer would improve their usage (Omondi and Shikuku, 2013) and consequently productivity. The government should also improve on education of farmers, particularly female famers whose education is significantly lower compared to male farmers.

However, these findings should be interpreted with care as they may not necessarily be true in other regions of Kenya where opportunities and farming conditions are different.

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Table 1: Description of variables used in the regression model

Variable	Description	Expected sign
Experience	Natural logarithm of number of years of farming	+
Education	Natural logarithm of number of years of formal education of household head	+
Household size	Natural logarithm of the number of persons in a household	±
Off farm income	Binary variable (1=earns off farm income, 0=does not earn off farm income)	±
Annual household income	Natural logarithm of the annual income in Ksh. earned by a household	+
Credit	Binary variable (1=accessed credit, 0=did not access credit)	+
Price	Natural logarithm of price of dry paddy (Ksh./kg)	+
Insecticide	Binary variable (1=applied insecticide , 0=did not apply insecticide)	+

Table 2: Computation of Chow test

RSS_W	RSS_F	RSS_M	F*	F(K,T-K) at 5% significance level	Decision
6.35	1.45	4.29	2.39	1.99	Separate male and female data

Source: computed from survey data (2012)

Table 3: Descriptive statistics for testing for differences in means between male and female rice farmers

Variable	Mean Male farmers (n=154)	Mean Female farmers (n=66)	Mean Whole sample (N=220)	Mean difference
Age (years)	53.62	53.91	53.71	-0.29
Farming experience (years)	17.84	18.48	18.03	-0.66
Education (years)	8.18	5.39	7.32	2.74***
Household size (number)	5.90	5.09	5.66	0.81***
Annual income (Ksh.)	80,396.14	76,397.17	79201.88	3,999
Off farm income (1=earns off farm income,0=otherwise)	0.45	0.27	0.39	0.17**
Land size (acres)	4.40	3.91	4.26	0.49*
Credit (1=accessed credit,0=otherwise)	0.26	0.39	0.30	-0.13*
Extension (1=accessed extension services,0=otherwise)	0.79	0.70	0.76	0.10
Insecticide/fungicides(1=used insecticides/fungicides,0=otherwise)	0.83	0.88	0.85	-0.05
Rice harvested (kg/acre)	2,093.94	1,860.45	2024.21	233.49***
Rice sold (%)	76.83	79.31	77.57	-2.48
Price (Ksh.)	43.31	43.49	43.37	-0.18
Distance (km)	2.75	2.73	2.75	0.02

Source: Computed from field survey data 2012 *,**,*** means significance at 10%, 5% and 1% level

Table 4: Test for differences in means of input use intensity and input prices among male and female farmers

Variable	Mean Male farmers (n=155)	Mean Female farmers (n=66)	Mean Whole sample (N=221)	Mean difference
Quantity of seed (kg/acre)	25.22	25.30	25.25	-0.08
Quantity of fertilizer (kg/acre)	82.90	85.23	83.60	-2.32
Chemical cost (Ksh./acre)	494.77	492.42	494.07	2.35
Labour cost (Ksh./acre)	24,426.72	24,048.83	24,313.72	378.39
Seed price (Ksh./kg)	67.26	72.15	68.72	-4.89***
Fertilizer price (Ksh./kg)	45.42	46.25	45.67	-0.83

Source: Computed from field survey data 2012 *, **, *** means significance at 10%, 5% and 1% level

Table 5: Distribution of the percentage of paddy sold by male and female farmers

Range of the percentage of rice sold	Male farmers (n=155) %	Female farmers (n=66) %
0-10	1.9	0.0
11-20	1.3	0.0
21-30	5.3	0.0
31-40	7.1	4.5
41-50	4.5	7.6
51-60	1.3	4.5
61-70	3.9	7.6
71-80	12.3	22.7
81-90	28.4	25.8
91-100	34.2	27.3

Source: Computed from field survey data 2012

Table 6: Determinants of the degree of rice commercialization among male and female farmers

Variable	Male farmers (n=155)		Female farmers (n=66)		Whole sample (N=221)	
	Coefficient	**t-ratio**	**Coefficient**	**t-ratio**	**Coefficient**	**t-ratio**
Experience	-0.01	-0.06	0.02	0.47	0.01	0.37
Education	0.01	0.48	0.01	1.15	0.00	0.86
Household size	0.01	0.34	-0.07	-2.29**	-0.01	-0.51
Off farm income	-0.09	-2.80***	-0.12	-1.98*	-0.10	-3.37***
Annual income	0.04	0.83	0.13	2.05**	0.07	1.78*
Credit	0.10	2.77***	0.05	1.18	0.09	3.56***
Price	0.40	2.07**	0.09	0.40	0.37	2.58**
Insecticide	0.37	6.34***	0.08	0.95	0.29	5.81***
Constant	-1.50	-1.85*	-1.01	-0.94	-1.68	-2.68***
R^2	0.5439		0.2666		0.4435	

Source: Computed from field survey data 2012 *, **, *** means significance at 10%, 5% and 1% level