

Analysis of Socio-Economic Factors Influencing Farmers' Adoption of Coffee Organic Farming in Gakenke District of Rwanda

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Abstract: Smallholder-based agriculture is the main source of livelihood, especially in the rural areas, where most of the population live. Coffee is one of the most important cash crops across the world and a major source of export earnings. The adoption on awareness of farmers about organic farming is one of the best preferable measures to improve both high quality and quantity of coffee production. The general objective of this study is to analyze socio-economic factors influencing farmers' adoption of coffee organic farming in Gakenke district of Rwanda. This study employed a cross-sectional survey design and a multi-stage sampling technique was adopted to select sample for this study. Hence, the total sample size for this study was 182 respondents. Descriptive statistics such as frequency and percentage was used to analyze the first and second objectives. While inferential statistics (logit regression) was used to analyze objective three. The overall objective of the study to analyze socio-economic factors influencing farmers 'adoption of coffee organic farming in Gakenke district of Rwanda. In this study, the majority 60.4% of the respondents were male. Result shows that farmers had high level of awareness in Recycle wastes of plant and animal (100%). The most commonly and highly adopted practices was crop rotation of intercropped crops such as bush beans, tomatoes, pineapple and vegetables in general. The result of logit regression analysis in Table 4 shows that four factors such as education level, land size, farming experience and gender had positive and significant influence on adoption of organic coffee farming. It was therefore recommended that youth should be encouraged and supported to enter this sector because they are in their active age and are more adopter of innovation than old people who are more conservators. Provision of training and technical advice on organic farming practices through agricultural extension services and developing information networks among farmers is vital.

Keywords: Analysis, Socio-Economic, Factors, Adoption, Coffee Organic Farming

1. Introduction

In sub-Saharan African (SSA), smallholder-based agriculture is the main source of livelihood, especially in the rural areas, where most of the population live. Livelihood challenges such as poverty and hunger are prevalent among farming and rural households in the region, and they are largely attributed to low agricultural productivity [6].

In the other hand, poor soil fertility should be a challenge to achievement of food security and rural wellbeing in Sub-Saharan Africa [15]. Nutrient depletion, being a key

factor in low soil fertility results when nutrients removed through crop off-take and other loses are not adequately replaced, which is widespread across sub-Saharan Africa countries including Rwanda at large [14].

Coffee is one of the most important cash crops across the world and a major source of export earnings. It is second only to crude oil as the most important internationally traded commodity in monetary value [5]. In spite of high export earnings from coffee globally, coffee produced in most African countries fetch low prices compared to coffee from other continents due to relatively lower quality coffee [3]. One

of the major constraints to improving coffee yields and quality is the generally low standard of management adopted by smallholder coffee farmers who produce the bulk of Rwanda's coffee.

The Agriculture sector is the main economic activity in Rwanda where 64% of the working population are employed in Agriculture. Agriculture GDP represents around a third of the National GDP and currently stands at 24 % [10]. The majority of the land found in Rwanda is arable, with favourable conditions for cultivation.

Coffee in Rwanda is mainly grown for export with only few quantity Consumed local despite the high tourist potential particularly in northern region; promotion of coffee utilization and coffee value addition has been low with farmers only limited participation at farm level. This has been due over regulation of the sector making opportunistic players exploit the farmer the like roasters. Low coffee production in Rwanda despite of high quality and production potential is due to low prices, lack of promotion of domestic consumption, global massive overproduction crisis, high cost of production, inaccessible credit facilities and strict rules prohibiting trading, expansion or uprooting of the crop [11].

The country's export coffee remains largely obscured on the global market. Challenges exist on how to effectively establish the country's coffee on the international market and also to ensure that the marketing system keeps up with changes in the dynamic global market for high quality coffee. Strategic management of the country's niche markets remains largely unexplored. This factor has also contributed to declining export earnings for coffee in the country [12].

A challenge for agricultural researchers is to understand what, how and when farmers and the constraints affecting their use the developed technologies. This has resulted in the search for information relating to the mechanisms underlying technology use [12]. The adoption on awareness of farmers about organic farming is one of the best preferable measures to improve both high quality and quantity of coffee production. Organic farming (OF) is an integrated system approach that is not concerned solely with one facet of the system such as output, but incorporates a wider range of factors in its concerns as it aims to improve both the production base and the output of the production [4].

Some local non-governmental organizations and international development agencies are promoting organic farming as a pro-poor strategy for improving agricultural productivity and the livelihood conditions of rural and farming households on the sub-continent ([17]. They argue that organic farming management practices can help address poor soil fertility and severely degraded soils, two major underlying factors for low agricultural productivity in SSA [17]. They also contend that organic farming can open financially rewarding domestic and international markets, with livelihood enhancing opportunities for African smallholder farmers [17].

Despite the popularity of coffee cash crop in Gakenke district, there is low productivity of this crop. This may be due to factors such as planting of poor quality variety, late planting,

inaccurate planting spacing, inappropriate fertilizer application timely and at right quantity, lack or in adequate pruning, lack of proper pest and diseases control, poor knowledge of appropriate GAP of coffee, and post-harvest handling activities and storage facilities.

The major constraints to adoption were found to be lack of capital, high cost of fertilizer and lack of market for produce [9]. Moreover, non-adoption of organic coffee farming production practices negatively affects coffee production in the study area. In order to promote organic coffee farming productivity, the government has undertaken several measures to ensure an increase of coffee yields per unit area as a strategy of improving agriculture production as a whole. Among the measures undertaken is creation of awareness among coffee farmers, provision of clean seeds/seedlings, production price stabilization and training under several programs such as FFS, learning by doing through field demonstration plots at zoning level in collaboration with District cash crops officers and NAEB. However, the general objective of this study is to analyze socio-economic factors influencing farmers' adoption of coffee organic farming in Gakenke district of Rwanda. Therefore, the specific objectives are:

- 1) To describe the socio-economic characteristics of coffee farmers,
- 2) To assess the level of awareness, and adoption of organic coffee farmers,
- 3) To determine the factors influencing adoption of organic coffee farming in study area.

publication. Margins, column widths, line spacing, and type styles are built-in; examples of the type styles are provided throughout this document. Some components, such as multi-leveled equations, graphics, and tables are not prescribed, although the various table text styles are provided. The formatter will need to create these components, incorporating the applicable criteria that follow.

2. Methodology

2.1. Study Area

The District of Gakenke is one of the five districts of the Northern Province with 704, 06 km². It is subdivided into 19 administrative sectors, 97 cells, 617 villages and 84,456 Households. The district shares borders with Rulindo District to the East, Burera and Musanze Districts to the North, Nyabihu District to the West, Kamonyi and Muhanga Districts to the South. The location of the District on the road Kigali-Musanze provides some opportunities related to some activities that may be attractive to passengers like that of Nyirangarama Enterprise. Gakenke district is characterized in general by high inclined hills separated by rivers and marshlands. The relief seems to comprise two distinctive regions with the high altitude.

The District of Gakenke is endowed with reserves that could provide enough water for both consumption and

agricultural purposes. These include substantial rainfall (between 1100 and 1 500 mm per year) and the abundance of streams and watercourses. The vegetation in Gakenke district composes of eragrostis, a dominant grass (which is an evident sign or characteristic of the high level of deteriorated soil), whereas on different small and high mountains big planted trees are evident. Here and there on nice hills and valley, green crops cultivated near or far houses in the framework of land use consolidation mainly constitute the vegetation. Forestry coverage is 20900 Ha (29%) against 30% planned targets in 2018/2019. On hillsides, the soil is from the granite origin whereas in marshlands and valley the soil is clay. As far as the fauna goes, there are variety of bird species like eagle, sparrow hawk, cranes and ravens and that can be attractive to tourists. The climate in Gakenke district is generally the type of humid climate with the average annual temperature varying between 16°C and 29°C. The humid wind comes from East to West. The rainfalls are relatively abundant with a scale between 1100 and 1500 mm per year.

2.2. Sampling Technique and Sample Size

Multi-stage sampling technique was adopted to select sample for this study. The first stage involved the purposive selection of four (4) sectors out of nineteen (19) in Gakenke district. These sectors are Coko, Muyongwe, Muhondo, and Rushashi. Purposive selection was used to select zones based on high volume of coffee production. The second stage was a random selection of six (6) Coffee washing stations such as Twongere Kawa Coko, Dukunde Kawa Mbirima, Muhondo coffee company, Bumbogo coffee washing station, Muyongwe coffee company, and Abakunda Kawa. The third stage involved random selection of three (3) cells in each sector under which twelve (12) sites/zones were selected (Nyanza, Kiruku, Mbirima, Nyange, Musenyi, Guhinga, Gasiza, Bwenda, Ruganda, Va, Burimba, and Kageyo). This gave a total number of coffee farmers (335) where a total of 182 respondents was taken into consideration.

2.3. Data Analysis

Descriptive statistics such as frequency and percentage was used to analyze the first and second objectives. While inferential statistics (logit regression) was used to analyze objective three. The regression model is expressed as:

$$Y = a + b_1x_1 + b_2x_2 \dots b_{10}x_{10} + e \quad (1)$$

Where Y = adoption of organic coffee farming productivity (1=adoption, while 0=non adoption)

X1 = Age (years)

X2 = Gender (male or female)

X3 = Family Size (number)

X4 = Educational status (years spent in school)

X5 = Farming experience (years)

X6 = Distance to the market (km)

X7 = off farm-income (ha)

X8 = Extension services (1=yes, 0=no)

X9 = Land size (ha)

X10 = Access to credit (1=yes, 0=no)

a = Constant (intercept)

e = Error term

b₁-b₁₀= regression parameters estimated

3. Results and Discussions

3.1. Socio-Economic Characteristics of Coffee Farmers

In this study, the majority 60.4% of the respondents were male as indicted by results in table 2. This implies that male mainly dominates coffee production in study area while this crop is mostly taken as a cash crop.

The result of this study indicated that majority 51.2% of the coffee farmers are between the ranges of 36-50 years followed by the farmers who are in range between 21-35 years. The last class is that of farmers of 66 years and above actually older. The result therefore revealed that most of the coffee farmers in study area are mature and tend to be old who physically are less energetic because they are in their maturity age. Thus, labor productivity of coffee farmers is expected to be high due to different good agricultural practice carried out themselves.

The majority of the coffee farmers (53.3%) have household size of 4-7 people followed by the household size of 1-3-7 people with 28.65% while the household size of 8 and above people have 18.1%. From this result, it is found that the respondents' large family size is above the recommended average size of five (5) composed of parents and three children per family in Rwanda. This means that the family with larger members is reviewed as an important source of labor supply in smallholder farmers that actually cultivate food crop production in most part of Africa including Rwanda. These results show that there is significant number of people in a family that provide labor in coffee production, which reduce cost for farm activities in a family. The results also agrees with the work of Abdullai and Huffman [1] that the rice farmers in Northern Ghana had average household size of about eight members.

The result in Table 1 indicated the majority of coffee farmers 55.5% attended primary school. The 24.2% of the coffee farmers in the area (illiterate) never attended even primary while 2.7% of the respondents have attended university studies. The result implies that only 24.2% are not attended school while the rest of the coffee have attained education up to university. Primary education is a good literacy level and hence it is expected that educated farmers have a good ability to process information related to coffee production from extension officers and agrochemical traders or dealers.

The findings in table 1 revealed that majority (70.3%) of the respondents have been farming coffee for around 11-20 years followed by those 16.5% of about 21 and above. only 13.2% have been in the cultivation of coffee production as business for a period between 1-10 years. This indicated that farmers in the study area have earned more experience in coffee production so; the adoption of new technology should never be a new issue.

Table 1. Distribution of Coffee Farmers According to the Socio-Economic Characteristics (n=182).

	Frequency	Percentage
Gender		
Male	110	60.4
Female	72	39.6
Age		
21-35	48	26.43
36-50	93	51.2
51-65	25	13.7
66 and above	16	8.8
Family size		
1-3	52	28.6
4-7	97	53.3
8 and above	33	18.1
Education level respondents		
Illiterate	44	24.2
Primary	101	55.5
Secondary school	20	11
Vocation	12	6.6
University	5	2.7
Farming experience		
1-10	24	13.2
11-20	128	70.3
21 and above	30	16.5

3.2. Level of Farmers' Awareness on Organic Coffee Farming Among Smallholders Farmers in Gakenke District

Result in Table 2 shows that farmers had high level of awareness in Recycle wastes of plant and animal (100%), use of Plant trees along hills side to control soil erosion (97.2%), Crop rotation of intercropped crops (85.7%), Growing nitrogen fixing legumes (80.8%), and Planting row of nitrogen fixing trees (56.1%). This implies that coffee farmers were familiar with these practices. The findings of this study was also supported by the study of [9] when they studied awareness of new maize varieties by maize farmers. They further explained that maize farmers found information on improved maize varieties from radio, extension agents, other farmers, village/ward heads and their friends while explaining that most of the farmers obtained information (awareness) through extension agents. Majority of the farmers obtained information from extension agents followed by fellow farmers [8]. [7] Explained that maize farmers who adopted the technologies benefited a lot from increased awareness, yield, and income.

Table 2. Distribution of Coffee Farmers According to the Level of Awareness of Organic Coffee Farming Practices.

Organic production system	Aware		Not aware	
	F	%	F	%
Recycle wastes of plant and animal	182	100	0	0
Plant trees along hills side to control soil erosion	155	97.2	5	2.7
Crop rotation of intercropped crops	177	85.7	26	14.3
Growing nitrogen fixing legumes	147	80.8	35	19.2
Planting row of nitrogen fixing trees	102	56.1	80	44
Manure application in fodder crop field	78	42.8	104	57.1
Increase soil biological activity	66	36.3	116	63.7
Maintain long-term soil fertility	42	23.1	140	77

3.3. Level of Farmers' Adoption of Organic Coffee Farming Practices

Table 3 shows the distribution of respondents based on their level of adoption of organic coffee farming practices. Crop rotation of intercropped crops (100%), Plant trees along hills side to control soil erosion (95.6%), Recycle wastes of plant and animal (90.6%), planting row of nitrogen fixing trees (75.8%), and Growing nitrogen fixing legumes%(53.3). All of these above were the most adopted organic farming practices

among coffee farmers. This result indicates that coffee farmers found those practices easier to adopt. The most commonly and highly adopted practices was crop rotation of intercropped crops such as bush beans, tomatoes, pineapple and vegetables in general. This supported by [16] indicated recommended and no recommended crops with coffee in Uganda include bananas, non-climbing (bush beans), soya-beans, groundnuts and tomatoes. However, Maize, cassava and potatoes are high nutrient demand crops and are therefore not recommended.

Table 3. Distribution of Farmers According to the Level of Adoption of Organic Coffee Farming Practices.

Organic production system	Highly adopter		Lowly adopter	
	F	%	F	%
Crop rotation of intercropped crops	182	100	0	0
Plant trees along hills side to control soil erosion	174	95.6	8	4.4
Recycle wastes of plant and animal	165	90.6	17	9.3
Planting row of nitrogen fixing trees	138	75.8	44	24.1
Growing nitrogen fixing legumes	97	53.3	85	46.7
Manure application in fodder crop field	73	40.1	109	60
Increase soil biological activity	39	21.4	143	78.6
Maintain long-term soil fertility	33	18.1	149	81.9

3.4. Socio-Economic Factors Influencing Adoption of Organic Coffee Farming in Study Area

The result of logit regression analysis in Table 4 shows that four factors such as education level, land size, farming experience and gender had positive and significant influence on adoption of organic coffee farming. As indicated by the significance of results education level, land size, farming experience are statistically significant at 1% level of probability. This for example implies 1-year increase in farming experience should influence the adoption of organic coffee farming by 3.1%. In other hand, this should implies that larger the farm size, the higher the adoption of organic coffee farming production practices in study area. This was supported also by the study of [2] and [13] reported that farm size had bearing on the capacity of farmers to utilize agricultural innovation and new farm practices. They indicated that there was positive and significant relationship between farm size and agricultural innovation utilization.

However, findings in this study show that adoption of organic coffee farming was negatively influenced by age, marital status, and distance to market. This implies that 1 km increase to the market should reduce organic coffee farming by 0.8%. In the other word, the closer the market, the higher adoption of innovation in agriculture farming production.

Table 4. Logit Regression Analysis of Socio-Economic Factors Influencing Adoption of Organic Coffee Farming.

Variables	Coeff.	Std. Error	P> z
Age	-0.046	0.402	0.037
Gender	0.109	0.065	0.124
Marital status	-0.360	0.124	0.078
Education level	0.0451	0.0118	0.000
Land size	0.073	0.025	0.000
Farming experience	3.103	0.463	0.000
Distance to market	-0.87	0.15	0.001
Constant	-2.762	0.715	0.000
Number of observations =182	Prob > chi2 = 0.0000		
Log likelihood = -41.527	Pseudo R2 = 0.713		

4. Conclusion and Recommendations

The overall objective of the study to analyze socio-economic factors influencing farmers' adoption of coffee organic farming in Gakenke district of Rwanda. In this study, the majority 60.4% of the respondents were male. The result of this study indicated that majority 51.2% of the coffee farmers are between the ranges of 36-50 years followed by the farmers who are in range between 21-35 years. The last class is that of farmers of 66 years and above actually older. Result in Table 2 shows that farmers had high level of awareness in Recycle wastes of plant and animal (100%), use of Plant trees along hills side to control soil erosion (97.2%), Crop rotation of intercropped crops (85.7%), Growing nitrogen fixing legumes (80.8%), and Planting row of nitrogen fixing trees (56.1%). This implies that coffee farmers were familiar with these practices.

Table 3 shows the distribution of respondents based on their

level of adoption of organic coffee farming practices. The most commonly and highly adopted practices was crop rotation of intercropped crops such as bush beans, tomatoes, pineapple and vegetables in general. The result of logit regression analysis in Table 4 shows that four factors such as education level, land size, farming experience and gender had positive and significant influence on adoption of organic coffee farming. As indicated by the significance of results education level, land size, farming experience are statistically significant at 1% level of probability. This indicated that there was positive and significant relationship between farm size and agricultural innovation utilization.

Based on these findings, the following recommendations are highly made:

- 1) The result of this study indicated that majority of the coffee farmers are their old ages and showed a negative influence on organic coffee farming adoption. Youth should be encouraged and supported to enter this sector because they are in their active age and are more adopter of innovation than old people who are more conservators.
- 2) Efforts to promote organic coffee farming on small-scale farms should focus on enhancement of farmer-awareness of the environmental, economic and other benefits of organic agriculture, as well as trading opportunities for developing countries.
- 3) Extension services should be increased as far as possible to assist farmers adopt agricultural innovations particularly about organic farming. This will enable them to better use resources and protection ecosystem as well as create opportunities to access international market standards, which in turn generate high household income.
- 4) Provision of training and technical advice on organic farming practices through agricultural extension services and developing information networks among farmers is vital.

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