Why do Farmers in Nyaruguru District Adopt Organic Coffee Production Methods?

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Abstract

Purpose: Nyaruguru is the most southerly district in Rwanda, lying between the cities of Butare and Cyangugu and along the Burundian border. It is mountainous, containing part of the montane forest of Nyungwe, one of Rwanda’s most popular tourist destinations. Innovation and adoption of new technologies in agriculture is one of the keys that should reduce poverty in that area. The aim of this study is to analyse the factors influencing farmer’s adoption of organic coffee production practices in Rwanda.

Methodology: This study employed a cross-sectional survey design and a multi-stage sampling technique to select a sample for this study. However, a total sample size of 150 respondents was used. The functional form of the stochastic frontier production (or cost) model employed for this study is the Cobb-Douglas (C-D) functional form. In the analysis, descriptive statistics and a Tobit model were used with the help of STATA.

Findings: The study found out that appropriate seeds and planting material is one of the most important factors in production. The findings of logit regression analysis also indicated that four factors such as education level, land size, farming experience, gender and enhanced soil fertility had positive and significant influence on adoption of organic coffee production practices. The demand for organic products creates new export opportunities. The market returns from organic agriculture can potentially contribute to local food security by increasing family incomes.

Conclusion: The study conclude that the most common constraints to adoption of organic coffee production practices were lack stable and reliable market, high cost of inputs, lack of extension services, and inadequate capital.

Recommendations: The study recommended that efforts aiming at promoting organic coffee production practices among smallholder’s farmers should focus on enhancement of farmer-awareness, provision of training and technical advice on organic farming practices. This can be achieved through agricultural extension services and developing information networks among farmers. Also, the government should strive to improve extension services through field visit and strive to stabilize coffee markets.

Keywords: Farmers, adoption, organic, coffee production.
1.0 INTRODUCTION

Agriculture is the dominant sector and mainstay of the world’s population especially, in developing countries (Bechdol et al., 2010). 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 (FAO, 2017). In Africa, better than other economic sectors, a GDP growth of agricultural sector is paramount importance in reducing poverty, rising farm income and invigorating non-farm activities (WB, 2008). More particularly, in Sub-Saharan Africa (SSA), smallholder agriculture is an input for poverty reduction and food security (FAO, 2009); source of foreign exchange and engine of development (Shimelles et al., 2009); income and employment (Olajide, 2011) and rural regeneration (Bosshaq et al., 2012).

In Rwanda, agriculture is the main support of the economy and is crucial to the growth of the country and its poverty reduction. The agriculture sector accounts for 39% of gross domestic production, 80% of employment and 63% of foreign exchange earnings (USAID, 2018). The majority of the land found in Rwanda is arable, with favourable conditions for cultivation. The country has designed and implemented different poverty reduction strategies including land use consolidation, Twigire Muhinzi, and crop insurance. Increasing agricultural production, therefore, is vital for ensuring food security, providing inputs for industrial sector, invigorating export earnings, GDP and then getting better the income and living condition of the people where the revenues generated from the export of Agricultural export products for the FY 2017-2018 indicated an increase of 44.71% (MINAGRI, 2018).

Nyaruguru District Mayor commissioned the plan to support coffee farmers to keep on improving the quality and quantity of their crops. The hilly district is favourable to tea and coffee production due to its climate and soil acidity. Increasing production and value addition for the yield will ensure that local farmers get a share on the market. The mayor also rolled out a three-year project planned under the district’s five-year development plan (2013-2017) to promote coffee production targeting more than 3,000 coffee farmers who will be linked to markets. The aim was to promote growing of cash crops, champion the increase of soil fertility, reducing soil erosion, and improving land consolidation.

Coffee is one of the major cash crops produced in Rwanda and the country is one of developing countries that have been producing it for export market because of its wide use as world’s beverage. Coffee is an important cash crop mainly valued for its aroma and stimulation. The crop is also one of the important berries that serve as the source of income particularly for smallholder producers in many parts of southern province of Rwanda (Clay & Turatsinze, 2014).

Coffee like most other plants, prefer well drained, moisture holding loam soil (sandy loam) containing some organic matter (Lemma & Edward, 1994). A pH of 6.5-7.5 is suitable and the land should be level to 0.01-0.03 % slope to allow adequate drainage and prevent root diseases. It performs well warm climatic conditions with areas that receive 600 – 1,200 mm of rainfall annually which is well distributed throughout the growing period is required. The optimal temperature range is 18 – 30°C. Water stress can cause abscission of fruit and flowers, especially when it occurs during flowering (Matta & Cotter, 1994) and reduces yield through reduced pollination. The extreme case can result in increased risk of diseases. Poorer soil types and water stress are believed to produce lower yields (Haigh et al., 1996). Coffee is a high value crop (Aliyu et al., 2012) and has economic significance in the world market.
potentials to generate foreign exchange and can be utilized in confectionary, medicinal, and culinary purpose (Mohammed et al., 2016). Coffee production is an important source of foreign exchange and its exportation in Rwanda has been reported to be lucrative (FAOSTATS, 2014).

Various estimates say that up to 40% of food is lost in the postharvest stage. Dried coffee are produced for export mainly in the Nyaruguru District. FAOSTAT reports that in 2013, 400 hectares were cultivated and 5,400 tons produced in Rwanda, a figure that includes all fresh coffee. This indicates that coffee serves as one of the important sources of income to smallholder farmers and as exchange earning commodity in the country (Beyene & David, 2007).

The coffee sector in Rwanda comprises three main varieties namely; Caturra, Catuai, and Bourbon which are mostly dried and exported. In spite of its importance, coffee production system has stayed as low input and low output with a national average yield of 3.6 t/ha for green beans (CSA, 2006). The decline of coffee production is also attributed to poor varieties, poor cultural practices, the prevalence of fungal (blights) and bacterial as well as viral diseases (Fekadu & Dandena, 2006). According to Babatunde et al. (2010) financial capital appears to be the most limiting factor for farming, so that cash income from off-farm activities can help to expand farm production. Education is the key factor that determines agricultural production in adopting inputs in general and management demanding practices in particular (Uwagboe et al., 2012). According to Lugandu (2013), from the input adoption view point, small land size owners are obliged to adopt inputs and other land management practices to increase agricultural production. The major constraints to adoption were found to be lack of capital, high cost of fertilizer and lack of market for produce (Kudi et al., 2011).

One of the most well-known practices to recover and maintain the soil productivity is to add organic amendments. Organic manure plays an invaluable role in rectifying land degradation and enhancing productivity thus achieving farm household food security, income and agricultural development (IFDC, 2007; Alimi, 2002). Organic manure can increase soil drainage, soil aeration, water holding capacity and the ability of the soil to hold nutrients. The beneficial effects of organic matter on soil structure can have a greater effect on plant growth than the fertilizer value of some of the organic materials (FAO, 2000). Organic farming avoids the use of synthetic fertilizers and pesticides and relies on developing biological diversity in the field to disrupt habitats for pest organisms and the purposeful maintenance and replenishment of soil fertility. Organic farming emphasizes the use of renewable natural resources and their recycling (Emsley, 2001). It eliminates the use of synthetic pesticides, growth hormones, antibiotics and gene manipulation in the crop production system and this poses a challenge to crop and pest management specialists to device new tactics for crop and animal protection (Ivbijaro, 1990; Tapondjon et al., 2002).

Organic systems rely on crop rotation, crop residues, animal manures, legumes, green manures, off-farm organic wastes and aspects of biological pest control to maintain soil productivity and till, to supply plant nutrient and to control insects, weed and other pests (Lampkin, 1990; Miguel, 1998). Despite these beneficial effects and the vital role in supporting crop production and soil fertility improvement, organic manure is not regularly applied by most farmers, even in areas where aggregate livestock population may permit its use (Adejobi & Kormawa, 2002) in Sub-Saharan Africa.

Crop rotation is one of the nearest and easily be done agronomic practices that could potentially increase soil fertility and even kill weed and pests. In theory and practice, according to Chiputwa et al., (2011) in Zimbabwe and Chomba (2004) in Zambia, nitrogen fixation crops
do maintain soil fertility much better than cereal crops. Thence, rotating legumes after cereals and vice versa improves soil fertility and break weed and pest life that pave the way for increased crop production. Animal manures, particularly cattle dung, were the main source of nutrients for the maintenance of soil fertility in settled agriculture until the advent of mineral fertilizers (Ofori & Santana, 1990). Farmyard manures are responsible to nutrient availability for crop in demand, improve soil physical properties/aggregation and hence improve water retention capacity, infiltration rate and biological activity of soil (Aliyu, 2000). The advantage of farmyard manure application, however, greatly depends, among others, on proper application methods, which increase the value, reduce cost, and effectiveness (Teklu et al., 2004).

Now days, it is widely recognized that quality product and access to fair market is a key element in providing a route out of poverty for small scale producers in developing countries including Rwanda. In Nyaruguru District area, coffee is a major cash crop produced by the majority of farmers for export. There is therefore a strong need to help small producers to achieve sustainable production and fair access to coffee markets in order to increase their income and secure their livelihood by providing adaptable and high yielding varieties. In the other hand, poor soil fertility should be a challenge to achievement of food security and rural wellbeing in Sub-Saharan Africa (Sanginga & Woomer, 2009). 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 (Onwonga & Freyer 2006).

Agriculture being the backbone of the Rwanda’s economy relies heavily on environmental resources. Therefore, for Rwanda to attain the Millennium Development Goals and realize vision 2030, environmental conservation by way of organic farming should be prioritized. This can only be carried out if there is a clear understanding of the factors that influence adoption of organic farming among farmers in rural Rwanda where intensive farming is carried out. The adoption of organic farming practices and the participation in fair trade certification regimes provides access to global markets for smallholder farmers (ADB, 2012). Organic coffee marketed under fair trade regimes provides an opportunity to diversify agricultural export markets. This can contribute to increased and a more stable income from agriculture. While certification improves production standards and labeling generates economic and environmental benefits (Waibel & Zilberman, 2007).

It therefore the general objective of this study was to analyse the factors influencing farmer’s adoption of organic coffee production practices in Rwanda with focus on Nyaruguru District. Therefore, the specific objectives were to assess the level of awareness, and adoption of organic coffee production practices, to identify the factors influencing adoption of organic coffee production practices, to determine the constraints of adoption of organic coffee production practices.

2.0 METHODOLOGY

2.1 Study Area

Nyaruguru District is one of the eight districts of Southern Province of Rwanda and covers a total area of 1012 km². The district is the most southerly in Rwanda, lying between the cities of Butare and Cyangugu and along the Burundian border. It is mountainous, containing part of the montane forest of Nyungwe, one of Rwanda's most popular tourist destinations, which also provides cooking charcoal for much of the Southern region. Nyaruguru district is divided into 14 sectors namely; Cyahinda, Busanze, Kibeho, Mata, Munini, Kivu, Ngera, Ngoma,
Nyabimata, Nyagisozi, Muganza, Ruheru, Ruramba and Rusenge. The hilly district is favourable to tea and coffee production due to its climate and soil acidity. Increasing production and value addition for the yield will ensure that local farmers get a share on the market.

Figure 1: Administrative map of Nyaruguru District


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 six (6) sectors out of fifteen (14) in Nyaruguru District. These sectors are Busanse, Kibeho, Munini, Ngera, Ngoma, and Rusenge. A purposive selection method was used to select cells/zones based on high volume of coffee production. The second stage involved random selection of two (2) cells in each sector under which twelves (12) cells were selected. The farmers were proportionally selected from each cell based on the number of coffee farmers found in each cell. However, a total sample size for this study was 150 respondents engaged in coffee farming as business.

2.3 Data Analysis

The functional form of the stochastic frontier production (or cost) model employed for this study is the Cobb-Douglas (C-D) functional form. 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:

\[ Y = a + b_{1}x_{1} + b_{2}x_{2} + \ldots + b_{10}x_{10} + e \]  

Where \( Y = \) adoption of organic coffee production practices (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 reserved to coffee (ha)  
X10 = Access to credit (1=yes, 0=no)  
a = Constant (intercept)  
e = Error term  
\( b_1 - b_{10} \) = regression parameters estimated

3.0 RESULTS AND DISCUSSIONS

3.1 Household characteristics of farmers in Nyaruguru District

The mean age for adopters of organic coffee production practices was about 47 years while that for non-adopters was about 54 years. Age of the household head plays a key role in influencing the decision to adopt one or more different new technologies. Result of two-tailed t-test indicate that age was statistically significant at 5% indicating that non-adopters of organic coffee production practices were more aged than adopters.

Table 1: Description of farm and farmer characteristics in Nyaruguru District.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Mean</th>
<th>Overall</th>
<th>t-ratio</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Adopters</td>
<td>Non-adopters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>46.7</td>
<td>53.3</td>
<td>47.45</td>
<td>-1.576</td>
</tr>
<tr>
<td>Household size</td>
<td>6.4</td>
<td>4.9</td>
<td>5.82</td>
<td>5.661</td>
</tr>
<tr>
<td>Land size</td>
<td>0.75</td>
<td>1.66</td>
<td>1.36</td>
<td>0.464</td>
</tr>
<tr>
<td>Experience</td>
<td>8.97</td>
<td>5.74</td>
<td>7.455</td>
<td>0.235</td>
</tr>
<tr>
<td>Extension</td>
<td>3.32</td>
<td>1.29</td>
<td>2.32</td>
<td>7.618</td>
</tr>
<tr>
<td>Training</td>
<td>4.17</td>
<td>2.70</td>
<td>3.48</td>
<td>-1.570</td>
</tr>
<tr>
<td>Farm proximity</td>
<td>0.25</td>
<td>1.54</td>
<td>0.89</td>
<td>-4.231</td>
</tr>
<tr>
<td>Off-farm income</td>
<td>158554.07</td>
<td>182869.69</td>
<td>170712.8</td>
<td>0.412</td>
</tr>
</tbody>
</table>

The mean household size was about 7 members for adopters of organic coffee production practices and about 5 for non-adopters. Result of two-tailed t-test show that household size was statistically significant at 1% revealing that adopters of organic coffee production practices had more household members than non-adopters. This due to the non-adopters are oldest people who stopped to give birth while rather than young people. Large household size positively influences adoption of labour-intensive agricultural technologies since they have the capacity to relax the labour challenges required during the installation of heavy infrastructures used in technological agriculture.

The mean farm size was 0.75 hectares for adopters and 1.66 hectares for non-adopters. Result of t-test show that land size was statistically significant at 1% indicating that non-adopters had
larger land sizes than adopters. Small land holding hinder adoption of technologies compared to large land holding. Big portions of land allow farmers to practice different agricultural practices like crops rotation, agroforestry, planting of leguminous crops and integration of animals into farming system.

In case of farming experience, the mean number of years of farming was about 9 for adopters and about six for non-adopters. However, the result of t-test show that experience was insignificant at 10% level to influence adoption indicating that adopters and non-adopters of organic coffee production practices were in only the difference of three years. Adopters had a mean of 3.32 contacts per year with extension officers while non-adopter had a mean of 1.29 contacts with extension officers. Result of two-tailed t-test show that extension was statistically significant at 1% indicating that adopters of organic coffee production practices had more extension services than the non-adopters. This result was supported by the study of (Adesina et al., 2000) who showed that the number of contacts with extension officers is a proxy measure for access to information and this positively contributes to awareness and subsequent adoption of new technologies.

The mean farm distance from the farmers homestead to the farm for adopters of was 0.25 kilometers while that for non-adopters was 1.54 kilometers. This indicated that non-adopters are far from their farms which many times hinder adoption and protection of grown crops. Result of t-test analysis show that farm proximity was negatively and statistically significant at 1% indicating that non-adopters of organic coffee production practices had their farms located very far from their homestead than the adopters of organic coffee production practices. However, this could be a factor reducing many farmers from adopting new technology. This implies that 1 km increase from the homestead to their Farm should reduce adoption by 0.9%.

The mean off-farm income was 158554.07Rwf for adopters and 182869.69Rwf for non-adopters. Result of t-test analysis revealed that off-farm income was significant at 5% indicating that non-adopters of had more off-farm income compared to adopters. This Perhaps should because non-adopters of organic coffee production practice have other resources those adopters in study area. However, the higher the off farm income, the higher the money can be allocated to agricultural activities especially purchase of agricultural inputs (improved seeds, organic fertilizers and pesticides) and payment of labors.

3.2 Socio-Economic and Demographic Characteristics of Coffee Farmers

In this study, the majority 55.3% 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 that has both national and international market. The result of this study indicated that majority 53.3% of the coffee farmers are between the ranges of 36-50 years followed by the farmers who are in range between 51-65 years. The last class is that of farmers of 66 years and above actually older with 7.3%. The result therefore revealed that most of the coffee farmers in study area are mature representing more than 80% of all farmers. Thus, labor productivity of coffee farmers is expected to be high due to different good agricultural practice carried out themselves. However, young people ignore this sector as indicated by the results.

The majority of the coffee farmers (57.3%) have household size of 4-7 people followed by the household size of 8 and above members with 28%. Therefore, it has been found that the respondents’ large household size is above the recommended average size of five (5) composed of parents and three children per family in Rwanda. This implies that the larger household size, the more chance of getting none hired labor force from outside. These results show that there is significant number of people in a household that provide labor in coffee production, which
reduce cost for farm activities in a family. The results also agree with the work of Abdullai and Huffman (2005) that the rice farmers in Northern Ghana had average household size of about eight members.

The result in table 2 indicated the majority of coffee farmers 47.5% attended primary school followed by illiterate with 22.7%. The lowest and last class is of university people represented by 3.3% of the coffee farmers in the area. This implies high-educated people are not engaged in agriculture sector due mainly to the old mentality and sometimes lack of initial capital for inputs purchase, labor payment and particularly land as main primary factor of production. The result of this study was supported by the study of Renato and Euan (2004) that found out that education is a significant factor, which has positive impact on farmers’ productivity and efficiency.

The findings in table 2 revealed that majority (58.7%) of the respondents have been farming coffee for around 6-10 years followed by those 26% of 11 years and above in farming coffee. Only 15.3% have been in the cultivation of coffee crop as business for a period less than 5 years. This indicated that farmers in the study area have earned more experience in coffee production. Hence, the adoption of new technology should not be a new item. The result was supported by study conducted by Tashikalma (2011) indicated that farmers with more years of farming experience in terms of farm operations handle better, compared to farmers with few years of farming experience.

Table 2: Distribution of coffee farmers by the socio-economic characteristics (n=150)

<table>
<thead>
<tr>
<th>Descriptive characteristics of respondents</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>83</td>
<td>55.3</td>
</tr>
<tr>
<td>Female</td>
<td>67</td>
<td>44.7</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between 21-35</td>
<td>19</td>
<td>12.7</td>
</tr>
<tr>
<td>Between 36-50</td>
<td>80</td>
<td>53.3</td>
</tr>
<tr>
<td>Between 51-65</td>
<td>40</td>
<td>267</td>
</tr>
<tr>
<td>66 and above</td>
<td>11</td>
<td>7.3</td>
</tr>
<tr>
<td><strong>Family size</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between 1-3</td>
<td>22</td>
<td>14.7</td>
</tr>
<tr>
<td>Between 4-7</td>
<td>86</td>
<td>57.3</td>
</tr>
<tr>
<td>8 and above</td>
<td>42</td>
<td>28</td>
</tr>
<tr>
<td><strong>Education level respondents</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illiterate</td>
<td>34</td>
<td>22.7</td>
</tr>
<tr>
<td>Primary</td>
<td>71</td>
<td>47.3</td>
</tr>
<tr>
<td>Secondary school</td>
<td>25</td>
<td>16.7</td>
</tr>
<tr>
<td>Vocation</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>University</td>
<td>5</td>
<td>3.3</td>
</tr>
<tr>
<td><strong>Farming experience</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 5 years</td>
<td>23</td>
<td>15.3</td>
</tr>
<tr>
<td>Between 6-10</td>
<td>88</td>
<td>58.7</td>
</tr>
<tr>
<td>11 and Above</td>
<td>39</td>
<td>26</td>
</tr>
</tbody>
</table>
3.3 Level of Farmers’ Awareness on Organic Coffee Production Practices in Nyaruguru District

Result in table 3 shows that farmers had high level of awareness in appropriate seeds and planting material (96.7%), Crops rotation (88.8%), Planting of agroforestry plants (80.6%), green manuring (63.3%), Incorporation of crop residues (60.7%), and organic pest management (55.3%). This implies that coffee farmers were familiar with different agricultural practices. The results of this study was studded by the study of (Kudi et al., 2011) 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 (Komolafe et al., 2014). Jamilu et al. (2014) explained that maize farmers who adopted the technologies benefited a lot from increased awareness, yield, and income. In contrast, the results of the study showed that farmers had high level of not aware inTerraces and soil bunds (86%) followed by mulching and intercropping with (76.5%) and (52%) respectively. Appropriate seeds and planting material is one of the most important factors in production, which can lead to high yields and minimum losses. The results show that 96.7% of the households use aappropriate seeds and planting material. This one provides a greater window of an opportunity for replant decisions, minimizes the first yield-limiting barriers such as weeds and pest and diseases.

Crop rotation was practiced by (88.8 %) of the households. This is because, crop rotations help to reduce pests and diseases in the cropping system as well as controlling weeds by including smothershing crop species or green manure cover crops in the rotation. In addition, crop rotations give other benefits by improving soil quality, better distribution of nutrients in the soil and increases biological activity (Litterick et al., 2002). Agroforestry trees plantation was practiced at (80.6%) because it plays an important role in food security as well as environment conservation especially in dry region of Eastern Province. In addition, agroforestry produces organic matter, which serves as fertilizer and saves the farmer from expenses of buying and transporting fertilizer from off-site.

The most common grown agroforestry tree species were *Alnus accuminata*. Integrating tree growing with crop production on the farm helps in solving the problems of wood shortages, stakes for climbing beans, indeterminate tomatoes and environmental degradation. Waste products or surpluses from agroforestry trees are used as fodder for livestock. In terms of services, agroforestry trees provide service as windbreaks and shade. They control both kind of soil erosion and demarcate land when planted along the farm boundaries. Intercropping in study area was found that farmers aware this activity at (48%). It was found to be commonly a leguminous crop like beans or a green manure crop in alternating rows with maize or another cereal crop or vegetable is a common practice in organic farming to diversify production and maximize benefits from the land. In intercropping, special attention must be paid to avoid competition between the crops for light, nutrients and water.

Mulching was practiced by (23.3%) of the respondents on their farms. Mulching is important practice in crop production since it controls soil erosion, suppresses the growth of weeds and improves soil moisture content during dry seasons. It was practiced at low level compared with other practice because in this region when it is applied it should directly be a source of bad pest particularly mites. For this reason, farmers prefer to not use it if they can use grasses.
Table 3: Distribution of coffee farmers according to the level of awareness of organic coffee production practices

<table>
<thead>
<tr>
<th>Organic production practices</th>
<th>Aware F</th>
<th>%</th>
<th>Not aware F</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appropriate seeds and planting material</td>
<td>145</td>
<td>96.7</td>
<td>5</td>
<td>3.3</td>
</tr>
<tr>
<td>Crops rotation</td>
<td>133</td>
<td>88.8</td>
<td>17</td>
<td>11.3</td>
</tr>
<tr>
<td>Planting of agroforestry plants</td>
<td>121</td>
<td>80.6</td>
<td>29</td>
<td>19.3</td>
</tr>
<tr>
<td>Green manuring</td>
<td>95</td>
<td>63.3</td>
<td>55</td>
<td>36.7</td>
</tr>
<tr>
<td>Incorporation of crop residues</td>
<td>91</td>
<td>60.7</td>
<td>59</td>
<td>39.3</td>
</tr>
<tr>
<td>Organic pest management</td>
<td>83</td>
<td>55.3</td>
<td>67</td>
<td>44.7</td>
</tr>
<tr>
<td>Intercropping</td>
<td>72</td>
<td>48</td>
<td>78</td>
<td>52</td>
</tr>
<tr>
<td>Mulching</td>
<td>35</td>
<td>23.3</td>
<td>115</td>
<td>76.7</td>
</tr>
<tr>
<td>Terraces and soil bunds</td>
<td>21</td>
<td>14</td>
<td>129</td>
<td>86</td>
</tr>
</tbody>
</table>

3.4 Socio-Economic Factors Influencing Adoption of Organic Coffee Production Practices in Nyaruguru District

The result of logit regression analysis in Table 4 indicates that four factors such as education level, land size, farming experience, gender and enhanced soil fertility had positive and significant influence on adoption of organic coffee production practices. As indicated by table 4 the education level, land size, farming experience are statistically significant at 1% level of probability. This was supported by study of (Dipeolu & Akinbode, 2008) indicated that education was also found to have positive effect on efficiency of coffee farmers. Educated farmers will be able to adopt innovations in production, which may be necessary to improve yield. This indicated these three factors have more and significant influence on organic coffee adoption in study area. For example implies 1-year increase in farming experience should influence the adoption of organic coffee production practices by 3.6%. In other hand, this should implies that larger the farm size, the higher the adoption of organic coffee production practices in study area. This was supported also by the study of Bawa and Ani (2014) and Olusegun et al. (2014) 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 production practices was negatively influenced by age, marital status, and distance to market. This implies that 1 km increase to the market should reduce adoption of organic coffee production practices by 1%.

Table 4: Logit regression analysis of the factors influencing adoption of organic coffee production practices

| Variables                  | Coeff. | Std. Error | P>|z| |
|----------------------------|--------|------------|-----|
| Age                        | -0.053 | 0.462      | 0.037 |
| Gender                     | 0.125  | 0.074      | 0.024 |
| Marital status             | -0.414 | 0.142      | 0.078 |
| Education level            | 0.058  | 0.013      | 0.005 |
| Land size                  | 0.084  | 0.029      | 0.009 |
| Farming experience         | 3.568  | 0.532      | 0.000 |
| Enhanced soil fertility    | 0.2421 | 0.0520     | 0.027 |
| Distance to market         | -1.005 | 0.174      | 0.056 |
Number of observations =150, Prob > chi2 = 0.0000, Log likelihood = -53.902
Pseudo R2 = 0.7590

3.5 The Effects of Adoption of Organic Coffee Production Practices on Livelihood of Smallholder Farmers in Study Area.

Organic agriculture is an integrated production management system, which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil biological activity (FAO/WHO Codex Alimentarius Commission, 2007). Organic agriculture follows the principles and logic of a living organism, in which all elements (soil, plant, farm animals, insects, the farmer and local conditions) are closely linked to each other. According with IFOAM (2003), the organic agriculture practices are based on four principles namely principle of health, principle of ecology, principle of fairness, and principle of care.

![Figure 2: The effects of adoption of organic coffee production practices on livelihood of smallholder farmers](image)

The finding of this study in figure (2) indicated that organic farming practices affected their life through social sustainability, economic sustainability, and market opportunities. The findings revealed that adoption of organic coffee production practices increase soil biological activity, enhance crop and biological diversity (100%), followed by maintain long-term soil fertility(94.3%), fair trade(86.6%), ensure food security(80.2%), improving soil structure(78.6%), minimize all forms of pollution(72.7%), recycle wastes of plant and animal(67.3%), enhance soil protection(63.4%), reduce some diseases for human(48.5%), promote organic qualities of produce(44.5%), and medicinal plants conservation(36.8%). It implies that soil biological activity, and biological diversity should be performed through adoption of use of natural pest controls rather than synthetic pesticides, which, since misused, are known to kill beneficial organisms (e.g. natural parasites of pests, bees, earthworms), cause pest resistance, and often pollute water and land.
For the case of recycle wastes of plant and animal, the findings showed that, its effect present (67.3%). Therefore, this should be achieved through recycling the nutrients by using crop residues (straws, stoves and other non-edible parts) both directly as compost and mulch or through livestock as farmyard manure. With this study, farmers of respondents also said organic production practice should sustain and enhance the health of ecosystems and organisms from the smallest in the soil to human beings. However, this should be achieved through avoidance of effective use of fertilizers, pesticides, animal drugs and food additives that may have adverse health effects. The reduction of inputs by reuse, recycle and the efficient management of materials and energy will contribute to improve environmental quality and will conserve resources.

Natural and environmental resources that are used for production and consumption should be managed in a socially and ecologically fair way and should be held in trust for future generations. Where fairness requires systems of production, distribution and trade that are open and equitable and account for real environmental and social costs. It has been found that organic agriculture contributes to the social well-being by reducing the losses of arable soil, water contamination, biodiversity erosion, greenhouse emissions, food losses, and pesticide poisoning. By using local resources, local knowledge, connecting farmers, consumers and their markets, the economic conditions and the development of rural can be improved. Organic farming appears to generate 30% more employment in rural areas and labor achieves higher returns per unit of labor input. By using local resources better, organic agriculture facilitates smallholders’ access to markets and thus income generation.

The findings indicated that the demand for organic products creates new export opportunities. Organic exports are sold at impressive premiums, often at prices higher than the same products produced on non-organic farms. Under the right circumstances, the market returns from organic agriculture can potentially contribute to local food security by increasing family incomes. The findings showed that organic agriculture contributes to the social well-being by reducing the losses of arable soil, water contamination, biodiversity erosion, greenhouse emissions, food losses, and pesticide poisoning. It appears to generate more employment in rural areas and labor achieves higher returns per unit of labor input. The demand for organic products creates new export opportunities since organic exports are sold at impressive premiums, and can potentially contribute to local food security by increasing family incomes.

3.6 Challenges of Adoption of Organic Coffee Production Practices in Study Area

The constraints to adoption of organic coffee production practices are presented in figure 3. This figure indicates that the most common constraints to adoption of organic coffee production practices were lack of stable irrigation system (100%), lack stable and reliable market (98.7%), unreliable (weather) climate (96.1%), high cost of inputs (94.7%), lack of extension services (84.5%), and inadequate capital (83.3%). This finding was supported by the findings of Kudi et al. (2011) indicated that the major constraints to adopt was lack of capital and high cost of inputs. However, Umar et al. (2014) found that unavailability of seed was the major constraint of maize production to maize farmers, followed by inadequate fertilizer.
4.0 CONCLUSION AND RECOMMENDATIONS

The general objective of this study is to analyse the factors influencing farmer’s adoption of organic coffee production practices in Rwanda. A case study of Nyaruguru Districts. In this study, the findings indicated that the majority of the respondents were male as indicted by results in table 2. The result of this study indicated that majority of the coffee farmers are between the ranges of 36-50 years followed by the farmers who are in range between 51-65 years. The majority of the coffee farmers have household size between 4-7 people followed by the household size of 8 and above members. The result revealed that the majority of coffee farmers attended primary school followed by illiterate. The lowest and last class is of university people in the area. It has been also found that the majority of the respondents have been farming coffee for around 6-10 years followed by those of 11 years and above in farming coffee. Result in Table 3 showed that appropriate seeds and planting material is one of the most important factors in production, which can lead to high yields and minimum losses. Crops rotation was practiced at the second place followed by agroforestry trees plantation, and mulching was practiced at low level compared with other practice because in this region when it is applied it should directly be a source of bad pest particularly mites.

The result of logit regression analysis in table 4 indicates that four factors such as education level, land size, farming experience, gender and enhanced soil fertility had positive and significant influence on adoption of organic coffee production practices. The demand for organic products creates new export opportunities. Organic exports are sold at impressive premiums, often at prices higher than the same products produced on non-organic farms. Under the right circumstances, the market returns from organic agriculture can potentially contribute to local food security by increasing family incomes. The findings showed that organic agriculture contributes to the social well-being by reducing the losses of arable soil, water contamination, biodiversity erosion, greenhouse emissions, food losses, and pesticide poisoning. It appears to generate more employment in rural areas and labor achieves higher returns per unit of labor input. The demand for organic products creates new export opportunities since organic exports are sold at impressive premiums, and can potentially
contribute to local food security by increasing family incomes.

The findings showed that the most common constraints to adoption of organic coffee production practices were lack of stable irrigation system, lack stable and reliable market, unreliable (weather) climate, high cost of inputs, lack of extension services, and inadequate capital respectively. Based on these findings, the following recommendations are highly made:

1. Efforts to promote organic coffee production practices among smallholder’s farmers should focus on enhancement of farmer-awareness of the environmental, economic and other benefits of organic farming, as well as trading opportunities of cash crops for developing countries.

2. Regression analysis results further revealed that farm education level, land size, farming experience, gender and enhanced soil fertility had positive and significant influence on adoption of organic coffee production practices. So these variables/factors would likely influence productivity of coffee farming in the study area.

3. Provision of training and technical advice on organic farming practices through agricultural extension services and developing information networks among farmers is vital. To ensure high return for the produce the county Government come up with farm input subsidy programme and also ensures the inputs are supplied to farmers timely as well as to overcome the problem of agricultural production losses.

4. As the inadequate capital, high cost of inputs were found to be one of the challenges of adoption of organic coffee production practices. The government should facilities farmers’ access to agricultural credit facility’s needs, and subsidies. This will help to eliminate liquidity challenges experienced in the purchase organic manure from agro dealers or from other important sources.

5. The findings showed that the most common constraints to adoption of organic coffee production practices were lack of stable irrigation system. Therefore, the Government should made effort in stable and durable irrigation systems especially drip and sprinkler irrigation system in this region where many lacs are found and even the altitude is very low compared to other agro-climatic zone of the country. This will reduce farmers to depend their farming business rain fed agriculture water.

6. Lack stable and reliable market, lack of extension services were found to be also the challenges for adoption of organic coffee production practices. Therefore, government through ministry of agriculture and animal resources and its agencies particularly National Agriculture and Export Development board (NAEB) should make effort the improvement of extension services through field visit and more effort in marketing of cash crops. This will be more important to stabilize and retain farmers in agriculture sector as business.

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Conflict of Interest

Authors declares no conflict of interest.

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