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Effects of a Coffee Washing Station on Coffee Plantation and Farmers' Welfare in Western Rwanda

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Preface

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Abstract

This paper assesses the impact of the Vunga Coffee Washing Station (VCWS) on coffee growers' incomes and their welfare as well as on coffee plantations. Data was collected from 86 coffee growers selected randomly from VCWS members in September 2015. Data was analyzed using both descriptive statistics and a paired-samples T-test. The results from the paired-samples t-test shows that the coffee growers' incomes after the construction of VCWS in 2009 (593.62 US$) was higher than their annual incomes before the station was constructed (249.31 US$), and the number of coffee trees after VCWS was set up (around 588 on average) was also more than earlier (around 286 on average) given the significance value which is less than α (α=0.05). Further, VCWS also contributed to job creation (57 percent), acquisition of new farming technology (46.5 percent) and the creation of non-farm activities (31.4 percent). These results are good indicators of VCWS's positive impact on coffee growers' incomes, the coffee plantation and the welfare of coffee growers. Therefore, it is recommended that the government should enhance fair trade between coffee producers and foreign consumers to help coffee growers sustain their livelihoods. In collaboration with the government and development partners, VCWS should organize training for its members specifically training in how to save and adopting new technologies for coffee farming.

Keywords: Impacts; coffee washing station; farmers' welfare; paired-samples; t-test; Rwanda;

JEL Classification Codes: D60; O 13; O 18; Q 13; R20

1. Introduction

In most developing countries coffee production provides an important income generation option for resource poor households and is thus essential for the socioeconomic development of these countries (ICARD, 2002). Agriculture remains the mainstay of the Rwandan economy and coffee is the main source of income for household producers of this crop in Rwanda (Gisaro Ca-Madeberi, 2013; Kamola, 2007) as it has been a major export item for decades (Bourdeaux, 2013; OCIR Café, 2009; MINAGRI and Ministry of Trade and Industry, 2008; Schluter and Finney, 2001). The beginning of coffee farming in Rwanda can be traced back to 1904 and its export to 1917 (Chemonics International, 2006). Coffee production was estimated at 16,000 and 20,000 tons in 2009 and 2010 respectively and its value accounted for 36 percent of Rwanda's total export earnings in 2009 (Boudreaux, 2013). This tonnage is relatively low when compared to the main coffee producers in Africa such as Ivory Coast and Uganda which produce an annual average of 3.5 and 2.7 million tons respectively (Mutandwa et al., 2009).

According to a MINECOFIN report (2003), a number of constraints are cited as militating against the attainment of higher productivity in Rwandan coffee production. These include high production costs, pests and diseases, production and market risks, low international prices and small landholdings. Other factors affecting coffee quality in East and West African countries include poor agronomic practices, lack of access to agricultural credit, inadequate research and development linkages, poor processing methods, high costs of farm inputs, low international prices, high transportation costs, pests and diseases and inadequate infrastructure in rural areas (FAO, 2004). Coffee revenue in rural areas is about 14.8 billion Rwanda francs, which is equivalent to 19,944,478.88 US$ (US$ 1 = 742.06 FRW).

Coffee cropping is primarily done by small farmers. These are poor growers who dig their fragmentary land plots. Other actors in the coffee sector are small businessmen, shucking and exporting companies, government organizations and rural and farmers' organizations.

In 1964, the Ministry of Agriculture and Animal Resources (MINAGRI) created OCIR-Café (*Office des Cultures Industrielles au Rwanda pour le Café* or the Rwanda Coffee Development Authority) with the mission of connecting coffee producers in Rwanda to trading companies or consumers. From 1964 till 1988, there were only two companies whose main business was coffee exports -- RWANDEX and ETIRU (Bourdeaux, 2013). In the early 1980s, coffee exports were handled by two companies -- RWANDEX and ETIRU -- and the government had a high capital share in these companies. From 1988 till 1991, OCIR Café was authorized to commercialize coffee (Mutandwa et al., 2009).

In 1991 it was decided to liberalize the coffee sector but this happened only after 1994 through the provision of exporting licences to various exporters and the creation of coffee processing companies like RWANDEX, the Rwanda Coffee Processor and Exporter (RWACOF), COFFEX (an Australian coffee processing and trading company) and CAFERWA (coffee processing and exporting company in Rwanda) (Bourdeaux, 2013). Before the liberalization of the coffee sector, farmers sold coffee beans to merchants, who resold them to RWANDEX which sold them to foreign buyers. However, now the coffee value chain has improved and RWANDEX's monopoly has been broken (Mugabekazi, 2014).

After the liberalization of coffee processing and marketing, coffee farmers' cooperatives and individual producers and traders entered the market which increased competition in

the local market for raw coffee. This resulted in high prices and helped many farmers gain high incomes (Bourdeaux, 2013). The other advantages of liberalization include job creation, training opportunities to acquire modern farming techniques, strengthening human and social capital and the provision of useful additional benefits to farmers. For increasing the quantity and improving the quality of coffee, the Government of Rwanda has stimulated coffee producers to group into cooperatives to gain market power and thus gain benefits from their businesses.

The goal of cooperatives is multidimensional. The members benefit from services such as access to inputs, input use, monitoring of their utilization and improvements in quality thanks to processing of coffee beans at washing stations. The ultimate objective is to raise coffee growers' involvement and contribution to transformational changes in farmers' living conditions. Their increased participation leads to higher quality and quantity and helps farmers earn higher incomes for their produce (Mugabekazi, 2014). Figure 1 shows the coffee produced in Rwanda during 1980-2010.

Cooperatives in the Rwandan coffee industry have not yet been able to attract many members. The agricultural cooperatives in general and coffee cooperatives in particular have performed poorly because their financial capital base, which correlates highly with membership, is low (RCA, 2006). The initial investments do not allow coffee cooperatives to get expected results. In any case, a sub-optimal use of the cooperatives' washing stations due to lack of sufficient supply of coffee cherries needed as raw material for processing may also be contributing to their financial problems. Because coffee in Rwanda is grown by poor smallholders who make up a vast majority of the population (around 90 percent), the Government of Rwanda in collaboration with different stakeholders including coffee growers' cooperatives has reshaped the coffee industry by modifying the regulatory framework and developing market linkages between producers and foreign buyers and creating coffee washing stations (CWS) (Bourdeaux, 2013) since 2005 (SNV, 2012).

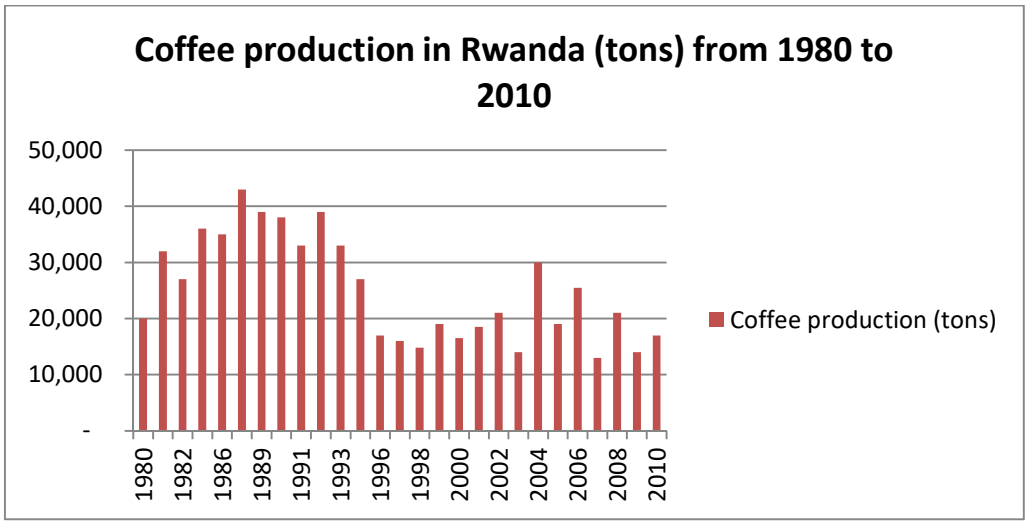

Figure 1. Coffee production in Rwanda (1980-2010)
Source: NAEB (2011).

Coffee washing stations are expected to help smallholder farmers work together to improve the quality, marketing and branding of their coffee (Boudreaux, 2013; Schilling and McConnell, 2003).

Research throughout the world shows the positive impact of coffee farming on farmers' livelihoods. Aoki (2012) assessed coffee as a livelihood support in Nepal. Using a value chain approach, he reported that small-scale farmers in Hamsapur village were very interested in the coffee industry. However, low quality, market imperfections at the local level and organizational bottlenecks were the main factors leading to low incomes. In India, cooperatives are like modern one-stop centers for shopping where a farmer can access credit and farm inputs, get technical guidance and storage and marketing facilities. Viewed thus, they are potential institutions for transforming smallholder agriculture into a viable business enterprise enabling small players to enter a big world and acting as vehicles for effective financial inclusion (Patra and Agasty, 2013).

In Africa, Wanyama et al. (2008) show that cooperatives have contributed significantly to the mobilization and distribution of financial capital, created employment and income-generating opportunities, constituted a forum for education and training and set up solidarity schemes to cater to unexpected expenses related to illnesses, social welfare, death and other socioeconomic problems. A study by Hussain (2014) in Nigeria identified the need to educate cooperatives' members to enhance their capacity for achieving optimum results and sustainability. He suggests that the government should devise a strategy for supervising the activities of cooperative organizations for quality assurance and control and for supporting them in terms of providing an enabling policy environment and giving them assistance for enhancing their activities.

In Tanzania, Sizya (2001) analyzed the role played by cooperatives in poverty reduction. He recognized the potential of cooperatives contributing to poverty reduction but concluded that the weakening of cooperatives had contributed to the deepening of poverty in the country. Sumelius et al. (2013) did a study on cooperatives as a tool of poverty reduction and promoting business in Tanzania. They underline that coffee growers' cooperatives have helped their members improve their living conditions because all business activities are in the hands of the members. Another critical condition is that the secondary structure is light with only a few employees facilitating entry or exit, dealing with knowledge management, disseminating information and undertaking business negotiations with buyers.

In Ethiopia, Mohammed and Lee (2014) assessed the role of cooperatives in rural development with special reference to the South Nations Nationalities and the People Region. Their study shows that the Government of Ethiopia is promoting cooperatives as organizations that could enhance the development of small farmers and other communities. They are expected to serve farmers by providing agricultural inputs, marketing services for their produce, mobilizing savings and providing credit services to their members. This study points out that cooperatives in Ethiopia have not done as well as was expected due to weak leadership and supervision, weak and irregular technical assistance, lack of knowledge about management and skills, weak documentation and information and weak horizontal and vertical relations and coordination.

In Rwanda Gisaro Ca-Madeberi et al. (2012) analyzed the contribution of coffee cooperatives in women's empowerment in rural areas, more specifically in the Karaba coffee zone, Huye district, southern Rwanda. Their results show that cooperatives

contributed to poverty reduction in the district, especially among coffee growing families. Cooperatives provide credit to members through rotating funds locally known as *ibimina*. They also provide vocational training to their members for empowering women like providing adequate shelter, observing human rights, providing access to medical insurance, paying school fees for children, undertaking entrepreneurial activities, achieving unity and reconciliation between members and enhancing household incomes.

Gisaro Ca-Madeberi et al. (2012) also analyzed the contribution of the AKM (*Abakunda-Kawa ba Maraba)* cooperative on the socioeconomic development of coffee growers in Huye district. They found that the cooperative had helped in bringing electricity and safe water to the rural area. It had improved the standard of living of the rural population in Maraba sector by building new houses and renovating the old ones for small farmers.

Further, Gisaro Ca-Madeberi (2013) assessed the socioeconomic impact of KOPAKAMA (Cooperative of Coffee Growers in Mabanza) in Rutsiro district, western Rwanda. Their research findings showed that coffee washing stations were the main reason for the high quality of coffee and they also served as structural elements in the rural areas. The author points out that these structures helped create jobs for coffee producers, granting loans, motivating farmers because of an increase in incomes, guaranteeing a market for the produce and making the prices attractive for members thus improving the socioeconomic conditions of the producers. This in turn helped reduce poverty among coffee grower households.

Even though there are studies on the impact of CWS' their impact on socioeconomic development in all areas of Rwanda is not well documented. Hence, this study examines the benefits of CWS' to the development of rural areas in Rwanda with special reference to VUNGA. The study aims specifically to analyze the effects of the Vunga Coffee Washing Station on: (1) coffee plantations, (2) coffee growers' incomes, and (3) social conditions of coffee grower households in its operational zone.

The rest of the paper is structured as follows. The next section focuses on the materials and methods used for the study. This is followed by the results and a discussion of the major findings. The last section gives the conclusion and recommendations.

2. Materials and Methods

The study area and data

Rwanda is a small country in central Africa with a size of 26,338 square kilometers. It is located between 1°04' and 2°51' below the Equator and at longitudes 28°45' and 31°15' to the right of the Greenwich Line. It is bordered by the Democratic Republic of Congo, Uganda, Tanzania and Burundi in the west, north, east and south respectively. It is divided into five provinces, 30 districts, 416 sectors, 2,148 cells and 14,837 villages.

Located in the western province of Rwanda and in the west part of the country, Nyabihu district has 12 sectors (Bigogwe, Jenda, Jomba, Kabatwa, Karago, Kintobo, Mukamira, Mulinga, Rambura, Rugera, Rurembo and Shyira). These areas are further divided into 73 cells and 473 villages. Taking into account its administrative limits, in the north there is Musanze district and the Virunga National Park, which separates it from the Democratic Republic of Congo (DRC). In the south, there are Ngororero and Rutsiro

districts and in the east there are Gakenke and Musanze districts. Finally, in the west there is Rubavu district.

Ninety percent of Rwanda is characterized by rugged mountains with slopes of more than 55 percent leading to high risks of erosion. Hence, there is a need for establishing effective mechanisms for controlling and preventing erosion and other harm associated with climate change. The soil is sandy and clay, laterite and volcanic in nature and is very fertile. Precipitation is almost uniform throughout the year and is close to 1,400 mm per year. It has a temperate climate with an average temperature of 15^0 C which favorable for growing agro-pastoral products throughout the year with less risks of bacteria and diseases.

The economy of Nyabihu district is heavily dependent on subsistence agriculture; a majority of the households are smallholders. Approximately 74 percent, or 105,672 of the 143,000 population in the district, gets its income by exploiting the soil. However, there is scarcity of land because according to EICV3, 50 percent of the population has an area less than 0.3ha. Agricultural food and industrial and ornamental products are grown extensively. The food crops grown here are Irish potatoes, corn, beans, wheat, bananas and vegetables. Cash crops include tea, coffee, pyrethrum and patchouli that contribute to economic development and improving household welfare (Nyabihu District, 2013)

The Vunga Coffee Washing Station (VCWS) is a coffee growers' cooperative operating in the Shyira sector in Nyabihu district in the north-west of Rwanda. Figure 2 gives VCWS's operational area. In this area, coffee is grown on uneven land plots, especially on the hillsides and in the valleys, with normal water sources in the volcanic soils of the Albertine Rift Valley. Around 35 percent of the entire coffee production comes from plots owned by the cooperative; the rest is produced by individual farmers who grow coffee as a complement to maize, beans and bananas. The average number of coffee trees on each farm ranges from 100 to 200. Sun-drying was the primary technique used by the farmers when they prepared coffee themselves for the market, but this poor technique meant that they sold coffee at very low profits. That is why Technoserve subsidized the establishment of VCWS in 2009 so that the area could get a quality structure to process wet cherries and enable the producers to earn higher profits (Square Mile Coffee Roasters, n.d.).

For my study I collected data from 86 coffee growers selected randomly from 220 members of the Vunga Coffee Washing Station using a structured questionnaire. The questionnaire was mainly used for getting socioeconomic details of the coffee growers, the status of coffee trees, the level of coffee growers' incomes and their living conditions before 2009 and after 2009 when the Vunga Coffee Washing Station was set up.

Methods of data analysis

Descriptive statistics (frequencies, percentages, mean, maximum, minimum, sum, variance, etc.) were used to describe the living conditions of coffee growers' households (Francis, 1998, 2004; Rukwaru, 2007). In a description of living conditions, the high frequency of a status indicator implies high quality living conditions. In socioeconomic characteristics of the respondents, high frequency and percentages of characteristics were used among the members of Vunga Coffee Washing Station. Descriptive statistics (mean,

maximum, minimum, variance, standard deviation) help arrive at the variables under analysis in terms of comparison.

Besides descriptive statistics, I also used inferential statistics to test whether a statistically significant difference existed between two mean scores of the same group at two different points in time. I did a paired-samples t-test to determine if there was a difference between mean scores and whether that difference was statistically significant or different from zero (Hurst, 1995; Jackson, 2009; Singh, 2006). The paired-samples t-statistic is given by:

$$(1)\quad t = \frac{\sum d}{\sqrt{\frac{n\left(\sum d^2\right) - \left(\sum d\right)^2}{n-1}}} = \frac{\bar{d}}{\sqrt{S^2/n}}$$

where $\bar{d}$ is the mean difference between the two samples, S^2 stands for the sample variance, n is the sample size, n-1 is the degree of freedom and t is the paired-samples t-test.

This technique was used for comparing mean scores of coffee growers' incomes and mean scores of coffee trees considering two points in time, that is, before and after the Vunga Coffee Washing Station was set up in 2009. On one side, the mean score of coffee growers' incomes before VCWS was set up in 2009 was compared to the mean score of coffee growers' incomes after it was set up. On the other side, the mean score of coffee trees before VCWS came up was compared to the mean score of coffee trees after it was set up. The test aimed at determining whether there was a significant change in coffee growers' incomes and in the number of coffee trees as a result of VCWS being set up. I also tested whether the difference between the mean score before and after 2009 was statistically different from zero. The significance level that I used to determine whether the results were statistically significant is $p \leq 0.05$. If the significance level was less than 0.05, the difference was statistically significant; whereas, if the significance level was greater than .05, the difference was not statistically significant.

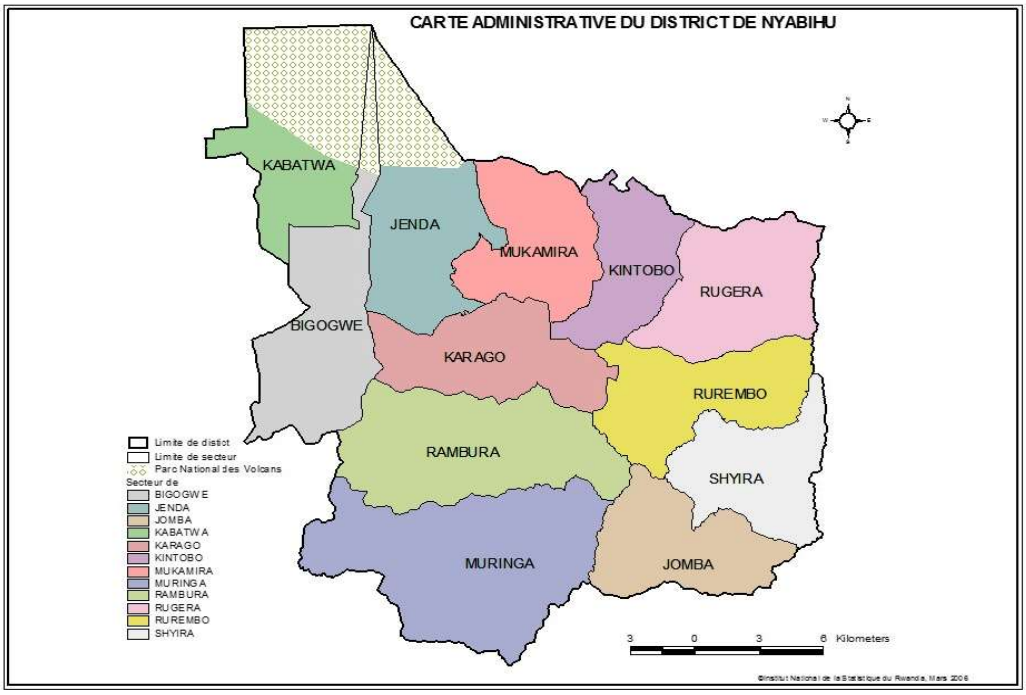

Figure 2. Map of Nyabihu district showing the study area (Shyira, Jomba, Rugera and Rurembo sectors)
Source: Nyabihu District (2013). Available at: www.nyabihu.gov.rw. Accessed on 16 November 2015.

3. Results

Distribution of the respondents

The respondents were distributed by gender, age, marital status and education levels. Table 1 shows that a majority of the respondents were male (66.3 percent); there were 33.7 percent women making them a minority.

Table 1: Distribution of respondents by sex

Sex	Frequency	Percent	Cumulative Percent
Male	57	66.3	66.3
Female	29	33.7	100.0
Total	86	100.0	-

Source: Field survey (August 2015).

The information in Table 2 indicates that a majority of coffee farmers served by the Vunga Coffee Station were aged between 46 and 60 years (34.9 percent) and between 31 and 45 years (27.9 percent); 17.4 percent were over 61 years. It also shows that only 19.8 percent were under 30 years of age. This implies that coffee growers were experienced enough and good at coffee farming practices. However, they were not strong enough for other agricultural activities.

Table 3 shows that 52.3 percent of the respondents were married, 24.4 percent were single, 20.9 percent were widowed and 2.3 percent were divorced. Table 4 shows that 36.0 percent of the respondents had completed primary education, 26.7 percent had no formal education and only 14.0 percent had completed secondary education; 9.3 percent had done professional courses and 14.0 percent had attended university. The table also shows that a majority of VCWS members were less educated as a majority (that is 62.8 percent of the respondents) had only primary education or less.

Table 2: Distribution of respondents by age

Age	Frequency	Percent	Cumulative Percent
Below 18	3	3.5	3.5
18-30	14	16.3	19.8
31-45	24	27.9	47.7
46-60	30	34.9	82.6
Above 60	15	17.4	100.0
Total	86	100.0	100.0

Source: Field survey (August 2015).

Table 3: Distribution of respondents according to marital status

Status	Frequency	Percent	Cumulative Percent
Married	45	52.3	52.3
Single	21	24.4	76.7
Widow	18	20.9	97.7
Divorcee	2	2.3	100.0
Total	86	100.0	100.0

Source: Field survey (August 2015).

Table 4: Distribution of respondents according to their education levels

Level of education	Frequency	Percent	Cumulative Percent
Below primary	23	26.7	26.7
Primary	31	36.0	62.8
Secondary	12	14.0	76.7
Professional	8	9.3	86.0
University	12	14.0	100.0
Total	86	100.0	100.0

Source: Field survey (August 2015).

An Assessment of the impact of VCWS on coffee growers' incomes

Table 5 shows that the coffee growers' mean income before the construction of VCWS in 2009 was FRW 188,500 or 249.31 US$ (US$ 1 = 742.06 FRW) and the mean income of coffee growers after VCWS was set up was FRW 440,500 or 593.62 US$.

Table 5: Descriptive statistics of coffee farmers' incomes (analysis done by the researcher in September 2015)

Income of coffee farmers	N Statistic	Range Statistic	Minimum Statistic	Maximum Statistic	Mean Statistic	Std. deviat Statistic	Variance Statistic
Before creation of Vunga CWS in 2009	86	169110	70890	240000	1.885E5	46601.84	2.1729
After creation of Vunga CWS	86	645900	123000	768900	4.405E5	113381.1	1.28610

Table 6: Paired-samples t-test of coffee growers' annual incomes before and after VCWS (analysis done by the researcher in September 2015)

Parameter	Mean	Std. Deviation	95% Confidence Interval of the Difference		T-test	Df	Sig. (2-tailed)
			Lower	Upper			
Income of coffee growers after VCWS construction in 2009 - Income of coffee growers before VCWS	2.472	87518.040	228416.675	265944.488	26.192	85	0.0000

Table 6 shows that the significance value was 0.0000. As this value is less than α (α=0.05), it implies that the difference between coffee growers' incomes before and after VCWS was statistically different from zero. This means that the coffee growers' annual income after the construction of VCWS in 2009 (FRW 440,500 or 593.62 US$) was more than their income before 2009 (FRW 188,500 or 249.31 US$). In other words, VCWS had a positive impact on coffee growers' incomes.

Assessment of VCWS on coffee plantation

As described in Table 7, the average number of coffee trees after the setting up of VCWS was around 588; this average was around 286 earlier. The descriptive statistics also shows that the number of coffee trees increased after VCWS.

Table 7: Paired-sample statistics of number of trees before and after VCWS

Number of coffee trees	Mean	N	Std. Deviation
After creation of Vunga CWS	587.87	86	387.262
Before creation of Vunga CWS	285.59	86	174.398

Source: Data analysis by the researcher based on field survey data (September 2015).

Table 8 shows that that the significance value is 0.0000. As this value is less than α (α=0.05), it implies that the difference between coffee trees before and after VCWS is statistically different from zero. This also means that the number of coffee trees after VCWS (around 588 coffee trees on average) was more than the number of coffee trees before VCWS (around 286 coffee trees on average). In other words, VCWS had a positive impact on the coffee plantation.

Table 8: Paired-samples T-test of the number of coffee trees before and after VCWS

Parameter	Mean	Std. Deviation	95% Confidence Interval of the Difference		T-test	Df	Sig. (2-tailed)
			Lower	Upper			
Number of tree after - Number of trees before VCWS	302.279	225.635	253.903	350.655	12.424	85	0.0000

Source: Data analysis by the researcher based on field survey data (September 2015).

Assessment of VCWS on the welfare of coffee growers' households

Table 9 reports VCWS's different socioeconomic effects. The coffee growers interviewed reported that VCWS had helped them initiate new farm income generating activities and

thus contributed to job creation (57 percent), acquiring new technologies for coffee farming (46.5 percent), creating non-farm income generating activities (31.4 percent), paying school fees for children (19.8 percent) and providing assistance to vulnerable persons (16.3 percent). Through increased incomes, coffee growers could also pay for health insurance of their household members in due time (10.5 percent) and coffee growing households also had increased access to food stuff (12.8 percent). VCWS had led coffee growers to acquire decent shelter (12.8 percent) and good clothing (12.8 percent). These results are good indicators of VCWS's contribution to welfare improvements of coffee growers' household members.

Table 9: Coffee growers' views on VCWS's socioeconomic benefits

Parameter	Frequency	Percent
Increase in food availability and accessibility	11	12.8
Acquisition of good shelter	11	12.8
Acquisition of good clothing	11	12.8
Creation of employment	49	57.0
Payment of health insurance	9	10.5
Payment of school fees for children	17	19.8
Acquisition of new technology for coffee farming	40	46.5
Assistance to vulnerable persons	14	16.3
Creation of off-farm income generating activities	27	31.4

Source: Data analysis by the researcher based on field survey data (September 2015).

4. Discussion

Research findings from the paired-samples t-test indicate that the Vunga CWS positively impacted coffee growers' incomes which were FRW 188,500 or 249.31 US$ before its construction in 2009 as compared to FRW 440,500 or 593.62 US$ after 2009. This implies that coffee growers' incomes have increased significantly since the construction of Vunga CWS. These increasing incomes serve as an incentive to coffee growers to grow more coffee trees. These results are supported Wanyama et al., (2008) who demonstrated that cooperatives significantly contributed to the creation of income-generating opportunities in Africa, as well as the findings of Gisaro Ca-Madeberi (2013) who reported that increased incomes due to cooperatives in Rutsiro district in western Rwanda had motivated farmers. They also support Gisaro Ca-Madeberi et al., (2012) whose findings show that cooperatives contributed to poverty reduction in the country, especially among families of coffee growers in the Karaba coffee zone, Huye district in southern Rwanda. But they are in contrast to Aoki's (2012) findings in Hamsapur village in Nepal where the cooperatives failed to secure incomes for small scale farmers.

Regarding improvements in farmers' livelihoods, my study found that the Vunga CWS's members lived under good socioeconomic conditions. This was endorsed by the respondents

who reported that VCWS had contributed to job creation (57 percent), acquisition of new technology for coffee farming (46.5 percent), creating non-farm income generating activities (31.4 percent), paying school fees for children (19.8 percent), giving assistance to vulnerable persons (16.3 percent), helped in paying health insurance (10.5 percent), led to an increase in food availability and accessibility (12.8 percent) and acquisition of good shelters (12.8 percent) and good clothing (12.8 percent). These results are good indicators of VCWS's contribution to improvements in the welfare of coffee growers' household members. These results support Sumelius et al.'s (2013) findings on cooperatives as a tool of poverty reduction and promoting business in Tanzania. These authors also underlined that coffee growers' cooperatives had helped their members improve their living conditions thanks to the fact that all business activities were in the hands of the members. In contrast, these results oppose studies which conclude that cooperatives had no significant effects on farmers' socioeconomic conditions (Mohammed and Lee, 2014; Patra and Agasty, 2013; Sizya, 2001).

5. Conclusion and Policy Implications

The purpose of this research was to assess the impact of Vunga Coffee Washing Station on coffee growers' incomes, on coffee plantations and on the welfare of coffee growers' household members. Data was collected through a field survey conducted among 86 coffee growers randomly selected from the Vunga Coffee Washing Station's members. A structured questionnaire was used to find the socioeconomic characteristics of coffee growers, the status of coffee trees, the level of coffee growers' incomes and living conditions of coffee growers' households before and after the setting up of the Vunga Coffee Washing Station in 2009.

I used both descriptive statistics (mean, maximum, minimum, variance, standard deviation) and inferential statistics (paired-samples t-tests) to analyze the data. I used inferential statistics to test whether there was a statistically significant difference between two mean scores in the same group at two different points in time. Hence, I used a paired-samples t-test to determine if there was a difference between mean scores and whether or not that difference was statistically significant or different from zero. I found that a majority of the respondents were male (66.3 percent); there were 33.7 percent female respondents. The results also show that 52.3 percent of the respondents were married, 24.4 percent were single, 20.9 percent were widowed and 2.3 percent were divorced. The data also shows that coffee growers were experienced enough and good at coffee farming practices given that a majority (34.9 percent) were aged between 46 and 60 years, 27.9 percent were between 31 and 45 years and 17.4 percent were above 61 years.

The results from the paired-samples t-test shows that the significance value (p value) was equal to 0.0000. As this value is less than α ($\alpha = 0.05$), it implies that the difference between coffee growers' annual income before and after VCWS was set up was statistically different from zero. This further means that the coffee growers' incomes after VCWS was set up (FRW 440,500 or 593.62 US$) was more than their incomes before 2009 (FRW 188,500 or 249.31 US$). In other words, VCWS had a positive impact on coffee growers' incomes. The results also indicate that the number of coffee trees after VCWS (around 588

coffee trees on average) was more than the number of coffee trees before VCWS (around 286 coffee trees on average). Further, the respondents said that VCWS had contributed to job creation (57 percent), acquisition of new technology for coffee farming (46.5 percent), creation of non-farm income generating activities (31.4 percent), payment of school fees for children (19.8 percent), assistance to vulnerable persons (16.3 percent), payment of health insurance (10.5 percent), increase in food availability and accessibility (12.8 percent), acquisition of a good shelter (12.8 percent) and acquisition of good clothing (12.8 percent). These results are good indicators of VCWS's contribution to the improvement of the welfare of coffee growers' household members.

In keeping with these results, I would like to recommend that the coffee growers should know and respond to consumers' preferences and the government should enhance contact between coffee producers and consumers (that is, promoting fair trade). The Vunga Coffee Washing Station in collaboration with the government and development partners should organize training for its members, specifically training in savings and in constituting and adopting new technologies for coffee farming.

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