

EFFECTS OF FARM COOPERATIVES ON FARMERS' INCOMES AND WELFARE: EMPIRICAL ANALYSIS FROM VUNGA COFFEE WASHING STATION IN NYABIHU DISTRICT, WESTERN RWANDA

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ABSTRACT

This paper assesses the impacts of Vunga Coffee Washing Station (VCWS) on coffee growers' incomes and their welfare as well as on coffee plantations. Data were collected from 86 coffee growers selected randomly from VCWS members in September 2015. Data were analyzed using both descriptive statistics and paired-samples T-test. The results from the paired-samples t-test show that the coffee growers' incomes after the construction of VCWS in 2009 were higher than their annual incomes before the station was constructed, and the number of coffee trees after VCWS was set up was also more than earlier given the significance value which is less than 0.05. Further, VCWS also contributed to job creation, acquisition of new farming technology and the creation of non-farm activities. These results are good indicators of VCWS's positive impact on coffee growers' incomes, the coffee plantation and to the welfare of coffee growers. Therefore, it is recommended that (1) the government should enhance the fair trade between coffee producers and foreign consumers to help coffee growers sustain their livelihoods, and (2) VCWS should organize trainings for its members specifically trainings in how to save and adoption of new technologies for coffee farming.

Keywords: Impact; coffee washing station; farmers' welfare; t-test; Rwanda.

RESUME

IMPACT DES COOPERATIVES AGRICOLES SUR LES REVENUS ET LE BIEN-ETRE DES AGRICULTEURS: ANALYSE EMPIRIQUE DE LA STATION DE LAVAGE DE CAFE DE VUNGA DANS LE DISTRICT DE NYABIHU, OUEST DU RWANDA

Cet article évalue les impacts de la station de lavage du café de Vunga (VCWS) sur les revenus et le bien-être des caféiculteurs, ainsi que sur les plantations du café. Les données ont été collectées auprès de 86 caféiculteurs aléatoirement sélectionnés en septembre 2015 parmi les membres de VCWS. Les données ont été analysées en utilisant à la fois des statistiques descriptives et un test de Student. Les résultats montrent que les revenus des caféiculteurs après la construction de VCWS en 2009 étaient supérieurs à leurs revenus annuels avant la construction de la station, et le nombre de cafés après la mise en place du VCWS était également plus élevé qu'avant au niveau de signification de 0,05. La VCWS a également contribué à la création d'emplois, à l'acquisition de nouvelles technologies agricoles et à la création d'activités non agricoles. Par conséquent, il est recommandé que (1) le gouvernement renforcerait le commerce équitable entre les caféiculteurs et les consommateurs étrangers, et que (2) le VCWS devrait organiser des formations pour ses membres sur la sauvegarde et l'adoption de nouvelles technologies pour la culture du café.

Mots clés : impacts; station de lavage de café; bien-être des agriculteurs; test de Student; Rwanda.

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, 2010). This tonnage is relatively low when compared with 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 (Rwanda Exports Company) and ETIRU (Processing Factory of Ruhengeri, Rwanda) (see 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).

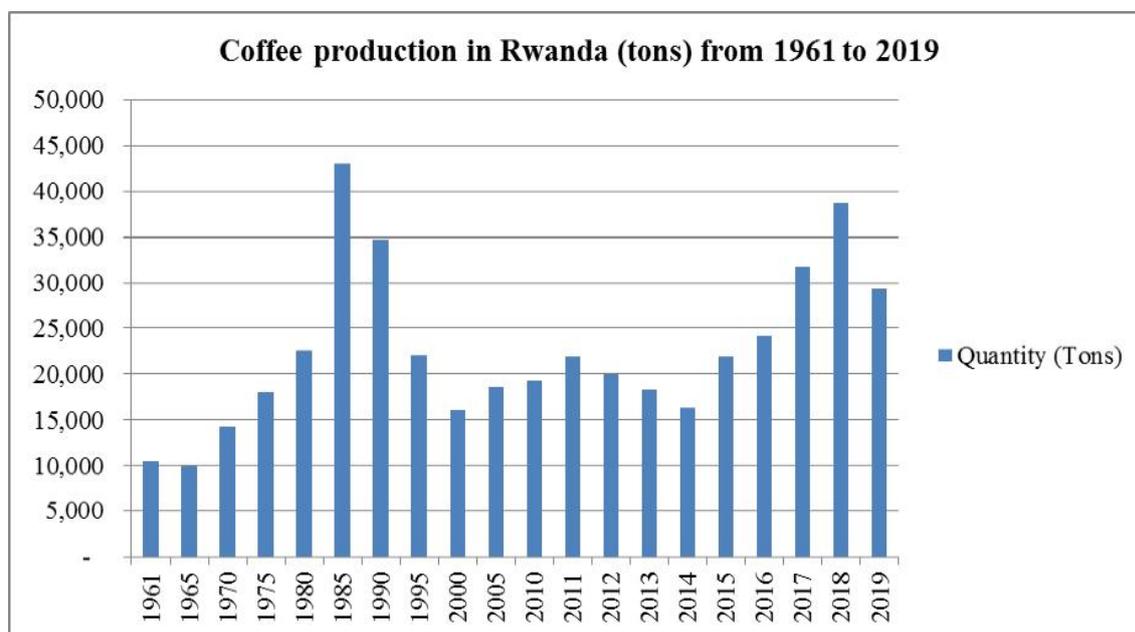
In 1991 it was decided to liberalize the coffee sector but this happened only after 1994 through the provision of exporting licences to various exporters and the creation of coffee processing companies like RWANDEX, the Rwanda Coffee Processor and Exporter (RWACOF), COFFEX (an Australian coffee processing 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 1980-2019.



Source : FAOSTAT (Rwanda Crop production).

Figure 1 : Coffee production in Rwanda in tons from 1980 to 2019.

Evolution de la production du café au Rwanda en tonnes de 1980 à 2019.

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) (Bourdreaux, 2013) since 2005 (SNV, 2012).

The reforms of Rwanda's coffee sector resulted in encouraging small-scale coffee producers to

shift from the production ordinary semi-washing coffee bean towards specialty (or fully-washed) coffee. Subsequently, coffee producers were helped to form cooperatives, and build and manage their own washing stations to process coffee cherry (NAEB, 2016; Ortega *et al.*, 2019). Besides, it is important to note that coffee processing sector in Rwanda is composed of both private companies and cooperative-owned CWSs (Ortega *et al.*, 2019) with the aim to improve small-scale coffee producer's income and living conditions mostly «by providing technical assistance and inputs for production, processing fully-washed coffee, increasing farmers' bargaining power and market entry opportunities» (Bizoza 2011). Coffee washing stations are also expected to help smallholder farmers work together to improve the quality, marketing and branding of their coffee (Schilling and McConnell, 2003; Boudreaux, 2013). For the case of our study, the coffee washing station is owned and managed by coffee producers' cooperative known as «Vunga Coffee Washing Station».

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 (Elder *et al.*, 2012; Gisaro Ca-Madeberi, 2013; Ortega *et al.*, 2019), their impact on socioeconomic development in all areas of Rwanda is not well documented. Hence, this study examines the benefits of a farm cooperative to the development of rural areas in Rwanda with special reference to Vunga Coffee Washing Station. 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. In intent to achieve these objectives, primary data were collected from 86 coffee producers randomly selected in the study area. We used descriptive statistics and t test for data analysis.

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.

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 150 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 this study, data were collected 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, inferential statistics were also used to test whether a statistically significant difference existed between two mean scores of the same group at two different points in time. Following van Elst (2019), the significant differences in the mean scores of farmers' incomes were investigated, and the number of coffee trees in two situations, that is the situation before and the situation after

the VCWS was set up in 2009 within one and the same random sample. Therefore, a paired-samples t-test was conducted to determine if there was a difference between mean scores of the variables of interest with reference to the two situations, and examine whether that difference was statistically significant or different from zero (Hurst, 1995; Jackson, 2009; Singh, 2006). The paired sample statistic t is given by the formula 1.

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

where \bar{d} is the mean difference between 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 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 0.05, the difference was not statistically significant.



Source : Nyabihu District (2013); www.nyabihu.gov.rw accessed on November 16, 2015 at 9:47 am.

Figure 2 : Map of Nyabihu District showing the study area: Jomba, Shyira, Rurembo and Rugera Sectors.

Localisation géographique de la zone d'étude sur la carte du District de Nyabihu : secteurs de Jomba, Shyira, Rurembo et Rugera.

RESULTS

DISTRIBUTION OF THE RESPONDENTS

The respondents were distributed by gender, age,

Table 1: Distribution of respondent by sex.

Répartition des répondants par sexe.

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.

The results in table 3 show that 52.3 percent of the respondents were married, 24.4 percent were

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.

single, 20.9 percent were widowed and 2.3 percent were divorced. The results in table 4 show 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.*Répartition des répondants par âge.*

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.*Distribution des répondants par état civil.*

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 level of education.*Distribution des répondants par niveau d'éducation.*

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).

ASSESSMENT OF THE IMPACT OF VUNGA COFFEE WASHING STATION 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 6 shows that the

significance value was 0.00. As this value is less than α ($\alpha=0.05$), 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.

Table 5 : Descriptive Statistics of coffee farmers' income.*Statistiques descriptives du revenu des caféiculteurs.*

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	169.110	70.890	240.000	1.885E5	46601.84	2.1729
After creation of Vunga CWS	86	645.900	123.000	768.900	4.405E5	113381.1	1.28610

Table 6 : Paired Samples T-test on coffee growers' annual income before and after VCWS.*Test de comparaison des revenus annuels des caféiculteurs avant et après l'établissement de la Station de lavage de café de Vunga.*

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 E5	87.518.04	228.416.68	265.944.49	26.192	85	0.00

ASSESSMENT OF THE EFFECT OF VUNGA COFFEE WASHING STATION ON COFFEE PLANTATION

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.

As described in Table 7, the average number of

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

Les statistiques des échantillons appariés sur le nombre de caféiers avant et après l'établissement de la Station de lavage de café de Vunga.

Number of coffee trees	Mean	N	Std. Deviation
After creation of Vunga CWS	587.87	86	387.26
Before creation of Vunga CWS	285.59	86	174.39

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

Table 8 shows that that the significance value is 0.0000. As this value is less than α ($\alpha = 0.05$), 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 on number of coffee trees before and after VCWS.

Test de comparaison des nombres de caféiers avant et après l'établissement de la Station de lavage de café de Vunga.

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	302.28	225.64	253.90	350.66	12.42	85	0.00

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

ASSESSMENT OF VUNGA COFFEE WASHING STATION 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 socioeconomic benefits from Vunga Coffee Washing station.

Appréciations des caféiculteurs sur les bénéfices socioéconomiques apportés par la station de lavage de café de Vunga.

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

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

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 by 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, this 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, the results of this study oppose studies which conclude that cooperatives had no significant effects on farmers' socioeconomic conditions (Mohammed and Lee, 2014; Patra and Agasty, 2013; Siza, 2001).

CONCLUSION

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.

Both descriptive statistics (mean, maximum, minimum, variance, standard deviation) and inferential statistics (paired-samples t-tests) were used 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) was 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 show that the significance value (p value) was equal to 0.00. 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, it is recommended 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. Since this study would not capture all dimensions of Vunga Coffee Washing Station's impacts, a qualitative or a mixed method research should be recommended.

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REFERENCES

- Aoki, K. (2012). Coffee as a Livelihood Support for Small Farmers: a Case Study of Hamsapur Village in Nepal. *Journal of International Agricultural Extension and Education*, 19 (1), 16-29.
- Bourdeaux, K. C. (2013). *A Better Brew for Success: Economic Liberalization in Rwanda's Coffee Sector*. Chemonics International, 2006. Assessing USAID's investments in Rwanda's coffee sector best practices and lessons learned to consolidate results and expand impact.
- Elder, S. D., Zerriffi, H., & Le Billon, P. (2012). Effects of fair trade certification on social capital: the case of Rwandan coffee producers. *World Development*, 40(11), 2355-2367.
- FAO. (2004). *Table C.10: Most important imports and exports of agricultural products (in value terms)*. FAO Statistics Division, 2006, Archived from the original.
- Francis, A. (1998). *Business mathematics and statistics* (5 Ed.). London, Continuum.
- Francis, A. (2004). *Business mathematics and statistics* (6th Ed.). London: Thomson Learning.

- Gisaro Ca-Madeberi, Y. B. (2013). Socio-economic impact of rural farming structure in Rwanda: Case of KOPAKAMA coffee growing cooperative and coffee washing station, Rutsiro District, Western Province. *Rwanda Journal*, 1(1), 32-51.
- Gisaro Ca-Madeberi, Y. B., Lebailly, P., & Mbonyinkebe, D. (2012). *Coffee has given us a voice: Coffee Cooperatives and Women Empowerment in Rwanda's rural areas*. Available at: <http://ccr.ica.coop/sites/ccr.ica.coop/files/attachments/1.5%20Bititi%201.pdf>.
- Gisaro Ca-Madeberi, Y. B., Lebailly, P., Burny, P., & Mbonyinkebe, D. (2013). Role of KOPAKAMA in promoting socio-economic development of coffee farmers. *International Non-Governmental Organizations Journal*, 8 (3), 61-67.
- Hurst, S. (1995). *The Characteristic Function of the Student-t Distribution*. Financial Mathematics Research Report No. FMRR006-95.
- Hussain, M. S. (2014). The Role of Cooperative Organizations in Rural Community Development in Nigeria: Prospects and Challenges. *Academic Research International*, 5 (3), 189-197.
- ICARD. (2002). *The impact of the Global coffee trade on Dak Lak Province, Vietnam: Analysis and Policy Recommendations* (Final Draft). September 2002, OXFAM Publications.
- Jackson, S. L. (2009). *Research Methods and Statistics: A Critical Thinking Approach* (3rd Ed.). Wadsworth: Cengage Learning.
- Kamola, I. (2007). The Global Coffee Economy and the Production of Genocide in Rwanda. *Third World Quarterly*, 28, 571-592.
- MINAGRI & Ministry of Trade and Industry. (2008). *Rwanda National Coffee Strategy Update (2009-2012)*, Kigali, Rwanda.
- MINECOFIN. (2003). *PRSP Annual Progress Report* (June 2002-June 2003), Kigali, Rwanda.
- Mohammed, N., & Lee, B. W. (2014). Role of Cooperatives in Rural Development, the case of South Nations Nationalities and People Region, Ethiopia. *Developing Country Studies*, 4 (19), 32-39.
- Mugabekazi, D. (2014). *Evaluation of factors influencing membership in coffee cooperatives in Huye District, Rwanda*. MSc thesis, University of Nairobi, Nairobi, Kenya.
- Mutandwa, E., Kanuma, N. T., Rusatira, E., Kwiringimana, T., Mugenzi, P., Govere, I., & Foti, R. (2009). Analysis of coffee export marketing in Rwanda: Application of the Boston consulting group matrix. *African Journal Business Management*, 2 (4), 210-219.
- NAEB. (2011). *Annual Report 2010*. National Agricultural and Export Board, Republic of Rwanda, Minagri, Kigali.
- Nyabihu District. (2013). *District Development Plan for 2013-2018*. Nyabihu District, Western Rwanda, June 2013.
- OCIR Café. (2009). *National coffee Census*. February 16th 2009 to March 27th 2009, Kigali, Rwanda.
- Ortega, D. L., Bro, A. S., Clay, D. C., Lopez, M. C., Tuyisenge, E., Church, R. A., & Bizoza, A. R. (2019). Cooperative membership and coffee productivity in Rwanda's speciality coffee sector. *Food Security*, 11, 967-979.
- Patra, R. N., & Agasty, M. P. (2013). Cooperatives, Agriculture and Rural Development: Role, Issues and Policy Implications. *International Organization of Scientific Research (IOSR) Journal of Humanities and Social Sciences*, 13 (2), 14-25.
- RCA. (2006). National policy on promotion of cooperative, Kigali, Rwanda.
- Rukwaru, M. (2007). *Fundamentals of Social Research*. Nairobi: Eureka Publishers.
- Schilling, M., & McConnell, T. (2003). *Model for Sitting Coffee Washing Stations in Rwanda*. Butare: National University of Rwanda.
- Schluter, J. E., & Finney, A. (2001). Rehabilitation of Coffee Sector, Rwanda, Development of Washed Processing Within a Framework of Private Investment, Common Fund for Commodities/International Coffee Organization (Mimeo).
- Singh, Y. K. (2006). *Fundamental of research methodology and statistics*. New-Delhi: New Age International (P) Limited.
- Sizya, M. J. (2001). *The Role Cooperatives Play in Poverty Reduction in Tanzania*. Paper Presented at the United Nations in observance of the International Day for the Eradication of Poverty on 17 October 2001.
- SNV. (2012). *Tougher links make stronger chains: Strengthening coffee cooperatives in Rwanda*. Netherlands Development Organisation in Rwanda, Kigali, Rwanda.
- Square Mile Coffee Roasters. (n. d.). *Vunga*

Nyabihu Bourbon Washed. Accessed at <https://cdn.shopify.com/s/files/1/0017/1562/files/Vunga.pdf> (accessed on September 11th 2015 at 3: 36 pm).

Sumelius, J., Tenaw, S., Bäckman, S., Bee, F., Chambo, S., Machimu, G., & Kumburu, N. (2013). *Cooperatives as a Tool for Poverty Reduction and Promoting Business in Tanzania*. Finland, Department of Econ. Manag.

van Elst, H. (2019). *Foundations of descriptive and inferential statistics. Lecture notes for a quantitative – methodological module at the bachelor degree (B.Sc) level*. Köln: parclT GmbH. E-Print: arXiv:1302.2525v4 [stat.AP]

Wanyama, F. O., Develtere, P., & Pollet, I. (2008). *Encountering the Evidence: Cooperatives and Poverty Reduction in Africa*. Working Paper on Social and Co-operative Entrepreneurship WP–SCE 08.02.

List of abbreviations, acronyms and

signs

CWS: Coffee Washing Station

ETIRU: Processing Factory of Ruhengeri (Rwanda)

FRW: Rwandan francs

MINAGRI: Ministry of Agriculture and Animal Resources (Rwanda)

MINECOFIN: Ministry of Finance and Economic Planning (Rwanda)

OCIR: Cash Crop Promotion Agency in Rwanda (Office des Cultures Industrielles au Rwanda)

RCA: Rwanda Cooperative Agency

RWANDEX: Rwanda Exports Company

SNV: Netherlands International Development Organisation

US\$: United States dollars

VCWS: Vunga Coffee Washing Station