



The Effects of rural income project on silk exports and livelihood of smallholder producers in Gatsibo District, Rwanda

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ABSTRACT

Sericulture has been seen in Rwanda as an opportunity for increasing raw materials for the textile industry. Therefore, it has provided a new source of income, reduced unemployment and most likely to improve the livelihood status of poor sericulture smallholder producers by increasing their income earnings. The high yield in silk production has been pleasing due to the favorable climatic conditions for mulberry cultivation; sericulture has been seen as a potential tool to reduce poverty and also to generate foreign exchanges from exportation. The broad objective of this paper focuses on the impact of the livelihood status of smallholder producers in Rwanda. Purposive and simple random sampling techniques were employed in selecting 286 sericulture households' farmers in the Gatsibo district. Data for this study were analyzed using descriptive statistics, inferential statistics, paired-samples t-test, cross-tabulation and chi-square test of independence. The results of this study showed clearly a significant improvement in the livelihood of the farmers. It was gathered that 82% asserted there are organized markets available for silk exportation. 77% affirmed an improvement in their income status. The average level of income per year from cocoon production among the farmers was estimated to be \$227.59. It is of topmost priority for this program to continue because its effect has a very positive impact on the livelihood status of the beneficiaries. Farmers should be provided with continuous training, access to credits. If sustained properly it will resolve future challenges and springs more opportunities for farmers and likewise to the country through exports.

Keywords: Sericulture, Livelihood, Smallholder producers, Silk export.

Abbreviations: GDP: Gross Domestic Product; IFAD: International Fund for Agricultural Development; AEB: National Agricultural Export Board; ODK: Open Data Kit; PRICE: Project Rural Income through Exports; RWF: Rwandan Franc.

INTRODUCTION AND PROBLEM STATEMENT

Rwanda is a landlocked country within the Great Lakes region of East Africa. Agriculture has an important role in sustainable development, poverty reduction, and enhanced food security, and supplies over 90% of the food consumed in the country, while manufacturing accounts for only 13% of Gross Domestic Product (FAO, 2008a). Agriculture is the backbone of the

economy in Rwanda, 89% of the rural households are practicing small-scale farming (WFP, 2019). The agricultural sector accounts for 33% of the national Gross Domestic Product (GDP). In general, Rwanda's Gross Domestic Product (GDP) has been growing at a rate of 7% since 2014. Silk, tea and coffee are the major exports and contributions from exports to the Gross Domestic Product from agricultural commodities in Rwanda increased to 505 RWF Billion in the first quarter

of 2019 from 490 RWF Billion in the fourth quarter of 2018 (FAO, 2019b; Trading Economics, 2019).

The agricultural sector through its employment and income generation activities in the economy is thus a major factor in tackling rural poverty and also contribute to an increase in livelihood situation which affects the smallholder producers' farmers. However, the sector faces constraints due to poor rainfall, famine, floods and the limited amount of land that is suitable for agriculture, alongside pests and diseases, which continue to pose risks to food security. General constraints still affecting the agricultural sector remains however linked to the low access to modern inputs, modern technologies, finance and other support services, land fragmentation deriving from a 2.5% demographic growth and lack of economic infrastructure. Due to the outcome of low endowment in production factors, such as land, water and capital assets, most of the smallholder farmers produce low quantities of products that are equally of poor value, which contributes to their products being abandoned by output markets. Agricultural arable land takes up to 91% of the land-2,294,390 Ha (Mbonigaba, 2013).

According to Project Rural Income through Exports (PRICE), the poverty rate is 74% for those households with less than 0.3 ha, 67% for households with up to 1 ha and 54% for those households that have more than 1 ha. For the poor rural household family to reduce poverty, there is a need to carefully balance food and cash crop production to meet family requirements and to seek agricultural labour, which is the main livelihood strategy to earn an additional source of income. Sericulture development in Rwanda has been constrained due to a lack of sufficient technological expertise, silk manufacturing factories in the silk production processes and cocoon processing requirements. Sericulture is a forest-based and agro-based cottage industry confined to rural areas whereas marketing of sericulture products largely depends on urban populations (Lalit et al., 2008).

Although Rwanda is a major silk exporter, spinning and knitting of silk thread are carried out in more than 30 countries, generally by smallholder farmers. These are China and India, which account for more than 50% of worldwide production, followed by Japan, Korea, and Thailand. The main producers in Europe are Italy and Spain. Zambia, Kenya, Egypt, and Uganda in Africa, while in Latin America, Brazil is the largest producer, with Bolivia and Colombia as smaller producers (Zambrano-Gonzalez et al., 2017).

Despite all these, most of the agricultural activities in Rwanda is done by smallholder farmers with little access to land finance and institutional supports. As a result, rural poverty is mostly associated with the smallholder producers

which has many forms and is a considerably more complex phenomenon. Poverty alleviation requires suitable policy interventions and appropriate technological options that can increase agricultural productivity without adversely affecting the productive capacity of natural resources (Dewangan et al., 2011a). Poverty can be reduced because sericulture is capable of generating more income, compared to the other crops like paddy wheat, rice, sorghum etc. because most of these crops mentioned above can be grown once or twice in a year but sericulture can be practised 4-5 times in a year (Dewangan, 2018b). Some of the financial problems are resolved by cooperatives societies which serve as an institutional tool to improve market participation of smallholder farmers, increase farm incomes and reduce rural poverty (Bernard and Spielman, 2009). The number of agricultural cooperatives in the country has expanded very quickly during the past couple of years, from 645 in 2008 to 2,400 in 2013 (Verhofstadt, 2015). But there is still room for improvement in the production and exports of these agricultural products.

Many programmes and policies have been initiated to solve the main problems facing the agricultural sector of the economy especially those that limit production, distribution and exports of the agricultural outputs to improve the general livelihood of rural smallholder farmers. This includes Project Rural Income through Exports (PRICE) being one of the interventions to increase rural income. It is therefore important to examine if these interventions can achieve the objectives for which they were created. This paper, therefore, assesses the effects of PRICE on the level of cocoon production among smallholder sericulture farmers as well as determines the effects of PRICE on silk exports. It also examines the nature and profile of the livelihood status of smallholder sericulture farmers in rural income project (PRICE) were highlighted and examined.

This paper proceeds as follows: The next section is the literature review followed by the theoretical framework methodology and data. Section 4 presents the results and discussion before we conclude in section 5 with some policy implications of our findings.

REVIEW OF LITERATURE

Livelihood is sustainable when it can maintain or enhance its capabilities and assets without deterioration of the natural resources available, and cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future (Kamwi et al., 2018a). Livelihood diversification is the process of accomplishing activities by the rural household to outlive and improve their standard of living (Kassa, 2019). Livelihood diversification strategies can be classified as on-farm, nonfarm

and off-farm activities. The major on-farm livelihood activities are crop production and livestock rearing.

Addisu (2017) classified livelihood strategies into six such as farming, breeding, fishery, trading, employment, and craftsman (Addisu, 2017). Non-farm livelihood activities include petty trade, handicraft, remittance, mining, carpentry, hiring of oxen and land (Asfir, 2016; Dadi, 2016; Yona and Mathewos, 2017; Yishak, 2017). Livelihood activities and skills are fundamental in improving livelihood opportunities, decrease poverty, enhance employability, and promote sustainable development (Kamwi et al., 2015b). Livelihood diversification activities have been cognizant to increase households' income accumulation and to maintain livelihoods confronting an increase in climatic and economic risks. Over the years, research has consistently espoused the nexus between climate change and smallholder farmers' livelihood activities as adaptation strategies that are diverged and complementary (Yamba et al., 2017).

Livelihood is a very broad perception and encompasses many aspects of one's life. In deep dive livelihood assessments, approaches to livelihoods may include disaggregated analysis of livelihood systems for different socio-economic groups and wider social issues such as health, children in school, and access to clean water (COSA, 2016). The Integrated Household Living Conditions Survey or *Enquête Intégrale sur les Conditions de Vie des ménages* (EICV, or the English acronym IHLCs) is conducted every five years in Rwanda, this survey provides information on changes in the well-being of the population such as poverty, inequality, employment, living conditions, education, health, household consumption, and housing conditions, amongst others (NISR, 2015). Smallholders are characterized by family-focused motives such as favouring the stability of the farm household system, using mainly family labour for production and using part of the produce for family consumption. Over three-quarters of the economically active extremely rural poor are engaged in agriculture as a primary activity, although they do not necessarily work on their unit of production, whether farms, forests or fisheries (Castañeda et al., 2018).

Poor smallholder producers are confronted with multiple structural constraints, market failures and higher exposure to risks that foreclose their agricultural livelihoods being more productive, including lack of rights (or rights not recognized) over natural resources, inputs, technical assistance, access to credit and insurance, as well as social protection. Smallholder farmers are also known as subsistence farmers, who self-provide livelihood strategies through agricultural produce. Smallholder farmers are exceedingly reliant on natural resources, and availability which is constantly threatened by land

management practices, human activities and development trends such as population growth rates (Ncube et al., 2017). Smallholder farmers can play a significant role in the creation of sustainable livelihoods amongst the rural poor. Although smallholder production is critical for household food security, the efficiency of this subsector is quite low. The high costs and limited availability of farm inputs such as hybrid seeds, fertilizers, pastures, exotic animals, high labour cost, veterinary costs, irrigation equipment, tractors, post-harvest technology, herbicides, among others. These factors limit their ability to move beyond smallholder (subsistence) farming and also responsible for the declining agricultural yields among smallholder farmers. Funds and support for smallholder farmers would also enhance the equity and sustainability of income and livelihoods. It would not only increase world food security but would also contribute a significant dent in poverty and food insecurity. Hence, there is a need to greatly increase the efficiency of smallholder farmer production to ensure long term food security.

Sericulture is a major source of income in improving the livelihood status of a large section of the rural and semi-urban population. Currently, sericulture is opted by many farmers as a cash crop in the agricultural sector and it is a boon to the farmers to change their socio-economic status. The sericulture sphere is an eco-friendly activity afterwards mulberry is a perennial crop with good foliage which contributes to soil conservation and provides greenery. Similarly, the waste from silkworm rearing can be recycled as inputs to the garden. The sericulture industry will furnish socio-economic development through the creation of job employment, low gestation, higher returns. Thus, sericulture plays an important role in rural employment generation and therefore it ensures a minimum income throughout the year (Chanotra et al., 2019). People engaged in sericulture practices often take part in mulberry planting, weeding, manuring, irrigating, leaf picking, leaf transporting and storage. Although the pre-cocoon to post-cocoon sectors of the sericulture industry i.e. mulberry cultivator, cooperative rearers, silkworm seed producer, reeler, twistor, weaver, hand spinners of silk waste, traders etc. The sericulture industry production of quality mulberry leaves plays a crucial role in the production of silk. Amongst the different factors, the mulberry leaf contributes more than one-third to cocoon production. The procedures of mulberry sericulture begin with the cultivation of suitable and best fit mulberry varieties for an eco-zone (FAO, 2018c).

Neelaboina et al., (2018) acknowledged that mulberry leaves are supplements in feeding cattle presuming that this will increase milk production, so convincingly smallholder farmers are encouraged to be engaged in the practice of

sericulture (Neelaboina et al., 2018). Studies also showed that mulberry leaf fed to silkworms can also serve as a good feedstuff for sheep because of the high crude protein in mulberry silage which makes it superior to those of the other forage crops. Consequently, mulberry can also be used as a feed supplement to other silage crops, because it does not only provide fermentable energy, but also fermentable protein (Divyashree et al., 2020).

Silk is the most elegant textile in the world with unparalleled magnificence, natural sheen, and essential affinity for dyes, high absorbance, lightweight, soft touch, and high durability and known as the "Queen of Textiles" (Dewangan, 2018b). In silkworm rearing, women are engaged in leaf-cutting, feeding, bed cleaning, worm spacing, mounting, harvesting, and disinfections (Bukhari et al., 2019). More than 8 million families with 80% are in the poor rural communities involved in silk production as part of their livelihood, engaging in sericulture as an agro-based cottage industry has witnessed a boost in their income, assets and reduction in poverty levels over the years (ITC, 2016).

CONCEPTUAL FRAMEWORK AND METHODOLOGY

The theoretical framework that was used in this study, as shown in the diagram below, shows the theoretical model of how the logical idea was achieved of the relationships among the several factors that were identified. The human factors will affect the income and the livelihood status of the smallholder producers. The socioeconomic status of an individual is the economic and sociological conditions that measure an individual work experience, family economic and social position with others. The major factors that determine an individual socioeconomic condition include; occupation/employment, income and education. The major socio-economic factor is occupation/employment because this will determine the income of an individual, whereas, the income level often relates to an individual level of education. The level of education is another factor that will dictate the employment

status; thus, the level of education, employment status and income will dramatically influence and determine the health condition of such an individual. Furthermore, sociodemographic is relating social and demographic factors together, the example of these factors are age, ethnicity, gender, socioeconomic status, marital status, geographic area and family size. Therefore, the human factors mentioned above will contribute predominately to the livelihood status and level of income of the sericulture smallholder producers. In conclusion, the other factors in this framework give a view of how silk production and silk export will affect either positively or negatively on the livelihood levels of the smallholder sericulture producers because an increase in silk production will cause huge revenue from silk export and thereby causing an increase in the income of the sericulture smallholder farmers.

The study area

This research was conducted in Gatsibo, this district is located in the North-Eastern province of Rwanda and it lies between Kayonza and Nyagatare, on a coordinate: 1°36'S 30°27'E, covering a total density of 270/km², the total area covered 1,578 km² (609 sq. mi). The capital of this district is called Kabarore. This research centre was selected as this has the facilities to carry out the necessary experiments efficiently, making them the most suitable for this research study. Mulberry is currently grown in 28 districts of Rwanda, Gatsibo being the main producer. The German post was located here in Gatsibo, as this is the present-day Gabiro military camp. The Eastern part of the Gatsibo district is in Akagera National Park, with the Kagera River starting the border with Tanzania. Gatsibo district is divided into 14 sectors (imirenge): Gatsibo, Gasange, Gitoki, Kageyo, Kiramuruzi, Kabarore, Kiziguro, Murambi, Muhura, Nyagihanga, Ngarama, Remera, Rwimbogo and Rugarama. Gatsibo district is as well known for bumper yield in beans, maize, coffee, rice, and bananas (Figures 1 and 2).

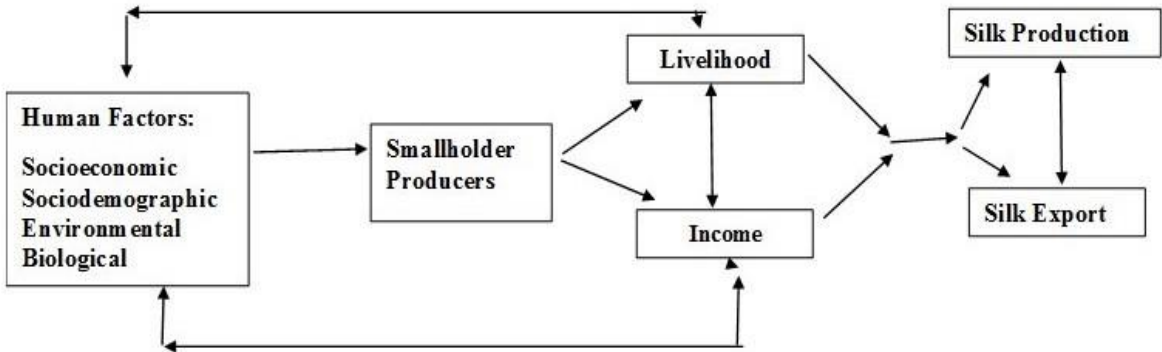


Figure 1. Author’s conceptualization.



Figure 2. Image showing the location where the questionnaire was administered in Gatsibo District in Rwanda.

Research design and data collection process

A multi-stage sampling technique was used in this study. The different stages combined purposive and simple random sampling technique. The first stage involves the purposive selection of the Gatsibo district which is one of the twenty-eight districts that PRICE covers. Gatsibo district has also recorded great success in sericulture practices. Based on the population of the district, a proportionate to a population sample size of sericulture farmers for Gatsibo was determined. The population in the Gatsibo district is 433,020 (2012 census). The representative sample for smallholder sericulture farmers interviewed was determined scientifically. Since the population size of smallholder sericulture producers in the Gatsibo district in the Eastern Province is 1,115. This was followed by a random selection of the actual respondents from different households. The respondents are sericulture beneficiaries of the PRICE project. Random sampling was employed to select the 286 smallholder sericulture farmers that were interviewed and in a manner that ensures representativeness.

The primary instrument employed for gathering data for this study is the questionnaire. The type of data collected includes socio-economic data, agricultural productivity, income, and strategies for coping with vulnerabilities. Factual information which is crucial for decision making on the influence of collective action on smallholder sericulture farmers in the Gatsibo area of the Eastern Province of Rwanda was gathered. The list of these farmers was obtained from the National Agricultural Export Board (NAEB).

The questionnaires were administered with the help of research assistants and local enumerators from this district. Engagement with local enumerators who can speak and write the English Language, who went ahead to translate the questionnaire into Kinyarwanda which the farmers speak fluently. These local enumerators were well trained on ethical principles in research and thoroughly briefed about the study and the content of the questionnaire before the commencement of the data collection. While a pilot study was done by administering questionnaires to the farmers in one group to assess the ability of the respondents to understand and answer the questions asked correctly. The questionnaire was administered in a survey conducted among the PRICE beneficiaries in the Gatsibo district. To ensure enhanced validity and reliable instruments, the Open Data Kit (ODK) was used before been transferred to the Statistical Package for Social Sciences (SPSS).

The relevant variables for this study are export and livelihood. Export is measured by the number of goods and services in one country and sold to buyers in another country which is calculated in monetary value while livelihood is measured by using the following key indicators such as Natural Capital: land, water, biological resources (biodiversity). Financial Capital: stocks of money or assets in liquid form. Social Capital: right or claims derived from group membership. Physical Capital: infrastructure, resources created through economic production and Human Capital: quantity of labour available. For this research study, we utilized agricultural productivity and income generation, social services, physical and financial assets, vulnerability and adaptability strategies. These variables are measured through the Likert's

scale and open-ended scale numerical responses. This implies that the data series for these variables are obtained through the numerical responses of the respondents to the questions related to the variables in the questionnaire.

Different analytical techniques were utilised in achieving the stated objectives of this paper. Analysis of Variance (ANOVA) and independent samples t-test where appropriate (for variation in production across background factors), paired-samples t-test (for variation in production before and during PRICE), cross-tabulation and chi-square test of independence (for factors associated with improved production since joining PRICE. For the second objective, which seeks to determine the effects of PRICE on silk exports, we used inferential statistics: independent samples t-test (for variation in income during PRICE across background factors), cross-tabulation and chi-square test of independence (for factors associated with improved income since joining PRICE). The third objective which seeks to determine the income level of smallholder sericulture farmers in rural income project (PRICE), we applied descriptive statistics: measures of averages-median and quartiles. As for the fourth objective which seeks to determine the livelihood status of smallholder farmers in rural income project (PRICE), we also used descriptive statistics: Frequency, percentages and charts.

RESULTS AND DISCUSSION

Demographic characteristics of the respondents

Table 1 shows the respondents' characteristics. Averagely, each of the participants was aged 49 years; 33% were below 45 years, 35% were aged 45 to 54 years, 25% were aged 55 to 64 years, while not more than 8% are aged 65 years and above. Most of the respondents (71%) had just the primary school education, 16% had a secondary school education, 12% had no form of education at all, while only one respondent indicated having a higher education. The study also revealed that the majority of the respondents are male with 66% and 34% are female. The respondents disclosed that (88%) have male persons as their head of households with 12% indicating they had a female person heading their households. Averagely, the household size observed from the entire respondents has about six persons per household; also, revealed was that each household had about 3 females and 3 males averagely. A very large proportion of the respondents (72%) had at least five persons in their household, 24% had a household size of three to four persons, 4% had a household size of not more than two persons.

Table 1. Demographic characteristics information.

	Frequency	Percentage
Age (49.0 ± 10.91)		
Below 45 years	94	32.9
45-54 years	99	34.6
55-64 years	70	24.5
65 years and above	23	8
Level of education		
Non-formal	35	12.2
Primary school	203	71
Secondary school	47	16.4
HND/University degree	1	0.4
Gender		
Male	189	66.1
Female	97	33.9
Head of household		
Male	251	87.8
Female	35	12.2
Total household Size [5.9 ± 2.1]		
1-2	11	3.8
3-4	69	24.1
5 or more	206	72
Source: Data generated by the authors from a field survey (n=286).		

Cocoon production among smallholder sericulture farmers

In Table 2, this show before and during the intervention of the PRICE project. 70% of the respondents had a self-owned farm, 18% inherited mulberry farmlands, 2% indicated they owned rented mulberry farmlands, 8% reported having jointly owned mulberry farmlands and 2% acquired their farmlands by other forms before joining the PRICE project. 73% reported self-ownership of the mulberry farmlands during PRICE, 16% still used

inherited farmlands, while 2% claimed they still used rented farmlands during PRICE, while 7% reported jointly owned farmlands and 3% reported that they got their mulberry farmlands by other forms during PRICE. This study also revealed that 44% of the respondents claimed farm ownership affected their cocoon production before PRICE intervention while 40% indicated their farm ownership currently has an effect on cocoon production during PRICE.

Table 2. Number of farmers in Cocoon production before and during price.

Before PRICE			During PRICE	
	Frequency (n=286)	Percentage	Frequency (n=286)	Percentage
Farm ownership			Farm ownership	
Self-owned	199	69.7	208	72.7
Inheritance	51	17.8	45	15.7
Rent	7	2.4	5	1.7
Jointly owned	22	7.7	20	7
Other forms	7	2.4	8	2.8
Effect of farm ownership on cocoon production			Effect of farm ownership on cocoon production	
Yes	125	43.7	114	39.9
No	161	56.3	172	60.1
Member of farmer's Cooperative			Member of Farmer's Cooperative	
Yes	139	48.6	164	57.3
No	147	51.4	122	42.7
Member of savings and loan group			Member of savings and loan group	
Yes	215	75.2	238	83.2
No	71	24.8	48	16.8
Accessing finance assistance from savings and loan group			Accessing finance assistance from savings and loan group	
Yes	112	39.2	118	41.3
No	174	60.8	168	58.7
Access to market			Access to market	
Yes	177	61.9	221	77.3
No	109	38.1	65	22.7
Source: Data generated by the authors from a field survey (n=286).				

Effect of cocoon production on the livelihood of smallholder sericulture producers

This study found that the level of cocoon production of the farmers during PRICE was distributed by various background characteristics, with a view to understanding if production differs across categories of some variables. The result showed that the cocoon production level of the farmers did not significantly vary across age group, household size, gender, cultivating other agricultural

commodities, farm ownership, and awareness of an organized market for silk (Table 3). Conversely, production level differed by land acquirement status of the farmers; farmers who planted mulberry on a leased land had the highest production of the cocoon (391 kg per year), while those who planted mulberry on purchased land had a cocoon production of about 164 kg per year, and those with inherited land produced the least cocoon (114 kg per year). Moreover, it was discovered from the result that the level of education and the number of years of experience in mulberry

plantation contributes to huge cocoon production; farmers with secondary school education had cocoon production of (223 kg per year), for farmers with primary school education realized cocoon production of (181 kg per year), while those with Non-Formal education had cocoon production of (126 kg per year). Whereas, farmers with 11-20 years of experience in mulberry plantation produced (196 kg per year), and those with 1-10 years of experience produced cocoon of (156 kg per year).

Furthermore, (Table 4) shows the income level from cocoon production was dispersed across various background factors to determine if the income level varies by categories of any of the factors. Results from the analysis revealed that the income level of the farmers was significantly different by the level of education, age, household size, gender, cultivating other agricultural commodities, years of experience, land acquirement, farm ownership, awareness of an organized market for silk exportation and access to market during PRICE. Notable from the result was that sericulture farmers with no formal education had the highest annual

income \$360.75 (USD) per year, farmers with secondary education averaged an annual income level of \$327.52 (USD), while those with primary education had the least income with \$177.17 (USD) per year. It was also observed from the result that farm ownership is keen because sericulture farmers with self-owned mulberry farmlands averagely receive an income of \$247.77 (USD) annually; sericulture farmers with inherited mulberry farmlands received an average of \$189.10 (USD) per year; those farmers with rented mulberry farmlands incurred an average of \$177.77 (USD) per annum; while jointly owned mulberry farmlands farmers had an average income of \$135.83 (USD) annually, and sericulture farmers that indicated that they got their farmlands from other means made an average of \$201.60 (USD) per year. Besides, age also plays a key role because the result proves that sericulture farmers between the ages of 45-54 years earned an average income of \$265.52 (USD) annually; as for the sericulture farmers of 65 years and above received an average income of \$169.61 (USD).

Table 3. Distribution of production level before and during PRICE by background.

		Before PRICE		During PRICE	
		Average quantity produced (in kg)	p-value	Average quantity produced (in kg)	p-value
Age	Below 45 years	73.4	0.372	124.4	0.29
	45-54 years	76.4		195.9	
	55-64 years	81		239.2	
	65 years and above	72		135.5	
Level of education	Non-formal	75.8	0.582	126	0.555
	Primary	75.5		180.5	
	Secondary	80.7		222.7	
Total household size	1-2	97.4	0.007	152.8	0.783
	3-4	69.6		208.2	
	≥ 5	77.2		171.2	
Gender	Male	74.1	0.108	186.7	0.667
	Female	80.2		165	
Cultivate other commodities	Yes	75.9	0.455	177.1	0.701
	No	81.6		217.5	
Years of experience	1-10 years	66.7	<0.001	156.1	0.411
	11-20 years	82.7		195.9	

Land acquirement	Inherited	82.7	0.257	114.1	0.007
	Purchased	74.8		163.9	
	Lease	75.4		391	
Farm ownership	Self-owned	75.7	0.893	195.6	0.756
	Inheritance	80.6		108.4	
	Rent	69.6		102	
	Jointly owned	79.1		121.9	
	Others	75		130	
Aware of an organized market for silk	Yes	76.1	0.637	179.9	0.84
	No	82.5		143.8	
Source: Data generated by the authors from a field survey (n=286).					
*“p-value” implies p-value for ANOVA for those variables with more than 2 categories (like the Age and Level of Education) t-test for those variables with just 2 categories (like Gender – which has Male and Female as options.					

Table 4. Distribution of income during PRICE by background information.

		Average Annual Income \$ (USD)	p-value
Age	Below 45 years	212.34	0.552
	45-54 years	265.52	
	55-64 years	215.96	
	65 years and above	169.61	
Level of education	Non-formal	360.75	0.001
	Primary	177.17	
	Secondary	327.52	
Total household size	2-Jan	249.94	0.849
	4-Mar	208.21	
	≥5	233.73	
Gender	Male	244.74	0.258
	Female	195.96	
Cultivate other commodities	Yes	213	0.01
	No	410.53	
Years of experience	1-10 years	297.49	<0.001
	11-20 years	149.6	
Land acquirement	Inherited	189.93	0.207
	Purchased	252.49	
	Lease	154.16	

Farm ownership	Self-owned	247.77	0.588
	Inheritance	189.1	
	Rent	177.77	
	Jointly owned	135.83	
	Others	201.6	
Aware of an organized market for silk	Yes	212.35	0.095
	No	301..24	
Access to market during PRICE	Yes	227.11	0.922
	No	231.9	
Source: Data generated by the authors from a field survey (n=286).			
“p-value” implies p-value for ANOVA for those variables with more than 2 categories (like the Age and Level of Education) t-test for those variables with just 2 categories (like Gender which has Male and Female).			

Interestingly, the result established the findings that there is more awareness among the smallholder sericulture farmers regarding the organized market for silk exportation and therefore, the impact of the rural income project on silk exports and livelihood of smallholder producers has been extremely improved because this intervention project has generated more income for the sericulture farmers and has improved them socioeconomically. Hence, the PRICE intervention programme has been beneficial because there has been a turnaround in the lives of many sericulture farmers engaged in this project. After all, the impact has been felt

on the livelihood status and social status of these farmers.

In Figure 3, the majority of the farmers confirmed their income level, production level, and quantity of silk exported have been on the improving side since they joined PRICE; most of them also indicated improvement in social services such as access to drinking water, access to electricity, access to school, access to healthcare services, means to communication and access to information while few affirmed that the state of electricity, access to drinking water and access to school worsened since they joined the PRICE intervention program.

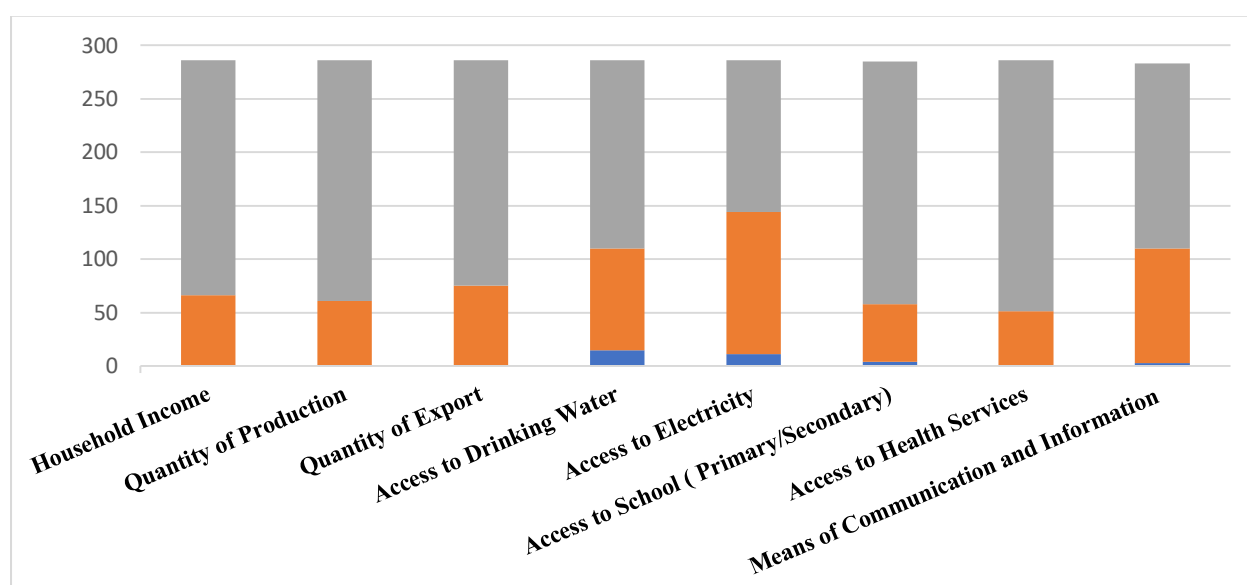


Figure 3. Status of social services and farm outputs since joining PRICE. **Note:** ■ Worsened; ■ No Change; ■ Improving.

Generally, in Figure 4 it was evaluated that 70% of the farmers have had an improvement in their farming outputs and access to social services

since they joined PRICE. 28% of the respondents remarked there was generally no change, with 2% who remarked the situation had worsened.

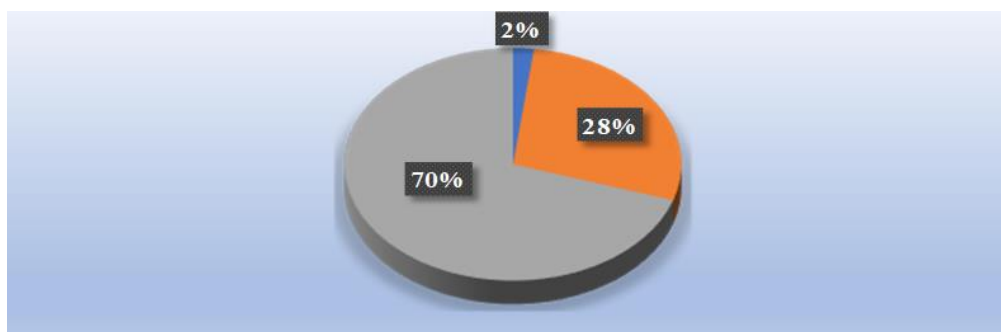


Figure 4. Overall assessment of farm outputs and social services since joining PRICE. **Note:** ■ Worsened; ■ No Change; ■ Improving.

Sources of financing to the farmers

Finance has been identified as one of the main factors militating against the production and activities of smallholder farmers. Many of the farmers have limited access to finance. Before the PRICE intervention program, 49% of the farmers were cooperative members while 57% belonged to a cooperative group during PRICE. 75% of the respondents belong to a savings and loan group before PRICE and 83% were members of a savings and loan group during PRICE. 39% had financial assistance from a savings and loan group before PRICE while 41% had access to financial assistance during PRICE. 62% had access to the market before PRICE intervention while 77% reported having access to the market since their engagement on the PRICE programed.

While access to credit increased during the PRICE period, this study reveals that 21% of the sericulture farmers received a loan in the previous year. Averagely, each of the loan beneficiaries received about \$212.70 (USD); while some received not more than \$10.64 (USD), others received as much as \$1,063.52 (USD). Most of the recent loan beneficiaries stated they opted-in for monthly repayment

(98%), only 1 of the recent loan beneficiaries claimed repayment weekly.

In Figure 5, it present that the respondents who received loans revealed that loan accessed before PRICE were commonly used for solving personal problems (27%), purchase a farm asset (17%), to enhance production generally (11%), to improve cocoon production (6%), to improve other farm activities (9%) and a similar evaluation of the purpose of loan accessed during PRICE revealed that most of the respondents had accepted loans to purchase a farm asset (3%), to enhance production generally (24%) and to improve their cocoon production (42%).

It is therefore interesting to find that sericulture has provided downstream employment and income generation in rural areas and there is high participation for low income and socially underprivileged groups. The annual average level of income from cocoon production among the farmers was estimated to be \$227.59 (USD); while some farmers reported annual income from cocoon production is as low as \$1.07 (USD), others reported annual income from cocoon production rising to \$3,703.47 (USD).

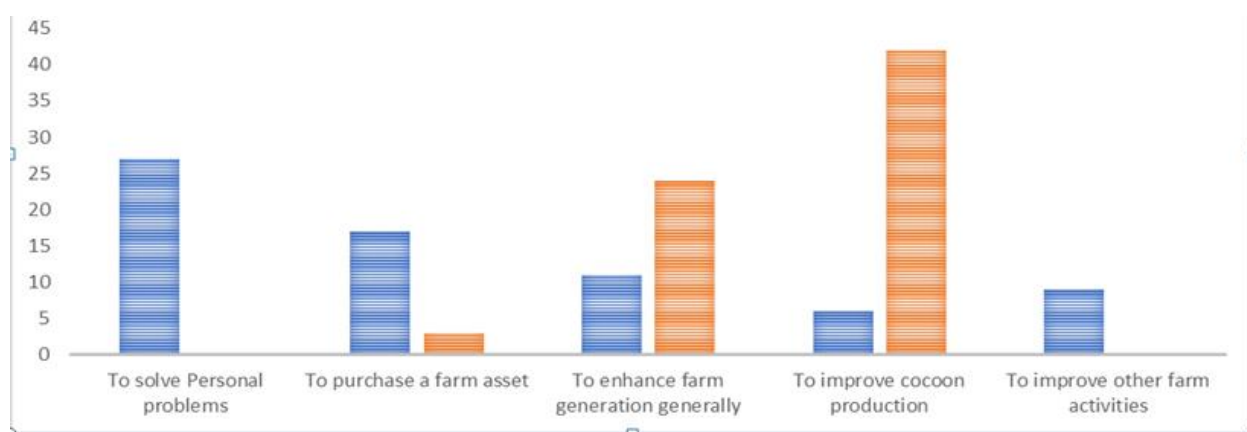


Figure 5. Purpose of finance assistance before and during price. **Note:** ■ Before; ■ During.

Impact of cocoon production on the livelihood of smallholder sericulture producers

This study further disclosed that the livelihood

status of the sericulture farmers has been improving since joining the PRICE project which includes the household income, quantity and quality of cocoon production and silk exportation, household savings and access to

financial institutions (credit, loan and savings societies). Access to improved social services such as drinking water, electricity, educational institutions (primary/secondary schools), health services, better means of transportation, market information and communication.

We further investigated if there is no significant difference in the proportion of beneficiaries indicating no change and improvement in income level during the rural income exports intervention program. Equally, no significant difference in the level of cocoon production before and during the rural income exports intervention programme. The results indicate that 77% affirmed an improvement in their income status, while 23% claimed they had not

experienced a change in income since joining PRICE (Table 5). The production of cocoons for farmers per year was 80 kg before PRICE but surged to 120 kg during the PRICE intervention programme.

It is therefore imperative to know that cooperative society also plays a critical role in the improvement of productivity and income of smallholder farmers. Based on the result, the policy implications signify that the government of Rwanda needs to do more in the provision of access to affordable, sustainable and clean renewable energy, also in the area of improving good health and well-being, quality education, and clean water and sanitation.

Table 5. Hypothesis.

	No change	Improving	p-value
Level of Income	66 (23.1%)	220 (76.9%)	<0.001
Production of-Cocoon (kg)	80	120	
Source: Data generated by the authors from a field survey (n=286) **“p-value” * implies p-value for Chi-square variable for level of income.			

Constraints to the PRICE programme

Results from this study further identified the various constraints faced by farmers. 43% of the farmers reported that they are still faced with little or no technical support. Other constraints identified include lack of good seedlings to

ensure quality produce (30%), lack of adequate farm input (28%), lack of storage facility (22%), lack of information on training (21%), lack of funds to enhance production on a larger scale (13%), unavailability of lands to farm (10%), and a few others presented in Figure 6.

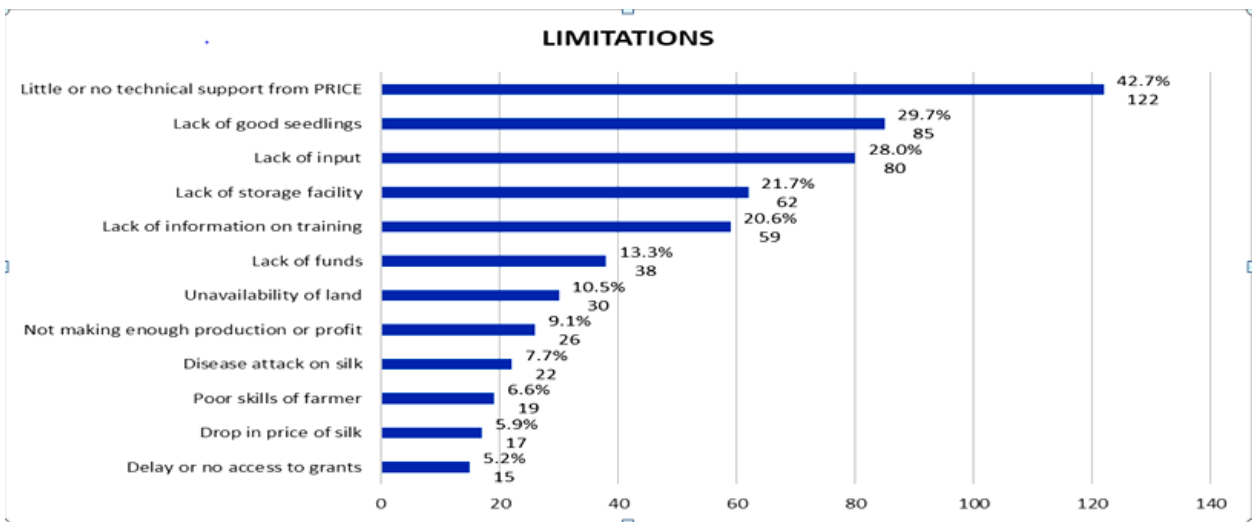


Figure 6. Reported constraints of the impact of the price program.

CONCLUSION AND RECOMMENDATIONS

The major findings imply that majority of the respondents acknowledged that there is an improvement in their income status since joining the PRICE project. Equally, the level of cocoon production for farmers per year was soared up during the PRICE project. It was concluded from this study that the livelihood status of the PRICE sericulture beneficiaries has critically been improved through an increase in the level of income generated from silk export and agricultural productivity during this IFAD-PRICE intervention. Overall, this is a redoubtable step in reducing poverty and unemployment in Gatsibo District, Rwanda. This is because this intervention has a positive and tremendous impact on decreasing the poverty rate. Therefore, the involvement of more beneficiaries for this PRICE project will enhance the livelihood status of these beneficiaries; this will also create more opportunities for income generation to the sericulture farmers and also boost the Gross Domestic Product of the Republic of Rwanda. Thus, improving and strengthening the economic potential of the country through the exportation of silk products and other agricultural commodities will also place the country at an advantage for direct foreign investment in Rwanda which will attract more investors to establish more textile and silk reeling manufacturing factories.

It is no doubt that the PRICE intervention programme has improved the rural livelihood of the sericulture farmers in Gatsibo. However, the PRICE intervention should continue to build on its positive impact on the lives of poor rural households. There is a need to establish more training centres closer to rural farmers to improve their technical know-how and technical support as well as to continually improve the training capacity and skills required by the farmers for adequate sericulture management which will contribute to an increase in cocoon production.

These improved capacities of the farmers will improve productivity that will effectively promote the value chain process which has not been fully harnessed in this industry. Moreover, this will provide more job opportunities and value-added services to the sericulture industry which will eventually bring an increase to silk exportation and generates more revenue for the country which means indirectly the PRICE smallholder sericulture beneficiaries will benefit from the boost in Gross Domestic Product (GDP) and the means of livelihood will be enhanced.

REFERENCES

- Addisu Y (2017). Livelihood strategies and diversification in western tip pastoral areas of Ethiopia. *Pastoralism*. 7(1): 1-9.
- Asfir S (2016). Determinants of rural households livelihood strategies: evidence from Western Ethiopia. *Journal of Economics and Sustainable Development*. 7(15): 103-109.
- Bernard T, Spielman DJ (2009). Reaching the rural poor through rural producer organizations? A study of agricultural marketing cooperatives in Ethiopia. *Food policy*, 34(1): 60-69.
- Bukhari R, Kour H, Aziz A (2019). Women and the Indian Sericulture Industry. *Int. J. Curr. Microbiol. Appl. Sci*. 8(5): 857-871.
- Castañeda A, Doan D, Newhouse D, Nguyen MC, Uematsu H, Azevedo JP (2018). A new profile of the global poor. *World Development*. 101: 250-267.
- Divyashree HJ, Chandrashekhar S, Deepa KB, Vishaka GV (2020). Evaluation of moisture percentage of mulberry based silages. *J.Pharm and Phytochemistry*. 9(4): 729-730.
- Chanotra S, Bali RK, Bali K (2019). Estimation of Genetic Variability and Heritability in Selected Mulberry Germplasm Accessions (*Morus* spp.). *Int. J. Curr. Microbiol. App. Sci*. 8(2): 493-499.
- Committee on Sustainability Assessment (COSA) (2016). Towards-a-Shared-for-Approach-Small-Holder-Performance-Measurement-Common-Indicator-Metrics.012516.
- Dadi W (2016). Livelihood Diversification As Household Strategies. A Case Study of Rural Kebeles Around Gelan Town, Oromia, Ethiopia (Doctoral dissertation, Thesis MA in Geography and Environmental Studies Addis Ababa University, Addis Ababa, Ethiopia).
- Dewangan SK, Sahu KR, Achari KV, Soni S (2011a). Socio-Economic Empowerment of Tribal Women through Sericulture a Study of Lailunga Block of Raigarh District, Chhattisgarh, India. *International Journal of Business and Management*. 6(12).

- Dewangan SK (2018b). Economics of Sericulture-A Study of Raigarh District—Chhattisgarh—India. *Int. J. Res. App. Sci. Eng. Tech.* 6(1): 573-579.
- FAO (2018c). Using Market Information to Get Better Prices.
- FAO (Food and Agriculture Organization of the United Nations) (2008a). Boosting food production in Africa's "breadbasket areas": New collaboration among Rome-based UN Agencies and AGRA (Alliance for a Green Revolution in Africa). Rome: FAO.
- Food and Agriculture Organisation of the United Nations (2019b). Rwanda at a glance.
- Yishak G (2017). Rural Farm Households' Income Diversification: The Case of Wolaita Zone, Southern Ethiopia, *Social Sciences*. 6(2): 45-56.
- Kamwi JM, Chirwa PWC, Graz FP, Manda SOM, Mosimane AW, Kätsch C (2018a). Livelihood activities and skills in rural areas of the Zambezi Region, Namibia: Implications for policy and poverty reduction. *African. J. Food. Agr. Nut. Dev.* 18(1).
- Kamwi JM, Chirwa PW, Manda SO, Graz PF, Kätsch C (2015b). Livelihoods, land use and land cover change in the Zambezi Region, Namibia. *Population and Environment*. 37(2): 207-230.
- Kassa WA (2019). Determinants and challenges of rural livelihood diversification in Ethiopia: Qualitative review. *J. Agri Ext Rur Dev.* 11(2): 17-24.
- Lalit KD, Shrinibas, Tarun KO, Bibhu SB (2008). Sericulture and its prospect in promoting development of rural people of odisha. *Int J Agri Sci Res.* 8(2): 163-170.
- Mbonigaba MJ (2013). Rwanda Agricultural Sector and its Impact on Food Security and Economy. Kigali: Rwanda Agriculture Board.
- National Institute of Statistics of Rwanda (NISR) (2015). Integrated Household Living Conditions Survey Enquête Intégrale sur les Conditions de Vie des Ménages Rwanda (EICV) 2013/2014. Rwanda Poverty Profile Report August 2015.
- Ncube B, Fanadzo M, Shikwambana S, Pili O, Carelsen R. (2017). Improving smallholder farmer livelihoods through developing strategies to cope and adapt during drought periods in South Africa.
- Neelaboina BK, Kumar S, Ahmad MN, Ghosh MK (2018). Studies on the Performance of Some Silkworm, *Bombyx mori* L, Breeds in Temperate Region of Jammu & Kashmir. *Int J Cur Micr Appl Sci.* 7(11): 2192-2201.
- Trading economics from 2019, 20:36.
- Verhofstadt E, Maertens M (2015). Can Agricultural Cooperatives Reduce Poverty? Heterogeneous Impact of Cooperative Membership on Farmers' Welfare in Rwanda. *Appl Eco Per Pol.* 37(1): 86-106.
- World Food Programme (WFP) (2019). Where we work: Rwanda.
- Yamba S, Appiah DO, Pokuaa-Siaw L, Asante F (2017). Smallholder farmers' livelihood security options amidst climate variability and change in rural Ghana. *Scientifica*. 2017.
- Yona Y, Mathewos T (2017). Assessing challenges of non-farm livelihood diversification in Boricha Woreda, Sidama zone. *J Dev Agr Eco.* 9(4): 87-96.
- Zambrano-Gonzalez G, Ramirez-Gonzalez G, Almanza-P MI (2017). The evolution of knowledge in sericultural research as observed through a science mapping approach. *F1000 Res.* 6(2075): 2075.