

Effect of Institutional Factors on Adoption of Sericulture Technology in Rwanda

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Abstract

The main objective of this study was to investigate the effect of institutional factors on sericulture technology adoption amongst the smallholder farmers in Gasabo District, Rwanda. A sample of 111 respondents was selected through multistage random sampling technique. Data were collected from both adopters and non-adopters of sericulture and they were estimated using probit model in stata program. The result revealed that cooperative membership; access to extension services and access to credit were the institutional factors that influenced the adoption of sericulture technology in the study area at 5% level of statistical significance.

Based on the adoption barriers assessed in this study, in order to effectively promote the technology on a commercial basis in Rwanda, and their subsequent adoption at scale; all actors must work together to increase the extension activities. There is also a need to expand rural network for financial institutions and a well-designed loan product at reasonable rate of interest for smallholder farmers. Lastly, farmers should be mobilized to form or join sericulture cooperatives and provide them with capacity building in regard with cooperative and financial management as well as marketing.

Key words: *Sericulture Production, Technology, Adoption, Probit Model*

1. Background information

Globally it is acknowledged that the labor-intensive sericulture sector provides high employment potential from the agricultural activities of mulberry cultivation and silkworm rearing to the industrial process of raw silk and silk fabrics and it can raise high income for rural households in short period(Kim et al., 2016). According to Kim et al. (2016), the present global silk production is fluctuating around 18000-20000M.T and the demand for silk is annually increasing by 5%. With the increase in population and also with the increased demand for fashionable clothing items due to fast changing fashion designs in developed countries, the demand for silk is bound to increase even more (Kim et al., 2016).

According to Bhat (2014), sericulture employs numerous semi-literate and semi-skilled poor workers throughout the year. Hence, several countries like China, India, Brazil, Thailand, Latin America and some of the African countries, Rwanda inclusive have taken up sericulture to provide employment to the people in their rural areas. According to Rahmathulla, Srinivasa, and Vindhya (2010), sericulture provides gainful employment, economic development and improvement in the quality of life to the people in rural area and therefore it plays an important role in anti-poverty program and prevents migration of rural people to urban area in search of employment. Many scholars studied the factors that influence the adoption of sericulture. For example, In Japan and China one of the major silk producers in the world (Kim et al., 2016), institutional factors such infrastructure and continued innovation(prevailing reeling machine combining transplanted stem reeling machine with the indigenous hand reeling one) as well as rationalization of the production organization contribute to the adoption and diffusion of sericulture technology.

In Rwanda Sericulture has been identified as a prospective earning sector as it is capable of creating employment, as well as alleviating poverty for major portion of the population in the country especially in rural areas where the majority of poor people lives in a subsistence economy. However, its adoption determinants and its effectiveness as an alternative source of income have not been well explored, as most of the adoption studies so far conducted in Rwanda largely focused on crop varieties and associated agronomic practices. This paper therefore provides a micro-perspective of the potential sericulture adoption institutional determinants in Gasabo District, Rwanda.

2. RIVIEW OF LITERATURE ON ADOPTION OF AGRICULTURAL TECHNOLOGY

2.1. Farmer-Decision Making Behavior Theory

There are certain decisions that one has to analyse possible outcomes and their consequences (Gebre, 2014). The decision-making theories have been largely considered in adoption studies, simply because when an individual has alternatives each with significant consequences, and that he or she is unsure about which choice is the best, a decision problem exists (Nigussie et al., 2017). According to Nigussie et al. (2017), decision-making takes different aspects based on whether information about all possible alternatives, their outcomes

and the preference of decision makers is available. According to the Rational Decision-Making Model; a model in which decisions are made systematically and based consistently on the principle of economic rationality people strive to maximize their individual economic outcomes (Nsengiyumva, 2017). According to Nigussie et al. (2017), decisions in farming are determined not only by the goal to reach profit/benefit maximization or risk reduction, but also by willingness to accept criticism from the community. This theory was used in this research to know what institutional factors that determine farmers to adopt sericulture technology in the study area.

2.2. Institutional theory

Institutional Theory provides a theoretical lens through which researchers can identify and examine influences that promote survival and legitimacy of organizational practices, including factors such as culture, social environment, regulation tradition and history, as well as economic incentives (Validi, Bhattacharya, & Byrne, 2014). According to Glover, Champion, Daniels, and Dainty (2014) institutional theory explains that the external social, political, and economic pressures influence firms' strategies and organizational decision-making as firms seek to adopt legitimate practices or legitimize their practices in the view of other stakeholders. In this study, this theory was employed as well to determine the effect of moderating variables such as cooperative membership, access to credit, access to sericulture information, provision of subsidy and access to extension services on the adoption of sericulture technology in Rwanda.

3. Methodology

The study adopted a case study design, which was suitable for this particular study since it sought to provide insights and understanding of the institutional factors influencing the adoption of sericulture technology among smallholder farmers in the study area. For this study, Gikomero sector of Gasabo District in the city of Kigali was selected, as it is known for sericulture activities compared to other sectors in the same district. Through a multi-stage sampling, 111 farmers' adopters and non-adopters of sericulture technology were selected and the study was conducted through interview using a pre-prepared and tested questionnaire. Data on different factors such as cooperative membership, sericulture subsidy, access to sericulture information, access to credit and extension services, among others were collected, analysed and presented.

3.1. Data Analysis Model

The econometric model employed in this study was the Probit Regression Model, which is a statistical probability model with two categories in the dependent variable. This model is based on the cumulative normal probability distribution whereby the binary dependent variable, takes on the values of 0 and 1. The choice of the probit model in the present study was to provide statistically significant findings of institutional factors and the dependent variable used for Probit Model was adoption which is a binary variable in nature that takes the value 1 or 0 whereby the value 1 indicates a farmer who adopted the sericulture technology while the value 0 indicates a farmer who did not adopt.

According to Uzunoz and Akcay (2012) probit model assumes that F represents the cumulative distribution function (F) of a standard normal variable. The cumulative distribution function (F) is then expressed as follow: $Prob(Y_i = 1) = \Phi(\beta_i X_i) = \int_{-\infty}^{X_i} 2\pi^{-0.5} \exp(-\frac{X_i^2}{2}) dX_i$ (1)

The inverse of equation above (1) gives the linear form of the probit model also estimated in studies by (Meral, 2012) and (Ajagbe, 2012). It is stated as: $\Phi^{-1}(p_{ij}) = Y_i^* = \beta_i X_i + \epsilon(2)$

Therefore, following Teferi A. (2014), the probit regression equation of the adoption of sericulture technology in this particular study was specified as follows:

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + u_i$$

Where:

X1= Cooperative membership

X2=Access to extension services

X3=Sericulture information

X4: Sericulture subsidy

X5: Extension contacts

Bo=Constant

Y_i stands for adoption of Sericulture Technology with a value of 1 for adopters and 0 for non-adopters.

u_i refers to the error term which is an independently distributed random variable with a mean of zero.

4. RESULTS AND DISCUSSION

In this section, both descriptive statistics and econometric model were used to analyze the primary data. Descriptive statistics were employed to describe the demographic characteristics of sample farmers including the adopters and non-adopters of sericulture technology. Econometric models were used to identify how the institutional variables such as cooperative membership, access to sericulture information, access to credit, and access to extension services as well as sericulture subsidy influence the adoption of sericulture technology in the study area.

4.1. DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS

4.1.1. Gender of Respondents

The variables used to describe demographic characteristics of sample farmers were educational level, sex, marital status, age and ratio of respondents ensuring the roles of household head and their relationship. The results presented in figure 1 depicts that 50.47% were female while the remaining 49.53% of the respondents were male. These findings really differ a bite from the report of (NISR, 2016), in which agricultural operators in Rwanda by gender was 70.0% male and 31.1% female cited by (Muhoza, Rutayisire, & Umubyeyi, 2016).

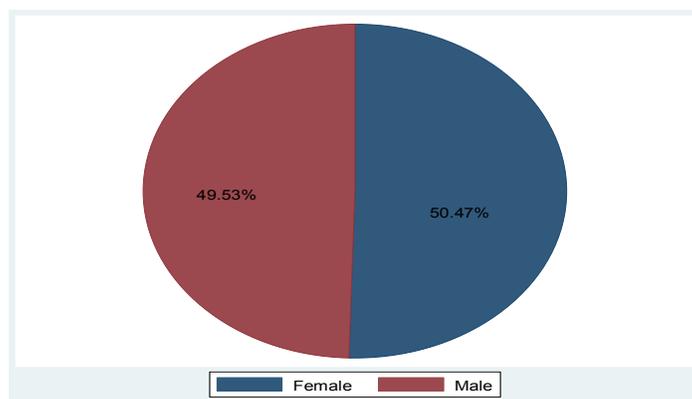


Figure 4.1: Distribution of respondents by sex

4.1.2. Marital Status of Respondents

Results from the table 1 summarize farmers' distribution according to their marital status. The resultants revealed that 83.5% were married while 9.7% were single. The results are in the same line with the national statistics as reported by (NISR, 2016) cited by Muhoza et al. (2016). This result shows the availability of labor force from married respondents in the study area.

Table 4.1: Distribution of respondents by marital status

Marital status of respondents	Freq.	Percent
Single	10	9.71
Married	86	83.50
Separated	2	1.94
Divorced	1	0.97
Widowed	4	3.88
Total	103	100.00

4.1.3. Education Level of Respondents

The results revealed that 41.8% attended primary 4-6 while 30.9% never attended school. The level of education in the study area is similar to the national education status as reported by (NISR, 2016) cited by Muhoza et al. (2016) where the results revealed that 66.6% of agricultural operators had attended primary level education, 25.9% had no education, and 6.5% attended secondary level education and only 1.0% had attended tertiary level education. This is an implication for low levels of education in the study area.

Table 4.2. Education Levels of Respondents

Education background of respondents	Frequency	Percent
None	34	30.91
Primary 1-3	17	15.45
Primary 4-6	46	41.82
Primary 7-8	9	8.18
Secondary 1-3	1	0.91
Secondary 4-6	2	1.82
Vocational	1	0.91
Total	110	100.00

4.1.4 Age of Respondents

The results from the table 4.3 showed the age category of sampled respondents. Accordingly, the mean age category of sericulture adopters and non-adopters were 47.14 years and 41.76 years respectively with the combined mean age of 44.45 years. The age category from this study revealed that farmers are still in age group and are more energetic to contribute to sericulture production.

Table 4.3: Distribution of Respondents by Age

Age	Obs	Mean	Std. Err.	Std. Dev.
Non adopters	61	41.76	1.880634	13.29809
Adopters	50	47.14	1.621289	11.46425
Combined	111	44.45	1.264462	12.64462
Diff		-5.38	2.483015	

diff = mean(No) - mean(Yes); t = -2.1667; Ho: diff = 0; degrees of freedom = 98; Ha: diff < 0; Ha: diff != 0; Ha: diff > 0, Pr(T < t) = 0.0163; Pr(|T| > |t|) = 0.0327; Pr(T > t) = 0.9837

4.2. INSTITUTIONAL FACTORS INFLUENCING THE ADOPTION SERICULTURE TECHNOLOGY

The results indicate that the most significant institutional variables are cooperative membership, access to extension services and access to credit and they influenced the adoption of sericulture technology in the study area at 5% level of statistical significance.

Table 4.4: Effect of institutional factors on the adoption of sericulture technology

Adoption of sericulture technology	Coef.	Std. Err.	Z	P> z
Cooperative membership	4.128	0.987	4.18	0.000*
Access to credit	2.117	0.782	2.71	0.007*
Access to sericulture information	-1.379	0.966	-1.43	0.153
Sericulture subsidy	-0.649	0.646	-1	0.315
Access to extension services	1.645	0.576	2.86	0.004*
_cons	-0.652	0.198	-3.28	0.001

Probit regression; Number of Obs=111; LR chi2(7)= 51.42; Prob> chi2 =0.0000; Log likelihood = -49.921; Pseudo R²= 0.34

Cooperative membership

Probit model showed that cooperative membership influenced farmers to adopt the sericulture technology in the study area. The plausible reason for this is that membership in a well-structured and managed cooperative increases the bargaining power and access to loans in the financial institutions, among others. Further to this, farmers' cooperatives/Self-Help Groups do facilitate information transfer and trust between farmers and buyers and these results are similar to the findings of (Hellin, Lundy, & Meijer, 2009) who studied on farmer organization, collective action and market access in Meso-America.

Access to extension services and contacts

The results from the study proved that access to extension services influenced the adoption of sericulture technology in the study area. In fact, extension services are not well-developed in the country and most farmers are often not aware about the existence of sericulture or perceive this technology to be very expensive. Similarly, there is a limited awareness in agro dealers. Therefore, there is no apparent interest in non-adopters to adopt sericulture technology and agro dealers to promoting and marketing the sericulture products. Therefore, in this study, it was proven that access to extension services would provide farmers with the information and skills that enable them to alter their farming technologies thus improve their livelihoods. According to Davis (2008); (Memon, Panhwar, Chandio, Bhutto, & Khooharo, 2014), agricultural extension is now seen playing a wider role by developing human and social capital, enhancing skills and knowledge for production and processing, facilitating access to markets and trade, organizing farmers and producer groups, and working with farmers toward sustainable natural resource management practices.

Access to credit

Results revealed that access to credit influenced positively smallholder farmers to adopt sericulture technology in the study area. In fact, it is acknowledged that the biggest barrier to the adoption of sericulture technology in Rwanda is finance. Despite the fact that sericulture technology is a competitive option in the face of other crops, it requires farmers to incur a high upfront cost for either purchasing land, mulberry cultivation or silkworm rearing when compared to the much lower capital cost of conventional crops. Furthermore, most of FIs, especially commercial banks have limited rural networks and they charge high interest rates (18 percent) and collaterals, which small-scale farmers cannot easily afford. Therefore, accessing the finances/credit would definitely enable them to adopt the technology.

5. CONCLUSION

This study analyzed the effect of institutional factors on sericulture technology adoption amongst the smallholder farmers in Gasabo District, Rwanda. The results estimated using both descriptive statistics and Probit model in STATA software indicated that cooperative membership, access to finance/credit, access to extension services are the most significant variables that affect the adoption of sericulture technology in the study area.

These results of the study provide information on policy makers and other stakeholders on the institutional factors that would increase the adoption rate among small-scale farmers in Rwanda. They stress the need for the appropriate policy formation and implementation in light with sericulture technology in the country as it is expected to have many benefits on economic growth and poverty reduction at both micro and macro levels.

6. RECOMMENDATIONS

Based on the adoption barriers assessed in this study, in order to effectively promote the technology on a commercial basis in Rwanda, and their subsequent adoption at scale, all value chain actors should:

Firstly, work together to increase the extension activities that aim at informing farmers, agro dealers, financial institutions and other relevant stakeholders about the benefit of sericulture technology as well as provide them with technical support. Secondly, there is a need to expand rural network for financial institutions and a well-designed loan product at a reasonable rate of interest for smallholder farmers who wish to adopt the sericulture technology, among many other agricultural technologies. Lastly, farmers should be mobilized to form sericulture cooperatives or where possible join the existing cooperatives/Self-Help Groups and provide them with capacity building in regard with cooperative and financial management and marketing.

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