

**DETERMINANTS OF MEMBERSHIP AND BENEFITS OF PARTICIPATION IN  
PYRETHRUM COOPERATIVES IN MUSANZE DISTRICT, RWANDA**

**BY**

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**Declaration**

I declare that this thesis is my original work and has not been presented for an award of a degree in any other academic institution.

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## **DEDICATION**

*With a profound gratitude, this thesis is dedicated to my wonderful family; my husband; Didier Uhoraningoga, my daughter; Hirwa Nikita Ornella, my Son; Hirwa Lucas Michael and my parents.*

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## **ABSTRACT**

For many years, pyrethrum in Rwanda has been among the top cash crops that earn significant foreign exchange for the country. Farmers grow subsistence crops for their own food needs and rely on pyrethrum as the cash crop to supplement their income. Cooperatives have been an important institution to organize farmers especially in agriculture export, so as to earn significant foreign exchange. Despite the effort in improving pyrethrum enterprise and strengthening farmers along the value chain, membership to cooperatives is still low and the sector is also under stress of shortage in the supply of raw materials. It is therefore interesting to explore the apathy in the pyrethrum cooperatives. Such institutions should be attractive and guarantee economic benefits to their members. The study investigated the membership and participation in pyrethrum cooperatives in Rwanda, and the respective subsequent benefits. It used primary data collected from a sample of 250 pyrethrum farmers from Musanze District. Descriptive and endogenous treatment regression/Heckman model were used for analysis. The study observed differences between members of farmer cooperatives and non-members with respect to households' characteristics, production resource endowments and access to institutional services such as credit and extension. The mean difference indicates that members of pyrethrum cooperative earned higher gross margin than non-members. The average means for members and non-members were Rfw 360,208.5 and Rwf 178,292.8 respectively while the mean gross margin was Rwf 280165.6 (US\$1 = 900 RwF). The results showed that the majority of pyrethrum farmers are relatively old persons. The study also found that there were capital constraints to join pyrethrum cooperatives and subsequently, farmers with access to credit, off-farm income, higher land size and higher share of pyrethrum income are more likely to be members. This reflects the need to encourage youth to join cooperatives and also facilitate them to acquire the required

capital. This is because membership seems to favour older persons who appreciate the benefits and also have required capital. In regard to the benefits of participation, the study found that membership to pyrethrum cooperatives had a positive and significant effect on farm profit. In fact by participating in a pyrethrum cooperative a farmer could increase his/her farm benefit by Rwf 548567.8 (US\$1 = 900 Rwf) per hectare per year. Moreover, the study perceived that members benefited from a numbers of opportunities including; access credits and extension services through cooperatives. Furthermore, future plan to expand the production scale and access to extension services had negative effect on farm profit. The negative relationship between access to extension services and farm profit implies the need to develop a new and specific extension package pertaining to pyrethrum production. However this will also need to assess the effectiveness of the extension approach currently used in pyrethrum sector. Despite a number of factors that may hinder farmers from joining pyrethrum cooperatives, relevant institutions should address key concerns that include the need to organize farmers into cooperative so as to improve smallholder farming profitability. This implies that farmers must be facilitated to meet membership requirement and different capital required to join cooperative. Furthermore membership fees should be accepted to be paid through different installments to help small holders with resource constraints to join cooperatives.

**Keywords:** Cooperatives; Pyrethrum; Farm profit; Farm benefits; Rwanda

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## **CHAPTER ONE**

### **1. INTRODUCTION**

#### **1.1 Background**

Farmers' organizations are acknowledged worldwide as suitable institutional arrangements to address poverty and improve food security and farm income (Tolno et al., 2015; Verhofstadt & Maertens, 2014; World Bank, 2008). Cooperative framework is progressively being presented as a condition for individual development through joint action and mutual responsibility, where one can achieve more due to the influence of collective action (International Labor Office, 2014). Members of cooperatives cut across various backgrounds including rural, urban, gender divide, agricultural and non-agricultural sectors and sometimes professionals. Members of agricultural cooperatives are mostly rural large and small farmers. From the evidence in developing countries, where over 3.1 billion people live in rural areas and a quarter of them still live in extreme poverty, it is obvious that cooperatives are essential means in alleviating poverty given that membership is open to all community members without any discrimination (Todaro & Smith, 2012; Wanyama, Develtere, & Pollet, 2008). Todaro and Smith (2012) argue that, in order to end rural poverty, emphasis should be placed on rural areas in general and agriculture sector in particular. However, the latter is fraught with risks and uncertainties, particularly in less developed countries. Hence, there is need for Africa to strengthen institutional arrangements for economic development through collective action. This includes promotion of cooperatives for the sustainability, profitability and productivity of the predominant agricultural sector.

The process of improving productivity, profitability and sustainability of smallholder farming is highlighted as an essential way out of poverty in developing countries. However, the impact on poverty reduction depends on rural farmers' participation as well as ownership of the development process (Verhofstadt & Maertens, 2014). World Bank (2008) acknowledges producer organizations as the main component of institutional innovations to ensure the enabling environment and structural changes for the productive agricultural sector. It also reveals the key role of farmer organizations in responding to the increasingly competitive world with strong rules of globalization.

Producer organizations can take on different legal forms such as cooperatives, associations and societies (World Bank, 2008). A number of studies have stressed on the potential role of cooperatives in improving its members and community's wellbeing in different ways. Evidence from Tanzania shows how cooperatives in export crops have enhanced farmers' entry to Warehouse Receipt System as a means of mitigating against price fluctuation and access to finance (Antonaci et al, 2014). Evidence from Rwanda in the last decade also shows that tea planters' cooperatives had an impressive employment of 4,476 temporary workers on a yearly basis (Wanyama et al., 2008).

The government of Rwanda has experienced a significant contribution of cooperative enterprises to the economic growth, though challenges remain daunting (Musahara, 2012). The coffee sector in Rwanda has been a good example in demonstrating how effective cooperatives can be in the process of development. The effort in coffee sector has resulted in a great impact because ever since the formation of cooperatives, the country embarked on production and exportation of specialty coffee whose revenue rose from \$0 in 2001 to over \$ 27,000,000 in 2011 (Bizimana et

al., 2012; Bourdreaux, 2011). Therefore, there are strong theoretical and practical bases to encourage smallholder farmers to actively participate in cooperatives.

In alignment with Vision 2020, the government of Rwanda has made the agricultural sector the main stake in its aim to accelerate economic growth and increase export revenue. Furthermore, a heavy emphasis is being placed on coffee, tea and pyrethrum, recognized as traditional export crops. Beside this, horticulture as an emerging sector with high diversification potential, is also among priorities to boost export revenues (GOR, 2013). Cooperative platforms are acknowledged to have played a key role in organizing farmers to earn the country's foreign exchange through increased productivity and quality in accordance with the export market (Mukarugwiza, 2010).

In Rwanda, pyrethrum is produced by 25,000 farmers, both small and large, and mainly in Musanze District where the climate is more conducive. Pyrethrum is grown across 3,200 hectares in Western and Northern provinces of Rwanda. All produce is marketed through cooperatives, and there is only one processor; SOPYRWA. The processed commodity is mainly for export although a little proportion that is used locally in the manufacture of pesticides (Bizimana et al., 2012; Government of Rwanda, 2012). Typically, farmers in the sector grow subsistence crops for their own needs and rely on pyrethrum as the cash crop to supplement their income. Thus pyrethrum industry potentially has an important contribution to the livelihood and wellbeing of farmers.

In the 1990s, Pyrethrum industry was owned and operated by a government agency. The sector later collapsed due to the effect of 1994 Genocide. Hence, following the country's development agenda; vision 2020 that brings attention to private sector-led development, pyrethrum industry was privatized in 2001. The state acts only as a catalyst; ensuring that infrastructure, human

resources and legal frameworks are availed towards stimulation of production in accordance with the directives of export markets. After privatization, farmers were informally organized in 22 cooperatives, poorly managed with non-active members (Stoelinga & Gathani, 2013). The poor management of pyrethrum cooperatives led to poor management of commodity chain and subsequently the total exports fell from 30 tonnes in 2006 to 4.6 tonnes in 2008. Since 2009, the government in collaboration with development partners and the processor embarked on mobilizing the organization of self-sustained, formal and well managed producer cooperatives (Huggins, 2013). The sector was restructured and seven new self-sustained cooperatives with strong management were established (Kagera, 2015).

Farmers are encouraged to form and join cooperatives to collectively address risks and related challenges that hinder production and improvement of income levels. In the same context, the processor does not accept pyrethrum from individual farmers and hence, non-members also have to sell their produce through cooperatives. Besides the role of cooperatives in increasing knowledge and skills as well as improving access to credit, the profit margins gained by cooperatives after sales are retained as shares for cooperative members only. Cooperative effort had a great contribution in the increase in production on the global market, from 6 percent to 15 percent between 2009 and 2015 respectively (Kagera, 2015). However the domestic as well as international markets have not yet been fully realized and the factory is still functioning below capacity, due to the insufficient supply of raw materials (GoR, 2013). Moreover, the government is striving to increase the productivity as well as the area under pyrethrum production that are anticipated to lead the increase in pyrethrum export revenue from 6, 200,000 USD in 2013 to 28, 000,000 USD by 2018 ( Stoelinga & Gathani, 2013; National Agricultural Export Development Board, 2015).

## **1.2 Statement of the research problem**

Cooperatives have been a successful model in poverty reduction through different ways. Various researchers have demonstrated the effectiveness of cooperative platforms in economically and socially empowering its members as well as the whole society. However, membership impact is to some extent challenged by the incidence of poor performance of cooperatives (Khumalo, 2014).

Facilitating pyrethrum farmers to join cooperatives reflects the provisions of the Rwanda's cooperative policy and law No 50/2007 of 18/09/2007, which provide incentive for inclusive participation. The current situation in cooperative perspective shows how active the Government of Rwanda has been in strengthening cooperative development, however it does not guarantee a maximum and direct membership. According to Kagera (2015), membership to pyrethrum cooperatives has increased from 2,769 in 2012 to 5,265 in 2015. Given the number of farmers in the sector, membership is still at 20 percent, and thus, it is not clear why farmer apathy in the cooperative movement exists. This is complicated by the fact that non-members of cooperatives do not have a different channel to sell their produce. Moreover, the supply of dried flowers to the factory is not yet up to the required capacity. The factory processing capacity is estimated at 3000 Metric tons per year while the factory produces at less than 50 percent of its capability (National Agriculture Export Development Board, 2017). Therefore, the question remains whether cooperatives make a difference in terms of benefits among members.

To make a difference in livelihoods, cooperatives need to be both inclusive and effective (Verhofstadt & Maertens, 2014). In this case the inclusivity reflects high participation level while the effectiveness reveals cooperative's impact on income levels and wellbeing, unambiguously from increased productivity. The pyrethrum industry is characterized by the low

supply of dried flowers (GoR, 2013) and there is little documentation to indicate whether this is linked to the low trend of cooperative membership. The most obvious reason for individual farmers to join cooperatives is to improve their level of performance so as to become economically better off (Hansen et al, 2006). Therefore, there is need to understand the dynamics in pyrethrum farm profit with respect to the nurturing institutions; the pyrethrum cooperatives.

### **1.3 Objectives of the study**

#### **1.3.1 Overall objective**

The purpose of this study is to explore the membership and participation in pyrethrum cooperatives in Rwanda, and the respective subsequent benefits.

#### **1.3.2 Specific objectives**

1. To characterize farmer participation in pyrethrum cooperatives.
2. To analyze factors influencing farmer participation in pyrethrum cooperatives.
3. To assess the financial benefit of participating in pyrethrum cooperatives.

### **1.4 Research hypotheses**

1. There are no characteristic differences among pyrethrum farmers in Musanze District.
2. Socio-economic and institutional factors have no effect on farmers' decision to participate in pyrethrum cooperatives.
3. Membership to pyrethrum cooperatives, socio-economic and institutional factors have no effect on farm profit.

## **1.5 Justification of the study**

Under Rwanda's Vision 2020, agriculture is acknowledged as an important pillar, to accelerate the country's economic growth. The Strategic Plan for the Transformation of Agriculture prioritizes the development and promotion of producer organizations as one of the strategies to accelerate the agricultural sector growth. Mukarugwiza (2010) highlighted the importance of cooperatives in organizing producers to earn the country's foreign exchange. Pyrethrum is amongst the top agricultural export products that earn country's foreign exchange (Bizimana et al., 2012) and drive the livelihood of about 25,000 farmers. Hence, the promotion and support of pyrethrum cooperatives should be at the center of the sector concerns if the country's foreign exchange and farmers' income levels are to be improved.

The study displays the key underlying factors that explain pyrethrum cooperative membership and its impact on members' performance. This provides insight on policy inputs that are needed to fuel the institutional and socio-economic environment within which pyrethrum cooperatives operate in, so as to increase membership and the level of farmers' performance. Additionally the underlining factors that explain membership and farm profit should be brought to the fore and analyzed for policy consideration. The results of the study also give insights on how farmers exploit pyrethrum cooperatives, the challenges they face and possible desirable interventions to promote successful cooperatives that guarantee the greatest level of membership and benefits. This study therefore adds to the existing literature that explain different potential benefits associated with farmer groups and their impact on farm benefits. This suggests that the results of this study are applicable in other fields of agriculture in which farmers face similar conditions, especially in Rwanda. Furthermore the results of the study are in line with provisions of the country's development agenda; vision 2020, SDG1 and SDG2. Rwanda Vision 2020 prioritizes



the transformation of Agriculture from subsistence to a knowledge based and value creating sector which contribute to the national economy and ensure food security in a sustainable way.

## **1.6 Organization of the Thesis**

Chapter one of the thesis presents the background of cooperatives, particularly in poverty reduction and raising income levels among poor rural farmers in developing countries. The research problem, objectives and research hypotheses and questions are also covered in this chapter. Chapter two is a review of different elements of literature. It covers issues of agricultural cooperatives in Rwanda, pyrethrum subsector and studies that addressed related topics. Chapter three presents the methodology, which covers the conceptual, theoretical, and empirical frameworks. It also reviews the underlining theory on which the study is based and the analytical approach that was used in the study. It further describes techniques that were used in sampling and data collection. Chapter four covers the results of the study then chapter five presents the summary, conclusion and recommendations.

## **CHAPTER TWO**

### **2. LITERATURE REVIEW**

#### **2.1 A historical account of the development of cooperatives in Rwanda**

Cooperatives in Rwanda have their origins in the efforts of the colonial government that sought to create institutions for implementing policies, but on the other hand, the spirit of cooperation as part of traditional social capital has been in Rwanda since time immemorial (Musahara, 2012). Until the colonial period to the independence in 1962, cooperatives were used as political tools for implementing policies that attempted to keep the population in disadvantaged positions. This resulted in little growth of these institutions during the colonial period whereby only 8 cooperatives were formed by 1962 (Mukarugwiza, 2010; Sentama, 2009). After independence, the new government used the cooperative movement as an instrument for economic development, which resulted in increased cooperative entities. In 1996, the number of cooperatives was estimated at 4,557 and by 2005, about 10,038 associations were identified, and notably 68 percent of them were operating in agriculture (Musahara, 2012).

Following ILO's (2003) advice to governments to support cooperatives growth, the Government of Rwanda promoted and supported cooperative growth through the promulgation of cooperative policy in 2006 followed by the endorsement of law governing cooperatives' structure and functioning. Furthermore the country's midterm strategy titled Economic development and poverty reduction strategy (EDPRS), embraces cooperative as precondition for the achievement of national development goals. Hence, cooperative platforms are acknowledged as the appropriate and pertinent way for the development of the majority of the population, of whom 80 percent are employed in the agricultural sector (GoR, 2013). Furthermore, for the fulfillment of

cooperative policy, the government established an agency named Rwanda Cooperative Agency, which is mandated to provide consistent regulatory services to cooperatives (Mukarugwiza, 2010). The prevailing evidences show how active the government of Rwanda has been in creating enabling environment for the improvement of cooperatives. The participation of the people in the movement, however, still stands challenged.

## **2.2 Cooperatives in Rwanda's Agriculture development**

Agricultural cooperative is defined as a group of farmers united voluntarily with the main purpose of pooling their resources together in certain area of activity to facilitate optimal production through efficient use of these resources (Msimango & Oladele, 2013). Agriculture is argued to be the main foundation for economic growth through improving the productivity, profitability, and sustainability of smallholder farmers (Verhofstadt & Maertens, 2014). For such achievement, institutional innovations are critical for structural changes towards the transformation of the agriculture sector from subsistence into a diversified and market oriented sector. The government of Rwanda targets high value productive and market oriented agriculture as a bridge towards achieving vision 2020 goals. To that effect, the strategic plan for the Transformation of agriculture (PSTA), put farmers' cooperatives at the center of its concern in its aim to shift the agricultural sector from subsistence to a commercialized one.

The current situation portrays the key role that cooperatives played in the success of the Crop Intensification Program (CIP) introduced by the Government of Rwanda in 2007. The Program aimed at increasing agricultural productivity to ensure food security and self-sufficiency. However, inadequate land size was an extremely limiting factor to meet its objectives and hence the only option was to increase the productivity of the land. To this effect, Land Use

Consolidation approach was used to address the land fragmentation issue and to make the available land more productive (Cantore, 2011). The effort built on cooperation spirit among farmers. It organizes farmers in a specific area to consolidate their small plots of land and grow a specific crop with respect to the agro-ecological and climatic conditions of the area without altering the plot ownership. The Program was successful as improvement in productivity was noticed, whereby maize yield increased from 0.65 to 2.5 metric ton per hectare between year 2000 and year 2010; wheat yield increased by 2.5 times during the same period. Beside this, cooperation among farmers has reduced transaction costs through bulking up production to access markets (GoR, 2013). Cooperatives engaged in cash crop production, such as tea, pyrethrum and coffee, play a major role in organizing small holder farmers to increase their levels of income and earn the country foreign exchange (Mukarugwiza, 2010). In the Rwandan coffee sector, cooperative effort resulted in improved management and use of coffee washing station which prompted dramatic growth since 2002, with receipts growing at an average of 30 percent per year (GoR, 2013).

Besides success stories related to cooperatives in Rwanda agricultural sector, various challenges with respect to performance remain discouraging. Among others, the low human capital of farmers has exacerbated the poor performance of agricultural cooperatives (GoR, 2013). This reflects the need to support and promote farmers' cooperation in agricultural sector so long as the sector development growth is expected to drive the achievement of the country's Vision 2020. Cooperatives in the pyrethrum sector have not yet attained their optimal membership, and the supply of their major commodity still below expectation.

### **2.3 Role of cooperatives in Pyrethrum value chain in Rwanda**

Pyrethrum crop is grown for its flowers which are dried and processed into natural insecticides or botanical pesticides, to control a wide range of insects and parasites. Pyrethrum farming in Rwanda is limited to the Northern and Western Provinces due to the prevailing suitable climatic conditions. Four districts namely; Musanze, Nyabihu, Rubavu and Burera are known to be the producers of pyrethrum in Rwanda (Huggins, 2013) .

Pyrethrum value chain in Rwanda has three main players, namely; farmers, cooperatives and the processor named SOPYRWA. The chain starts with farmers that grow pyrethrum for the production of dried flowers. Furthermore, farmers are not only responsible for growing pyrethrum but also for performing drying operation which makes the value chain very delicate, since it requires alertness to maintain the product quality in terms of moisture content. Flowers are picked by hand, and approximately 27-45 kilogram of flesh flowers per person per day can be picked and thus the labor intensive characteristic of pyrethrum farming. Because the processor does not accept produce from individuals, all production is collected or purchased by cooperatives, from both members and non-members (Huggins, 2013; Stoelinga & Gathani, 2013), but the benefit margins gained after selling the produce to the processor flow back to members only. It is therefore interesting to investigate why some pyrethrum farmers have not joined cooperatives.

Cooperatives are responsible for weighing, storing, and paying farmers after checking on quality. They also assist their members in applying good agricultural practices, and act as mediators between farmers and the processor. After sufficient quantity of dried flowers is collected, it is delivered to the processor, who pays cooperatives after checking on quality at a specific

laboratory for that effect (Huggins, 2013). Should the quality, specifically moisture content, not meet the required standards, the cooperative is likely to incur financial losses as it is paid less than what it has already paid farmers. This may negatively affect membership and later affect cooperative performance. Therefore the drying process depicts the uncertainty and risk bearing function of farmers and cooperatives along the value chain and may lead to low supply of dried flowers if not well handled. Due to the perishability and labor intensive characteristic of pyrethrum, it requires large expenditure to fund production and processing at farm level, yet pyrethrum farmers are small scale and often depend substantially on the crop for its cash to meet their family expenses.

Since the establishment of cooperatives in 2009, the sector recorded progress, However, Pyrethrum commodity chain still faces challenges and thus low supply of dried flowers. The main challenges include: (1) limited land availability, (2) competition between pyrethrum and Irish potatoes and (3) limited availability of planting materials (GoR, 2013). The link between these and farmer apathy in pyrethrum cooperatives as well as farmers' performance is worth an inquiry.

#### **2.4 Factors that influence participation in farmer organizations**

Technological, organizational and institutional innovations are key factors for the development of the agriculture sector in many developing countries (Botlhoko & Oladele, 2013). Producer organizations offer the institutional framework to boost smallholder farming sector through which the majority of the population derive their livelihood. The prevailing evidence provides a basis to promote active and successful farmer organizations. However for their sustainability and

effectiveness as well, emphasis should be put on an enabling environment as an incentive system for those organizations to flourish. To that effect, technical, institutional and socio-economic factors need to be identified and tackled. A number of studies have revealed different variables that influence membership to different types of producer organizations. According to Awotide et al. (2015), gender, education, farm size, output and expenditure per hectare significantly affect farmer's decision to participate in agricultural cooperative organizations in Nigeria. Similarly Kimutai (2016) analyzed determinants of small scale horticulture farmers' decision to join farmer based organizations in Kenya and found that education level, gender and farm size were significant. Zheng et al (2012) revealed that farmers who plan to expand their production scale in future are more likely to become members of agricultural cooperatives since the latter can ensure reduced risks for their investments. This concurs with Leathers (2006) who asserted that reduced production and marketing risks is one among other economic reasons that explain why farmers decide to join cooperatives.

Nugussie (2010) argues that besides personal interests of rural population, there are other factors that motivate them to join agricultural cooperatives. Among others, the author highlighted access to credit and trainings as the important predictors of farmers' decision to join Agricultural cooperatives. Furthermore, Ouma & Abdulai (2009) found that household's resource endowment such as access to off-farm income , education and number of adult members in the household significantly affect the probability of joining a farmer welfare group. The author also reported social capital such as trust, to be the main predictor of membership to a welfare group. Similar studies also found that age, access to social networks and information are important factors that determine membership to farmer group (Asante et al., 2011; Fischer & Qaim, 2011; Gyau et al., 2016). Therefore one can say that participation in agricultural cooperatives is driven

by farmers' human, physical and social capital. The actual situation in pyrethrum cooperatives in Rwanda deserves an investigation especially due to farmer apathy regardless of what the institution promises. The prevailing conditions show the role of different factors in attracting farmers to join producers' organizations. However, participation must generate positive benefits for its members (Ngaruko & Lwezaula, 2013). Therefore successful farmer based organizations should be attractive and effective as well. This implies the level of participation and performance of members, which deserve analysis on own sake.

## **2.5 Effect of cooperatives on farmers' levels of performance**

There is substantial evidence in literature that farmers' organizations are institutional tools to improve smallholder agricultural performance through improved market participation, improved levels of income, and in effect, rural poverty reduction (Fischer & Qaim, 2012; Verhofstadt & Maertens, 2014; Tolno et al., 2015). Similarly Abebaw & Haile. G, (2012) found that agricultural cooperative has a positive impact on new agricultural innovation and technology adoption. The prevailing evidence provides a basis for concluding that farmer based organizations are central for improved livelihood through a wide range of opportunities and services offered to its members.

Wollni & Zeller (2006) conducted a study to identify farmer benefits from participating in specialty coffee and cooperative market channels in Costa Rica. The results revealed that participation in cooperatives significantly affect the probability that farmers choose to grow specialty coffee. This implies that membership to farmer cooperative, provides members with the capacity to evaluate and adopt high quality and competitive product for remunerative market. Different empirical studies have stressed different potential benefits associated with agricultural



cooperatives. For example Tolno et al. (2015) argue that farmers' organizations play a key role in enhancing their levels of income. Verhofstadt & Maertens (2014) have demonstrated the importance of agricultural cooperatives in improving farm income and reducing rural poverty in Rwanda. However, their findings highlighted a phenomenon that the effect of membership is too low for land-poor farm households. Similarly Tanguy et al (2008) found that farmers' cooperatives have a positive impact on the commercialization of cereals in Ethiopia, however the impact was more pronounced for large farmers than for smallholder ones. Conversely Ngaruko & Lwezaula (2013) argue that sustainable farmer groups should satisfy their members' felt-needs and generate net positive benefits regardless of whether they are small or big farmers. Pyrethrum farmers are smallholders with limited access to production resources such as land and high yielding planting materials and consequently, it is evident that cooperative members are more likely to be smallholder farmers. Therefore there is a need to understand the effectiveness of these entities given the resource constraint characteristics of pyrethrum farmers.

Zheng et al .(2012) argue that farmers view cooperatives as important organizations which enable them to improve their economic welfare; however they are to some extent disappointed by the performance of these cooperatives. Therefore, there is a need to understand whether under the current production, marketing and institutional environment, cooperative entities are effective and at which extent farmers can benefit from membership. Yet, there is limited literature on diverse impacts of agricultural cooperatives in Rwanda. Moreover the current study anticipates the endogeneity bias that may arise from the unobservable factors that affect both selection function (membership to pyrethrum cooperative) and the outcome level (farm profit) and thus the endogenous binary treatment variable.

## **2.6 General approaches/methods used in similar studies**

A number of econometric methods have been used to estimate the probability of participation and effect of an intervention or program while controlling for bias in observational settings. For example, Tanguy et al. (2008) used the propensity score matching to assess the impact of cooperatives on commercialization of cereals in Ethiopia. The method analyzes the effect of an intervention on the behavior and welfare by estimating the counterfactual and uses it to identify the intervention's effect. However, this model emphasizes more on the mechanism of randomization to balance data between treated and untreated groups rather than modeling structures of selection bias that may arise from the unobservable attributes which may also lead to the endogeneity.

Akpalu & Normanyo (2013) analyzed the effect of illegal fishing on catch potentials among small scale fishers in Ghana. The study applied the endogenous switching regression model to estimate the counterfactual catch potentials of violators and non-violators in the first step and used it to identify the effect on catch levels for violators and non-violators in the second step. The model consists of the selection equation and two continuous regression equations that describe the behavior of a farmer as he/she faces two regimes of violating or not-violating fishing regulations. This approach accounts mainly for selection bias that may arise from both observable and unobservable behavioral factors. However, the model assumes a trivariate distribution of error terms and does not provide the effect of parameters of a linear regression model augmented with an endogenous binary treatment variable. Asfaw et al. (2010) explain the trivariate distribution of error terms as mainly the three sources of variation in the endogenous switching regression model where the first is the variation in regime one, second; the variation in regime two and thirdly; cross variation between the two regimes.

The two stage least square method is also used in the same context. The use of this approach is based on the suspected bias from the fact that the dependent variable's error terms are correlated with the independent variable. This is known as endogeneity bias (Wooldridge, 2012) which may arise from the self-selection bias, omitted variables or some measurement errors. The model corrects for this bias by the use of instrumental variable which is not easy to find given the assumptions that an instrumental variable has to be correlated with the endogenous variable but uncorrelated with outcome. Mburu et al (2002) used the two stage least squares approach to analyze relative importance and the determinants of transaction costs incurred by individual community members of wildlife conservation program in Kenya. The authors assumed that other participants' behavioral characteristics that were not measured could affect both the magnitude of participation costs and the benefits from participation. Hence, participation benefit as an explanatory variable that affects the magnitude of transaction costs was considered as an endogenous variable.

Other authors have estimated the effect of a program or intervention on members' performance using Heckman model also called the endogenous treatment regression. Briggs (2004) used the Heckman model to estimate the effect of commercial coaching programs on the SAT performance of high school students. The SAT is a kind of examination that high school graduates should pass to be admitted in competitive four-year colleges in the United States of America. Similarly the model was discussed in Brown and Mergoupis (2010). The model assumes that participants may self-select themselves based on some unobservable phenomena which in turn are correlated with the outcome response function and thus the treatment variable

is endogenous. This is known as endogenous binary treatment which occurs in the case of selection on unobservable aspects (Cerulli, 2014). In such a context, the endogenous treatment regression model (Heckman model) is the appropriate econometric approach that can be used to derive the asymptotically unbiased program or intervention effect. This model is used to estimate the Average Treatment Effect and other parameters of a linear regression model augmented with an endogenous binary treatment variable (Cerulli, 2014). Therefore, the present study applied the endogenous treatment regression, also called Heckman model to analyze membership decision making and the benefits of participation (impact of cooperative on farm profit). This is because due to some non-measured behavioral characteristics of farmers, cooperative members might be self-selected into cooperatives and since the level of farmers' performance (farm profit) is a function of membership, it is evident that those behavioral characteristics are more likely to be correlated with the level of performance and thus the cooperative membership variable is endogenous.

## **CHAPTER THREE**

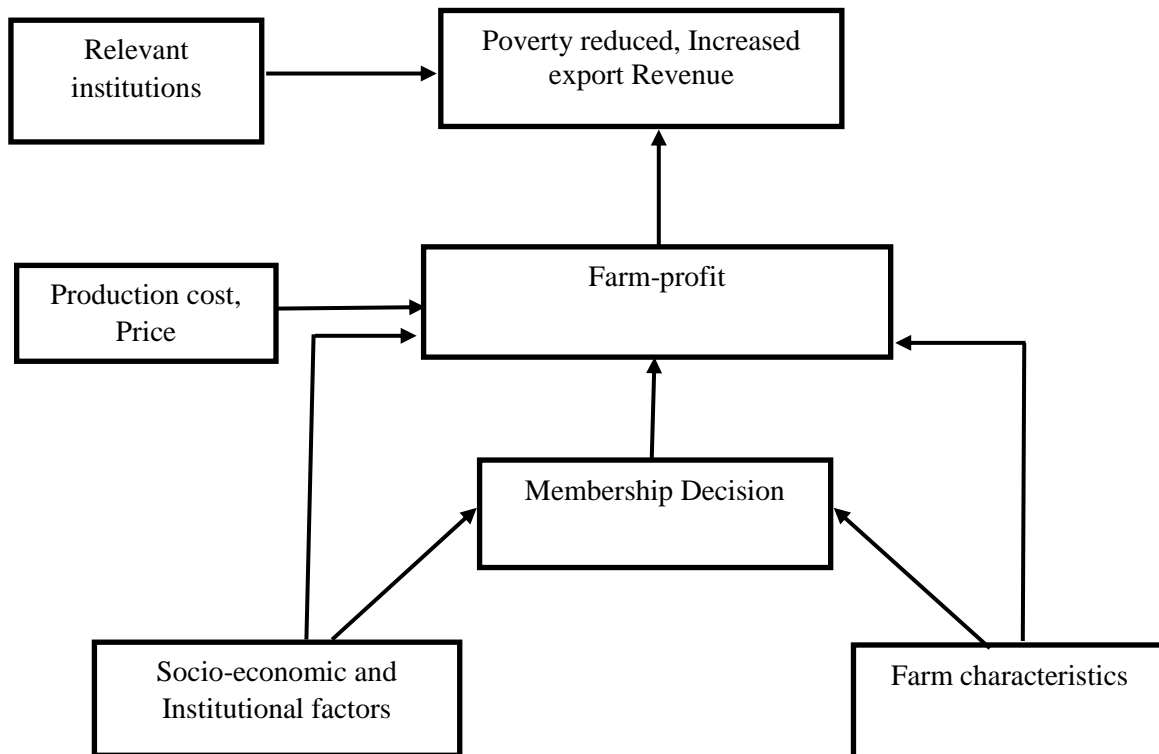
### **3. METHODOLOGY**

#### **3.1 Conceptual Framework of farmer's decision and benefit of participation in pyrethrum cooperatives**

This study is conceptualized as a two-step approach to draw the causal inference between a response schedule and a selection function. This means that a farmer's performance (generated farm profit) is a function of cooperative membership. A farmer makes a decision on whether or not to participate in a pyrethrum cooperative. Thereafter, membership to cooperatives, farm characteristics, institutional and socio-economic factors define the performance of such farmers (farm benefit). It is expected that membership should benefit farmers in terms of derived benefit from pyrethrum production. Members benefit from a number of opportunities from which they decide on adopting new production technologies, hiring more labor or land, given their perceived level of benefits. Hence the membership choice which appears to include a number of subsequent decisions is more likely to affect farmers' level of farm profitability. The implication here is that different performance levels are possible depending on whether a farmer is a member of cooperative society or not.

This conceptual framework summarizes the study. It presents the contextual variables which determine farmers' choice on membership or otherwise, effect of cooperative on farm profit, and ultimately increased export revenue from pyrethrum. The social-economic logic behind this is that some factors such age, education, access to off farm activities and to institutional services such as extension and credit, can explain the membership decision making. This is because for example; the risker taking characteristics of youth can influence them to take a decision to join cooperative. Educated farmers are also able to analyze and understand different opportunities that pertain to improve pyrethrum production and improve the livelihood of the household.

Access to institutional services such as extension and credit are also the determinants of membership. The Cooperative is the strategic channel to fetch the appropriate knowledge and information to improve on production. It can serve as the source of credit as it can also serve as a network to link farmers to different funding sources. Membership to pyrethrum cooperative is also expected to have an influence on farm profit. Therefore, socio-economic and institutional factors explain why households behave differently and can help them to make decisions to become more productive and improve their livelihood. The interventions are imperative to ensure the enabling environment for better functioning of cooperatives which in turn impact on the performance of their members.



**Figure 3.1:** Conceptual framework of farmers' decision and benefit of participation in pyrethrum cooperatives

Source: author

### 3.2 Theoretical framework

The study followed the Random utility model (RUM), which assumes that a choice is a discrete event. A household head chooses to participate in cooperative so as to maximize a welfare-enhancing factor or utility, subject to his/her specific behavioral characteristics. According to the theory in question, this study assumes that heads of households choose to participate in pyrethrum cooperatives because it maximizes their utility, otherwise they might choose not to participate if membership costs outweigh benefits. Therefore, the study used RUM to represent the membership decision making process based on the utility maximization. Farmers make decisions on whether or not to participate in pyrethrum cooperatives and on how to improve their production process either through hiring more labor and / or land, or improving processing procedures. Their decision is purposively to maximize the return from pyrethrum production.

According to Greene (2002), a rational farmer will choose to participate in a cooperative if the utility ( $U_{ij}$ ) derived from participating is greater than that derived from not participating ( $U_{ik}$ ).

$$U_{ij} (\beta_j X_i + \varepsilon_j) > U_{ik} (\beta_k X_i + \varepsilon_k) \quad \forall j \neq k \quad (1)$$

$$P_{ij} = \Pr [U_{ij} - U_{ik} > 0] \quad \forall j \neq k \quad (2)$$

$$= \Pr [(\beta_{ij} + \varepsilon_{ij}) - (\beta_{ik} + \varepsilon_{ik})] > 0 \quad (3)$$

$$= \Pr [X (\beta_{ij} - \beta_{ik}) + \varepsilon_{ij} - \varepsilon_{ik} > 0 | X] \quad (4)$$

$X$  is a vector of socio-economic and institutional characteristics of the individual/farm, and  $\varepsilon$  is the stochastic component of the utility function representing the unobserved attributes affecting individual  $i$ 's choice ( $k, j$ ), while  $\beta$  is the parameter to be estimated. The major focus of this study is to provide an estimate of the probability that a farmer will choose to participate in a cooperative and this will have an effect on the farm profit. Gross margin per hectare of land per year was used as a proxy for farm profit in pyrethrum farming.

### 3.3 Empirical framework

#### 3.3.1 Endogenous treatment regression/Heckman model specification

The endogenous treatment regression model (Heckman model) is a two-step approach that is widely used to estimate the treatment effect while catering for endogeneity bias arising from selection on non-observable factors (Cerulli, 2014; Greene, 2007). The model is estimated in two steps; (1) the selection function (a dummy variable indicating the treatment condition) and (2) a continuous regression equation which is observed for both subsamples (treated and control). In the second step, the treatment variable is directly entered into the continuous regression equation. Furthermore the first step involves the estimation of treatment probability then includes it in the second step outcome regression. Therefore the treatment equation is specified in two equations as follows:

$$P_i^* = \alpha Z_i + v_i \quad P_i = \begin{cases} 1 & \text{if } P_i^* = 1 \\ 0 & \text{otherwise} \end{cases} \quad (5)$$

$$Y_i^* = \beta X_i + \delta P_i + \varepsilon_i \quad (6)$$

Equation (5) represents the probit model used in the first step of Heckman model. Under this model, the equation is specified as a selection function which identifies factors that influence farmers' membership decision making. In the relationship,  $\alpha$  is a vector of parameters to be estimated,  $Z_i$  is a vector of explanatory variables expected to influence membership decision making,  $P_i$  is a dummy variable that takes on the value of 1 if a farmer is a member to pyrethrum cooperatives and 0 if not a member. Furthermore,  $v_i$  is a random error term assumed to be normally distributed and to account for unobservable factors that determine the decision to join pyrethrum cooperatives.



Equation (6) represents the second step which is the outcome function, where  $Y_i$  is the pyrethrum farm's gross margin per hectare per year,  $X_i$  is a vector of the explanatory variables that are expected to impact on farm gross margin,  $P_i$  is a dummy variable representing cooperative membership,  $\beta$  and  $\delta$  are the parameters to be estimated, and  $\varepsilon_i$  is a random error term.

Following Greene (2007), the expected value of  $Y$  conditional on whether a farmer is a cooperative member or not is given by:

$$E[Y_i | P_i = 1, X_i] = \beta X_i + \delta + E[\varepsilon_i | P_i = 1, X_i] \quad (7)$$

$$= \beta X_i + \delta + \rho \sigma E\left(\frac{\phi(\alpha Z_i)}{\Phi(\alpha Z_i)}\right)$$

And

$$E[Y_i | P_i = 0, X_i] = \beta X_i + E[\varepsilon_i | P_i = 0]$$

$$= \beta X_i + \rho \sigma E\left(\frac{-\phi(\alpha Z_i)}{1 - \Phi(\alpha Z_i)}\right) \quad (8)$$

The difference in expected farmers' level of benefit between participants and non-participants is given by:

$$E[Y_i | P_i = 1] - E[Y_i | P_i = 0] = \delta + \rho \sigma E\left(\frac{\phi_i}{\Phi_i(1 - \Phi_i)}\right) \quad (9)$$

Following Brown and Mergoupis (2010), Equations 7 and 8 represent separate models for outcome for treated and non-treated participants respectively. This is so since the term in bracket,

$\left(\frac{\phi_i}{\Phi_i(1 - \Phi_i)}\right)$ , is always positive, and the term  $\rho$  which measures the correlation can take on values

between -1 and 1. Therefore given the negative or positive sign that  $\rho$  can take, the least squares method could underestimate or overestimate the treatment effect. According to Green (2007), by estimating the two separate equations for participants and non-participants it would be the same as estimating two regressions by OLS, which would lead to inconsistent estimates due to the

selection bias. Therefore, the treatment effect is given by Equation (9) with the causal parameter of interest  $\delta$ .

### 3.3.2 Empirical model

#### Objective 2

By fitting into explanatory variables, the model is estimated as follows;

The first step which is deciding whether to participate in cooperative or not is:

$$P_i(0,1) = \alpha_0 + \alpha_1 Z_1 + \dots + \alpha_n Z_n + v_i \quad (11)$$

$$P_i = \alpha_0 + \alpha_1 AGE + \alpha_2 FAMLSIZE + \alpha_3 PLAN + \alpha_4 EXTENSION + \alpha_5 CREDIT + \alpha_6 DIST + \alpha_7 EDUC + \alpha_8 OFF\_FARMINCOM + \alpha_9 LANDSIZE + \alpha_{10} PROPINCOME + \alpha_{11} TRUST + \alpha_{12} CONDITIONALITY + \alpha_{13} PROFITMOT + V_i \quad (12)$$

The hypothesis that socio-economic and institutional factors have no effect on farmers' decision to participate in pyrethrum cooperatives ( $H_0: \alpha_i = 0$ ) is rejected if  $\alpha_i \neq 0$

#### Objective 3

The Second step which involves the impact outcome response (pyrethrum farm's gross margin per hectare per year);

$$Y_i = \beta_0 + \beta_1 X_1 + \dots + \beta_n X_n + \delta P_i + \rho \sigma (P_i, \alpha Z_i) + \varepsilon_i \quad (13)$$

$$Y_i = \beta_0 + \beta_1 AGE + \beta_2 FAMLSIZE + \beta_3 PLAN + \beta_4 EXTENSION + \beta_5 CREDIT + \beta_6 DIST + \beta_7 EDUC + \beta_8 OFF\_FARMINCOM + \beta_9 LANDSIZE + \beta_{10} PROFITMOT + \delta P_i + \varepsilon_i \quad (14)$$

The hypothesis that membership to pyrethrum cooperative, socio-economic and institutional factors have no effect on farm profit ( $H_0: \beta_i = 0, \delta = 0$ ) is rejected if  $\beta_i \neq 0, \delta \neq 0$ .

Different studies have demonstrated that membership to cooperatives or farmer groups and the resulting impact may be explained by different factors related to farmer and farm characteristics as described in Section 3.3.2.1

### **3.3.2.1 Justification of variables hypothesized to affect membership decision making**

Following the conceptual framework and based on some literatures on farmers' organizations, relevant explanatory variables that are expected to affect the likelihood of participation in cooperative were identified and included in this study. Key factors were identified and considered, based on findings from similar studies. Education, family size, off-farm income, age, proportional income from pyrethrum, plan to expand the production scale in the future, access to credit and extension services, land size, profit motivation and distance from household to the collection center were used in this analysis. Social capital feature such as trust is also anticipated to be a key driver of membership.

Education is hypothesized to have a positive effect on membership since it equips farmers with knowledge and skills to easily understand and respond to new ideas and information aiming at increasing household's livelihood (Gyau et al., 2016). Land size is also hypothesized to have a positive effect on membership likelihood because big farmers need more support in terms of improved technologies and information on their use, so as to increase their farm revenue given the related expenses (Asante et al., 2011). However farmers with large parcels are likely to produce more of whatever commodity and hence may not require cooperatives or other farmer organizations in purchases and in sales, yet a statutory requirement that pyrethrum processors buy from cooperatives only will make large farmers join cooperatives, and education is expected to enhance this. Age is expected to have a negative effect on adoption or in responding to new ideas (Olukunle, 2016). This implies that active and dynamic working population such as youth who are interested in searching for new production information rather than relying on their experience, are more likely to participate in cooperatives. The size of the family plays an

important role in the supply of family labor (Fischer & Qaim, 2011). Thus given the labor intensive characteristic of pyrethrum farming and the prevailing wage rate, the household heads are more likely to attend the available social network since they have a significant number of family labor to take in hand a number of production and processing activities.

Access to off-farm income is an alternative source of income for farmers to meet their needs (Ouma & Abdulai, 2009). Therefore access to off-farm income is expected to have a negative effect on the likelihood to join pyrethrum cooperatives. Furthermore, access to institutional services such as credit and extension are expected to have a positive effect on the likelihood to participate in cooperatives (Mugabekazi, 2014; Nkurunziza, 2014; Tolno et al., 2015). According to Zheng et al. (2012) the plan to expand the production in future is hypothesized to have a positive effect on the probability of participation in cooperatives. This is mainly because farmers who plan to expand their production scale in the future are more likely to join cooperatives since the latter insure reduced risks and thus provide farmers the opportunity to expand their operating scales. Moreover, Woolcock & Narayan (2000) reported trust as an important facet of social capital which indicates the level of trust of an institutional arrangement and thus an important key predictor of the membership probability. Other variables hypothesized to have a positive effect on the decision to participate in pyrethrum cooperatives are; proportional income from pyrethrum, profit motivation and the perception of farmers on the conditionality to participate in pyrethrum cooperatives. Given the smallholder characteristics of pyrethrum farmers, the higher income from pyrethrum farming should drive the likelihood to be highly involved in farming activities and other social network that promote pyrethrum production. Furthermore profit motivation is another important predictor of the likelihood to join pyrethrum cooperatives. This is mainly related to the historical background of pyrethrum

farming in Rwanda that started under the compulsory method where farmers were given land and it was mandatory to grow pyrethrum on 40 percent of the land. Therefore, given different changes in agricultural production and farmers' behavior due to some programs such as Crop Intensification Program which improved the use of improved inputs and pushed farmers to consolidate their lands, farmers are motivated by different reasons which can affect their decision making process.

### **3.3.2.2 Justification of variables hypothesized to affect the benefits of participation**

Suitable factors considered as the strong and important predictors of level of performance (pyrethrum farm's gross margin per hectare per year) were also included in the model to identify membership impact outcome. In this view, there is substantial evidence that farmers' organizations significantly and positively affect the respective level of income, selling price, reduce rural poverty and increase market participation (Barrett, 2007; Wollni & Zeller, 2006; Fischer & Qaim, 2012; Vendeplas, Minten, & Swinnen, 2013; Verhofstadt & Maertens, 2014). It is expected that membership to pyrethrum cooperative will affect the level of farmers' performance in terms of realized profit from pyrethrum production. Based on findings from the above cited authors, the following exogenous factors were identified as the main possible determinant of farmers' level of performance (gross margin). These are; Education, Family size, off-farm income, access to extension and credit services, land size, age and distance from the household to the collection center. Moreover, given the historical background of pyrethrum farming inherited from the colonial period, the study included profit motivation as an important predictor of the level of farmers' performance because it was noticed that farmers have different behavior behind pyrethrum farming. It is also expected that farmers who plan to expand their

future production scale are more likely to invest in long term assets which in turn can increase the production costs and thus negatively affect the gross margins. This explains the inclusion of PLAN, a dummy variable which indicates if a farmer has a plan to expand the pyrethrum production or not. The respective variables hypothesized to affect membership decision making and benefits of membership are defined in Tables 3.1 and 3.2, respectively.

**Table 3. 1:** Definitions of variables that are hypothesized to affect membership decision making

<b>Variables</b>	<b>Definition of variables</b>	<b>Expected signs</b>
AGE	Age of the household head	-
EDUC	years of formal education of household head	+
FAMLSIZE	Number of members of a household	+
PROFITMOT	Profit motivation (1= for expected profits, 0= otherwise)	+
PLAN	Plan to expand production in future (1=yes, 0=no)	+
LANDSIZE	Household's total arable land ( hectares)	+
DIST	Distance from household to cooperative ( Km)	-
TRUST	Trust the management of cooperative (1=yes, 0=no)	+
CONDITIONALITY	Conditionality of participation (1=high , 0=low)	-
OFF_FARMINCOM	Access to off farm income (1=yes, 0=no)	-
CREDIT	Access to credit (1=yes, 0=no)	+
EXTENSON	Access to extension services ( 1=yes, 0=no)	+
PROPINCOME	Proportional income from pyrethrum (percentage)	+

**Source: author**

The variables in Table 3.1 are used to test the hypothesis that socio-economic and institutional factors have no effect on farmers' decision to participate in pyrethrum cooperatives. The predicted signs or directions of influence of each variable are shown on the right-hand column of the table.

**Table 3. 2:** Definitions of variables that are hypothesized to affect the benefits of participation

<b>Variables</b>	<b>Definition of variables</b>	<b>Expected signs</b>
AGE	Age of the household head	-
EDUC	years of formal education of household head	+
FAMLSIZE	Number of members of a household	+
PROFITMOT	Profit motivation (1= for expected profits, 0= otherwise)	+
PLAN	Plan to expand production in future (1=yes, 0=no)	-
LANDSIZE	Household's total arable land ( hectares)	+
DIST	Distance from household to cooperative ( Km)	-
OFF_FARMINCOM	Access to off farm income (1=yes, 0=no)	+
CREDIT	Access to credit (1=yes, 0=no)	+
EXTENSON	Access to extension services ( 1=yes, 0=no)	+
COOPMSHIP	Cooperative membership (1=member, 0=non-member)	+

**Source: author**

The variables in Table 3.2 are used to test the hypothesis that membership to pyrethrum cooperative, socio-economic and institutional factors have no effect on farm profit. The predicted signs or directions of influence of each variable are shown on the right-hand column of the table.

### 3.4 Data sources and sampling procedure

This study used primary data for analysis. Semi-structured questionnaires were designed, pre-tested and administered to pyrethrum farmers in Musanze District of Rwanda. The questionnaire was developed to adequately collect data on farmer and farm characteristics by conducting face to face interviews. The sampling frame comprised of pyrethrum small holder farmers from Musanze District while the sample unit was the head of household (participant and no-participant in pyrethrum cooperatives). Random, purposive and multistage sampling methods were applied. Musanze district is made up of 15 sectors, out of which 7 were purposively selected because pyrethrum production takes place in those sectors. Amongst 7 sectors purposively selected, 4 were selected based on identifiable highly active cooperatives in those sectors. Sampling was done in three stages; firstly, the cells where pyrethrum production is more concentrated were identified. Secondly, members and non-members were identified, and finally, farmers to be interviewed were randomly selected. Interviews with key informants were conducted to get insight on opportunities, issues and efforts in place for the improvement. Key informant groups consisted of various actors in the value chain, extension staff and cooperative management.

According to Kothari (2004), the sample size when estimating a proportion and in the case of infinite population is given by:

$$n = \frac{z^2 \cdot p \cdot q}{e^2}$$

n is the sample size, Z is standard variation at a given confidence level (e.g. 95%) worked out from the table showing the area under normal curve, e is the desired level of precision, p is the



proportion of the population in the issue of focus; in this case p is the proportion of those farmers in cooperatives, and q is 1-p, i.e. the proportion of farmers not in cooperatives.

Kothari (2004) argues that, one method to estimate the value of p must be based on a personal judgment, results of a pilot study or on past data. The level of cooperative membership in pyrethrum sector of Rwanda is estimated approximately at 20 percent. Therefore, the variability in the proportion that will be participating in cooperative is assumed to be 0.2. Hence the value of p is assumed to be 0.2 and q; 0.8. The desired confidence level is 95 percent and  $\pm 5$  percent the desired level of precision. The resulting sample is specified below:

$$n_0 = \frac{Z^2 pq}{e^2} = \frac{(1.96)^2 (0.2)(0.8)}{(0.05)^2} = \frac{0.614656}{0.0025} = 246$$

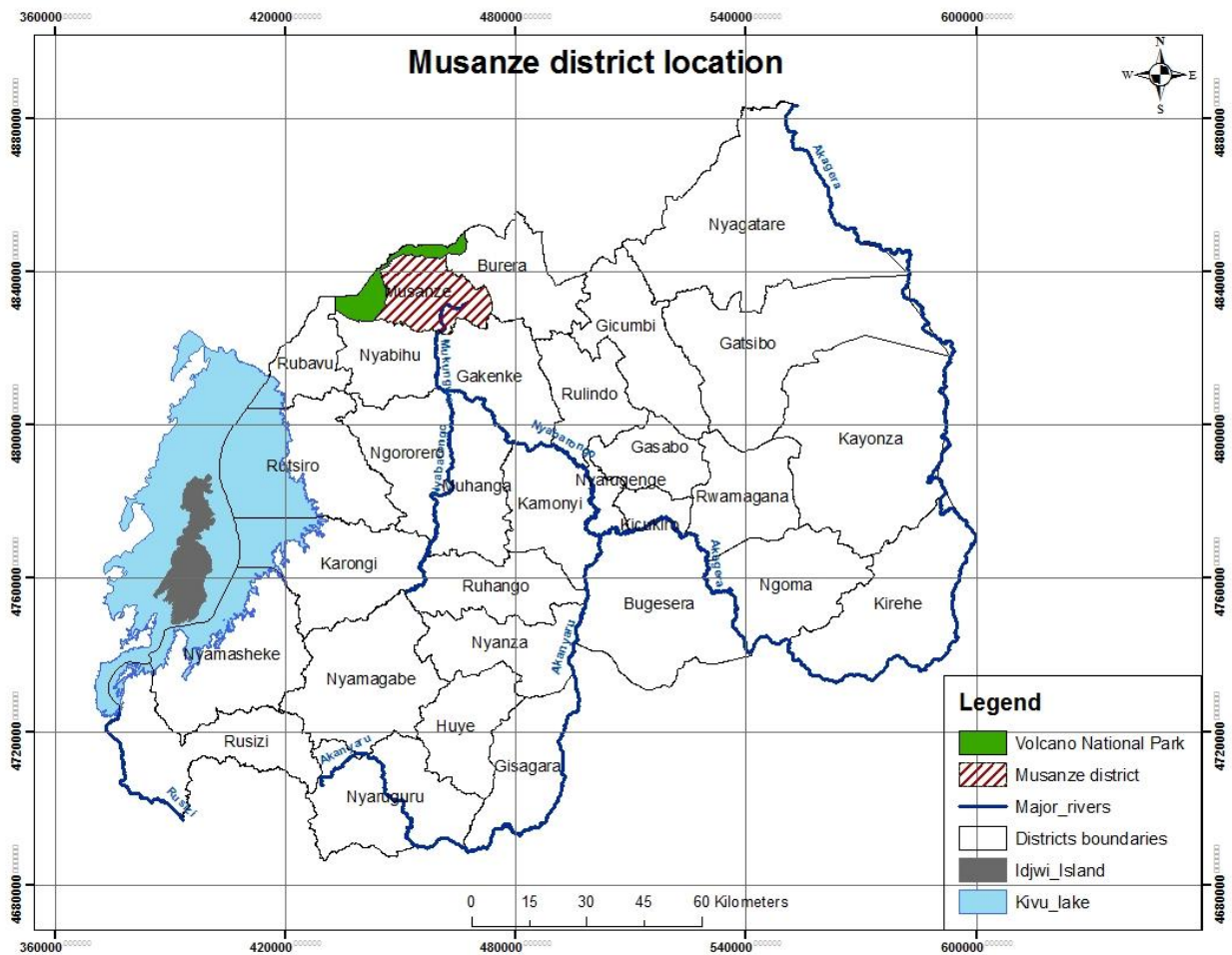
Hence a sample size of 246 was arrived at. However the study used a sample of 250 to reduce errors that may arise when some questionnaires are not filled appropriately and also the author had resources to reach 250 farmers.

### **3.5 Study area**

This study was conducted in Musanze District located in the Northern Province of Rwanda. The district is known to be a mountainous area with moderate slopes and volcanic ash soils. It also presents the friendly climate with an average altitude of 1860 meters above sea level and an average temperature of 20°C. Rains are generally abundant, ranging from 1,000 to 2,000 millimeters (GoR, 2012) and hence it presents suitable condition for growing pyrethrum which is ideally grown on an altitude of 1900 - 2000 meters, on volcanic soil, and requires sufficient rain and sunshine. The district experienced a significant expansion of area under pyrethrum production in the recent past; to date it accounts for 50 percent of land under pyrethrum production in Rwanda. The district has a total population of about 368,267 of whom 91 percent

are employed in the agriculture sector, with the poverty level of 20.1 percent (National Institute of Statistics of Rwanda, 2014). Musanze district is purposively selected because it is the main producer of pyrethrum, which is anticipated to have a great contribution in reducing rural poverty in this District. Figure 3.2 shows a map of Rwanda indicating the geographical position of Musanze District.

**Figure 3.2: Map of Rwanda Showing the location of Musanze District**



Source: National Institute of Statistics of Rwanda

## **3.6 Diagnostic tests**

### **3.6.1 Test of Multicollinearity**

To test for the suitability of explanatory variables included in the model; multicollinearity test was carried out. The correlation matrix was also used. Using the Pearson's correlation coefficient of  $\pm 0.5$  and above which reflects the existence of multicollinearity, the variable EXPERIENCE was omitted from the model because it was correlated with AGE. (*See Appendix4*)

### **3.6.2 Test for the goodness of fit of the model**

The log likelihood for the fitted model and Wald Test were considered when testing the goodness of fit of the model. (*See Appendix3*)

## CHAPTER FOUR

### 4. RESULTS AND DISCUSSIONS

#### 4.1 Farmer, cooperative and farm characteristics

##### 4.1.1 Level of membership

The sample contained 140 members and 110 non-members from four sectors namely; Gataraga, Shingiro, Kinigi and Nyange. Kinigi and Nyange present the highest number of respondents compared to other remaining sectors. The explanation here is that cooperatives in those sectors have the high level of membership compared to other sectors. Table 4.1 presents the level of membership in the sample.

**Table 4. 1: Level of cooperative membership per sector**

Sectors	Non-members (n= 110)		Members (n=140)		Pooled (n=250)	
	Frequency	Percent	Frequency	percent	Frequency	Percent
Gataraga	25	22.7	27	19.3	52	20.80
Shingiro	29	26.4	28	20	57	22.80
Kinigi	34	30.9	51	36.4	85	34.00
Nyange	22	20	34	24.3	56	22.40

**Source: Survey data (2017)**

Pyrethrum cooperatives serve not only as pyrethrum markets at the proximity of farmers but also offer employment to their members and the whole society as well. To perform all marketing related activities, pyrethrum cooperatives use permanent and casual workers. In this regards, 85 permanent workers were employed by cooperatives. They also use to employ casual workers where 19,728 of them were employed by 2016. This is evidence that pyrethrum cooperatives

play a key role in empowering farmers economically, both members and non-member through job creation initiatives in rural areas.

#### 4.1.2 Level of members' commitment

Table 4.2 presents the extent to which members are involved in cooperatives' activities as shown by the ratio of participation. This ratio was measured in terms of the number of activities attended over the total number of organized activities by the cooperative.

**Table 4.2: Ratio of participation in pyrethrum cooperatives**

Cooperatives	Number of Members	Mean ratio of participation	Standard deviation	Minimum	Maximum
KOABI	27	0.685	0.203	0.333	1
ABAKUNDUMURIMO	28	0.696	0.279	0.167	1
ABAKUNDIBIRETI	51	0.611	0.303	0	1
JYAMBERE	34	0.583	0.326	0	1
Pooled	140	0.635	0.288	0	1

**Source: Survey data (2017)**

The findings show that the ratio of participation in the cooperatives' activities is about 0.63, implying that at least members attend 63 activities out of 100 organized activities per year. This reflects the commitment and motivation of members towards the achievement of shared goals as well as their own economic goals.

Gyau et al. (2016) discussed that among members of any farmer group, the level of commitment and intensity of participation vary across individuals, given that their motivation and perceived benefits are different. Moreover, the success of such groups does not depend on only

membership, but also on members' commitment as argued by Fischer and Qaim (2011). The current study analyzed the ratio of participation within pyrethrum cooperatives. According to Vorlaufer et al. (2012), the commitment of members influences the collective action outcome and hence the performance of the group. The results show that, members of cooperatives are active in general since the mean ratio of participation is above 0.5. At least 3 out of 6 organized activities were attended. Fischer and Qaim, (2011) argue that low rate of participation in joint activities may be a drawback for the success and viability of farmer groups. Therefore the sustainability and success of pyrethrum cooperatives will depend on potential members that are committed to contribute to the achievement of cooperatives' goals.

#### **4.1.3 Socio-economic and institutional characteristics of farmers**

The descriptive statistics for the sample farmers are presented in Table 4.3. The average age of sample farmers was 47 years. This backed the argument of Bojang and Ndeso-Atanga (2013) who assert a very low participation of African youth in primary agriculture production and natural resource conservation and preservation. Furthermore the mean age of formal education is between 4 to 5 years which implies that the majority of sample farmers had at least completed part of primary school. The implication here is that, the majority of farmers are able to read and understand different opportunities that can improve their pyrethrum production. Additionally the majority of respondents were mainly farmers with only 36 percent who had off farm income and members were found to earn more off-farm income than non-members. This reflects the national figures where the off-farm employment in rural areas is about 13 percent of the working population (National Institute of Statistics of Rwanda, 2014).

**Table 4.3: Farmers' households' characteristics**

Variables	Mean			Test of significance	
	Non-members (n=110)	Members (n=140)	Combined (n=250)	t-statistic	p-values
AGE	43.24	50.52	47.32	-4.006	0.0001***
EDUC	4.57	4.89	4.75	-0.675	0.5003
FSIZE (hectares)	0.31	0.40	0.36	-2.8023	0.006***
LANDSIZE (hectares)	0.64	0.85	0.76	-3.3632	0.001***
FAMILSIZE	4.68	4.57	4.62	0.4326	0.665
GROSS_MARGIN(Rwf)	178292.8	360208.5	280165.6	-3.4602	0.0006***
PROPINCOME (%)	22	33	28	-4.3869	0.000***
DIST (Km)	1.64	1.71	1.68	-0.7024	0.7024
Discrete variables	Percent			$\chi^2$ -statistics	p-values
OFF_FARMINCOME	25	45	36	10.165	0.001***
PROFITMOT	76	91	84	9.635	0.002***
CREDIT	9	29	20	15.471	0.000***
EXTENSION	66	94	82	32.537	0.000***
TRUST	70	86	79	9.1056	0.003**
CONDITIONALITY	38	6	20	40.5866	0.000***
PLAN	50	66	59	6.279	0.012**

**Source: Survey data (2017)**

As indicated from the table 4.3, about 84 percent of respondents reported that the main motivation behind the production of pyrethrum was the expected profit from flower sales; members appeared to be more profit motivated than non-member ( $p < 0.01$ ). It is generally noteworthy that pyrethrum production is mainly driven by financial returns from pyrethrum flower sales. This agrees with Msimango and Oladele (2013) who argue that the majority of farmers participate in cooperatives to improve on profit. It was also observed that for the future,

59 percent of respondents plan to expand their production, however members were more concerned about the future than non-members ( $p < 0.05$ ).

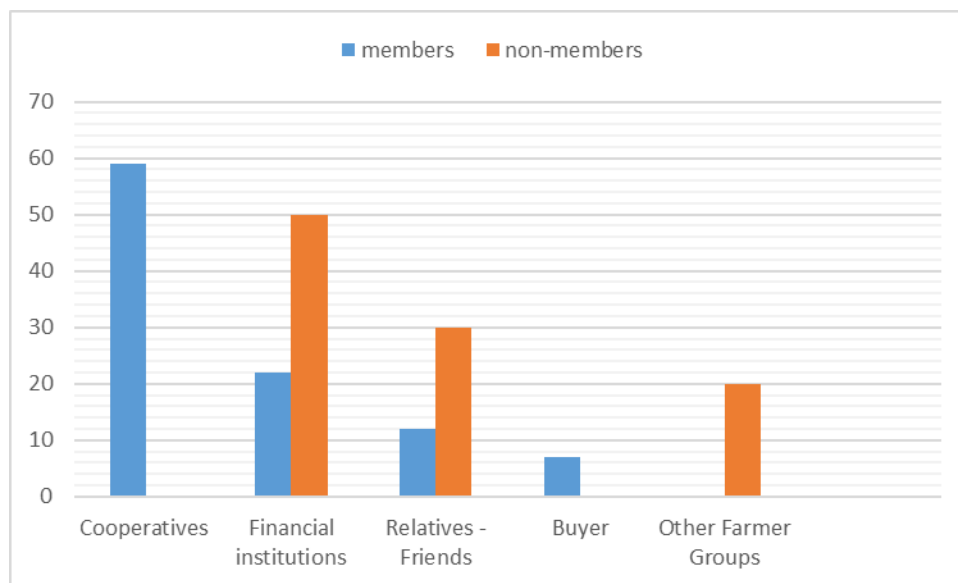
The overall mean total land among the sample farmers was 0.76 hectares and results indicated a significant difference in land size across the two categories. This mirrors the GoR (2013) which highlights the limited availability of land as the main challenge that limits pyrethrum production. Besides this, the country's statistics indicate that the average size of land for rural farmers is low, about 0.6 hectares and often divided into three to four plots (GoR, 2013). The pooled mean gross margin per hectare per year is Rwf 280165.6 (\$1 = Rwf 900) and members had higher gross margin than non-members.

Observing from the table 4.3, about 20 and 82 percent of sample farmers respectively had access to credit and extension services, and the proportion of those who had access to credits and extension services during the last 12 months were higher among members of cooperatives. Pyrethrum cooperatives offer credits and extension services to their members. A significant proportion of members; 59 percent sourced their credit through pyrethrum cooperatives, while 44 percent received extension services through pyrethrum cooperatives. Farmers reported to have different sources of credits.

Figure 4.1 describes different sources of credits indicated by sample farmers. It gives summary on different channels where farmers source credits to invest in pyrethrum production.



**Figure 4. 1: Different sources of credit for pyrethrum farmers in Musanze District**



**Source: Survey data (2017)**

Access to credit is still low; only 20 percent of households had access to credit and this presents a key challenge to access to farm inputs and other equipment required in production and processing. Cooperatives represent the main source of funds for pyrethrum production investment for their members. Pyrethrum cooperatives and financial institutions contributed to 59 and 22 percent of credits given to members respectively, while financial institutions (SACCOs and banks) which were the main source of credits to non-members has contributed to 50 percent of credit offered to this group. Apart from being the main and affordable source of funds to invest in pyrethrum production, pyrethrum cooperatives serve as a guarantor to facilitate their members' access to loans via banks or SACCOs. Furthermore the buyer offer credits to cooperative members only. This portrays the importance of cooperative to link farmers with different networks where they can source credits. In the same view, farmers have described different limitations to access credits (Table 4.4).

**Table 4.4: Different constraints that limit farmers' access to credits in pyrethrum production**

<b>reason for non- access to credit</b>	<b>Frequency</b>	<b>Percent</b>
Lack of required collateral	67	34
High cost to obtain credit	61	31
Short period of repayment	18	9
Adequate collateral but denied amount	6	3
Lack of information	25	12

**Source: Survey data (2017)**

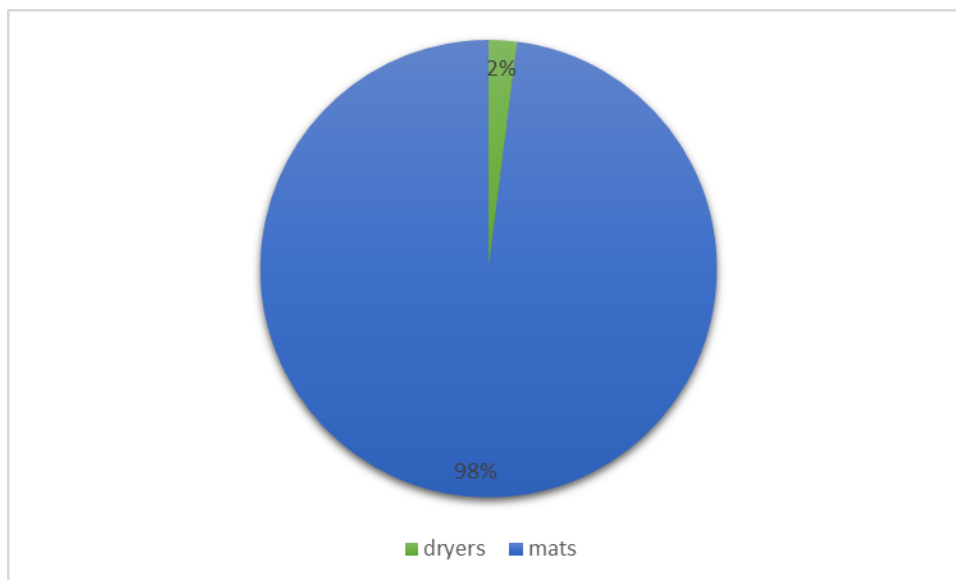
Given the low level of access to credit in pyrethrum sector, the study has identified different challenges that limit farmers' access to credit if they are to improve their access to both input and output markets and also to adopt new technologies involving some costs. Observing from the table 4.4, lack of required collateral, high cost, and lack of information are the main challenges that limit farmers' access to credit, at 34, 31 and 12 percent respectively. The study concurs with Kiplimo et al. ( 2015) who argue that, the problem of access to credit is exacerbated by the inability of lenders to provide loans to farmers due to lack of farm records and lack of required guarantee. Furthermore lack of knowledge on different procedures to obtain credits also represents a major challenge. Access to credit could enable farmers obtain capital for not only primary production but also marketing which involves further processing to dry flowers to the required level of moisture. The marketing step represents an important stage in production process because it helps to achieve the average moisture content for the produce to be accepted by the buyer. Marketing characteristics of pyrethrum farmers is explained in section 4.1.4.

#### 4.1.4 Marketing characteristics of pyrethrum farmers

##### 4.1.4.1 Use of dryers

The industry requires some specialized tasks to accomplish the marketing process. Some farmers spread their flowers on mats for drying at home, while some take to the society dryers. Figure 4.2 depicts the ability of farmers to access drying facilities.

**Figure 4. 2: Distribution of farmers per method used in drying process**



**Source: Survey data (2017)**

The drying process requires care to achieve the maximum acceptable moisture content. This imposes the use of drying facilities that can help farmers to avoid losses which may arise from the process. However, the sector presents post-harvest losses under stress of shortage in drying facilities (NAEB, 2017). The results show that the use of dryer is still low; only 2 percent of all respondents use dryers, while 98 percent use mats. About 72 percent of respondents reported that most post-harvest losses were due to the lack of access to dryers. The study area had only six

dryers of which each could accommodate 2 metric tons of fresh flowers at one go. Thus in the rainy season when the climate is not conducive for drying, farmers are more likely to incur losses since they handle a number of competing enterprises and thus it rains over pyrethrum flowers in their absence.

#### **4.1.4.2 Pyrethrum marketing channels**

Pyrethrum market in Rwanda is dominated by monopoly power. The industry presents one main buyer at national level; SOPYRWA, while the produce is mainly sold through pyrethrum cooperatives, following the buyer's instructions (Huggins , 2013). However, the value chain presents few brokers who consolidate produce from different farmers at the lowest price and at non-uniform price. About 9 percent of respondents reported having sold their produce through brokers. Brokers, as opposed to pyrethrum cooperatives, buy either fresh or dried flowers and pay farmers immediately. Thus some farmers; members and non-members of cooperatives prefer to sell to brokers and obtain quick cash because payment after delivery to the cooperative is not instant; it occurs within one week after the delivery. Brokers deliver to pyrethrum cooperatives, and thus it is not clear why brokers are still allowed to sell to cooperatives and in most of the cases, they are non –members. The price paid to farmers per kilogram of dried flowers was 1080 Rwf, however the minimum price could get to 800 Rwf when sold to brokers. Furthermore, non-members of cooperatives indicated different reasons that hinder them from joining the statutory farmer organizations.

#### 4.1.5 Reasons that limit farmers from joining cooperatives

Table 4.5 presents the main challenges that hinder farmers from joining cooperatives, as reported by the respondents. It gives more insights on which strategy to adopt in order to help farmers meet the conditionality to become members of cooperatives.

**Table 4.5: Reasons for not joining cooperatives**

Reasons for not joining cooperatives	Number	Percent
Not aware of membership advantages	33	30
High membership fees	63	57.27
Previous experience	10	9.09
Low trust for the management	4	3.64
Total	110	100

**Source: Survey data (2017)**

About 57 percent of non-members interviewed indicated high membership fees as being their main reason of the status. Also about 30 percent of them were not aware of any benefits from membership, while 10 percent were not interested in joining cooperative and they did not see any benefit or loss from joining or not joining cooperatives. This is because those farmers have experienced the case of cooperative mismanagement before the restructuring of the value chain. The other remaining 4 percent said that the main reason they did not join cooperatives was the lack of trust in regards to cooperative management. In pyrethrum cooperatives, membership fee is paid in one installment. This means that for a farmer to be a member, he or she has to pay membership fees in one installment. This is a major limitation for poor farmers to fulfill the membership requirements. Another important share of non-members; 30 percent, was still working in the shadow of ignorance because they were not aware of different potential benefits they could obtain by joining pyrethrum cooperatives. Therefore, awareness initiatives should be expanded to reach more pyrethrum farmers. The membership fee was estimated at 15,000 Rwf

(\$1=900 Rwf) which is an important amount for a small farmer to pay in one installment. Flowers can be picked 10 to 12 times a year and to be able to pay the above mentioned membership fees, it requires a farmer to reach more than 14 kg of dried flowers equivalent to 56 kg of fresh flowers that worth 15,000 Rwf. Considering other family expenses, it could be very difficult for a small farmer to pay this fee in one harvest. However through several installments, it is possible for small holders to meet financial requirements to join pyrethrum cooperatives.

#### **4.2 Determinants of participation in cooperatives and its benefits**

The results from the regression confirm that membership to pyrethrum cooperatives has a statistically significant and positive effect on farm profit ( $p < 0.1$ ). The likelihood ratio test of independent equations rejected the hypothesis of zero correlation between errors in the selection and outcome equations at 1 percent. This justified the use of the Heckman model. The negative sign of rho ( $\rho$ ) indicates the direction of the bias, and hence without the use of this model, OLS would have underestimated the effect of cooperative membership. The log likelihood for the fitted model was -3671.6146. The Wald test resulted in a chi-square of 78.95 and the p value of 0.000. Hence the null hypothesis that all parameters in the regression equal to zero was rejected.

The variance Inflation factor (VIF) test for all variables in the regression was 1.26 and none of these variables had a VIF that is above 2. Gujarati (2003) argues that as a rule of thumb, if the VIF of any variable in the regression exceeds 10, which might happen if the R-squared from the regression of  $X_j$  on the remaining explanatory variables exceeds 0.90, that variable is said to be highly collinear. Also using the correlation matrix to test for multicollinearity, the variable AGE was highly correlated with EXPERIENCE with the correlation coefficient of 0.68 and thus, the latter variable was omitted from the model.

#### 4.2.1 Factors influencing farmers' decision to participate in pyrethrum cooperatives

Table 4.6 presents the parameter estimates from the first stage of the model. Parameters estimates from this stage explain the direction of the probability to join cooperatives with respect to the explanatory variables used in the model.

**Table 4.6: Determinants of membership in pyrethrum cooperatives**

Explanatory variables	Cooperative membership (n=250)	
	coefficients	Robust std.error
AGE	0.018824**	0.0084727
FAMILSIZE	-0.0538035	0.0525111
PLAN	0.2824245	0.192955
PROFITMOT	0.6005274**	0.279535
EXTENSION	1.097045***	0.2643612
CREDIT	0.8620955***	0.2633775
DIST	0.0530954	0.0775766
EDUC	0.0420424	0.0298181
OFF_FARMINCOM	0.7084776***	0.2032472
LANDSIZE	0.3443292*	0.1875562
PROPINCOME	0.0291588***	0.0053273
CONDITIONALITY	-0.6395905**	0.2942146
TRUST	0.6954495	0.4323863
CONSTANT	-4.394765***	0.765895

**Source: analyzed from Survey data (2017)**

\*\*\*, \*\*, \* indicate 1%, 5% and 10 % significance levels

Conversely with the study hypothesis, the age of the head of the household had a positive and significant effect on the decision to participate in pyrethrum cooperatives. From the earlier observations, the majority of pyrethrum farmers are old. Therefore given the age and position in the household, older members of households are more likely to take decisions that can affect the

family's livelihood. This contrasts Awotide et al (2015) who found that age of the farmer exhibits a negative influence on participation in cooperative organization in rural Nigeria. This is because young farmers are perceived to be better risk takers than older farmers, and hence they are more likely to embrace change. The study agrees with Gyau et al. (2016) who found a positive relationship between age and participation in farmer groups in Kenya.

The results also reveal that the more a farmer is profit motivated, the higher the likelihood to become a cooperative member. The plausible explanation here is that given the compulsory nature of pyrethrum production from the colonial period, farmers are driven by divergent aims, among others; the compulsory nature as they were given land, inheritance of land and profits or income from flower sales. It is expected that farmers who are purposely producing pyrethrum with the aim to increase their farm income or their family livelihood, will behave differently from those growing pyrethrum to follow their traditional ties or because it is compulsory. Hence the desire to satisfy the economic goals behind pyrethrum farming is positively associated with cooperative membership. Hansen et al. (2002) argue that farmers tend to join cooperatives in order to satisfy their desire to become financially better off. Thus, they expect their membership to benefit them in terms of higher income derived from a specific commodity production. Therefore, given variant motivation of farmers behind pyrethrum production, it is evident that profit oriented farmers are more likely to join pyrethrum cooperatives.

Contrary to the hypothesis, access to off-farm income had a positive and significant effect on membership. Pyrethrum cooperatives are more acknowledged as marketing agencies at the proximity of farmers and hence present a number of employment opportunities to perform all necessary marketing activities throughout. This opportunity is primarily offered to members and



hence a number of members possess either casual or permanent jobs with their cooperatives, which in turn can influence other farmers' membership decision making. This finding is contrary to Ouma and Abdulai (2009) who found that the likelihood of membership to a welfare group is lower for households with access to off-farm income. This is because the off-farm activities provide farmers with alternative sources of income to satisfy their needs and hence, they are not motivated to join cooperatives.

Access to institutional services had a positive and significant effect on membership decision making. As hypothesized, the results showed that access to credit increases the likelihood of participating in pyrethrum cooperatives ( $p < 0.01$ ). This variable measures whether farmers are able to afford financial services for the facilitation of production and processing. This implies that cooperatives serve as sources of credits or networks to link farmers to financial services, which in turn can attract other farmers to join cooperatives. Hong and Hanson (2016) argue that for every dollar invested in agriculture in Rwanda, it produces more than three dollars to GDP. Hence investment in agriculture is crucial in the country's economic development pathway. However smallholders tend to have little or no access to formal credit, which limits their capacity to invest in agriculture and hence limits agricultural yields and income. Therefore, given the nature of smallholder farming; poor farmers with resource constraints who mostly struggle to meet the requirements of participation in cooperatives, access to credit may help to strengthen financial capacity of such households and hence an incentive to join cooperatives. Similarly, Mugabekazi (2014) and Nkurunziza (2014), independently, found that access to credit positively influenced farmers' decisions to join coffee producers' cooperatives in Rwanda.

Access to extension services was positively associated with participation in pyrethrum cooperatives. This may be explained by the fact that extension personnel from the Government, and other partners, often mobilize farmers to adopt new production technologies and persuade them to join cooperatives since some new inputs such as seedlings and information on their use are shared through pyrethrum cooperatives. It is therefore evident that farmers who often have access to extension services, are more likely to join pyrethrum cooperatives. This concurs with Nugussie (2010) who argues that access to some training and visits exposures, plays a key role in enhancing the awareness of the rural people on the importance of cooperative societies.

The proportional income from pyrethrum was found to be an important driver of membership to pyrethrum cooperatives. This indicates the economic contribution of pyrethrum industry to the household total income. The findings imply that the more the household income heavily depends on pyrethrum, the higher the likelihood to join cooperatives.

#### **4.2.2 Determinants of benefits of participation in pyrethrum cooperatives**

Table 4.7 presents parameter estimates from the second stages of the Heckman model; factors that influence benefits of participating in pyrethrum cooperatives/impact of membership on farm benefit (gross margin).

**Table 4.7: Determinants of benefits of participation in pyrethrum cooperatives**

Explanatory variables	Gross Margin(n=250)	
	coefficients	Robust std.error
AGE	-1612.52	2457.985
FAMILSIZE	537.5144	17437.37
PLAN	-126477.8**	58965.44
PROFITMOT	162869.7**	57961.33
EXTENSION	-160146.7*	83022.79
CREDIT	2491.13	78365.28
DIST	16359.74	20702.5
EDUC	9186.447	7947.678
OFF_FARMINCOM	-53223.44	59860.31
LANDSIZE	-83800.7	80111.78
COOPMSHIP	548567.8***	90586.62
CONSTANT	126492.4	171768.4
/athrho	-0.8934463***	0.1739432
/lnsigma	12.97217***	0.0816568
Rho	-0.7130917	0.0854931
sigma	430269.8	35134.46
lambda	-306821.8	51502.08

Wald test of independent equations (rho = 0):  $\chi^2(1) = 50.22$  Prob >  $\chi^2 = 0.000$

\*\*\*, \*\*, \* indicate 1%, 5% and 10 % significance levels

**Source: analyzed from Survey data (2017)**

As hypothesized, the study found that cooperative membership had a positive effect on farm profit. The results show that the average treatment effect was 548567.8 Rwf (\$1 = 900 Rwf) which indicate that a cooperative member could increase her/his farm profit by 548567.8 Rwf per hectare year. This implies that pyrethrum cooperatives had a strong positive impact on farm profit. This concurs with some empirical evidence that farmers' cooperatives have a positive impact on farm income, adoption of technology and profitability ( Magreta et al., 2010; Abebaw et al., 2012; Tolno et al., 2015; Vendeplas et al., 2013).

The future plan to expand the production scales had exhibited a negative and significant effect on farmers' level of profit from pyrethrum production ( $p < 0.05$ ). This is because farmers who plan to expand their production scales in the future tend to invest in long term assets and this could increase the cost of production and thus reducing the gross margin. The results also indicated a positive and statistically significant effect of profit motivation on farm benefit ( $p < 0.05$ ). It is hypothesized that farmers who are motivated by the profit from pyrethrum flower sales, contrary to those motivated by the compulsory nature of pyrethrum or by the traditional ties, will probably embrace possible innovations and invest more resources in pyrethrum production. Therefore, in the long run, their investment is more likely to increase benefits from pyrethrum production

Another important predictor of pyrethrum farm profit is the accessibility to extension services. Contrary to the hypothesis, the results indicated that having access to extension services does not necessarily increase farm profit. The results may attribute this to the fact that the information received by farmers is general and does not specifically address the pyrethrum production or processing constraints with specific details. In addition to this, the study found that only 5 percent of respondent who received extension services has been in contact with extension agents either from the Government or Development partners, while the remaining benefited from farmer to farmer communication message and its effectiveness is not known. This contradicts findings by Birkhaeuser, Evenson, & Feder (1991) and Owens, Hoddinott, & Kinsey (2003) who found that agricultural extension increases farm production and the value of crop production. However the awareness of the extension message is not only the important determinant of farm production achieved, but also the detailed knowledge and skills on the correct methods of application subject to the complexity of methods (Birkhaeuser et al., 1991).

## **CHAPTER FIVE**

### **5. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS**

#### **5.1 Summary**

Pyrethrum farming proved to have potentials on farm profit among members of cooperatives in Musanze District. However, participation in pyrethrum cooperatives is still low which in turn can impact on farmers' level of farm benefit. The current study employed the endogenous treatment regression alternatively called Heckman model to estimate the probability that a farmer will choose to participate in pyrethrum cooperatives and the benefits of participation in terms of farm profit. Descriptive statistics were also used to characterize pyrethrum farmers.

Findings showed that pyrethrum farming is predominantly smallholder and employs more of relatively older persons than those in the youth bracket. The results also revealed statistically significant differences between members of cooperatives and non-members with respect to household characteristics, production resource endowments and access to institutional services. Results indicated that members managed to earn higher farm profit than non-members. Regarding factors that determine participation in pyrethrum cooperative; Age, profit motivation, access to off-farm income, proportional income from pyrethrum, access to institutional services such as extension and credit, positively influenced the probability of membership into pyrethrum cooperatives. In regards to benefits of participation, the results showed that membership to pyrethrum cooperative had a positive and significant effect on farm profit. In fact by participating in a cooperative a farmer can increase his/her farm benefit by Rwf 548567.8 per hectare of land per year. It was also found that the profit motivation characteristic of farmers is positively associated with realized profit from pyrethrum production, while the future plan to

expand the production scale and access to extension services negatively affected farm profit. It is also important to highlight that cooperative members benefited from a number of opportunities such as sourcing credits and extension services from cooperatives. Besides this, cooperatives served as guarantor to facilitate farmers' access to finance. In this view, the study found that 59 percent of credits offered to members were sourced from cooperatives.

## **5.2 Conclusions and recommendations**

The results of this study support the statement in farmer organization literature that producer cooperatives are institutional tools to improve smallholder production performance and thus improving farm income and profitability. However, despite a number of potential benefits associated with membership in farmer cooperatives, very few farmers joined producer cooperatives. The study emphasized the importance of cooperatives in improving farm income through the improved farm profit. Hence initiatives focusing on awareness of different potential benefits of membership to farmer cooperatives could be advanced to attract more farmers to join cooperatives. It is therefore important that the Government takes a lead and partner with the processor (SOPYRWA) to support and promote pyrethrum cooperatives.

Results also revealed that aged farmers are more likely to join cooperatives. Therefore, in addition to promoting and supporting pyrethrum cooperatives, special attention should be put on getting youth participation and involvement in pyrethrum cooperatives, since the long term sustainability of these cooperatives will build on such potential members. This should go hand in hand with facilitating them to acquire required capital, since the study indicated capital constraint such as credits and land as key predictors of membership. Other farmers should also be facilitated to acquire needed capital to meet membership requirements.

Furthermore, results indicated that profit motivation is an important positive predictor of membership to pyrethrum cooperatives. Observing from the descriptive statistics, the high proportion of farmers were motivated by economic benefits; however there was no significant incentive to reward best farmers. Farmers are paid based on weight and the quality does not matter. To recognize the effort of farmers, there should be incentive to reward the best quality such as higher pyrethrin content.

Challenges such as inadequate dryers still impose limits on production levels. From early findings, the study showed that farmers often incur losses under stress of shortage in drying facilities. Results indicated that only few farmers had access to dryers and the lack of access to dryers was reported as the main source of loss during post-harvest handling. Therefore, effort should be centered on improving farmers' access to dryers. This will help in improving profitability by reducing or removing possible sources of losses during pyrethrum production at farm level. This implies that the support in terms of basic infrastructure such as dryers should be higher on the policy agenda.

It was also found that access to extension services positively affected the membership decision making. This implies that training and advisory services are required for the processor to produce the good quality with respect to the requirements of export markets. The Government could partner with the processor to train more extension agents and facilitate them to train farmers appropriately. The study however showed that having access to extension services does not necessarily increase farm profit. This indicates that farmers may receive general information which may not necessary help to improve on pyrethrum production because it is not specific to pyrethrum production. It can therefore be recommended that special pyrethrum production extension packages should be developed and disseminated to farmers. However, there is a need

to make sure that information pertaining pyrethrum is clear, focused and reliable so that farmers are not confused. This requires the close collaboration with farmers to familiarize them with all aspects of the technology and ensure the correct application of the technology.

### **5.3 Areas for further research**

The results from this study highlight the role of agricultural cooperatives in the pathway of rural development and poverty reduction in Rwanda. Increasing agricultural productivity is fundamental for this to be achieved and will enable farmers to improve on farm income. However, it will involve some costs at farm level. The present study showed the role of pyrethrum cooperatives in enabling farmers to increase farm profit and thus improving pyrethrum income. However, the scope of the study was limited since the sample was taken from only one pyrethrum growing district. Future study should extend this work by expanding the scope of the analysis to cover a wide range including all pyrethrum producing districts. This would help to generalize the result on the wider pyrethrum sector in Rwanda. It will also provide more insights on all-inclusive policy interventions. Also the apparent negative impact of extension services to farm profit is confusing considering that extension is among key agricultural services that cooperatives offer. However, the general information given to farmers with no specific details on pyrethrum production and processing seems to be confusing them. The study therefore recommend further research on the impact of membership on farm profit but with special attention to the heterogeneity of members and also the effectiveness of a farmer to farmer extension approach that is mainly used in this industry.



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## **APPENDICES**

### **Appendix 1: Household interviews questionnaire**

**UNIVERSITY OF NAIROBI**

**DEPARTMENT OF AGRICULTURAL ECONOMICS**

#### **QUESTIONNAIRE FOR PYRETHRUM FARMER HOUSEHOLD**

This questionnaire is destined to collect data on pyrethrum farmers in Musanze District for the academic purpose. The researcher is pursuing a master's degree in Agricultural and Applied Economics at the University of Nairobi. The acquired information will be handled with confidentiality and no name will appear on the report. Your assistance will be highly appreciated.

#### **DETERMINANTS OF MEMBERSHIP AND BENEFIT OF PARTICIPATION IN PYRETHRUM COOPERATIVES: A CASE STUDY OF MUSANZE DISTRICT, RWANDA**

## INTERVIEW SCHEDULE FOR FARMERS

### SECTION A: Households characteristics (for both members and nonmembers)

#### A1. Location

Household No:	Date(day/month/year):	District:
Sector :	Cell:	Village:

Name of the interviewer:

#### A2. Identification

1	Name of respondent:
2	Gender ( 1= male, 0=female)
3	Relationship to the head of household:
4	Name of the household head :
5	Respondent phone contact :
6	Marital status of respondent : codes
7	Membership to pyrethrum cooperative : ( 1= yes, 0=no)
8	Name of cooperative :

6: Marital status

1=Unmarried, 2=Married, 3= Widow/widower, 4=Separated/divorce, 5=others (specify)

#### A3. Background of the household

	list of household members /names	Sex	age	marital status	years of schooling	Group membership	Primary Occupation
1							
2							
3							
4							
5							
6							
7							
8							

**Sex**  
 Female.....0  
 Male.....1

**Marital status**  
 Married .....1  
 Unmarried.....2  
 Widow/widower.....3  
 Separated/divorced.....4  
 Others (specify).....5

**Occupation:**  
 Cultivation (crop farming)..... 1  
 Agri. labour ..... 2  
 Non-agri. labour ..... 3  
 Petty business ..... 4  
 Business (other than petty business)..... 5  
 Private job ..... 6  
 Government job..... 7  
 Other (specify)..... 8

**Group Membership**  
 No Group.....0  
 Saving & credit group/ibimina .....1  
 Farmers' group .....2  
 Other community group.....3

**SECTION B: PRODUCTION CHARACTERISTICS**

B1.a).Land ownership (land title)

category of land	Number of plots	Owned(ha)	leased in land(ha)	leased out land(ha)	Total operational land
Less than 1 hectare					
1-2 ha					
Above 2ha					

b) What is the estimated size of your land under pyrethrum production? .....

C) Type of cropping: 1. pure cropping  0. Intercropping

B2. a) Do you own livestock? 1. Yes  0. No

b) If yes, indicate the number of animals kept

	Livestock owned	Number owned and present at home	Value (Rwf)	Owner
1	Cattle			
2	Sheep			
3	Goats			
4	Chickens			
5	Pigs			
6	Rabbit			
7	Bee hive			
8	Other( specify)			

Owner codes 1: head of household, 2= spouse, 3=soon, 4=daughter, 5=other joint (specify codes), 6= others (specify)

B3.What are other important crops that you grow?

	Name of crop	Size of land( ha)	Pure cropping=1, intercropping=0	Number of years in the cropping
1				
2				
3				
4				
6				
7				

B4. Income from pyrethrum last year

	Quantity of flesh flowers	Quantity of dried flowers(kg)	Loss(kg)	price per kg of dried flowers	total revenue/ last year
1					

B5. Do you hire labors?

1. Yes

0. No

B6. Pyrethrum farming practices and associated costs

1. Materials

Number	Materials	Quantity	Unit cost	Total costs
1	Hoes			
2	Bags			
3	Mats			
4	Total costs			

2. Farming practices

		number of labor	type of labor 1=hired labor, 0=family labor	Unit cost of labor (Rwf)	total cost of labor(Rwf)	quantity (kg)	Unit cost(Rwf/kg)	total cost
1	Ploughing							
2	Planting							
3	Fertilization							
	a)							
	b)							
	c)							
4	Weeding							
5	Pruning							
6	Harvesting							
7	Drying							
8	others specify							

3. Other production costs

B7. Transaction cost incurred during production and processing

		Quantity per year	Unit cost	Total cost per year ( Rwf)
1	Transport to and from the collection center			
2	Extension services/information /calls			
4	Others(specify)			
9	Total cost			

B8. Goss margin per hectare (to be calculated).....

B9. What is your motivation to grow pyrethrum?

- 1. For making money (profit)
- 2. Tradition
- 3. Compulsory
- 4. Others specify

B10. How many years you have been growing pyrethrum? .....

B11. Which kind of planting materials do you use?

	<b>codes</b>
	1= seedlings, 0= wild from the field
1	

B12 a) In the last 12 months did you get any financial support/ credit in your production?

1. Yes  0. No

b) If yes what is the source of your credit

	Source of credit , 1= Government, 2=bank, 3=cooperative/farmer group , 4=own savings, 5=relatives/friends, 6=Buyer, 7=input dealers, 8= NGOs, 9= others(specify)	Form of credit 1=money, 2=inputs, others specify	Amount (Rwf)	Interest rate (%)
1				

c) If no why didn't you obtain any credit?

	<b>codes</b>
	1= I don't have the required guarantee, 2=high cost to obtain the loan/credit, 3= short period of repayment , 4=Guarantee adequate but denied amount 5=I don't need any financial support, 6=others(specify)
1	

B13. Have you received information or extension service or training about other crop production (excluding pyrethrum) in the last 12 months?

1. Yes  0. No

B14. a) Have you received information or extension service or training about pyrethrum production and marketing in the last 12 months?

1. Yes  0. No

b) If yes, what kind of information or area of training or extension service did you receive about pyrethrum production and through which approach?

	Source of services	Types of services
	1= reading materials/newspaper, book, 2= Government, 3=cooperative, 4= neighbors, 5=buyer, 6=input dealers, 7=NGOs	1= good agricultural farming methods, 2=drying methods, 3=pests and disease management, 4=fertilizer application, 5= record keeping, 6=others specify

B15. How do you handle pyrethrum after harvesting (drying process)?

	codes
1	1= use dryer, 0= use mats

B16. a) Do you transport fresh flowers to dryer, immediately after harvesting?

1. Yes  0. No

b) If no, why?

	codes
	1= not a cooperative member, 2= don't have enough time, 3= dryer is very far, 4= I don't need a dryer to perform the drying process 5= others specify
1	

B17. Nature of losses that often happen at farm Level

<b>1</b>	<b>Nature of losses</b>	<b>Main source of losses</b>
	pre-harvest Losses	
1		
2		
3		
4		
5		
	Post-harvest losses	
1		
2		
3		
4		
5		

B18. a) Changes in quality and quantity of produce in the last five years

	<b>codes</b>
<b>1</b>	1= no change 2= improved , 3= worsened

b) If improved what are the reasons for that change

	<b>codes</b>
	1=use of integrated pests and diseases management, 2= increased acreage, 3= use of improved seeds and fertilizers, 4=all , 5, others specify
1	

B19.Reasons for worsened

	<b>Reasons for no change</b>	<b>Rank according to the priority</b>
1	No access to fertilizer	
2	Limited capacity to adopt resilience strategy	
3	No access to drying facility	
4	Low benefit	
5	Lack of information on good production methods	
6	Others specify.....	



B20. a) Do you plan to expand your production scale in the next 5 years?

1. Yes  0. No

b) If yes why do you want to make that change?

- 1. increase family revenue
- 2. imitating your neighbors
- 3. expected benefits
- 4. Increase savings
- 5. Others (specify).....

B21. How do you store dried flowers?

	<b>codes</b>
	1= in bags, 2= heaped in the corner ,3= others specify
1	

**SECTION C: MARKET ACCESS**

C1. How do you transport pyrethrum from farm to collection center?

	<b>codes</b>
	1= head , 2= truck , 3= car, 4= others specify
1	

C2. What is the distance from your home to the

		<b>Distance in walking hours</b>	<b>Distance in Km</b>
1	Nearest input dealers		
2	Cooperative( collection center)		

C3. Road condition from home to the collection center

	1= all seasons tarmac, 2= all seasons murrum roads, 3=seasonal murrum roads. 4. Others specify
1	

## SECTION D: HOUSEHOLDS' INCOME AND EXPENSES

D1. a) Is pyrethrum your main source of income?

1. Yes  0. No

b) Other sources of income

	Source of income	Rank according to the priority	Monthly income (Rwf)	Annual Income (Rwf)
1	Remittances			
2	Rental income from Land			
3	Rental income from Buildings			
4	Off farm income			
<b>5</b>	<b>Income from other crops</b>			
	a)			
	b)			
	c)			
	d)			
6	Income from business			
7	Livestock			
8	Other(specify)			

D2. Estimation of farmers' expense

Expenses	Amount in RFW
Food	
Clothing	
School fees	
Medical	
Entertainment	
Donations	
Purchase of assets	
Savings	
Others(specify)	

D3. Proportional income from pyrethrum .....

**SECTION E: farmers' assessment in regards to cooperative structure, conduct and performance**

C1. Do you trust the cooperative members and the management system?

	<b>codes</b>
	1= yes    0= no
1	

C2. How do you see the conditionality for joining cooperative ?

	<b>codes</b>
	1= high    0= low
1	

C3. Do you think pyrethrum cooperatives guarantee better livelihood ?

	<b>codes</b>
	1= yes    0= no
1	

C4. Do think pyrethrum cooperatives guarantee easy access to production inputs?

	<b>codes</b>
	1= yes    0=no
1	

**SECTION D: members of Cooperatives**

D1. For which purpose did you join cooperative

1. It was compulsory
2. Followed others
3. Expected benefits
4. Others (specify).....

D2. Does membership to pyrethrum cooperative benefit you when compared with before joining cooperative?

	<b>codes</b>
	1= yes 0= no
1	

D3. If yes, which benefits? Rank according to the priority (at least 5)

	<b>Types of benefit</b>	<b>Ranking</b>
1	Improved household livelihood	
2	Compliance to quality	
3	Access to credit	
4	Access to inputs	
5	Risks coping strategy	
6	Trainings	
7	Reduced transport costs	
8	Others (specify)	

D4. Does the cooperative has a transparent structure for conflict resolution

1. Yes  0. No

D5. Level of satisfaction with membership

	<b>Level of satisfaction</b>	<b>Tick the right answer</b>
1	Highly satisfied	
2	Satisfied	
3	Indifferent	
4	Not satisfied	

**SECTION E: Non-members**

E1. a) Do you know that there is a policy that the processor buy only through cooperatives?

1. Yes  0. No

b) Reasons for not joining cooperative

	<b>Reasons</b>	<b>Tick the right answer</b>
1	Not aware of membership advantages	
2	Cooperative is far away	
3	High membership fees	
4	Previous experience of cooperative mismanagement	
3	Others specify	

c) How did you know about a)?

	<b>codes</b>
	1= public extensionists, 2=buyer, 3= neighbor member of cooperative ,4= family member 5= others specify
1	

E2.Do you perceive any loss from not joining cooperative

	<b>codes</b>
	1= yes 0=no
1	

E3. Do you plan to join cooperative

1. Yes  0. No

## **Appendix 2: Checklist for key informants interview**

### Key informants' discussion questionnaire

1. Are there challenges that restrict farmers from reaching the potential productivity?
2. If yes, what are these challenges?
3. What are possible solutions to address those challenges /cope with risks that may arise due to those challenges?
4. Does cooperative affect the pyrethrum commodity chain or is the pyrethrum itself that affect the commodity value chain?
5. Did cooperatives fully achieved their objectives
6. If no, Which challenges that may restrict cooperative from reaching its objectives ?
7. Is there a policy on the quality of pyrethrum? ( in cooperative and in general)
8. If yes, Do farmers met its provisions?
9. Is there contract farming between cooperatives and the buyer?
10. If yes, do cooperatives consistently meet its specifications?
11. How do cooperatives make certain that farmers meet the buyer's requirements
12. What do you think should be done to meet the buyer's requirements?
13. Beside pyrethrum what are other activities that the cooperative is involved in?
14. Separate pyrethrum activities from non-pyrethrum activities.
15. What do you think are general recommendations for improving pyrethrum farming

### Appendix 3: Test for the Goodness of fit of the model

#### Results for the goodness of fit of the model

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<b>Endogenous treatment regression model</b>
Number of observation = 250
Wald Chi Square = 78.95
Prob > Chi Square = 0.000
Log Pseudo likelihood = -3671.6164
Wald test of indep. equations (rho = 0): Chi Square = 20.42, prob > Chi Square = 0.000

---

\*Prob >Chi square = 0.000 shows joint significance of variables in the model

\*Pro>Chi square = 0.000 in the Wald test of independent equations, shows the correlation of error terms in the selection and outcome equations and hence, justifies the use of the model.



## Appendix 4: Tests for multicollinearity

### 1. Variance Inflation Factor

<b>Variable</b>	<b>VIF</b>	<b>1/VIF</b>
COOPMSHIP	1.59	0.627291
GROSS_MARGIN	1.58	0.631054
PROPINCOME	1.57	0.635889
CONDITIONALITY	1.30	0.771955
EXTENSION	1.26	0.793073
EDUC	1.23	0.810877
PROFITMOT	1.22	0.821658
LANDSIZE	1.19	0.839571
DIST	1.16	0.863500
OFF_FARMINCOM	1.15	0.868295
CREDIT	1.14	0.874821
PLAN	1.08	0.921673
FAMILSIZE	1.08	0.922841
TRUST	1.03	0.967936
Mean VIF	1.26	

## 2. Correlation matrix

	AGE	EXPERI~E	FAMLSIZE	EDUC	OFF_FA~M	LANDSIZE	PROFIT~T	CREDIT	EXTENS~N	PLAN	DIST	PROPIN~E	TRUST
AGE	1.0000												
EXPERIENCE	0.6827	1.0000											
FAMLSIZE	-0.1709	-0.1878	1.0000										
EDUC	-0.4195	-0.2994	0.2326	1.0000									
OFF_FARMIN~M	-0.2066	-0.1981	0.1302	0.2522	1.0000								
LANDSIZE	-0.0280	0.0769	0.1218	0.1818	0.1523	1.0000							
PROFITMOT	-0.0689	-0.2321	0.0551	0.0455	0.0503	-0.0085	1.0000						
CREDIT	0.0201	0.0657	-0.0097	0.0526	-0.0116	0.1774	0.0262	1.0000					
EXTENSION	0.1652	0.1461	0.0060	-0.0678	0.0299	0.2195	-0.0006	0.1338	1.0000				
PLAN	0.0588	0.0625	0.0273	0.0886	0.0928	-0.0195	0.0433	-0.0603	0.0943	1.0000			
DIST	0.1518	0.0985	0.0007	-0.1136	0.0113	0.1153	-0.2419	-0.0926	0.0099	0.0285	1.0000		
PROPINCOME	0.2468	0.0627	-0.0599	-0.0936	-0.0017	-0.0326	0.1933	0.0491	0.0327	0.0664	0.0614	1.0000	
TRUST	0.0486	0.1164	-0.0223	0.0014	0.0812	-0.0264	0.0153	0.0118	0.0518	0.0978	-0.0275	0.0147	1.0000
CONDITIONA~Y	-0.0314	0.0066	-0.0439	-0.0717	-0.1496	-0.1256	-0.1433	-0.1539	-0.2863	-0.0488	-0.0911	-0.0469	-0.0878
	CONDIT~Y												
CONDITIONA~Y	1.0000												