AN ECONOMIC ANALYSIS OF FACTORS INFLUENCING PARTICIPATION IN PYRETHRUM GROUP MARKETING CHANNELS AMONG FARMERS IN NYANDARUA COUNTY, KENYA

By

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This thesis is my original work and has not been submitted for examination in any other university.

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DEDICATION

This work is dedicated to my entire family but more so to my parents Mrs Hannah Wangari Kamau and the late Mr. Joseph Kamau Mwangi for supporting my education during my nursery, primary, secondary, and undergraduate studies.

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I am indebted to many people who had an input in it in one way or the other. But my supervisors, Dr. Sabina Wangia, Dr. Kimpei Munei, the late Dr. Fred Mugivane and Dr. Patrick Irungu stand out uniquely. They are perfect examples of what lecturers ought to be. May God bless them all. Thanks too to my sister Eunice W. Kamau for typing this work.

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ABBREVIATIONS AND ACRONYMS

AFC	Agricultural Finance Corporation
AFFA	Agriculture, Fisheries and Food Authority
BCC	Board Collection Centres
DAP	Diammonium Phosphate
FAO	Food and Agriculture Organization
FCS	Farmers Co-operative Society
GoK	Government of Kenya
KENFAP	Kenya National Federation of Agriculture Producers
LDCs	Less Developed Countries
MoA	Ministry of Agriculture
MRLs	Maximum Residue Levels
NIE	New Institutional Economics
OLS	Ordinary Least Squares
PBK	Pyrethrum Board of Kenya
PGA	Pyrethrum Growers Association
RUM	Random Utility Models.
SAPs	Structural Adjustment Programmes
SHG	Self-Help Groups
USA	United States of America

ABSTRACT

This study analyzed the factors influencing the decision and level of participation of smallholder pyrethrum farmers (household heads) in group marketing in Nyandarua County. The data which were collected through questionnaires administered to 124 household head farmers and analyzed using Ms Excel and Statistical Package for Social Science (SPSS). Participants were defined as farmers who were members of a pyrethrum marketing group and therefore used group marketing channels. Descriptive statistics and a two-stage Heckman model were used to determine factors influencing farmers' decision to participate and the level of group market participation in the study area. The results showed that participants were 78.2% and non-participants were 21.8% of all the 124 farmers. Findings on the gender of farmers indicated that 80.6% were male while the remaining ones were female. The mean land size for the participants and non-participants was 3.5 and 3.0 hectares (ha) respectively, which was statistically significant ($t>2.0$). Credit facilities to boost pyrethrum production were accessed by 24% and 15% of the participants and non-participants, respectively. Women groups were the major source of informal cash credit. All the respondent households had contact with extension services once a year which was not adequate. Results of the first stage of the Heckman model showed that age, gender, education level of the household head, other farm income, distance to the market, number of extension visits, price of pyrethrum and membership in pyrethrum producer groups positively and significantly influenced farmers' decision to participate in group marketing. Results of the second stage of the Heckman model showed that gender of household head, monthly non-farm income, good road condition and membership in pyrethrum marketing group positively and significantly influenced the pyrethrum farmer's level of market participation in the county. The second objective of this study sought to examine the effect of participation in the group marketing channels on smallholder pyrethrum farmers' gross margins. Results showed that education level of the household head, credit availability, pyrethrin content of the produce and membership of the household head to pyrethrum marketing group positively and significantly increased the pyrethrum farmer's gross margins in the county. It was recommended that the County Government of Nyandarua should ensure that the feeder roads from the farms to the market are always in good condition. The Ministry of

Agriculture should increase the frequency of extension contact with pyrethrum farmers in the county. The Pyrethrum Board of Kenya should support the farmers by buying directly from them to eliminate brokers. Policy makers in the Ministries of Social Services and Cooperatives should promote membership to farmer groups or cooperatives. The Agricultural Finance Corporation should sensitize the farmers in the county about their financial products so that they can make informed decisions to use them. The study concluded that the farmers' decision to participate in pyrethrum group marketing channel was significantly influenced by their social, institutional and economic factors and that the farmers' participation in group marketing channels significantly increased their gross incomes. Results also revealed that once a smallholder farmer decided to enter group marketing of pyrethrum, the gender of the household head, monthly non-farm income, road condition and the farmers' group membership are key factors that influenced the volumes they sold into the market.

Keywords: *Pyrethrum farmers, Marketing channels, Heckman model, Nyandarua County*

CHAPTER ONE
INTRODUCTION

1.1 Background

Kenya is the world's leader in pyrethrum production since it commands 70 per cent of the world's market share (Ronge et al., 2010). Other producers include Tasmania and Australia (20%), Tanzania (8%), Rwanda (5%), and Papua New Guinea (2%). A total of 97% of Kenya's production is by small scale farmers with less than one hectare under pyrethrum. The bulk of pyrethrum and pyrethrum products produced is exported through Pyrethrum Board of Kenya (PBK). Only 3% of production is sold to locally (Table 1.1).

Table 1.1: Percentage of Kenya's Pyrethrum Export Destinations

Destination	Percentage
Kenya	3
Africa (other countries other than Kenya)	3
Australia	4
Asia, India, Middle East	5
Europe	25
USA	60

Source: MoA Crops Division Annual Report (2010)

Farmers deliver dried flowers to the Pyrethrum Board of Kenya (PBK) through one of the following marketing channels:

- Self-Help Groups (SHG)
- Farmer Cooperative Societies (FCS)
- Board Collection Centres (BCC)
- Directly to the Board (PBK)
- Middlemen (Brokers) who then deliver to PBK either directly or through SGH and FCS channels (Figure 1.1).

The major pyrethrum growing counties in Kenya include Nakuru, Uasin Gishu, Kisii and Nyandarua. Self Help Groups (SHG) are currently a major pyrethrum marketing channel used by farmers in Nakuru, Uasin Gishu and Nyandarua counties. But in Kisii County,

the more formal cooperative society (FCS) marketing channel is the main marketing channel (Table 1.2).

Table 1.2: Preferred Marketing Channels across Major Pyrethrum Growing Regions

Production region (County/Area)	Marketing channel	Variety planted	Pyrethrin content	Price per kg (Kshs)
Nyandarua /Kenton	SHG	P4	1.6	200.00
Nakuru/Kamara	SHG	P4	1.5	212.50
Nyandarua /Mawingu	BCC	Ndege	1.5	187.50
UasinGishu/Ainabkoi	SHG	Chui	1.4	175.00
Nakuru/Naivasha	PBK	Local	1.4	175.00
Nyandarua /Shamata	BCC	Katumani	1.3	162.50
Kisii/Ibacho	FCS	Nyamasibi	1.1	137.50
Kisii/Ramasha	FCS	Nyamasibi	1.1	137.50
Kisii/Keumbu	FCS	Nyamasibi	1.1	137.50

Source: Pyrethrum Board of Kenya (2010)

For the sake of this study, both SHG and FCS are considered as the pyrethrum group marketing channels because both involve more than one farmer collectively pooling their resources together to do the marketing.

A smallholder farmers association is made up of producer marketing groups (FAO, 2001). Based on group members' socio-economic characteristics, they may recognize strong benefits of working as a group. The group brings together individuals with common problems and aspirations and who, as individuals cannot meet certain goals (marketing) as efficiently as when in a group (Obare, 2005). Despite the inherent benefits of marketing as a group, only one out of the three major growing areas (Kenton) in Nyandarua, where farmers market their pyrethrum collectively through SHG (Table 1.2). Hence, this study sought to evaluate the economic factors that influence farmers' decision

to participate in pyrethrum farmers' group marketing channel (SHG) in Nyandarua County, which is also dominated by brokers (Figure 1.1).

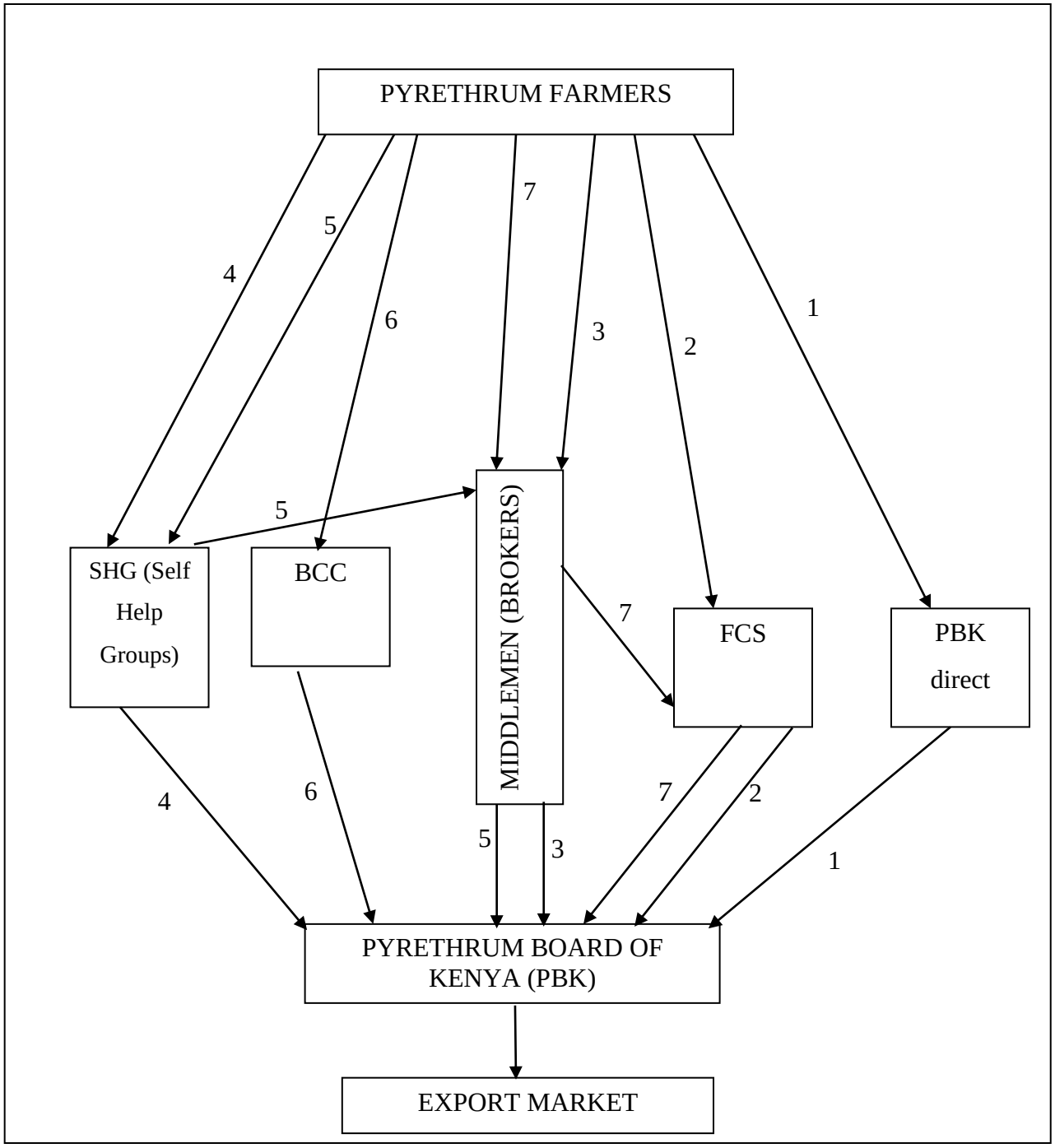

Figure 1.1: Generalized pyrethrum flower marketing channels in Kenya

Source: Adapted from Ronge et al. (2010)

Key: Numbers 1-7 in Figure 1.1 represent seven different pyrethrum marketing channels.

Generally, pyrethrum production in Kenya steadily declined over the years as shown by the black downward sloping line (Figure 1.2). But production of pyrethrum temporarily rose in the years 1974/1975, 1982/1983, 1992/1993 and 2001/2002. But from the year 2003 there has been a marked all time decline. This could be attributed to the increased production of synthetic insecticides, which affect production and marketing of pyrethrum in the world markets.

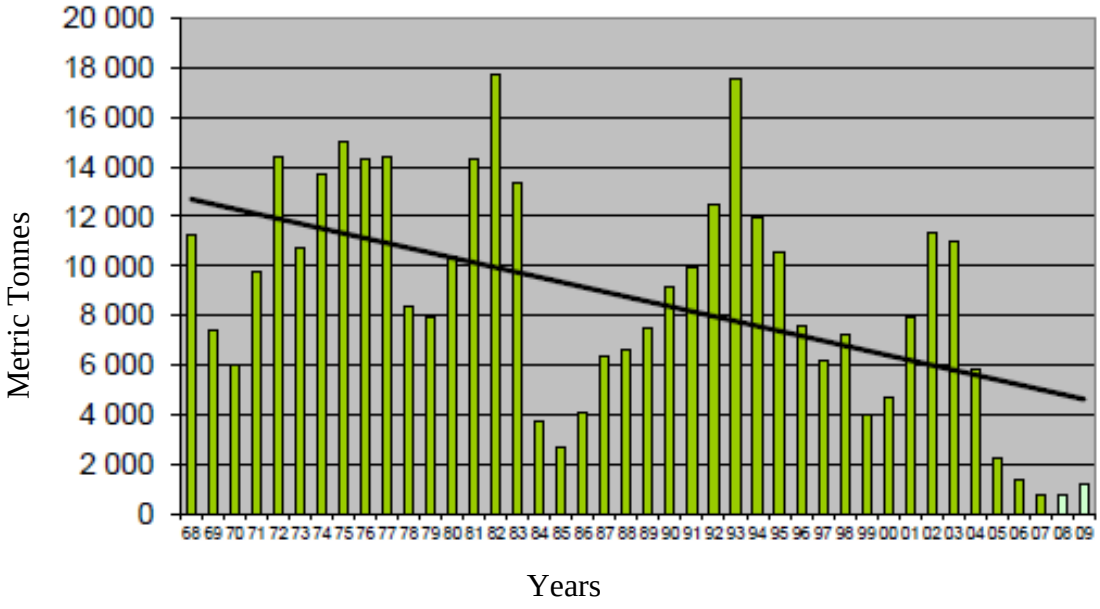

Figure 1.2: General Pyrethrum Production Trends in Kenya (1968-2009)

Source : Pyrethrum Board of Kenya (2010)

Pyrethrum production in Nyandarua County has decreased rapidly. The gross payment and land size under cultivation also declined steadily (Table 1.3).

Table 1.3: Recent Pyrethrum Production Trends for Nyandarua County

Year	Total Production (Metric tonnes)	Average Pyrethrin Content (%)	Gross Pay (Ksh)	Approximate Hecterage
2007/2008	104.471	1.413	10,917,274.45	650
2008/2009	106.023	1.394	10,897,220.00	720
2009/2010	45.282	1.377	7,873,202.00	385
2010/2011	32.144	1.495	6,068,837.50	340
2011/2012	24.818	1.418	4,441,475.00	310

Source: Pyrethrum Board of Kenya (2013)

The Pyrethrum Act, CAP 340 of the Laws of Kenya (1963), which provides the regulation for the pyrethrum industry, requires all farmers to sell pyrethrum to regulation for the pyrethrum industry, requires all farmers to sell pyrethrum to Pyrethrum Board of Kenya (PBK), but through one of the following marketing channels: Self-Help Groups (SHG), Farmers' Cooperative Societies (FCS), Board Collection Centers (BCC), directly to the PBK or through Brokers. Once flowers are delivered to the PBK, they are checked for pyrethrin content (referred to as PC Test). The maximum PC is 3% (Appendix II) and local producers in Nyandarua County achieve a maximum of 1.6% pyrethrin content (Table 1.2**).**

In the past, PBK offered a bonus program for farmers where quality and quantity were rewarded. In 2000, the bonus was as high as 39% of the price of a crop. In 2001, the bonus declined to 3% and as of 2002, no bonuses were paid. In fact, some farmers have not even been paid for the delivery of their harvest (Ronge et al., 2010). When farmers are paid, the amount farmers receive does not reflect the actual market price due to the substantial deductions imposed by the PBK. These deductions include: cess: (1%); gunny bag depreciation charges: Ksh 1/35 kg bag; transport: Kshs 17-28/35 kg bag and PBK service deductions: Kshs 3- 4/kg. Once these deductions are made, proceeds from sales backtrack through the marketing agent who also deducts service charges before funds are released to farmers. FCS deducts 7-10 percent of the farmers' pyrethrum sales, while SHG deducts approximately 5 percent of the sales. In addition, brokers who consolidate

harvest from numerous smallholder farmers, also charge for their services. These administrative costs burden farmers to a point where pyrethrum farming is becoming increasingly less attractive for Kenya farmers. The price is determined by deducting these costs from the respective amount offered by PBK for the various outputs with different pyrethrin contents (Inyamu, 2006).

In Nyandarua County, there is loss in pyrethrin content in addition to the high marketing costs. The pyrethrin content of deliveries determines the price received. However, many farmers do not have any control over post-farm factors that affected this parameter. Such factors include quick flower oxidization after harvesting which reduced pyrethrin content level rapidly. Others were PBK inefficiencies like prolonged testing time and eventual warehousing of stock which resulted to poor quality pyrethrum that led to poor returns for farmers. A few farmers with comparatively larger farms are licensed to deliver directly to PBK, thereby increasing their producer prices by avoiding long marketing channels which were dominated by brokers who increased costs. But most pyrethrum farmers in Nyandarua County were smallholders and so they did not have such licences. Marked differences had been observed in the pyrethrin content and prices received through the different channels as Table 1.2 shows. Payment for deliveries follow the same channel back to the farmers, with marketing costs being deducted at every stage (Ronge et al., 2010).

The Government of Kenya (GOK) has undertaken key changes affecting the regulatory and research functions in a major agricultural sector reform milestone authorized by law (Monda, 2014). The changes involved the dissolution of eight former regulatory agencies, the creation of a new overarching regulatory agency, the Agriculture Fisheries and Food Authority (AFFA) and the merger of four research institutions to form the Kenya Agricultural and Livestock Research Organization (KALRO). The merged institutions with effect from July 1, 2014 are Kenya Agricultural Research Institute (KARI), Kenya Tea Research Foundation (KTRF), Coffee Research Foundation (CRF) and Kenya Sugar Research Foundation (KSRF). The GOK operationalized the Crops Act with effect from August 1, 2014 and created the new regulatory body, AFFA, and consequently dissolved eight former agencies. The consolidation aims at harmonizing and streamlining the

agricultural regulatory functions governed by the AFFA and the Crops Acts, both enacted by parliament in January, 2013. The Crops Act also repealed ten agricultural statutes and established eight directorates and a Commodities Fund under AFFA as follows: Pyrethrum and Other Industrial Crops Directorate, Coffee Directorate, Tea Directorate, Sugar Directorate, Horticulture Crops Directorate, Fiber Crops Directorate, Nuts and Oil Crops Directorate, Food Crops Directorate and Commodities Fund. Kenya Plant Inspection Service (KEPHIS) and Pest Control Products Board (PCPB) were retained as independent regulatory agencies (Monda, 2014). Generally, AFFA Act 2013 has provided for the consolidation of the laws on the regulation and promotion of agriculture so as to provide for the establishment of the AFFA, to make provision for the respective roles of the national and county governments in agriculture excluding livestock and related matters. Generally, the Crops Act 2013 shall promote best practices in production, processing, marketing, grading, storage, collection, transportation and warehousing of agricultural crop products (like pyrethrum).

The Pyrethrum Act 2013 is new and is in force. Every smallholder grower, for purposes of accessing economies of scale, shall have the freedom to register with a licensed pyrethrum processor, who shall keep for statistical purposes a register of all pyrethrum growers so registered. There is establishment an authority to be called Pyrethrum Regulatory Authority. The functions of the authority shall be to develop and promote the pyrethrum industry. It shall register processors, formulators and persons running pyrethrum nurseries. It shall also co-ordinate the activities of stakeholders and organizations within the pyrethrum industry. Other functions include setting required standards for pyrethrum products, facilitating equitable access of benefits and resources of pyrethrum industry by all interested parties plus carrying out and facilitate the flow of research findings to interested parties through the provision of effective extension services. It shall monitor the domestic and international market with a view to identifying and advising the Government and interested parties on any distortions and trends in the pyrethrum market (Monda, 2014).

The principal objective of Pyrethrum Amendment Bill (2011) was to amend the Pyrethrum Act (Cap. 340) in order to remove the obstacle of the monopoly created by section 16 of the Act. This was expected therefore to result in the liberalization of the pyrethrum market leading to more competitive pricing and enhancement of the process of value addition to pyrethrum. Liberalizing the market was also expected to result in rewarding high quality and improved efficiencies. The amendment would also be a step towards liberalizing the pyrethrum sector. Besides, the liberalization it would be an incentive that would promote industrialization in the sector.

The Pyrethrum industry has grown since 1928 when the first plant was introduced in Kenya. In the early years, pyrethrum produce was shipped directly to Europe, America and other export markets (Kiiru, 1999). Pyrethrum Board of Kenya (PBK) constructed the current pyrethrum-processing factory in 1959, while the second was constructed in 1962. The two factories are currently the only pyrethrum processing units in Kenya and are both based in Nakuru. Their annual installed capacity is 30,000 tonnes, though this has reduced to between 5,000 - 6,000 tonnes due to a fire at one of the factories in March 2003. PBK is the sole processor of pyrethrum in Kenya. The Board provides input to the farmers who in turn take their produce to the Board, which processes and markets the refined extract in Kenya and abroad. Traditionally, co-operative societies have been the major producers of pyrethrum in Kenya. However in recent years, self-help groups and individuals have also been registered as producers and suppliers of pyrethrum flowers to PBK (Griffin, 1994).

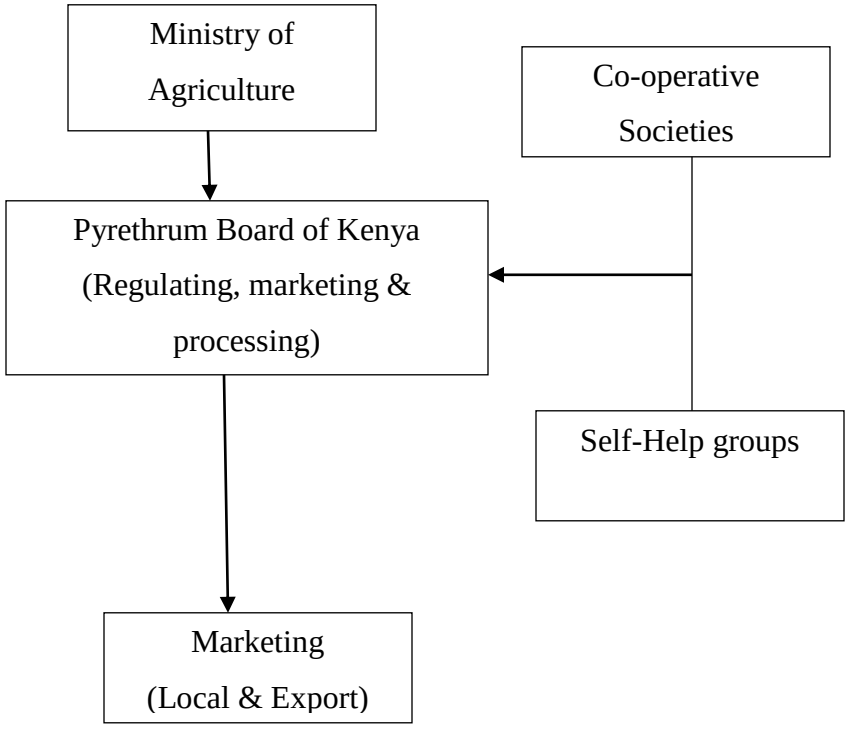

Figure 1.3: Organisational Structure of the Pyrethrum Industry in Kenya

Source: Pyrethrum Board of Kenya (2013)

From this section it evident that despite Kenya being the world's leader in pyrethrum production, pyrethrum output both nationally and in particular Nyandarua County is steadily declining (Figure 1.2 and Table 1.3 respectively). Poor marketing policy has created distortions due to the monopoly of the PBK in the purchase and sale of pyrethrum which is a great disincentive to the pyrethrum farmers. Liberalizing the market is the long term solution to revamp the pyrethrum sector in Kenya. But as the farmers anticipate for it, marketing their produce in groups (cooperatives) is an option that pyrethrum farmers should exploit so as to improve their dwindling incomes (Obare, 2005). Therefore, this study sought to evaluate the economic factors that influence farmers' decision to participate in pyrethrum farmers' group marketing in Nyandarua County.

1.2 Problem Statement

A report on Kenya's pyrethrum industry, (Ministry of Finance Planning and Economic Development, MFPED, 2004) notes that there is stringent control of government in the marketing of the cash crop through the Pyrethrum Board of Kenya (PBK) as a monopoly. The report also records the fluctuations in demand of pyrethrum extracts in Kenya, mainly due to fluctuations in demand in the world market and also due to increasing competition from inorganic products. The report stresses that the Pyrethrum Act, CAP 340 of the Laws of Kenya (1963) requires all farmers to sell pyrethrum to Pyrethrum Board of Kenya (PBK) only, through one of these marketing channels: SHG, FCS, BCC, directly to the PBK or through Brokers (Figure 1.1). Both Self Help Groups (SHG) and Farmers' Cooperative Societies (FCS) are considered by this study as the pyrethrum group marketing channels. Most of the channels available to the majority of farmers are long and inefficient causing delays in collection of dried flowers and in payment to farmers. Brokers consolidate pyrethrum from smallholder farmers and channel the flowers either directly to PBK or through the other marketing channel(s). Such channels include the ones for group marketing. The brokers who dominate most pyrethrum marketing channels charge for their services which reduce the famers' price because the payments are determined by deducting these costs from the respective amount offered by PBK (Inyamu, 2006). But by participating in group marketing channels (either SHG or FCS), pyrethrum farmers in Nyandarua County can avoid such brokers and hence their related costs thereby improving their incomes. SHG and FCS pyrethrum marketing channels have an option of avoiding the brokers (channels 4 and 2 respectively in Figure 1.1). According to FAO (2011), smallholder farmers' associations are made up of producer marketing groups. Based on group member's socio-economic characteristics, marketing together may recognize strong (monetary) benefits of working as a group. Hence, this study sought to specifically examine the effect of participation in the group marketing channels on smallholder pyrethrum farmers' net income.

Furthermore, though there is a lot of research on farmer market participation (as documented in the literature review), many of these studies seem to concentrate on food crops. Little attention has been given to cash crops like pyrethrum. A review of past studies indicates that little is known about the factors influencing smallholder pyrethrum

farmers' participation in marketing groups. Bridging this information gap is necessary in promoting participation in group marketing among pyrethrum farmers in order to gain from the inherent benefits that arise from bargaining together when selling their produce and also the economies of scale that arise when sourcing inputs together. Thus, this study broadly sought to assess the factors that influence farmers' decision and level of participation in pyrethrum farmers' group marketing channels in Nyandarua County.

1.3 Objectives of the Study

The purpose of the study was to assess the factors that influence farmer participation in pyrethrum group marketing in Nyandarua County. The specific objectives of the study were:

1. To assess the factors that influence smallholder farmers' decision and level of participation in pyrethrum group marketing channels in Nyandarua County.

2. To examine the effect of participation in the group marketing channels on smallholder pyrethrum farmers' income.

1.4 Hypothesis

The following hypotheses were tested: -

1. (a) That social, economic and institutional factors do not influence farmers' decision to participate in pyrethrum group marketing channel(s) in Nyandarua County.

1. (b) That social, economic and institutional factors do not influence the farmers' level of participation in group marketing channels.

2. That pyrethrum farmers' income is not influenced by their participation in group marketing channel in Nyandarua County.

1.5 Justification

Pyrethrum is Kenya's fourth largest cash crop and the country has been the world's number one producer. The production of pyrethrum was highest between the mid-1970s and mid 1980s (Figure 1.2). Since then, corruption, competition from synthetics, poor farming conditions, competition from new market entrants, mismanagement of PBK and

other factors have dwindled Kenya's leadership position to the point where production reached a low of less than 4,000 tons per annum in 2010 (FAOSTAT, 2013). Even with the dramatic decline in production, Kenya continues to hold on to a leadership position in the world pyrethrum market, commanding between 60-70% of the world's market share compared to Tasmania (20%); Tanzania (8%); Rwanda (5%); and Papua New Guinea (2%) (Ronge et al., 2010). Kenya's dominant position in the world pyrethrum market was reflected in the fact that virtually all pyrethrum produced in Kenya are exported, with only 3% sold to local manufacturers of pyrethrum based products (Table 1.1). But this disproportionate market distribution indicates the low level of local value addition that currently takes place in the pyrethrum market in Kenya.

To consolidate and continue being a market leader in pyrethrum exports, hence earning more foreign exchange, the Kenyan government is expected to implement the findings of this study through PBK. PBK as a major stakeholder, is also expected to mobilize pyrethrum farmers to harness their marketing strategies to their fullest potential. Middlemen dominate the pyrethrum marketing channels in Kenya (channels 3, 5 and 7 in Figure 1.1), with the profit margin going to the smallholder pyrethrum producer continuing to reduce. This exposes the farmers to the constraint of low farm income hence low standards of living.

This study is justified because it will contribute to the understanding of the socio-economic factors that influence farmers' decision to participate in pyrethrum farmers' group marketing. Non-participant farmers in pyrethrum group marketing will benefit from its findings by the revelation of the inherent benefits they can get by joining or forming such groups. The participant farmers will be expected to use the findings to strengthen and consolidate more group marketing benefits from their existing association. It is expected knowledge generated by this study will be found important by the government of Kenya through the Ministry of Agriculture for designing policies that increase participation by farmers in group marketing to increase their bargaining power and hence household income. This would in turn improve the standards of living of those pyrethrum farmers.

One of the major challenges of commercial production by smallholder farmers in the rural areas has been low bargaining power resulting from lack of collective sales of their produce and hence no benefits from economies of scale. Policy makers in the pyrethrum industry (like PGA) can use the results of this study to enlighten farmers on the benefits that group marketers (participants) accrue as opposed to non-participants who do not bargain collectively.

1.6 Organisation of the Thesis

This thesis is organized as follows. Chapter one presented the introduction which is comprised of background information, problem statement, objectives and the hypothesis tested. Chapter Two reviews the relevant theoretical and empirical literature while Chapter Three presents the methodology. Chapter Four discusses the results of both descriptive statistics and econometric analysis. In Chapter Five, a summary of major findings, conclusions and policy recommendations are presented.

CHAPTER TWO
LITERATURE REVIEW

2.1 Pyrethrum Growing in Kenya

Kenya's climatic conditions are ideal for growing pyrethrum, particularly in the upper and lower highlands (1,500-3,000 meters above sea level) where there is high rainfall, good drainage and high soil fertility. As such, smallholder farmers, especially in the Rift Valley, Central and Nyanza, have tended to adapt their farming activities to pyrethrum farming. Currently, it is estimated that over 200,000 smallholder farmers are involved in pyrethrum farming in Kenya. The life cycle of the plant is at least three years during which the largest costs (investments in planting material) are incurred during the first year, while the peak harvest occurs during the second year when there is limited input costs. By the third year, the yield rate begins to decline. While some farmers may elect to keep the plant intact even after the third year, plant diseases and declining yields make it uneconomical to extend the plant cycle for more than 3 years (Global Development Solutions, 2009).

Kenyan pyrethrum production declined from around 18,000 tonnes in 1992/93 to a low of 4000 tonnes in 1998/99. However, production recovered to around 11000 tonnes in 2002/2003 (Figure 1.2). Current indications are that this upward trend will continue, provided that the improved marketing systems, including prompter payment to farmers, introduced by the PBK, continue. The main reasons for the decline of production in the 1990's were adverse weather conditions, ethnic clashes, low profitability due to the high cost of inputs and low yields resulting in high unit costs of production. Other reasons include the labour intensive nature of pyrethrum production and harvesting, competition from alternative crops and enterprises, unavailability of suitable high yielding planting material and inadequate extension services to farmers. Inadequate marketing arrangements leading to exploitation by middlemen and poor prices to farmers was also another reason (Pyrethrum Board of Kenya, 2010).

The 1990's saw the withdrawal of government in production and marketing activities in the agricultural sector. However, the pyrethrum industry is the only sub-sector that is still under tight government control. Under CAP 340 of the Laws of Kenya, the PBK is

mandated to be the sole organ licensing farmers, purchasing and delivering of all pyrethrum, processing, sale and export of pyrethrum and its products, payment of farmers, research and regulation of imports of pyrethrum and its products (Ronge et al., 2010). Some in the industry feel that this tight control has no place in present day economies as it stifles participation by the private sector. It does not allow the exploration and injection of efficient ways in production, marketing or processing. It also has limited opportunities for a domestic pyrethrum-based processing industry to develop (Ministry of Finance Planning and Economic Development, MFPED, 2004).

Therefore, one other major factor that led to the dwindling production of pyrethrum is the requirement by law that pyrethrum farmers market their crop through a central board (PBK) structure with multiple marketing agencies. Under this structure, farmers are denied the full revenue benefits coming from the market prices for their crop because they have no alternative markets (Inyamu, 2006). This policy has created various distortions which include non-payment to farmers by the board, elimination of the bonus structure to reward high quality, high deductions for services which are not rendered properly, lack of internal efficiencies and regulatory practices which often conflict with the trade interest that the board may have. The monopoly of the board in the purchase and sale of pyrethrum is therefore a great disincentive to prospective investors in the pyrethrum industry.

The bulk of pyrethrum extract or powder is sold to manufacturers in the USA by private treaties and is not available to both local manufacturers and international companies. Kenya imports insecticides based on synthetic substitutes from manufacturers in other countries. There is a question as to whether PBK should maintain monopoly status over exports or whether other investors should be encouraged into the market. Pyrethrum flower is dried and processed into an extract or powder, which are called pyrethrines. These concentrates are generally sold overseas for use in insecticide formulation, as well as for a number of consumer products. Key markets for Kenyan pyrethrum is the United States (60%-70%), EU (25%), Australia (4%), and Asia and the Middle East (5%) (Monda, 2011).

Currently, the PBK is responsible for making available high yield hybrid seedlings, but lack of resources resulting from bureaucratic inefficiencies and corruption has made it virtually impossible for local farmers to access competitively priced, high quality planting material from PBK. As a result of this breakdown in the supply chain, farmers have tended to split their own plants, or other-wise borrowed from neighboring farms. As anticipated, consistent use of the same root stock has contributed to disease and increasingly low yields per hectare (Monda, 2011).

The Agricultural Finance Corporation (AFC) is the only agro-based agricultural finance institution to all farmers in all crop and animal enterprises. The absence of support for accessing finance has become a critical problem for pyrethrum production, particularly during the initial planting phase. As a result of the lack of financing available to farmers, the use of poor planting material and thus increasingly poor quality and low yields has become a common, characteristic of the Kenyan pyrethrum market. However, in many tropical countries, governments have set up farmers' cooperative credit and marketing systems which are useful mechanism for rural development and mobilising external aid. However, experience with such cooperatives in Kenya has shown that cooperatives can become a major obstacle to agricultural development because they frequently fail to achieve their goals resulting in defeat of integrated programmes built round them (Global Development Solutions, 2009).

2.2 Market Participation Concept and Group Formation

Market participation is both a cause and consequence of economic development (Abdula et al., 2007). In order to develop their economies, many Sub Saharan Africa (SSA) countries were using market led paradigms and widespread liberalization during the 1980's to 1990's as engines for development and structural transformation in their economies, including the agricultural sector. In order for agrarian and rural transformation to occur, and result in economic development, households must transition from a subsistence mode to a market engagement mode, where most of the inputs and outputs are not provided and consumed internally but are purchased and sold off the farm. This can only happen when farmers participate in markets, by trading most of their output to gain income for purchasing inputs and other needs.

A smallholder farmers' association is made up of cooperatives or farmer field schools or farmer (producer marketing) groups (FAO, 2001). It is normally created and financed by member farmer groups to provide them with services that help improve their economic and social conditions (Gatarwa, 2005). An association is a form of collective action; the farmer groups undertake a voluntary action to achieve a common interest (Meizen-Dick, 2004). Collective action typically arises in instances where there are significant incentives to cooperate (Van Heck, 2003). Based on group member's socio-economic characteristics, they may recognize strong benefits of working as a group. The group brings together individuals with common problems and aspirations and who, as individuals, cannot meet certain goals as efficiently as when in a group (Obare, 2005). By pooling their capital, labor and other resources, the members are able to carry out profitable activities which if undertaken by individuals would involve greater risks and effort. The association is formed of individuals at the same stage of development, with a common interest to jointly solve their problem and meet their needs. The common views, opinion and willingness to work together drive them to work towards a common goal (Gatarwa, 2005).

A typical smallholder farmers' association in Kenya is made up of a range of five to ten cluster groups with total membership of 25-150 individual members (FAO, 2001). The location of the members is normally close for ease of regular attendance of meetings. The members own and control their association. Each cluster group elects representatives on a regular basis as agreed on by members to act on behalf of its members. The representatives make most of the association's decisions. The association has a chairperson who conducts meetings and manages the association. The producer marketing associations in Kenya are formally registered as welfare organizations as is permitted under Kenyan law. They have well-defined objectives, by-laws, and an elected body that leads the group on behalf of the members. Their objectives go beyond social welfare and include improved access to market for their produce, technologies and inputs.

World Bank (2011) revealed that an estimated 450 million of the world's smallholder farmers continually face poor market linkages. But the report also notes that producer organizations could overcome these barriers and improve productivity. Citi Foundation

and Dalberg Development Advisors (2010) show that in Kenya small plots and low productivity leave smallholders more vulnerable to risk than large farmers, who can better diversify their crops and spread capital improvements over larger areas. The study also found out that smallholders' power to negotiate prices is limited, in part because of information asymmetries inherent in the market. Smallholders might overcome these impediments through producer marketing organizations, but most smallholders are dispersed and non-aggregated. According to the report, a typical smallholder has poor links to markets and has minimal, if any, access to credit. In addition, smallholder farming practices are not productive due to limited access to resources needed for optimal inputs, such as high yielding seeds, fertilizer, irrigation, and machinery. Most Kenyan smallholder farmers rely on manual family labour. Without access to credit, most smallholders are confined to sub-optimal inputs and methods, which result in low productivity. The study shows that belonging to a producer organization is one way that smallholders can access finance, certifications, and technical assistance, and although the smallholder's input costs increase, so do his prices, yields, productivity, and profits. In principle, a group of farmers who market their produce together are able to benefit from economies of scale and increase their bargaining power by offering a larger quantity concentrated under a single management (Global Development Solutions, 2009).

2.3 Methods Used to Analyze Market Participation

A number of methods are used in market participation studies. They include binary choice models like probit and logit, discrete choice models like multinomial logit, limited dependent variable models like tobit model, and sequential choice models like the double-hurdle and Heckman models (Olwande et al., 2012).

A binary choice model is one in which decision makers participate or choose from among two alternatives. The probit model is one example of binary choice model. The probit model is used when seeking to explain a variable using a set explanatory variables. When faced with a situation where explanation of a variable using a set of explanatory variables is sought, and this variable of interest is a discrete variable that can only take values of 0 and 1, Ordinary Least Squares (OLS) becomes inappropriate for estimation. This is because OLS estimates variables with values

that run from positive infinity to negative infinity. If OLS is inappropriately applied in this situation, the estimates from this linear probability model will be inconsistent. The decision to participate in a market is a discrete variable that takes the value of 1 if a household participates and a value of 0 if it does not. In this case, the interest is the households that participate in the market by selling their output (Gujarati, 2007). Therefore, the probit model is a widely used statistical model for studying data with binomial distributions. The probit model can be expressed in probability as follows.

$$Prob(Y = 0) = 1 - F\left[\sum_{K=1}^{K} \beta_K b_K\right] = F\left[\sum_{K=1}^{K} \beta_K b_K\right] = \psi\left[\sum_{K=1}^{K} \beta_K b_K\right] \quad (1)$$

The equation for probability of non event is then:-

$$Prob(Y = 0) = 1 - \left[\sum_{K=1}^{K} \beta_K b_K\right] \quad (2)$$

The farmer's decision on use of a particular input depends on the criterion function:-

$$Y^* = {}_{Y}Z_i + U_i \quad (3)$$

Where, Y^* = underlying index reflecting the difference between the use of an input and its non-use, V = vector of parameters to be estimated, Z_i = vector of exogenous variables which explain use of an input and U_l = standard normally distributed error term. The only limitation of probit models is that they require normal distributions for all unobserved components of utility (Gujarati, 2004).

A discrete choice model is one in which decision makers participate among a set of alternatives. To fit within a discrete choice framework, the set of alternatives - the choice set - needs to exhibit three characteristics: (i) alternatives need to be mutually exclusive, (ii) alternatives must be exhaustive, and (iii) the number of alternatives must be finite. One such model is known as the multinomial logit model (Gujarati, 2004). The basic utility equation for individual *n* choosing alternative *j* in a multinomial logit model is shown below.

$$Unj = V_{nj} + {}^{E}{}_{nj}$$

According to He et al. (2009), sequential choice models constitute a two-stage decision nature implying that participation decision and the level of market participation should be modeled jointly. The Heckman two-stage selection model is an example of a

sequential choice model. Heckman procedure is relatively simple for correcting sample selectivity bias (Hoffman and Kassouf, 2005). That is why the Heckman two-stage selection model was used to determine the market participation and extent (level) of participation in this study. Heckman two-step selection model involved estimation of two equations: That is, it consists of two steps. First, a selection equation was estimated using a probit model. A household either participated in the pyrethrum group market or not. Second, an outcome equation was estimated to find out the extent of market participation (proportion of sales). Therefore, this model predicts the probability that an individual household participate or does not in the pyrethrum market as shown in equation 1 and 2.

$$P(Y_1 = 1) = P(Q_i > 0) = X_1\alpha + \varepsilon \qquad \text{(Market participation model)} \quad (1)$$

$$Q_1 = Z_1\beta + \mu \qquad \text{(Participation intensity model)} \quad (2)$$

Equation 1 defines the market participation model where Yi takes the value of one if a household made any positive sales to the market and zero if no sales were made. Qi is the proportion of quantity sold or value sold and Xi and Z_1 define factors that affect the discrete probability of participation and intensity of participation respectively.

2.4 Empirical Studies on Market Participation in Kenya and Other Parts of the World

Many studies on small holder market participation have modeled both output and input market decisions as a two-step decision process, based on the assumption that households make two separate decisions. One involves the decision to participate in the market or not and secondly the level of participation. These studies have used either the sample selection model of Heckman (1979) (Makhura, et al., 2001; Boughton, et al., 2007) or the double-hurdle model (Omiti, et al., 2009, Goetz, 1992; Key et al., 2000). Farmer market access is a vital component of market participation. A smallholder farmer can access the market either by selling to a buyer at the farm gate or physically transporting the produce to the market place using available means.

Muricho (2002) assessed the determinants of market participation regimes among smallholder maize producers in Kenya using a random effect probit model. The study found out that households that faced high producer selling prices of maize were likely to be net buyers but the household with membership to agricultural production groups had increased likelihood of their farmers being net sellers.

Lapar (2003) assessed the magnitude of neighbourhood influences in smallholder decisions concerning market entry by smallholder livestock producers in Phillipines using spatial probit model estimation. Estimation required a metropolis-step addition to a basic Gibbs sampling algorithm and generated useful insights concerning quantities that are important for market access policy. The study found out that neighbourhood effects are significantly influential in motivating household decisions to participate in markets. Though just like this study, they dealt with neighbouring farmers and market participation, but this study is different in that it is specifically assessing group effect in market participation.

Bellemare et al. (2004) investigated whether rural households in developing countries make livestock market participation and volume decisions simultaneously in Northern Kenya and Southern Ethiopia. The study used a two-stage model of livestock with the first stage being an ordered probit model of partition the real line into net buyer, autarkic and net seller households and estimated an ordered probit model of household discrete choice with respect to market participation. In the second stage, determinants of how each net seller or buyer household transacted in the market was assessed. Results indicated that prices matter to the extent of participation and that fixed transaction costs matter both in the participation decisions. Similarly, this study used a (heckman) two-stage-model whereby factors affecting (pyrethrum) market participation were also analyzed at two levels.

Aliguma et al. (2007) analyzed the factor that necessitated group potato market participation in Uganda using the Heckman two step model. The author also aimed at identifying what (factors) constituted better practice in connecting small scale producers

with dynamic markets. They found out that farmers needed strong group dynamics with effective leadership.

Makhura et al. (2001) used a Heckman model to determine the factors affecting the decision and level of smallholder farmers' participation in maize market in Northern Province of South Africa. The study found that the size of household, arable land, capital owned and proximity to town and road conditions determined participation in maize market. The study also found that age, gender and the level of education of the household head were the factors that influenced the level of participation in the maize market.

Goetz (1992) studied the participation of Senegalese agricultural households in grain marketing using a Heckman model. In the first stage, the probability of participating in the market was estimated using a probit model. In the second stage, OLS was used to determine the extent of market participation. The study explicitly assumed sequential choice: The household initially decides whether or not to participate in the market and then decides on the volume purchased or sold conditional on having chosen market participation.

Hudson and Herndon (2002) applied binomial probit model to study the motivation for opportunities and participation in mergers and joint venture in agriculture cooperatives in the United States of America. The results revealed that research and development, market diversification affected the opportunities and participation. Farm size, placement in market channel influenced the frequency of participation in the merger. Though the current study is also about participation, it differs from this one of Hudson in that it did not use the Heckman model and so it did not analyze the level of participation.

Ngigi (2000) evaluated the factors that determine milk sales among the smallholder farmers in Nairobi, Kenya. The study hypothesized that dairy farmers in Nairobi milk shed chose milk outlets and levels of cash sales that reduced transaction cost and help assume reliable future outlets at the expense of current income. The study used a tobit model to estimate the share of producer output sold for cash rather than credit. The results showed that the younger, more educated producers, receiving a regular off-farm salary

and situated near market center were more likely to accept sales on credit. Ngigi's study also assessed the levels of cash sales.

Shapiro and Brorsen (1988) used the tobit model to analyze factors that affect decision of participation in Indiana corn market and found that farmers' social and economic factors significantly influenced their participation.

Key et al. (2000) developed a structural model to estimate structural supply functions and production threshold for Mexican farmers' participating in maize market. They modeled the household head to make the discrete market participation decision simultaneously with the decision for volume purchased or sold. The study found that both types of transactional costs play a significant role in household behavior with proportional transaction costs being more important in selling rather than buying decision.

2.5 Summary

From the literature review, it is evident that economic factors are empirically tested to identify their influence on the decision and level of participation in group marketing regardless of the enterprises considered. However, other factors are included in the analysis depending on the context of the study. Though some work has been carried out on different agricultural produce group marketing in America, Asia, and Africa including Kenya, there is hardly any study that has focused on economic factors that influence smallholder farmers' decision and level of participation in a pyrethrum group marketing.

The few studies of pyrethrum (e.g. Inyamu, 2006) in Kenya have mainly focused on productivity enhancement among pyrethrum producers without critically assessing the market of pyrethrum produce. Therefore, the current study is unique in that it has examined farmers participation of pyrethrum group marketing channels in Nyandarua county focusing on analysis of how economic factors affect the overall performance of the market. This study aimed to fill this gap.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Study Area

Nyandarua County was purposively selected for this study because of its continuous production of pyrethrum of relatively high pyrethrin content of 1.6 (Table 1.2) despite reduction in hecterage in size (Table 1.3). The pyrethrin content of deliveries is a big issue as it determines the price received (the higher the content the higher the payment). The county also has the most varieties of pyrethrum planted (Table 1.2). The study was conducted in Kenton and Mawingu areas in Nyandarua County. The areas were selected purposively for being the only remaining pyrethrum producing areas in the county. The main economic activities in the study areas are growing crops especially potatoes and rearing dairy cattle. .

Nyandarua County (Figure 3.1) is located in former Central Province and borders the following counties: Laikipia to the North and North East, Nyeri and Murang'a to the East, Kiambu to the South, and Nakuru to the South West. Administratively, the county is made up of the following 5 constituencies: Kinangop, Ndaragwa, Oljororok, OlKalou, and Kipipiri. Nyandarua is deemed as the food basket that feeds Nairobi and its environs because it is one of the agricultural rich zones in the country. And it is for this reason that the county is believed to be among the richest countrywide as it produces a lot of potatoes, varied vegetables and other food products. Dairy farming is one of the major practices that the farmers have adopted.

The pyrethrum sector in Nyandarua County is yet to be revived since the enterprise was almost entirely replaced by other competitive alternative enterprises which seem to be more profitable. The county has only two major roads which cut across the five constituencies. The roads are the newly constructed Njabini-OlKalou-Ndundori and Nyahururu-Gilgil.

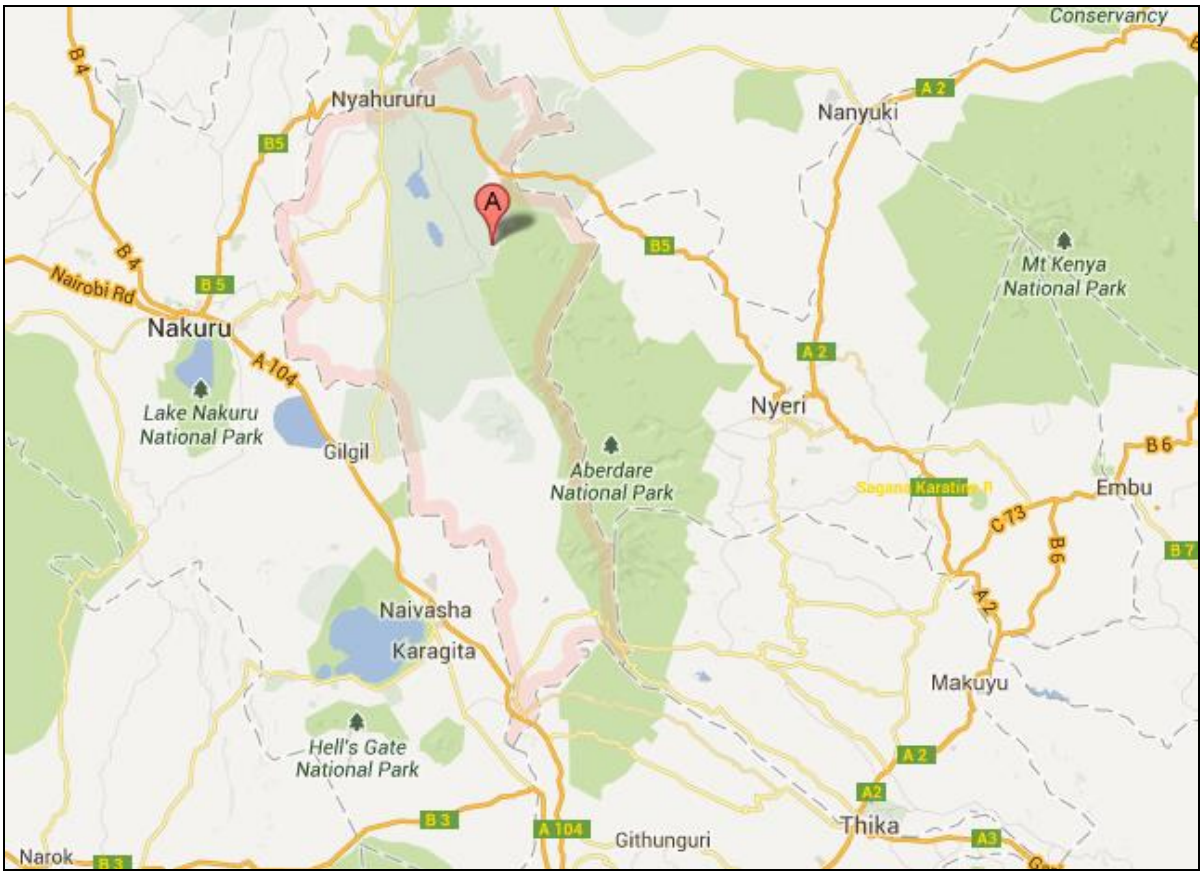

Figure 3.1: Map of the study area (pink outline) showing its environs. (www.google.co.ke/map of Nyandarua County) 10th June 2013

3.2 Conceptual Framework

Farmer social-demographic characteristics play an important role in either promoting or hindering his/her participation in agricultural markets. In this section, the key social-demographic and economic factors related to group market participation of smallholder farmers are shown (Figure 3.2).

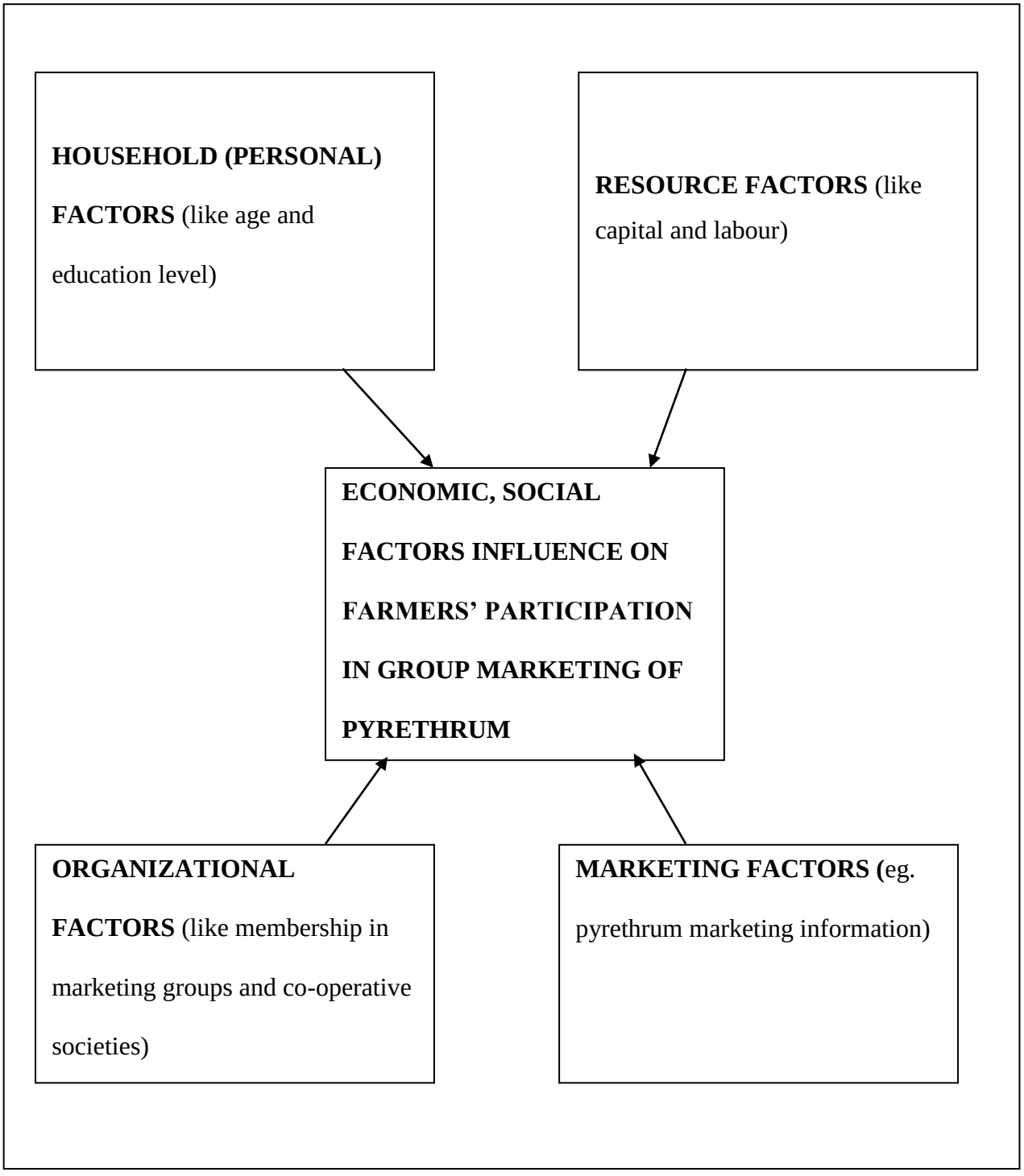

Figure 3.2: The Conceptual Framework on Factors Influencing Pyrethrum Farmers' Participation in Group Marketing in Nyandarua County

Source: Author

The conceptual framework shows how the various household resource, organizational and marketing factors act in totality to influence farmers' participation in group marketing of pyrethrum in Nyandarua County. That is, these household, resource, organizational and marketing factors act on the economic and social factors that influence group marketing participation. But their combined effect is the one that replicates on the farmers' decision to participate in group marketing of pyrethrum. Household (personal factors like age and education level of the household head (farmer) directly influence farmers' participation in group marketing of pyrethrum. Resource factors like capital and labour also influence group marketing participation directly in that synergies are created by farmers when they group together hence optimize the use of such resources. Organizational factors like belonging (membership) to a marketing group or cooperative society act like a catalyst to influence (decision making in) participation in marketing pyrethrum together. In other words, by the virtue of existence of such group(s) the environment helps those wishing to market pyrethrum together to have decision making easy to do so. Marketing factors like readily available pyrethrum marketing information helps farmers to directly influence on their participation in group marketing because such information act as an incentive to exploit economic and social benefits of marketing their produce communally (Figure 3.2).

Ideally, household characteristics and farmer endowments are the key factors that influence how much will be sold in the market. Factors like education level of the farmer, membership to a farmers' group or cooperative influence the level of market participation in form of how much is sold.

3.3 Theoretical Framework

This study was based on the Random Utility Model (RUM). According to Thurston (1972), a household is assumed to maximize a welfare-enhancing factor which is utility in this case. Household utility maximization is a function of household characteristics, as well as on other attributes related to the consumption of goods and services. In this study, households were assumed to participate in group marketing because it maximized their utility. The RUM was used to link the decision to participate in group marketing and utility maximization hence making it possible to model the household's decision-making process. Given two marketing channels to participate in, W_1 and W_2 with their associated

utilities, U_1 and U_2, where U_2 is greater than U_1, based on RUM, a household would participate in marketing channel W_2, instead of W1 because W_2 has a higher utility than W_1. In other words, the household would choose to participate in the marketing channel that yields the highest utility (Shepherd, 2007). The utility derived from participating in any channel selected by a farmer can be expressed as a linear sum of the two components, a deterministic part, R_{ij} that captures the observable components of the utility function and ε_{ij}, a random error term that captures unobservable components of the function including measurement errors (Shepherd, 2000). The resulting utility function is:

$$U_{ij} = R_{ij} + \varepsilon_{ij} \quad (3.1)$$

where U_{ij} is the utility derived by an individual household i by making the participation decision j, R_{ij} is the observable component which contains the vector of household, economic and institutional factors as well as the vector of parameters or the coefficients to be estimated, while ε_{ij} is the unobserved component or the error term (Shepherd, 2007).

To participate or be selected to participate in any research study may not necessarily be random. Consequently, selection bias or selectivity bias may exist. In this respect because participation in pyrethrum group marketing in Nyandarua County was based on selection of participants (farmers who had a standing crop only), there could be bias. Thus, Heckman two stage procedure was used to control possibility of selection bias problem. Often people that respond to a survey are self selected implying that they do not constitute a random sample of the general population. Further a farmer's decision to participate or not is guided by the perceived utility that will be derived out of engagement in that activity (Madala, 1983). Utility maximization behavior of a farmer cannot be observed and therefore the decision made is assumed to represent their utility maximization behaviour. Heckman (1979) addresses the problem and this approach was employed in this study. The main advantage of using a two-stage Heckman over other models of participation is that in the first equation Inverse Mills Ratio (IMR) is calculated and used in the second equation as one of the independent variables to correct term for

the bias that arises from selectivity bias problem. The Heckman model is stated as follows.

$$y_{1i}^{*} = x_{1i}'\beta_1 + u_{1i} \quad (3.2a)$$

$$y_{2i}^{*} = x_{2i}'\beta_2 + u_{2i} \quad (3.2b)$$

$$y_{1i} = y_{1i}^{*} \quad if \ y_{2i}^{*} > 0$$

Model (3.2b) is a probit-type selection equation that describes the propensity to participate. The participation equation can then be written as:

$$y^{*} = \beta X + u \quad (3.2c)$$

where y^{*} is a latent variable, which is the utility the farmer gets from participating in a marketing channel and u is the random error term (Heckman, 1979). β is the parameter estimated through regression and X represents the independent variables influencing group marketing participation. The binary model is then stated as:

$$y_i = \beta X_i + u_i$$

$$y = \begin{cases} 1 & \text{if farmer sells any pyrethrum and} \\ 0 & \text{otherwise.} \end{cases} \quad (3.3)$$

Where β is the parameter for estimation and X_i represents the independent variables influencing group marketing participation.

Equation 3.3 is operationalized using either a probit or a logit model (Heckman, 1979). In the case of the two-stage Heckman, a probit is preferred because the model predicts the probability that an individual household participate or does not in the (pyrethrum) market (Gujarati, 2004). The probit model is used in the first stage to calculate the Inverse Mill's Ratio (IMR) and includes this as a regressor in the underlying regression model.

$$Pr(y_1) = f(x_i, \boldsymbol{e}) \quad (3.4)$$

where, $Pr(y_1)$ is the probability of a farmer to participate in a marketing channel x_i are the independent variables and $\boldsymbol{e}$ is the error term which is assumed to be normally distributed with zero mean and variance of sigma squared (Heckman, 1979).

In the second stage of the Heckman model, OLS is used to estimate the effect of hypothesized factors on the level of participation. The inverse mill's ratio is inserted into the OLS regression so as to capture the selection bias effect. The OLS regression is stated as:

$$Q = f(T_i, IMR, \varepsilon) \quad (3.5)$$

where,

Q is the quantity sold annually through the channel that the farmer decides to participate in, T_i are the independent variables hypothesized to influence the quantity sold by a farmer through the marketing channel, IMR is the inverse mill's ratio and ε is the error term assumed to be normally distributed with zero mean and variance of sigma squared (Gujarati, 2007).

3.4 Empirical Estimation

3.4.1 Empirical Model for Factors Influencing Household Heads' Participation in Pyrethrum Group Marketing

Table 3.1 presents the factors hypothesized to influence household heads' decision to participate in group marketing. Equation 3.6 was specified as follows:

$$P=\beta_0+\beta_1AGE+\beta_2AGESQ+\beta_3GENDER+\beta_4EDUC+\beta_5FAMILAB+\beta_6OTHEFI+\beta_7LIVEVAL+\beta_8NONFI+\beta_9MKTDIST+\beta_{10}EXTEN+\beta_{11}ROADCON+\beta_{12}SALEPRIC+\beta_{13}GROUPME+\boldsymbol{e} \quad (3.6)$$

Table 3.1: Independent Variables Hypothesized to Influence Probability of Participation in Pyrethrum Group Marketing in Nyandarua County

Variable	Definition	Measurement	Hypothesized sign
AGE	Age of household head	Years	+
AGESQ	Age squared	Years	+
GENDER	Gender of the household head	Dummy:1=Male, 0=Female	+
EDUC	Education level of the household head (farmer)	Years	+
FAMILAB	Family labour	Mandays	_
OTHEFI	Other farm income	Ksh	+
LIVEVAL	Livestock value	Ksh	_
NONFI	Monthly non-farm income	Ksh	_
MKTDIST	Market distance	Km	+
EXTEN	Extension visits per year	Number	+
ROADCON	Road condition	Categories:1=Good, 0=Poor	_
SALEPRIC	Sale price of produce deliveries	Ksh	+
GROUPME	Group membership	Dummy: 1=Membership, 0=Non-membership	+

Source: Author

3.4.2 Factors influencing the level of participation in pyrethrum group marketing

The factors influencing the level of participation in pyrethrum group marketing in Nyandarua County are outlined in Table 3.2.

3.4.3 Empirical model for factors influencing the household heads' level of participation in pyrethrum group marketing

The following empirical model was fitted into the data.

$$QTY=\beta_0+\beta_1AG+\beta_2AGSQ+\beta_3GEND+\beta_4EDU+\beta_5FAMILB+\beta_6TAQH+\beta_7PCBM+\beta_8NONF+\beta_9MKTD+\beta_{10}EXT+\beta_{11}ROADC+\beta_{12}SALEP+\beta_{13}GROUPM+\beta_{14}IMR \quad (3.7)$$

Table 3.2 presents the second stage variables of the Heckman model which are the factors hypothesized to influence the household heads' level of market participation.

Table 3.2: Independent Variables Hypothesized to Influence Level of Participation in Pyrethrum Group Marketing in Nyandarua County

Variable	Definition	Measurement	Expected sign
AG	Age of the household head	Years	_
AGSQ	Age squared	Years	+
GEND	Gender of the household head	Dummy:1=Male, 0=Female	+
EDU	Education level of the household head (farmer)	Years	+
FAMILB	Family labour	Mandays	_
TAQH	Total annual quantity harvested	Kgs	+
PCBM	Possession of cart/bicycle/motorcycle	Dummy:1=Yes, 0=Otherwise	_
NONF	Monthly non-farm income	Ksh	+
MKTD	Market distance	Km	+
EXT	Extension visits per year	Number	_
ROADC	Road condition	Categories:1=Good, 0=Poor	_
SALEP	Sale price of produce deliveries	Ksh	+
GROUPM	Group membership	Dummy:1=Membership, 0=Non-membership	+

Source: Author

3.4.4 Justification for Inclusion of Factors Influencing the Probability of Participation in Pyrethrum Group Marketing in Nyandarua County

Age of the household head (AGE)

Age of the farmer was expected to influence the probability of participation in pyrethrum group marketing positively. The age was collected as continuous variable measured in years. Older members of the family tend to make the key decisions that affect the family welfare. Gebremedhin et al. (2007) also found a positive and significant relationship between age and farmer group market participation whereby older farmers had a higher probability of wheat market participation in Ethiopia.

Gender of the household head (GENDER)

Gender of the farmer was expected to influence the probability of participation in pyrethrum group marketing positively. The variable gender was capturing the sex of the farmer who was expected to be the head of the household. This variable was coded as a dummy with a value of 1 for male and a value of 0 for female. Holden et al. (1998) found that gender (male) to positively and significantly affect smallholders' likelihood to participate in markets in developing countries. Sex of household head has an impact on the decision to participate in the market. In most cases it is the males in a family who make the decisions on whether to sell produce or not. This means that females are less likely to participate in the whole process of selling pyrethrum.

Education level of the household (EDUC)

Education of the farmer was expected to influence the probability of participation in pyrethrum group marketing positively. The education level of the farmer was a continous variable capturing the number of years of formal schooling. Jaleta et al. (2009) found that the education level of the household heads had a positive and significant effect on household market participation. The authors found literacy of the heads of households who make decisions on livestock market participation a key factor among Ethiopian farmers.

Family labour (FAMILAB)

Family labour was expected to influence the probability of participation in pyrethrum group marketing negatively. The quantity of family labor available for pyrethrum production purposes per year was a continous variable measured in man-days. Family labor used on the farm from those under the age of 18 was considered child labor. Lerman (2004) however, found household labour to be an influential but cheaper asset that leads to higher production volumes which positively and significantly influenced the farmers' market participation in Asia.

Other farm income (OTHEFI)

Other farm income was expected to influence the probability of participation in pyrethrum group marketing positively. The income was collected as continuous variable

measured in Kenyan shillings. Boughton et al. (2007) studied patterns of household market participation in Mozambique and also found out that other farm income generated by the farmer positively and significantly affected crop group market participation.

Livestock value (LIVEVAL)

Livestock value was expected to influence the probability of participation in pyrethrum group marketing negatively. The value was collected as continuous variable measured in Kenyan shillings. Jaleta et al. (2009) also pointed out that ownership of livestock by a household negatively affected participation in the crop market because it distracts the farmer into an alternative source of income. They were studying smallholder farmers' commercialization processes, determinants and impact among Ethiopian farmers. But Pravakar et al. (2010) found that households with larger livestock endowments in the Himalayas had a positive and significant effect on the probability of crop market participation. They produced and sold more crop produce which the authors explained that it was because the households used manure from the livestock to enhance crop yields.

Monthly non-farm income (NONFI)

Non-farm income was expected to influence the probability of participation in pyrethrum group marketing negatively. The income was collected as continuous variable measured in Kenyan shillings. Eskola (2005) however, found that non-farm income had a positive and significant effect on smallholder farmers' likelihood of participation in food crop markets in Tanzania.

Market distance (MKTDIST)

Market distance was expected to influence the probability of participation in pyrethrum group marketing positively. The distance from the farms to the flower market was collected as continuous variable measured in kilometres. Owuor (2009) found a positive significant coefficient of the household distance to the market in the study of empirical evidence from Kenya of whether group based credit uphold smallholder farmers' productivity. Proximity to the market has economic implication on the household farm and market activities.

Extension visits per year (EXTEN)

Extension visits were expected to influence the probability of participation in pyrethrum group marketing positively. The visits were collected as a continuous variable measured as the number of times in a calendar year that agricultural extension officers visited the farmers specifically to offer advice on pyrethrum production. Heltberg et al. (2001) also got a similar result when they found a positive and significant effect of the number of extension visits on the decision to participate in the food crop market in Mozambique by smallholder farmers.

Road condition (ROADCON)

Road condition was expected to influence the probability of participation in pyrethrum group marketing negatively. This variable was categorized as whether the condition of the road to the market was good or poor. That is, a value of 1 for good condition if road was not pot-holed and a value of 0 for poor condition if road was pot-holed. Makhura et al. (2001) found that the state of bad roads negatively impacted on the farmers' access to urban markets, hence a hindrance to smallholder farmers' probability of market participation (commercialization) of horticultural produce in the Northern Province of South Africa.

Sale price of produce deliveries (SALEPRIC)

The sale price was expected to influence the probability of participation in pyrethrum group marketing positively. The price was collected as continuous variable measured in Kenyan shillings gotten by the pyrethrum farmers as payment for the delivery of their produce. Omiti et al. (2009) also asserted that better output price in the rural and peri-urban areas of Kenya had a positive and significant effect on the probability of market participation. The authors were studying the factors influencing the intensity of market participation by smallholder vegetable farmers.

Group membership (GROUPME)

Group membership was expected to influence the probability of participation in pyrethrum group marketing positively. The variable group membership was determining whether a pyrethrum growing household was a member of a pyrethrum farmer marketing

group/association or not. This variable was coded as a dummy with a value of 1 for membership and a value of 0 for non-membership. Technoserve (2004) observed that banana market participation in agro-commodity marketing association in Central Kenya had a positive and significant effect on the farmers' level of market participation. Such group members pool together their experience, information, capital and labour assests to perform successfully what they cannot do effectively on individual basis (Van Heck, 2003).

Inverse Mill's Ratio (IMR)

The Inverse Mill's Ratio, named after John P. Mills, is the ratio of the probability density function over the cumulative distribution function of a distribution. Use of the inverse Mills ratio is often motivated by the following property of the truncated normal distribution. If *x* is a random variable distributed normally with mean μ and variance σ^2, then it is possible to show that

$$E(x|x>\alpha) = \mu + \sigma\mathbf{[\{\varphi((\alpha-\mu)/\sigma)\}/\{1-\Phi((\alpha-\mu)/\sigma)\}]} \quad (3.8)$$

where α is a constant, φ denotes the standard normal density function, and Φ denotes the standard normal cumulative distribution function. The term in square bracket denotes the Inverse Mill's Ratio which was expected to influence the probability and level of participation in pyrethrum group marketing positively. The IMR which is estimated from the first (selection) equation is added to the second (outcome) equation as an independent variable so as to capture the selection bias effect. It also brings consistency in estimation of the remaining coefficients of the equation (Dolton et al., 1986).

3.4.5 Justification for Inclusion of Factors Influencing the Level of Participation in Pyrethrum Group Marketing in Nyandarua County

Age of the household head (AG)

Age of the farmer was expected to influence the level of participation in pyrethrum group marketing negatively. But Heltberg et al. (2001) found a positive and significant effect on the age of the household head's ability to make decisions on the levels of market participation. They were studying agricultural supply response in Mozambique.

Gender of the household head (GEND)

Gender of the farmer was expected to influence the level of participation in pyrethrum group marketing positively. Vigneri et al. (2011) showed that women in Sub-Saharan Africa rarely had similar access to assets and markets as men, which led to different levels of participation in cash crop markets. Doss (2001) also supported this finding by indicating that female farmers who grew subsistence crops in Eastern Africa for food security had lesser influence on levels of market participation than their male counterpants who mainly grew cash crops to cater for cash needs of the household.

Education level of the household head (EDU)

Education level of the farmer was expected to influence the level of participation in pyrethrum group marketing positively. This is the formal education of the household head which was a continous variable capturing the number of years of formal schooling. Lubungu et al. (2012) revealed that the education level of the household head had positive and significant relationship on the smallholders' level of participation in the livestock market in Zambia. Formal education is an essential requirement for utilization of market information whereby it enhances understanding of market dynamics resulting into informed market participation level.

Family labour (FAMILB)

Family labour was expected to influence the level of participation in pyrethrum group marketing negatively. Lerman (2004) however, found household labour to be an influential but cheaper asset that leads to higher production volumes which also positively and significantly influenced the farmers' level of market participation in Asia.

Total annual quantity harvested (TAQH)

Total annual quantity harvested was expected to influence the level of participation in pyrethrum group marketing positively. The amount was collected as continuous variable measured in kilogrammes. Pravakar et al. (2010) found that households with larger harvested volumes of their crop produce had a positive and significant effect on the level of market participation. The authors studied commercialization of agriculture in the Himalayas.

Possession of cart/ bicycle/ motorcycle (PCBM)

Possession of cart/ bicycle/ motorcycle by the farmer was expected to influence the level of participation in pyrethrum group marketing negatively. This variable was capturing whether the farmer owned means of transporting pyrethrum to the market (collection point) or not. The variable was coded as a dummy with a value of 1 if yes and a value of 0 if otherwise. Boughton et al. (2007) using an asset-based approach to study patterns of household market participation in Mozambique found that private household assets, especially means of transporting farm produce to the market positively affected crop market participation level.

Monthly non-farm income (NONF)

Monthly non-farm income of the farmer was expected to influence the level of participation in pyrethrum group marketing positively. Eskola (2005) also found that non-farm income had a positive and significant effect on smallholder farmers' level of participation in food crop markets in Tanzania. Omiti et al. (2009) however, asserted that non-farm income significantly reduced the sales of vegetables in the market in their study of the factors influencing the intensity of market participation by smallholder vegetable farmers in rural Kenya.

Market distance (MKTD)

Market distance was expected to influence the level of participation in pyrethrum group marketing positively. Meinzen-Dick (2004) also found a positive significant coefficient of the household distance to the market in their study of methods of collective action in rural development. The authors concluded that as the distance of the household to the nearest agricultural market increases, smallholders would be better off by organizing to lower their transaction costs.

Extension visits per year (EXT)

Extension visits per year was expected to influence the level of participation in pyrethrum group marketing negatively. Gebremedhin et al. (2007), however, found a positive and significant effect of extension visits on the volume of rice sold in Ethiopia. The authors were researching on cereal marketing and household market participation.

Road condition (ROADC)

The road condition was expected to influence the level of participation in pyrethrum group marketing negatively. This variable was categorized as whether the condition of the road to the market was good or poor. That is, a value of 1 for good condition if road is not pot-holed and a value of 0 for poor condition if road is pot-holed. Makhura et al. (2001) also found that the state of bad roads negatively impacted on farmers' level of market participation of horticultural produce, hence a hindrance to increased incomes in the Northern Province of South Africa.

Sale price of produce deliveries (SALEP)

The sale price of the produce deliveries of the farmer was expected to influence the level of participation in pyrethrum group marketing positively. Enete et al. (2009) also found that output price had a positive and significant influence on the level of farmers' market participation in cassava markets in Eastern Africa which is supported by economic theory that price induces increased supply.

Group membership (GROUPM)

The group membership of the farmer was expected to influence the level of participation in pyrethrum group marketing positively. Jagwe (2011) found that belonging to a farmer group in the banana markets of Burundi significantly influenced the extent (level) of farmer participation in market. The author found that farmers who belonged to a farmer group had cohesion in terms of gaining and sharing knowledge as well as capacity to produce more for marketable surplus. Shepherd (2007) also suggested collective action in form of farmer cooperatives or groups to increase smallholder market participation in less developed countries. Njuki et al. (2006) however added that forming farmer groups though recognized as essential for efficient farmer learning, receiving external support and achieving economies of scale, it must be accompanied by incentives to participate in markets in Malawi.

3.4.6 Effect of Participation in Group Marketing on the Gross Margins

The factors influencing participation in pyrethrum group marketing on the gross margins of household heads in Nyandarua County are outlined in Table 3.3.

Table 3.3: Independent Variables Hypothesized to Influence Participation in Pyrethrum Group Marketing on the Household heads' Gross Margins

Independent Variables	Defination	Measurement	Expected sign
A	Age of the household head	Years	+
ASQ	Age squared	Years	+
G	Gender of the household head	Dummy:1=Male, 0=Female	+
E	Education level of the household head (farmer)	Years	+
D	Distance to the collection points	Km	+
C	Credit availability	Categories:1=Available, 0=Unavailable	+
PC	Pyrethrin content of the produce	Number	+
FGM	Farmer's Group membership	Dummy:1=Membership, 0=Non-membership	+
Dependent Variable			
Q	Quantity of pyrethrum sold by the household head	Kgs	+

Source: Author

3.4.7 Empirical Model for Factors Influencing Participation in Pyrethrum Group Marketing on the Household Heads' Gross Margins

The following empirical model was fitted into the data.

$$GM = \beta_0 + \beta_1 A + \beta_2 ASQ + \beta_3 G + \beta_4 E + \beta_5 Q + \beta_6 D + \beta_7 C + \beta_8 PC + \beta_9 FGM + \varepsilon \quad (3.9)$$

Where GM = Gross Margin calculated as:

Gross Margin (GM) = Total Revenue (TR) – Total Variable Costs (TVC). (3.10)

The farmers who sold to brokers through the SHG (participants) earned a gross margin that was 81% of the total revenue when family labour was excluded. Those who sold directly to brokers (non-participants) got a gross margin that was 71% of the total revenue (Appendix III). The average price of 1kg of the sun-dried pyrethrum flowers sold to brokers through the group channel at their collection centre was Ksh150 and the average price of 1kg of similar flowers sold directly to brokers through the non-participant channel fetched Ksh100 at their collection point. All the brokers did not grade the flowers and neither did they categorize the dry flowers according to their pyrethrin content. Costs were similar for both participants and non-participants because they sourced inputs from the same agro-chemical shops. On average, both smallholder participants and non-participant farmers used about the same amount of inputs (inorganic fertilizer and organic manure). On average each farmer in both categories used 21 kgs D.A.P fertilizer and 123 kgs of compost manure per hectare per year. However, the two sets of farmers used more family labour than what was hired. Family labour was valued the same rate as hired labour Ksh100 per man day. Each household employed 1 causal labourer during peak periods and family labour is excluded from Gross Margin. Yield per acre was 300.4 Kgs per year but due to handling wastages it was approximated at 300.0 Kgs. Farmers in both channels incurred transportation costs at an equal rate charged by donkey owners at Ksh5 per flower kilogram delivered to the collection points 4 kilometers uphill. This resulted in a gross margin of Kshs36, 295 per hectare per year for the group channel participants compared to Kshs21,295 per hectare per year for the non-participant farmers (Appendix III).

3.4.8 Justification for Inclusion of Independent Variables in Equation 3.9

Age of the household head (A)

Age of the farmer was expected to influence the gross margin positively. Barret et al. (2007), however, found that the age of the household head had a negative but significant effect on gross returns with all other factors held constant. It is believed that younger people are more enthusiastic to participate in tomato market than the older people in Eastern and Southern Africa. In their study they used the Heckman two-step model.

Gender of the household head (G)

Gender of the farmer was expected to influence the gross margin positively. Benfica et al. (2006) used the Heckman model to investigate the determinants of participation of cotton and tobacco contract farmers in the Zambezi valley of Mozambique. The results showed that gender and age of the household heads had a positive and significant effect on their gross margins.

Education level of the household head (E)

Education level of the farmer was expected to influence the gross margin positively. This is the formal education of the household head which was a continuous variable capturing the number of years of formal schooling. Geoffrey et al. (2013) in their study of determinants of market participation among small-scale pineapple farmers in Kericho County, Kenya found that education level of the household head significantly and positively influenced gross returns. Heckman two-stage model was used.

Quantity of pyrethrum sold by the household head (Q)

Total annual quantity sold was expected to influence the gross margin positively. The amount was collected as continuous variable measured in kilogrammes. Winter-Nelson (1992) used econometric analysis by using past data on costs and effectiveness of synthetics to model market demand for pyrethrum and found a positive and significant effect of quantity of pyrethrum sold by the household heads' on their gross margins. The study also found out that increase in the level of production of synthetics always negatively affected the demand for pyrethrum in Kenya.

Distance to the collection points (D)

Market distance was expected to influence the gross margin positively. Makhura et al. (2001) found that distance to the collection points (markets) had a positive and significant effect on gross margins (returns) of the household heads and both the decision to participate in markets and the proportion of output sold. The authors used a Heckman model to determine the factors affecting the decision and level of smallholder farmers' participation in maize market in Northern Province of South Africa.

Credit availability (C)

Credit availability was expected to influence the gross margin positively. This variable was categorized as whether the credit was available or unavailable. That is, a value of 1 for available if the credit is accessible and a value of 0 for unavailable if credit is not accessible. Ngugi (1999) found a positive and significant effect of credit availability by the household heads' on their gross margins (incomes). The author used a supply response approach, partial adjustment model and model of formulation to study the effects of technology, delayed payments and rainfall variability on pyrethrum production in Kiambu district.

Pyrethrin Content of the produce (PC)

The pyrethrin content of the produce deliveries of the farmer was expected to influence the gross margin positively. Wanjala, (2003) showed through various sample tests how pyrethrin content of pyrethrum plants growing where weeds were controlled as compared to those affected by the weeds had a positive and significant effect on the household head's gross margins. PC is important because it determines the prices received by farmers (Appendix II and Table 1.2) since all flowers delivered to the PBK are checked for pyrethrin content (referred to as PC Test).

Farmer's Group Membership (FGM)

The group membership of the farmer was expected to influence the gross margin positively. Inyamu (2006) sought to evaluate the pricing efficiency of alternative marketing channels used by pyrethrum growers in Nakuru district. The results showed that marketing in groups and cooperatives by the household heads' had a positive and

significant effect on their gross margins and that marketing through middlemen (brokers) was the most inefficient with growers using this channel getting the lowest returns for their produce.

3.4.9 Diagnostic tests

Testing for Multicollinearity

Before modelling the pyrethrum group market participation, a diagnostic test of multicollinearity was carried out on the independent (explanatory) variables to assess their suitability for inclusion in the empirical model. Multicollinearity was tested using the correlation matrix (Appendix VIII) for independent variables hypothesised to influence decision to participate in pyrethrum group marketing in Nyandarua County. According to Woolridge (2000), the existence of multicollinearity means that there is a perfect linear relationship among some or all the explanatory variables of a regression model. In the presence of multicollinearity, the regression coefficients of the explanatory variables are indeterminate and their standard errors are infinate or if determinate, they possess large standard errors. This means that the coefficients cannot be estimated with great accuracy. They might have wrong signs and smaller t- ratios which may lead to drawing the wrong inference about the effect of hypothesized variables on the dependent variable (Gujarati and Sangeetha, 2007). A correlation matrix was used to examine the explanatory variables for multicollinearity for this study.

The following variables were suspected to be correlated using a statistically significant Pearson's correlation coefficient of ±0.5 and above to imply existence of multicollinearity: age of the farmer and farming experience, family labour and the farmer's household size, market distance and accessibility to the market. Therefore, in modelling the empirical model for this study, the variables farming experience, the farmer's household size and accessibility to the market were omitted from the model and this omission resolved the multicollinearity problem.

Testing for heteroscedasticity

Heteroscedasticity is present when a sequence of random variables has different variances. This violates the assumption of equal variances in least squares estimation. If

there is heteroscedasticity, OLS estimators remain unbiased and consistent, but are inefficient. So, OLS will be no longer result in the BLUE (Best Linear Unbiased Estimator). There are several procedures to correct for heteroscedasticity.

The presence of heteroscedasticity makes OLS estimates asymptotically inefficient. This results in large standard errors and increasing the likelihood of type I error (Gujarati and Sangheeta, 2007). In this study, the Beursch-Pagan test was used to test the hypothesis of homoscedasticity. The chi-square was 2.46 with one degree of freedom and was statistically not significant (p=0.1), hence the null hypothesis could not be rejected thereby indicating absence of heteroscedasticity in the model.

Testing for Goodness-of-fit

A goodness-of-fit statistic is a measure indicating the accuracy with which a model approximates the observed data. To measure this statistic in quantitative response model, Greene (2003) suggests the use of the likelihood ratio index (LRI). The LRI is computed from the formula:

LRI = 1-LnL/LnLo where,

LRI = Log likelihood index

LnL = Log likelihood function value for the model with all independent variables.

LnL_0 = Log likelihood function value for the model computed with the constant term only. A zero LRI indicates a perfect lack of it. LRI of value 1indicates perfect fit (Jarvis, 1990). Empirical evidence suggests that LRI usually lies between 0.2 and 0.4 (Appendix VII).

3.5 Data Types and Sources

Both primary and secondary data were used in this study. Primary data were obtained through administrating of a questionnaire (Appendix I). The survey assessed the factors that influence smallholder farmers' decision and level of participation in pyrethrum group marketing channels in Nyandarua County. The questionnaire captured detailed information on household head, resource, marketing and organizational factors concerning this survey. Secondary data were used in background information and to identify missing gaps to be filled. The secondary data used in this study were obtained

from economic surveys, published and unpublished materials on pyrethrum growing and marketing.

3.6 Sample Size and Sampling Procedure

Participants were defined as farmers who sold their pyrethrum through the group marketing channel while non-participants were defined as farmers who were not members of any pyrethrum marketing group and therefore they did not sell it through group marketing channels. The researcher selected all pyrethrum growers from the sampling frame which was readily available from the District Agricultural Office in the county. After an informal discussion of the objective of the study with the District Agricultural Officer and farmers, Kenton and Mawingu administrative locations were purposefully selected. All 132 pyrethrum farmers in the two locations were selected. A total of 124 households were covered because 8 potential respondents absconded. Therefore, the final sample size was 124 farmers. The farmers were selected regardless of the marketing channels in which they participated. Structured questionnaires were used with the farmers to generate information on factors that influenced smallholder farmers' decision and level of participation in the pyrethrum group marketing channel in Nyandarua County.

3.7 Data Collection

A reconnaissance survey was carried out for four days in the study areas to familiarize with them. A major limitation for this study was that the farmers did not keep records concerning their farming activities so data gathered during interviews was based on their recollections. Four enumerators with education up to at least secondary level and the ability to communicate effectively in English, Kiswahili and local language (Kikuyu) were selected. They went through a training which involved explaining the aim of the study, the meaning and implication of each question, and time management during the data collection exercise. The main target of the household survey was the household heads. Their households were easily identified by the enumerators because they identified the standing pyrethrum crop which they had seen earlier during the reconnaissance survey.

A total of 20 small scale household heads were the respondents of the questionnaire during the pretest exercise which enabled refinement of the questionnaire in order to strengthen its reliability in actual data collection. Data were collected between April and May 2013. The collected data were on household endowments, credit access, farming experience, farm characteristics, household socio-demographic characteristics, pyrethrum prices, marketing and market conditions related to market access and infrastructure, production and information access and also inputs used in production.

3.8 Data Capture and Analysis

The data were captured in MS Excel and analyzed in Statistical Package for Social Science (SPSS). Descriptive statistics were computed using percentages and means (using a t-test) of the collected data so as to compare between participants and non-participants. Three separate regressions were run for equations 3.6, 3.7 and 3.9 in accordance to the study objectives. To achieve objective one, a Heckman two-step model was used to determine factors that influence smallholder farmers' decision (equation 3.6) and level (equation 3.7) of participation in pyrethrum group marketing. Many participation studies have mainly applied logistic model to determine factors that affect participation in various agricultural enterprises which could lead to selection bias problem (Madala, 1983). This study applied the Heckman model to address the problem. To achieve objective two, a gross margin analysis was computed and then used as the dependent variable in regression equation 3.9 to examine the effect of participation in group marketing on smallholder pyrethrum farmers' income.

CHAPTER FOUR
RESULTS AND DISCUSSION

4.1 Respondents' Socio and Economic Characteristics

The study found that Pareto Self Help Marketing Group was the only active pyrethrum marketing group in the study area at the time of the survey. All co-operative societies in the area were also defunct due to mismanagement. As stated earlier (page 2), at the onset of the this study, both SHG and FCS were considered as the pyrethrum group marketing channels because both involve more than one farmer collectively pooling their resources together to do the marketing. But because no farmer was found to sell in the area through any pyrethrum marketing co-operative society, then this study was left only with Self Help Group (SHG) to represent those selling under group channel (participants). The other category that sold to brokers directly as individuals were considered in this study as non-participants.

4.1.1 Socio-Economic and Institutional Factors Influencing Group Market Participation

Table 4.1 shows the different socio-economic and institutional factors influencing participation in pyrethrum group marketing channels among farmers in Nyandarua county.

Table 4.1: Means of Socio-Economic and Institutional Characteristics of Survey Households in Nyandarua County

Characteristic (variable)	Participants n=97	Non participants n=27	Pooled N=124	t-value
	Mean	**Mean**	**Mean**	
Age of the farmer (years)	54.1	36.2	50.2	1.8
Education level (years)	12.4	8.3	11.5	1.3
Family labour (man-days/year)	30	31	30.2	1.7
Total land size owned (Ha)	3.5	3.0**	3.4	2.4
Land under pyrethrum (Ha)	1.1	0.9	1.0	0.6
Distance from home to market (Km)	11.5	11.5	11.5	1.2
Farmers non-farm income (Ksh).	34,250	39,820	35,463	1.1
Pyrethrum farming experience (years)	20.0	11.5	18.1	0.4

Source: Survey data

4.1.2 Farmers' Household Characteristics

Demographic information of the pyrethrum farmers (household heads) included their age, education level, pyrethrum farming experience, gender and the marketing channels they belonged to (group membership). Participants were 97 and non-participants were 27 farmers. Participants were defined as farmers who sold their pyrethrum through group marketing channels while non-participants did not sell their produce through any group but they sold as individuals. However, both participants and non-participants sold their pyrethrum to PBK through brokers (channels 5 and 3 respectively in Figure 1.1). In other words, a total of 78.2% (97 farmers) of the respondent household heads participated through the group marketing channel in selling their produce to brokers after bargaining the price collectively. The remaining 21.8% (27 farmers) also sold their dried pyrethrum flowers to brokers directly but individually. It is worthwhile to note that farmers in Nyandarua County deliver dried flowers to the Pyrethrum Board of Kenya (PBK) through Self-Help Groups (SHG) and Board Collection Centres (BCC) marketing channels (Table 1.2 and Figure 1.1). Participants are those that sell their produce through SHG and non-participants sell through BCC.

Findings on the gender of farmers indicated that 100 (80.6%) were male while 24 (19.4%) were female. Despite males being more than females, this gender distribution was deemed appropriate in giving information about the farmers' economic factors that influence their decision to participate in pyrethrum farmers' group marketing channel (SHG) in Nyandarua County. A higher percentage (79.4%) of participants (in the group marketing channel) were men. Likewise, men also out-numbered women among non-participants because they were 85.2% against 14.8% women.

The mean age of the household heads participating in group marketing channel was 54 years; the mean age of men was 55 years while that of women was 52 years. The mean

age of the non-participant households was 36 years; the men having a mean age of 38 while that of women was 34 years. The results indicated that the participants in the group channel were on average 18 years older than the non-participants. However, the mean age differences were not statistically significant between participants and non-participants.

4.1.3 Farmers' Production Resources

The mean land size for the participants and non-participants was 3.5 hectares (ha) and 3.0 ha, respectively (Table 4.1), and these means were statistically significant ($t>2.0$). The overall mean land size for all the 124 respondent households was 2.5 ha. The average land size under pyrethrum was 1.1 ha and 0.9 ha for participants and non-participants, respectively. All participants and non-participants were individual owner-operators. No land under pyrethrum in the study area was rented. Land is an important factor in group marketing participation. This implies land is a scarce resource in the study area and it is likely that those with bigger pieces of land prefer to invest in long term crop enterprises like (fruit) trees. This leads to low pyrethrum production and therefore the non-participation behaviour. This finding tallies with that of COMESA (2010) which reported that limited land is one of the major reasons why the majority of smallholder farmers engage heavily in subsistence farming and so do not participate much in the market because of their little output. Land can be used as collateral for securing a loan if group market participation requires a substantial investment. Land is crucial due to space requirements for growth of more produce which may eventually be sold off by farmers collectively (COMESA, 2010).

Family labour made up 92% of the total labour used by participants and while 8% was hired labour. Family labour made up 94% of the total labour used by non- participants and while 6% was hired labour. Both participating and non-participating households used both family and hired labour in almost equal measure. Women provided 46% of the family labour, 52% from family members were below the age of 18 years and the remaining 2% were from men in the households. This showed that the farmers used child labour due to the fact that hiring adult labour is expensive. This is against the law. Most of the hired labour for the participating households was mainly for harvesting of pyrethrum. Due to financial constraints that translates to inadequate productive resources,

the results showed that generally the smallholder farmers tend to have low ability to use hired labor. They resort to using family labour. Sixty four and 58 percent of participants and non-participants earned non-farm income, respectively. This implies that most farmers in both marketing channels probably use some of their off-farm income to support pyrethrum production. Both participant and non-participant households hired draught power (hired donkeys harnessed to their carts) to transport the dried pyrethrum flowers to collection points. The brokers who received the produce bore the larger transport costs of taking it to PBK headquarters in Nakuru, about 100 kilometers away.

A total of 120 farmers got their planting material from neighbours and the remaining 3.2% (4 farmers) obtained theirs from their own farms. This has often led to low productivity because they do not obtain high yielding varieties from PBK. Farmers are advised to plant only cultivars recommended for their regions by PBK. Such materials are propagated in pyrethrum nurseries located in all pyrethrum growing counties. Farmers are advised to obtain such planting materials from these nurseries. Improved cultivars have high yields and high pyrethrin content; they are also non-lodging and resistant to diseases and pests. But farmers the respondents in this study indicated that they were not willing to travel far away to Ol kalou where the nearest nursery is located. They also claimed that the nursery was not run properly by PBK because the planting material was not available in good time for planting.

The most popular pyrethrum variety grown by households interviewed was the P4. This variety was grown by all the respondent farmers because of its tolerance to pests and diseases in the area. Hence, no pest and disease control measures were taken by all the 124 interviewed farmers.

The other economic attribute of the P4 pyrethrum plantlets that favoured the farmers was its uniform maturity which enabled the members of marketing channels easily start picking pyrethrum flowers at almost the same time. The pyrethrum in the study area is totally rain-fed and so the farmers plant at the onset of the long March to May rain. The average yield of the P4 pyrethrum variety was 300.4 kilogrammes (kgs) per hectare per year (Appendix III).

Credit facilities to boost pyrethrum production were accessed by 24% and 15% of the participants and non-participants respectively. Women groups were the major source of informal credit facilities to both participant and non-participant farmers. The loan was in form of cash. The former accessed 22% of the cash while the latter borrowed 11% of the loan group money (Appendix IX). More than 75% of the farmers in both marketing channels did not access credit for agricultural development. All these farmers reported a decline in access to credit from an average of Ksh 15,550 to Ksh 4,330 per year. This was attributed to the stringent conditions to access agricultural credit. This results differ from the observation of Feder et al. (1985) who noted that increased credit access boosted farmers' participation in group marketing. In this study, very few participants used credit (Appendix IX).

All the respondent households (100%) had contact with extension services with 96% of the participants and 94% of the non-participants having contact with extension services providers only once a year (Appendix IX). The extension workers usually provided information on market availability and information on new and improved varieties. The Ministry of Agriculture was the major source of agricultural extension service to the majority of farmers. A frontline Agricultural Extension Officer was available in each District offer services on demand.

The participants demanded for extension service and were trained as a group. Ten percent of the participants and 11% of the non-participants had agricultural extension services only average once a year on average from private agents (farm managers) at a small fee (Appendix IX). The extension messages disseminated included farming as a business with emphasis on good agricultural practices, adoption of modern farming technology (like using the higher yielding tissue culture plantlets for pyrethrum establishment) and formation of commodity-based farmer organizations (Common Interest Groups).

The major source of pyrethrum marketing information (99% for participants and 97% for non-participants) was through peers (Appendix IX). The farmers were mainly taught more on agricultural production practices and very little about pyrethrum marketing. Given that the farmers did not access the extension services frequently, they were not

well enlightened about the benefits of either collective (group) marketing, the modern farming technologies or post-harvest handling of the crop.

4.2 Presentation of Econometric Results

4.2.1 Factors influencing the Decision to Participate in Pyrethrum Group Marketing

Table 4.2 shows the results of the first stage of the Heckman model about the factors that affected the smallholder household head's (farmers') decision to participate in pyrethrum group market.

Table 4.2: Factors Influencing Decision by the Household Head to Participate in Pyrethrum Group Marketing in Nyandarua County

Variable	β	Std error	t-value	p-value
Age of the household head	0.0063	0.0021	2.414	0.000***
Age squared	0.0042	0.0043	2.212	0.204
Gender of the household head	0.0145	0.0467	2.662	0.001**
Education level of the farmer	0.0582	0.0031	2.112	0.000***
Family labour	0.0014	0.0047	-0.689	0.321
Other farm income	0.0234	0.0435	2.732	0.000***
Livestock value	0.0012	0.0234	0.823	0.105
Non farm income	0.0173	0.0032	-0.919	0.217
Market distance	0.0089	0.0034	2.019	0.002**
Extension visits per year	0.0132	0.0057	2.224	0.001**
Road condition	0.0184	0.0432	-0.113	0.207
Sale price of produce deliveries	0.0404	0.0002	2.303	0.004**
Group membership	0.0521	0.0334	2.158	0.000***
constant	2.1432	1.2141	1.034	0.458

Source: Survey data

** and *** indicate 5% and 1% significance levels respectively

4.2.2 Factors Influencing Group Market Participation Level by Pyrethrum Farmers in Nyandarua County

Results of the second stage of the Heckman model that depict the factors that influenced the farmers' level of participation in the pyrethrum group marketing are shown in Table 4.3.

Table 4.3: Factors Influencing Level of Participation in Group Marketing by Pyrethrum Farmers in Nyandarua County

Variable	β	Std error	t-value	p-value
Age of the household head	0.0208	0.0274	1.971	0.301
Age squared	0.0471	0.4321	0.414	0.241
Gender of the household head	0.0143	0.5432	2.467	0.000***
Education level of the farmer	0.0637	0.0304	0.011	0.164
Family labour	0.0765	0.0823	-0.931	0.123
Total annual quantity harvested	0.0311	0.1237	1.422	0.165
Possession of cart, bi/motorcycle	-1.323	0.2781	-0.117	0.198
Non farm income	0.0002	0.0004	2.007	0.002**
Market distance	0.0064	0.0311	-0.008	0.302
Extension visits per year	0.0921	0.2898	1.348	0.215
Road condition	0.0734	0.3436	2.113	0.004**
Sale price of produce deliveries	0.1817	0.4011	0.789	0.254
Group membership	0.0987	0.6742	2.087	0.001**
Inverse Mill's Ratio	0.1612	0.7677	2.092	0.000**
constant	2.2142	1.1381	1.116	0.321

Source: Survey data

** and *** indicate 5% and 1% significance levels respectively

4.2.3 Effect of participation in group marketing on farmers' income

Table 4.4 shows the effect of participation in pyrethrum group marketing on the farmers' income in Nyandarua county.

Table 4.4: Effect of Participating in Group Marketing on Farmers' income in Nyandarua County

Variable	β	Std error	t-value	p-value
Age of household head	0.0041	0.0012	0.964	0.233
Age squared	0.1212	0.0021	0.097	0.472
Gender of the household head	0.0156	0.0211	1.846	0.124
Education level of the farmer	0.0181	0.0423	2.411	0.004**
Quantity of pyrethrum sold	0.0021	0.0074	-0.857	0.314
Distance to the collection points	-0.171	0.0237	0.107	0.401
Credit availability	0.1243	0.0364	2.084	0.001**
Pyrethrin content of the produce	0.1875	0.0123	-2.428	0.000***
Farmer's group membership	0.0814	0.0314	2.116	0.002**
Constant	1.843	0.345	1.278	0.712

Source: Survey data

** and *** indicate 5% and 1% significance levels respectively

The following is a discussion of the results in Table 4.2. All the variables had the expected positive sign meaning that they promoted the pyrethrum farmer's group market participation decisions in Nyandarua County.

The age of the household head had a positive coefficient and significantly ($p<0.01$) influenced the pyrethrum farmer's decision to participate in the market. This is because many decisions made in the household on whether to sell or not depend on ones position in the order of hierarchy in headship of the family. Older members of the family tend to make the key decisions that affect the family welfare. Heltberg et al. (2001) concurred with this study's finding by asserting that age is an indicator of the position of the

household's ability to comprehend and use accessed market information to make informed group market participation decisions. They were studying agricultural supply response in Mozambique. Gebremedhin et al. (2007) also found a positive relationship between age and farmer group market participation whereby older farmers had a higher probability of wheat market participation in Ethiopia.

The gender of household head had a positive and significant ($p<0.01$) impact on the decision to participate in the pyrethrum market. The results show that per unit increase in the number members of the male gender of the farmer increases the probability of pyrethrum market participation by 1.45%. This implies that household heads increased number of male house hold heads is more likely to increase the probability of pyrethrum market participation. In most cases it is the males in a family who make the decisions on whether to sell pyrethrum or not. This means that females are less likely to participate in the whole process of selling pyrethrum. Vigneri et al. (2011) showed that women rarely had similar access to assets and markets as men, which led to different levels of participation in cash crop markets in Sub-Saharan Africa.

The education level of the household head had a positive and significant ($p<0.01$) effect on smallholder farmer's decision to enter the pyrethrum market. The results show that per unit increase in the education level of the farmer increases the probability of pyrethrum market participation by 5.82%. This implies that household heads increased level of education is more likely to increase the probability of pyrethrum market participation. This can be highly attributed to the fact that education empowers a farmer to make informed decisions and identify market opportunities where they exist. Odulaja et al. (1996) however found results that indicated that farmer's ability to produce and sell more in a market was highly and positively related to their education levels. The authors asserted that farmers, who had attained secondary education and had combined it with informal education, were more likely to produce and sell more pyrethrum.

The results indicated that other farm income generated by the farmer had a positive and significant ($p<0.05$) effect on the decision to participate in the pyrethrum market in Nyandarua County. The results show that per unit increase in other farm income

generated by the farmer increases the probability of pyrethrum market participation by 2.34%. This implies that increase in other farm income generated by the farmer is more likely to increase the probability of pyrethrum market participation. Boughton et al. (2007) used an asset-based approach to study patterns of household market participation in Mozambique and also found out that other farm income generated by the farmer positively and significantly affected crop group market participation.

Distance to the nearest market (collection point) had a positive and significant ($p<0.01$) effect on pyrethrum farmer's decision to participate in the market. The results show that per unit increase in the distance to the nearest market increases the probability of pyrethrum market participation by 0.89%. This implies that an increase in the distance to the nearest market is more likely to increase the probability of pyrethrum market participation. This results contradicted Heltberg et al. (2001) from Mozambique where they studied agricultural supply response whose results showed that a decrease in the distance to the nearest market is more likely to increase the probability of pyrethrum market participation. Von Oppen et al. (1997) found that physical infrastructure like market sites can increase the efficiency of both marketing and production of agricultural crop products in India, Kenya and Sudan.

In this study, results indicated that the number of extension visits from government workers had a positive and significant ($p<0.01$) effect on the decision to participate in the market. The results show that per unit increase in the number of extension visits from government workers increases the probability of pyrethrum market participation by 1.32%. This implies that increase in the number of extension visits from government workers to the farmers is more likely to increase the probability of pyrethrum market participation. This is because extension workers usually provide information on market availability as well as information on new and improved varieties that enhances the farmer's knowledge and provide a range and choice of market opportunities. Gebremedhin et al. (2007) also got a similar result when they found a positive and significant effect of extension access on the probability of group rice market participation in Ethiopia.

The results also revealed that price of pyrethrum had a positive and significant ($p<0.05$) influence on the decision to participate in the pyrethrum market. The results show that per unit increase in the price of pyrethrum increases the probability of pyrethrum market participation by 4.04%. This implies that increase in the amount of the producer price is more likely to increase the probability of pyrethrum market participation. This is because many farmers respond to higher prices because it means getting higher incomes from their produce. Farmers tend to study price trends over seasons and can appropriately predict and respond to the prices. Jaleta et al. (2009) supported this argument and result by stating that unfavourable prices affected household incomes and consumption adversely. The authors were studying improvement of crop and livestock productivity and marketing among Ethiopian smallholder farmers. Enete et al. (2009) also found that the producer price had a positive and significant influence on the farmers' group market participation decision in cassava markets in Africa.

Membership in pyrethrum producer groups was positive and statistically significant ($p<0.01$) at 5% level. The results show that per unit increase in membership of pyrethrum groups' increases probability of pyrethrum market participation by 5.21%. This implies that an increase in the membership of pyrethrum producer groups by the farmers is more likely to increase the probability of pyrethrum market participation. That means that belonging to a producer group increased the likelihood of a household to participate in the pyrethrum market in Nyandarua County. This findings are consistent with Jagwe et al. (2010) who argued that producer groups in Burundi can be good platforms for social capital formation and through which smallholder farmers can obtain market information at a lower cost hence promoting their market participation decisions.

The following is a discussion of the results in Table 4.3. All the variables except the road condition had the hypothesized (expected) sign. All had a positive sign meaning that they promoted the pyrethrum farmer's level of market participation in Nyandarua County.

Gender of household head had a positive and significant ($p<0.01$) impact on the level of participation (volumes of pyrethrum sold) in the pyrethrum market. The results show that

per unit increase in the number members of the male gender of the household head increases the level of pyrethrum market participation by 1.43%. This implies that an increase in the male gender household heads is more likely to increase the level of pyrethrum market participation. Wang'ombe (2008) in studying potato value chains in Kenya also found that male gender of farmer positively and significantly influenced farmer's volume of sales in the market. The author stated that the reason is that women spend much of their time doing domestic work and allocate less time to other matters like market transactions. Hence, by being male, a farmer had higher chances of selling more pyrethrum to the market because male farmers have more contacts that are social with both pyrethrum buyers and their agents whom they often meet in trading centres. Males dominate in selling pyrethrum to the market and as expected, they make the decisions that affect all family members. Female farmers lack such contacts and are in most cases excluded from direct transactional negotiations with buyers. It is mostly men in a family who make the decisions on how much pyrethrum to sell. Doss (2001) also supported this finding by indicating that female farmers in East Africa grow subsistence crops for food security and cash crops meant for cash income are grown mainly by male farmers to cater for cash needs of the household.

The results indicate that monthly non-farm income earned by a pyrethrum farmer was found to positively and significantly ($p<0.01$) affect the volumes of pyrethrum sold in the market. The results show that per unit increase in monthly non-farm income increases the level of pyrethrum market participation by 0.02%. This implies that an increase in monthly non-farm income earned by a pyrethrum farmer is more likely to increase the level of pyrethrum market participation. But farmers engaged in off-farm work and earning other incomes from different sources (apart from pyrethrum) tend to dedicate less time to production and marketing of pyrethrum, which possibly results into smaller quantities sold. Omiti et al. (2009) also found out that non-farm income had a positive and significant influence on the farmers' level of participation in the vegetable market in rural and peri-urban areas of Kenya. But this study's findings negated Rios et al. (2008) who found a negative relationship between off farm income and agricultural sales which the authors attributed to time constraints on agricultural production and farm management. This is because non-farm employment competes with farm activities for the

time resource. Non-farm incomes of rural households may be derived from casual labour hire, wage employment, private business activity (self-employed) or remittances. Barret et al. (2007) in support of the importance of off farm income to the smallholders in Eastern and Southern Africa, contended that off-farm earnings may be essential to maintaining a viable farm that cannot generate enough cash income to satisfy the household's cash requirements. Reardon et al. (2003) stressed the importance of non-farm income to the smallholder farmers in Latin America, whereby it provides working capital required to purchase farming inputs which boosts production hence promoting volumes of staple crop sales.

Against the researcher's expectation, good road condition (road without pot-holes) to the nearest market had a positive sign and was significant ($p<0.01$) meaning that it promoted the farmer's level of participation in the pyrethrum market in Nyandarua County. The results show that per unit increase in good road condition increases the level of pyrethrum market participation by 7.34%. This implies that an increase good road condition to the nearest market is more likely to increase the level of pyrethrum market participation. Makhura et al. (2001) found that the state of bad roads (pot-holed roads) negatively impacted on farmers' access to crop markets in Northern Province of South Africa, hence a hindrance to smallholder farmers' level of market participation.

A pyrethrum farmer's membership in a group or marketing cooperative positively and significantly ($p<0.05$) influenced the volumes of pyrethrum produce sold in a market. The results show that per unit increase in the farmer's membership in a group increases the level of pyrethrum market participation in by 9.87%. This implies that an increase in the farmers' membership of a group is more likely to increase the level of pyrethrum market participation. The main reason for this was that working in a group creates synergy among the farmers and enabled them to access market information as well as sharing experiences. Abera (2009) and Fischer et al. (2012) while studying smallholder agricultural commercialization and collective action in Kenya also found a positive and significant influence of membership in a group on the level of commercialization. The authors stated that membership to a farmers' group improves access to technology, training and output markets and consequently increasing expected profits.

The Inverse Mills Ratio (IMR) term was significant and positively signed (Table 4.3), which means that the error term in the selection equation is positively correlated. This implies that unobserved factors that make participation in pyrethrum group marketing in Nyandarua County are more likely to be associated with higher score on the dependent variable. The variable was found to be statistically significant at 5% level of confidence which justified the existence of selection problem and the use of the model. In other words, the significance of the IMR in the second equation implies that the use of the Heckman model was appropriate in this study. In the first equation valuable information would have been lost and the second equation would have given biased results.

The following is a discussion of the results in Table 4.4 about the effect of participation in group marketing on the farmers' income in Nyandarua county.

Education transforms "raw" human beings into productive human capital by inculcating skills required by both traditional and modern sectors of the economy (Psycharopoulus and Woodhall, 1988). The education level of the farmer had a positive and significant ($p<0.05$) effect on the gross margin obtained by the farmer. Per unit increase in education level of the farmer increased the gross margin by 1.81%. This implies that household heads increased level of education is more likely to increase the gross margin. Catacum et al. (2006) evaluated the factors determining smallholder farmers' participation in group processing and marketing of tree seeds and seedlings in Philippines. The authors revealed that most farmers who participated in the group activities had more years of formal education and got a better farm gross income than those with fewer years of formal education.

Credit availability by the farmer had a positive and significant ($p<0.05$) effect on the gross margin obtained by the farmer. Per unit increase in household access to credit increased the gross margin of the farmers by 12.4%. This implies that a household that has access to financial credit is more likely to obtain a higher gross margin and subsequently more profit. Asfaw et al. (2010) assessed smallholder market participation and rural poverty in Tanzania and revealed that credit availability positively influences producer groups' returns from their enterprises. This implies that a group that has access

to financial credit is more likely to obtain higher gross margins and consequently better profits. Following the argument that poor households experience difficulties in compliance with the membership in producer groups, access to credit would help them to their better financial (margins) returns.

The pyrethrin content (PC) of the dried flowers had a positive and significant ($p<0.01$) effect on the gross margin obtained by the household head (farmer). Per unit increase in the PC the gross margin increased by 1.88%. This implies that household heads' increased level of PC for their flowers is more likely to increase the gross margin. Inyamu (2006) sought to evaluate the pricing efficiency of alternative marketing channels used by pyrethrum growers in Nakuru district. The results showed that PC had a positive and significant effect on the gross margins. The PC is important because it determines the prices received by farmers since all flowers delivered to the PBK are checked for pyrethrin content through a PC test. The maximum PC is 3% (Appendix II) but the producers in Nyandarua County achieve a maximum of 1.6% pyrethrin content (Table 1.2). Because flowers oxidize quickly after they have been harvested, the level of PC declines rapidly, which in turn diminishes the profit margin for farmers. Taking into account interval inefficiencies within the PBK prolonged testing time and subsequent warehousing of stock has contributed to increasingly poor quality (low PC) of pyrethrum available in the market and poor returns for farmers.

Membership of the farmer to a producer group had a positive and significant effect on the gross margin obtained by the farmer at 5% level of significance. Per unit increase in membership of the farmer to the producer group increased the gross margin by 8.15%. This implies that households increased membership to producer groups is more likely to increase the gross margin hence increased profits. Gadzikwa (2006) conducted a study that identified factors that explain farmers' participation in a certified organic smallholder group in Kwazulu Natal, South Africa. The results indicated the gross margin was higher if market information, transport services and certification services of the members were fully subsidized. Gatarwa (2005) assessed rural agricultural produce market development through household participation in group activities to identify factors that influence farmers to join groups and the benefits of participating in-group marketing activities. The

results suggested that men were motivated to join groups that had an element of commercialization (higher gross margins).

4.3 Reasons for Non-Participation in the Pyrethrum Self Help Group (SHG) Channel

Twenty eight (28) percent of the non-participants cited bureaucracy associated with group marketing. That is the inability of group leaders (officials) to pay hard cash on the spot for the delivered produce was the reason for not participating in the group marketing channel. Though the brokers paid to their selected group leaders on the spot, there is a group rule that compelled the officials to deliver their pay through their bank accounts due to the rising insecurity in the study area, which is located down a steep valley. Their bank was located in Naivasha, which is a bit far from them. This delays their payments for a few days and hence the non-participants preferred working alone because they get their cash more quickly (fortnightly). Some non-participants lacked trust in the group leaders. Twenty-seven percent of the non-participants cited lack of sustainability of groups formed and in existence of marketing groups in the village as the reasons why they did not participate in group marketing. Sixty-five percent of the participants and 34% of non-participants had been members of other agro-commodity groups. The farmers had been members of milk cooperatives or potato marketing groups. The farmers did not use Safaricom's M-Pesa money transfer technology to settle their payments. Another reason why non-participants preferred to market their own produce directly was because sales and henceforth payment at group marketing collection point were made only once a month. But sales and payments for farmers supplying directly to brokers at their marketing collection point were made twice a month promptly in cash and hence recipients avoided any delays associated with payment through the banks. They hence avoided bank charges and the travel costs to the bank.

4.4 Gross Margin Analysis

All the surveyed households in the sample produced pyrethrum as one of the major crops on their farms. Inorganic fertilizers and organic fertilizers (farmyard manure) were used in the pyrethrum farms by both participants and non-participants. It was noted that on average, both categories of farmers participating in the two marketing channels used

about the same amount of inputs (inorganic and organic fertilizers). On average each farmer in both groups used 21 kgs D.A.P fertilizer and 123 kgs of compost manure per hectare per year (Appendix III). Costs were the same for both groups because they sourced their inputs from the same locality (agro-chemical shops) and transported produce to the same nearest flower collection points (market). Non-participants lost Ksh 50 per kilogramme because they were paid Ksh 100 per kilo by the brokers unlike the Ksh 150 per kilo the brokers pay the group marketers (Appendix III). But if farmers in both channels were able to sell direct to PBK without involving brokers at all they would have earned as high as Ksh 200 per kilo because the average pyrethrin content in the study area is 1.6 (Tables 1.2 and Appendix II). Therefore, participants lost Ksh 50 (Ksh 200- Ksh 150) per every kilo they sold to the brokers through their marketing group. But non-participants lost more per kilo (Ksh 200- Ksh 100) because they were paid only Ksh 100 per kilo instead of the Ksh 200 per kilo that they would have obtained from PBK. This means non-participants actually lost to the brokers exactly half of what they would have gotten from PBK. But all the non-participants indicated that they would rather receive less from brokers rather than be promised more by PBK which would be delayed for so long or PBK would not pay for their deliveries at all.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

The study analyzed the factors influencing the participation of smallholder pyrethrum farmers (household heads) in group marketing in Nyandarua County. The data which were collected through questionnaire administered to 124 household head farmers was captured in MS Excel and analyzed in Statistical Package for Social Science (SPSS). Participants sold pyrethrum through group marketing channels. Descriptive statistics and Heckman two-stage model were used. The results of descriptive statistics showed that participants were 78.2%. The mean land size for the participants and non-participants was 3.5 hectares (ha) and 3.0 ha respectively which statistically significant. Credit facilities to boost pyrethrum production were accessed by 24% and 15% of the participants and non-participants respectively. Most respondent households had contact with extension services (96% of participants and 94% of non-participants) but only once a year which was not adequate. Results of the first stage of the Heckman model showed that eight factors positively and significantly affected farmers' decision to participate in the pyrethrum group marketing. This meant that they promoted the pyrethrum farmer's group market participation decisions in the county. They were the age of the household head (farmer), gender of household head, education level of the household head, other farm income, distance to the market, number of extension visits, price of pyrethrum and membership in pyrethrum producer groups. Results of the second stage of the Heckman model showed that four factors positively and significantly affected farmers' level of participation in the pyrethrum group marketing. This meant that they promoted the pyrethrum farmer's level of market participation in the county. They were the gender of household head, monthly non-farm income, good road condition, and membership in a group. The second objective of this study sought to examine the effect of participation in the group marketing channels on smallholder pyrethrum farmers' gross margins. Results showed that four factors positively and significantly affected farmers' net income. This meant that they promoted the pyrethrum farmer's gross incomes in the county. They were

the education level of the farmer, credit availability, pyrethrin content of the produce and membership of the farmer to a producer group.

5.2 Conclusion

The findings of this study proved that the farmers' decision and level of participation in pyrethrum group marketing channel was significantly influenced by their social, economic and institutional factors. The farmers' participation in group marketing channels also significantly affected their net income levels. Results revealed that once a smallholder farmer decided to enter group marketing of pyrethrum, household characteristics and the farmers' endowments were the key factors that influenced the volumes they sold into the market. Factors like gender and membership to a farmers' group or cooperative significantly influenced the level of market participation in form of volumes of pyrethrum sold.

5.3 Recommendations

From the study results, the following recommendations were made.

i. This study found that good road condition positively influenced farmers' volume of pyrethrum into the market. The County Government of Nyandarua should ensure that the feeder roads from the farms to the market are always in good condition. Together with the government of Kenya, they can team up to make new and maintain the main roads in good condition.

ii. The study found that extension visits positively influenced farmer participation decision in the markets. But such visits should be frequent so that the farmers can access useful information frequently. The average of one extension visit per year to the farmers by government extension visit is not adequate. Therefore, the government of Kenya through the Ministry of Agriculture should increase the frequency of extension contacts with pyrethrum farmers in Nyandarua County.

iii. The study found that the producer price of pyrethrum positively influenced farmer participation decision in the markets. The Pyrethrum Board of Kenya (PBK) should support the farmers by buying directly from the farmers to

eliminate brokers who offer the farmers lower price than what the Pyrethrum Board of Kenya pays the farmers (appendix II). This will minimize the exploitation by the brokers.

iv. Policy makers should promote membership to farmer groups or cooperatives being a key factor in enhancing both the decision to participate in group marketing and the volumes of pyrethrum sold. They should promote collective action among smallholders because it eases access to production and marketing information as well as to sources of cheaper inputs. Group membership also had a positive and significant effect on smallholder pyrethrum farmers' gross margin.. The government of Kenya through the Ministry of Co-operative Development should make concerted efforts to increase and strengthen the existing farmer groups and cooperatives.

v. Credit availability also had a positive and significant effect on smallholder pyrethrum farmers' net income. Therefore, Agricultural Finance Cooperation (AFC) should sensitize the Nyandarua County pyrethrum farmers about their credit products so that they can take informed decisions to uptake them. That would help minimize the farmers' over-reliance on women group loans which are limited.

5.4 Areas for Further Research

It is recommended that a similar study be conducted in the other pyrethrum growing counties like West Pokot, Kisii and Nakuru. This is with a view of direct comparisons of the findings because the enterprise, methodology and objectives would remain the same. Results from such counties would be better for generalization to the wider Kenyan pyrethrum sector than results from Nyandarua County alone. Further research on economic analysis of factors influencing non-participation in pyrethrum group markets among farmers in Nyandarua County will help in coming up with broad based all-inclusive policy and/or practice interventions. More studies can be conducted after the pyrethrum sub-sector is fully liberalized to assess the financial impacts to the farmers.

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APPENDICES

Appendix I: Farmers' Survey Questionnaire

Introduction

Dear respondent,

This questionnaire aims at collecting data that will form part of the study on "**An Economic Analysis of Factors Influencing Participation in Pyrethrum Group Marketing Channels Among Farmers in Nyandarua County, Kenya".** This study is being conducted by Kamau Titus Njoroge, who is a Postgraduate student at the University of Nairobi, Upper Kabete Campus in the Faculty of Agriculture, Department of Agricultural Economics. You are kindly requested to assist in the attainment of the study objective.

With kind regards

Yours sincerely,

Kamau Titus Njoroge.

Instructions: Please fill the response(s) in the space provided after question or tick where appropriate

PERSONAL DETAILS

Name of farmer

Sex : Female Male

Village……

Location ……

Division ……

Age ……

Are you the household's head? Yes No

If no, how are you related to the household's head? ……

a) Household head factors:

1. What is the name of the household's head?.....
2. What is the level of education of the household's head?

i) Primary school level

ii) Secondary school level

iii) Beyond secondary school level (give years of formal education)

3. When did you start producing pyrethrum ?
4. If farm manager then, what is the farming experience?.....

b) Resource factors:

5. How many of your children aged between 0-18 years permanently live on the farm and work on the pyrethrum farm?.....
6. What is the number of adults above 18, who permanently live and work on the pyrethrum farm ? .....
7. How much time in a month does the family devote to pyrethrum production? .....
8. How much labour does the family hire for pyrethrum production in a month? .....
9. What is the size of your farm in acres? .....
10. How many acres of your farm are under pyrethrum? .....acres
11. Have you leased land for pyrethrum production? Yes No
12. If yes to (11 above), how many acres did you lease? .....acres
13. What are the major crops grown on your farm.....
14. What is the value of the livestock on your farm if you have any? Ksh.....
15. Do you use manure from your livestock in your pyrethrum farm? Yes No
16. If Yes to (15) above, on average how many tonnes of manure did you get from your livestock to use on pyrethrum in year 2012? …….tonnes
17. Do you purchase manure to use on the pyrethrum farm? Yes No

18. If yes to (17) above how much manure did you buy in year 2012? …….tonnes.

19. Where do you get the pyrethrum plantlets?

i) From own farm

ii) Neighbours

iii) Buy Tissue Culture improved type

iv) Others (specify)…….

20. Which type of pyrethrum do you grow?

i) P4

ii) Ndege

iii) Chui

iv) Tissue Culture

v) Local

vi) Katumani

vii) Nyamasibi

viii) Others (specify)……

21. Why did you choose to grow the type of pyrethrum in (20) above?

i) Early maturing

ii) Higher yields

iii) Tolerance to disease

iv) Uniform maturity

v) Tolerant to drought

22. What was the primary reason for planting pyrethrum?

i) For its suitability to the area's agro-ecological climate.

ii) To sell and earn some income

iii) To intensify use of land

23. If you grow the tissue culture plantlets do get the supply of improved pyrethrum plantlets in required quantities and right time? Yes
No

24. What factors influenced your decision on the size of land allocated to pyrethrum production?

i) Household needs for other food crops

ii) Need to sell pyrethrum and earn income

iii) The size was dictated by availability of inputs like manure, availability of planting material

iv) Others (specify)……..

25. Do you use any soil improvement technologies on the pyrethrum farm? Yes
No

26. If Yes in (25), what types of fertilizers do you use?

i) DAP

ii) CAN

iii) Compost

iv) Others (specify)……

27. How much money do you spent on soil improvement technologies?.....

28. How far do you get the supply of inorganic or organic fertilizers?.....Km

29. Do you carry out irrigation on your pyrethrum farm? Yes No

30. If yes in (29), which types of irrigation system do you use?

i) Drip

ii) Bucket

iii) Using sprinklers

iv) Using hose pipe

v) Using money maker pump

31. Who carries out most of pyrethrum production activities?

i) Wife

ii) Husband

iii) Son

iv) Daughter

v) Permanent employee

vi) Casual

vii) Other (specify)……..

32. What is the main source of labour on your farm?

i) Family labour

ii) Hired labour

33. If you use hired labour, what is the cost of labour per month? Kshs…….

34. Do you access any credit for farm activities? Yes No

35. If yes to (34) where do you get the credit?

36. If yes to (34) how much money did you get as credit?

37. How often do you harvest pyrethrum on your farm? After ……. days

38. How much pyrethrum did you harvest in year 2012? .....kilogrammes?

39. For the time you have grown pyrethrum which constraints have you experienced?

i) High cost of planting material

ii) Limited land size

iii) Infestation by diseases

iv) Infestation by pests like moles

v) Inadequate manure

vi) Droughts

vii) Any other (specify)…….....

40. How do you think these problems can be resolved?

i) Subsidize the cost of planting materials

ii) Research into production of clean planting materials

iii) Access to credit facilities

iv) Any other (specify)…….

c) Marketing factors

41. How much pyrethrum did you sell in year 2012…….

42. Do you also buy pyrethrum from other farmers to sell? Yes……. No…….

43. If yes to (45), how much pyrethrum do you buy?.....Kgs per month?.....Kgs in the year (2012)?

44. What factors influence your decision on amount of pyrethrum to produce sale?

i) The price

ii) Quality requirements

iii) Availability of own means of transport

iv) Demand and supply factors

d) Organizational factors

45. Are you a member of any pyrethrum marketing group apart or co-operative? Yes……. No…….

46. If yes in (45) above, what is the name of the association?.....

47. If yes to (45) which activities do you carry out in the group?.....

48. How do you benefit from the membership of the group?

i) Get fair prices of our produce

ii) Bulks the produce and organized ready market of our produce

iii) Dries pyrethrum for sale

iv) Organizes transport for pyrethrum

v) Any other (specify)……

49. Have you ever participated in pyrethrum farmers' fields' day or on farm trials demonstration organized by the ministry of agriculture or any development organization? Yes……. No……

50. If yes to (49), did your attendance have any influence on the choice of the pyrethrum marketing channel to participate in? Yes…….
No……..

51. How do you market (sell) the pyrethrum?

i) To brokers at the nearest market centre

ii) Through a pyrethrum Self Help Group (SHG)

iii) Direct to PBK

iv) Through a Farmers Cooperative (FCS)

v) Through a pyrethrum Board Collection Centres (BCC)

vi) Any other (specify)……..

52. Through which channel in (51) do sell most of your pyrethrum?..... about how many kilos?

53. Whose decision was if to sell through the channel above?

i) Husband

ii) Wife

iii) Husband & wife

iv) Sons

v) Others (specify)……..

54. From whom did you learn about this marketing channels?

i) Neighbours

ii) Radio

iii) Members of a pyrethrum marketing organization

iv) Others (specify)……..

55. Why did you choose the marketing channel in question (54)?

i) Offers high prices

ii) Prompt payment

iii) Can sell the pyrethrum taken to market regardless of quality

iv) Others (specify)…….

56. Do you access any market information? Yes……... No……..

57. If yes to (56) where do get the information on price and quantities required from

i) Other farmers

ii) Brokers

iii) Others (specify)……

58. Has the local agricultural extension officers visited your from in the recent past? Yes No

59. Has any extension officer, neighbour or member of pyrethrum marketing organization requested you to consider participating in a pyrethrum farmers' group marketing channel? Yes No

60. How many times have you attended pyrethrum training/seminars organized by agriculture extension staff since the year 2012?.....

61. Has any agency visited your farm or farmers group in your village to sensitize you on importance of selling pyrethrum through an association?
    Yes No

62. If yes in (61) what is the name of the organization (s)?.....

63. If yes to (61 and 62), did you consider participating in the marketing channel?
    Yes No

64. If no to (63), what are the reasons for not participating in the pyrethrum farmers association- marketing channel?.....

65. If you don't sell pyrethrum at farm gate, how far is the market……km

66. How do you transport pyrethrum to the market

i) Using human labour

ii) Using a farm animal cart

iii) Using a pick up/ truck

iv) Any other (specify)……

67. What is the source of means of transport?

i) Own family

ii) Hired means

iii) Any other specify……..

68. What is the type of the road to the market?

- Tarmac
- Gravelled
- Earth road

69. What is the condition of the road to the nearest market?

- Good (if not pot-holed)
- Poor (if pot-holed)

70. How much does it cost you to deliver the pyrethrum to the market? Ksh.....

71. Do you access credit facilities to boost your pyrethrum business?
Yes No

72. If yes to (71) where do get the credit?

i) From the marketing association

ii) From the bank

iii) Others (specify)……..

73. If yes to (72), how much money did you get?

74. Was the credit provided enough to enable you carry out the pyrethrum (marketing) activities? Yes No

75. Do you grade the pyrethrum for sale? Yes No

76. If yes to 75, how do you grade the pyrethrum?

- By color
- By physical appearance
- By pyrethrin content
- Others (specify)……

77. How much does it cost you to deliver pyrethrum to the market for each of these activities?

- Loading Ksh……..
- Transport Ksh…….
- Cess Ksh…….
- Off loading Ksh……..

78. How much money do you get from the sale of pyrethrum in a month Ksh……, in a year Ksh…….

79. For the time you have sold pyrethrum, which constraints do you face?

- Limited market
- Oppressive prices
- High cost of transport
- Inadequate capital
- Inconsistent supply to meet market demand
- Competition from other enterprises

- Any other (specify)……

80. How do you think the problems can be resolved?

i) Form marketing organizations so as to benefit from high bargaining power

ii) Access to credit facilities

iii) Pyrethrum marketing policy to allow free entry and exit of participants in the market

iv) …… ……. (Specify any other).

81. Following the president's signing of the pyrethrum bill 2011 to become law on January, 3, 2013, what are your general expectations/impact on the pyrethrum sub-sector in your locality and Kenya, especially on issues of its marketing?……
……
……
……
……
……
……

Appendix II: Pyrethrum Price List

Current Pyrethrum Board of Kenya Producer Payment Rates (New Price List)

	PRICE IN KSHS / KG	**PRICE IN SHS / KG**
PYRETHRIN CONTENT (%)	**OLD**	**NEW**
0.8	58.40	100.00
0.9	65.70	112.50
1.0	73.00	125.00
1.1	80.30	137.50
1.2	87.60	150.00
1.3	94.90	162.50
1.4	102.20	175.00
1.5	109.50	187.50
1.6	116.90	200.00
1.7	124.10	212.50
1.8	131.40	225.00
1.9	138.70	237.50
2.0	146.00	250.00
2.1	153.30	262.50
2.2	160.60	275.00
2.3	167.90	287.50
2.4	175.20	300.00
2.5	182.50	312.50
2.6	189.80	325.00
2.7	197.10	337.50
2.8	204.40	350.00
2.9	211.70	362.50
3.0	219.00	375.00

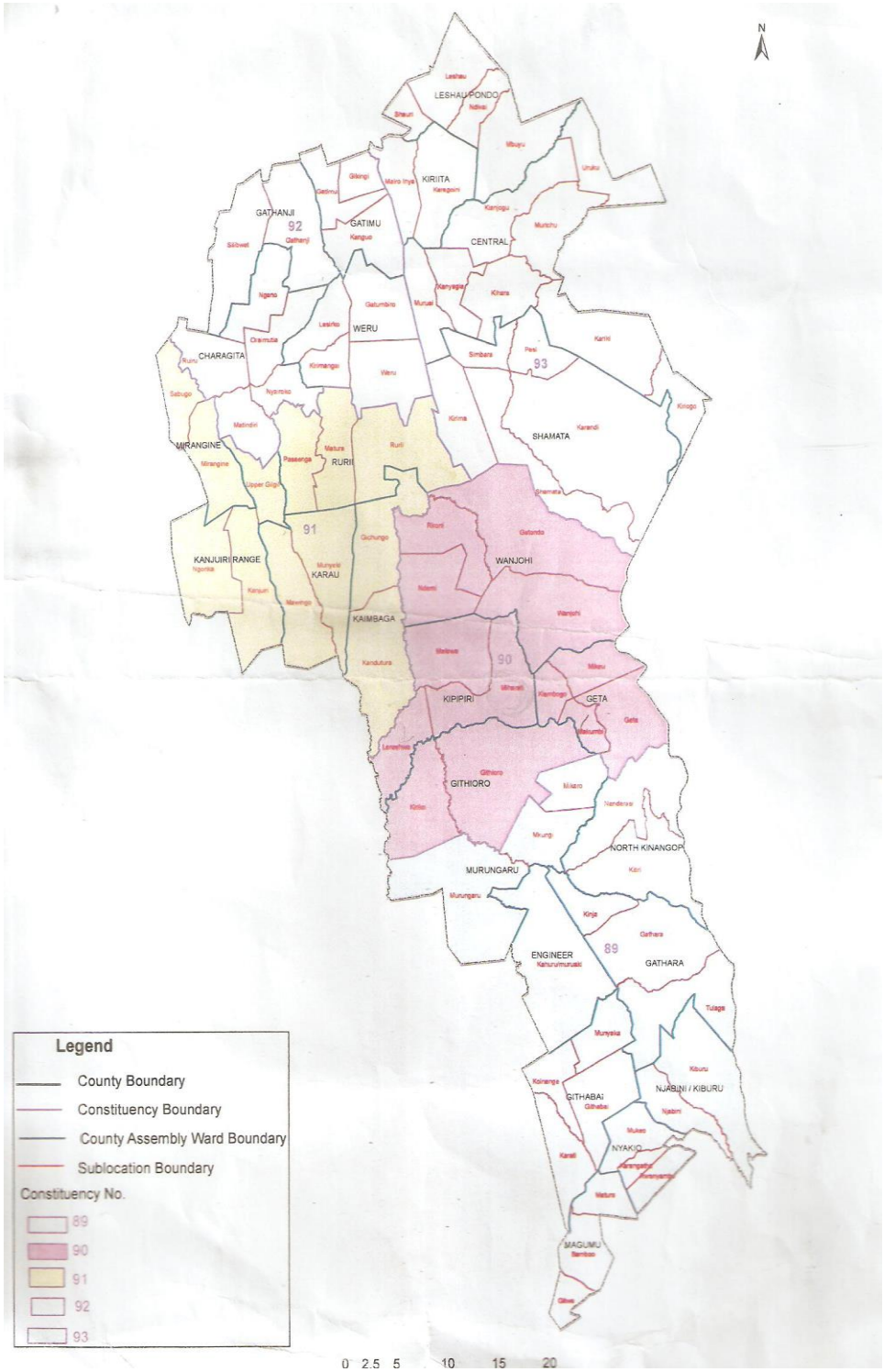
Source: Pyrethrum Board of Kenya, 2010

Appendix III: Gross Margin Analysis of Participants Versus Non-participants at their respective flower collection points

Data are per hectare per year		**Participants**				**Non-participants**			
List items	**Unit**	**Units**	**Unit cost (ksh)**	**Cost total (ksh)**	**% total revenue**	**Units**	**Unit cost (kshs)**	**Cost total (kshs)**	**% of Revenue**
Inputs									
Manure(for top dressing)	Kg	123	15	1,845	4.1	123	15	1,845	6.2
D.A.P fertilizer(for planting)	Kg	21	60	1,260	2.8	21	60	1,260	4.2
Total				**3,105**	**6.9**			**3,105**	**10.4**
Labour activities									
Land preparation	Day	2	100	200	0.4	2	100	200	0.67
Planting	Day	1	100	100	0.2	1	100	100	0.3
Weeding	Day	12	100	1,200	2.7	12	100	1,200	4.0
Total				**1,500**	**3.3**			**1,500**	**5.0**
Harvesting	Day	26	100	2,600	5.8	26	100	2,600	8.7
Transport	Kg	300	5	1,500	3.3	300	5	1,500	5.0
Total				**4,100**	**9.1**			**4,100**	**13.7**
Total production cost				8,705	19.3			8,705	29.0
Total revenue	Kg	300	150	45,000	100.0	300	100	30,000	100.0
Gross Margin				**36,295**	**80.7**			**21,295**	**71.0**

Source: Author

Appendix IV: Administrative Boundaries of Nyandarua County



Administrative Boundaries of Nyandarua County

Appendix V: Farmers' Expectations of the New Pyrethrum Law

The last question (81) of the questionnaire had sought the views of the farmers following President Mwai Kibaki's signing of the Pyrethrum Bill 2011 to become law on January, 3, 2013. The pyrethrum farmers in the study area expressed the following general expectations. Most of them were optimistic that, if reforms as proposed in the draft pyrethrum amendment Bill 2006 now 2011, were successfully implemented, there would be restoration of the Kenyan pyrethrum industry and the improvement of pyrethrum farmer incomes. In particular they expected the following.

(i) Twenty six percent of the respondents (both participants and non-participants) expected a vibrant pyrethrum industry contributing to the creation of jobs in the local industries that use pyrethrum extracts as raw materials.

(ii) Kenya consolidating itself as the largest world producer of pyrethrum in a few years because pyrethrum grows and matures fast (17%).

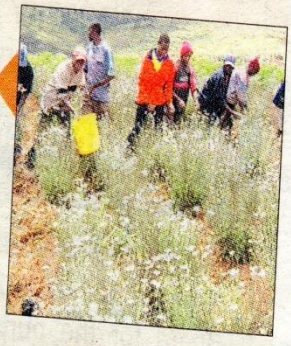
(iii) Improved livelihoods through forward and backward linkages in the economy resulting in poverty reduction (as envisioned in the vision 2030) due to increased foreign income (23%).

(iv) Reduction in insecurity and criminal cases as reported in the potential pyrethrum growing areas as a result of youth unemployment which a major problem in the study area (34%).

Appendix VI: Pyrethrum Articles in Kenyan Print Media (for Nyandarua County)

RoundUp

NYANDARUA: Governor's plan to revive pyrethrum sector



Leaders in Nyandarua have pledged to work with their counterparts from other pyrethrum-growing regions to revive the sector. The leaders noted that there was the need to work hand in hand with other stakeholders to make sure that the pyrethrum sector becomes profitable like in the past. Nyandarua Governor Daniel Waithaka said that they were consulting with leaders from Nakuru and West Pokot counties to find ways of how the crop can be reintroduced. This is after the sector collapsed with most farmers being forced to uproot the crop.

TAVETA:

Thursday, April 18, 2013 / The Standard

Pyrethrum farmers push for liberalisation

By JAMES MUNYEKI

Nyandarua County

Pyrethrum farmers from Nyandarua County want the devolved Government to push for liberalisation of the pyrethrum sub-sector to allow private investors and farmers to benefit from the produce.

The farmers said failure by the Pyrethrum Board of Kenya (PBK) to do so has forced them to uproot the crop despite the Government's frantic effort to heal the ailing sector. Most of the farmers have shifted to dairy, horticultural production and small-scale businesses.

Consequently, the acreage under pyrethrum in the region has declined immensely.

Led by Kiarie Njoroge, the farmers said they were willing to cultivate the once vibrant cash crop but more players needed to be allowed into the sector so that farmers benefit from competition.

"This is the only way farmers can stop relying on other crops that do not have much profit like pyrethrum," he said.

Another farmer, William Murioga, said pyrethrum farming in the region had been neglected since PBK does not allow private players in the sector, leaving farmers to languish in poverty.

Tuesday, August 26, 2014 / The Standard

CENTRAL NEWS / Page 25

Allow more pyrethrum agents, CS told

NYANDARUA COUNTY

By JAMES MUNYEKI

County Executive for Agriculture Agatha Thuo wants the Government to license more pyrethrum processors to boost production for export.

Currently, all pyrethrum products are handled by the Directorate of Py-

shillings.

The county government set aside Sh4.5 million in the 2013/ 2014 financial year to revive the sector, which Thuo said has been used to purchase pyrethrum seeds and seedlings.

"Before its collapse, it was a source of livelihood and a large income earner for small-scale farmers in this county and therefore, we have laid down strategies to ensure farmers in

farmers have in the past been a disillusioned and disappointed lot, saying a new beginning has come and that the company is ready to guarantee them maximum benefits.

Dr Maina said the company is set to play a key role in the supply of seeds and planting materials, adding that it will also be ready to purchase

the crop from farmers and process pyrethrine.

He said a processing factory has been established with a capacity of 24 tonnes per day, adding that once all the processes kick off, the company wants all farmers to join it.

He said HighChem has identified Nyandarua and Nakuru counties for a

pilot project, saying this will soon be expanded to other pyrethrum-producing areas.

He said his company targets more than 4,000 farmers in the region in efforts to restore the crop that, he said, was once

a major cash crop for residents of the area in the years gone by.

Appendix VII: Testing for Goodness of Fit of Level of Participation in Pyrethrum Group Marketing Channel

LRI = 1-LnL/LnLo where,

LRI = Log likelihood index

LnL = Log likelihood function value for the model with all independent variables.

LnL_0 = Log likelihood function value for the model computed with the constant term only

LnL =-54.3824

LnL_0 = -70.3628

LRI = 1 -(-54.3824/-70.3628)

=0.2271

Appendix VIII: Correlation matrix for explanatory variables hypothesized to influence participation in pyrethrum[a/]

	Age	Gender	Education	Family Labour	Farming Experience	Other farm income	Household size	Livestock value	Non-farm income	Market distance	Extension	Road condition	Market accessibility	Sale price	Group membershi
	1.000														
	0.023 (0.073)	1.000													
	0.031 (0.298)	0.229 (0.017)	1.000												
	0.442 (0.726)	0.344 (0.024)	0.277 (0.187)	1.000											
	0.543 (0.001)	-0.011 (0.819)	0.073 (0.241)	0.404 (0.392)	1.000										
	0.111 (0.049)	0.432 (0.633)	0.114 (0.197)	0.091 (0.017)	0.444 (0.936)	1.000									
	0.127 (0.124)	0.069 (0.346)	-0.438 (0.232)	0.571 (0.000)	0.084 (0.014)	0.028 (0.234)	1.000								
	0.491 (0.732)	0.035 (0.619)	0.333 (0.021)	0.211 (0.239)	0.089 (0.817)	-0.129 (0.721)	0.273 (0.034)	1.000							
	-0.325 (0.736)	0.411 (0.027)	0.019 (0.365)	0.115 (0.814)	0.491 (0.471)	0.266 (0.237)	0.044 (0.015)	0.143 (0.636)	1.000						
	-0.013 (0.078)	0.025 (0.021)	0.349 (0.241)	0.353 (0.893)	0.212 (0.214)	0.243 (0.251)	0.199 (0.789)	0.007 (0.215)	0.403 (0.318)	1.000					
	0.159 (0.284)	0.417 (0.861)	0.077 (0.122)	0.196 (0.899)	0.156 (0.341)	0.012 (0.414)	0.176 (0.322)	0.425 (0.191)	0.412 (0.472)	0.313 (0.324)	1.000				
	0.216 (0.113)	0.022 (0.819)	0.443 (0.724)	0.175 (0.472)	0.116 (0.111)	0.187 (0.237)	0.206 (0.232)	0.417 (0.431)	0.037 (0.334)	0.095 (0.214)	0.026 (0.831)	1.000			
	0.061 (0.231)	0.407 (0.011)	-0.497 (0.419)	0.415 (0.212)	0.074 (0.341)	0.019 (0.234)	0.004 (0.432)	0.036 (0.819)	0.198 (0.311)	0.582 (0.000)	0.169 (0.234)	0.348 (0.438)	1.000		
	0.072 (0.015)	0.332 (0.217)	0.404 (0.345)	0.493 (0.317)	0.435 (0.716)	0.228 (0.392)	0.101 (0.212)	0.124 (0.412)	-0.009 (0.233)	0.918 (0.432)	0.202 (0.747)	0.141 (0.347)	0.301 (0.333)	1.000	
	0.129 (0.241)	0.078 (0.681)	0.041 (0.238)	0.039 (0.327)	0.171 (0.117)	0.048 (0.434)	0.002 (0.213)	0.093 (0.150)	0.365 (0.632)	0.536 (0.158)	0.154 (0.117)	-0.354 (0.891)	0.424 (0.314)	0.205 (0.034)	1.000

Source: Author 2015

Appendix IX: Percentages of Socio-Economic and Institutional Characteristics of Survey Households in Nyandarua County

Characteristic (variable)	**Participants n=97**	**Non-participants n=27**	**Pooled n=124**
	Percentages	**Percentages**	**Percentages**
Gender of the farmer (male)	78.0	89.0	83.5
Road condition to the market (good)	29	34	31.5
Farmer having other farm income	54.6	43.4	49.0
Membership to pyrethrum group	78.2	21.8	50.0
Annual Extension visits	100	100	100
Source of credit facilities			
Women groups	22	11	11.5
Friends	1	2	1.5
Relatives	1	2	1.5
No credit	76	85	80.5
Source of extension services			
Ministry of agriculture	90	89	89.5
Private agents	10	11	10.5
Frequency of extension contact			
One time	96	94	95
No contact	4	6	5
Source of market information			
Other farmers	99	97	98
Radio	1	3	2

Source: Survey data

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