ECONOMIC ANALYSIS OF INCOME EFFECTS, RESOURCE-USE EFFICIENCY AND INSTITUTIONAL ARRANGEMENTS IN THE HORTICULTURE SECTOR IN GUINEA

ギニアにおける園芸作部門の所得効果、資源利用効率と生産者組織に関する経済分析

Ph.D. THESIS

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ECONOMIC ANALYSIS OF INCOME EFFECTS, RESOURCE-USE EFFICIENCY AND INSTITUTIONAL ARRANGEMENTS IN THE HORTICULTURE SECTOR IN GUINEA

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DEDICATION

In memory of my Father Augustin Tamba Yeyas Tolno,

To my Mother Denise Foulo Yaradouno,

With love and appreciation

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CHAPTER I

INTRODUCTION

This chapter serves as the introduction of the study and consists of the background information, the research problem and research questions, the objectives of the study, the significance and limitations of the study, and in the last section, the organization of the thesis and the conceptual framework employed to guide the study are provided.

1.1. Background of the Study

The natural endowments of Guinea give it a comparative advantage for any meaningful and sustainable development as it is heavily weighted with non-renewable and renewable resources, land, biodiversity, forests and fisheries. The country boasts significant agricultural assets, for accelerating growth and creating lasting jobs. Yet, despite the wealth of resources, Guinea remains a developing country and the majority of its population continues to live in poverty. Classified as an income poor nation, its rural economy remains significantly underdeveloped. The extent of poverty in rural communities and the importance of rural livelihood security to the national economy, call for the adoption of adequate measures to ensure livelihood sustainability and improvement of the rural economy. Shepherd, Arnold and Bass, (1999), in their study on Sustainable Livelihood concluded that, livelihood insecurity remains a major problem in less developed countries,

particularly those in Africa. Poverty, famine and malnutrition are serious perennial problems that these nations have to grapple with. They further stressed that poverty in the developing world is more a rural than an urban phenomenon, and in the poorest developing countries, 65-80 percent of the population still live in rural areas. The same can be said about Guinea where, according to the results of the Rapid Survey for Poverty Assessment carried out in 2012 (ELEP-2012), 55.2% of the population are deemed to be poor of which 64.7% live in rural areas. The importance of the rural sector to the economy and the extent of poverty in this sector have been acknowledged by successive governments since independence in 1958, with relentless efforts in implementing policies that aim at poverty reduction; yet, poverty still persists in the country especially in the rural communities. Agriculture, which is mainly rural-based and the core of the country's economy, remains the principal sector for the development and growth of the economy. Particular emphasis has been placed on agricultural and food policies as they play a crucial role in reducing poverty and help to increase incomes of the rural poor.

Indeed, the agriculture sector plays a significant role by providing a broad-based income and employment to the vast majority of the population in the country, most of which are smallholder farmers engaged in subsistence and semi-commercial farming. From a macroeconomic perspective, agriculture has long been and continues to be the backbone of the country's economy accounting for nearly 25% of the GDP, and employing about 80% of the workforce. The sector remains the main source of income and livelihood for the vast majority of the rural and peri-urban communities who solely depend on subsistence agriculture for food production. With one of the most favorable climates for agriculture in

West Africa, Guinea has huge agricultural potential with 6.7 million hectares of arable land and an estimated 367,000 hectares of developable areas for irrigation (PNDA-Vision 2015). There is a relatively long rainy season, (extending for five to eight months depending on the region), with annual rainfall ranging from 1,200 mm to 4,000 mm, and providing about 400 billion m^3 of water. In addition, the potential of floodplains is also important with a water system of 6,500 km and a continental shelf of 43,000 km², providing the country with important surface and groundwater resources. Furthermore, Guinea has a rich heritage of vegetables and fruits production, giving it comparative advantage and tremendous potential to develop horticulture, which is very important for providing nutritional and food security.

The horticultural sub-sector, like in other Sub-Saharan countries, is known for its rural growth and pro-poor impacts due to its contributions to income and employment generation and to food security. Moreover, these impacts are expected to be enhanced with the growing demand for the commercialization of horticultural farming as a result of globalization, urbanization and population growth. The horticulture sector is also one of the major strategic components for poverty reduction in rural areas in Guinea, and the major source of cash inflow and income earning source for the smallholder farmers. The significance of the sector is not only driven by producers' need for immediate cash, but also through institutional and technical changes, supported by millions of smallholder farmers (Bassett, 2001). The pineapple, eggplant and potato are important cash crops providing meaningful source of income to many producers in Guinea. Several initiatives by governmental as well as non-state actors are in place to promote intensification and commercialization of smallholder farming. Agricultural commercialization refers to the

process of increasing the proportion of agricultural production that is sold by farmers (Pradhan *et al.,* 2010). And commercializing smallholder agriculture is an indispensable pathway towards economic growth and development for most developing countries relying on the agriculture (von Braun 1995; Pingali and Rosegrant 1995; Timmer 1997).

In Guinea, cash crops farming and commercialization is dominated by spot markets, with a recent increase of some movements towards farmers' engaging collectively in crops production and marketing through producer organizations. It is recognized that agricultural commercialization and investment are the key strategies for promoting accelerated modernization, sustainable growth and development and, hence, poverty reduction in the sector. However, Guinea's agricultural sector growth is inextricably bound to the macroeconomic progress in the country. The average growth recorded over the past five years (2.4%) was not significant enough to spur increased investment in the productive sectors and reduce poverty. As elsewhere in other developing economies, smallholder farmers characterize the Guinean agriculture. In general, land holding is perhaps the most direct and easily introduced indicator of smallholder farming. In Guinea, the average size of land cultivated varies from 0.3 to 1.5 hectare; only 26% of the potential of arable land is cultivated (less than 10% annually) and only 9% of the irrigable land is developed. Most of the farmers cultivate food crops such as rice, maize, vegetables etc. for own consumption and commercialization; improving the livelihoods of resource-poor farmers with the smallest parcels of land remains a challenge for policy-makers and practitioners in Guinea.

There are several factors affecting the agriculture sector in Guinea. First, agriculture is

rain-fed and therefore unfavorable weather results in poor agricultural performance. In addition, the problems with smallholder agriculture dwell on the use of traditional technology which is associated with low productivity, the large majority of the crop area being cultivated by hand, the extension services which are not properly funded, and the lack of farmers access to agricultural inputs. Despite the low levels of technology, it is established that there are significant linkages between increased agricultural production of cash crops and farmers income. Hence, addressing the issue of how to increase agricultural production and farmers' incomes is crucial to both agricultural growth and poverty alleviation in Guinea. Growth in agriculture and farm incomes can come about three ways: through increases in the prices received by producers, increases in physical and human capital of farmers, and increased productivity and efficiency of resource use by farmers. Higher prices received by producers can come about either because of an increase in domestic or international prices of the products they produce, or by a reduction in the marketing margins between farmers and the final consumers. The latter aspect involves markets and marketing organizations through farmers' collective actions. Farmer organizations, as institutional innovation tools, are increasingly seen as key to achieving not only agricultural growth by overcoming market failures, but also to ensure that poor smallholder farmers also benefit from this process. There are suggestions that the presence of farmer organizations in cash crops farming, raises farmers' income and benefits to the farmer. Available evidence indicates that farmer organizations can provide a mechanism to increase the total level of resources supporting agricultural development and the efficiency with which these resources are allocated at the farm level (Kerry J. Byrnes, 1985). The

study of Key and Runsten (1999) suggested that farmer organizations could increase farmers' bargaining power and reduce the cost of farming business. In Guinea, farmers' organizations are inclusive of the poor and are charged with the purpose of becoming a market outlet for smallholder farmers. Improving farmers' income earning capability and agricultural productivity has been an important strategy of Guinea's agriculture development policy. Understanding the challenges at the smallholder production levels, the determinants of farm productivity, requires comprehensive and in-depth farm level insights, under the different crop production systems and institutional arrangements.

1.2. Problem Statement and Research Questions

Smallholder agriculture represents the key livelihood activity for the majority of the Guinean population, and is a significant driver for economic growth in the country. The performance of the Guinean economy depends mainly on the production of the primary sector, where agricultural production plays a significant and vital role. Poor performance observed in this essential sector of the economy aggravates poverty, especially in rural areas, as agriculture is the most important source of income. Hence, the transformation of subsistence agriculture as practiced by the majority of farmers into a market oriented and driven sector is crucial. Production and commercialization into the horticulture sector has often been seen as a pro-poor development strategy. Commercialization of agriculture involves a transition from subsistence-oriented to increasingly market-oriented patterns of production and input use. Economists have long advocated cash crop production as part of a broader strategy of comparative advantage. The underlying premise is that markets allow

households to increase their incomes by producing that which provides the highest returns to land and labor, and then, use the cash to buy household consumption items, rather than be constrained to produce all the various goods that the household needs to consume (Timmer 1997; Pingali 1997). The horticultural crops production drives tremendous interests and is a key opportunity sector for supporting rural development and poverty reduction in Guinea. Despite the significance of the sub-sector and its economic potential at macro level, the extent to which the economic gains derived from horticulture production and commercialization impact on the resource-poor farmers at the household level, is yet to be clearly understood in Guinea. Thus, it is essential to address its great potential for increased output and quality of the horticultural produce. Pineapple, potato and eggplant are among the important horticultural crops grown in Lower and Middle Guinea with the potential of improving farmers' livelihood. In comparison with other cash crops, these crops are more profitable and considered as the basis for the implementation of market-driven agro-business oriented rural development policies. Despite this importance and the market prevalence, cash crops production levels in Guinea remain low, calling for an investigation on the factors affecting cash crop farming. Agricultural producers face a large number of human, technical, institutional and environmental challenges. And today, throughout the developing countries, donors, technical assistance agencies, and host country governments search for solutions to a number of institutional and organizational problems that stand in the way of accelerating the pace of development of small farmer agriculture in these countries. To attract investment into agriculture, it is imperative that those constraints inhibiting the performance of the sector are first identified with a view to

unlocking them and creating a conducive investment climate in the sector. Research throughout the developing world has shown a potentially strong relationship between agro-industrial investments, growth in smallholder agriculture, and poverty reduction (Jaffee and Morton, 1995; Dorward et al. 1998; Delgado, 1999). More pointedly, Dorward *et al.* (2005) argue that current emphasis in research and policy discussions on the institutional environment in Africa is at the expense of sufficient attention to institutional arrangements, calling for more investigation, especially for farmer organizations.

Indeed, the productivity of smallholder agriculture and its contribution to the economy, food security and poverty reduction depend on the services provided by well-functioning institutional environments. And increased agricultural production, sustainable agricultural intensification involve scaling up farming practices that both efficiently use available farm inputs and maintain the resource base on which smallholders depend, so that it continues to support food security and rural development. Such challenges point to the need for targeted interventions and in-depth studies that can improve productivity for resource-poor farmers and improve food security in Guinea. Efficiency analysis in agricultural production is generally associated with the possibility of farms producing a certain level of output from a given bundle of resources or certain level of output at least cost (Girei *et al,* 2013a and Girei *et al*., 2014b).

Despite long-term efforts by development agencies and government to promote agriculture and cash cropping, very little is known about cash crops production and commercialization in Guinea and there is limited evidence documenting a relationship between these crops, food security and the well-being of households cultivating them. The

current study was therefore undertaken based on a number of evidences. First, most smallholders in Guinea have limited access to inputs, technical advice, credit and other financial services, and to inputs and output markets. Thus improving their access is a major challenge for smallholder agricultural development. Second, an enabling agricultural investment climate and the provision of rural public goods by the state are either poor or non-existent, but yet necessary conditions to ensure efficient farm productivity and the betterment of farmers' livelihood. Third, agribusiness in Guinea strongly depends on smallholders' productivity and farmer organizations are necessary tools to efficiently improving farmers access to inputs and output markets. The limited capacity of resource-poor farmers to respond quickly to price incentives, combined with price volatility and higher costs for inputs, poses a great challenge for rural women and men as they struggle to feed their families and make agricultural production a more profitable enterprise. Thus, it is critical to generate adequate policies to encourage investments and increase agricultural productivity, particularly among smallholder farmers. Fourth, smallholder farmers will not increase the production and productivity levels of their agricultural systems unless such increases enable them to achieve a significant and relatively assured increase in the income which they derive from the production of food and other agricultural commodities.

Empirical studies on smallholder farmer productivity and farmer organizations remain largely scanty, isolated and devoid of in depth analyses of the income effects, resource use efficiency of smallholder cash crops farmers and how membership in farmer organizations affects their income. More, very little is known concerning how farmers join their forces together through collective actions in Guinea and how these institutional changes affect

them. The absences of such studies have left a void in research. Understanding the functioning of input and output marketing, the institutional arrangements in the Guinean horticulture sector and marketing is essential to the improvement of farm productivity and smallholders' agricultural commercialization.

Hence, to fill the dearth in empirical research, the current study was designed to provide insights into the trade-offs between horticultural crops production, the institutional players and the effects of the latter on farming income in Guinea. In pursuing its goals, the study attempts to answer the following questions:

(1). What determines the profitability of the horticulture crops production, especially for potato, eggplant and pineapple farmers?
(2). Are the resources being used to their optimal level so as to yield the desired outcome?
(3). Under what conditions can farmer organizations most effectively develop their potential catalyst role and how does this impact farmers' income?
(4). How can the combination of agricultural productivity, farmer organizations and markets linkages contribute to raise farmers' incomes and reduce poverty and hunger?

1.3. Objectives of the Study

The overall objective of this dissertation is to investigate the income effects, resource use efficiency in the Guinean horticulture sector and the linkages with farmer organizations. Given the structure of cash crops production and marketing mainly potato, eggplant and pineapple, this allows examining the pathways to improve farmers' livelihood. To achieve the main goal, the study focuses on the following specific objectives:

1. To investigate the determinants and income effects of membership in farmer organizations in potato farming.
2. To analyze the factors influencing potato production and supply.
3. To analyze the production economics and resource use efficiency in pineapple production in Guinea.
4. To investigate the determinants of total factor productivity and income from Eggplant production.
5. To identify the production and marketing constraints for the targeted horticultural crops.
6. To provide policy recommendations for smallholder farmer livelihood improvement.

1.4. Significance and Limitation of the Study

The key to unleashing Guinea's agricultural development potential lies in improving farming conditions and the smallholder farmers' access to the production and market resources essential for increased productivity and incomes. This study, which involves two rounds of farm household survey in 2012 and 2014, conducted in four major cash crops producing districts in Guinea, seeks to assess the income and poverty effects of cash crops production and commercialization, with a special focus on production resource use efficiency, under farming organizations. In addition to analyzing the dynamics of smallholder participation in farmer groups, the study also identifies and evaluates the performance of institutional arrangements that link the small producers to the inputs and output markets. The key empirical ingredient of the current research is the investigation of the income effects in the cash crops production and marketing, the estimation of the profitability and resource use efficiency, under the given socio-economic conditions and institutional arrangements in the study areas.

The need of this study is necessitated in response to the fact that smallholder cash crops production and marketing is reliant on the view that in-depth studies could lead to increase farm productivity, incomes, thereby improving smallholder farmers' livelihood. The larger aim is to understand how changes in institutional arrangements come about, particularly in the form of reduced transaction costs, reliable source for inputs and output market and higher farm income. Besides, given that little or none is known about smallholder agriculture especially in the study areas, making it difficult for extension agents, policy makers and researcher, in extending agricultural technologies for increased productivity and efficiency in the horticulture sector, the current study would be a useful reference for researchers and other personnel interested in the area of study. This study mainly emphasizes on eggplant, pineapple and potato farmers' productivity, resource use efficiency and income effects of their participation in farmer organizations.

The limited scope of the study and the relatively small sample size in addition to the general lack of data and time constraint, represent some limitations. Nevertheless, findings of study provide knowledgeable facts on smallholder horticulture production and farmer organizations in Guinea. It also immensely contributes to the limited body of literature and as such, provides useful insights for the government policy makers, researchers and other relevant stakeholders whose interest might be in subsequent studies.

1.5. Organization of the Thesis and Conceptual Framework

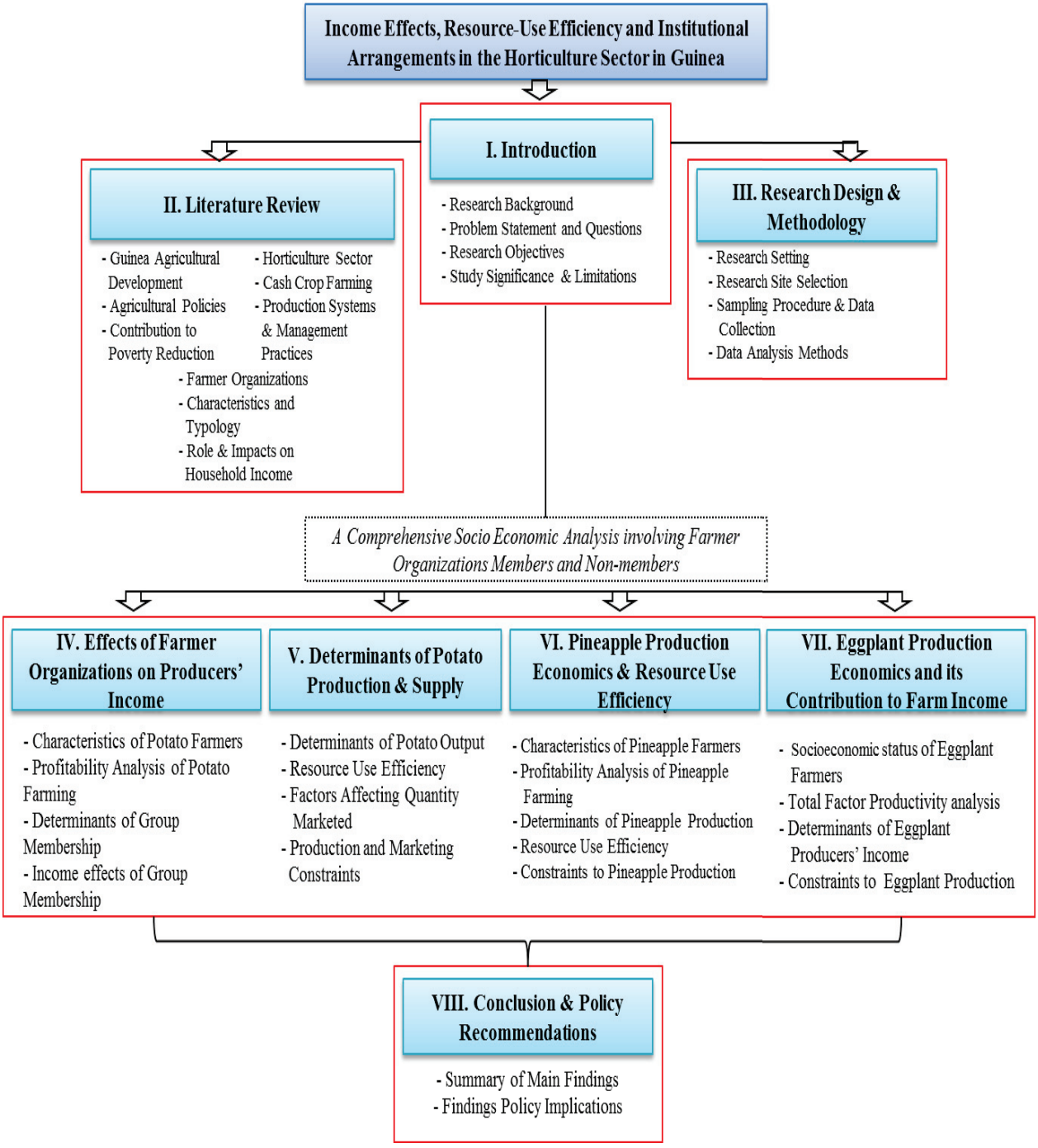

Figure 1.1: Scope of the Thesis

This thesis is organized in eight chapters. The First Chapter introduces the dissertation with highlights on the background of the study, the problem statement and research questions and the objectives of the study. In addition, the chapter presents the significance and limitations of the study and finally concludes with the organization of the dissertation and the conceptual framework employed for the study. The Second Chapter presents an overview of the agricultural development, the horticulture sector and farmer organizations in Guinea. Chapter Three provides details on the research design and methodology, including a description of the study areas, sampling procedure and data collection as well the analytical tools used for the study and a framework of analysis in forthcoming chapters. A brief description of the survey instrument used closes the chapter. In Chapter Four, an assessment of the effects of farmer organizations on the smallholder potato farmers' income is presented with a highlight on the profitability analysis of potato farming and determinants of membership in farmer organizations. A summary of the chapter is also provided. The determinants of potato production and supply by smallholder farmers are explored in Chapter Five where, insights from the econometric models described in chapter three, helped to understand the factors affecting the quantity of potato output and marketed as well the efficiency of resource use by farmers. The production and marketing constraints of potato farming are presented at the end of the chapter with a brief summary provided. In Chapter Six, after presenting the socio-economic characteristics of pineapple farmers, I explored the production economics and resource use efficiency in pineapple farming in Guinea. The chapter presents details on the profitability of pineapple farming, the factors determining the crop output and producers' income as well as their efficiency in resource

use. Challenges faced by pineapple farmers and a summary presentation of the chapter are given to end the end the chapter. The eggplant production economics and effects on producers income are covered in Chapter Seven. Finally, in Chapter eight, the dissertation ends with the conclusion and policy recommendations where, I present in the first part, the summary of findings and in the second and last section of the chapter, address the specific policy implications of the findings.

CHAPTER II

AGRICULTURAL DEVELOPMENT, HORTICULTURE SECTOR AND FARMER ORGANIZATIONS IN GUINEA

2.1. An Overview of Agricultural Development in Guinea

Agricultural and food policies have a crucial role in reducing rural as well as aggregate poverty in Africa, given that the bulk of the poor are in rural areas, and are employed in agriculture. The principal activity and primary source of income is Agriculture for the vast majority of the population in Guinea. Despite the wealth of resources, Guinea remains an underdeveloped country and the majority of its population continues to live in poverty. More than 52% of the country's poor population lives in rural areas and most cultivation is carried by smallholding farmers who make up nearly 80% of the population.

In the years leading up to independence, several programs were launched to improve the agricultural sector. However, the compulsory character of the system, the international management problem and the insufficient extension support were among the numerous problems that handicapped the survival of the colonial agricultural system after the country got its independence (Bah, 1998). Committed to meeting all the development challenges, the government set as its major objective, the achievement of an annual agricultural Gross Domestic Product (GDP) growth rate of 10% (in 2010) and has made the agricultural sector the priority of its economic and social development policy. As in much of Sub-Saharan

countries, the Guinean government engaged in the general and imperative structural adjustment programs, prolonged and amplified in the years 1990 by the increasing liberalization of market exchanges. Farmer based organizations have attracted interest as vehicles for providing an array of collective services including common property management, technology development and testing and management of rural infrastructure, and marketing of key production inputs or farm outputs (Tinsley, 2004). During the First and Second Republic, the economic and agricultural reforms aimed at boosting rural and economic development. However, other areas where the public sector has traditionally supported the agricultural sector in particular were neglected; agricultural research, training, and extension activities were ignored, rural infrastructure deteriorated, and the state's responsibilities as manager and protector of publicly owned natural resources were not met. Despite some progress made in improving the conditions for the rural population, productivity is still low because farmers have little access to information, new technologies, basic infrastructure and rural financial services. In 2008, the Government introduced a series of reforms and resolutions to address the worsening poverty and social deterioration in the country. The Poverty Reduction Strategy Paper (PRSP) and the National Policy on Agricultural Development – Vision 2015, were adopted and focused on development of the crop and livestock subsectors and the national food security strategy.

Table 2.1 Summary of Guinea agricultural policies

Period	Agricultural Policy	Objective	Characteristics	Results
Colonial era (1898-1958)	Agricultural Development Policy	Improve rice production	Farming organization and management pattern were intricately connected to the colonial system. The Native Societies for Providence (SIP) were created by the colonist in 1932 along with six other types of agricultural cooperatives. A succession of programs launched by the French to extend improved agricultural technologies to rural farmers organized in cooperatives groups.	Creation of research centers. Guinea is the third largest rice producer in Africa.
First Republic (1958-1984)	Socialism, collectivization of the means of production	1. Reorganize the properties of agrarian cooperatives 2. Increase rice productivity 3. Food self-sufficiency	76% of the country's export was agricultural products, mostly sold on the French markets. Various farming schemes were introduced (1960s-1970s), including highly mechanized state-run farms and socialist farm complexes. All land was declared to be the property of the state. Direct investment in agricultural production and marketing by the government.	Creation of mechanized brigades, harnessed for production; decrease in agricultural production; abandonment of cash crops.
Second Republic (1984-2008)	Economy liberalization -LPDA* 1 -LPDA 2	1. Removal of marketing standards 2. Trade liberalization 3. Removal of import licensing 4. Increase agricultural production; decrease imports	Market liberalization measures; increased role of commercial banks; devaluation of the national currency. Investment in commercial production of fruits and vegetables (Coastal and Southern Foothills Zones), and of coffee and palm oil (Forest Zone). Private firms organized farmers on their periphery to produce commodities according to their requirements. Letter of Agricultural Development Policy in 1992 (LPDA1) and (LPDA2) in 1998, were established.	Investment in agriculture; Increase in annual growth of GDP. Increase in rice production; From 2000, increase in imports. Decrease in the agriculture growth rate and cultivated areas.
Third Republic (2008-Now)	National Policy for Agricultural Development (vision 2015)	1. Promote agricultural entrepreneurship 2. Improving market access for agricultural products 3. Increase the production of crops for export.	(Ongoing activities) New agricultural technology development; basic infrastructure and rural finance development; Sustainable development of rice production; Diversification of agricultural production for greater food security; Promotion of agricultural products for export and agribusiness; Integration of sustainable natural resource management; Strengthening of institutions supporting agriculture	Results not yet passed

The Government intends to ensure food security in the country and to become a food exporter. The plan seeks to attract private sector investments and is designed to contribute to a significant reduction in poverty through rural development, thereby helping to reverse socio-economic decline. It is within this context that Guinea has implemented several initiatives to improve production and productivity of rice, the staple food for the local population, with the aim of limiting dependence on imports. The agricultural sector of the economy has stagnated since independence. The precipitate withdrawal of the French planters and removal of French tariff preference hurt Guinean agriculture, and drought conditions during the 1970s also hindered production. Since 1985, however, the free market policies of the Second Republic have encouraged growth in agricultural production, with slow but steady increases in output. Guinea is a net food importer, however, importing some 30% of its food needs. The agricultural sector in Guinea is made up almost entirely by small-scale and subsistence farmers, around 80% of all farmers, and is characterized by a high marketing wedge which excludes many subsistence farmers from the market. Market participation is clearly dependent upon the risk and the technology facing the farmer, and market segmentation is high.

Price controls have also had a dampening effect on output. In theory, until the reforms of the early 1980s, the state controlled the marketing of farm produce. However, even during the late 1970s, when all private trade in agricultural commodities was illegal, only a small amount of agricultural production actually passed through the state distribution system; some 500,000 private smallholders reportedly achieved yields twice as high as government collectives, despite having little or no access to government credit or research and extension

facilities. During the 1970s and early 1980s, agricultural exports fell markedly, and food production decreased, necessitating rice imports of at least 70,000 tons a year. However, some restrictions on marketing were removed in 1979 and 1981; more recently, prices were decontrolled and many state farms and plantations dissolved. These steps appeared to bring improvements. The principal subsistence crops (with estimated 2004 production) are manioc, 1,350,000 tons; rice, 900,000 tons; sweet potatoes, 60,000 tons; yams, 40,000 tons; and corn, 90,000 tons. Cash crops are peanuts, palm kernels, bananas, pineapples, coffee, coconuts, sugarcane, and citrus fruits. In 2004, an estimated 430,000 tons of plantains, 280,000 tons of sugarcane, 210,000 tons of citrus fruits, 150,000 tons of bananas, 300,000 tons of peanuts, 53,000 tons of palm kernels, and 22,500 tons of coconuts were produced. That same year, coffee production was estimated at 20,500 tons, compared to 14,000 tons on average annually from 1979 to 1981. Prior to the reforms, a large portion of the coffee crop was smuggled out of the country. Guinea's trade deficit in agricultural products was $164.3 million in 2004.

Based on the premise that liberalized commodity markets would increase agricultural profitability, which in turn would stimulate farm investment and rural development, the dismantling of official boards and other parastatals was expected to raise both commodity output and supply-chain performance. Yet, significant increases in farm productivity have not generally been observed and the reform programs have produced mixed results, often due to the overlooking of commodity-specific and rural institutional frameworks (Jayne et al., 1997).

2.2. Horticulture and Cash Crops in Guinea

Guinea's economy is dominated by a large, labor-intensive agricultural sector; cash-crop agriculture production. The agriculture sector is constrained by structural impediments that have deterred investment including weak coverage of transport networks and complex customary land ownership that inhibits private investment. The sector, including cash and subsistence crops, is dominated by small scale family farmers in rural settings although there are a number of medium to large sized enterprises which operate in oil palm, copra, tea, coffee and fisheries exports. Many small-scale seed producers enter into the production system with very little capital. The commonest source of capital amongst these farmers is usually another farmer or government incentive loans. However, it is generally known that small-scale farmers have difficulty in securing loans to produce seed in sub-Saharan Africa. These organizations and individuals inevitably have different perspectives, but they all have a common interest: developing the ability of farmers to produce and sell a product that consumers want, on a reliable basis thus empowering their stake along their value chain.

2.2.1. The Potato Sector

Agricultural activities in Guinea have long been focused on traditional food production, focusing on crops such as rice, cassava, maize, yams, potatoes, fonio, peanuts, mangoes and pineapples. Maize, rice and cassava are the three most important food crops in Guinea, rice being the predominant and major staple food in the diet of both urban and rural households. However, its domestic production has never been able to meet the increasing national demand, leading to serious concerns about food security. These food deficits repeatedly ruin the efforts made by more than 85% of the population who depend solely on agriculture

for their subsistence. From this point of view, potato has emerged as an important food crop, taking a leading role in the crops cultivation systems in Guinea, while increasing food diversity and providing income.

Potatoes were first introduced in Guinea during the early 1920s and have shown excellent results in the central plateau of the Fouta-Djallon where the average annual temperature is 23˚C, with lows reaching 4˚C in certain areas. This region has a tropical climate with two humid seasons accompanied by 1,500-2,000mm of rain for six months of the year. Potatoes were brought into the region during colonial times and have remained, although the seeds have degenerated and the size of the potatoes has diminished. According to 2010 FAO statistics, Guinea potato production of 10,800 tons from 1,750ha, indicate an average national yield of about 6.2t/ha. This is low compared with the 25t/ha that can be attained by farmers under organized production systems (FPFD, 2010). In Guinea, potato production is concentrated in the Fouta Djallon highlands. The table below shows the characteristics of the main producing areas.

2.2.2. Production System

Traditional production system is the most dominated form of potato cultivation in Guinea. Production is particularly intensified on small farms near homesteads (Tapade, in the Fouta Djallon) and a non-sedentary production system is as well practiced by slash and burn. However, because of the low fallow period, soil fertility is being drastically reduced; as a result, increased in potato production predominantly depends on the increased in production areas.

Table 2.2. Potato production zones in Guinea

	Production zones	Characteristics
Main zones	Timbi Madina (Pita)	The Timbi-Madina area is the most important potato production zone with a huge potential. Altitude varies between 900 and 1,200m with about 30,000ha of plains and bas-fonds, favorable to potato production. With 70ha and 35 ha of irrigated plains and bas-fonds respectively, the zone produces 75% of the total potato production. Although the water system is irregular in this region, it offers important possibilities for potato production. The total cultivated area is estimated at 32,000ha and the average yields of about 3-5t/ha (Diallo, 2009).
	Soumbalako (Mamou)	The Soumbalako zone in Mamou prefecture is the second largest production area, with 246ha of irrigated land and 30ha used for potato production; the presence of the Bafing River in the area gives potential for expanding production. Altitude varies between 400 and 800m and production quantities estimated to 500-560 tons, yearly.
Expansion zones	Dalaba	Dalaba is a lesser mountainous area with altitude averaging 800m. The area benefits from 1,500 to 2,500mm of rain every year and there has been growing interest in cultivation of potato in this area.
	Mali	The Mali zone is a mountainous area with 800m to over 1,000m altitude. The favorable agro ecological conditions in this zone give it a huge potential for potato production.
	Tougue	Tougue (in Fatako sub-prefecture), this zone has vast plains for potato production and altitude varies between 400m to over 800m. Potato is produced in the area during dry season and off season.
	Labe	Altitude in Labe prefecture varies between 800m and 1,000m and the huge water system in the area is a considerable asset for potato production. The irrigated farm lands of Sagara, Labedheppere and Kalan are of a great potential for potato production.

Alternative improved production system disseminate by government extension services are yet to yield significant results. Potatoes are cultivated on the Guinean plains and basins in rotation with rice, maize and legumes; while in the basins they are mostly cultivated during the dry season, planted between November and December.

2.3. Farmer Organizations in Guinea

Small and marginal farmers in Guinea have been vulnerable to risks in agricultural production. Several organizational prototypes are emerging to integrate them into the value chain with the objectives of enhancing incomes and reduction in transaction costs. One such alternative is Farmer Producer Organizations (FPOs). Small and marginal farmers constitute the largest group of cultivators in Guinean agriculture; 85% of operated holdings are smaller than or about two hectares and amongst these holdings, 66% are less than one hectare. These issues include lower scale of operation, lack of information, poor communication linkages with the wider markets and consequent exploitation by intermediaries in procuring inputs and marketing fresh produce, access to and cost of credit and, in isolated cases, aggressive loan recovery practices. Hence the government has been promoting a new form of collectives called Farmer Producer Organizations (FPOs) to address the challenges faced by the small farmers, particularly those to do with enhanced access to investments, technological advancements, and efficient inputs and markets. Furthermore, the effect of farmers' organizations depends on how well they function, how the contract negotiations between the farmers and the company for the contract are conducted and in what context. Most of these groups are usually created in order to access the best available support for a group of beneficiaries – without adequate structuring or

knowledge of the necessary spirit or cooperative principles, to which is added a lack of organizational development and promotion of economic interests of members of these groups, an objective which a self-financing and self-managed company could reach. These producer groups are usually affiliated with local umbrella organizations (unions and federations) very dysfunctional and uninitiated in the organization and management of industry, but who can mobilize and bring together all those active in the industry.

Different forms of organization and groupings of farmers is an ancient phenomenon in Guinea, and the traditional forms of groupings for mutual help in the village level still exist in local communities. The most common form of farmers' organizations in Guinea has been that of a development instrument employed for the implementation of government policies that often were biased towards certain crops and regions of production, which in turn was reflected in the development of producers' organizations. The modern and juridical concept of farmers' organizations was created in the colonial era and has taken various forms under different contexts provided by the state. According to F. Bah (1995), the whole social life in pre-colonial Guinea was based on cooperative principle of cohesion, solidarity and justice. Cooperative farming was initiated in the mid-19th century; however, official forms of agricultural cooperatives were created only in the third decade of the colonial period.

As in other French colonies, the Indigenous Providence Societies (SIP) inaugurated in 1932, were among the first cooperatives created by the colonists. All types of agricultural cooperatives created during this period had the objectives of supplying farming goods, distributing credit, marketing farm produce and the like. The SIP required farmers around

headquarter towns of the administrative districts to enroll as members and maintain dues payments. In exchange, the SIP made loans in cash and in kind to its members, assured marketing of production, and extended agricultural technologies. The compulsory character of farmer participation in the SIP was its undoing. None survived after independence, having been a support to the colonial administration. During the First Republic (1958- 1984), several new Agricultural Cooperatives were created. In this post-independence era, all cooperatives were created and administered by the state. The period was mainly characterized by strong collectivization of the means of production to facilitate access to urban populations of agricultural products with a price control at all stages of distribution. These different forms of organization however have led to a decline in farming-related excesses of management and leadership and resulted in failure (decrease or stagnation of production).

The FAPAs were the most famous of the Agricultural Cooperatives. They were well designed and could have succeeded had not it been some mistakes committed during their execution. One reason for failure was the government's decision to send all university students to Fapas for one year prior to their graduation. The decision displeased students as well as their parents, the majority of whom were farmers, who wanted to ensure their children's access to other professions. Another reason for failure was that the initial number of Fapas, 200, was inflated to 360 at an early stage. During the Second Republic (1984-2008), the country engaged in a market oriented economy following the liberalization process and the withdrawal of the state from marketing and production function.

Table 2.3: **Chronology of Agricultural Cooperatives in Guinea**

Year of creation	Type of Agricultural cooperatives
	The Colonial Period (1893-1958)
1910	Indigenous Providence Societies (SIP)
1940	European Planters Cooperative (BANACOP)
1943	Guinean Banana Cooperative (COBAG)
1951	Cooperatives Sector for Development and Rural Equipment (SCAER)
1953	Mutual Societies for Rural Production (SMPR)
1958	Mutual Societies for Rural Development (SMDR)
	The First Republic (1958-1984)
1960	Agricultural Production Cooperatives (CAP)
1966	Rural Education Centers (CER)
1973	Draft Animal Production Brigades (BAP types A and B)
1974	Modern Peasants Cooperatives (CPM)
1974	Agricultural Workers' Mutual Benefit Societies (MAT)
1975	Mechanized Production Brigades (BMP)
1979	Rural District Farms (FAPAs)

Source: Adapted from A. M. Bah (1998)

As reported by A.M. Bah, 1998, this shift engendered an explosion of farmers' organizations, deemed an essential economic development tool, particularly for attracting private and foreign investors as a type of farm business.

Farmers' organizations were then emerging during the Second Republic (since 1984), in a context of reaffirming the challenges of agricultural development; these producer organizations (POs) are privileged interlocutors of the government for food safety issues, integration of producers to markets but also local democracy. Several programs of "professional agriculture" were introduced by the Ministry of Agriculture, with major support from the French cooperation.

2.3.1 Classification and organization of farmer organizations

Most producer organizations in Guinea are in the first place, family base type organization and management with voluntary membership and relative democratic control as mean essence. Individual farmers, from grass root level, seeking to get most benefit from their agricultural production and sustaining family livelihood, gather themselves into primary agricultural groups ranging from community based associations to commodity based organizations. Community-based associations, sometimes called self-help groups, are built around customary principles and ideas of promoting and protecting individuals as well as collective well-being. Farmer organizations and agricultural cooperatives may be broadly classified into primary organizations (production units) and rooftop farmer organizations. Production units are subdivided into three types: cooperative societies (CSs), farming groups (FGs) and village associations (Vas). In the law regulating cooperatives, the Code of Economic Activity (law L/92/043/CTRN issued in 1992), CSs are defined as "voluntary associations of persons (physical and moral) having common economic and social interest", with the objectives of cost reduction and product improvement (quantity and quality). Several CSs may form a union; and several unions, a prefectural or regional federation.

Farming groups are associations of farmers with formal or informal agreement, usually specialized in one type of crop (livestock, coffee, potato, vegetables, etc.). They are under the jurisdiction of the Department of Agricultural and prefectural authorities. Farming groups are usually smaller then CSs, but large groups do exist, especially in livestock farming.

Village associations are voluntary unions of households with the main objective of organizing production for members. Officially under the jurisdiction of farming groups, they ensure acquisition of credit and farming goods (seeds, fertilizers, etc.), organization of nonfarm activities and marketing of farm produce for members. They are also involved in development activities for their communities (education, health, environment protection, etc.). Figure 2 shows the classification of farmer organizations and depicts their linkages.

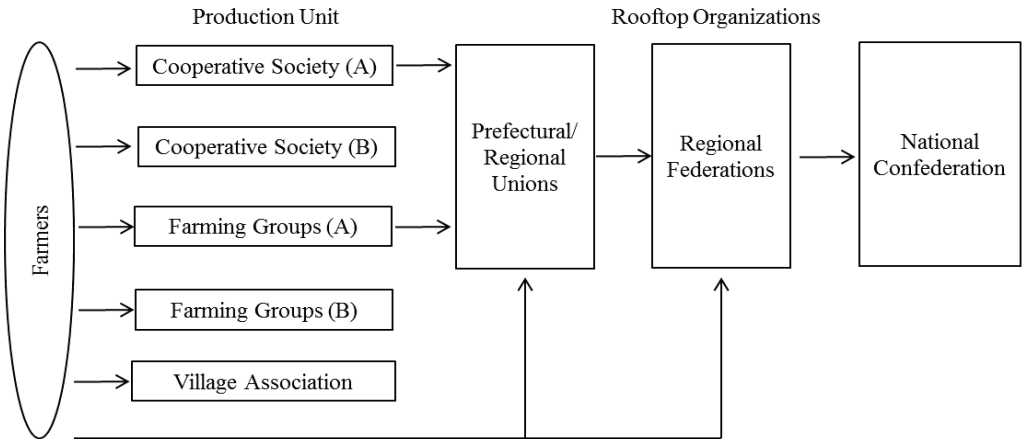

Figure 2.1. Classification of farmer organizations

Grassroots farmers' groups do not always join rooftop farmers' organizations; they are farmers' associations with formal or informal agreement. Village associations usually operate separately and can even act as small rooftop organizations since they sometimes include small groups of farmers along with individual households. Farmers' groups that do join the rooftop organizations are specified in the figure by "A" and the others by "B". Inversely, some farmers directly join the rooftop organizations.

Rooftop farmers' organizations consist of unions and federations at prefectural and regional level and national farmers' confederation. They are not directly involved in the

production process and their main role is to provide funds, farming goods and technical counseling for peasants and to ensure the marketing of their products. Between rooftop farmer organizations and the production units, there are intermediate farmer groups, specialized in marketing. Their relationship with production cooperatives is more consistent but limited to post-harvest operations (transport, husking of cereals, distribution, etc.). Some of these farmer cooperatives play additionally the role of bridging production and rooftop organizations. These production groups, in seeking to represent a wider interest of the community in which they are based, form commodity based organizations, combining economic, social and political functions. While focusing more on their economic functions at regional level (federations), farmer organizations mirror the diversified farming systems and crops produced and support the production and marketing of single cash crop by providing a number of services to their members, from inputs supply, marketing and market linkage development to lobbying and advocacy. Farmers' organizations membership patterns and functions are shown in figure 2.3.

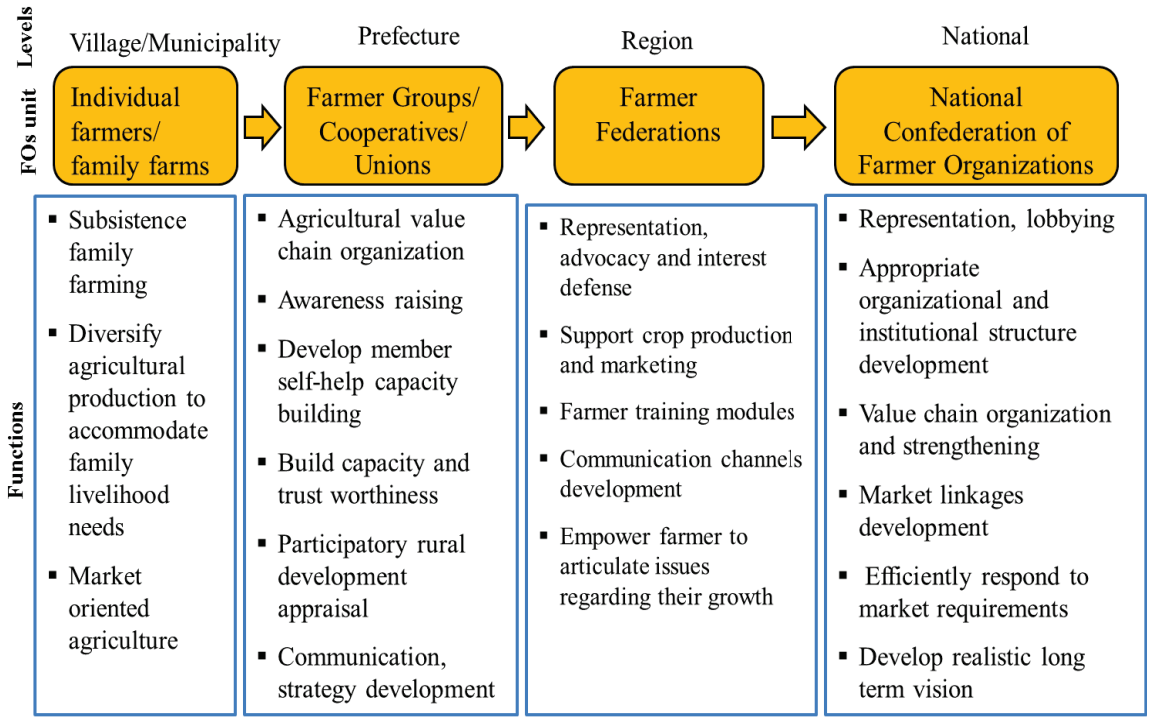

Figure 2.3. Farmer organizations membership pattern and functions

The basic functions of farmer organizations performed at regional level are coordinated and strengthen at the national level by their national representation that seeks, apart from members' interest defense and representation, to ensure that farmers play a key role from early stages and participate a greater share to the country's socio economic development.

In Guinea as in many of Sub-Saharan countries, the government engaged in the general and imperative structural adjustment programs, prolonged and amplified in years 1990 by the increasing liberalization of marketing exchanges. The country have liberalized its economy and developed poverty reduction strategies that are intended to open new market-led opportunities for economic growth.

The Letter of Agricultural Development Policy and Poverty Reduction Strategy Paper, states that the role of professional agricultural organizations (OPA) should be strengthened and that professional agricultural movement must gradually take shape. The figure below shows the framework of the Fouta Djallon Farmers' Federation's intervention and the National Agriculture Development Program.

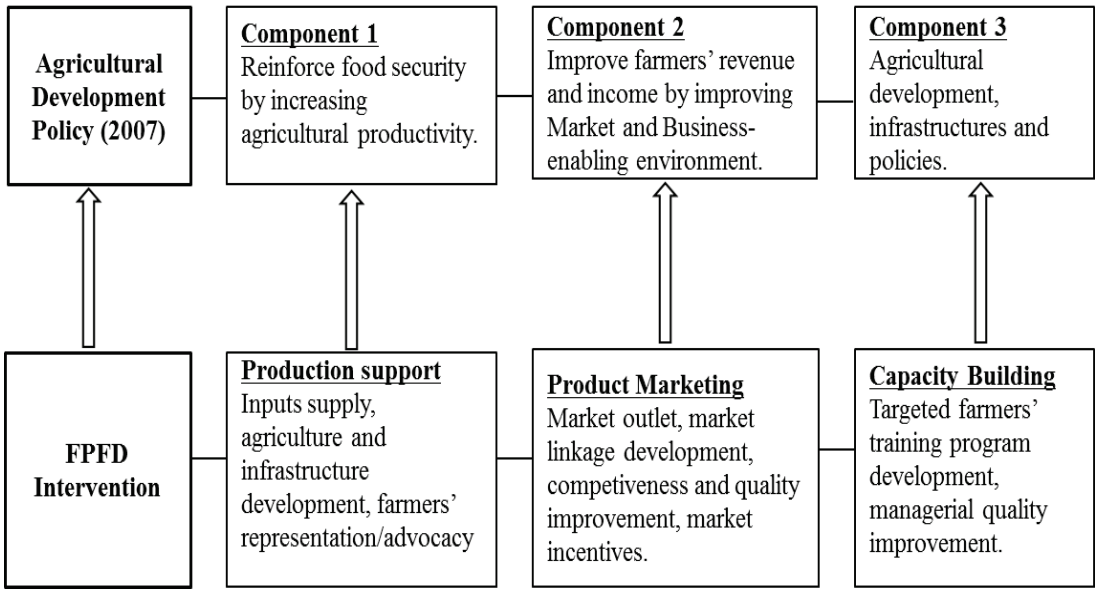

Figure 2.4: FPFD Potato Development Approach and the Agricultural Development Policy

The movement of professional agricultural organizations was then progressively established in Guinea in the 90s on the commodity value chain development basis and the management of agricultural production equipment, following the withdrawal in 1985 of the state from production and marketing functions. In all natural regions of Guinea unions and federations of agricultural producer groups were set up, bringing together grass root organizations, the majority of which had already formed farmer groups and unions. With

the overall objective evolving around increasing producer income and livelihood improvement, these farmer organizations have since been attempting to define and develop appropriate strategies in a competitive open market and deliver much needed agricultural services to their membership. However farmer organizations intervention remains in line with the government development priorities. The changing role of the government as part of measure for liberalization however led to important changes in the agricultural sector and had challenged agricultural producers, the majority of whom are small scale farmers. Soon, producer organizations have become aware that a number of actions require a national scale. The defense of the peasant movement, the sharing of certain means to develop methods, tools for producer groups, the exchange between organizations to confront the visions are all objective reasons lead to a national structure. Accordingly, in May 2000, in Timbi-Madina, the existing four federations of agricultural producers at that time created the National Council of Organizations Peasant Guinea. They are: Fouta Djallon Farmers' Federation (FPFD) in Middle Guinea; National Federation of Coffee Growers (FNPCG) in Forest Guinea; Federation of Cotton Producers of Guinea (FPCG) in Upper Guinea; Federation of Peasant Organizations in Lower Guinea (FOPBG);

2.3.2 Guinea National Confederation of Farmer Organizations (CNOP-G)

Following solicitations from government and the development partners, calling for professional farmer organizations greater participation in shaping agriculture development programs and strategies, the national confederation of farmer organizations of Guinea (CNOP-G) was then established.

Objectives

Driven by the goal of building a dynamic professional agricultural representation, negotiating and defending members' interest, the CNOPG had at its early stage, 4 prioritized practice areas.

- Improving members' and institutional capacity building
- Inputs supply
- Support members' products marketing
- Promulgate and ensure producer organizations development by targeting a legal, regulatory and juridical environment throughout the country

Membership

Throughout the country's four natural regions, the CNOP-G represents 18,000 grass root producer organizations, 46 unions and 9 federations, bringing together the total of 480,000 members. Throughout the country, the CNOP-G brings together producers organized into groups, unions and federations across the four natural regions. The figure below shows the general organization of the CNOP-G with an emphasis on the FPFD.

In lower Guinea, the Lower Guinea farmer organizations federations (FOP-BG); Federations, Unions and Groups in Upper (Guinea Cotton Growers' Federation, Regional Federation of Vegetable Farmers) and Forest Guinea (Regional Federation of Palm tree and Rubber tree Growers, National Federation of Coffee Growers), are covered by Professional Peasant Organizations' Regional Chamber (MAROPA); in Middle Guinea, the most important producer organizations are the Fouta Djallon farmer federation, the Regional Federation of Beekeepers, and the Regional Federation of Vegetable Farmers.

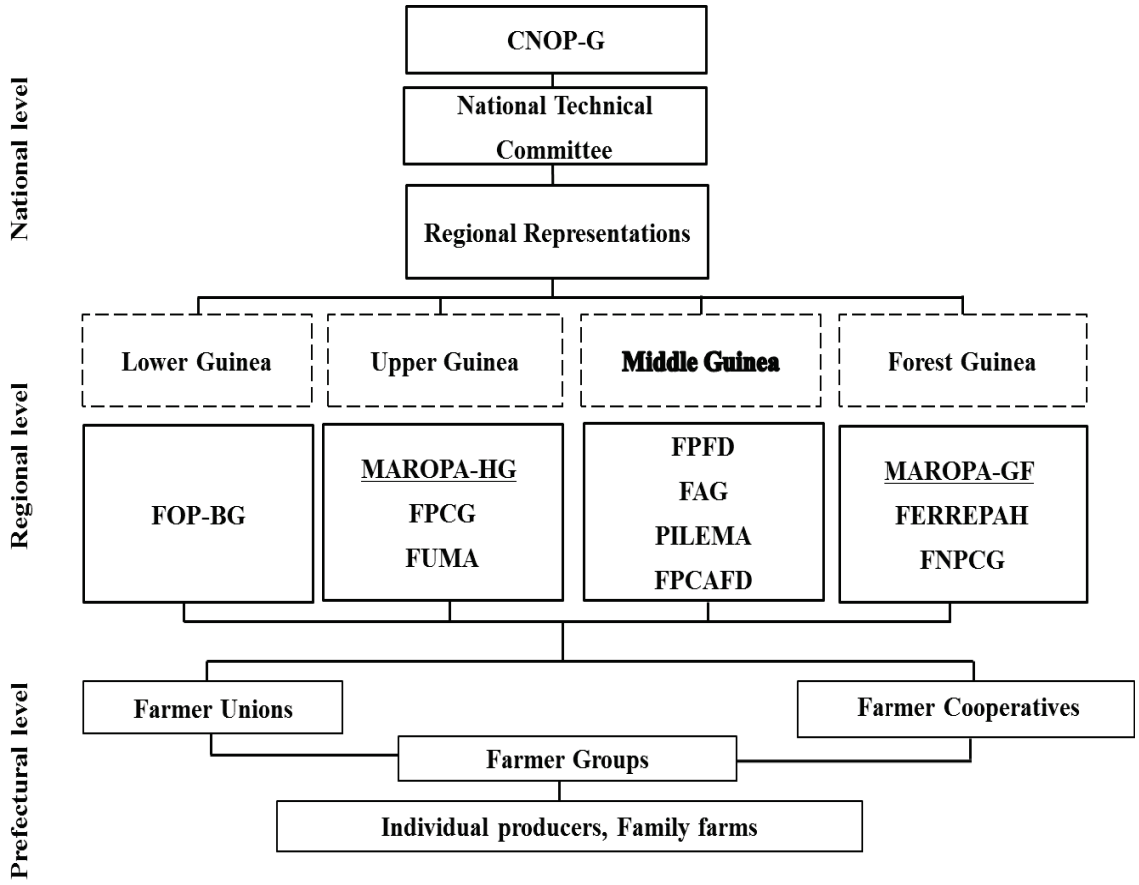

Figure 2.5: Structure of the Guinean National Council of Farmer Organizations

Source: Author's compilation, Field Survey (March-April 2012)

Partnership

In pursuing its goals and seeking to effectively deliver various services to its members, the CNOP-G collaborates with many supporters and partners directly or indirectly participating in the process. Governmental agencies, domestic and international NGOs and donors often develop and execute programs to assist producers through their organizations by setting up a vertical coordination system. The CNOP-G partnerships are established at different level (institutional, technical and financial), the main partners among others are:

Government and local authorities (Ministry of Agriculture, Ministry of Commerce, Ministry of Territorial Administration and Decentralization), sub regional and international: Producer Organization Networks in West Africa (ROPPA), Canadian Producer Union (UPA), Canadian Center for International Studies and Cooperation (CECI), Guinean-Italian Fund for Debt Conversion (FOGUIRED), French Development Agency (AFD), International Fund for Agricultural Development (IFAD), FAO, the European Union, etc.

Governing Bodies

Recognizing the enormous contribution that local and indigenous communities and farmer organizations of all regions of the country have made, and continue to make in using agriculture for development, the National Confederation of Farmer Organizations serves as a rooftop organization. The organization's Governing Bodies take necessary decisions and actions to provide guidance on the resources mobilization and implementation as the basis of food and agriculture production throughout the country. The organizational structure of the CNOP-G is depicted in the figure below.

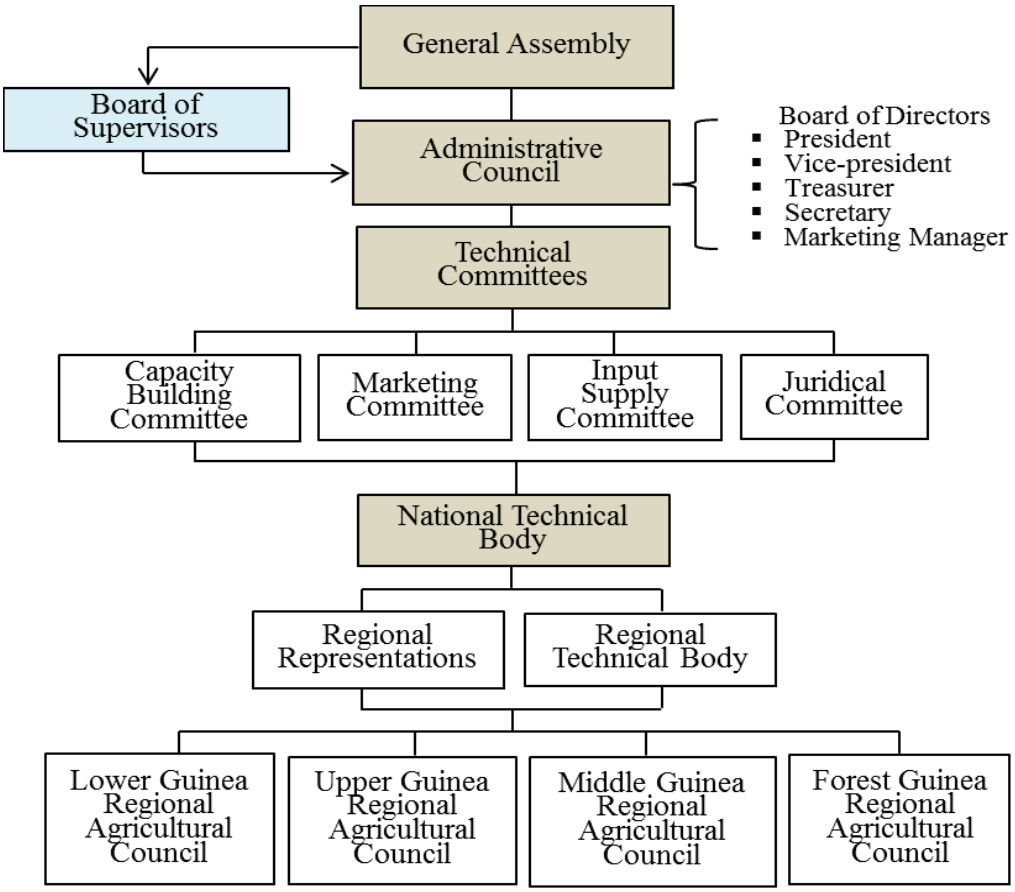

Figure 2.6: structure of the National Confederation of Farmer Organizations

Source: Author's compilation, Field Survey (March-April 2012)

a. The General Assembly (GA)

The GA provides members with formal channels to make and adopt decisions, address issues regarding internal and external arrangement, elect and/ or replace board members. Member general assembly meets once a year, gathering representatives from 3 categories of members: CNOP-G founder federations, joined federations, unions and cooperatives.

b. The Board of Directors (Administrative Council)

It is consist of 5 elected members by the GA: the President, Vice-president, Secretary, treasurer and a Manager in charge of Input supply, Production and Marketing. The Board of Directors is in charge of the effective implementation of the general assembly taken decisions.

c. The Board of Supervisors

The Board of Supervisors is consist of 3 elected members and is assigned with the rights of an effective internal monitoring. In order to address its growth constraints at all levels, the CNOPG adopted a committee operation mechanism in charge of elaborating and supporting sustainable growth for each practice area. These committees operate at national and regional level and are assisted by a technical supporting body.

The CNOP-G plays an important role in strengthening the capacity of farmer organizations and effectively contributes to improving the economic social and cultural well-being of the millions of small-scale producers in the Guinea.

CHAPTER III

RESEARCH DESIGN AND METHODOLOGY

3.1. Introduction

In Middle and Lower Guinea, horticultural farming is largely practiced by smallholder farmers and is predominantly the major contributor to household income. Almost the entire national potato and pineapple production comes respectively from the two regions. The sections presented in this chapter describe the geographical coverage of the study, the sample selection methodology, the survey instrument used for primary data collection and the methods of data analysis. In the research setting part, the chapter portrays Labe, Pita, Kindia prefectures and their respective selected districts, the establishment and geographical positions of the areas, as well as the socio-economic activities. In the steps described in the second section, research design, the analyses presented are based on a two-wave primary datasets collected through a survey of 268 producers, in five major cash crops producing districts. The analytical tools employed to meet the objectives of the study include: descriptive statistics analysis, correlation analysis, profitability analysis, total factor productivity analysis, production function analysis, resource use efficiency and the Heckman two-step approach among others. A summary of the content covered in this chapter is presented at the end.

3.2. Research Setting

The first step of the current research was conducted in three districts of two prefectures in Middle Guinea, Pita and Labe. The study sites are located in the Fouta Djallon region in the middle of the central plateau, between 11° 05' and 11° 10' latitude north and 12° 13' and 12° 22' longitude west. Middle Guinea, which covers about 52,939 km², is the most mountainous region of the country. Its altitude is between 750 and 1,400 meters. The region has an annual rainfall ranging between 1,300 mm in the north and slightly more than 2,000 mm in the south. The areas have the same geomorphological divisions of the Fouta Djallon. This region is distinguished by low hills attesting ancient planation surfaces, and also a resistant surface structure of indurated sandstone. The chemical fertility depends on the degree of weathering; the high concentration of gravel is responsible for the high agricultural value to farmers of some soils since their water filtration and porosity are very suitable to the growth of upland rice and other crops. In general the aspect is similar over the whole Fouta Djallon. Systems of production are grouped into two: intensive farming within infields and extensive farming within outfields (Garvey, 1987). Besides these two agro-systems there is agroforestry where fruit trees and/or timbers are planted. The main occupation of the people in these areas is farming and trading. The major food crops grown are rice, potato, cassava, maize, onion, tomato, fonio, peanut and other vegetables. Potato is the most marketed cash crop at both large and small scale with most of its value chain functions performed by producers themselves.

3.2.1. Pita Prefecture

Pita prefecture is located in the Mamou Region of Guinea, 370 km form the capital Conakry and covers an area of 4,320 km.² It has, in addition to the urban commune, 11 sub-prefectures with an estimated population of 239,236 inhabitants (National census, 1999). 92 percent of the population lives in rural areas; Agriculture is practiced by 85 percent of the population, 55.7 percent of women. Timbi Madina and Timbi Touny districts are both located in Pita prefecture and have the same geomorphological divisions of the Fouta Djallon. By the national census of 1999, the population of the basin was 66,645 inhabitants, of whom 55.7 percent are women. The population density is 60 inhabitant /km², and the area is one of the country's most populated. This region is distinguished by low hills attesting ancient planation surfaces, and also a resistant surface structure of indurated sandstone. The chemical fertility depends on the degree of weathering. The high concentration of gravel is responsible for the high agricultural value to farmers of some soils since their water filtration and porosity are very suitable to the growth of fonio, groundnut, and upland rice. The characteristic climate within the Pita sites is Sudano-Guinean, called by Auberville the "foutanian climate". There are two seasons namely rainy season lasting from May to October and dry season from November to April. This area is subject to heavy anticyclones over the Sahara and Azores directing in the Harmattan which blows from November to February. The rainy season is characterized by moderate rainstorms produced by the monsoon from the South Atlantic Ocean. In general the aspect is similar over the whole Fouta Djallon area. The characteristics of the landscape consist of succession of hardpans (Bowal) separated by largely open areas; two lithographic units

which are sandstone and dolerite. The lower part of the zone is dominated by grassland both on the hardpan (Bowal) and N'Dantari soils. Trees are found only alongside watercourses or on Hansangheré soils (gravelly soils) on the upper slopes, particularly below areas of hardpan. The villages and tapades (infields) are the enclosed areas of the landscape, 26.5 % of the total land showing heavy pressure on the biophysical environment.

3.2.2. Labe Prefecture

Labe prefecture is one of the 5 prefectures of Labe administrative region. This prefecture covers an area of 3,991 km2 and is divided into 12 sub-prefectures and the urban commune. It has a population of 251,504 inhabitants according to 1999 national census, 54.7 percent of women with density of 63 inhabitants /km2. Hafia is one of Labe sub-prefectures, 20 km from Labe urban commune and 40 km from Timbi Madina. The characteristics of this site area are similar to those of Pita prefecture sites. In this local area, the majority of households are involved in agriculture. In large villages there are more diverse livelihood activities such as salaried employment, service-based and small-scale transformation businesses (rice hulling, coffee crushing and soap production). However, these are small scale and provide limited surplus income. Systems of production are grouped into two: intensive farming within infields and extensive farming within outfields. Besides these two agro-systems there is agroforestry where fruit trees and/or timbers are planted. The main occupations of the people in these areas is mainly farming and trading. The major foods grown are rice, potato, cassava, maize, onion, tomato, fonio, peanut and other vegetables. Potato is the most marketed cash crop at both large and small scale with

most of its value chain functions performed by producers themselves.

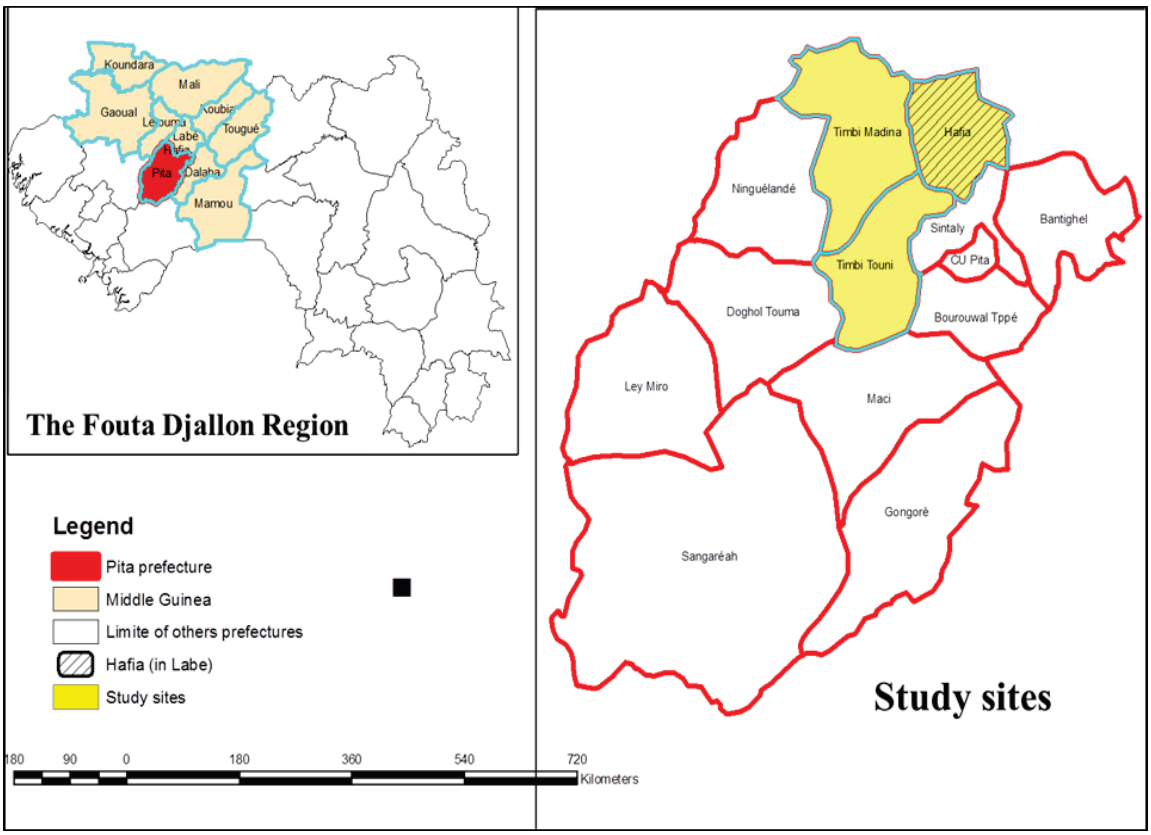

Figure 3.1: Location of the Study Areas in Middle Guinea

3.2.3. Kindia Prefecture

The second stage of data collection was conducted in Kindia prefecture, in Lower Guinea. Maritime Guinea, with an area of approximately 47,513 km², has 300 km of coastline and covers a wide area of 100 to 150 km of coastal strip, which includes formations of mangroves, a set of continental lowlands, and plateaus formed of foothills on the west side of the Fouta Djallon region. The region is crossed by many rivers and receives more than 2,000 mm of rain per year, reaching a maximum of 4,000 mm in Conakry.

The socio-economic conditions of Kindia prefecture are influenced by two predominant aspects: agriculture and mining at the bauxite reserves, with a population of about 401,296 people who engage in agriculture, raising livestock and fishing. It has 10 sub-prefectures namely Kindia town, Bangouyah, Souguéta, Samaya, Danmakania, Kolenté, Friguiagbe, Molota, Madina oula and Manbia. The climate is generally tropical, semi humid called "sudano-guinean". It is characterized by two distinct seasons with a rainy season of 6 months starting from May to October and a dry season from November to May.

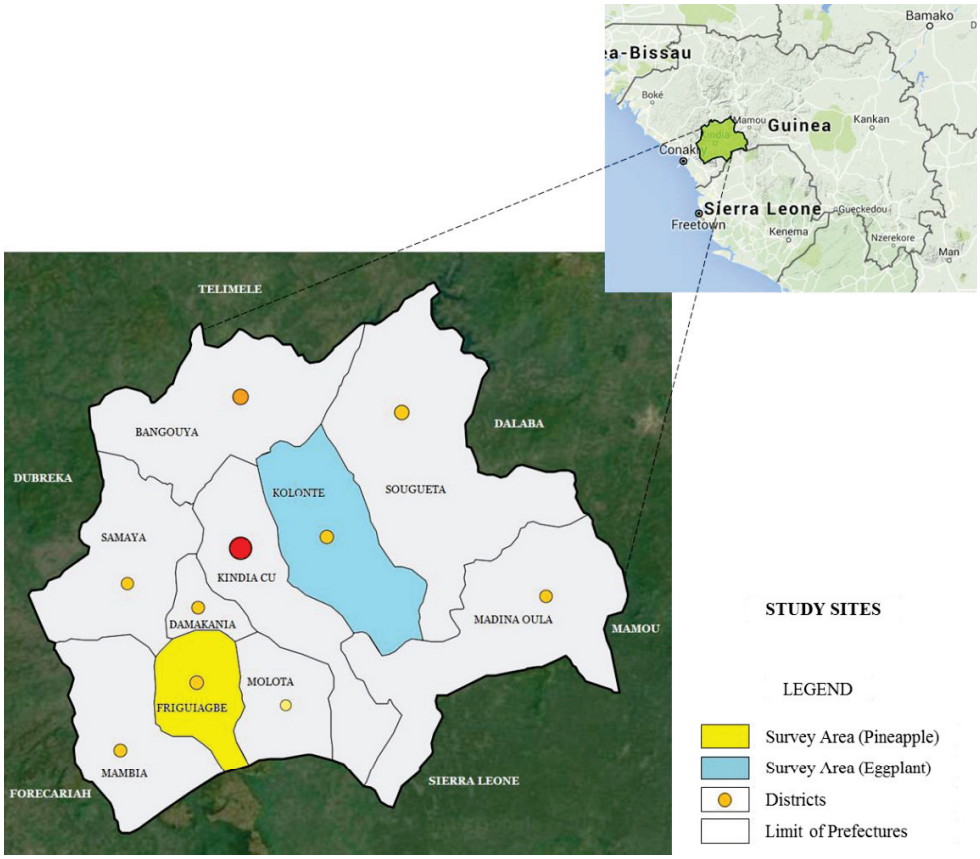

Figure 3.2: Location of the Study Areas in Lower Guinea

The average rainfall varies from 1900 to 3600 mm per annum. The farmer population accounts for 80% of the total population of the region and takes 79% of its income from agricultural activities. Customary rather than formal procedures typically govern land tenure in the local and regional study area. The major economic activities of the people include farming, trading and handicraft. The major crops are rice, cassava, pineapple, water melon, eggplants, sweet potato, plantain, oil palm, fonio, citrus, mango, banana, palm, and kola nut, avocado, vegetable, maize, coconut, orange, and other fruits etc. More so, it consists of marshy plains with a few mountains: Gangan (1116 m), Benna (1124 m), Kakoulima (1,011 m). The agricultural population of the region of Kindia is characterized by a predominance of women population. They represent approximately 15.4% of the total population and 51.6% at the regional level. Among the rainfed crops, 52% are located on hills or mountains and 38.6% on the plateau and 89.9% of the recession crops are located in mangrove. Growth in this predominant agricultural economy is largely constrained by environmental and socio-economic factors, including: limited availability and quality of agricultural land; limited access to modern agricultural techniques and equipment; limited access to markets due to poor transportation infrastructure; limited access to processing techniques for local valorization of agricultural output; and limited access to credit.

3.3. Research Design and Data Collection

This aims to establish the steps and methods describing how the field survey was conducted. In three sequential steps, the site selection was done in the first step, followed by the sample selection in the second, and in the third step, the data collection.

3.3.1. Sampling Procedure and Data Collection in Timbi Madina, Timbi Touny and Hafia

The basic information for the analysis was obtained from primary data collected from potato producers in three major potato producing districts of the Fouta Djallon highlands (Figure 2), in the Middle Guinea: Timbi Madina, Timbi Touny (Pita prefecture) and Hafia (Labe prefecture). The region was purposively chosen because it is the major potato producing area in Guinea, with identifiable producer groups and most importantly, it has one of the successful farmer organizations, the Fouta Djallon Farmers' Federation. The study areas were selected purposively based on their potato productivity to obtain a sample of individual producers; this was also driven by contextual circumstances and the need to ensure that an important number of potato growers would be identified in a random sample. To obtain a sample of members of producer groups, a random sample of registered farmers of the Fouta Djallon Farmers' Federation (FPFD) was drawn from a complete list in each area and farmers were then selected from among the listed members. A comprehensive and structured questionnaire was used to collect data from members and non-members of farmers' groups among the smallholder potato producers. Face-to-face interviews were conducted with 90 potato producers to collect information on the farm economy, farming practices, as well as the social and economic characteristics of the farm household. However, due to missing data, the effective sample used for the empirical analysis was 85 farmers (56 farmers' group members and 29 non-members). In addition, key informants and focus group discussions were conducted; secondary data was synthesized from literature review and reports from the Ministry of Agriculture and the Guinea National Confederation

of Farmers' Organizations (CNOP-G) among other sources.

3.3.2. Sampling Procedure and Data Collection in Friguiagbe

This study uses literature and in-depth interviews with farmers producing pineapple and eggplants. A purposive and simple random sampling technique was used in the selection of the respondents for the study. Based on their relative importance in pineapple production, a total of 100 farmers were drawn from eight (8) villages including Wondemodouya, Toureya, Centre 1, Centre 2, Wondimadia, Moledigou, Gbassagbe, Koliagbe, within the district. The areas provide a good agricultural setting in terms of farm size, quality of resources, modes and production methods. The data collected were on the respondents' socioeconomic characteristics, experience in pineapple farming, production inputs and output as well as the farming practices. The main vegetables grown include onions, potatoes, tomatoes, eggplant (local and European), fresh maize, large peppers, and hot peppers. All these crops are grown for the local market, for markets in nearby cities and towns, for major urban centers, and for exports. Traders come to weekly markets in production areas; in some cases they also go straight to field of major producers or of producers organized in groups. Some producers, particularly in areas well connected with the Conakry market, such as those from Labé, Coyah, Kindia, and Forecariah, take the product directly to market themselves. Market chains vary from product to product. For many products, many different channels are active at the same time. In addition to domestic sales, many of the products from the Fouta Djallon are sent north to Senegal, Guinea-Bissau, and the Gambia; however, the main export market is Dakar itself.

3.3.3. Sampling Procedure and Data Collection in Kolente

The study collected primary data on the eggplant farming system, including the processes and actors involved in the production and marketing practices; and the constraints encountered in both production and marketing by farmers. The primary data were obtained from a sample 78 eggplant producers. The opinions of those surveyed were generally quite consistent, signifying a relatively high level of consensus for most vegetable crops. Primary data were generated through farm surveys conducted from March to April 2014. The data collected included farmers' socioeconomic and demographic characteristics; area planted and production; type and quantity of production inputs used; and production and marketing practices, including problems and constraints.

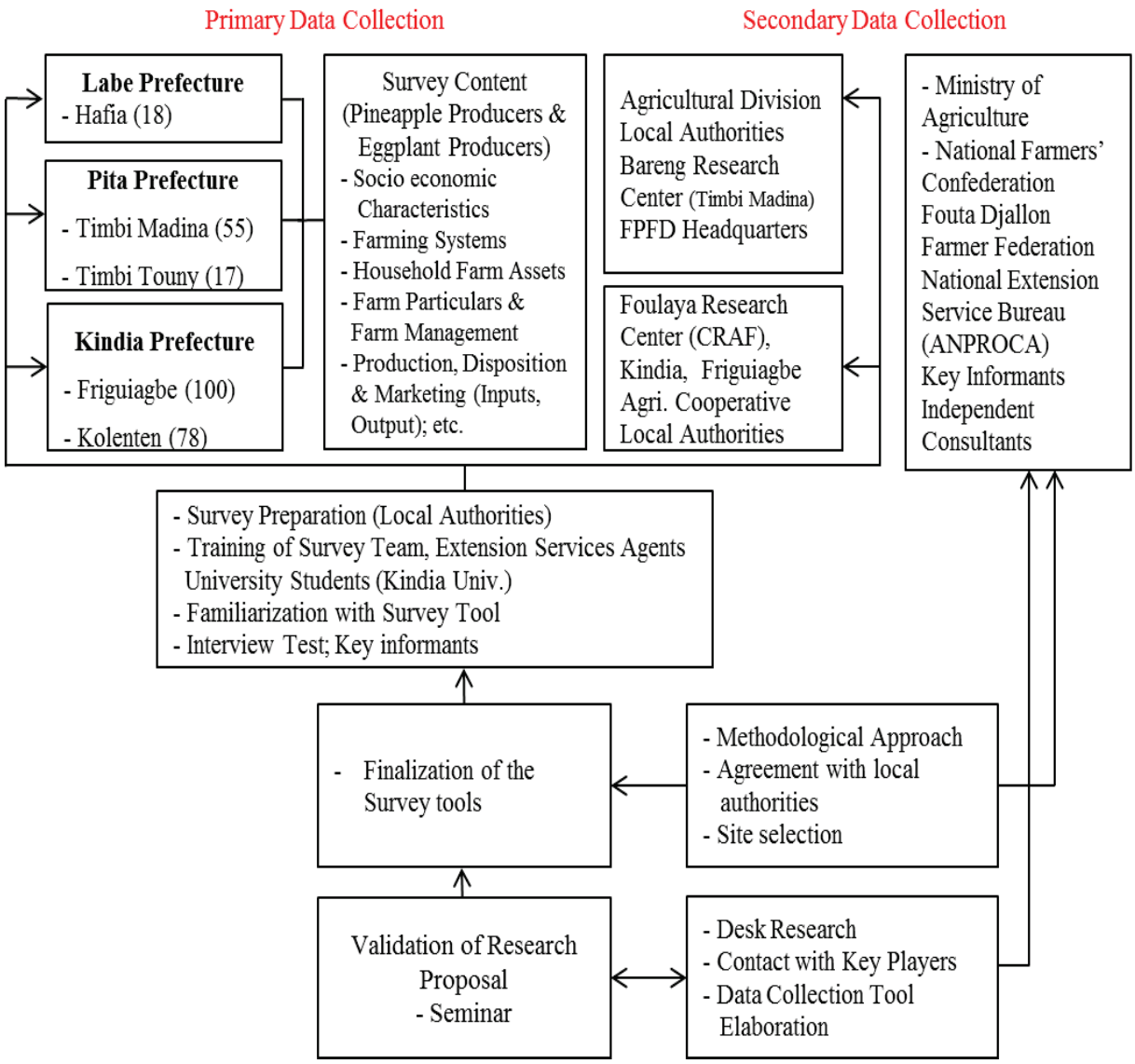

Figure 3.3: Iterative Data Collection Approach

3.4. Data Analysis Methods

3.4.1. Econometric Model Estimation

Estimating the impact of group membership on producers farm income might be subject to selection bias resulting from unobserved factors influencing not only the producers

willingness to join the farmers' organization, but also their performance. It is therefore necessary to efficiently address the issue of selection bias (Qaim & de Janvry, 2005). Selection bias is introduced on observables if, for example farmers who are wealthier or whose yields are higher in the absence of group membership are also likely to join. Unobserved variables such as inherent management ability of the farmer can also affect both the decision to join the farmers' group and the farm income. In that case, Ordinary Least Square (OLS) estimation would lead to biased parameter estimates as running a simple regression of farm income on a dichotomous variable that indicates group membership will overestimate the impact of group membership on farm income. As originally conceptualized by Ravillion (1994), the dilemma of assessing impacts is essentially one of missing observations. For this current study, to control for potential selection bias, we estimated the Heckman two-step approach; this approach is known as one of the most widely used to correct sample selection bias (Greene, 2008). In this model, an auxiliary probit regression is used to obtain the probability of participation in farmers' group and derive the inverse Mill's ratio, which is then included as a selectivity correction in the outcome equation on income. Esham et al. (2006), in a study on contract farming in Sri Lanka, used the computation of the inverse Mill's ratio to estimate the impact of contract farming. This analysis is implemented as a maximum likelihood and identification is provided by the inclusion of a variable in the selection model that is not found in the outcome equation.

The probit model used to identify the factors that influence the decision of producers growing potato to join farmers' groups, is expressed below and is used as the selection equation.

$$P_{(1,0)} = \alpha Z_i + \varepsilon_i \quad (1) \qquad (1)$$

Where α = constant, P is a dummy variable (1 for group members and 0 for non-members) Z_i is the set of respective observed factors expected to influence the decision to join farmers' groups and ε_i = random error term, assumed to be normally distributed to take account of unobserved factors that influence decision to join farmers' groups.

As mentioned above, from the selection equation, the inverse Mill's ratio (M_i) is derived and then inserted into the second stage outcome equation (expressed below) to estimate the effect of group membership.

$$Y_i = \beta X_i + \varphi P_i + \delta M_i + \mu_i \quad (2) \qquad (2)$$

Where Y_i is the impact outcome variable (gross farm income in fg/ha) for potato producers; X_i is a vector of independent variables affecting farm income; P_i is a binary variable representing group membership; β, φ and δ, are parameter vector to be estimated; and μ_i a normally distributed random error term.

Production function

For the empirical analyses, we included three categories of variables that are expected to influence farmers' group membership decision as well as determine the impact of group membership on farm income.

Generally, production function shows how the factors of production such as land, labor, capital and entrepreneur are combined to produce output. Factors of production have derived demand because only factor of production does not provide utility to human being e.g. fertilizer provides no utility to human beings but it increases output when used in production process. According to Beattie and Taylor (1985), production function is the highest output that a farmer can get from a given set of inputs with the given technology

There are two types of inputs which are used in the production process. They include variable inputs and fixed inputs. Variable inputs can be defined as the amounts, which can be changed during a production process whereas fixed inputs are those inputs whose amount does not change in a production process for certain of time. So we can say there are two time periods namely short run period and long run period. All inputs used in the production process are assumed as variable inputs in the long run time period. Whereas in the case of short run time period one input is assumed as variable input and all others remain fixed.

For the purpose of this study, we employed the production function framework. Specifically, the study uses a Cobb Douglas functional form to investigate factors influencing potato production, while a supply function was used to investigate factors influencing the quantity of potato marketed. The Cobb Douglas functional form for the production function is specified below:

$$\ln Q_{pi} = \theta_0 + \sum_{j=1}^{J} \alpha_j \ln Z_{ij} + \sum_{k=1}^{K} \beta_k D_{ik} + \varepsilon \qquad (3)$$

Where the subscript i, indicates the ith household in the sample (i=1,….,85); ln is the natural logarithm; α_j and β_k are parameters to be estimated (J=1,….,5; K=1,….3) and represent the elasticity of output with respect to each ith input. Q_p= quantity of potato produced (kg) by the ith farmer; θ= constant; Z_1= age of the farmer (years); Z_2= potato area (ha); Z_3= quantity of improved potato seed used (kg); Z_4= labor hired (man-days/ha); Z_5= quantity of fertilizer used (kg); D_1=gender of the household head (dummy:1=male; 0=female); D_2= access to extension service (dummy:1=yes; 0=no); D_3= respondent's estimate of production loss (dummy:1=high; 0=low)) and ε = error term.

The functional form for the supply function is presented below:

$$\ln Q_{\pi i} = \delta_0 + \sum_{j=1}^{J} \delta_j X_{ij} + \sum_{k=1}^{K} \beta_k D_{ik} + \varepsilon \qquad (4)$$

Where the subscript i, indicates the ith household in the sample (i=1,….,85); α_j and β_k are parameters to be estimated (J=1,….,8; K=1). $Q_{\square}$= quantity of potato marketed (kg); X_1= family size (persons); X_2= respondent's education level (years); X_3= quantity of potato produced (kg); X_4= distance to market (Km); X_5= potato price (Fg/kg); X_6= quantity of potato retained for seed (kg); X_7= quantity of potato kept for food and gifts (kg); X_8= estimate of potato sold four weeks after harvest (%); D_s= estimate of production loss (dummy:1=high; 0=low); and ε=error term.

Estimation of the model outlined in the above equations followed a series of regression diagnostics. Collinearity diagnostics tests were done using a simple regression matrix of the

variables. Variance Inflation Factor (VIF) was used to check for tolerance level of multicollinearity. The average VIF of less than 10 implies that the variables in the model had no serious multicollinearity (Gujarati, 2004). In addition, heteroskedasticity was checked using Breusch-Pagan/ Cook-Weisberg tests (Green, 2003).

The Cobb-Douglas functional form enabled to determine the extent of resource use efficiency in potato production in the study area. The production function analysis gives the physical or technical relationship between inputs and output in any production scheme or process (Farrel, 1957; Olukosi *et al.,* 1989). To evaluate the extent to which potato farmers in the study area are employing their resources into efficient use, the study also adopts the marginal value product (MVP) and the marginal factor cost (MFC) approach to measure the ability of farmers in achieving the best combination of different inputs to produce a given level of output considering the relative price of these inputs.

Following Rahman *et al.,* (2003), Fasasi, (2006), and Manjunath *et al.,* (2013), the efficiency of resource used in potato production was determined by the ratio of the Marginal Value Product (MVP) to Marginal Factor Cost (MFC) using the formula below.

$$r = \frac{MVP}{MFC} \qquad (5)$$

Where r = Efficiency ratio; MVP = Marginal Value Product; MFC = Marginal Factor Cost. The marginal value product (MVP) of each input was estimated as a product of the marginal physical product (MPP) of each production input and the unit price of output.

$$MVP = MPP_{Xi}.P_y \quad (6)$$

Where MPP_{Xi}=Marginal Physical Product with reference to resource Xi; P_y=Unit price of output. And the marginal physical product (MPP) was determined using the formula:

$$MPP_{Xi} = \text{bi}\ \frac{\bar{Y}}{\overline{Xi}} \quad (7)$$

Where $\bar{Y}$ = Geometric mean value of output; $\overline{Xi}$ = Geometric mean value of the ith input considered; bi= Elasticity coefficient of the ith independent variable.

The prevailing market price of input was used as the Marginal Factor Cost (MFC):

$$MFC = P_{Xi} \quad (8)$$

Where P_{Xi} = Unit price of input Xi.

The decision rule for the efficiency analysis was as: i. r = 1, implies that resources are used efficiently by potato farmers in the study area, thus an optimum utilization. ii. r >1, implies resource is underutilized and increasing the rate of use of that resource will help increase productivity. iii. r <1, implies resource is excessively used or over utilized hence reducing the rate of use of that resource will help improve productivity.

Efficiency

Generally, efficiency describes the extent to which the factors of production will be utilized for the intended farm objective (Hortsa, 2014), According to Heady (1960), Ethis (1988) and Thessell and Toming (1983), efficient use and allocation of resources imply that a

redistribution or re-allocation of resources achieves optimal level of production. They further stated that economic efficiency combines both technical and allocative efficiency and that occurs when a firm chooses resources in such a way as to attain economic optimum. The analysis of efficiency according to Ethis (1988) is generally associated with the possibility of farmers producing a certain optimal level of output from a given bundle of resources or certain level of output at least cost.

There is a large literature on the need to increase the quantity and quality of inputs in agriculture in developing countries as well as the need to increase access to resources to finance these inputs. However, it is also possible to increase output even given current levels and quality of inputs by increasing overall economic efficiency of farmers (Bravo-Ureta and Pinheiro 1997). The concept of efficiency is critical in developing country agriculture. Given the level and quality of inputs available, how well farmers are able to utilize these inputs is an important determinant of the quantity of output they are able to produce. Recent measurement of farmer efficiency has been based on the seminal paper by Farrell (1957), who decomposed economic efficiency into its technical and allocative components.

Technical efficiency refers to the ability of a producing unit to obtain maximum (optimal) output from a given amount of inputs. Formally, the level of technical efficiency is measured by the distance of farm production from the optimal production frontier. A firm that sits on the production frontier is said to be technically efficient (Henderson 2003). Allocative (or price) efficiency refers to the ability of the firm to choose its inputs in a cost-minimizing manner (Murillo-Zamorano 2004; Chavas and Aliber, 1993). For allocative

efficiency to hold, farmers must equalize their marginal returns with true factor market prices. Thus, technical inefficiency is related to deviations from the frontier isoquant, while allocative inefficiency reflects deviations from the minimum cost input ratios (Bravo-Ureta and Pinheiro 1997).

Profitability

Despite the numerous constraints faced by farmers in the production process like the small size of farm holdings and the use of rudimentary inputs, studies of farming establishments across the country show that farming is generally a profitable enterprise for small scale farmers. Profitability measures the ability of farmers to cover their costs and is an important concept, because it provides incentives for entry into and longevity in the farming business. While many studies of Guinean farms across the country report profitability, profit margins are often very small.

Resource Use

According to Reddy et al (2006), anything that aids in production is a resource. Thus Famuelson et al (2001) inferred resource as inputs or factors of production. Likosi and Erhabor (1988) characterized resources into variable resources which are referred to as inputs or factors of production such as labour, seeds are fertilizers used up in one production process and fixed resources which are more durable resources that contribute to the production process over several production periods and they may include land, machinery, farm building etc. According to Nwosu et al (2009), resource use is regarded as the allocation of productive inputs such as land, labour, management, water and capital in its many forms between competing alternatives. WJA (2008) stated that in attempt to utilize

resources, the farm firms' objectives must be greatly considered. According to the report, the resources can be infused into a farm firm or producing unit whose ultimate goal or objective may be profit maximization, output maximization, cost minimization or utility, maximization or a combination. In the productive process, a firm may be concerned with efficiency in the use of the resource inputs to achieve his aim. Amechi (2007) reported that resource poor farmers have limited resources (capital) to hire labour and to make effective or optimal use of their lands. Few farmers have access to formal and informal credit. Resource utilization is therefore an important determinant of profitability and so every rational farmer should aim at minimizing cost in order to maximize profit.

CHAPTER IV

EFFECTS OF FARMER ORGANIZATIONS IN ENHANCING SMALLHOLDER POTATO FARMERS' INCOME IN MIDDLE GUINEA

4.1. Introduction

Smallholder agriculture is argued to remain important for economic development and poverty reduction in developing countries, but its development is challenged by the need for institutional innovations to overcome market failures (World Bank, 2008; Hazell et al., 2010). There is a renewed interest from donors, governments and researchers in cooperative producer organizations as an institutional vehicle to improve smallholder agricultural performance, particularly through improved market participation (Bernard & Spielman, 2009; Fisher & Qaim, 2012a, 2012b). Smallholder producers participation in market-oriented production holds potential for diversifying their incomes and increase agriculture productivity hence promoting food security and poverty eradication. With the numerous farming problems in developing countries, low agricultural productivity has negative effects on the economic welfare of the rural populations. Farmers' organizations have been suggested as a key tool to improve the living conditions of the resource-poor farmers in developing countries. There is a positive effect on small-scale farmers' income from being member in a farmers' organization (Bachke, 2009). And membership to such organizations is considered to increase the level of agricultural production and yield economic benefit to farmers as well as promote their general welfare (Oyeyinka et al., 2009; Mwaura, 2014).

In many developing countries, including Guinea, agriculture is often referred to as the backbone of the economy, contributing to about 25% of the Gross Domestic Product (Guinea, Country Strategy Paper 2012-2016). The sector emerges as a key tool in achieving economic growth and poverty reduction and its potential to meet the increasing demand for food, depends largely on the productivity and market access of small farms.

However, smallholder farmers in Guinea are predominantly resource-poor and live in a hybrid world; their participation in commercialized production is generally limited by various institutional, technical and investment constraints. With the increase lack of agricultural production resources, smallholder farmers try to find the means to simultaneously guarantee household food security and maximize income from agriculture. Thus, in pursuing strategies of survival and in seeking prosperity, small farmers gather resources from wherever available, whether through formal or informal systems. In the midst of these, farmers have resulted in a number of options to enhance their farm production and improve their well-being. One of these options includes pooling their resources and working together as members of farmers' organization (FO). The justification arises from their potential in realizing pro-poor economic growth and sustainably empowering small scale farmers. Fischer and Qaim (2012a, 2013); Olwande and Mathenge (2012) indicate that organization among smallholder farmers has proved to be one of the means for smallholder farmers to overcome market imperfections. Strong and vibrant farmers' organizations can provide opportunities to farmers to effectively play a role in the market economy and benefit from it (Millie et al., 2006).

Economic benefits mainly income, is the primary motivation for producers to join these farmers' groups; failing to get the desired benefit could threaten their participation in such entities. While aiming at increasing farmers income by providing services at lower costs and better prices for their produce, the expected role of farmer organizations could be challenged by various problems such as poor infrastructures, lack of investment, inadequate service provision, poor extension services, competition with local traders, etc. To our knowledge, not much research has been done on farmers' organizations in Guinea and empirical studies on their socioeconomic impacts are limited. Therefore, in light of the above mentioned and given the assumed role of farmers' organizations in Guinea, the present study seeks to contribute to the existing body of literature and research on farmer organizations in Guinea.

As the study attempts to assess the effects of farmer organizations on smallholder potato producers in Guinea by comparing producer members of farmer organizations and non-members, the following objectives are presented in this chapter:

(1) To examine the socio-economic characteristics of potato producers in the study area;
(2) To conduct a profitability analysis of potato farming;
(3) To identify the factors influencing farmers' decision to participate in farmer groups;
(4) To assess the effects of group membership on farm income among smallholder potato producers.

In the remainder of the chapter, the brief description of the variables included in the analysis is depicted, followed by the description of potato farmers in the study area is

presented in the first section. The results and discussion of the empirical analysis are presented in the third section. The last and final section presents the summary of the research covered in this chapter.

4.2. Explanatory variables used in the analysis

A detail description of the variables included in the current empirical study is highlighted in Table 4.1. Variables used in the analyses include indicators of household wealth, such as farm size, ownership of farm land and income derived from non-farm activities. Household wealth is expected to enable farmers to overcome the barriers and obstacles to meeting group membership requirement as well as production cost. Farm size is included to represent farmers' physical production resource. As effective utilization of farm land requires the application of appropriate farm practices and inputs, in the absence of more means of assessing effectiveness, this variable would either be positively or negatively related to group membership and the overall farm productivity. Off-farm income can help diminish on-farm constraints and serve as alternative capital inputs and would encourage participation in farmers' groups.

Table 4.1 Definition of explanatory variables used in the analysis

Variables	Definition	Mean	Std. Dev
Group membership	Membership in farmer group (1=yes; 0=no)	0.66	0.477
Age	Farmer's actual age (years)	50.85	10.94
Gender	Respondent's gender (1=male; 0=female)	0.40	0.49
Marital status	Whether respondent is married (1=yes; 0=no)	0.94	0.24
Education	Actual level of schooling (years)	2.76	3.86
Family size	Number of household members (persons)	7.34	3.22
Family labor	Family members working on the farm (persons)	4.58	2.30
Land ownership	Whether respondent owns farm land (1=yes; 0=no)	0.68	0.47
Farm size	Household's total arable land (ha)	1.51	1.52
Potato area	Potato production area (ha)	0.89	0.72
Distance to road	Distance from farm to main road (km)	1.03	1.26
Labor used	Hired labor (man day/ha)	199	317
Extension access	Access to extension service (1=yes; 0=no)	0.73	0.447
Distance to market	Distance to primary market (km)	4.44	2.32
Share of potato sold	Quantity of potato sold to total harvested (percent)	1.94	1.98
Potato price	Potato market price (fg/kg)	4,480	860.81
Farm income	Gross farm revenue (fg/ha)	22,858,405	17,438,460
Credit access	Access to farm inputs credit (1=yes; 0=no)	0.54	0.50
Off farm income	Income from non-farm activities (fg)	2,851,300	3,782,486

A second set of variables includes indicators of capability and information, such as education, extension service, farm credit and membership in farmers' groups. Used as a proxy for human capital endowment, education level of farmers (years of formal schooling of the household head) is important in the decision-making process. Access to farm credit and extension workers capture farmers access to these services and the associated costs and difficulties that influence group membership; they are expected to have a positive effect on farmers' decision to join farmers' organizations. Group membership is expected to have a positive effect on farmers' income as it may increase market participation as well as linking producers to potential markets. Fischer et al. (2012a) argue that membership of farmers'

organizations can benefit producers by reducing high transaction cost associated with smallholder agriculture.

The third category of variables refers to indicators of socio demography like family size, gender, age of the head of household, marital status, family labor as detailed in Table 4.1. Family size for instance accounts for the supply of family labor and may have a significant impact on group membership if it provides labor efficiently. Gender of the household head is used to capture the differences in preferences between male and female headed households. Female farmers are expected to have higher chances of joining farmers' groups while male headed household is less likely to participate in farmer groups. This may be because of pro-gender policies and the increasing efforts to mainstream gender in rural farmers' groups. The age of farmers is used to measure the behavioral pattern of the respondents and is expected to be positively related to participation in farmer groups. With the kind of labor-intensive farming system that prevails in the study area, labor availability is an important factor. Increase in labor use may enhance farm production which in turn may increase the share of output sold, hence incomes. The market price of potato may have a significant impact on farmers' income; it can also show the performance of the farmers' group in paying higher market price to its membership. This variable is expected to be positively related to producers' farm income. All else being equal, these factors may shape the household decision but also influence producers' farm income as well as access to productive resources.

4.3. Socio economic Characteristics of Potato Farmers

Descriptive statistics for the sample farmers are presented in Table 4.2 The average farm size of our sample farmers is 1.5 ha (Table 3), but only 0.89 ha is dedicated to potato production on the average; about 68% of the farmers owned their farm land. This closely mirrors the situation of farmers in Guinea where the average farm size is 0.5 ha. The majority of the farmers are female (60%) and the sample farmers are 50 years old on average with about 94% of them being married. With respect to farmers access to extension service and farm credit, overall, 73% and 54% of them reported to have access to the services respectively. Comparing farmer group members and non-members, a few differences with respect to socioeconomic household characteristics can be observed between the two groups. Although for the majority of the household's socioeconomic and demographic characteristics as well as household resource endowment, no major difference was revealed, a few significant correlations were established.

Table 4.2 Socio economic Characteristics of Potato Farmers

Continuous variables		**Group members**	**Non members**	**t-statistic**	**p-value**
Age		53.05	46.59	2.678	0.009***
Education		2.54	3.21	-0.758	0.450
Family size		7.57	6.90	0.915	0.363
Family labor		4.61	4.52	0.169	0.866
Farm size		1.46	1.61	-0.433	0.666
Potato area		0.92	0.83	0.527	0.600
Distance to road		1.10	0.89	0.724	0.471
Hired labor used		210.67	176.97	0.463	0.645
Distance to market		4.49	4.35	0.269	0.789
Potato price		4,557	4,332	1.144	0.256
Off farm income		3,109,821	2,352,086	0.874	0.384
Categorical variables		**%**	**%**	**X^2statistic**	**p-value**
Gender	Male	33.9	51.7	2.521	0.161
	Female	66.1	48.3		
Marital status	yes	94.6	93.1	0.082	1.000
	no	5.4	6.9		
Land owned	yes	62.5	79.3	2.491	0.144
	no	37.5	20.7		
Extension access	yes	94.6	31	39.166	0.000***
	no	5.4	69		
Credit access	yes	75	13.8	28.826	0.000***
	no	25	86.2		

Note. ***, indicates significance level at 1%.

Source: Author's survey (2012).

Generally, results in Table 4.2 indicate that household characteristics across the two groups were not statistically significant except in terms of age, access to extension services and access to credit. For group members, the average age of household head was 53.05 years whereas their counterpart had an average of 46.59 years. Results show a statistically significant difference ($p < 0.01$); it has been established that this variable is a key determinant of behavioral patterns of farm households (Bembridge, 1984). Young farmers are expected to be more technically constrained than older farmers who are perceived to

have acquired experience on farming and resources. Similarly, there was a significant difference for credit and extension service access. More producers with membership in farmers' group have access to farm credit and assistance from extension workers. Namely, 94.6% and 75% of group members respectively have access to extension service and credit whereas for their counterpart, figures are different; 31% have access to extension workers and only 13.8% of non-members have access to credit. Access to credit measures whether farmers had access to agricultural input and/or equipment on credit for the facilitation of production. Agricultural training and extension services are provided by governmental entities and other institutions. A larger share of our sample farmers benefited those services through their membership in farmers' groups. In fact, only a very small percentage (5.4%) of members of farmers' groups did not have access to services from extensions workers. Finally, results depicted in Table 4.2 revealed that the agricultural resource endowment is not a decisive factor in producers participation in farmers' groups. No significant difference was found between the two categories with respect to family labor, farm size, cultivated potato area, off farm income amongst others.

4.4. Profitability Analysis of Potato Farmers

The estimation of crop profitability between the two categories of producers is presented in Table 4.3.

Based on the net farm profit, profitability estimation between farmers' group members and non-members shows some significant differences. As depicted in Table 4.3, the highest cost for our sample farmers is on potato seed and fertilizer accounting respectively for about

51% and 23% of the total farm production cost. The net farm profit is the return to land, agricultural capital as well as production and labor cost. The cost on fertilizer is considerable and higher ($p < 0.05$) for non-members accounting for about 30% against 16% for members. This is mainly because potato producers with membership in farmers' groups have access to readily available farm input at a rather lower cost than non-members. This could be explained by the bulk purchasing of farm input by producers through their membership in the farmers' group. Because of particularly high costs on seed and fertilizer, there is a considerable difference in farm revenue; the net farm profit is higher ($p < 0.05$) for members than non-members.

Table 4.3 Profitability estimation of potato production per ha

Characteristics	Group members	Non members	t-statistic	p-value
A. Farm revenue (fg)	25,632,638	17,501,264	2.078	0.041*
B. Variable input cost (fg)				
Seed cost	5,019,999	3,580,126	1.624	0.108
Fertilizer cost	1,444,761	2,368,444	-2.515	0.014**
Farm manure cost	857,832	728,534	0.587	0.559
Labor cost	1,109,448	1,021,088	0.315	0.753
Machinery cost	180,238	107,042	0.934	0.353
Total	8,612,279	7,805,234	0.570	0.571
C. Fixed input cost (fg)	199,797	148,545	0.658	0.512
D. Production cost (B+C)	8,812,076	7,953,779	0.595	0.554
E. Net farm profit (A-D)	16,820,562	9,547,484	2.436	0.017**
Ratio of revenue to cost (A/D)	3.53	2.69	1.828	0.071*
Ratio of net farm profit to revenue (E/A)	0.62	0.47	2.758	0.007***

Note. ***, **, * indicate significance level at 1% and 5% and 10% respectively, Franc Guinéen (Fg): unit of Guinean currency.

Source: Author's survey (2012).

More, due to high input cost, the ratio of revenue to cost and the ratio of net farm profit to revenue are significantly different between the two groups ($p < 0.10$ and $p < 0.01$

respectively). They are greater for group members than for non-members; overall, group members realize a farm profit of nearly twice than that of non-members. This is certainly due to the support they receive from their membership in farmers' group. However, the total farm management and production cost is nearly the same between members and non-members of farmers' group. The cost on seed, farm manure, labor and machinery as well as the fixed input cost present no significant difference between the two groups. Farmers in the study area in general, in addition to the high cost of farm input, are constrained to access to farm input and agricultural equipment.

4.5. Determinants of Group Membership in Farmer Organizations

A probit model described in Chapter II and was used to explain variables assumed to influence the decision of producers to join the farmers' group. Among the variables described, only age, gender, education, farm size, extension service, access to credit and off farm income had significant marginal effect on marginal probability of participating in farmer groups. The results are presented in Table 4.4.

Table 4.4 Determinants of Membership in Farmer Organizations

Variables	Coefficients	Std. Error	Marginal effect	p-value
Age	0.060	0.029	0.0059	0.041**
Gender	-1.651	0.887	-0.1619	0.063*
Marital status	-1.477	1.102	-0.1449	0.180
Family size	0.050	0.122	0.0049	0.681
Education	-0.133	0.077	-0.0131	0.084*
Land ownership	0.333	0.696	0.0327	0.632
Farm size	0.506	0.293	0.0496	0.084*
Extension service	3.909	1.149	0.3834	0.001***
Distance to road	0.434	0.355	0.0426	0.221
Credit access	2.768	1.019	0.2716	0.007***
Off farm income	3.60e-07	1.40e-07	3.53e-08	0.010**
Constant	-6.150	2.219		0.006
N				85
LR chi2(11)		75.28	Log likelihood	-16.9159
Prob > chi2		0.0000	Pseudo R2	0.6899

Note. ***, **, * indicate significance level at 1% and 5% and 10% respectively.

Source: Author's survey (2012).

The estimation results indicate that participation in farmer groups is strongly associated with the households' socioeconomic and demographic characteristics. Holding other factors constant, positive significant coefficient of the age of the household head implies that per unit increase in the age of the farmer increases the probability of participation in farmer groups by 0.59%. Participation in farmers groups increases with age; older farmers are more likely to join the farmers' group. The labor-intensive nature of potato production in the study area would have prompted older farmers to join the farmers' group. On the other hand, the findings support the role of age in resource ownership; in the study area, older household heads have better access to land resource which is an important factor of production unlike the younger household heads that mainly rely on inherited land. This means that young farmers are less likely to join and participate in farmer groups because

they are forced to wait longer before they own ample production resources which could enable them to participate in farmer group activities.

Gender is significant and negatively related to participation in farmer groups. This is an important indicator of household decision making whereby in traditional setup, key decisions in a household are made by men. Male-headed households are less likely to join farmers groups; all other variable held constant, the probability of participation in farmer groups is 16.19% lesser for male than female. A plausible explanation for this could be that potato production in the study area was traditionally regarded as a women activity. This also depicts preferences of male heads and female household heads. Results in Table 4.4 show that male headed households are less likely to join groups (by about 16.19%). The findings agree with observation of Musyoki et al. (2013) that gender is a crucial determinant of household decision to join community associations.

Education of household head was significant and negatively related to group membership and revealed the tendency of educated farmers to staying away from farmers groups by 1.3%. The reasons explaining this could probably be that the majority of educated farmers in the study area are better off farmers, they are usually government workers who are involved in farming and they have better access to farm inputs and other services.

Although the magnitude of its effect is rather small, an increase in farm size increases the probability of group participation by 4.96%. This is particularly important as stated before, farmers are in their majority resource-poor; cultivating on larger farm sizes requires more

resources and investment; therefore participation in farmer groups is in most cases the ultimate way of overcoming such obstacles.

Access to extension service has statistically significant and positive effects on group membership; it increases group participation by 38.34%. This is probably because as agricultural extension agents are better informed, they are likely to discuss with farmers about membership in farmers groups and influence their decision about group membership. The more the extension contact with smallholder farmers, the better their involvement in farmer group and the better productivity increases. Extension service is an important source of farming information and advice to smallholder farmers (Enki et al., 2001).

The statistically significant coefficient of credit in the results indicates that access to credit influences the decision of producers to join farmer groups. Per unit increase in farmer access to credit increases probability of participation by 27.16%, all else being equal. This implies that a farmer that has access to credit is more likely to join farmers' group. Given that poor households, in their quest for membership in farmers' groups, experience difficulties such as compliance with the group membership demands, access to farm credit may be an incentive for group membership. In a similar study, Asante et al. (2011) found that access to credit positively influenced farmers' decisions to join farmer based organizations in Ghana. Access to credit helps to better strengthen the capacity of such households hence facilitating membership into farmers' groups.

Similarly, income from non-farm activities also enables the capabilities of producers to meet group membership requirement given the poor household resource endowment as a

whole, hence facilitating group membership. Generally, producers tend to join farmers' groups in order to benefit from the advantages this could give in terms of access to farm inputs and output market.

4.6. Effects of Membership in Farmers' Group on Farm Income

After identifying the factors that influence the decision of the sample farmers to join farmers' groups, we explore the effects of group membership on farmers' income. Potato producers join the farmers' group mainly to benefit agricultural services (farm inputs, farm tools, training, etc.) but also they expect their membership to benefit them in terms of higher farm incomes derived from potato production.

Table 4.5 Effect of Membership in Farmer Groups on Farm Income

Variables	Coefficients	Std. Error	p-value
Constant	2,812,865	1.49e+07	0.851
Group membership	7,413,487	3,817,742	0.056*
Age	-37,421.92	176,719.7	0.833
Education	186,767.1	479,573.9	0.698
Labor used	14,677.29	5,687.39	0.012**
Family labor	-329,451.2	781,430	0.675
Potato area	5,719,886	3,371,019	0.094*
Distance to market	-808,928.3	772,860.4	0.299
Potato price	1,310.738	2,093.4	0.053*
Share of potato sold	4,140,134	1,267,374	0.002***
Inverse Mill's ratio	206.12	237.97	0.389
N			85
F(10, 74)	3.36	R-squared	0.3122
Prob > F	0.0012	Adj R-squared	0.2193

Note. ***, **, * indicate significance level at 1% and 5% and 10% respectively.
Source: Author's survey (2012).

Results presented in Table 4.5 show the results of the regression model on farm income. Results revealed that five variables were significant in explaining the effects of group

membership on farmers' income and these variables are group membership, labor used, cultivated potato area, potato price and the share of potato sold.

Results of the model confirm a statistically significant and positive effect of group membership ($p < 0.10$) on producers' farm income (dependent variable). From the auxiliary probit regression used in our analysis to obtain the probability of participation in farmers' groups, the inverse Mill's ratio was computed and then included as a regressor into the second stage outcome equation. This term corrects for possible selection bias and yields consistent estimates in the income model. As shown in Table 4.5 the F test of the regression is significant and the inverse mills ratio was not significant, indicating that there was no selection bias. By participating in farmers' group, farmers could significantly increase their income from potato production. For instance, group membership on average, was able to increase the participant's farming income by 7,413,487 fg per cultivation. Another important factor that influences farmers' income is the share of potato sold ($p < 0.01$); farmers will try to maximize their income by increasing their share of potato sold. It is important to highlight that higher income from potato production can be a result of several factors including higher prices, larger shares of output sold, or better yields. Our results show that potato price and share of potato sold are statistically significant and have a positive effect on farm income at 10% and 1% significance level respectively. Farmers who have access to higher potato market price are able to secure higher income. Our results backed finding by Bernard et al. (2008) that farmers may gain from increased price levels for farm products or lower price levels for supplies. According to the model estimates, an increase by 1ha in total potato cultivated area, would lead to a 5,719,886 fg increase in farm

income. This could be explained by the effective utilization of farm land which may enhance production and consequently marketable surplus thereby increasing farming income. This is in line with the finding by Randela et al. (2008) that farmers with larger farms have a higher probability of selling more of their output because large farms have potential to increase marketable surplus. Similarly, labor use also has a significant impact on farm income ($p < 0.05$), indicating that all other factors held constant, farmers who use more labor, may obtain higher farm income. Under the kind of labor-intensive farming system that prevails in the study area, labor availability and use may significantly contribute to increasing farm income by enhancing farm production.

4.7. Summary

This chapter aimed at investigating the effects of group membership on farmers' income. Farmers' organizations are inclusive of the poor and are charged with the purpose of becoming a market outlet for smallholder farmers in Guinea. Improving farmers' income earning capability and agricultural productivity has been an important strategy of Guinea's agriculture development policy. However, despite their growing importance, empirical studies on how farmers' organizations have impacted their members' income are limited in Guinea. This paper investigates the determinants and effects on farm income of group membership, using the sample of 90 smallholder potato producers in Middle Guinea. A probit model was used as a selection equation to identify factors that influence group membership decision by smallholder potato farmers. The results revealed that the age of the potato farmers, land ownership, extension service, credit access and off-farm income are positively associated with group membership while gender and education level of the

farmer negatively influenced their decision to join farmer groups. Results of the second stage outcome equation found positive farm income effects of group membership. Furthermore, results revealed that farm income is predominantly determined by labor used, the size of the cultivated potato area, share of potato sold and potato market price.

Since farmers are resource-poor and that farmer organizations are constrained by various institutional, technical and investment constraints despite their potential, it is recommended that favorable polices should be geared toward smallholder agriculture in Guinea in order to ensure the success of farmer organizations. Our results show that farmer groups can be an important institution for the transformation of smallholder farming, increase productivity and incomes thereby reducing poverty.

CHAPTER V

DETERMINANTS OF POTATO PRODUCTION AND SUPPLY BY SMALLHOLDER FARMERS IN GUINEA

This chapter presents the results of the empirical study on factor affecting the quantity of potato produced and supplied to the market. After a description of the socio economic profile of the sample farmers, the chapter presents the determinants of the quantity of potato output, the factors influencing the quantity marketed, the efficiency of resource use and in the last section the production and marketing problems faced by farmers are highlighted.

5.1. Introduction

Potato is the fourth most important food crop in the world after wheat, rice, and maize. Because of climate change, the reduction of arable land, increasing population, and frequent occurrence of natural disasters, food security has become a crucial issue. To face this situation, increased food supply has become a priority in the world's development agenda. Due to the recent surge in the global food prices, several international organizations have been giving emphasis to the potato as a key part of world food production. Many countries and international development agencies give due concern to the intensification and commercialization of smallholder agriculture as a means of achieving poverty reduction; and thus they have reflected it in their official policies (Leavy and Poulton,

2007). Until recently, in many Developing and Least Developed Countries, potato was relatively unknown and mostly regarded as a subsistence crop. However, today the market is expanding rapidly as potatoes are increasingly popular as a source of affordable food for growing urban populations. According to FAO statistics, potato production in developing countries has increased by 94.6% over the last 15 years. And out of the four major food crops (rice, wheat, potato and maize), potato has the best potential for yield increases. In terms of nutritional value, adaptability to diverse environments and yield potential, the potato is a preferred crop, especially in developing countries. Many of the poorest producers in these countries and most undernourished households depend on potatoes as primary or secondary sources of food and nutrition. In addition, a more affluent middleclass has developed a preference for potatoes in processed forms such as fries and chips. This growing domestic market presents a valuable opportunity for smallholder farmers and provides a path out of subsistence farming and poverty with little risk exposure to farmers.

Farmers' 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. Commercializing smallholder agriculture is an indispensable pathway towards economic growth and development for most developing countries relying on the agriculture (von Braun et al., 1994; Pingali and Rosegrant 1995; Timmer 1997). Moreover, commercialization acts as a go-between input and output sides of a market. Although the net welfare gain from agricultural commercialization at the household level is universally accepted, there is no common standard for measuring the degree of household commercialization. Some literature has

considered different types of ratios such as marketed outputs or inputs to the total value of agricultural production or total household income (von Braun et al., 1994; Strasberg et al., 1999). Understanding the functioning of input and output marketing is essential to the improvement of farm productivity and smallholders' agricultural commercialization.

In Guinea, the agricultural production is as elsewhere in other developing economies dominated by the smallholder farmers. It accounts for about 25% of the Gross Domestic Product (Guinea, Country Strategy Paper 2012-2016). More than 85% of Guinea's population depends on subsistence agriculture for food production and the sector remains the main source of income and livelihood for the vast majority of the rural and peri-urban communities. Most of the farmers cultivate food staples such as rice, maize, potato, vegetable food crops, etc. for own consumption and commercialization. Many of the producers of the potato in Guinea are smallholders who cultivate less than one hectare and the majority are subsistence farmers with low productivity and yields. Barret, (2007) argued that farm households especially subsistence ones must have access to productive technologies and adequate private and public goods in order to produce a marketable surplus. Yet investment in private assets, improved technologies and public goods requires that households earn enough that they can save and invest. Kumar (1994) in a study on the adoption of hybrid maize in Zambia argues that an increase in maize supply by smallholder farmers can be attributed to their access to hybrid maize seeds as well as other agricultural inputs. Potato as one of the main cash crop grown in Guinea is an essential source of income for the majority of smallholder farmers with about 18,000 tons of annual production entirely produced in Middle Guinea. However, in addition to the low yield, its production

and market access, as for many other cash crops, face numerous constraints that limit productivity and income earning capability of producers.

There are a number of factors that affect potato production and agricultural productivity in general in Guinea including rainfed agriculture, poor farming technology and limited inputs among others. In addition, a high proportion of the agricultural commodities is sold in the form of raw materials with insignificant value addition. Smallholder farmers are faced with many constraints, some of these include low uptake of improved farm inputs, weak links to markets, high transportation costs, small and weak farmer organizations, lack of information on markets and prices. As reported by Key et al. (2000), high transaction costs are one of the main reasons for smallholder farmers' failure to participate in markets and supply adequate quantity of produce. Several initiatives by governmental as well as non-state actors are in place to promote intensification and commercialization of smallholder farming. One of the organizations spearheading the commercialization of smallholder farming in Guinea is the National Confederation of Farmer Organizations (CNOP-G), a farmer-based organization that aims to deliver adequate services to smallholder farmers so as to improve their production and incomes.

There is largely a consensus that potato production and commercialization is crucial and has differential impacts on rural farm households in Guinea. However, the relatively poor output realized by farmers and the poor performance of the agricultural sector may be an indication that little emphasis is placed on the crop and that resources needed in the production are not being used at their optimal levels. This situation affects the conditions of commodity production and supply, calling for an assessment of the potato production and

marketing. The current research aims at analyzing the factors influencing potato production and supply to the market by smallholder farmers in Guinea in view of bridging the knowledge gap in the literature.

5.2. Summary statistics of demographic and socio-economic variables

Variables used for the empirical analyses are presented in Table 5.1. Previous research has shown that agricultural production and market access by farmers are strongly influenced by factors such as the physical conditions of the infrastructures, access to production and marketing equipment (Killick *et al.,* 2000).

Table 5.1 Summary statistics of demographic and socio-economic variables

Variables	Definition	Mean	Std. Dev
Age	Actual age of household head (years)	50.85	10.937
Gender	Respondent's gender (1=male; 0=female)	0.40	0.493
Education	Number of years in school (years)	2.76	3.860
Family size	Number of household members (persons)	7.34	3.220
Potato area	Planted potato area (ha)	0.89	0.722
Labor used	Total labor hired (man-days/ha)	199	317.219
Fertilizers used	Quantity of fertilizer used (kg/ha)	401	381.28
Potato seed used	Improved potato seed used (kg/ha)	508	437.70
Quantity produced	Total output of potato (kg/ha)	4,224	5,802.867
Distance to market	Distance to the nearest market (km)	4.44	2.318
Potato price	Market price of potato (Fg/kg)	4,480	860.814
Quantity sold	Total quantity of potato marketed (kg/ha)	3,829	2,917.361
Future seed	Amount of potato kept as future seed (kg/ha)	946	997.130
Food and gift	Quantity for consumption and gift (kg/ha)	370	417.746
Sales in 4 weeks	Sales 4 weeks after harvest (percent)	75	28.914
Production losses	Estimate of output loss (1=high; 0=low)	0.42	0.497
Extension access	Access to extension service (1=yes; 0=no)	0.73	0.447

Source: Author's Field survey (2012)

The summary of the variables presented include indicators of household agricultural resource endowment such as the farm size. The majority of farmers cultivate less than 1 ha; the average planted potato area is 0.89 ha. This reveals a pattern that closely mirrors the situation in respect to the overall farm size in Guinea. An increase in farm size may

enhance production if the land is effectively utilized which entails application of appropriate farm practices and inputs. Access to extension service is 73%; this is however mainly through farmers groups implying that the majority of farmers have poor access to extension workers to solve their farming problems.

Also included are the household demographic factors, potato production and marketing, variables indicative of farmers' market access conditions. The demographic variables include the gender, age and education of the household head, family size. The market access variables include the distance to the primary market and the estimate of sales four weeks after harvest. With an average family size of 7 persons ensuring availability of labor and farm expansion, the average age of potato farmers in the study area is 50 years old and the majority are female (60%). Family size is a key determinant of farmers' behavioral pattern in production and productivity given the labor-intensive nature of potato farming in the study area. Farm labor used is 199 man-day/ha and large household size would reduce the cost of hired labor. With about only 3 years of education, the literacy level is very low in the study area; only about 35% of farmers are educated, 48% and 50% of the respondents, respectively members and non-members of farmers groups have a primary school education.

The quantity of fertilizer used is 401 kg/ha on average; this variable is expected to be positively related to productivity; a farm unit that is too constrained to afford an adequate amount of fertilizer will most probably experience lower output and ultimately less marketable surplus. The use of improved potato seeds with an average of 508 kg/ha is expected to have the potential of high yields and recovering from adverse effects of drought, pest and diseases. However, access to fertilizer and improved seeds, mainly through

membership in farmers groups and other suppliers (traders, money lenders, private companies), is a major constraint to crop production. Difficulty to access farm inputs in general led to farmers retaining important quantity of potato (946 kg/ha) to serve as future seed. More, with production averaging 5,148 kg/ha, 85% of producers sell 75% of output just four weeks after harvest (3,829 kg/ha sold on average), and farmers keep on average 370 kg/ha for consumption and gifts. It is expected that output of potato positively influenced quantity market. The more the quantity of potato produced, the higher would be the share of potato supplied to the market.

Given the poor production and management technology, production loss (post-harvest) estimated at 42%, is a major impediment to potato production across the producing areas. In effect, in Guinea as in many West African countries, farmers store their crops in homes, on the field, in the open. Which is the case in the low-income countries, where pre-harvesting management, processing, storage infrastructure and market facilities are either not available or are inadequate (World Bank et al., 2011). With regard to the selling price, the average potato price was 4,480 Fg/kg, with the unit price ranging from 2,600 Fg to 7,000 Fg. Better potato price can provide an incentive to farmers for market participation by supplying more quantities. Many producers seek higher market price through their membership in farmer organizations, however, the performance of the latter in paying a higher price to their members remains in question. The majority of farmers are bound to sell their produce to buyers to whom they may have obtained input credit from.

Distance to market is 4.44 km on average and is hypothesized to be negatively related to producers' market access. The further the production area from the market, the less likely

would be the farmers' participation. This comes with the logistical problems in terms of the availability of transport facilities, increased transportation costs and the poor access to market information and facilities.

5.3. Socio-economic characteristics of respondents

The variables discussed above were tested for their significance and considered for the models. Comparing farmers members of farmers groups and non-members, the respondents' socio economic characteristics are depicted in the table below.

The socio economic characteristics of the sample farmers both members of farmer groups and non-members are presented in Table 3. More female (60%) are involved in potato production than male. However, the figure for the two categories of producers, show that 48.3% are female and non-members of farmer groups compared with 66.1% for members. The average age of the members of farmer groups was 53.05 years and 46.59 years for non-members, revealing a significant difference between the two groups. This also suggests that potato farmers in the study area are relatively old; therefore, young farmers need to be encouraged to join farming. The finding corroborates with that of Ekwe et al., (2010) highlighting the necessity for youth to effectively participate in potato farming. Results in Table 5.2 show that farmers suffer significant crop losses. 28.6 % of members of farmer groups and 69% of non-members reported having experienced high crop losses. These are physical losses caused by poor harvest technologies, sorting, handling and transportation among others. Household characteristics between the two groups of farmers were similar in many aspects.

Table 5.2 Socio-economic Characteristics of Respondents

Continuous variables		Group members	Non members	t-statistic	p-value
Age		53.05	46.59	2.678	0.009***
Education		2.54	3.21	-0.758	0.450
Family size		7.57	6.90	0.915	0.363
Potato area		0.92	0.83	0.527	0.600
Labor used		210.67	176.97	0.463	0.645
Improved seeds used		553.336	420.688	1.331	0.187
Fertilizer used		436.802	333.254	1.190	0.237
Quantity produced		4,733	3,243	1.124	0.264
Distance to market		4.49	4.35	0.269	0.789
Potato price		4,557	4,332	1.144	0.256
Quantity sold		4,296	2,928	2.091	0.040*
Future seeds		1,086	676	1.826	0.071*
Food and gift		360	388	-0.294	0.769
Sales in 4 weeks		73.93	77.24	-0.499	0.619
Categorical variables		**%**	**%**	**X^2statistic**	**p-value**
Gender	Male	33.9	51.7	2.521	0.161
	Female	66.1	48.3		
Extension service	yes	94.6	31	39.166	0.000***
	no	5.4	69		
Production losses	High	28.6	69	12.769	0.000***
	Low	71.4	31		

***, indicates significance level at 1%
Source: Author's survey (2012)

There was no difference in the quantity of potato produced between the two groups of farmers, however, there existed a difference in the quantity sold and retained for seeds. While members of farmer groups kept 1,086 kg/ha for future seed and supplied 4,296 kg/ha to the market, the figure for non-members shows 676kg/ha and 2,928 kg/ha respectively for the quantity of potato kept for seed and sold. Table 3 also shows that the majority (94.6%) of members of farmer groups declared to have access to extension service while only 31% of non-members receive extension services. The implication of this that the lack of extension service which is a channel through which agricultural technology and

information are passed to farmers, could lead to inefficient use of farm resources, consequently low productivity and threaten food security. As argued by Schultz (1975), agriculture-specific human capital is important in improving farm yields in a changing environment because it enhances resource allocation abilities of farmers. Agricultural extension service plays a role in linking the different stakeholders involved in input–output marketing and credit supply; this could be the government agency or ministry responsible for promoting the adoption and utilization of new scientific farming practices through educational procedures (Anaeto et al., 2012).

5.4. Factors influencing Potato Production in the Study Area

The factors influencing the amount of potato produced are presented in Table 5.3.

Table 5.3 Determinants of the quantity of potato produced by farmers

Variables	Members		Non-members		Total sample	
	Coefficients	Std. Error	Coefficients	Std. Error	Coefficients	Std. Error
Constant	1.462	0.491	0.859	1.186	1.412	0.432
Age	0.217	0.284	0.668	0.596	0.346	0.244
Gender	-0.001	0.057	-0.048	0.104	-0.010	0.047
Potato area	1.046***	0.069	1.043***	0.127	1.037***	0.061
Improved seeds	0.353***	0.090	0.259***	0.080	0.249***	0.048
Labor hired	0.033	0.031	0.045	0.063	0.044	0.026
Fertilizer used	0.314***	0.100	0.385*	0.176	0.386***	0.073
Extension service	0.136	0.118	0.111	0.127	0.032	0.057
Production losses	-0.177***	0.057	-0.079	0.102	-0.119**	0.047
R-square		0.863		0.830		0.842
Adjusted R square		0.840		0.762		0.826
F		36.971***		12.209***		50.753***

Note: ***, **, * significance at 1%, 5% and 10% respectively; VIF= 1.71; $F_{(8,\ 84)} = 50.753$; chi2= 0.25; Prob > chi2 = 0.6204

Source: Author's Field survey (2012)

The results of the Cobb-Douglas production function show that the value of the coefficient of multiple determinations for the total sample is 0.842. This implies that 84.2% of the total

variation in the output of potato farmers is explained by the variation in the independent variables included in the model. For variables with positive regression coefficient, this means that a unit increase in any of them holding others constant, will lead to a unit increase in the gross output. The F-value (50.753) was significant at 1% and determines the overall significance of the model. Specifically, the results show that the coefficients of planted potato area, improved seed used and fertilizer used carried positive signs and are significant for both farmers members of farmer organizations and non-members.

The positive and highly significant effect of planted area ($p<0.01$) implies that there is a direct and positive relationship with the potato output. That is, as farm size increases, holding other variables constant, the output of potato increases consequently. This is a critical variable upon which output in potato farming depends in the study area. Thus, farmers who allocated more of their land for potato would realize more potato production under good management. Findings from our study in the area had revealed that the effective utilization of farmland enhanced production and consequently marketable surplus and thus increase farm income (Tolno et al., 2015). This is consistent with results from a study by Obare et al., (2010) suggesting that productivity would be higher if more land is brought under potato cultivation. Yusuf et al., (2015) in a study on sweet potato production reported that increase in farm size means more inputs would be utilized and consequently more output would be expected.

High crop yields can usually be attributed to the improvements in plant varieties. In the study area, farmers plant both their own saved potato seeds and improved seeds accessed through informal systems (traders, money lenders, etc.) or through their organizations. The

results show that for both farmers members of farmer organizations and non-members, improved seeds have positive and significant effects on potato output. Keeping all other factors constant, a one percent increase in improved seeds used resulted in about 0.25% increase in potato output at one percent significant level; figures for this variable show an increase of 0.353% and 0.259% for a unit increase in improved seeds respectively for members and non-members. The results corroborate with the findings of Chirwa et al., (2007) study, on implementing the bean seed strategy in Malawi, where it was found that farmers using improved seeds often realize higher outputs than those using indigenous seeds. Maruod et al., (2013) in exploring the potential for improvement in agricultural production and productivity reported that improved seeds have a positive impact on small farmers' productivity, income and livelihood. Farmers using improved seeds often realize higher potato yields and thus are more likely to increase outputs and market surplus. Improved potato seeds have high yields and producers would benefit from planting them. However, access to improved potato seeds is still a major challenge to a number of smallholder producers leading to low production levels in the study area.

With a statistically significant level at 1% and 10% respectively for members and non-members, the coefficient of fertilizer use was overall, positive and highly significant ($p<0.01$) implying that the quantity of fertilizer applied was directly related to potato output. A one percent increase in fertilizer used resulted in about 0.39% increase in potato production, showing that the amount of fertilizer used had a positive effect on the quantity of potato produced. Fertilizer input is a significant and important variable that affect potato production (Ekwe et al., 2010). Wang'ombe et al., (2013) established that with

recommended application regimes, fertilizer used can have a great impact on potato yields and productivity. Thus, besides the improved nature of seeds used, potato production can be greatly enhanced by practices such as fertilizer application. Although 66% of our sample respondents were members of farmers' group, the role and effectiveness of collective action in mitigating the numerous challenges facing farmers are still critical.

Production losses resulting from the poor production technique, pest and disease, poor weather condition, negatively influence potato production ($p<0.01$). Results show that potato output decreases by 0.12% for one percent increase in production losses. Producers in the study area both members and non-members, prioritized these losses as key constraints to achieving high potato output; thus farmers who realize less production losses would have a relatively higher output of potato. This suggests that measures to reduce production losses would equally contribute to an increase in the quantity of potato produced. Although the age of the farmers and the labor hired have no significant influence on the quantity of potato produced, both variables show a positive relationship with the potato output. The lack of productive assets being a common problem to all farmers in the research area, most potato producers rely on human labor to produce potato. Young farmers contribute more and are more productive given the labor-intensive nature of potato farming.

5.5. Efficiency of Resource Use

Table 5.4 Marginal value product and efficiency of resource use

	Members			Non-members			Total sample		
Inputs	**Seed**	**Labor**	**fertilizer**	**Seed**	**Labor**	**fertilizer**	**Seed**	**Labor**	**fertilizer**
MPP	0.471	0.062	0.439	0.357	0.092	0.527	0.336	0.084	0.536
MVP	2,149	281	2,002	1,548	399	2,285	1,506	379	2,403
MFC	9,095	8,170	4,476	9,690	8,569	5,128	9,298	8,306	4698
Eff.	0.236	0.034	0.447	0.160	0.047	0.446	0.162	0.046	0.512

Source: Author's Field survey (2012)

The estimated coefficients of the relevant independent variables were used to compute the marginal value products (MVP) and their corresponding marginal factor costs (MFC). The ratio of the MVP to MFC was then used to determine the resources use efficiency as shown in equation (3).Table 5 presents the results of the resource use in potato production in the study area. As depicted in the table, for the total sample farmers, fertilizer has the highest MPP; hence a unit increase in fertilizer is estimated to increase output by 0.54kg per ha. An increase in one unit of laborer per day is estimated to increase potato output by 0.08kg per ha. Furthermore, an increase of one unit of seeds is estimated to increase the total output by 0.34kg per ha. However, evaluating the efficiency of these inputs, the results indicate that all the resources were inefficiently utilized; comparison of the ratio of MVP to MFC shows resulting ratios to be less than unity for seed, fertilizer and labor. The results revealed that for both members of farmer organizations and non-members, potato seeds, labor and fertilizer were used above the economic optimum level, implying that these inputs were been over utilized as indicated by their respective efficiency ratio. Increasing the quantity of seeds, labor and fertilizer usage would decrease potato output and thus profit level. The sub-optimal resource allocation in potato production can be attributed to different factors.

Potato production being a labor intensive activity in the study area, family labor is a readily available pool of labor to draw from whenever needed, thus there is a tendency of over utilizing labor. This result supports the findings of Baiyegunhi et al., (2010) who found that the surplus family labor available to the smallscale sorghum farmers led to the over utilization of labor. The majority of farmers in the study area rely on own stocks of potato seeds of comparatively low yield; this is accentuated by the poor storage conditions of the potato kept for seeds due to the lack of adequate storage facilities. In addition, the lack of a viable functional system of agricultural practices through farmer education in general in Guinea has a negative impact on the technical knowledge of potato producers. This situation may have contributed to the over utilization of inputs (seeds and fertilizer) in the potato farms. Comparable results of the over utilization of production resources such as seeds have been reported by Danso-Abbeam et al., 2015. For potato producers in the study area to achieve levels of optimal resource allocation, inputs such as seeds and fertilizer may have to be reduced. This will, with improved technical and managerial ability of the farmers, increase potato output and consequently incomes from the potato farming business.

5.6. Factors influencing Potato Supply to the Market in the Study Area

Table 5.5 presents the determinants of the quantity of potato supplied to the market by farmers.

Table 5.5 Factors influencing quantity of Potato marketed by farmers

Variables	Members		Non-members		Total sample	
	Coefficients	Std. Error	Coefficients	Std. Error	Coefficients	Std. Error
Constant	4,989.239	2,094.222	811.453	1,582.481	2,720.323	1,430.919
Family size	-37.145	89.551	-129.137	87.757	-57.204	65.223
Education	-207.109**	89.375	-48.993	50.654	-143.750**	53.083
Quantity produced	0.255***	0.048	0.155**	0.057	0.247***	0.037
Distance to market	-148.851	124.967	-6.157	104.299	-74.889	89.298
Production losses	-975.515	635.318	-393.975	524.382	-1,020.913**	409.750
Potato price	0.662*	0.342	0.296	0.228	0.250	0.231
Future seeds	-0.992***	0.288	-1.255***	0.382	-0.978***	0.220
Food and gift	-2.508***	0.802	-2.521***	0.484	-2.468**	0.516
Sales in 4 weeks	12.070	9.908	-1.949	10.124	12.428*	7.192
R-square	0.676		0.821		0.682	
Adjusted R square	0.613		0.736		0.644	
F		10.67***		9.71***	(9, 75)	17.90***

Note: ***, **, * significance at 1%, 5% and 10% respectively;
Source: Author's Field survey (2012)

The results show that education has a significant and negative effect ($p<0.05$) on the quantity of potato supplied to the market. This shows the tendency of educated farmers not to sell their potato output. Possible explanations to this could be that educated farmers in the study area are aware of the fact that during harvest periods, farmers face lower prices as they increase supply of potato.

The total output of potato, for both members and non-members, positively influenced potato marketed. A unit increase in the quantity of potato produced resulted in about 24% increase in the quantity of potato marketed for the total sample. This is confirms the findings of Birachi et al., (2011) who noted that farmers who realize higher output will

supply larger proportions to the market. The results also confirm findings of Reyes et al., (2012) that quantity of potato produced positively affected quantity sold.

Post-harvest losses are negatively associated with the quantity of potato marketed ($p<0.05$). As revealed during the field survey, the poor storage conditions and the predominant transportation means (carrying on the head, bicycles, wheelbarrows), are a major impediment to potato marketing in the study area. In a study on market supply response of cassava, Adesiyan et al., (2012), found that losses have a negative impact on marketed surplus.

Potato stored for future seeds negatively affected the quantity of potato supplied to the market ($p<0.01$). Figures are the same for both member farmers and non-members. Farmers in the study area, in general, are resource-poor; the majority of them therefore, retain significant quantities of their crop output for future seeds. Producers who retain less quantities of potato for seeds are able to supply more to the market. Potato retained for seeds and stored traditionally, have low yields as result of poor conservation and diseases, which is an important impediment to crop productivity. The quantity of potato kept for food and gift is also negatively associated with quantity marketed ($p<0.05$) and might be due to the size of farm household. This implies that the lower the quantity kept by households for consumption and gifts, the higher the quantity of potato available to the market for sale. The economic implication could be that the larger the household size, the higher the quantity kept for food and the lower the quantity supplied to the market.

Although not significant, distance to market has a negative coefficient, suggesting that distance to the market channels could affect potato marketing. Potato price on the contrary

positively affects quantity marketed ($p<0.1$). It acts as an incentive to members of farmer organizations, thereby highlighting efforts of the latter to pay higher prices to its membership. Better output price and market information are the key incentive for increased sales (Omiti et al., 2009).

The share of potato sold four weeks after harvest is positively related to quantity marketed ($p<0.1$). Several reasons could explain this. 85% of the surveyed farmers sell their crop output within four weeks after harvest; the lack of storage facilities, the seasonal price instability, the need for immediate cash could have triggered this. As observed during our field investigations, farmers are bound to sell their product to market participants (local collector, money lenders, wholesale agents) from whom they may have obtained credits.

5.7. Production and Marketing Constraints

The major potato production and marketing constraints are presented in Table 5.6 Across all the surveyed districts, pest and diseases were regarded as the main constraint to potato production, especially for members of farmer organizations. Pest and diseases have been reported to cause losses ranging from 5 to 30%. This could be attributed to the lack of appropriate management practices and research in the sector leading to higher vulnerability of potato to diseases mainly during the cropping and storage period. Maldonado et al., (1998), found that diseases were one of the most important limiting factors to expanded potato production and use. The poor irrigation was singled out by 48.2% of the total farmers as the next major constraint in importance. An essential point observed during our field survey was the farm irrigation system. For the majority of farmers in the study area, irrigation is poor or non-existent. Potato production is also handicapped by the lack of

funds (agricultural credits) to face the high cost of inputs. Kaguongo et al., (2008) reported that high cost of inputs especially seeds, fungicides and fertilizers greatly limit the production of potatoes in Kenya. Similarly, Fawole, 2007, established that the lack of credits facilities and improved practices are limiting factors to potato production, contributing to low outputs.

Climate-related factors (drought, wildfire, flooding) and labor shortage were also listed as constraints in potato production. Household related factors were considered by 16.5% of the total sample farmers as a factor that seriously hampered potato production. The unavailability of the head of the household or an active family labor could hinder the household's farming business.

Table 5.6 Production and marketing constraints

Constraints	Members		Non-members		Total sample	
	Freq.	Rank	Freq.	Rank	Freq.	Rank
Production						
Pest and disease	32 (57.1)	1	17 (58.6)	3	49 (57.6)	1
Climate-related factors	20 (35.7)	4	14 (48.3)	4	34 (40)	4
Lack of funds	14 (25)	3	25 (86.2)	1	39 (45.9)	3
Household related factors	10 (17.9)	6	4 (13.8)	5	14 (16.5)	6
Poor irrigation	22 (39.3)	2	19 (65.5)	2	41 (48.2)	2
Labor shortage	11 (19.6)	5	4 (13.8)	5	15 (17.6)	5
Marketing						
High cost of transportation	7 (12.5)	5	10 (34.5)	4	17 (20)	5
Low potato price	27 (48.2)	2	21 (72.4)	1	48 (56.5)	1
High market taxes	3 (5.4)	6	3 (10.3)	7	6 (7.1)	7
Poor transport infrastructure	21 (37.5)	3	11 (37.9)	3	32 (37.6)	3
Trade restrictions	34 (60.7)	1	9 (31)	5	43 (50.6)	2
Lack of price information	1 (1.8)	7	6 (20.7)	6	7 (8.2)	6
Lack of storage facilities	7 (12.5)	5	12 (41.4)	2	19 (22.4)	4

Note: Numbers in parentheses indicate the percentage
Source: Author's Field survey (2012)

In marketing, low potato price was regarded as the major bottleneck and 56.5% of the farmers ranked it as the maint limiting factor in potato marketing. Hussain et al., (2006) reported that lower potato price was the major problem faced by farmers in the marketing of potato. Restriction on trade imposed by the government was another crucial problem in

potato marketing and this was particularly important for farmers members of farmer organizations (60.7%). Additionally, the poor quality of the transport infrastructures was reflected by the high cost of transportation. Transport of potato to the market is expensive due to poor road infrastructure in producing areas (Muthoni et al., 2009, Hussain et al., 2006). This situation reflects the state of agricultural infrastructures in general in Guinea; transport infrastructure, particularly roads, are in poor conditions and underdeveloped; the provision of transportation services is insufficient; and the other types of infrastructure supporting agricultural markets (e.g., for storage and processing) are also underdeveloped. Problems related to storage facilities are also noteworthy; 41.4% of non-members listed the lack of adequate storage facilities to be the next most important constraint in potato marketing. This hinders farmers' marketing capacities as the majority of them are obliged to sell their produce despite the unfavorable price they are offered. The high market taxes and the lack of information on the market price of potato were also regarded as limiting factors in potato marketing by 7.1% and 8.2% of the surveyed farmers respectively. The latter was mostly important for non-members (20.7%) who usually get information on crop output and inputs prices from various market participants (rural collectors, wholesale traders etc.) participating at different stages of potato supply chain.

5.8. Summary

The purpose of the current study was to assess the determinants of the quantity of potato produced and marketed by smallholder farmers in Guinea. Potato has emerged as an attractive cash crop due to its income-generating potential and is one of the main sources of income for the majority of the resource-poor smallholder farmers. Thus increasing

production and improving marketing efficiency has the potential for raising incomes of the farming households. Using a multi-stage sampling technique, data was collected from a sample of 90 potato producers in Middle Guinea. Results of the Cobb Douglas production function showed that potato area, improved seed use and fertilizer, positively influenced the potato output, while production losses are negatively associated with the potato output. A supply function used to investigate factors influencing the quantity of potato marketed revealed that quantity produced, price of potato and share of sales four weeks after harvest were positively associated with quantity of potato supplied to the market, whereas quantities retained for seed, food and gifts, and post-harvest losses have negative effects on the quantity of potato marketed. Results also revealed that none of the relevant production inputs used by the sample farmers were efficiently allocated and utilized. Constraints to potato production and supply include lack of funds, poor irrigation, pest and disease, the high cost of transportation, lack of storage facilities among others. Findings, therefore, suggest that government and development stakeholders should encourage and support farmer organizations, develop agricultural and marketing infrastructures, so as to boost agricultural production and farmers' market access.

CHAPTER VI

PRODUCTION ECONOMICS AND RESOURCE USE EFFICIENCY OF PINEAPPLE PRODUCERS IN GUINEA

6.1. Introduction

Pineapple is the second harvest of importance after bananas, contributing to over 20 % of the world production of tropical fruits (Coveca, 2002). Nearly 70% of the pineapple is consumed as fresh fruit in producing countries. Its origin has been traced to Brazil and Paraguay in the Amazonic basin where the fruit was domesticated. Thailand, Philippines, Brazil and China are the main pineapple producers in the world supplying nearly 50 % of the total output (FAO, 2004). Other important producers include India, Nigeria, Kenya, Indonesia, Mexico and Costa Rica and these countries provide most of the remaining fruit available (50%).

At Independence in 1958 Guinea was a largely rural economy with most people engaged in traditional small-scale agriculture and livestock production. The traditional sector produced the country's staple foods, rice, cassava, maize, sweet potatoes and livestock. During the period preceding independence, in the 1950s, the Guinean horticulture dominated the French West African colonies. Following the government's move to a centrally planned economic model that led to a wholesale exodus of French expatriates, Guinea's horticultural economy has lost much of its success and prosperity from banana and pineapple production. The government undertook several measures to stimulate the fresh fruit and vegetable sector within the context of its state-owned and -operated economic

model, as evidenced in particular by the construction of two major processing facilities in Kindia (Lower Guinea) and Kankan (Upper Guinea). The horticultural crops production drives tremendous interests and is a key opportunity sector for supporting rural development and poverty reduction in Guinea. Despite the significance of the sub-sector and its economic potential at macro level, the extent to which the economic gains derived from horticulture production and commercialization impact on the resource-poor farmers at the household level, is yet to be clearly understood in Guinea. Thus, it is essential to address its great potential for increased output and quality of the horticultural produce.

This study is therefore necessary and was designed to update the knowledge on the economics of pineapple production and the resource use efficiency by farmers. The research is intended to fill the gap of knowledge in the Guinean horticulture sector, for researchers, economic specialists and policy makers and help farmers to implement enhanced productivity and sustainability within their farming operations. The following objectives are pursued: i) to examine the socio-economic characteristics of the pineapple farmers; ii) to estimates the costs, returns, and profitability of pineapple farming; iii) to investigate the determinants of pineapple production and analyze farmers' resource use efficiency; iv) to identify the production and marketing constraints in the pineapple farming scheme and suggest some policy recommendations.

This chapter deals with the production economics and resource use efficiency of the pineapple farmers

6.2. Socioeconomic Characteristics of Pineapple Farmers

Table 6.1 shows the characteristics of the sample pineapple farmers. The table reveals that pineapple farmers in the study area with average 11 persons per household, are 49 years old on average and only 13.40% of them are women. This shows that female producers are less involved in the pineapple production. The table also revealed that farmers are relatively young, the youngest farmer being 29 years old. This finding is in line with Esiobu *et al.,* (2014), who in their study, reported that the younger farmers are, the more receptive they are to innovation and the better their efficiency in agricultural production. The same can be observed in our study area, where farmer, mostly male, engage in different agricultural training and workshops. Although the household size is relatively large, only 4 family members on average work on the farm land. Education level of farmers expressed in the number of years of school attainment, is, despite its importance, very low. The average level of education is 6.16 years, this characteristic of the majority of the rural dwellers in Guinea and depicts the overall educational attainment, especially in rural areas. As for the area allocated for pineapple production, the average land size is 1.34, a situation that closely mirrors the overall farm size in Guinea. Farmers, with an average farming experience of 14.70 years, grow pineapple on less than 1 hectare for the vast majority of them. With higher farming experience farmers are most likely more efficient and have better knowledge of efficient allocation of farm resources (Onubuogu et *al.,* 2014). The average off farm income is 6,624,226 Guinean Francs; this has some important implications for pineapple farming given the high cost of inputs, households with higher off

farm income will be more involved in pineapple production. In fact, for pineapple farming, 44.32 percent of our sample farmers declared to have contracted loans.

Table 6.1. Characteristics of Farmers

Characteristics	Mean
Age (years)	49.37
Gender (%)	
Female	13.40
Male	86.60
Education level	6.16
Coop membership (%)	
Membership	63.91
No membership	36.08
Farming experience (number of years)	14.70
Household size (number of persons)	11.38
Family labor (Number of active family members)	4.15
Off farm income (Gf)	6,624,226
Farm size (ha)	1.34
Loan for faming (Used loan for farming) (%)	44.32
Extension service access (%)	58.76
Primary reason for production (%)	
Sale	76.28
Home consumption and Sale	23.71

Access to extension services is also reported in Table 6.1; 58.76 percent of the respondents have access to extension services. However, farmers contact with extension workers was reported to be 1-2 times of average per year. This implies that farmers have poor access to agricultural support and could bring about low farm productivity. Extension services are important channels through which farmers can have access to agricultural innovation and information. Poor access to extension service could have negative effects on farm productivity as well as farmers' technical efficiency and resource use efficiency. The pineapple is mainly considered as a cash crop by the majority of farmers; the primary reason for pineapple production was exclusively for commercialization (76.28%), 23.71

percent of the respondents however produce mainly for both commercialization and home consumption.

6.3. Profitability of Pineapple Farming

In performing the economic analysis of pineapple production, profitability analysis was conducted. As depicted in Table 6.2, the average pineapple yield is 23,359 kg/ha and the total farm revenue was 88,518,849 Fg. The total variable costs made 92% of the total pineapple production; this was however offset by the revenue accruing from the pineapple farming business. The Benefit Cost Ratio (BCR), also referred to as profitability index was obtained by dividing the total revenue from pineapple production (Gross revenue) by the total costs of production in the pineapple farming. The higher the BCR is, the better the investment. Results presented in Table6.2 shown that producers with membership in cooperatives have higher benefit cost ratio, thereby indicating that the pineapple farming business is more profitable to members than non-members of farmers' groups. This could be explained by the benefits of membership in cooperatives; group members usually, through the bulk purchase of farm inputs such sucker, fertilizers and agrochemical, significantly reduce the farm production costs. Overall, the results show that the benefit of pineapple farming is very attractive; this is also shown by the high ratio of net farm profit to revenue.

Table 6.2. Profitability Analysis of Pineapple Farming

Parameters	Coop Members	Non members	Total
Yield (Kg/ha)	23,359	22,285	22,971
Market Price (Fg/kg)	3,790	3,215	3,582
Total Revenu (A)	88,518,849	71,651,326	82,290,388
Variable cost (B)	16,621,827	20,477,535	18,013,062
Sucker cost	9,811,957	13,010,357	10,966,019
Labor cost	2,059,482	2,632,504	2,266,242
Fertilizer & Agrochemical	4,440,279	4,626,036	4,507,305
Expenditure on other inputs	310,109	208,638	273,496
Fixed cost (C)	1,363,940	883,877	1,190,721
Total farm production cost (D)	17,985,767	21,361,412	19,203,783
Gross Margin (E)	71,897,021	51,173,791	64,277,326
Net Farm Profit (F) A-B	70,533,081	50,289,914	63,086,604
Benefit Cost Ratio (A/D)	4.92	3.35	4.28
Ratio Net Farm Profit to Revenu (F/A)	0.80	0.70	0.77

Source: Author's computation; Survey Data, 2014

6.4. Determinants of Pineapple Production

Table 6.3 shows the results of the determinants of pineapple production. A multiple regression analysis was carried out in four functional forms (linear, semi-log, double log and exponential). From the estimated socioeconomic characteristics of farmers on pineapple production, the F-ratio of each functional form was significant at 1 percent. This implies that each of them is adequate and could be used for the analysis. However, based on the statistical significance of the coefficients, goodness of fit and the econometric model that supports production concept, the double-log functional form was chosen as the lead equation. The double-log (Cobb-Douglas) regression function was chosen as the lead equation based on the value of R square value (0.804), F-Ratio value (31.760), and highest

number of significant variables. The coefficient of multiple determinations indicates that 80.4% of the variation in the output of the pineapple farmers was explained by the explanatory variables while the rest was accounted-for by the error term or un-captured variables in the model.

Table 6.3. Determinants of Pineapple Production

Variables	Double-log	Semi-log	Exponential	Linear
Constant	-1.629 (0.425)	-276,019.299 (31946.665)	2.661 (0.174)	-10,566.769 (7343.255)
Age	0.205 (0.174)	8,887.974 (13062.987)	0.018 (0.033)	35.488 (121.092)
Gender	-0.071 (0.044)	-3,266.471 (3234.266)	-0.060 (0.045)	-2,502.160 (3481.553)
Coop membership	0.071** (0.031)	4,078.689* (2256.706)	0.089** (0.031)	6,089.097** (2422.726)
Household size	-0.013 (0.078)	-977.021 (5755.520)	0.006 (0.030)	166.425 (2422.726)
Labor used	0.016* (0.035)	433.680 (2644.444)	0.012 (0.008)	4.232 (23.389)
Farm size	0.695*** (0.064)	3,5950.178*** (4782.943)	0.010*** (0.001)	0.705** (0.088)
Farming experience	-0.039 (0.060)	-5,040.960 (4407.135)	-0.004 (0.022)	-153.672 (155.835)
Sucker	0.281*** (0.053)	14,666.455*** (3881.907)	0.003*** (0.001)	0.140*** (0.045)
Extension contact	-0.011 (0.010)	-854.657 (3881.907)	-0.014 (0.010)	-1,251.995 (801.768)
Fertilizer & Agrochemical	0.497*** (0.056)	26,367.320*** (736.715)	0.027*** (0.003)	12.014** (2.277)
Irrigation per week	0.022** (0.017)	404.407 (1261.566)	0.030** (0.017)	1,006.891 (1295.235)
R^2	0.804	0.665	0.739	0.644
Adjusted R^2	0.779	0.626	0.709	0.598
F-value	31.760***	17.080***	24.384***	13.962***
VIF	1.36	1.32	1.36	1.39

Note: ***,**,* denotes significance at 1%, 5% and 10% respectively; Values in parentheses are standard errors

Source: Author's computation; Survey Data, 2014

The findings present the marginal effects of the estimated econometric analysis. The regression analysis revealed that membership in cooperatives, farm size, sucker quantity, the use of fertilizer and agrochemical as well as labor used, are the variables significantly affecting pineapple production output. The results indicate that keeping all other factors constant, a unit increase in membership in cooperatives will lead to 0.071% increase in crop output. Similarly, a unit increase in labor used will increase pineapple production by 0.016%. Similar case was also reported by Pandit (2008) that labor affects quantity of crop production. The elasticities of production with respect to sucker used, fertilizer and agrochemical show that the variables positively contribute to pineapple production. For a unit increase in each of the variables, and holding all other factors constant, output of pineapple increases by 0.281% and 0.497% respectively. The findings are in line with Inoni, 2007 who reported that fertilizer usage, and seeds, significantly and positively affect crop production. Irrigation times per week also positively affected pineapple production ($p<0.01$); this is important as the majority of the farmers in the study area face poor irrigation problems. Farmers with better access to improved irrigation systems would realize higher crop output.

6.5. Resource Use Efficiency in Pineapple Farming

The results of the marginal analysis of input utilization are summarized in Table 6.4. The quantity of fertilizer applied to the pineapple farm had the highest marginal physical product (15.402 kg), followed by labor used and quantity of sucker. The results indicate that all the resources were inefficiently utilized as the marginal value products of fertilize,

labor and sucker, are all greater than their respective factor prices. The allocative efficiency (AE) indices of the resources indicate that all the resources were underutilized.

Table 6.4. Estimate of Marginal Factor and Resource Use Efficiency

	MPP	MFC	MVP	AE	D
Sucker	0.152	3,582.302	547.495	0.15	15.28
Labor	1.473	3,582.302	5,279	1.47	147.36
Fertilizer	15.402	3,582.302	55,177.53	15.40	1,540.28

6.6. Constraints in Pineapple Production and Marketing

Table 6.5. Production and Marketing Constraints

Production constraints	Frequency	Marketing constraints	Frequency
Lack of fertilizer	50 (51.5)	High transport cost	53 (54.6)
Lack of seed/plant	49 (50.5)	Low/ unstable price	35 (36.1)
Lack of other inputs	36 (37.1)	Limited sale outlet	52 (53.6)
Lack of farm material	40 (41.2)	Poor infrastructures	59 (60.8)
Pest and disease	47 (48.5)	No price information	50 (51.5)
Climate factors	27 (27.8)	No output buyers	30 (30.9)
Lack of fund/credit	63 (64.9)		
Labor shortage	25 (25.8)		
Household related factors	40 (41.2)		
No technical support	32 (33)		
Poor irrigation	20 (20.6)		

Table 6.5 reveals that greater proportion (64.9%) of the farmers complained of the lack of fund and credit for pineapple production, whereas 51.5% face difficulties in term of fertilizer access. This is followed by the lack of seed (pineapple sucker) and the negative

effects of pest and diseases. 41.2% and 37.1 % of the pineapple producers respectively complained of the lack of farm material and other agricultural inputs.

As for the pineapple commercialization, the poor state of marketing infrastructures was listed as the main problem (60.8%); this consequently makes transport cost very high (54.6%). In terms of access to price information on pineapple inputs and output, 51.5% of the respondents listed the lack of price information as a main constraint. This could be attributed to dearth in research on pineapple production as well as poor information dissemination on the part of the extension agents in the area, thus, information is lacking for farmers in the area. Inadequate information left the farmers unaware of not only price of inputs but also modern technique for pineapple production as well market situation for pineapple in the study area. About 53.6% and 36.1% of the farmers identified the limited marketing outlets and the low price of pineapple as difficulties that hinder pineapple marketing in the study area.

6.7. Summary

The main purpose of this chapter is to analyze the production economics and the efficiency of resource utilization in pineapple production in Guinea. The study was conducted in Friguiagbe district, Kindia prefecture. A random sample of 100 pineapple growers were administered and well structure questionnaire to capture information on the farmers' socioeconomic and demographic background farmers, the pineapple farming as well the problems they face in pineapple production and marketing. The area was chosen because it

is one the two major pineapple producing region in Guinea. Individual farmers were then interviewed by using questionnaires. Descriptive statistics analyses of the survey data were performed. Regression analysis was employed to estimate (from the four functional forms) the Cobb-Douglas production function from the farm data to investigate the determinants of pineapple production and the resource use efficiency of the pineapple farmers. The estimated elasticity from the production function and prices of input and output were subsequently used to calculate the measures of allotment efficiency of resource use by the farmers. The results showed that membership in cooperatives, farm size, labor used, the sucker quantity, the fertilizer and agrochemical used as well as the frequency of irrigation per week, positively affected pineapple production. None of the resources were optimally utilized by the pineapple farmers.

CHAPTER VII

EGGPLANT PRODUCTION ECONOMICS AND ITS CONTRIBUTION TO SMALLHOLDER FARMERS' INCOME IN LOWER GUINEA

7.1. Introduction

Guinea is a country where agricultural activities are predominant and agriculture is practiced by about 80% of the population and contributing to about 25% of the country' GDP. Most of the farmers cultivate food crops such as rice, maize, vegetables etc. for own consumption and commercialization. Addressing the issue of how to increase agricultural production and farmers' incomes is crucial to both agricultural growth and poverty alleviation in Guinea. Vegetables (leafy and fruits) are widely grown in most parts of sub-Saharan Africa, especially, in the urban areas, and they constitute the most affordable and sustainable source of micronutrients in diets. Cash crops farming and commercialization is dominated by spot markets, with a recent increase of some movements towards farmers' engaging collectively in crops production and marketing through producer organizations. Eggplant (Solanum melongena L.) World trade in horticultural products has been growing steadily. The sector has become the single largest category in agricultural trade, accounting for more than 20% of world agricultural exports. In line with this overall trend, horticultural exports from Sub-Saharan Africa have also increased and now exceed USD2bn (UNCTAD, 2012). The development of the fruit and vegetable sector in developing countries has a positive impact on the Food and Nutrition Security (FNS) of the people engaged in the

sector and for urban and rural consumers. Farmers that produce fruit and vegetables are increasing their income, especially compared to grains and other staple food crops.in Guinea, the fruit and vegetable sector provides many job opportunities for male and female workers. The traditional small-scale fruit and vegetable production and marketing sector is an important sector in terms of employment, income and scale of production. Improving the level of organization among horticulture farmers and creating economies of scale in the smallholder sector in Guinea is a priority for the government. Horticulture comprises diverse cropping systems in all agro-climatic zones, provides healthy and nutritious food, and generates employment and income for smallholder farmers, including women who are often the main primary producers. Benefits from horticultural development include improved nutrition for children and families, increased income from sale of horticulture products, and improved status and confidence of women farmers. In many cases, horticulture can generate substantial income from smallholdings that would not be profitable if planted only to cereal crop staples. In addition, women typically use the income generated from horticulture to invest in family health and education, which multiplies the benefits by increasing social capital. Fruit and vegetable crops generate more income for farmers compared to traditional staple crops. In addition they generate employment for the rural workers, and therefore improve access to food (Weinberger and Lumpkin, 2007). For example, Muriithi and Matz (2015) found a positive welfare effect for vegetable producers in Kenya. Afari-Sefa (2007) identified positive income effects for fruit producers in Ghana. Also English et al. (2004) indicate that vegetable production is more profitable for a smallholder than the traditional maize-bean intercropping system often

found in Kenya. Farmer in Guinea usually engage in cropping systems with high-value crops, providing an important source of cash income and Eggplant production in Lower Guinea is considered as one of the most important income earning capacity activity for the smallholder farmers. Rural women's main commercial activities center around the marketing of garden vegetables and food crops commercialization.

The socioeconomic influences of Kindia, Mamou, and Fria towns are expressed as differences in household livelihood strategies between rural farmer and urban wage-earner households in the southern foothills. The persistence of large rural household size is partly attributable to traditional incentives associated with prestige. The majority (51.6%) of Guinea's agricultural population is female and 62.6% of them list farming as their principal pursuit. Only another 9.4% are in school, while 20.6% of farm family males attend school instead of farming (Gasa Guinea). Commercial vegetable production has become a major source of income for small farmers, particularly women, in all parts of the country. Much of the production is carried out in bas fonds during the dry season. Its focus is on commercial production rather than direct family consumption. Product sales do, however, provide for family food security through increased income with revenues thus generated being used to purchase staple food products during times of scarcity when family food reserves are low. The focus of the production is on the market and thus is subject to the demands of the various markets in terms of the types and varieties of vegetable produced, quantities required and prices paid.

One of the main assumptions is that the cultivation, handling and marketing of horticultural crops create employment and generate income for growers and workers in the sector, and therefore improve access to food, including fruit and vegetables.

The objectives of the current chapter are as follow: 1) to describe to characteristics of eggplant producers; 2) to conduct a profitability and total factor productivity analysis of eggplant farming; 3) to investigate the determinants of farm income from eggplant production.

7.2.Characteristics of Eggplant Producers

Table 7.1 presents the characteristics of the eggplant farmers. On average, farmers were aged about 45 years with the youngest farmers being 25 and the older 80 years old. The majority of our sample farmers are female (74%) and the majority of the respondents were members of informal cooperatives. As reported during our field survey, the main reasons explaining the large proportion of women in eggplant production is that: (1) women are seen as more accountable in eggplant production and marketing especially; (2) the eggplant production system at the small scale farms requires lesser difficult tasks such as land preparation, internal transport and loading and unloading, more the large household size providing sufficient farm labor, encourage women to engage in eggplant farming; (3) women labor is readily available than their men counterpart since the latter usually prefer to work on their own or on rented fields. The farm size per household on average is 1.53 ha and only 19.23% of the farmers had access to extension service, with on average 2 visits a

year and a maximum of five. Farming experience was 12 years on average and only 20.51% of the sample farmers own their farm land. This is partly because in the traditional setting of rural Guinea, ownership of farm land is usually affected to male over female.

Table 7.1. Average statistics of Eggplant Farmers

Characteristics	Mean	Std. Deviation	Minimum	Maximum
Age (years)	44.95	12.803	25	80
Gender (% of Female)	0.74	0.439	0	1
Education (year)	2.46	3.681	0	12
Group Membership (% of membership)	65.38	0.479	0	1
Household size (persons)	8.33	3.459	3	22
Family Labor (persons)	3.41	1.903	1	11
Off farm income (Fg)	7,604,231	6,123,360	240,000	28,000,000
Farm size (ha)	1.53	0.858	0.20	4
Extension Access (%)	19.23	0.397	0	1
Extension contact a year (number)	2.10	1.401	0	5
Farm experience (years)	12.21	9.034	3	50
Quantity produced (kg)	3,547	982.671	1,400	9,000
Food and gift (kg)	1,19	68.693	25	400
Seeds (g)	2.17	1.025	1	5
Quantity marketed (kg)	3,427	953.913	1348	8595
Ownership of land (%)	20.51			

The data in table 7.1 show that farmers' off farm income is on average 7,604,231 Fg; this an important indicator of farm household wealth and plays a crucial especially for farm inputs purchase. The quantity produced is 3,547 kg and 1.19 kg, 2.17 gram are respectively kept for food and gift and retained for seeds. On average the quantity of eggplant marketed by farmers is 2.427 kg.

7.3. Cost-returns of Eggplant Production

As depicted in Table7.2, eggplant production is highly profitable. An economic analysis has been performed in order to estimate the profitability eggplant farming in the study area. The gross income (total production monetary value) was seen as the function of the total production and prevailing markets price. The total variable costs include the cost of seeds, the cost of manure, the pesticides cost and the labor cost. As for the Gross Margin (GM) also called income above variable costs, it is high because of the low variable costs. The fixed cost was calculated based on the depreciation of farm equipment and tools owned by farmers. The ratio of net farm profit to revenue revealed that eggplant farming, despite the low level of technology adopted by the producers, is profitable.

Table 7.2. Profitability of Eggplant Production

Profitability per ha of Eggplant Production	
Average Yield (Kg/ha)	3,323
Average Price (Fg/kg)	3,245
A) Average Total Revenu (Gf)	10,782,333
(B) Average Total Variable Costs (Fg)	1,915,402
Seed cost	238,537
Manure cost	289,962
Pesticide cost	606,686
Labor cost	780,217
(C) Average Total Fixed Costs (Fg)	1,059,821
(D) Total farm production cost (B+C) in Fg	2,975,223
(E) Gross Margin (A-B) in Fg	8,866,931
(F) Farm Income (A-D) in Fg	7,807,110
Benefit Cost Ratio (A/D)	3.62
Income Ratio H/A*100	72.40
Ratio Net Farm Profit to Revenu (F/A)	0.72

7.4.Determinants of Total Factor Productivity (TPF) among Eggplant Farmers

The data in Table 7.3 show the results of the economic analysis for determinants of total factor productivity among eggplant farmers in the study area.

Table 7.3. Determinants of Total Factor Productivity

Variables	Coefficient	Std. Error	t-statistics
Constant	-2.293	0.789	-2.907
Gender	-0.006	0.028	-0.226
Farm size	1.075***	0.060	17.882
Group Membership	0.028*	0.031	0.932
Farming experience	0.012	0.038	0.323
Family labor	0.078*	0.049	1.591
Education	-0.033	0.059	-0.554
Household Income	0.625***	0.065	9.588
Extension contact	-0.014	0.013	-1.122
Off farm income	0.063	0.041	1.533
Production costs	-0.821***	0.075	-10.968
R-square			0.923
Adjusted R square			0.827
F(10,18)	103.696***	VIF	1.74

Note: ***,**,* denotes significance at 1%, 5% and 10% respectively; Values in parentheses are standard errors

Source: Author's computation; Survey Data, 2014

The coefficients for farm size, group membership, family labor and household income were positively associated with eggplant productivity, significant at 1%, 10% and 1% respectively. This implies that an increase in farm size, group membership, family labor and household income by 1%, will increase the total factor productivity of eggplant farmers by 1.075%, 0.028% 0.078% and 0.625% respectively.

Production costs however negatively affected productivity. A unit increase in cost of production leads to a 0.821% decrease in Total factor productivity of the eggplant farmers.

7.5. Determinants of Eggplant Production Income

Table 7.4. Determinants of Income from Eggplant Production

Variables	Male		Female		Total sample	
	Coefficients	Std. Error	Coefficients	Std. Error	Coefficients	Std. Error
Constant	-26,251,695.542	14,031,909.980	-4,074,475.018	6,024,633.429	-4,392,102.682	5,505,536.262
Family size	-771,644.681	420,784.971	-97,874.573	133,249.809	-72,481.267	136,837.793
Group Membership	8,180,955.055**	2,671,822.323	-874,347.299	1,112,393.353	3,020,266.237***	1,057,304.820
Education	11,748.142	284,783.666	-35,616.899	155,522.994	8,3141.008	133,243.322
Ratio of active fam	16,275,674.664	9,431,825.908	7,756,405.217*	4,297,436.707	8,359,892.372**	4,099,275.216
Farm size	3,494,786.529**	1,424,259.524	6,061,736.267***	896,714.110	5,198,742.892***	790,028.620
Production levels	2,730.778**	992.011	2,261.144***	799.907	2,034.343***	550.054
Market price	7,796.972**	3,491.371	3,620.742**	1,550.034	3,624.102**	1,425.988
Production costs	-3.254***	0.695	-1.075***	0.216	-1.414***	0.214
Price information	2,237,326.513	3,526,510.591	-666,925.361	1,502,340.496	-1,965,633.715	1,366,278.243
Sales mode	1,916,977.736	2,992,332.647	-601,993.133	1181,294.873	469,128.534	1,135,906.236
R-square	0.928		0.815		0.789	
Adjusted R square	0.847		0.775		0.757	
F		11.54***		20.67***		25.024***

Note: ***,**,* denotes significance at 1%, 5% and 10% respectively; Values in parentheses are standard errors

Source: Author's computation; Survey Data, 2014

The variables significantly and positively affecting the eggplant producers' income are the membership in farmers groups, farm size, the ratio of active family members, the production levels and the market price.

The value of the R square of 0.789 indicates that 78.9% of the change in producers' income is accounted for the variables. Production cost is negatively associated with farm income.

7.6. Constraints to Eggplant Production

Table 7.5. Production and Marketing Constraints

Production constraints	Frequency	Marketing constraints	Frequency
Lack of fertilizer	48 (61.5)	High transport cost	32 (41.0)
Lack of seed	32 (41.0)	Low/ unstable price	48 (61.5)
Lack of other inputs	38 (48.7)	Limited sale outlet	38 (48.7)
Lack of farm material	40 (51.3)	Poor infrastructures	38 (48.7)
Pest and disease	49 (62.8)	No price information	46 (59.0)
Climate factors	23 (29.5)	No output buyers	13 (16.7)
Lack of fund/credit	47 (60.3)		
Labor shortage	15 (19.2)		
Household related factors	32 (41.0)		
No technical support	50 (64.1)		
Poor irrigation	25 (32.1)		

As for majority of farmers, production and marketing constraints are various. Farmers in the study area respectively listed the lack of technical support (64.1%) as the main problems in eggplant production. This is followed by the negative effects of pest and diseases, lack of fertilizer and the lack of other farm material among others.

As for the marketing constraints, farmers are faced with low price of produce (61.5%) followed by the lack of price information, the limited sale outlets and the poor quality of the marketing infrastructures as well as the lack of produce buyers.

CHAPTER VIII

CONCLUSION AND POLICY RECOMMENDATIONS

8.1. Summary of Findings

The present study investigates the income effects, resource efficiency and the institutional arrangement in the horticulture sector in Guinea.

Farmers' organizations are indispensable in facilitating and enhancing farm production and incomes of smallholder farmers in Guinea. Their potential for realizing pro-poor economic grow can no longer be underestimated. However, despite their growing importance, studies on farmers' organizations in Guinea are limited and there is still very little in the scientific literature about the importance and impact of farmers' organizations in Guinea.

Results from our empirical study revealed the following.

Firstly, the household resource endowments of the sample farmers present no significant difference between group members and non-members. Secondly, variables that significantly influenced membership into farmer groups are age of the household head, gender of the farmer, education level, land ownership, extension service, credit access and income from non-farm activities. Age of the farmer, land ownership, extension service, credit access and off-farm income positively influenced group membership whereas gender (if farmer is male) and education level had a negative effect on farmers' decision to join farmer groups. Thirdly, shedding light on the factors affecting farm income, results of the regression model showed that group membership was significant and positively associated

with farm income. The results also point that farm income is positively and significantly affected by labor used, potato price, share of potato sold and cultivated potato area. Furthermore, the analyses on the profitability estimation revealed that group members were able to earn significant higher net farm profit than non-members; the results show that there was a statistically significant difference in terms of net farm income between farmers' group members and non-members.

These outcomes support the assertions in the farmer organizations literature that group membership has the potential to benefit farmers by increasing their incomes and that farmer organizations provide a good platform for the provision of farm production inputs and marketing of output; this can immensely enhance farm productivity and increase farm income thereby contributing to the reduction of poverty.

This study focused on the economic analysis of potato production in three districts of the Fouta Djallon highlands. Specifically, the study identified the factors affecting the quantity of potato produced and supply to the market as well as the resource use efficiency. The results showed that potato area, the use of improved seeds, fertilizer, and production losses significantly influenced potato output; while education, the quantity of potato produced, quantities retained for seed, food and gifts, potato price and the share of potato sold four weeks after harvest, influenced the amount of potato marketed. The results also showed that farm resources were not efficiently utilized for potato production as well as pineapple production. Potato seeds, labor and fertilizer were all over-utilized, showing that none of the production inputs were optimally allocated and utilized. This was particularly attributed

to farmers' limited knowledge and lack of technical skills, suggesting that farmers should be educated through extension services.

Findings from the current study suggest that to enhance production, farmers should expand extent of land under potato cultivation within their existing farmland. To fully tap the potential of increased potato production and marketing, improvement in the level of farm however requires an understanding of the technical constraints in the use and allocation of resources such as fertilizer, seeds and labor. To benefit from better potato price and strengthen their bargaining power, producers are encouraged to actively participate in farmers groups. As an important institutional vehicle, farmer organizations should be encouraged and given appropriate support. Membership in farmers' group is likely to increase producers' income earning capabilities due to skills and joint learning among them as opposed to individual producers. Government and development organizations should work closely with farmers' groups as they are portrayed as the most effective outlets for inputs and output markets for smallholder farmers in Guinea. In addition, to realize higher incomes and productivity from potato production, the adoption of new agricultural technologies, improved agricultural and market infrastructures are indispensable and should be made affordable to the vast majority of resource-poor farmers. Results finally suggest the need to formulate policies aimed at efficiently addressing producers' production and marketing constraints and needs so as to boost agricultural production and farmers' access to markets in Guinea.

8.2. Policy Implication and Recommendations

From a policy implication perspective, this is crucial since the integration of smallholder farmers in the market-oriented production through farmer organizations can transform the rural economy through increased incomes. Improving agricultural productivity being one of Guinea's agricultural policy priorities, farmers' organizations can, in this respect, play an important role in improving the level of agricultural technology adoption and achieving better growth in the sector. In order to reduce poverty and improve food security in rural Guinea, there is a need to support and promote farmer organizations. Such approach should also be reinforced with investment in agricultural and transport infrastructure if farmer organizations are to efficiently play their role and become market outlet for smallholder farmers in Guinea.

Finally, despite the limited scope of the study as the results are based on a relatively small sample size, the findings of this paper contribute immensely to the limited body of knowledge on farmers' organizations and their benefits in Guinea. In particular, our findings suggest that providing support to farmers' organizations is important for the intensification and development of smallholder agriculture in Guinea through provision of improved farm inputs and output marketing. Since farmers' organizations are assuming much significant role for smallholder farmers in Guinea, we believe further research is needed to know more about the pathways of the impact of farmers' organizations on smallholder agriculture in Guinea. In particular, the key research areas would be on the desired impact of farmers' organizations on their members' economic activities, bargaining

power and commercialization by farmers in Guinea. It would also be essential for future research to focus on the impact of farmers' organizations on the adoption of improved agricultural technologies by smallholder farmers in Guinea.

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ECONOMIC ANALYSIS OF INCOME EFFECTS, RESOURCE-USE EFFICIENCY AND INSTITUTIONAL ARRANGEMENTS IN THE HORTICULTURE SECTOR IN GUINEA

ABSTRACT

In developing countries such as Guinea, smallholder agriculture remains important for development and poverty reduction. The country boasts significant agricultural assets, for accelerating growth and creating lasting jobs. There is a relatively long rainy season, with annual rainfall ranging from 1,200 mm to 4,000 mm, and providing about 400 billion m3 of water. Moreover, with 6.7 million hectares of arable land and an estimated 367,000 hectares of developable areas for irrigation, the agricultural sector accounting for nearly 25% of the country's GDP, plays a significant role by providing a broad-based income and employment to about 80% of the workforce. However, growth in the sector is inextricably bound to the macroeconomic progress in the country. Most of the smallholder farmers are engaged in subsistence and semi-commercial farming, producing food stables such as rice, potato, maize and horticultural crops, for own consumption and commercialization. Several initiatives by governmental as well as non-state actors are in place to promote intensification and commercialization of smallholder farming. The problems with the Guinean smallholder agriculture dwell on the use of traditional technology which is associated with low productivity, the large majority of the crop area being cultivated by hand. Cash crops farming is dominated by spot markets, with an increase of some movements towards farmers' engaging collectively in crops production and marketing through producer organizations. Farmers'

organizations as institutional innovation tools are inclusive of the poor and are charged with the purpose of becoming a market outlet for smallholder farmers.

Empirical studies on smallholder farmer productivity and farmer organizations in Guinea remain largely scanty, isolated and devoid of in depth analyses of the income effects, resource use efficiency of smallholder cash crops farmers and how membership in farmer organizations affects farm income. The current study was therefore designed to provide insights into the trade-offs between horticultural crops production, the institutional players and the effects of the latter on farming income in Guinea. Mainly, the study emphasizes on pineapple, potato and eggplant production economics, farmers' resource use efficiency and the income effects of their participation in farmer organizations. Using econometric analytical tools, the analyses performed in this study are based on a set of primary data collected from a sample of 268 farmers in a two-wave field survey in 2012 and 2014, respectively in Middle Guinea (Pita and Labe prefectures) and Lower Guinea (Kindia prefecture). The main objective of the study is to investigate the income effects, resource use efficiency in the Guinean horticulture sector and the linkages with farmer organizations. To achieve this goal, the analytical tools employed include: descriptive statistics analysis, profitability analysis, productivity analysis, the Heckman two-step selection model, production function analysis and resource use efficiency among others.

The study is organized and presented in eight chapters. The First Chapter introduces the dissertation with highlights on the background of the study, the problem statement and research questions and the objectives of the study. In addition, the chapter presents the significance and limitations of the study and finally concludes with the organization of the

dissertation and the conceptual framework employed for the study. The Second Chapter presents an overview of the agricultural development, the horticulture sector and farmer organizations in Guinea. Chapter Three provides details on the research design and methodology, including a description of the study areas, sampling procedure and data collection as well as the analytical tools used for the study and a framework of analysis.

In Chapter Four, an assessment of the effects of farmer organizations on the smallholder potato farmers' income is presented with highlights on the profitability analysis of potato farming and the determinants of membership in farmer organizations. In this chapter, the Heckman two-stage sample selection model used to assess the effects on farm income of group membership, revealed in its first stage that the age of the potato farmers, land ownership, extension service, credit access and off-farm income are positively associated with group membership while gender and education level of the farmer negatively influenced their decision to join farmer groups. Results of the second stage outcome equation found positive farm income effects of group membership. Furthermore, results revealed that farm income is predominantly determined by labor used, the size of the cultivated potato area, share of potato sold and potato market price. In Chapter Five, the Cobb-Douglas production function and a supply function were used to investigate the determinants of potato production and supply by smallholder farmers. The results showed that potato area, improved seeds use and fertilizer, positively influenced the potato output, while production losses are negatively associated with the potato output. Results from the supply function revealed that quantity produced, price of potato and share of sales four weeks after harvest were positively associated with quantity of potato supplied to the market, whereas quantities retained for seed, food and gifts, and post-

harvest losses have negative effects on the quantity of potato marketed. Results also revealed that none of the relevant production inputs used by the sample farmers were efficiently allocated and utilized. Insights from the econometric model used to explore the pineapple production economics and resource use efficiency presented in Chapter Six, showed significant results. Pineapple output was positively associated with the farm size, membership in cooperatives and labor used. Estimates of the marginal value and efficiency of resource use revealed that none of the resources was optimally allocated as their marginal value products were not sufficient to offset costs. Fertilizer and other agrochemicals were underutilized while labor was over utilized. The profitability analysis however showed that pineapple farming is highly profitable for the farmers; with cooperative members realizing nearly twice the profit on farm investment. The eggplant production economics and its contribution to farmers' income is covered in Chapter Seven. Results from the multiple linear regression showed that income from eggplant production is determined by the farm size, ratio of active family members, membership in cooperatives and the market price; while the cost of production was significant and negatively associated with the farm income. Despite the low levels of technology adoption, the profitability analysis showed a highly significant ratio of net farm profit to revenue, especially for female producers.

Finally, in Chapter Eight, the conclusion and policy implications are presented. In the first part, the summary of findings confirms that farmers are indeed resource-poor, cultivating on average less than one hectare and presenting no significant difference in terms of socioeconomic and demographic characteristics. With poor farm assets, farmers face numerous and similar production and marketing constraints across the study areas, including

the lack of inputs, poor irrigation, pest and diseases, poor infrastructures, the lack of adequate storage facilities among others. The government and development stakeholders should therefore encourage and support farmer organizations as the latter play a significant role in providing inputs and output markets with positive impact on producers' income; promote the adoption of improved agricultural technologies and practices through effective extension services; improve the agricultural and market infrastructures so as to boost smallholder farmers' productivity and income earning capacity. Overall, the findings of the study are important and provide knowledgeable facts on smallholder horticulture production and farmer organizations in Guinea. This also immensely contributes to the limited body of literature and as such, provides useful insights for the government policy makers, researchers and other relevant stakeholders whose interest might be in subsequent studies.

ギニアにおける園芸作部門の所得効果、資源利用効率と生産者組織に関する経済分析

ギニアのような発展途上国では、小規模農業は経済成長と貧困の削減のために未だ重要な役割を果たしている。ギニアは経済成長を加速し持続的な雇用を創出するために重要な農業資源を有している。ギニアでは比較的長期間の雨期があり、年間 1,200～4,000mm の降雨により 4,000 億立方メートルの水が供給されている。耕地面積は 670 万 ha あり、そのうち 36.7 万 ha は灌漑が可能であると推計されている。農業部門は国の GDP の約 25%を占め、労働人口の 80%に所得と雇用の幅広い機会を提供する重要な役割を果たしており、農業部門の成長が国のマクロ経済の動向にしっかりと結びつけられている。小規模農家のほとんどが,自家消費と販売のために米、ジャガイモ、トウモロコシ及び園芸作物等の生産を行っている。このような小規模農業を集約化し商業化を促進するために、政府や非政府組織によっていくつかの取り組みが行われている。

ギニアの小規模農家の課題は、農民が生産性の低い伝統的な技術を利用し、大部分の作物が手作業で栽培されている点にある。商品作物の生産は現金取引市場に支配されているが、農民が生産者組織を通じて作物の生産と販売を行う動きが現れている。生産者組織には、貧困層を巻き込み小規模農家の市場への販売経路となる制度改革の手段となることが託されている。

しかし、ギニアの小規模農家の生産性と生産者組織に関する研究は、これまで十分に行われておらず、特に小規模な商品作物生産農家の所得効果や資源利用の効率、生産者組織への加入が農家の収入に及ぼす影響などについての分析が欠けている。

本研究では、主にパイナップル、ジャガイモ、ナスを生産する農家の生産経済、資源利用の効率と生産者組織への参加による所得への影響に焦点を当てている。

分析は 2012 年と 14 年の２回の農家調査で得た合計 268 戸の農家データを用い、計量経済分析を行った。本研究の主目的は、ギニアの園芸部門における小規模生産者の所得への影響、資源の利用効率、生産者組織への参画の影響を明らかにすることである。この課題を達成するために、記述統計分析、収益性分析、生産分析を実施し、生産分析ではヘックマンの２段階推定、生産関数分析等の計量経済的手法を用いた。

本研究は、８章からなる。第 1 章は、研究の背景と問題の所在、研究の課題を論述し、論文の構成を示した。第 2 章は、ギニアにおける農業開発の現状、園芸部門と生産者組織の概要を述べた。第 3 章は、調査地域の概況、調査農家のサンプリング方法と調査方法、分析方法について述べた。

第 4 章では、ジャガイモ生産の収益性分析、生産者組織加入の決定要因の分析を中心に、小規模ジャガイモ生産者の収入に及ぼす生産者組織の影響を評価することを目的とした。この章では、ヘックマンの２段階推定を用いて、組織への加入が農業所得に及ぼす影響を評価した。分析の結果、性別や教育レベルは農民の組織参加に負の影響を及ぼしているのに対し、生産者の年齢、土地所有の状況、普及サービスの利用、金融へのアクセス、農外収入の程度が組織への加入と関係を持っていた。また、組織への参加が農業所得を増やすことを示した。さらに、農業所得が多くの場合労働力の利用状況、ジャガイモの生産面積、生産物の商品化率、市場価格により決まることを示した。

第５章では、小規模農家によるジャガイモの生産供給の決定要因を明らかにするために、コブ･ダグラス生産関数と供給関数を用いた分析を行った。分析の結果、生産ロスがマイナスの影響を及ぼすのに対して、ジャガイモの栽培面積、改良品種や肥料の使用がジャガイモの生産量に影響していた。供給関数の分析結果からは、種子用、自家消費用、贈答用に用いるジャガイモの比率、収穫ロスが負の影響を、ジャガイモの生産量、価格、収穫直後に販売した比率が市場へのジャガイ

モの供給量にプラスの影響を及ぼしていた。また、分析の結果、調査農家における生産資材の投入はいずれも効率的に利用されていないことが示された。

第６章では、パイナップル生産の経済性と資源の利用効率を検討した。パイナップル生産の収益性は、農場の規模、組合への参加、労働力の利用状況に関連していた。限界価値と資源利用の効率性の推計値より、限界価値が費用を相殺するのに不十分であり、資源が最適に利用されていなかった。労働力は過剰投入されているが肥料や農薬は十分に利用されていない。しかしながら、収益性分析の結果、パイナップル生産は生産者にとって高収益であり、組合員は農場への投資の２倍の利益を実現していた。

第７章では、ナス生産が生産者の所得に及ぼす影響を明らかにした。多重線形回帰分析の結果、ナスの生産コストは農場収入と負の関係があるのに対して、収入は耕作面積規模、家族内の農業従事率、組合の会員、市場価格により決定されていた。栽培技術採用の低さにも関わらず、収益性分析では特に女性の生産者が収入に対し高い所得をあげていた。

最後に、第８章では論文の結論と政策的含意を提示した。農民の所有する資源は乏しく平均 1ha 以下の耕作面積であり、社会経済的および人口統計学的特性の面で有意な差は存在しない。農民は投入資材の不足、貧弱な灌漑、病害虫、インフラの不足、適切な貯蔵施設の不足等の生産上、販売上の制約に直面していた。

それ故、政府や開発の利害関係者は、生産資材の供給と生産物の販売において生産者組織を奨励し支援すべきである。生産者組織は、改良農業技術と効果的な普及サービスの提供、小規模農家の生産性と所得獲得能力を高めるための農業生産や市場のインフラの改善によって、生産者の収入に重要な役割を果たすことができる。全体を通じた研究の結果は、ギニアにおける小規模園芸作物生産者と生

産者組織に関する有益な知見を提供しており、政府の政策立案者、研究者、その他の利害関係者にも有用である。

List of Related Publications

Tolno, E., Kobayashi, H., Ichizen, M., Esham, M., & Boubacar SiddighiBalde, B.S (2015). Economic Analysis of the Role of Farmer Organizations in Enhancing Smallholder Potato Farmers' Income in Middle Guinea. Journal of Agricultural Science; Vol. 7, No. 3; 2015 Covered in Chapter II, Chapter III and Chapter IV

Tolno, E., Kobayashi, H., Ichizen, M., Esham, M., & Boubacar SiddighiBalde, B.S (2015). Potato Production and Supply by Smallholder Farmers in Guinea: An Economic Analysis Asian Journal of Agricultural Extension, Economics and Sociology Volume 8, Issue: 3 Pages: 1-16, 2016; Article no.AJAEES 21726; ISSN: 2320-7027 Covered in Chapter III and Chapter V.