Agricultural investments, labor productivity and rural poverty reduction: gender disparities in Togo

Based on CBMS Database 2018

Draft 3 Thematic study Paper

13-05-2019

Project Team Members

Dr. Esso – Hanam ATAKE (Project Leader/Director)
Emails: asylvestre22@yahoo.fr ; atakesyl@gmail.com
Telephone number: +228 91569433/93609504

Research Team Members

This project was approved under the Community-Based Monitoring System program of PEP. This is being funded by the Department for International Development (DFID) of the United Kingdom (or UK Aid) and the International Development Research Centre (IDRC) of Canada.

List of tables

List of figures

Table of contents

List of acronyms

AGRISEF	:	Farmers Access to Financial Services
AJSEF	:	Youth Access to Financial Services
APSEF	:	Poor Access to Financial Services
AU	:	African Union
BAD	:	African Development Bank
CAADP	:	Comprehensive Africa Agriculture Development Program
ECOWAS	:	Economic Community of West African States
FAO	:	Food and Agriculture Organisation
FCFA	:	Francs des Communautés Françaises d'Afriques
FNFI	:	National Fund for Inclusive Finance
GDP	:	Gross Domestic Product
HDI	:	Human Development Index
IFPRI	:	International Food Policy Research
INSEED	:	Institut National de Statistiques et des Etudes Economiques
IRR	:	Internal Rate of Return
MAEP	:	MINISTERE DE L'AGRICULTURE, DE L'ELEVAGE ET DE LA PECHE
NEPAD	:	New Partnership for Africa's Development
PADAT	:	Project to Support Agricultural Development
PASA	:	Agriculture Sector Support Project
PNIASA	:	National Agricultural Investment and Food Security Plan
PNUD	:	Programme des Nations Unies pour le Développement
QUIBB	:	Questionnaire des Indicateurs de Base du Bien-être
SMIG	:	Interprofessional Guaranteed Minimum Wage
USD	:	United Stated Dollar
WAAPP-Togo	:	West Africa Agricultural Productivity Program in Togo
WB	:	World Bank
WFO	:	World Farmers Organization
WILDAF	:	Women in Law and Development in Africa

Abstract

In most countries of the world, improving agricultural productivity has been one of the major contributors to rural poverty reduction. Despite the crucial role of agriculture in countries' economic development, there is little information on the investments impact in this sector in order to inform policy makers and to interest them in increasing these investments for rural poverty reduction, especially in developing countries. Thus, the general objective of this study is to assess the impact of agricultural investments on labor productivity and poverty reduction in rural areas following a gender disparity. To achieve these objectives, descriptive statistics analysis and econometric model estimates of agricultural households was carried out on data collected from 4543 households in four townships in rural areas.

The main results of this study reveal that about 75.44% of farmers have at least the primary school education level. There are more women farmers with no education (41.85%) than men farmers (15.10%). Most households had between 1 and 3 persons (68.37%). Turning next to public services, we also found that access to safe water and sanitation remains a major problem in rural areas. About 51.17% of rural household do not have sanitation. It shows that farms do not have health insurance in the investigated areas. Looking for insurance against natural disasters, the results reveal that the majority of women and men have no access to this insurance. Moreover 75.60% of farmers have an average monthly income lower than the Interprofessional Guaranteed Minimum Wage (SMIG).

The econometric results reveal that, public investments in health education and telecommunication infrastructure improve the productivity of farmers. Moreover, the investments made by farmers in terms of inputs also contribute to improving their productivity. In this dynamic, we found that this increase in the productivity due to public and private investments made in rural areas reduces the number of farmers below the poverty line.

Considering the labor force in our study area, the estimated farm income gap between men and women is 44.1%.

however, it would be interesting to increase public investments and encourage private investment in education, health, drinking water and irrigation infrastructure. In addition, remote equity in the distribution of endowments (land for example) to equalize opportunities for disadvantaged or excluded groups, such as women, could reduce the income gap between men and women.

1 Introduction

1.1 Background and rationale of the study

Poverty reduction remains a major challenge, despite the substantial progress made in Togo. After a long period of socio-political crises, factors namely the resumption of international cooperation, investments in infrastructure, and the promotion of employment, have led to renew of the country's economic growth. Indeed, Gross Domestic Product (GDP) growth was estimated at 5.5% in 2014, 5.7% in 2015 and should reach 5.9% in 2016 (African Development Bank, 2015). This renewed growth has had a significant impact on poverty reduction. The incidence of poverty fell from 61.7% in 2006 to 58.4% in 2011, and was estimated at 55.1% in 2015 (INSEED, 2016a). Unfortunately, this poverty reduction has not sufficiently favored poor households (INSEED, 2016a).

It was noticed the persistence of poverty in rural areas, with a large disparity compared to urban areas. In 2015, the incidence of poverty was 68.9% in rural areas while it was 37.8% in urban areas (INSEED, 2016a). In 2015, seven rural households out of ten were using nature as a place of ease, while in urban areas households were nearly no longer using nature as a place of ease (INSEED, 2016a). Moreover, in 2015 only 16.2% of rural households had access to electricity, while this rate was 90.3% and 76.9% respectively in Lomé the capital city and in other urban areas. In short, analysis by place of residence shows that in rural areas more than seven out of ten households were poor (73.9%) (INSEED, 2016b). Thereby, it follows that despite the government's endeavor to improve Togolese's wellbeing, results have not met expectations yet, especially for rural population mainly agricultural. The predominantly agricultural rural population remains the poorest group, among the socioeconomic groups (PNUD Togo, 2011).

Of the 531,068 rural households counted during the fourth National Census of Agriculture in 2011, 95.8% were agricultural, against 4.2% non-agricultural (MAEP, 2013b). Is defined as agriculturally active in Togo: "every person aged fifteen (15) years and over involved in an agricultural activity, either on a full time or part time basis. Pupils, students and apprentices are excluded, even if their participation is significant and if they have their own field " (MAEP, 2013a). Furthermore, the agricultural sector contributes about 38% to the real GDP against 23% and 36%, respectively for secondary and tertiary sectors (FAO, 2012). It employs 40.7% of the total labor force (FAO, 2012). Despite this significant contribution to the country's economic

growth, analysis of the incidence of poverty by socioeconomic group of household head showed that in 2015, poverty was higher among households headed by independent farmers (INSEED, 2016a). The incidence of poverty of agricultural households was 72.6%, in 2015 (INSEED, 2016a). Producers (exclusively rural) of the agricultural sector considered as the engine of the economic development of Togo should be counted among the main beneficiaries of the economic performance given their levels of contribution to the GDP, if investment choices and adequate agricultural policies were implemented.

Indeed, impact of agriculture on poverty reduction depends on the interaction of several effects. Firstly, the direct effect of the agricultural sector growth is to improve income of employees in that sector (Grewal, Grunfeld, & Sheehan, 2012). Many poor households have a marginal attachment to agricultural employment; and growth of this sector should allow them to have a decent job and / or a better paid job (Grewal et al., 2012). Secondly, active participation of poor population in agricultural sector would depend on the extent of benefits they obtain from the growth of that sector (Grewal et al., 2012). But this depends on the type of agriculture practiced and the structure of properties. Poverty reduction in vulnerable agricultural populations would depend on the types of agricultural investments made, incentives for participation in agricultural activity, and the distribution of agricultural income. Increases in yields or farm productivity can come from increased use of inputs such as agricultural chemicals, and improvement of techniques (S. L. Wang, Heisey, Schimmelpfennig, & Ball, 2015). Use of improved varieties and other new agricultural technologies are also source of productivity improvement (Evenson & Gollin, 2003). Agricultural growth requires dissemination and use of biological control agents against pests for some major crops (Maredia & Raitzer, 2006). Moreover, agricultural productivity growth is correlated to R & D and other policies such as education and health status of workforce, transport infrastructure, pricing policies, etc. (Fuglie & Rada, 2013). In this light, many programs have been implemented in Togo, in order to improve farmers working conditions and reduce their vulnerability.

The Comprehensive Africa Agriculture Development Programme (CAADP) is at the center of efforts made by African governments at the initiative of the African Union (AU) and the New Partnership for Africa's Development (NEPAD), to accelerate growth and reduce hunger in African countries. Implementation of CAADP has resulted, in 2005 in the regional agriculture policy of the Economic Community of West African States (ECOWAP). To this end, the Togolese government has adopted in 2011 the National Agricultural Investment and Food Security Plan (PNIASA), to support farmers, particularly the most vulnerable. With support of

Food and Agriculture Organization of the United Nations (FAO) and the World Bank (WB), PNIASA aims at increasing farmers' incomes and enhancing sustainably the living conditions of rural people, particularly vulnerable populations, women and youth (MAEP, 2012). This program involves three complementary projects: (i) Project to Support Agricultural Development (PADAT), (ii) Agriculture Sector Support Project (PASA), and (ii) West Africa Agricultural Productivity Program in Togo (WAAPP-Togo). These projects have enabled the rehabilitation and the enhancement of beneficiaries' production capacities by focusing on some channel values, and the establishment of a favorable institutional environment, etc. (World Bank, 2014). Kits comprised of rice and corn seeds, fertilizer, herbicides, and sprayers have been made available to producers.

Despite these substantial progresses, Togolese agriculture is still facing enormous constraints. infrastructural condition, agricultural equipment, credits, and governance remain worrying (World Bank, 2014).

Approximately, 85.1% of the seeds used in rural areas is of traditional type (MAEP, 2013b). 88.7% of plots received traditional seeds. Seeds used by farmers, were largely from the agricultural exploitation: 67% of farmers collect seeds from their own production and 24% buy it in traditional markets (MAEP, 2013b). In 93.8% of farm households, agricultural production fell because of drought or the irregularity of rains. The second shock is the high rate of crop diseases (90.7%) and the third is linked to the destruction of crops by animals in transhumance pasturing (88.5%) (INSEED, 2016b). In 2008, the overall cost of agricultural damages caused by floods is about 11 billion CFA francs, of which 83.8% for food production, 12.5% for cotton and 3.7% for animal and other productions. With financial problems (difficulty to repay loans to microfinance institutions), some farmers opt for rural migration and non-farm activities. The vast majority of the rural population consists of small producers (Government of Togo & United Nations, 2011). They are poorly monetized, explaining their low productivity and their inability to take advantage of market opportunities (national or international) to increase their income and to access a number of services that could improve their living conditions (Board, 2012). Togo's agricultural sector is globally characterized by low input use (improved seeds), insufficiency and poor quality of rural infrastructure, rudimentary equipment, low organization of producers, low access to credit, small farms, land insecurity, etc. (Government of Togo & United Nations, 2011).

A 2009 study by the International Food Policy Research (IFPRI) on agricultural performance in Togo revealed that halving the number of rural poor would require 9.6% annual growth in the

agricultural sector during a five-year period (Government of Togo & United Nations, 2011).This constitutes a major challenge. It is up to policy makers to develop coherent policies in terms of rural poverty reduction.

To analyze the effect of agricultural investments (RD, education, health, sanitary, transport infrastructure, access to credit, etc.) on agricultural productivity and rural poverty reduction, in order to suggest strategies for a pro-poor agricultural growth, this study intends to fill information gaps for diagnosing the extent of rural poverty, determining the causes of rural poverty, formulating policies in favor of rural farm households, and assessing impact of agricultural investments on rural poverty reduction. It is intended to promote evidence-based decision-making.

In particular, this study intends to enlighten policy makers about the extent of disparities between men and women in agricultural investments, productivity and living standards. It should be emphasized that Togolese rural population is characterized by a predominance of female population representing respectively 51.2% of rural population; 51.1% of agricultural population and 54.2% of non-agricultural population (MAEP, 2013b). Women access to land, credit, education and technology can boost their productivity, and then enhance growth and social welfare (FAO, 2011). Increasing women's access to agricultural inputs could significantly reduce hunger and malnutrition. (FAO, 2011). The exclusion of women from access to and control over assets, whether land, technology or credit potentially lowers growth (Rao et al. 2008; Kelkar, 2011).

1.2 Research questions

1.2.1 Main research question

What are the gender disparities in agricultural investments, labour productivity and its impact or effect on poverty reduction?

1.2.2 Specific research questions

This study will address the following specific research questions:

a) *What are the effects of agricultural investments on male and female farm productivity?*

b) *What are the effects of farm productivity on rural poverty reduction by gender?*

c) *What is the level of gender wage gap in Togo' agriculture sector?*

1.3 Hypothesis

a. *Agriculture investments affects positively male farm productivity more deeply than female productivity thus increasing the gender rural poverty gap*

b. *Male wage workers in the agriculture sector receive remunerations that are much higher than what the average female wage workers receive.*

1.4 Objectives

This paper has two main objectives:

a. *Analyze the effects of agriculture's investments on productivity of plots managed by women with those managed by men;*

b. *Seek to understand whether agricultural productivity reduces rural poverty by gender*

c. *Analyze the gender wage gap in the agricultural sector.*

2 Review of Related Literature

Agricultural investments have been well documented and their effects on productivity and poverty are the focus of many empirical studies. In this section, we present the theoretical and empirical literature on the relationship between agricultural investments, productivity change and poverty reduction.

2.1 Theoretical Related Review

"Most of the people in the world are poor, so if we knew the economics of being poor, we would know much of the economics that really matters. Most of the world's poor people earn their living from agriculture, so if we knew the economics of agriculture, we would know much of the economics of being poor"(Schultz, 1980)

The agricultural sector provides, directly or indirectly, means of subsistence to the large part of the population in developing countries; even more in rural areas where poverty is much more

pronounced. This question fueled a plethora of theoretical studies. Many of these publications focus on the structural transformation of the economy in developing countries where the economic development is based largely on agriculture. Thus, the improvement of the economic situation in the agricultural sector would contribute significantly to economic growth and consequently to poverty reduction (Zepeda, 2001). Agricultural productivity gains can come from the increased use of inputs (land, labor, water, chemicals, physical capital, etc.) and from the improvement of production techniques (Chebbi & Lachaal, 2007). Indeed, the use of improved varieties coupled with new technologies can result in the improvement of the agricultural productivity (Evenson & Gollin, 2003). Moreover, the increase in agricultural productivity is correlated with R & D and other policies such as the improvement of human capital and the setting up of infrastructure (Fuglie, 2015). Thus, investments in education, health, infrastructure and social services can boost the contribution of the agricultural sector to economic growth and poverty reduction. The extension of infrastructure can facilitate access to cheap intermediate products and of a better quality; this would considerably reduce the costs of production and would increase the productive efficiency of farmers. Also, it should be noted that these infrastructures can improve the diffusion of new technologies and techniques, reduce marketing costs, and therefore stimulate productivity growth (Y.-C. Wang, 2015).

Moreover, the importance of agricultural growth, particularly through its effect on employment in the small scale rural non-agricultural sector was also demonstrated (Mellor, 1999). In the literature there are several channels through which agricultural productivity growth can contribute to poverty reduction: (1) direct effects of productive performances on the increase in farmers' real income, (ii) contribution to the creation of opportunities in other sectors, (iii) fall in the prices of agricultural products etc. (Schneider & Gugerty, 2011). Similarly, Bresciani and Valdés (2007) set the theoretical framework between productivity and poverty focusing on three pillars namely the labor market, agricultural incomes and the prices of agricultural products. Indeed, the increase in agricultural productivity can give rise to an increase in farmers' incomes; this also gives rise to an increase in the demand for non-agricultural goods and services. It should also be noted that the improvement of agricultural production stimulates employment in the agricultural and non-agricultural sectors through the increase in real income of households in these sectors.

2.2 Empirical Related Review

Investment and agricultural productivity

Empirical studies on agricultural investments are numerous and tend to conclude that the latter positively affect agricultural productivity change (Hayami & Ruttan, 1970; Nguyen, 1979; Schneider & Gugerty, 2011).

Fulginiti and Perrin (1998) examined the relationship between agricultural investments and the productivity of eighteen developing countries over the period 1961-1985. Using a non-parametric method, they showed a positive relationship between investment and agricultural productivity. The same results were found by (Zepeda, 2001). In Latin America, López and Valdés (2000) showed, on the contrary, that these investments affect slightly the productivity.

Velazco (2001) analyzed the factors that can influence agricultural productivity in Peru over the period 1950-1995. Using a Cobb-Douglas function of production, he analyzed how the use of fertilizer, technological progress and both private and private investments could improve agricultural productivity. The findings of this study had shown that private and public investments contributed positively to the improvement of agricultural productivity. As regards Asian countries, Chang and Zepeda (2001) analyzed the role of investments, both physical and human, on the improvement of agricultural productivity. The results indicate that the only alternative to improve agricultural productivity is to invest in human capital. Tripathi and Prasad (2008) for the case of India, conversely, showed that labor productivity alone is insufficient to improve agricultural productivity and suggest combining it with the productivity of capital and land.

Other studies have, however, explained the increase in agricultural productivity by investments in R & D (Fischer, Byerlee, & Edmeades, 2009; Githinji, Konstantinidis, & Barenberg, 2011). In this respect, Fan, Hazell, and Thorat (1999) analyzed the impact of investing in productivity and found that investments in road infrastructure and R & D have a significant and positive impact on agricultural productivity in India. Kiani (2008) for the case of Pakistan also analyzed the relationship between Investments in R & D and agricultural productivity over the period 1970-2004. The overall conclusion of this study is that investments in R & D played a very important

role in the growth of agricultural productivity. In another study on France, BUTAULT et al. (2015) tested the effect of R&D investments in agricultural productivity. They showed that these investments had had very significant effects on agricultural productivity. The conversion of these effects into Internal Rate of Return (IRR) estimates are approximately 30%. Generally, this result corroborates with numerous studies which have highlighted IRR relatively high - with a median of about 40% - (Alston, Babcock, & Pardey, 2010). Staatz and Dembele (2008) tested the same relationship in the rice production sector in Mali. The results showed that investments had considerably improved productivity in this sector.

African countries have also been the focus of empirical studies on agriculture investment and labor productivity change (Kibaara, Ariga, Olwande, & Jayne, 2009). Kibaara et al. (2009) analyzed the change of agricultural productivity in Kenya. The results highlighted a marked improvement in productivity. This improvement, according to the authors, can be explained partly by investment efforts in this sector. Muzari (2014) analyzed the evolution of agricultural productivity in sub-Saharan Africa and noted that the evolution of investments in human capital and R & D is similar to that of agricultural productivity. The authors then focused on measuring the impact of investments in agricultural productivity, especially in South Africa and Zimbabwe. The results highlight the potential benefits of investments (investments in infrastructure, reinforcement of agricultural human capital and R & D) in improving the agricultural productivity of these countries. Similar results are found in South Africa (Poonyth, Hassan, Kirsten, & Calcaterra, 2001; Thirtle, Piesse, & Gouse, 2005).

Agricultural productivity and poverty reduction

There is numerous empirical literature exploring the relationship between agriculture productivity and poverty reduction. Gallup et al. (1997) analyzed the effect of agricultural productivity on rural poverty and showed that an increase in agricultural productivity by 1% results in a rural poverty reduction by 1.61 %. Taking India as a case study and using general equilibrium model, Ravallion and Datt (1996) demonstrated that productivity in the agricultural sector is a key factor in reducing poverty. Many other empirical studies like Timmer (1995) for the case of Kenya; and Thorbecke and Jung (1996) for the case of Indonesia, reached similar results. With a sample of 25 countries, Cervantes-Godoy and Dewbre (2010) found that agricultural productivity plays a key role in reducing agricultural poverty. They found that more than 52% of poverty reduction in 12 of the 25 countries is driven by the growth of agricultural productivity.

Christiaensen, Demery, and Kuhl (2010) also showed that agricultural productivity positively affects the average income of farmers in rural areas. (Byerlee, Diao, & Jackson, 2005) tested the relationship between agricultural productivity and poverty in 12 developing countries. The results showed that the countries that improved their agricultural productivity experienced a decrease in the level of their rural poverty. Irz, Lin, Thirtle, and Wiggins (2001) have also shown that productivity generates more income for farmers and therefore contributes to poverty reduction. They have shown that a 1% increase in the agricultural productivity removes about 0.68% of the rural population from the poverty threshold. They have also shown that an increase in agricultural productivity by 1% results in an increase in the Human Development Index (HDI) by 0.12%.

Taking Ethiopia as a case study, Dercon and Gollin (2014) showed that improving productivity in the agricultural sector led to an increase in consumption by 16.3%; this resulted in a fall poverty by about 6.9 %. For the same country, Diao and Pratt (2007) reached similar results. Fan and Zhang (2008) for the case of Uganda showed that agricultural investments contributed to reduce significantly poverty. The same results are highlighted by Minten and Barrett (2008) in Madagascar. In the theory, other studies have shown that the rise in agricultural productivity has resulted in a fall of agricultural product prices, and therein a reduction of poverty and inequality (Binswanger & Quizon, 1989; Otsuka, 2000).

However, it should be noted that agricultural productivity growth can also be a source of the rise of poverty. Indeed, if the demand for agricultural products is very elastic, any increase in income will result in an increase in the demand for agricultural products and consequently in higher prices. This increase in prices aggravates rural poverty given that it makes it difficult for poor households to purchase goods and services. Thus, Byerlee et al. (2005) have demonstrated that in the Asian countries, the increase in the price of agricultural products due to productivity gains has increased rural poverty; similar results were already highlighted by Datt and Ravallion (1998). However, the latter showed that agricultural productivity generates jobs that ultimately reduce poverty. In this respect, Warr (2001) showed that besides jobs created for unskilled workers, the agricultural sector through productivity gains, contributes to the reduction of poverty in the rural area.

Conversely, Virmani (2007) found that in India, an increase in agricultural productivity by 1% leads to poverty reduction by 0.45%. Over the period 1990 - 2001, (Ravallion & Chen, 2007) found that in China the contribution of agriculture to poverty reduction is 3.5 times higher than

the contribution of the secondary sector or tertiary sector (1% growth in the primary sector contributes to reducing poverty by 7.85% against 2.25% for the non-primary sector). Later on, these results were confirmed by Montalvo and Ravallion (2010). Over the period 1993-2002, De Janvry and Sadoulet (2010) demonstrated that rural poverty was declining in East Asia owing to agricultural productivity gains. They also found the same results in some developing countries in Sub-Saharan Africa but conflicting results in Latin America. Indeed, they found that for the case of Latin America, productivity gains are driven by the capital factor, which does not create opportunities for job creation and de facto reduction of agricultural poverty.

Gender issues

Women play an important role in the rural economy in developing countries. Specifically, the World Farmers Organization (WFO) points that smallholder farmers mostly rural women account for a significant proportion of farming production (exactly 80% according to WFO, 2013). Women's productivity is lower than that of men; the main reason is both their input and human capital which are lower than those of men (IFPRI, 1995). For the case of Ethiopia, Tiruneh et al (2001) reveal that women' productivity is 35 % lower than that of men because of their weak utilization of input and poor access to extension services. In the Zimbabwean context, Horrell and Krishnan (2007) show that women's limited utilization of fertilizer and experience as well as the lack of access to extension service are the main factors explaining the low level of their productivity. Moreover, Mukasa and Salami (2016) find that reducing the gap in men's and women' productivity will increase monthly consumption per adult in Nigeria, Tanzania, and Uganda. Furthermore, Mukasa and Salami (2016) consider that to attain gender equality in the agricultural sector in Sub-Saharan Africa, it is a must to review land discriminatory laws and improve women's access to productive inputs (namely land, chemical fertilizer, improved seeds, and pesticides); also, we must promote women access to human capital, technology, agricultural finance, and extension services.

Lessons from the Literature Review

The review of related literature shows that some geographical areas have been studied more than others, with much more frequent studies on Asia compared to African countries. However, the latter are characterized by a rudimentary level of skills and equipment needed in modern agriculture; this results in a low productivity of farm workforce; hence a need to inform decision-makers about the importance of agricultural investments.

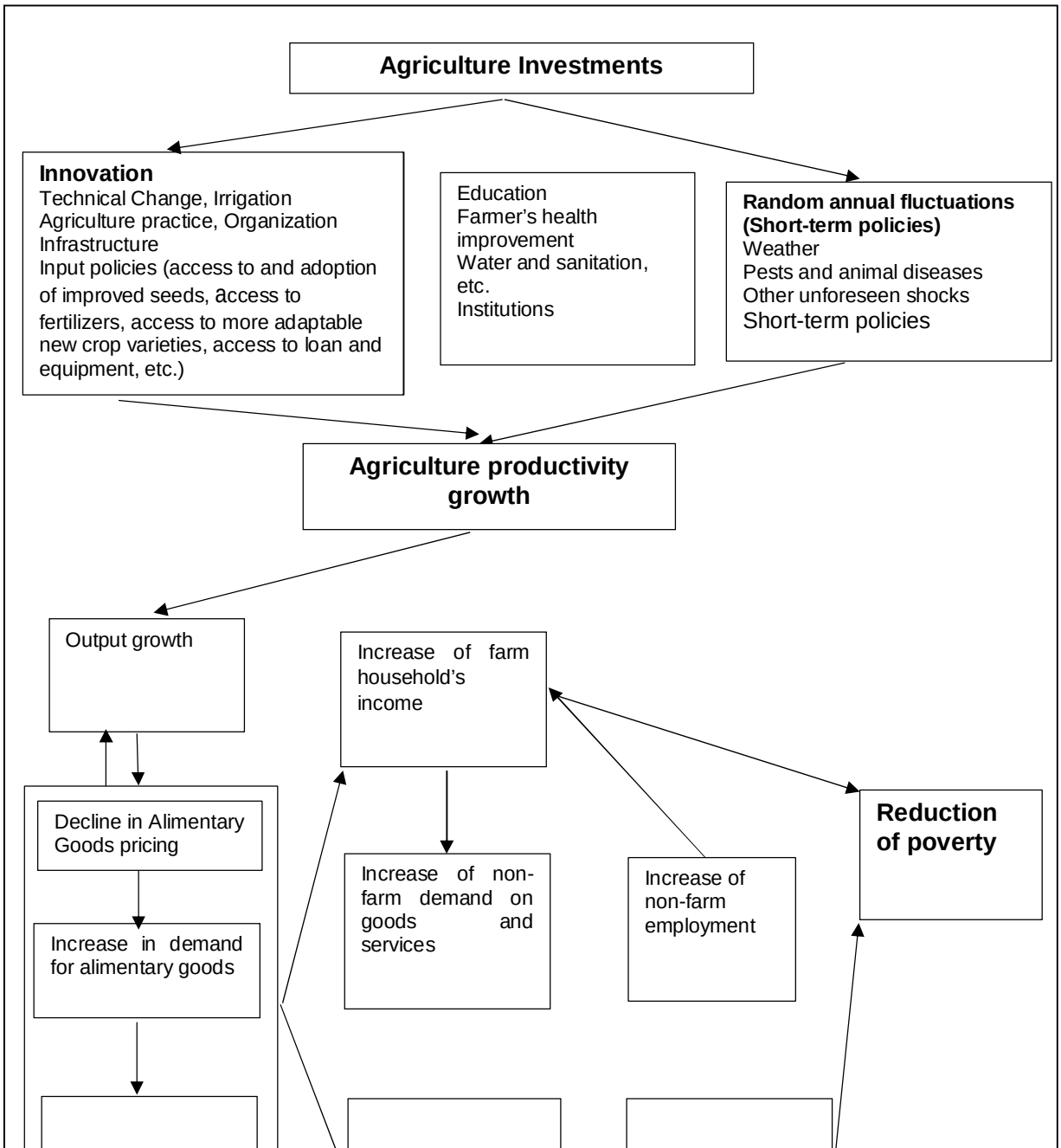
In sum, agricultural investments have a positive impact on agricultural productivity. However, from one study to another, the results are always mitigated. The review also shows that agricultural productivity contributes to poverty reduction. This contribution is all the more limited when it comes to the productivity gains of the capital. On the other hand, productivity gains can be a source of poverty if they lead to higher prices for agricultural and / or non-agricultural products. Effects on the reduction of Poverty are therefore conditioned to indirect effects on the creation of jobs. Also, it should be noted that despite its key role in poverty reduction, the growth of agricultural productivity in some cases leads to controversial results. Hasan and Quibria (2004) showed that if poverty reduction is driven by the agricultural sector in South Asia, it is rather driven by the industrial sector in East Asia. Finally, closing gender productivity gap would help households with female-managed lands climb out of poverty.

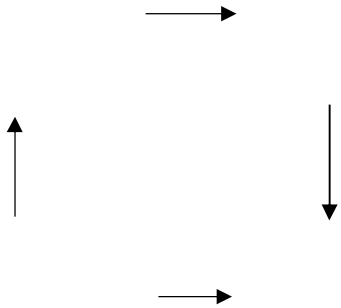
An investigation into this issue would be an even greater added value in the case of Togo where studies are few and almost non-existent to our knowledge.

3 Analytical framework

This paper assesses the impacts of agricultural investments on labor productivity and rural poverty reduction, following a gender-based analysis. Figure 1 illustrates the transmission channels between agricultural investments, productivity and poverty reduction. As shown in Figure 1, the research paper will follow a two-step methodology. The first part will provide an empirical estimate of the relationship between agricultural investments and labor productivity. The assumption according to which agricultural investments in infrastructure, transport, credit, energy, health, education, and related infrastructure have a positive impact on workers' productivity will be analyzed. Furthermore, the increase in agricultural productivity would lead to an increase in production and therefore a decrease in food prices. Given that the majority of rural households in Togo are smallholder staple crop farmers, increasing productivity could be important for rural poverty reduction. First, it could increase the income of the poor engaged in farming (Minten & Barrett, 2008). Second, it could generate non-farm employment through its spillover effects (Eswaran, Kotwal, Ramaswami, & Wadhwa, 1983; Ravallion, 2009). Thus, apart from these advantages in terms of growth, agricultural productivity has a significant impact on poverty reduction. The latter constitutes the second hypothesis that will be tested empirically.

Figure 1: Transmission channels agricultural investment - productivity – poverty reduction





Agriculture supported by increased investment will result in a significant increase in the share of agricultural products processed into differentiated products with high added value. Investment in the agricultural sector also improves agricultural productivity and focuses on agricultural development

Some research has shown that there is a potential macroeconomic relationship between agricultural investment and agricultural productivity (Chen, et al., 2017). This means that one cannot indefinitely increase one's level of long-term investment and at the same time expect a continuous expansion of economic activities. Indeed, the impact of investments on productivity depends on the use of fertilizers, technological advances and private and public investments that could improve agricultural productivity (Velazco, 2001). Another way to improve agricultural productivity is to invest in human capital.

Other studies have instead explained the increase in agricultural productivity through investment in R&D (Griliches, 1957; Fischer, Byerlee and Edmeades, 2009; Fuglie and Rada, 2013). Fan, Hazell and Thorat (1999) have analysed the impact of investment on productivity and find that investment in road infrastructure and R&D plays a very important role in agricultural productivity growth.

Economic growth that focuses on agriculture and that increases the incomes of poor family farmers and landless laborers is particularly effective in reducing poverty (Rosegrant and Hazell, 2001). Evidence shows that investment in agriculture is more effective in reducing poverty, particularly amongst the poorest people, than investment in non-agricultural sectors.

For the rural poor to benefit from agricultural growth:

- land and access to natural resources must be more equitably distributed;

- publicly financed agricultural research must focus on the problems faced by poor family farmers and small scale producers as well as those faced by larger, more commercially oriented farms;
- new technologies must be suitable and profitable for all farm sizes;
- input, credit and product markets must ensure that all farms have access to the necessary, modern farm inputs and receive similar prices for their products;
- the rural labor force must be able to migrate to access employment in agriculture or diversify into rural non-farm activities; and
- policies must not discriminate against agriculture in general and family farmers in particular (Rosegrant and Hazell, 2001).

By implementing inclusive economic and social policies, the public sector has an important role in ensuring that the above conditions exist relative to agricultural investment. Through public investment, countries provide public goods such as agricultural research and extension, infrastructure and services, as well as regulation and incentives for the sustainable management of natural resources and for protecting tenure rights. Public investment should also support policies to guarantee health, education and social protection for the rural population, including for the poorest of the poor.

Public investment can stimulate the positive conditions on the ground that can attract further private investment, both from the rural households themselves and from the corporate private sector. The latter has a multiplier effect on the local economy. These benefits include generating demand for food and other rural goods and services. This in turn creates more employment opportunities for poor rural people, including those without access to land (FAO, 2014).

4 Methodology

4.1 Effects of agricultural investments on male and female farm productivity

4.1.1 Agriculture households model: theory of household

Within Togo households, agricultural production occurs on many plots controlled by different members of the household. Togo farming plots are distributed between men and women in the household. In a farming household, women generally have their own farming plots. Based on

this information, an agriculture households model developed by Urdy (1996), to analyze gender issues in *investments and agriculture production* in the context in which agricultural production occurs on many plots controlled by different members of the household, will be used.

So, referring to Pareto efficiency, it implies that, the factors should be allocated efficiently across these plots. For this purpose, Lundberg and Pollak (1993) argue that the mechanism used to decide who does what for whom within the household is likely to be exceedingly complex, in particular because, within many of these households, agricultural production is simultaneously carried out on many plots controlled by different members of the household.

This study proposes to analysis the public's investments on farmer's productivity on the weak assumption of household models that allocate resources across these plots is efficient. Productivity is substantially lower on plots controlled by women than on similar plots controlled by men, planted with the same crop, in the same year, in the same household (Urdy, 1996)

Considering a household model, a necessary condition for the efficiency of the allocation is that factors of production are allocated efficiently to the various productive activities of the household. So, let consider a household with two members (the model generalizes easily to *N* members and an economy with private goods). The vector denotes the consumption of these goods by member , { , }. Aggregate consumption of these goods within the household is = + . The labor supply of person is and the public goods or service consumed within the household are denoted by .

The utility of member is determined by the function (, , , ,) and therefore may depend on her own consumption and on the consumptions and utility levels of the other members of the household. The household engages in production of at least some goods on the plots controlled by the household.

Let index the plots of the household, be the area of plot , and = { | plot is planted to crop k}. Then the production of goods in the household is

$$= \sum \quad (\ , \ , \ ) \qquad (1)$$

where and are female and male labor used on plot and (.) is a concave production function.

If crop is planted both on plots controlled by men and on plots controlled by women within the household, then equation (1) embodies the assumption that technology may vary

across crops but men and women have access to the same technology (.) for producing crop . Public good production within the household is determined by:

$$= (,) \quad (2)$$

Let's admit that there is no labor market in the Togo villages. (Nothing in this section hinges on this restriction. However, it is a reasonable approximation of the environment (Fafchamps 1993].) we can have:

$$= \sum + \quad (3)$$

and

$$= \sum + \quad (4)$$

The price vector is , so the budget constraint is:

$$\cdot \leq \cdot \quad (5)$$

where (, ,...,). A Pareto-efficient allocation of resources within the household solves

$$\max_{, ,} (\cdot) + (\cdot) \quad (6)$$

subject to equations (1)-(5), for some > 0 .

Consider any good produced on more than one plot in the household. Equation (6) is recursive. If and are the aggregate quantities of female and male labor inputs on plots planted with crop , then (6) implies that the allocation of labor across these plots solves as

$$\max_{,} \sum (, ,) \quad (7)$$

Subject to $\sum = , \sum = , , \geq 0$

This result is the standard separation result in agricultural household models, where production decisions are independent of preferences, except that this pertains to the allocation of resources within rather than across households. If (, ,) is concave, increasing, and strictly increasing in A, then (7) and = imply that , , = (, ,).

This is the implication of productive efficiency in the household that forms the basis of this study: within the household, variations across plots in output and factor inputs are functions only of variation in plot characteristics. So, we can define

$$= \frac{}{', ', } \quad \forall \qquad (8)$$

where are female and male labor inputs on plot in the solution to (7), and is the productivity on plot in the solution to (7), which depends only on the characteristics of plot . Let $^{-}$ be the average area of plots planted to crop . If is permitted to vary across , the first-order Taylor approximation from (8) is:

$$- \quad (^{-}) \approx \frac{( )}{} \cdot \quad - ^{-} \quad \forall \qquad (9)$$

The equation to be estimated, therefore, examines the deviation of plot productivity from the mean productivity as a function of the deviation of plot characteristics from mean plot characteristics within a group of plots planted to the same crop by the members of the same household in a given cropping season.

If we generalize (9) to accommodate multiple dimensions of plot characteristics and introduce notation to accommodate the existence of different households and investment realized in different localities of the study, we have

$$= \quad + \quad + \qquad (10)$$

where is a vector of characteristics of plot planted with crop by a member of household h (includes, variables relative to public investment that benefit households, household characteristics, the area of the plot and other information); is the

productivity on that plot; is the gender of the individual who controls the plot; and is an error term (possibly heteroskedastic and correlated within household-year groups) that summarizes the effects of unobserved plot quality variation and plot-specific production shocks on yields.

Conditional on plot size (and, of course, land quality), are productivity equal on plots planted with the same crop in the same year but controlled by different members of a household? It should be noted that in the absence of labor and land markets, (10) imposes no restrictions on relative productivity on plots controlled by different households, and with credit and liquidity constraints, (10) may not hold across plots controlled by the same household.

It is common for the household head and at least one of his wives to plant the same crop on their different plots during the same period. An important characteristic of the organization of agricultural production in these villages is that decisions with respect to crop choice and the timing and quantities of inputs on different plots within the household are made by different individuals within the household.

The estimates focus, therefore, on productivity variations between male and female plots planted to the same crop, in the same household, in the same season. The productivity differences might be caused by differences in input intensity of various inputs used on plots controlled by men and women.

However, somewhat more household female labor per hectare is devoted to plots controlled by men than to plots controlled by women. This model could show that a reallocation of the land, labor, fertilizer used, and public investments by a house- hold for the production of a specific crop in a given year could increase household production of that crop.

The different variables required to estimate the equation (10) are presented and defined in the following section.

4.1.2 Definition of model's variables

- *Dependent variable*

Agricultural productivity can be defined as production per unit of input (Yabi and Afari- Sefa, 2009). Thus, inputs can be labour, land or capital. The total productivity with both inputs(crop area and labor) is the ratio of farmer output value to total crop area and labor factors used in farm production

- Explanatory variables

The explanatory variables of the model are comprised of public investment variables in rural areas, private investments by farmers, characteristics of their farms, their socio-demographic characteristics and other variables accounting for the agricultural productivity and private investments of agricultural households.

Indeed, the analyses of the impact of public investments at the microeconomic level (with survey data) constitute a very common microeconomic approach for policy analysis. However, given that data on public investments or public capital do not vary at this level or following the unit of analysis (farm, household or village), the effect of public investments is taken into account by including in the regression variables which measure household access to public goods and services. Thus, for a given public investment, either the farmer benefits or not from goods and services produced. Thus, in this study, public investment variables were defined by distance between these infrastructure from farm residence or to access to these services as a binary variable, which takes the value 1 if the household is less than 5 km from public infrastructure or has access to the public service and 0 if farmer is more than 5 km or not access to public service.

The variable related to private investment is measured by the inputs of the farmers and investments made during the investigation period. It is also constituted by production equipment and other agricultural inputs (tractors, Plough, sprayers, livestock, outboard motors, fishing nets, improved seeds, fertilizers, Pesticides, food, fuel, hired jobs, etc.)

The explanatory variables and their expected effects on farming labor productivity are presented in Table 1.

Table 1: Definition of variables and their expected effects on farming labor productivity

Variables	Definition	Expected effects	Justification
Investment variables			

IRRIGAT	Farmer practice irrigation techniques (1. YES, 0. NO)	+	An increase in agriculture productivity requires both an expansion of irrigated areas (Audibert, 2010)
dist_secd	Distance to access to secondary school by the farmer. (1. Less than 5km, 0. More than 5Km)		Having a secondary school allows most of the population to have a secondary education level, which improves farmers' productivity (*Weir*, 1999)
dist_healt_center	Distance to access to health facilities in the case of illness by the Farmer (1. Less than 5km, 0. More than 5Km)	+	The use of health facilities in the case of an illness during the rainy season significantly improves farming labor productivity (Combary, 2016)
mob_phone	Possession of a mobile phone by the farmer (1. YES; 0. NO)	+	mobile phones usage significantly improve productivity in the agriculture sector, (Jensen, 2007)
acces_elect	Access to electricity by the farmer (1. YES; 0. NO)	+	Rural electrification generate positive employment spillovers in the agricultural sector and could spur broad local development through productivity spillovers increased. (Lewis and Severnini, 2017)
EAU_SANIT	Access to potable water and sanitation by the Farmer (1. YES; 0. NO)	+	Access to drinking water by households is a factor that positively contributes to farming productivity and development (Platt, 2012)
CREDIT_AGRI	Access to agricultural credits (1.YES ; 0. NO)	+	Access to agricultural credit increases productivity of farm households (Adesina & Djato, 1996; Diagne & Zeller, 2001)
nat_dist_ins	Benefit from insurance against natural disasters (1. YES; 0. NO)	+	insured against rainfall risk resulting in drought and food insecurity improve groundnut farmers productivity through loans (Hess and Syroka, 2005)
fertilizer	Use of fertilizers as an input during the production (1. YES; 0. NO)		Application of chemical fertilizers significantly improving crop productivity (Yadav, R. et al, 2000)
SEM_AMEL	Use of improved seeds as an input during the production (1. YES, 0. NO	+/-	The productivity of improved seeds compared to local ones was increased in some crops varieties and decreased among others (Briema, Maryoud, Elkhidir, & Mahmoud, 2013).
Socio-demographic variables			
AGE_CM	Age of Farmer	+	The older head of households carry out more sustainable farm practices with respect to seed source, soil fertility, crop management, pest and disease control and weed control (Tankou, 2013)
TAILLE	Size of the household	+/-	It was shown that although family size is high in rural Nigeria, agricultural productivity is low, as

			is income derived (Omideyi, 1988)
EDUC_CM	Educational level of Farmer. Categorical variable. (0. None 1. Primary, 2. Secondary, 3. Higher)	+	Education is one of keys factors that impact positively farming productivity (Ziagonas, 1993, 1999)
Variables related to farm exploitation			
Dist_RESID_MARCH	Distance from the Farmer's residence to the market in km (1. Less than 5km, 0. More than 5Km)	+	Distance, road infrastructure play an important role in farming being the determinants of inputs and output mobility for agricultural production and marketing (Kassali, 2006)
SUP_CULT	Farm size (in ha)	+	There is a strong inverse relationship between farm size and land productivity (Byiringiro & Reardon, 1996)
JOUR_OUVR	Number of person-working days on the farm	+/-	The relationship between women output and their working hours is non-linear: below an hour's threshold, output is proportional to hours; above a threshold, output rises at a decreasing rate as hours increase (Pencavel, 2015).

Source*: CBMS census, 2018*

4.2 Effect of farm productivity on rural poverty reduction by gender

Referring to Datt and Ravallion (1998), Minten and Barrett (2008), Eswaran et al. (2008), rural farm households' labor productivity could affect their incomes (or wages) and prices.

Let consider the indirect utility function of a rural household as: $V = V(p_j, y)$, where p_j is the price of farm output j, and y is income. According to Minten and Barrett (2008) and Eswaran et al. (2008), the effect of productivity change on the households welfare will depend on the degree of integration of the areas where these households are located in major regional markets, national and / or international markets and, in particular, the tradability of farm output beyond the village, region or country (Dzanku, 2015).

Denoting A, T, and L^f as land inputs, total stock of labor time, and household farm labor input, respectively, let household labour income, y, in $V = V(.)$ be decomposed into farm and nonfarm labour income:

$$y = p_j H * \Gamma(A, L^f, X|Z) + w(T - L^f) \quad (11)$$

Where, where H is Hicks-neutral coefficient which captures productivity of the technology, $\Gamma(.)$, used in the production agricultural output, $Q_j = H\Gamma(A, L^f, X|Z)$, X represents all other inputs used in the production process, Z designates agroecological characteristics which affect type of crop a household can cultivate and maximum yields achievable, and w the wage rate of the unskilled labor force. Suppose that the welfare of households is defined only by consumption of own products and goods purchased with the income y. Totally differentiating (11) and rearranging after dividing by the productivity coefficient yields:

— = —— , + —— , – —— , + – [,] – (12)

The effect of an increase in productivity on welfare depends on the terms in the brackets: price elasticity in relation to technical change, production elasticity in relation to technical change, labor demand elasticity in relation to technical change and wage elasticity in relation to technical change. These elasticities would have different effects on the welfare of the household, be it a seller, buyer, in autarky, or a combination of these with a level the household's involvement in a non-agricultural activity. For rural households with diversified subsistence economic activities, the determination of the effect of productivity on welfare is certainly not simple (Dzanku, 2015).

For a net seller of crop j, the effect of an increase in productivity on the income depends on the relative importance of the first two elasticities, ceteris paribus. Considering a decreasing aggregate demand curve, $(\varepsilon_{pj}, H) \prec 0$, and $(\varepsilon_{Qj}, H) \succ 0$; by definition, the welfare of a selling household increases if and only if $(\varepsilon_{pj}, H) \succ -(\varepsilon_{Qj}, H)$ ceteris paribus, (ε_{pj}, H) depends to a large extent on the level integration into regional, national and global markets.

An increase in productivity would have a different effect on the welfare of selling households depending on their location and their produced crops. For buyers, the effect on prices should entail the benefits of total welfare (Deaton, 1997), ceteris paribus. With regard to the demand for farm labor, the supply of non-farm labor and wages, the effect of prices still plays an important role. Demand for farm labor production should increase as long as the value of the marginal product of labor is positive; it also depends on the effect on prices. Thus, the demand for farm labor is expected to increase if the marginal product of the farm labor increases more rapidly than the decline in prices resulting from the increase in productivity. This could lead to the increase in non-agricultural wages followed by a decrease in the non-farm labor in agricultural households, ceteris paribus.

We will estimate two models based on monetary index measures of poverty and household income considered as dependents variables.

In the first specification, a binary consumption poverty model is specified:

$$W_i^* = \beta_0 + \beta_1^{'} X_i + \beta_2 \ln yield_i + c_i + u_i, ; \; i = 1,2,..., N \qquad (13)$$

$W_i = 1$ if $W_i^* \succ 0$; $W_i = 0$ otherwise,

Where W_i^* is the latent unobserved poverty level of household i; W_i is the poverty level which is observed only as a binary response and takes the value unity if a given household is below the defined poverty line, zero otherwise; the βs are unknown parameters; X_i is a vector of exogenous variables; $yield$ (in logarithms) is a partial measure of farm productivity; c_i is the time invariant household specific effect; and u_i is a random error term.

In the second specification, of the model that takes into account the mount of the income or consumption, we will use as dependent variable in the following model:

$$LogIncom_i = \gamma_0 + \gamma_j^{'} X_i + \gamma_k yield_i + u_i \qquad i = 1,2,..., N$$

(14)

Where the dependent variable, $Incom$, is the amount of household income; and the γs are unknown parameters to be estimated.

Table 2: Definition of variables and their expected effects on poverty

Variables	Definitions	Expected effect	Justification
Productivity variables			
Agricultural total productivity	ratio of farmer output value to total crop area and labor factors used in farm production	-	Agricultural productivity increases household's income, which reduces the number of households below the poverty threshold (De Janvry & Sadoulet, 2010)
Land agricultural productivity	Farmer output value per crop area cultivated	-	Land agricultural productivity contribute to farmer poverty reduction (Irz et al., 2001; Datt & Ravallion, 1998)
Labor agricultural productivity	Farmer output value per labor engaged in production	-	Labor agricultural productivity negatively influences the level of Household poverty (Datt & Ravallion, 1998).
Characteristics of the household			
Level of education	Educational level of farmer (0. None 1. Primary, 2. Secondary, 3. Higher)	-	There is a negative association between the probability of a household being poor and the education level of the household heads (Bilenkisi, Gungor, & Tapsin, 2015)
Age	Age of the farmer	+/-	Poverty risk decreases as the age of the household head increases (Bilenkisi et al., 2015). But, beyond a certain threshold, it may increase poverty of household.
Size	Size of household	+	It was shown that although family size is high in rural Nigeria, agricultural productivity is low, as is income derived (Omideyi, 1988)
Mart_stat	Farmer Marital Status (0. Single, 1. Maried, 2. Divorced / Separated Widowed)	+/-	Marriage has a large effect on reducing the risk of poverty. Unmarried individuals and single-parent families are more likely to live in poverty than their married counterparts (Blank, 1997; Furstenberg, 1990)
Transfer of migrant	Money transfer from migrant	+/-	Among households with migrants, there is no evidence that transfers are targeting households of lower welfare (Shaorshadze & Miyata, 2010)
Ratio of dependency	The dependency ratio is the ratio between number of members under 15 and over 64 to that of other members	+	High Dependency Household Ratio is associated with lower per capita and household poverty (Hadley, Belachew, Lindstrom, & Tessema, 2011)

	of the household		
Farm size	Farmer cultivated area	+	There is a strong inverse relationship between farm size and land productivity (Byiringiro & Reardon, 1996)
Sem select Fertilizer	Use of fertilizer (1. Yes; 0. No)	-	The use of fertilizer increases outputs and income, which reduces the number of households below the poverty threshold (Sarris, Savastano, & Christiaensen, 2006)
Infrastructure characteristics			
Access to electricity	Farmer Household's access to electricity (1. Yes; 0. No)	-	Modern sources of energy are required for the improvement of households living standards (Hussein & Leal Filho, 2012)
Use of phone	Use of phone by the farmer (1. Yes; 0. No)	-	Extending telecommunications services into rural areas could alleviate poverty, encourage economic and social growth, and overcome a perceived 'digital divide' (Bhavnani, Chiu, Janakiram, Silarszky, & Bhatia, 2008)
Practice of irrigation	Practice of irrigation by farmer (1.Yes; 0. No)	-	An increase in agriculture productivity requires both an expansion of irrigated areas and the adoption of high-yield varieties (Audibert, 2010)
dist_resid_march	Distance between the place of residence and health facility mostly used in Km (1. Less than 5km, 0. More than 5Km)	-	The further the health facility is, the more it can affect productivity of household and increase number of households below the poverty threshold (O'Donnell, 2007)
nat_dist_ins	Benefit from insurance against natural disasters (1. YES; 0. NO)	+	Insurance against natural disasters to farmer improve their productivity and contribute in poverty reduction (Barnett et al. 2008)

Source*: CBMS census, 2018*

4.3 Discrimination analysis: gender wage gap

The analysis by gender will consist in assessing differences in agricultural incomes between men and women. Estimation of labor market discrimination by gender, age, and race began with the decomposition of the wage gap developed by Blinder (1973) and Oaxaca (1973). Oaxaca-Blinder method was used to examine the assimilation of immigrants (LaLonde & Topel, 1992), school enrolment rates (Borooah & Iyer, 2005), health insurance coverage (Bustamante, Fang,

Rizzo, & Ortega, 2009), prevalence of smoking (Bauer & Sinning, 2008), or even local hunting lease rates (Munn & Hussain, 2010).

Reffering to Suh (2010), in this paper the methods of decomposition applied are those of Blinder and Oaxaca (1973) and Neumark (1988) will be used.

Consider a simple unadjusted model of wage determination (Suh, 2010) such that:

$$\ln w_{it} = X_{it}\beta_{it} + \varepsilon_{it} \quad (15)$$

Where w_{it} denotes the natural logarithm of weekly wages for an individual i at year t, X_{it} denotes a set of observed characteristics, β_{it} denotes the regression coefficients, and ε_{it} is a random error term.

To investigate the sources of gender differentials in detail, Suh (2010) estimates men's and women's wage functions separately such that:

$$\ln w_{it}^{m} = X_{it}^{m}\beta_{it}^{m} + \varepsilon_{it}^{m}$$

$$\ln w_{it}^{f} = X_{it}^{f}\beta_{it}^{f} + \varepsilon_{it}^{f} \quad (16)$$

where m represents men and f is women. A simple log mean wage difference between men and women can be estimated by subtracting the second equation from the first equation so that:

$$\ln w_{it}^{m} - \ln w_{it}^{f} = X_{i}^{m}\beta_{t}^{m} - X_{i}^{f}\beta_{t}^{m} + \mu_{t}$$

(17)

Where $\varepsilon_{it}^{m} - \varepsilon_{it}^{f} = \mu_{t}$.

Blinder and Oaxaca (1973) developed decomposition approaches to partition the gender wage differential into components caused by two factors (Suh, 2010):

$\ln w_{it}^{m} - \ln w_{it}^{f} = (X_{i}^{m} - X_{i}^{f})\beta_{t}^{m} + (\beta_{t}^{m} - \beta_{t}^{f})X_{t}^{f} + \mu_{t}$ (men as the reference group) or

$\ln w_{it}^{m} - \ln w_{it}^{f} = (X_{i}^{m} - X_{i}^{f})\beta_{t}^{f} + (\beta_{t}^{m} - \beta_{t}^{f})X_{t}^{m} + \mu_{t}$ (women as the reference group) (18).

The first term of the right hand side of the equation (19) captures how the male-female wage differential changed in response to changes in the men-women gap in characteristics. The first

term is sometimes called “observed X’s” or “observed gender gap in characteristics.” The second term measures the unexplained wage gap due to differences in coefficients or returns. This term is considered to measure the level of “gender discrimination”.

In order to overcome Blinder-Oaxaca index number problem, Neumark (1988) proposes a general decomposition of the gender wage gap suchthat:

$$\ln w_{it}^{m} - \ln w_{it}^{f} = (X_i^{m} - X_i^{f})\beta_t + (\beta_t^{m} - \beta_t)X_t^{m} + (\beta_t^{f} - \beta_t)X_t^{f} + \mu_t$$

(19)

where β_t is the non-discriminatory wage structure. The first term is the gender wage gap attributable to differences in characteristics. The second and the third terms capture the difference between the actual and pooled returns for men and women, respectively. He argues that under discrimination, men are paid competitive wages but women are underpaid (Suh, 2010). If this is the case, the coefficient of men should be taken as the non-discriminatory wage structure (Suh, 2010). Conversely, if employers pay women competitive wages but pay men more, then the women coefficient should be used as the non-discriminatory wage structure (Suh, 2010).

On the basis of estimates of wage (income) equations, the *method of Oaxaca-Blinder (Blinder 1973)* helps to decompose the average income differences between men and women in three effects:

(i) "endowment effects", which are the part of the differential resulting from differences in characteristic vectors of each group;

(ii) "coefficient effects" that correspond to differences in the outputs of these characteristics; and

(iii) "interaction effect": the segmentation hypothesis is verified when the second effect is statistically significant and positive, indicating that with similar characteristics, men receive higher wage than women.

We will use the R package oaxaca (Hlavac, 2014) to perform the Blinder-Oaxaca and Neumark decomposition.

4.4 Description of the study site

The study was carried out in two areas: the Tsévié area and the Kpalimé area. In the Tsévié area two villages were chosen, namely Gblainvié and Dalavé. In the Kpalimé area, these were the villages of Atigba and Elavagnon.

The area of the selected Plateau region is located in Danyi Prefecture. The canton of Danyi-Atigba-Elavagnon is chosen as the canton where the data were collected. Danyi-Atigba-Elavagnon is essentially agricultural. The population lives off cash crops (coffee, cocoa), food crops (maize, manioc, taro, rice, beans, etc.), livestock, etc. There are also large forests (mahogany, wawas, irokos).

The second chosen area is located in the Maritime region. These are rural areas called Dalavé and Gblainvié de Tsévié. There are several reasons for this choice. The first phase of the CBMS project entitled "Willingness to pay of Togolese workers in the informal sector for access to social protection: The CNSS social protection case study implemented in Togo was held in these two localities of Tsévié. The inclusion of the rural site from the previous phase made it possible to know the evolution of poverty indicators in its region and to include the analysis of panel data in our poverty profile document.

In total, data were collected from 4543 households, including 2550 in the township of Danyi-Atigba Elavagnon and 1993 households in Dalavé and Gblainvié. Danyi-Atigba Elavagnon and Dalavé and Gblainvié are part of southern Togo. In southern Togo, the climate is subtropical, therefore hot and humid. There are four (4) seasons in both sectors of the survey during the same period. Two dry seasons and two rainy seasons: a major rainy season (April to July), a small dry season (August), a short rainy season (September-October) and a major dry season (November to March).

The different cultures in each study area:

Danyi - Atigba Elavagnon: corn, manioc, corn, tropical fruits (mango, banana, orange, lemon, grapefruit, pineapple, papaya, coconut, avocado, corossol, passion fruit, guava, breadfruit, peanut, cashew nuts.); cash crops (coffee, cocoa); vegetables (tomatoes, awl, gboma, okra, carrots, cabbage, onions, peppers, peppers, peppers, aubergines, peanuts)

Dalavé and Gblainvié: corn, manioc, beans, tropical fruits (bananas, orange, lemon, grapefruit, pineapple, papaya, palm oil, groundnut); vegetables (tomatoes, alemo, gboma, okra, carrots, cabbage, onions, peppers, aubergines).

4.5 Data Collection

The statistician and the project team leader were responsible for data collection. The approach adopted is the Personal Tablet-Assisted Interview (PIAT) for data collection. This approach will be used to code the data.

The data used in our study are primary. The method used is the mixed method integrating the collection and analysis of quantitative and qualitative data. The questionnaire took into account more qualitative gender issues. Thus, we had the household questionnaire, the agricultural questionnaire and the community questionnaire.

Discussion points include the state of infrastructure, agricultural equipment, credit, governance, agricultural investment, organization of agricultural workers, land insecurity, working conditions and vulnerability, agricultural and non-farm income, non-agricultural activities, health insurance, etc. The questionnaires were first pre-tested to assess their effectiveness.

The household questionnaire aims to cover basic information on all household members, such as demographics, education and household characteristics such as poverty and basic access to services such as water and sanitation, housing, etc.

The Rider questionnaire is intended to cover additional information, including agricultural investment, agricultural labor productivity, agricultural production, vulnerability of agricultural workers, etc.

The questionnaire at Community level is designed to complement and provide additional information such as available educational institutions, industries present, employment programs and credit institutions in the region.

The head of the household will be the respondent of the household questionnaire. Then, all men and women involved in agricultural activity will answer the Rider questionnaire. As soon as a household member is identified as a farmer (household questionnaire), he or she is invited to complete the Rider questionnaire. The questionnaires are detailed enough to identify

agricultural investments among men and women. Investments in technologies, seeds, infrastructure, etc. would be gender-specific.

In order to ensure the reliability of data collection, all data collection procedures were pre-tested. To this end, a training session for enumerators (with a baccalaureate as a minimum level of education) was organized on data collection with tablets on which the application designed for data collection was installed.

5 Results

This section begins by descriptive statistics. It will then go on to analysis of empirical results

5.1 Descriptive statistics

This section presents the sample profile of the study and the CBMS core Indicators of poverty.

5.1.1 Demographic characteristics

We used the agricultural household's data carried out in the cantons of Danyi-Atigba, Elavagnon, Dalavé and Gblainvié. The data were collected in 4543 farm et non-farm households in seventy-seven (77) villages in Danyi and Zio prefectures (Table 1).

Table 3: Distribution of villages and households surveyed per townships

	Zio		**Danyi**		**Overall**
	Dalavé	Gblainvié	Atigba	Elavagnon	
Total number of villages	19	13	19	26	77
Number of households surveyed	1764	830	1096	853	4543

Source: CBMS Census, 2018

The age distribution shows that the majority of agricultural household heads are between 35 and 60 years old. 60.80% of farmers heads are between 36 and 60 years old. Farmers aged 60 and over represent 15.95% of all farmers. Furthermore, Table 4 shows that about 75.44% of farmers have at least the primary school education level. From a gender perspective, there is a significant gap. There are more women farmers with no education (41.85%) than men farmers (15.10%). These results collaborate with those obtained nationwide which show that 67.2% of

women farmers are illiterate compared to 41% of their male counterparts (INSEED, 2013). Most households had between 1 and 3 persons (68.37%), followed by household consisting of 4 or 6 persons (28.70%), finally households consisting of more than 6 persons (2.93%).

Table 4: Distribution of household's characteristics

		Women	Men	Total
Farmers Education Levels	**None**	41.85	15.10	23.67
	Primary	39.97	31.96	34.53
	Secondary	18.18	51.63	40.91
	Higher	0.00	1.31	0.89
Farmers Age	**15 - 35 years old**	22.30	23.69	23.24
	36 - 60 years old	58.33	61.97	60.80
	More than 60 years old	19.37	14.34	15.95
Household size	**1-3 persons**	77.42	64.09	68.37
	4-6 persons	21.31	32.19	28.70
	More than 6	1.28	3.72	2.93

Source*: CBMS census, 2018*

1.1.1 Socio-economic characteristics of the population of the agricultural households

Table 5 shows that about 73.77% and 81.32% of the population respectively in the cantons of Atigba and Elavagnon practice agriculture as their main activity. In these two cantons, more men practice agriculture than women (87.63% men against 56.22% women in the canton of Atigba and 94.93% men against 60.94% of women in Elavagnon). In Tsévié, about 86.12% of the population of Dalavé and 73.52% of the population of Gblainvié not practice agricultural as main activities

Table 5: Distribution of rural population by activity

	Atigba			**Elavagnon**			**Gblainvié**			**Dalavé**		
	M	W	All	M	W	All	M	W	All	M	W	All
Agricultural population	87.63	56.22	**73.77**	94.93	60.94	**81.32**	28.57	24.63	**26.48**	14.34	13.54	**13.88**
Non-agricultural population	12.37	43.78	**26.23**	5.07	39.06	**18.68**	71.43	75.37	**73.52**	85.66	86.46	**86.12**

Source*: CBMS census, 2018*

Turning next to public services, access to electricity remains a big challenge for agricultural households. Only 36.32% of farmers have access to electricity (Table 6). This has improved over time since in 2015 only 14.1% of rural households had access to electricity (QUIBB, 2015). We also found that access to safe water and sanitation remains a major problem in rural areas. About 51.17% of rural household do not have access to clean and safe water and sanitation (Table 6). Considering gender, women have more access to health care (56.41%) than men (45.25%).

In regards to mobile phone utilization, with the Agri PME program set up by the Togolese government for the commercialization of fertilizers through the electronic purse system, farmers deem it necessary to use mobile phone (BAD, 2016). This program is an instrument which permits to know in real time, the market condition, the availability of fertilizer stocks in the country as well as information on the agricultural sector (location, cultivable area, selected seeds etc.). Considering our results, 69.11% of farmers use a mobile phone, but men farmers (72.66%) use it more than women heads of households (61.59%). According to the results in Table 6, most farmers are more than 5km from a market to sell the agricultural products (34.93%).

Table 6: Proportion of farmers with access to public services

variables	Definition		Women	Men	Total
EAU_SANIT	Access to drinking water and sanitation by the Farmer	No.	43.59	54.75	51.17
		Yes	56.41	45.25	48.83
ACC_SOINS	Access to health facilities in the case of the Farmer	No.	43.70	51.08	48.70
		Yes	56.30	48.92	51.30
Access to electricity	Households' access to electricity	**No.**	62.87	64.06	63.68
		Yes	37.13	35.94	36.32
Use of phone	Use of phone by head of household	**No.**	38.41	27.34	30.89
		Yes	61.59	72.66	69.11

DIST_RESID_MARCH	Distance from the Farmer's residence to the market in km	Less than 5Km	67.37	63.99	65.07
		More than 5Km	32.63	36.01	34.93
Distance between the place of residence and health facility	Distance between the place of residence and health facility mostly used in Km	Less than 5Km	80.5	77.02	78.13
		More than 5Km	19.5	22.98	21.87

Source*: CBMS census, 2018*

5.1.2 Agricultural indicators

The results present in table 7 show that, farmers have not health insurance in the investigated areas. This can be explained by the low incomes of farmers. It is consequently necessary to extend health insurance to these segments of the population in order to achieve universal health coverage.

Regarding insurance against natural disasters, the results reveal that generally the majority of women and men have no access to this insurance. Indeed, the proportions of women and men who do not benefit from insurance against natural disasters are respectively 99.62% and 99.65 % (Table 7). These results show that the challenges in developing agricultural insurance services need to be addressed in these study areas. Furthermore, to facilitate farmers' access to financial services in Togo, the National Fund for Inclusive Finance (FNFI) has elaborated three products namely: APSEF (Poor Access to Financial Services), AGRISEF (Farmers Access to Financial Services) and AJSEF (Youth Access to Financial Services). These products have enabled more than 700,000 Togolese to have access to credit for starting or consolidating their income-generating activities (FNFI-Togo report, 2017).

The result in table 7 shows that only 3.54% of farmers in the study area have access to credit. Looking at the distribution by gender, the results reveals that only 3.08% and 3.75 % respectively of women and men have access to credit.

In Table 7, we find that about 75.60% of farmers has an average monthly income lower than the Interprofessional Guaranteed Minimum Wage (SMIG). Among them, more women (82.63 %) than men (72.28%) have an income lower than the SMIG. The results show also that about 17% of the farmers experienced an increase in their income over the last two crop years (Table

7). 18.85% of men experienced an increase in their income over the last two years compared to 13.01% of women.

Table 7: Agricultural indicators

Indicators	Women	Men	Total
Proportion of farmers (by gender) with average monthly income below the guaranteed minimum wage	82.63	72.28	75.60
Proportion of farmers (by gender) who have experienced an increase in their income, in the last two seasons	13.01	18.85	16.92
proportion farm workers benefiting from news agriculture practice per gender	39.83	47.88	45.30
Proportion of farm having access to health insurance and accident insurance at work per gender	0,00	0,00	0,00
Proportion of farm workers having access to insurance against natural disasters per gender	0.38	0.35	0.36
Proportion of farm workers who have access to credit per gender	3.08	3.75	3.54

Source*: CBMS census, 2018*

5.1.3 Agriculture practices

Natural disasters have repercussions not only on the yield but also affect the whole production chain. To minimize these consequences, new farming practices are implemented in order to help farmers. According to our results, only 39.83% of women farmers use new farming practices against 47.88% of men *(Table 7).* Most of the agricultural population in the study areas still adopt traditional farming practices.

Table 8 shows that men practice more irrigation than women owning plots. 4.43% of men farmers against 1.95% of women practice irrigation on their farms. The low proportion of agricultural households practicing irrigation is explained by the fact that irrigation equipment has a cost which most rural households cannot afford.

Fewer farming households are using traditional seeds, and among them, women owning plots have more access to selected seeds than men. About 83.38 % of farmers use selected seeds compared to 6.25% who use traditional seeds (Table 8). From a gender perspective, 86.57% of women farmers use selected seeds. There is a significant increase in the use of improved seeds compared to 2012 where only 14.9% of improved seeds were used. We should note that among the farmers some use both traditional and improved seed, 6.75% of them are women and 12.08% are men.

Access to inputs was, two years back, difficult for Togolese farmers because of the quantity and price set by the Togolese Government. In the last two years, with the liberalization of the fertilizer market, price has become the only barrier to access fertilizers; this situation explains why only 29.64% of farmers use fertilizers for their crops. The Government subsidy of fertilizers is insufficient considering the proportion of farmers with access to fertilizer. In addition, with precarious living standards of most agricultural households, only 0.51% of farmers protect their animals against diseases like the pest by adopting modern techniques.

Table 8: Agricultural practices

variable	definition		Women	Men	Total
IRRIGAT	Farmer access to new irrigation techniques, conservation and agricultural practices	No	98.05	95.57	96.37
		Yes	1.95	4.43	3.63
SEM_AMEL	Use of improved seeds as an input during the production	No	13.43	18.13	16.62
		Yes	86.57	81.87	83.38
SEM_TRAD	Use of traditional seeds as an input during the production	No	93.32	93.94	93.75
		Yes	6.68	6.06	6.25
SEM_AMEL&TRAD	Use of improved and traditional seeds as an input during the production	No	93.25	87.92	89.63
		Yes	6.75	12.08	10.37
APP_TECH	Technical support to the	No.	99.85	99.33	99.49

	Farmer in terms of Pest control, animal diseases	Yes	0.15	0.67	0.51
FERTILIZER	Use of fertilizer by farmers as an input during the production	No	74.04	68.63	70.36
		Yes	25.96	31.37	29.64

Source*: CBMS census, 2018*

5.1.4 Crops and productivity

Farm households in the investigated area practice several cultures namely, legumes, cereals, tubers, cash crops, market gardening and fruit trees. Apart from legumes, men head of households use more land for the other crops than women.

Table 9 presents descriptive statistics on productivity changes between plots owned by men and women with the same crop in the same year. The results of the productivity (in terms of the value of production per hectare and the labor force used on each plot) reveal that, in general, labor force utilization is higher on plots managed by men than on plots of women. On average, men achieve much higher productivity per hectare than women for the same crops, the same crop year and in much larger areas. The average productivity of all crops is USD 6683.87[1] for men and USD 3790.85 for women. On average, men use areas equivalent to twice those used by women. In the study areas, on average, men use 4.97 hectares of land against 4.81 hectares used by women heads of agricultural households.

Table 9: Table summarizing the types of crops by sex according to productivity, labor force used and cultivated area

variable		**Man**				**Women**			
		Mean	Std	min	max	Mean	Std	min	max
cereals	**Prodty_agri**	5911,36	5544,56	0	38537,46	3464,61	4175,56	0	28950,09
	Prod_trav	26,62	31,35	0	277,28	26,96	46,04	0	432,37
	area	4,56	33,80	0	500	5,42	34,80	0	500
legumes	**Prodty_agri**	8146,55	6589,59	0	30078,01	5484,74	5952,48	0	24062,41
	Prod_trav	38,69	38,09	0,03	164,49	56,87	56,15	6,15	180,47
	area	2,10	12,67	0	93,75	10,92	68,30	0	437,50
tubers	**Prodty_agr**	6800,49	5762,0	0	38537,4	3720,5	4302,9	0	36093,62

[1] Average USD Exchange rate (February) = 531.95

	i		7		6	0	3		
	Prod_trav	39,48	41,91	0	208,88	21,37	20,65	0	112,79
	area	3,32	30,30	0	425	2,74	24,13	0	312,50
Cash crop	**Prodty_agr**		5779,3		35341,6	4656,6	4919,7		
	i	7541,15	5	0	7	2	1	0	28950,09
	Prod_trav	73,02	93,49	0	657,96	64,34	99,81	0	469,97
	area	6,79	41,25	0	312,5	1,35	4,95	0	37,50
Market	**Prodty_agr**		7147,9		30078,0	4733,5	4934,9		
gardening	**i**	7339,58	4	0	1	8	9	0	25566,31
	Prod_trav	63,40	155,96	0	1109,13	53,11	65,75	0,01	311,68
	area	15,72	70,79	0	500	11,61	38,83	0	250
Fruit trees	**Prodty_agr**		7001,4		38537,4	3867,0	4772,1		
	i	7966,08	6	0	6	7	2	1,44	21994,55
	Prod_trav	86,15	175,89	0	939,94	42,82	45,79	10,4 4	75,20
	area	0,72	3,87	0	31,25	1,96	7,98	0	39,06
Total	**Prodty_agr**		5933,8		38537,4	3790,8	4426,2		
	i	6683,87	9	0	6	5	4	0	36093,62
	Prod_trav	43,23	77,99	0	1109,13	33,11	53,20	0	469,97
	area	4,97	36,47	0	500	4,81	32,13	0	500

Source*: CBMS census, 2018*

5.1.5 Farm and non-farm income distribution

Furthermore, the average annual income is USD 586.17 and USD 674.57 respectively for farmers and non-farmers. The distribution by sex reveals that the annual income of men is higher than that of women in both groups.

Table 10: Distribution of income by gender

Indicators	All	Women	Men	Gap
Average Income of farm, by gender	586.17	443.83	667.47	223.63
Average Income of non-farm, by gender	674.57	490.21	953.74	463.53

Source*: CBMS census, 2018*

5.2 Econometric result

5.2.1 Impact of agricultural investment on farmer’s land productivity

In order to achieve our first objective which consists in analyzing the effect of investments in rural areas on farmers' productivity, we distinguish between total factor productivity, land productivity and labor productivity. In addition, we distinguish between public investments measured by the accessibility of rural populations to infrastructure in the domains of education, health, transport and telecommunications. Private investments were measured by the various inputs used by farmers such as fertilizer, selected seeds, etc. Thus, the tables present both public and private investment results on total, land and labor productivity respectively.

By considering the results of the table 11, Fisher's statistics analysis shows that the different models estimate concerning women, men and both sex are significant at a threshold of 1%.

Looking at the impact of public investment on total farmer productivity presented in table 11, the results analysis reveal that the distance separating secondary school to places of residence (distance secondary school) positively and significantly influences the farmer’s productivity at 1 %. In other words, more the homes are away from secondary schools, farmer’s productivity is higher. The same effects are observed, considering men and women taken separately. This situation can be explained by the fact that since secondary schools are in most cases very far from farmer’s residence, children do not further their education in secondary schools and instead devote themselves to agricultural activities. Thus increasing the domestic labor force and, consequently, farmers’ productivity.

However, the results (table 11) show that the farmer’s education level has a positive and significant influence on agricultural productivity. Farmer with a higher education level are the most productive. The plausible reasons for such a positive correlation could be the skills that educated farmers have through access to information, agricultural planning practices, better technical and allocation decisions as well as efficient and effective use of inputs. These results corroborate with those of Coelli and Battese (1996) and Bravo-Ureta, et al. (1997) who find a positive correlation between agricultural productivity and education levels. In addition, Gul (2008) also shows that farmers with a high education have better access to knowledge and tools that improve their productivity. Similarly, Adeoti (2009) confirms this result by showing that educated farmers have higher productivity because education enhances the ability to adapt to change and the understanding of new practices and technologies. As a result, education improves the ability to face challenges and increases agricultural land productivity. Moreover,

considering the effect of men and women education on their respective productivity, we observe that being educated improves the productivity of women (0.166) compared to that of men (0.069).

Potable water being a major public health issue. Public investments should help ensure drinking water supply for the population. However, in our study area, estimates result show that access to drinking water and sanitary has a negative effect on the farmer's productivity. This result, contrary to the expected sign, does not collaborate with that of Platt (2012) which reveals that access to drinking water is a factor that contributes positively to farmers' productivity. Indeed, given that almost 50% of the population in the study area has difficulty to accessing the potable water, this result can be explained by the fact that the active population devotes more of their time to fetching drinking water; situation which has a negative impact on the labor time and, in turn, the land productivity.

Considering a cell phone use, which will be made possible only through access to telecommunication infrastructures in the different localities, the estimations results reveal that, it contributes to improve the agricultural productivity for all farmers. But the gender analysis show that, mobile phone use improves only the men productivity. This result can be explained by the fact that, farmers are more aware of agronomic practices and techniques through mobile telephony via the internet and information on the prices of inputs and outputs. In addition, mobile phone use is also an indicator of wealth. As a result, farmers who use a mobile phone have the financial capacity to invest more in farming and get a better return than those who does not have a mobile phone.

In addition to these public investments that influence agricultural productivity, private investments also play an important role. The irrigation practice has a positive and significant effect on farmer's agricultural productivity at 1%. This result confirms the earlier findings of Dillon (2011), Huang and al. (2006), Kemah and Thiruchelvam (2008) who indicate that irrigation is paramount importance for agricultural production. Indeed, this practice contributes to increased productivity by reducing losses caused by irregular seasons, land and crop expansion (Abro et al., 2014, Hussain and Hanjra , 2003, 2004, Mateos et al., 2010). In addition, it is observed that this practice affects significantly only the productivity of men compared to that of women. Investments in improved seeds affect positively and significantly the farmer's productivity. This result is all the more evident if traditional seeds are no longer, in most cases, adapted to climatic conditions whose variability remains one of the problems facing humanity.

By looking at the size of the household, we find that it has a negative influence on agricultural productivity in our study area. This result is not surprising given that most households have a higher number of children or inactive people. As these members do not contribute to production, this could explain the negative effect observed. Furthermore, with new farming techniques such as traction and tractors, the contribution of household members has decreased, and this might also be the source of this negative effect. Moreover, crop area and labor force measured by community and paid labor have negative effects on farmers' productivity. Thus, this result implies that by increasing the cultivated area, or labor force, the productivity of these farmer's decreases. This result can be explained by the farm size, which in most cases is less than one hectare.

The relationship between farm size and yield became a focus of agrarian debates after the 1960s. Ever since agricultural management surveys in India have established the empirical base (Gul Unal, 2008) of this debate, evidence has been so widely observed in many countries that the inverse relationship is considered a "stylized fact" of agriculture in developing countries (Heltberg 1998, Cornia 1985; 1995, Okoye et al., 2007). Some argue that small scale farms benefit farmers, because they reduce the risk of drought, floods, pests and other uncertainties resulting from separate plots. Small scale farms also benefit from reduced risk because of "all of one's land in one type of soil, in one place and only one exposure is considered risky" (Kaldjian, 2001). However, the analysis of the results remains consistent with previous work in so far as more the farms size increase, it negatively affects the productivity of farmers. The decline in productivity is more emphasized for women than for men.

Access to insurance against natural disasters of agricultural households has a positive and significant effect on farmer productivity at 1%. This variable is significant and positive on men farmer's productivity, but it's not significant for women farmers. This result can be explained by the fact that men are the heads of households in most households, they usually monopolies these insurances for the benefit of their farms than those of women.

Table 11: Estimation of agricultural investment on land productivity

Explanatory variables	Log(agricultural productivity)					
	Women		Men		All	
	coef	t-stat	coef	t-stat	coef	t-stat
irrigation	0.347	(1.20)	0.416**	(2.57)	0.393***	(2.73)
Distance to secondary school	0.483***	(3.36)	0.427***	(5.24)	0.464***	(6.56)
Distance to health center	-0.164	(-1.05)	-0.083	(-0.87)	-0.113	(-1.41)

Access to drinking water	-0.363***	(-3.10)	-0.588***	(-7.12)	-0.534***	(-7.84)
Use of mobile phone	-0.050	(-0.42)	0.283***	(3.19)	0.180**	(2.51)
selected seed	0.175	(1.07)	0.442***	(4.88)	0.385***	(4.72)
Access to electricity	0.173	(1.41)	0.148	(1.56)	0.150**	(1.97)
Age of farmer	-0.006	(-1.62)	-0.001	(-0.35)	-0.001	(-0.59)
Household size	-0.108***	(-2.66)	-0.050**	(-2.08)	-0.062***	(-2.86)
Level of education	0.129**	(2.49)	0.069*	(1.75)	0.151***	(5.07)
Time to products market	0.068	(0.48)	0.091	(1.11)	0.065	(0.92)
Total worker	-0.039**	(-2.49)	-0.059***	(-14.00)	-0.053***	(-7.91)
Crop Area	-0.026***	(-7.04)	-0.021***	(-10.61)	-0.023***	(-12.60)
Disaster insurance	-0.618	(-1.30)	0.982***	(4.08)	0.508	(1.63)
Use of fertilizer	0.180	(1.24)	-0.222**	(-2.09)	-0.082	(-0.95)
Access to Credit	-0.053	(-0.17)	-0.262	(-0.75)	-0.166	(-0.60)
_cons	13.291***	(48.18)	13.413***	(63.54)	13.185***	(80.01)
r2	0.381		0.438		0.411	
F	14.283		36.278		36.806	
p	0.000		0.000		0.000	
N	1201.000		2630.000		3831.000	

Source*: CBMS census, 2018*

5.2.2 Impact of agricultural investment on farmer's land and labor productivity

The results of the table12 highlights the effect of public and private investment on farmers' land productivity in our study area. To this end, results analysis shows that public investment effect on land productivity is similar to that of farmers' total productivity. However, we can note that access to electricity has a positive and significant influence on the land productivity of all farmers, but this was not the case in terms of total productivity. Furthermore, access to insurance against natural disasters is becoming significant and positive for land productivity for both sexes of all farmers. In health domain, the estimates result reveal that, when health centers are far from farmers' residences, this affects negatively and significantly land productivity. Indeed, the remoteness of health centers from populations do not encourage them to go for consultation in case of illness in order to receive adequate treatment. As a result, this negatively affects the domestic workforce, the labor force and reduces the productivity of farmers.

Looking at the size of agricultural households, results in table 12 show that it is not significant on land productivity compared to negative effects on agricultural productivity. Moreover, we observe an opposite effect of labor force on land productivity. According to economic theory, an increase in the labor factor results in increase of productivity. However, agriculture being a

labor-intensive activity in developing countries such as Togo, an increase in the labor force would increase the land productivity of farmers. Thus, the positive and significant effect of the labor force on women's land productivity only, can be explained by the fact that women in rural areas use more community or paid labor force than men.

Considering the time to market, the results analysis reveals that, it has a positive and significant impact on farmers' productivity throughout the study area. Indeed, more a farmer moves far from the market, less it goes to it and instead spends more time on its agricultural activities, which leads to an increase in land productivity.

***Table 12**: Estimation of agricultural investment on land productivity*

Explanatory variables	Log(land productivity)					
	Women		Men		All	
	coef	t-stat	coef	t-stat	coef	t-stat
irrigation	0.410	(1.54)	0.422***	(2.93)	0.411***	(3.24)
Distance to secondary school	0.455***	(3.31)	0.343***	(4.95)	0.403***	(6.39)
Distance to health center	-0.188	(-1.29)	-0.177**	(-2.02)	-0.184**	(-2.47)
Access to drinking water	-0.384***	(-3.49)	-0.579***	(-7.51)	-0.530***	(-8.29)
Use of mobile phone	-0.147	(-1.27)	0.221***	(2.60)	0.111	(1.60)
selected seed	0.162	(1.06)	0.351***	(4.15)	0.313***	(4.14)
Access to electricity	0.183	(1.59)	0.255***	(2.83)	0.222***	(3.08)
Age of farmer	-0.004	(-1.09)	0.000	(0.04)	0.000	(0.05)
Household size	-0.066*	(-1.81)	-0.024	(-1.04)	-0.029	(-1.46)
Level of education	0.166***	(3.40)	0.069*	(1.86)	0.167***	(6.01)
Time to products market	0.228*	(1.66)	0.206***	(2.72)	0.192***	(2.85)
Total worker	0.013***	(3.17)	0.006**	(2.49)	0.008***	(4.39)
Area	-0.026***	(-7.18)	-0.021***	(-10.54)	-0.022***	(-12.56)
Disaster insurance	0.779*	(1.70)	1.006***	(4.79)	0.888***	(4.08)
Use of fertilizer	0.301**	(2.22)	-0.141	(-1.42)	0.003	(0.04)
Access to Credit	0.061	(0.22)	-0.167	(-0.50)	-0.069	(-0.26)
_cons	13.251***	(50.98)	13.519***	(70.79)	13.219***	(86.10)
r2	0.365		0.330		0.338	
F	12.272		18.207		31.758	
p	0.000		0.000		0.000	
N	1201.000		2630.000		3831.000	

Source*: CBMS census, 2018*

Table 13 above presents the results of labor productivity estimation. Considering Fisher's statistics of the different models estimated, they reveal that these models are all significant at 1%. The analysis of the results reveals that, in general, the effects of

public investments through the setting up of basic infrastructure among farmers are similar on labor productivity.

It can be observed that irrigation, access to electricity, household size and access to insurance against natural disasters do not significantly influence labor productivity as has been the case for total and land productivity. In addition, the distance between secondary school and farmer's places of residence is not significant for women. However, the results show that the variables relating to the total number of workers used and the cultivated area have a negative impact on the farmer's labor productivity. This result is similar to those obtained for total productivity.

***Table 13**: Estimation of agricultural investment on labor productivity*

Explanatory variables	Log(labor productivity)					
	Women		Men		All	
	coef	t-stat	coef	t-stat	coef	t-stat
irrigation	0.317	(1.39)	0.167	(1.40)	0.203*	(1.85)
Distance to secondary school	0.056	(0.50)	0.384***	(5.66)	0.306***	(5.20)
Distance to health center	-0.286***	(-2.67)	-0.089	(-1.24)	-0.172***	(-2.88)
Access to drinking water	-0.120	(-1.61)	-0.323***	(-5.81)	-0.270***	(-5.95)
Use of mobile phone	0.200**	(2.55)	0.327***	(5.52)	0.293***	(6.10)
selected seed	0.042	(0.43)	0.352***	(5.79)	0.286***	(5.37)
Access to electricity	0.165**	(2.17)	-0.009	(-0.14)	0.036	(0.72)
Age of farmer	-0.000	(-0.07)	0.005**	(2.37)	0.004***	(2.60)
Household size	-0.019	(-0.69)	0.019	(1.19)	0.015	(1.04)
Level of education	0.011	(0.32)	0.081***	(2.94)	0.109***	(5.36)
Time to products market	0.050	(0.57)	0.072	(1.18)	0.059	(1.20)
Total worker	-0.045***	(-2.62)	-0.059***	(-14.09)	-0.055***	(-8.40)
Area	-0.003***	(-2.77)	-0.003***	(-3.70)	-0.003***	(-4.62)
Disaster insurance	-0.287	(-0.76)	0.412*	(1.73)	0.149	(0.64)
Use of fertilizer	0.268***	(2.87)	0.113	(1.61)	0.166***	(2.98)
Access to Credit	0.018	(0.09)	-0.354	(-1.56)	-0.245	(-1.41)
_cons	11.221***	(59.75)	11.098***	(74.28)	11.004***	(96.35)
r2	0.233		0.400		0.345	
F	3.938		30.030		22.434	
p	0.000		0.000		0.000	
N	1297.000		2724.000		4021.000	

5.2.3 Heterogeneity analysis of agricultural investment impact on farmer's productivity

Assuming that farmers do not have the same capacity or productive resource, and have different crop areas, the investment level should also be different. Thus, to take into account the heterogeneity of this on farmers' productivity, we used a quantile regression to analyze the effect of investments on farmers' agricultural productivity. The table 14 below present estimates for the 25 ,50 ,75 conditional quantiles. These estimate provide inferences about marginal effects of bull characteristics in the tails and in the central parts of the conditional productivity distribution.

Looking at all farmers of both sexes, the analysis of the results reveals that, the distance of residence from secondary school and from health centers has a positive and significant effect on farmers' agricultural productivity in all three quantiles groups. In addition, selected seed use and farmers' education levels have a positive and significant effect at on their agricultural productivity. If we consider the irrigation variable, it has a positive and significant effect only on the productivity of the 1st and 2nd quantile farmers. This result can be explained by the fact that low productivity farmers often have small farms. Thus, they will be able to cover the crop areas in the practice of irrigation. This can allow them to increase their productivity. That is not the case for large area farmers in the 3rd quantile.

By looking at access to electricity and use of fertilizers, the results reveal that these variables only improve agricultural productivity for farmers in 2nd and 3rd quantile. This result is obvious and can be explained by the fact that the first quantile farmers considered as small producers have low incomes to access these inputs. Moreover, access to natural disaster insurance only improves the productivity of smallholders in the first quantile. This result is not surprising, as with low productivity, it is clear that these farmers are among the vulnerable farmers who benefit most from these subsidy or natural disaster insurance programs

There is a significant and negative effect of agricultural credit on farmers' productivity in the 2nd and 3rd quantile. This significant result of agricultural credit on 2nd and 3rd

quantile farmer productivity reveals that the farmer's productivity level determines their accessibility to agricultural credit, excluding the 1st quantile farmers for whom the agricultural credit effect is not significant. Furthermore, the negative effect observed can be explained by the inadequate use of credits, delays in credits obtaining and finally climate variability. These various factors induce farmers to use credits in most cases for non-agricultural activities.

***Table 14**: Quantile regression of investment on agricultural productivity*

	Quantile (0.25)			Quantile (0.5)			Quantile (0.75)		
	Women	Men	All	Women	men	All	Women	men	all
irrigat	0.699***	0.429***	0.521***	0.642**	0.082	0.148**	-0.067	0.062	0.088
	(2.98)	(2.74)	(4.17)	(2.20)	(0.76)	(2.56)	(-0.50)	(0.45)	(0.68)
dist_secd	0.627***	0.318***	0.420***	0.329***	0.246***	0.329***	0.068	0.170***	0.204***
	(4.44)	(6.84)	(6.23)	(4.83)	(4.93)	(6.79)	(0.54)	(3.05)	(3.57)
dist_healt_center	-0.282*	-0.220***	-0.251***	-0.391***	-0.106*	-0.189***	-0.292**	-0.107*	-0.167***
	(-1.88)	(-3.19)	(-3.10)	(-4.21)	(-1.95)	(-3.86)	(-2.13)	(-1.82)	(-2.94)
eau_sanit	-0.522***	-0.657***	-0.580***	-0.244***	-0.274***	-0.256***	-0.013	-0.099**	-0.043
	(-4.15)	(-8.29)	(-8.25)	(-3.30)	(-5.25)	(-6.04)	(-0.16)	(-2.15)	(-0.99)
mob_phone	-0.152	0.129***	0.008	-0.272***	0.123***	0.029	-0.205**	0.098**	0.054
	(-1.50)	(2.62)	(0.15)	(-4.18)	(2.88)	(0.70)	(-2.40)	(2.26)	(1.20)
sem_select	0.036	0.258***	0.200***	-0.110	0.254***	0.231***	-0.151	0.213***	0.143***
	(0.38)	(5.36)	(3.68)	(-0.85)	(4.41)	(4.74)	(-1.49)	(3.79)	(2.97)
acces_elect	0.175	0.121*	0.070	0.250***	0.002	0.085**	0.265***	0.167***	0.146***
	(1.37)	(1.77)	(1.09)	(3.57)	(0.04)	(2.21)	(3.01)	(3.56)	(3.46)
age_yr	-0.000	0.004**	0.003	0.002	0.003**	0.002*	-0.006**	0.003**	0.000
	(-0.12)	(2.08)	(1.63)	(0.69)	(2.25)	(1.76)	(-1.99)	(1.97)	(0.29)
phsize	-0.026	-0.020	-0.025	-0.026	0.017	0.008	-0.020	0.018	0.007
	(-0.69)	(-1.14)	(-1.47)	(-0.97)	(1.38)	(0.74)	(-0.73)	(1.32)	(0.54)
niv_educa	0.226***	0.122***	0.278***	0.148***	0.053***	0.158***	0.065*	-0.014	0.061***
	(5.56)	(3.91)	(10.64)	(5.14)	(2.60)	(8.85)	(1.80)	(-0.59)	(3.21)
time_resid_marc h	0.402***	0.163***	0.207***	0.296***	0.034	0.084**	-0.093	0.155***	0.089*
	(3.86)	(3.02)	(3.13)	(3.56)	(0.74)	(1.97)	(-0.86)	(3.20)	(1.77)
tot_lab	-0.084***	-0.092***	-0.088***	-0.084***	-0.076***	-0.076***	-0.063***	-0.063***	-0.064***
	(-32.68)	(-22.87)	(-53.68)	(-14.82)	(-22.19)	(-21.76)	(-5.96)	(-23.41)	(-25.25)
super_tot	-0.048***	-0.038***	-0.042***	-0.033***	-0.024***	-0.025***	-0.022***	-0.019***	-0.020***
	(-2.77)	(-4.95)	(-5.62)	(-4.04)	(-5.95)	(-9.09)	(-7.10)	(-9.51)	(-13.96)
nat_dist_ins	-0.472	0.731**	0.602***	0.632	0.325	0.231*	-0.241	0.342***	0.339
	(-1.13)	(2.07)	(2.58)	(0.29)	(1.54)	(1.90)	(-0.68)	(4.49)	(0.40)

fertilizer	0.084	0.003	0.056	0.333***	0.089**	0.166***	0.570***	0.168***	0.268***
	(0.56)	(0.04)	(0.73)	(6.69)	(2.10)	(3.73)	(6.13)	(3.73)	(5.66)
credit_agri	0.273	0.235*	0.135	0.005	-0.253***	-0.093*	0.007	-0.324***	-0.270***
	(0.76)	(1.71)	(0.81)	(0.05)	(-4.06)	(-1.85)	(0.02)	(-3.51)	(-4.70)
_cons	12.413***	12.936***	12.508***	13.272***	13.541***	13.278***	14.413***	14.044***	14.010***
	(47.32)	(97.91)	(95.03)	(88.56)	(129.76)	(138.91)	(63.45)	(119.03)	(131.29)
r2									
F									
p									
N	1201.000	2630.000	3831.000	1201.000	2630.000	3831.000	1201.000	2630.000	3831.000

5.2.4 Impact of agricultural productivity on poverty reduction

In order to test the hypothesis that, increase in farmers' productivity reduces rural poverty in our study localities, we have reported Model 2 estimates in Table 15. Thus we consider in a first estimate the total productivity measured by land and labor factors and then we distinguish land and labor productivity. Poverty is measured on the one hand with a binary variable that takes the value 1 if the farmer household income is below the rural poverty line and 0 if not. Furthermore, the logarithm of farmer's income, is considered as proxy to assess the improves productivity impact on poverty reduction.

Considering the poverty measured with the binary variable, the results in Table 15 analysis reveals that the productivity coefficients have negative signs following both sex of the farmers in the study area and by the gender. This negative correlation means that the productivity improves leads to a reduction of poverty in the study areas. Indeed, there are multiple ways in which agricultural productivity increases can reduce poverty, including changes in household income, employment creation, non-farm multiplier effects.

The increase in agricultural productivity is likely to increase the demand for agricultural labour with a parallel increase in the area cultivated, intensity or frequency of cultivation (Irz et al 2001). Thus, farmers' incomes would increase and lead to a reduction in the proportion of farmers whose income is below the poverty line. In addition, the increase in agricultural productivity can lead to an increase in farmers' real incomes and thus contribute directly and indirectly to poverty reduction. Similarly, Datt and Ravallion (1998) show that an increase in agricultural productivity (defined as production per unit of land) contributes to poverty reduction in India. Their analysis of data from an Indian survey conducted between 1958 and 1994 shows that real incomes and higher agricultural yields reduce absolute poverty and that even the poorest benefit from productivity gains (Datt and Ravallion, 1998). This result confirms those of De Janvry & Sadoulet (2010) and Ravallion (2009) which show that improving agricultural productivity leads to a reduction in rural poverty. In addition, when looking at the gender analysis, the results show that increasing land productivity reduces poverty more for men than for women.

Table 15: Estimation of total productivity impact on poverty

Explanatory variables	Poverty (0. Not poor 1. Poor)					
	Women		Men		All	
	coef	t-stat	coef	t-stat	coef	t-stat
Log (productivity)	-0.252***	(-5.38)	-0.165***	(-8.05)	-0.204***	(-10.82)
Age of farmer	0.006	(1.13)	-0.004	(-1.06)	-0.004	(-1.36)
Household size	-0.025	(-0.50)	0.006	(0.23)	-0.006	(-0.25)
Education level						
Primary	-0.669***	(-4.68)	-0.189	(-1.38)	-0.501***	(-5.22)
Secondary	-0.664***	(-3.58)	-0.302**	(-2.29)	-0.709***	(-7.31)
High			0.162	(0.39)	-0.441	(-1.10)
Marital status						
Married	0.318	(1.11)	-0.208	(-1.40)	-0.068	(-0.52)
Divorced / voeuf	0.567**	(1.97)	0.136	(0.75)	0.408***	(2.84)
Dependence Ratio	-0.149	(-1.12)	0.363***	(3.57)	0.205***	(2.58)
Migrant transfer	-0.655	(-1.08)	0.084	(0.13)	-0.240	(-0.58)
Total area	0.022	(1.29)	0.001	(0.63)	0.001	(0.64)
Select seeds	-0.101	(-0.54)	-1.028***	(-7.54)	-0.685***	(-6.65)
Use of fertilizer	0.186	(1.24)	0.241**	(2.32)	0.239***	(2.85)
Practice of Irrigation	1.262**	(2.25)	-0.046	(-0.18)	0.105	(0.51)
Access to electricity	-0.033	(-0.24)	-0.111	(-1.10)	-0.079	(-1.00)
Use Mobile phone	-0.159	(-1.16)	-0.665***	(-6.67)	-0.484***	(-6.03)
Distance residence market	0.154	(1.11)	-0.002	(-0.02)	0.067	(0.88)
Natural disaster assistance	0.905	(0.83)	1.261**	(2.04)	1.138**	(2.16)
_cons	3.340***	(4.43)	2.603***	(6.79)	3.287***	(9.96)
P (chi2)	0.000		0.000		0.000	
N	1194		2560		3754	

Source*: CBMS census, 2018*

The table 15 shows that having a primary or secondary level of education contributes to reducing the poverty level of farmers by considering the other control variables. This result is obvious in that better educated, better trained farmers are better able, all else being equal, to absorb modern technologies and innovate. This should increase their productivity and allow them to generate more income and move out of poverty. This result is consistent with Coombs & Ahmed (1974) and Noor, (1980) works, which showed that farmers are less likely to be poor if they are more educated. The results also show that fertilizer use increases the probability that farmers have an income below the poverty threshold line. However, the result is not significant for women. On the other hand, irrigation practices increase the probability that women become poor. These different results on inputs use can be explained by the costs that it's incurred for households to use these factors that reduce their net income.

In addition, investments in improved farming techniques, improve productivity and therefore reduce poverty. Studies show that the adoption of improved technologies can increase agricultural productivity, overcome poverty and improve food security (Dontsop-Nguezet, Diagne, Okoruwa, & Ojehomon, 2011). Have a primary or secondary education and use mobile phones and assistance lead to a reduction in rural poverty.

Looking at the results of the table 16, we observe that by dissociating total land productivity and labor productivity, the increase of land productivity only reduces the probability of farmers being poor.

Table 16: Estimation of total productivity impact on poverty

Explanatory variables	Poverty (0. Not poor 1. Poor)					
	Women		Men		All	
	coef	t-stat	coef	t-stat	coef	t-stat
Log (land productivity)	-0.376***	(-6.47)	-0.363***	(-9.23)	-0.390***	(-12.32)
Log (labor productivity)	-0.030	(-0.58)	-0.013	(-0.41)	-0.023	(-0.85)
Age of farmer	0.007	(1.23)	-0.004	(-0.90)	-0.002	(-0.76)
Household size	-0.019	(-0.38)	0.015	(0.52)	0.006	(0.23)
Education level						
Primary	-0.593***	(-4.07)	-0.118	(-0.84)	-0.411***	(-4.19)
Secondary	-0.593***	(-3.21)	-0.226*	(-1.66)	-0.592***	(-5.96)
High	-	-	0.076	(0.17)	-0.448	(-1.00)
Marital status						
Married	0.265	(0.94)	-0.201	(-1.33)	-0.082	(-0.62)
Divorced / voeuf	0.544*	(1.91)	0.094	(0.52)	0.349**	(2.42)
Dependence Ratio	-0.168	(-1.28)	0.371***	(3.60)	0.185**	(2.35)
Migrant transfer	-0.590	(-0.99)	0.524	(0.69)	-0.107	(-0.22)
Total area	0.008	(1.02)	-0.003***	(-3.05)	-0.003***	(-3.34)
Select seeds	-0.133	(-0.71)	-1.035***	(-7.51)	-0.705***	(-6.79)
Use of fertilizer	0.326**	(2.13)	0.285***	(2.66)	0.327***	(3.80)
Practice of Irrigation	1.299**	(2.34)	0.030	(0.11)	0.182	(0.85)
Access to electricity	-0.007	(-0.05)	-0.114	(-1.11)	-0.078	(-0.97)
Use Mobile phone	-0.214	(-1.54)	-0.659***	(-6.45)	-0.497***	(-6.07)
Distance residence market	0.218	(1.53)	0.025	(0.26)	0.113	(1.43)
Natural disaster assistance	1.604	(1.48)	1.386**	(2.43)	1.356***	(2.78)
_cons	5.389***	(5.52)	5.437***	(9.32)	5.997***	(12.31)
P (chi2)	0.000		0.000		0.000	
N	1194		2560		3754	

The table 17 shows the marginal effects of the logit regression. Analysis of the results reveals that increasing total productivity by 1% increases farmers' chances to lift themselves out of poverty by about 20%. Moreover, we observe that the probability of lifting women out of poverty is higher than that of men when their productivity is increased by 1%. Moreover, considering the land's productivity, women are still more likely to escape poverty than men. This result can be justified by the fact that in addition to agricultural activity, women have other parallel activities. Thus, by increasing their productivity, it can increase their income level, as well as income from other activities, it can lift them out of the poverty line.

Table 17: Marginal effect of productivity impact on poverty

Explanatory variables	Poverty (0. Not poor 1. Poor)					
	Women	Men	All	Women	Men	All
poverty						
Log (productivity)	-	-	-	-0.252***	-0.165***	-0.204***
	-	-	-	(-5.38)	(-8.05)	(-10.82)
Log (land productivity)	-0.376***	-0.363***	-0.390***	-	-	-
	(-6.47)	(-9.23)	(-12.32)	-	-	-
Log (labor productivity)	-0.030	-0.013	-0.023	-	-	-
	(-0.58)	(-0.41)	(-0.85)	-	-	-
Age of farmer	0.007	-0.004	-0.002	0.006	-0.004	-0.004
	(1.23)	(-0.90)	(-0.76)	(1.13)	(-1.06)	(-1.36)
Household size	-0.019	0.015	0.006	-0.025	0.006	-0.006
	(-0.38)	(0.52)	(0.23)	(-0.50)	(0.23)	(-0.25)
Education level						
Primary	-0.593***	-0.118	-0.411***	-0.669***	-0.189	-0.501***
	(-4.07)	(-0.84)	(-4.19)	(-4.68)	(-1.38)	(-5.22)
Secondary	-0.593***	-0.226*	-0.592***	-0.664***	-0.302**	-0.709***
	(-3.21)	(-1.66)	(-5.96)	(-3.58)	(-2.29)	(-7.31)
High		0.076	-0.448		0.162	-0.441
		(0.17)	(-1.00)		(0.39)	(-1.10)
Marital status						
Married	0.265	-0.201	-0.082	0.318	-0.208	-0.068
	(0.94)	(-1.33)	(-0.62)	(1.11)	(-1.40)	(-0.52)
Divorced / voeuf	0.544*	0.094	0.349**	0.567**	0.136	0.408***
	(1.91)	(0.52)	(2.42)	(1.97)	(0.75)	(2.84)
Dependence Ratio	-0.168	0.371***	0.185**	-0.149	0.363***	0.205***
	(-1.28)	(3.60)	(2.35)	(-1.12)	(3.57)	(2.58)
Migrant transfer	-0.590	0.524	-0.107	-0.655	0.084	-0.240
	(-0.99)	(0.69)	(-0.22)	(-1.08)	(0.13)	(-0.58)
Total area	0.008	-0.003***	-0.003***	0.022	0.001	0.001
	(1.02)	(-3.05)	(-3.34)	(1.29)	(0.63)	(0.64)
Select seeds	-0.133	-1.035***	-0.705***	-0.101	-1.028***	-0.685***
	(-0.71)	(-7.51)	(-6.79)	(-0.54)	(-7.54)	(-6.65)

Use of fertilizer	0.326**	0.285***	0.327***	0.186	0.241**	0.239***
	(2.13)	(2.66)	(3.80)	(1.24)	(2.32)	(2.85)
Practice of Irrigation	1.299**	0.030	0.182	1.262**	-0.046	0.105
	(2.34)	(0.11)	(0.85)	(2.25)	(-0.18)	(0.51)
Access to electricity	-0.007	-0.114	-0.078	-0.033	-0.111	-0.079
	(-0.05)	(-1.11)	(-0.97)	(-0.24)	(-1.10)	(-1.00)
Use Mobile phone	-0.214	-0.659***	-0.497***	-0.159	-0.665***	-0.484***
	(-1.54)	(-6.45)	(-6.07)	(-1.16)	(-6.67)	(-6.03)
Distance residence market	0.218	0.025	0.113	0.154	-0.002	0.067
	(1.53)	(0.26)	(1.43)	(1.11)	(-0.02)	(0.88)
Natural disaster assistance	1.604	1.386**	1.356***	0.905	1.261**	1.138**
	(1.48)	(2.43)	(2.78)	(0.83)	(2.04)	(2.16)
_cons	5.389***	5.437***	5.997***	3.340***	2.603***	3.287***
	(5.52)	(9.32)	(12.31)	(4.43)	(6.79)	(9.96)

The table 18 presents the assessment results of productivity impact on rural poverty reduction using farmers' incomes as a proxy. Fisher's statistics of the various models estimated, reveal that these models are all significant at 1%.

The results analysis shows that agricultural productivity variable has a positive and significant sign on farmers' incomes. This result is in line with the literature showing that increasing agricultural productivity leads to poverty reduction. According to Schultz (1964), Mellor (1995 and 1996) and Gollin (2010), increased agricultural productivity leads to general equilibrium effects that further stimulate job creation and equitable growth and generate more dramatic wealth and stability benefits for society. For Gollin (2010), increased productivity leads to increased income and agricultural profitability, leading to improved living conditions for farmers and poor rural populations. It also leads to a reduction in food prices, which benefits both rural and urban consumers, including farmers who are net food buyers.

Table 18: Estimation of land and labor productivity impact on farmer's income

Explanatory variables	Log(income)					
	Women		Men		All	
	coef	t-stat	coef	t-stat	coef	t-stat
Log (productivity)	0.271***	(9.00)	0.235***	(9.58)	0.251***	(13.14)
Age of farmer	0.002	(0.61)	-0.004*	(-1.83)	0.000	(0.14)
Household size	0.053**	(2.29)	0.017	(0.92)	0.028**	(1.99)
Education level						
Primary	0.266***	(3.68)	0.077	(1.15)	0.197***	(3.94)
Secondary	0.141	(1.38)	0.077	(1.22)	0.223***	(4.37)
High			0.244	(0.96)	0.476*	(1.92)
Marital status						
Married	-0.252*	(-1.81)	0.085	(1.36)	-0.017	(-0.29)
Divorced / voeuf	-0.238*	(-1.73)	0.017	(0.23)	-0.121*	(-1.92)
Dependence Ratio	0.048	(0.81)	0.066	(1.35)	0.032	(0.85)
Migrant transfer	0.243	(0.74)	0.029	(0.10)	0.091	(0.40)
Total area	0.003***	(3.37)	0.002***	(3.23)	0.003***	(4.61)
Select seeds	-0.076	(-0.67)	0.370***	(5.64)	0.240***	(4.12)
Use of fertilizer	-0.072	(-0.90)	-0.184***	(-3.30)	-0.153***	(-3.30)
Practice of Irrigation	-0.250	(-1.15)	-0.323*	(-1.83)	-0.256*	(-1.74)
Access to electricity	0.112*	(1.67)	0.148***	(3.19)	0.117***	(3.04)
Use Mobile phone	0.122*	(1.76)	0.353***	(6.96)	0.280***	(6.76)
Distance residence market	-0.096	(-1.45)	-0.112***	(-2.66)	-0.108***	(-3.03)
Natural disaster assistance	-0.176	(-0.24)	-1.192***	(-2.94)	-0.910**	(-2.52)
_cons	8.345***	(18.05)	9.063***	(25.20)	8.631***	(31.36)
r2	0.256		0.246		0.254	
F	7.752		12.546		20.670	
p	0.000		0.000		0.000	
N	1170		2515		3685	

Source*: CBMS census, 2018*

5.2.5 Gender wage gap in the agricultural sector

Assessing the wage gap between men and women in the agricultural sector which gives rise to a discrimination is a difficult task in many respects. However, according to the empirical method of Oaxaca (1973) and Blinder (1973), it is difficult to systematically attribute any difference in income between men and women to discrimination against women. Indeed, considering only the African context, the hourly workload on farms is unequal between the two sexes, mostly because of housework activities or the practice of other activities such as trade, which mainly concerns women in rural areas. Thus, it is possible that for hard labor such as agriculture,

women productivity may be lower than that of men. It should also be added that due to certain impediments that can reduce the performance of women including pregnancy, the time taken from working hours to raise their children, this can lead to a reduction in their incomes to compensate the cost of their part-time work.

The empirical method of Oaxaca (1973) and Blinder (1973) consists in controlling, in a sample of farmers of both sexes, all the individual characteristics giving rise to differences in agricultural income: access to plot, use of agricultural inputs, level of education, etc., so as to isolate a residue which cannot be explained by these normal factors of income inequality, which in turn help to understand the sex discrimination. In other words, the objective is to assess the percentage of the average income gap between men and women that can quantify this sex discrimination among farmers.

This decomposition of the income gap has two parts: the first represents the differences in the returns of the characteristics weighted by the mean of women characteristics; it is the unexplained part due to the discrimination of income. The second part quantifies the differences due to individual characteristics weighted by men returns; this is explained part. Moreover, the unexplained part is broken down into two terms. The first is the return in performance, weighted by men structure, due to being male compared to the norm; it is the male advantage. The second term represents the yield gap due to being female, the female disadvantage (Madden, 1975 quoted by Die & Panthieux, 2000).

Table 19 presents the results of the estimates of the Oaxaca Blinder model. Considering the labor force in our study area, the estimated farm income gap between men and women is 44.1%. This difference is mainly due to dotation discrimination for 22.9, a relative contribution of 51.92% (0.229 / 0.441). The female disadvantage, that is, the under-compensation of the agricultural sector due to the fact that the farmer is a woman, contributes to this difference by -0.12% (-0.053 / 0.441). On the other hand, the effect of the male advantage, in other words the favoritism towards men, represents 60.1% (0.265 / 0.441) of this gap. These indices suggest that income discrimination between men and women is ostensibly a result of discrimination against women farmers. This discrimination against women can be explained by several customary, sociological and economic factors which hinder women access to land.

Indeed, land is an important means of production in economic activities and a main source of income in rural areas. The rights of access to land, its use and control are recognized to women in rural areas by the laws and legal texts in Togo. Yet, various limitations to women ability to

own and control agricultural land not only hinder their ability to engage in economic activities, but also significantly reduce the income they can derive from agricultural activities.

A study on land policies and women access to land in Togo conducted by Women in Law and Development in Africa (WILDAF, 2009) reveals that only 20 women out of 130 heirs (or 15.2%) are heiress and have access to farmlands relatively smaller than those obtained by men. Moreover, their inheritance is accompanied in most cases with restrictive measures to their right (refusal of transmissions to descendants, conditioned sale). The main reason justifying the refusal of the inheritance of land to women is the patrilineal regime adopted in Togo whereas according to communities and families, an heiress cannot preserve the inherited land but on the contrary should contribute to its crumbling and its attribution to other lineages (those of the spouses).

In addition, land transactions are very dynamic and allow women to access land as a whole but in case of rent, they do not secure the exploitation of women given the lack of written contract and non-respect of commitments by landowners. Apart from the inheritance, the only alternative for women to have a lasting control over their lands is the purchase but unfortunately women do not have the means to access the land by this alternative which is not even common in some localities.

To carry out their agricultural activities, women have access to farmlands by usufruct (48.7% or 37 women) and by lease (76.5% or 85 women). Through these ways, they have access to small farmland whose size ranges between less than 0.25 and 2 ha that they exploit in a certain land insecurity which does not allow them to adopt sustainable improvement techniques of their production. They are content with low yields despite the many needs they have to meet.

In addition, this discrimination is rooted in the fact that women not only take care of children but have to prepare and serve food for their husbands and other farm workers. They are also in charge of some work requiring particular attention like the sowing, the spreading of fertilizer and the harvest. They carry out post-harvest work such as winnowing and the transport, marketing and in some cases the processing of harvested products.

Table 19: Oaxaca decomposition of men and women farmer's income

A. Average gender differential	
Average productivity in men	12.366***
	(498.97)

Average productivity among women	11.925***
	(332.05)
The average difference in agricultural productivity by gender	0.441***
	(10.11)

B. aggregate decomposition	Endowment		men Structural advantage		women structural desavantage	
	coef	t-stat	coef	t-stat	coef	t-stat
	0.229***	(5.58)	0.265***	(5.70)	-0.053	(-1.19)

C. detailed decomposition	Endowment		men Structural advantage		women Structural disadvantage	
	coef	t-stat	coef	t-stat	coef	t-stat
Log (productivity)	0.126***	(5.19)	-0.458**	(-1.97)	-0.017*	(-1.85)
Age of farmer	-0.003	(-1.00)	-0.314*	(-1.94)	0.007	(1.46)
Household size	0.020**	(2.07)	-0.067	(-0.96)	-0.011	(-0.95)
Education level	0.070***	(2.81)	-0.074	(-1.49)	-0.046	(-1.48)
Marital status	0.017	(0.75)	0.065	(0.61)	-0.018	(-0.61)
Dependence Ratio	-0.005	(-0.55)	0.013	(0.29)	-0.003	(-0.29)
Migrant transfer	0.004	(1.29)	0.002	(0.28)	-0.001	(-0.28)
Farm area	-0.002	(-0.35)	-0.007	(-0.96)	0.001	(0.33)
Use of Select seeds	-0.004	(-0.93)	0.066***	(3.87)	0.019**	(2.55)
Use of fertilizer	-0.004	(-1.10)	-0.023	(-0.98)	-0.004	(-0.93)
Practice of Irrigation	-0.005	(-0.93)	-0.002	(-0.40)	-0.002	(-0.40)

Access to electricity	-0.002	(-0.94)	0.013	(0.42)	-0.001	(-0.40)
Mobile phone	0.013*	(1.81)	0.139***	(2.63)	0.023**	(2.42)
Distance residence market	0.003	(1.07)	-0.016	(-0.27)	0.001	(0.27)
Natural disaster assistance	-0.000	(-0.23)	-0.003	(-1.16)	-0.001	(-0.26)
Total	0.229***	(5.58)	0.932***	(2.81)	-0.053	(-1.19)

Source*: CBMS census, 2018*

5.2.6 Detailed decomposition

Section C of Table 18 highlights the results of the detailed decomposition for all co-variables included in the analysis. However, factors such as productivity, use of fertilizer, level of education and use of mobile phone are the factors that contribute most to explain discrimination against women.

Given the additive linearity property, it is possible to determine the contribution of each component to the wage discrimination respectively in case of endowment, male advantage and female disadvantage. The ratio of the different components effect on discrimination (and the overall gap) describes the importance of each factor: (i) farmer productivity represents 54.6% of the total endowment effect in absolute value (and 28.34% of the overall gender gap); (ii) level of education explains 30.56% (15.9%); (iii) household size represents in absolute value 8.7%; (4.5%). The components of the male structural advantage explain farm income are (i) farmer age, (ii) use of selected seeds, (iii) mobile phone using.

Most of these benefits for women (or disadvantages for men) may be due to diminishing returns of certain factors and lower amounts for female farmers. It would be interesting to analyze it within a Pareto-efficiency framework within households, as in Udry (1996) and Akresh (2005).

5.3 Main results

This section presents the main results of this study, which aims to analyse the impact of rural investments on farmers' productivity. It then assesses the effect of productivity on poverty reduction and finally the income gap between male and female farmers. Thus, descriptive

statistics reveal that in rural areas more men practice agriculture than women. There are more women farmers with no education (41.85%) than men farmers (15.10%) and households had between 1 and 3 persons (68.37%), followed by household consisting of 4 or 6 persons (28.70%). Only 36.32% of farmers have access to electricity and no farmers have health insurance in the investigated areas. This can be explained by the low incomes of farmers. Regarding insurance against natural disasters, the results reveal that generally the majority of women and men have no access to it. Only 3.54% of farmers in the study area have access to credit. Looking at the distribution by gender, the results reveals that only 3.08% and 3.75 % respectively of women and men have access to credit. The results show that, 75.60% of farmers has an average monthly income lower than the Interprofessional Guaranteed Minimum Wage (SMIG). Among them, more women (82.63 %) than men (72.28%) have an income lower than the SMIG.

In Agricultural practice, we find that, men practice more irrigation than women on their owning plots, about 4.43% of men farmers against 1.95% of womens. The low proportion of agricultural households practicing irrigation is explained by the fact that irrigation equipment has a cost which most rural households cannot afford. Access to inputs was difficult for Togolese farmers because of the quantity and price set by the Togolese Government. In the last two years, with the liberalization of the fertilizer market, price has become the only barrier to access fertilizers; this situation explains why only 29.64% of farmers use fertilizers for their crops.

We find that the average men crop areas equivalent to those of women, but the agricultural icome distribution by sex reveals that men have higher income than those of women.

Econometric estimates show that public investment in infrastructure such as education, irrigation, telecommunications, health, drinking water, etc. improves farmers' productivity. Thus, we observe that having a secondary school less than 5 km from the farmers' residence has a positive and significant impact on their productivity. Furthermore, the farmer’s education level has a positive and significant influence on agricultural productivity. Farmer with a higher education level are the most productive. The plausible reasons for such a positive correlation could be the skills that educated farmers have through access to information, agricultural planning practices, better technical and allocation decisions as well as efficient and effective use of inputs

Acces to potable water being a major public health issue. Public investments should help ensure drinking water supply for the population. However, in our study area, estimates result show that access to drinking water and sanitary has a negative effect on the farmer's productivity. This result is contrary to that expected is justified by the non-potable quality of the water considered by the farmers, even if it comes from the taps. In addition, there is a majority of farmers who use nature as sanitary facilities. Considering a cell phone use, it contributes to improve the agricultural productivity for all farmers. But the gender analysis show that, mobile phone use improves only the men productivity

By looking at farmers' own investments, the irrigation practice has a positive and significant effect on farmer's agricultural productivity. Access to insurance against natural disasters of agricultural households has a positive and significant effect on farmer productivity. We can note that access to electricity has a positive and significant influence on the land productivity of all farmers, but this was not the case in terms of total productivity. Furthermore, access to insurance against natural disasters is becoming significant and positive for land productivity for both sexes of all farmers. The results show also that irrigation, access to electricity, household size and access to insurance against natural disasters do not significantly influence labor productivity as has been the case for total and land productivity

Considering the heterogeneity of productivity, a quantile regression has shown that the irrigation variable, has a positive and significant effect only on the productivity of the 1st and 2nd quantile farmers. By looking at access to electricity and use of fertilizers, the results reveal that these variables only improve agricultural productivity for farmers in 2nd and 3rd quantile. This result is obvious and can be explained by the fact that the first quantile farmers considered as small producers have low incomes to access these inputs. There is a significant and negative effect of agricultural credit on farmers' productivity in the 2nd and 3rd quantile. This significant result of agricultural credit on 2nd and 3rd quantile farmer productivity reveals that the farmer's productivity level determines their accessibility to agricultural credit, excluding the 1st quantile farmers for whom the agricultural credit effect is not significant

The effect of productivity on poverty reduction reveals that, productivity coefficients have negative signs following both sex of the farmers in the study area and by the gender. however, we can conclude that increasing the productivity of farmers contributes significantly to reducing farmers' poverty. dissociating productivity into land and labor productivity, the results show that, the increase of land productivity only reduces the probability of farmers being poor.

Considering the labor force in our study area, the estimated farm income gap between men and women is 44.1%. This difference is mainly due to dotation discrimination for 22.9, a relative contribution of 51.92% (0.229 / 0.441). The female disadvantage, that is, the under-compensation of the agricultural sector due to the fact that the farmer is a woman, contributes to this difference by -0.12% (-0.053 / 0.441). On the other hand, the effect of the male advantage, in other words the favoritism towards men, represents 60.1% (0.265 / 0.441) of this gap.

Conclusions

In Togo, the agricultural sector is the main source of activity for rural populations and contributes more than 40% to the gross domestic product formation. However, with economic growth rising from 5.5% in 2014 to 5.7% in 2015, the incidence of poverty decreased from 58.4% in 2011 to 55.1% in 2015, but unfortunately did not sufficiently favor poor rural households. Particularly in rural areas where it is estimated at 68.9%, the poverty is a persistence with a great disparity compared to urban areas. Producers (exclusively rural) of the agricultural sector considered as the engine of economic development of Togo should be counted among the main beneficiaries of economic performance given their contribution to GDP, if investment choices and appropriate agricultural policies were implemented. With this in mind, many programs have been implemented in Togo to improve farmers' working and living conditions and reduce their vulnerability.

In order to evaluate the impact of investments in the agricultural sector through these projects, the general objective of this study is to analyze the impact of public investments on the labor productivity of farmers and the contribution of the latter to rural poverty reduction by gender. In addition, it assesses the income gap between men and women farmers.

Using statistical and econometric analysis tools, the main results of this study reveal that about 75.44% of farmers have at least the primary school education level. There are more women farmers with no education (41.85%) than men farmers (15.10%). Most households had between 1 and 3 persons (68.37%). Turning next to public services, we also found that access to safe water and sanitation remains a major problem in rural areas. About 51.17% of rural household do not have sanitation. Our results show that farmers do not have health insurance in the investigated areas. Looking for insurance against natural disasters, the results reveal that the majority of women and men have no access to this insurance. Moreover 75.60% of farmers have an average monthly income lower than the Interprofessional Guaranteed Minimum Wage (SMIG).

The econometric results reveal that public investments in health, education and telecommunication infrastructure improve the productivity of farmers. Moreover, the investments made by farmers in terms of inputs also contribute to improving their productivity. In this dynamic, we found that this increase in the productivity due to public and private investments made in rural areas reduces the number of farmers below the poverty line.

Considering the labor force in our study area, the estimated farm income gap between men and women is 44.1%. This difference is mainly due to dotation discrimination for 22.9, a relative contribution of 51.92% (0.229 / 0.441).

In the dynamics to improve the productivity of rural farmers and reduce their vulnerability, this study proposes the following recommendations for decision-makers and stakeholders in the agricultural sector:

- Increase public investments and encourage private investment in education, health, drinking water and irrigation infrastructure
- Integrate the roles of governments as regulators of agricultural commodity and input prices to create an optimal legal and institutional environment for investment in service delivery infrastructure that contributes to poverty reduction.
- Connect smallholders to dynamic new markets for high-value products that can increase their income and offer them an opportunity to reduce rural poverty more quickly.
- Invest in market infrastructure and improve the technical capacity of farmers to meet international standards in order to export their production and increase their income.
- Strengthen public investments in research and development to ensure the design of pro-poor technologies in soil, water and livestock management, as well as more sustainable and resilient farming systems, including more tolerant varieties to parasites, diseases and drought
- Create favorable conditions and incentives in rural areas to provide rural people with better access to savings and credit facilities.
- Put in place, institutional innovations in the field of agricultural insurance such as index insurance against drought risk or natural disasters at the level of private initiatives, and encourage farmers to subscribe to them to reduce the risks to farmer’s borrowers and lenders and unlock agricultural finance.
- Remove barriers to women's discrimination to promote agricultural growth on a potentially massive scale.
- Promote equity in the distribution of endowments to equalize opportunities for disadvantaged or excluded groups, such as women and ethnic minorities.

References

Adesina, A. A., & Djato, K. K. (1996). Farm size, relative efficiency and agrarian policy in Cote d'Ivoire: profit function analysis of rice farms. *Agricultural Economics, 14*(2), 93-102.

African Development Bank. (2015). Togo Economic Outlook.

Adeoti A. (2009). Factors Influencing Irrigation Technology Adoption and its Impact on Household Poverty in Ghana. *Journal of Agriculture and Rural Development in the Tropics and Subtropics*, vol. 109, n°1, p. 51-63

Akresh Richard, (2005) Understanding Pareto inefficient intrahousehold allocations, *IZA Discussion Papers, No. 1858*

Alene, A. D., & Manyong, V. (2007). The effects of education on agricultural productivity under traditional and improved technology in northern Nigeria: an endogenous switching regression analysis. *Empirical economics, 32*(1), 141-159.

Alston, J. M., Babcock, B. A., & Pardey, P. G. (2010). *The shifting patterns of agricultural production and productivity worldwide*: Midwest Agribusiness Trade Research and Information Center.

Audibert, M. (2010). Endemic diseases and agricultural productivity: Challenges and policy response. *Journal of African Economies, 19*(suppl 3), iii110-iii165.

Bauer, T. K., & Sinning, M. (2008). An extension of the Blinder–Oaxaca decomposition to nonlinear models. *AStA Advances in Statistical Analysis, 92*(2), 197-206.

Bhavnani, A., Chiu, R. W.-W., Janakiram, S., Silarszky, P., & Bhatia, D. (2008). The role of mobile phones in sustainable rural poverty reduction. *retrieved November, 22*, 2008.

Bilenkisi, F., Gungor, M. S., & Tapsin, G. (2015). The Impact of Household Heads' Education Levels on the Poverty Risk: The Evidence from Turkey. *Educational Sciences: Theory and Practice, 15*(2), 337-348.

Binswanger, H., & Quizon, J. (1989). What Can Agriculture Do for the Poorest Rural Groups? : Agricultural and Rural Development Department, World Bank.

Blinder, A. S. (1973). Wage discrimination: reduced form and structural estimates. *Journal of Human resources*, 436-455.

Board, A. F. (2012). PROPOSAL FOR TOGO.

Borooah, V. K., & Iyer, S. (2005). The decomposition of inter-group differences in a logit model: Extending the Oaxaca-Blinder approach with an application to school enrolment in India. *Journal of Economic and Social Measurement, 30*(4), 279-293.

Bravo-Ureta Boris E. et Pinheiro António E. (1997) Technical, economic, and allocative efficiency in peasant farming: evidence from the dominican republic. *The Developing Economies, XXXV-1 (March 1997): 48–67*

Bresciani, F., & Valdés, A. (2007). Beyond Food Production: The Role of Agriculture in Poverty Reduction. FAO, Rome.

Briema, A. E. E., Maryoud, M. E., Elkhidir, E. E., & Mahmoud, T. E. (2013). Impact of improved seeds on small farmers''productivity, income and livelihood of Bara locality in north Kordofan state, Sudan. *Russian Journal of Agricultural and Socio-Economic Sciences, 20*(8).

Bustamante, A. V., Fang, H., Rizzo, J. A., & Ortega, A. N. (2009). Heterogeneity in health insurance coverage among US Latino adults. *Journal of General Internal Medicine, 24*(3), 561-566.

BUTAULT, J.-P., LEMARIE, S., MUSOLESI, A., HUART, F., SIMIONI, M., & SCHMITT, B. (2015). IMPACT DE LA RECHERCHE AGRONOMIQUE SUR LA PRODUCTIVITE AGRICOLE FRANÇAISE: UNE APPROCHE PAR LE TAUX DE RENTABILITE INTERNE (TRI) DE LA RECHERCHE PUBLIQUE.

Byerlee, D., Diao, X., & Jackson, C. (2005). Agriculture, rural development, and pro-poor growth: Country experiences in the post-reform era. *Agriculture and rural development discussion paper, 21*, 1-72.

Byiringiro, F., & Reardon, T. (1996). Farm productivity in Rwanda: effects of farm size, erosion, and soil conservation investments. *Agricultural Economics, 15*(2), 127-136.

Cervantes-Godoy, D., & Dewbre, J. (2010). Economic importance of agriculture for poverty reduction.

Chang, H., & Zepeda, L. (2001). Agricultural Productivity for Sustainable Food Security in Asia and the Pacific: the Role of Investment: FAO

Corporate Document Repository, originated by: Economic and Social Development Department.

Chebbi, H. E., & Lachaal, L. (2007). Agricultural sector and economic growth in Tunisia: Evidence from co-integration and error correction mechanism.

Christiaensen, L., Demery, L., & Kuhl, J. (2010). The (evolving) role of agriculture in poverty reduction. *UNU-WIDER, Working Paper*(2010/36).

Combary, O. S. (2016). Impacts of Health Services on Agricultural Labor Productivity of Rural Households in Burkina Faso.

Cornia, G. A. (1985) Farm size, land yields and the agricultural production function: an analysis for lifteen developing countries. *World Development 13, 513-534*.

Datt, G., & Ravallion, M. (1998). Farm productivity and rural poverty in India. *The Journal of Development Studies, 34*(4), 62-85.

De Janvry, A., & Sadoulet, E. (2010). Agriculture for development in sub-Saharan Africa: An update. *African Journal of Agricultural and Resource Economics, 5*(1), 194-204.

Deaton, A. (1997). *The analysis of household surveys: a microeconometric approach to development policy*: World Bank Publications.

Dercon, S., & Gollin, D. (2014). CSAE Working Paper WPS/2014-22.

Diagne, A., & Zeller, M. (2001). *Access to credit and its impact on welfare in Malawi* (Vol. 116): Intl Food Policy Res Inst.

Diao, X., & Pratt, A. N. (2007). Growth options and poverty reduction in Ethiopia–An economy-wide model analysis. *Food Policy, 32*(2), 205-228.

Dontsop-Nguezet, Diagne, Okoruwa, & Ojehomon, (2011), Impact of Improved Rice Technology (NERICA varieties) on Income and Poverty among Rice Farming Households in Nigeria: A Local Average Treatment Effect, (LATE) Approach, Quarterly. *Journal of International Agriculture 50 (2011), No. 3: 267-291*

Dzanku, F. M. (2015). Household Welfare Effects of Agricultural Productivity: A Multidimensional Perspective from Ghana. *The Journal of Development Studies, 51*(9), 1139-1154.

Eswaran, M., Kotwal, A., Ramaswami, B., & Wadhwa, W. (1983). How Does Poverty Decline? *Evidence from India, 1999*, 07-05.

Eswaran, M., Kotwal, A., Ramaswami, B., & Wadhwa, W. (2008). *How does poverty decline? Suggestive evidence from India, 1983-1999," unpublished manuscript.* Paper presented at the University of British Columbia.

Evenson, R. E., & Gollin, D. (2003). Assessing the impact of the Green Revolution, 1960 to 2000. *Science, 300*(5620), 758-762.

Fan, S., Hazell, P. B., & Thorat, S. (1999). *Linkages between government spending, growth, and poverty in rural India* (Vol. 110): Intl Food Policy Res Inst.

FAO. (2012). CADRE DE PROGRAMMATION PAYS (CPP-TOGO), 2013 – 2017.

Finan, F., Sadoulet, E., & De Janvry, A. (2005). Measuring the poverty reduction potential of land in rural Mexico. *Journal of Development Economics, 77*(1), 27-51.

Fischer, R., Byerlee, D., & Edmeades, G. O. (2009). *Can technology deliver on the yield challenge to 2050.* Paper presented at the Expert Meeting on How to feed the World in.

Foster, A. D., & Rosenzweig, M. R. (2003). Agricultural development, industrialization and rural inequality. *Manuscript, Brown University and Harvard University*.

Fuglie, K. (2015). Accounting for growth in global agriculture. *Bio-based and applied economics, 4*(3), 201-234.

Fuglie, K., & Rada, N. (2013). Resources, Policies, and Agricultural Productivity in Sub-Saharan Africa. *USDA-ERS Economic Research Report*(145).

Fulginiti, L. E., & Perrin, R. K. (1998). Agricultural productivity in developing countries. *Agricultural Economics, 19*(1), 45-51.

Githinji, M., Konstantinidis, C., & Barenberg, A. (2011). Small and as Productive: Female-headed households and the inverse relationship between land size and output in Kenya. *Department of Economics Working Papers*.

Government of Togo, & United Nations. (2011). MDG Acceleration FramE work Improving the Agricultural Productivity of Small-Holder Fa rmers.

Gül Fatma Ünal, (2008), Small is beautiful: evidence of an inverse relationship between farm size and yield in Turkey, *Working papers // The Levy Economics Institute, No. 551*

Grewal, B., Grunfeld, H., & Sheehan, P. (2012). *The contribution of agricultural growth to poverty reduction*: Australian Centre for International Agricultural Research (ACIAR).

Hadley, C., Belachew, T., Lindstrom, D., & Tessema, F. (2011). The shape of things to come? Household dependency ratio and adolescent nutritional status in rural and urban Ethiopia. *American journal of physical anthropology, 144*(4), 643-652.

Hayami, Y., & Ruttan, V. W. (1970). Agricultural productivity differences among countries. *The American Economic Review, 60*(5), 895-911.

Heltberg Rasmus Rural market imperfections and the farm size productivity relationship: Evidence from Pakistan, *World Development Volume 26, Issue 10, October 1998, Pages 1807-1826*

Hlavac, M. (2014). oaxaca: Blinder-Oaxaca Decomposition in R. *Available at SSRN 2528391*.

Huang Qiuqiong, Scott Rozelle, Bryan Lohmar, Jikun Huang, Jinxia Wang, (2006), Irrigation, agricultural performance and poverty reduction in China, *Food Policy 31 (2006) 30–52*

Hussain Intizar and Hanjra Munir A., (2004), irrigation and poverty alleviation: review of the empirical evidence, *Irrig. and Drain. 53: 1–15 (2004)*

Hussein, M. A., & Leal Filho, W. (2012). Analysis of energy as a precondition for improvement of living conditions and poverty reduction in sub-Saharan Africa. *Scientific Research and Essays, 7*(30), 2656-2666.

INSEED. (2016a). Profil de pauvreté 2015. Lomé-Togo: INSEED.

INSEED. (2016b). Rapport QUIBB-2015.

Irz, X., Lin, L., Thirtle, C., & Wiggins, S. (2001). Agricultural productivity growth and poverty alleviation. *Development policy review, 19*(4), 449-466.

Kassali, R. (2006). Influence of village-farm distance on farmer's production decisions and performance: evidence from Nigeria. *Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria*.

Kemah T. and Thiruchelvam S. (2008), Analysis of the effect of the scale of irrigation on Paddy production, in Anuradhapura District, Tropical Agricultural Research Vol. 20 : 269-278

Kiani, A. (2008). An analysis of productivity growth and rate of return to research in agriculture sector of North West frontier province. *Sarhad J. Agric, 24*(3), 521-530.

Kibaara, B., Ariga, J., Olwande, J., & Jayne, T. S. (2009). *Trends in Kenyan agricultural productivity: 1997-2007*: Citeseer.

LaLonde, R. J., & Topel, R. H. (1992). The assimilation of immigrants in the US labor market *Immigration and the workforce: Economic consequences for the United States and source areas* (pp. 67-92): University of Chicago Press.

López, R., & Valdés, A. (2000). *Rural Poverty in Latin America*: Springer.

MAEP. (2012). PROGRAMME NATIONAL D'INVESTISSEMENT AGRICOLE ET DE SECURITE ALIMENTAIRE (PNIASA): PLAN D'ACTION DU VOLET NUTRITION 2012 - 2015. Lomé-Togo.

MAEP. (2013a). 4ème RECENSEMENT NATIIONAL DE L''AGRIICULTURE 2011--2014. Lomé-Togo: MINISTERE DE L'AGRICULTURE, DE L'ELEVAGE ET DE LA PECHE.

MAEP. (2013b). Profil de l'Agriculture Togolaise. Lomé-Togo: MINISTERE DE L'AGRICULTURE, DE L'ELEVAGE ET DE LA PECHE.

Mamatzakis, E. C. (2003). Public infrastructure and productivity growth in Greek agriculture. *Agricultural Economics, 29*(2), 169-180.

Maredia, M. K., & Raitzer, D. A. (2006). *CGIAR and NARS partner research in sub-Saharan Africa: evidence of impact to date*: Citeseer.

Mateos Luciano, David Lozano , Ahmed Baba Ould Baghil, Oumar Abdoul Diallo, Helena Go´mez-Macpherson , Jordi Comas , David Connor, (2010), Irrigation performance before and after rehabilitation of a representative, small irrigation scheme besides the Senegal River, Mauritania, *Agricultural Water Management 97 (2010) 901–909*

Mellor, J. W. (1999). Pro-poor Growth: The relation between growth in Agriculture and Poverty Reduction. *Unpublished paper prepared for USAID*.

Minten, B., & Barrett, C. B. (2008). Agricultural technology, productivity, and poverty in Madagascar. *World Development, 36*(5), 797-822.

Montalvo, J. G., & Ravallion, M. (2010). The pattern of growth and poverty reduction in China. *Journal of Comparative Economics, 38*(1), 2-16.

Munn, I. A., & Hussain, A. (2010). Factors determining differences in local hunting lease rates: insights from Blinder-Oaxaca decomposition. *Land Economics, 86*(1), 66-78.

Muzari, W. (2014). Agricultural Productivity and Food Security in Sub-Saharan Africa.

Neumark, D. (1988). Employers' discriminatory behavior and the estimation of wage discrimination. *Journal of Human resources*, 279-295.

Nguyen, D. (1979). On agricultural productivity differences among countries. *American Journal of Agricultural Economics, 61*(3), 565-570.

O'Donnell, O. (2007). Access to health care in developing countries: breaking down demand side barriers. *Cadernos de Saúde Pública, 23*(12), 2820-2834.

Oaxaca, R. (1973). Male-female wage differentials in urban labor markets. *International economic review*, 693-709.

Okoye A., MeierSchellersheim M., Brenchley J.M., Hagen S.I., Walker J.M., Rohankhed karM., Lum R., Edgar J.B., Planer S.L., Legasse A., Sylwester A.W., Piatak M. Jr ., Lifson J.D., Maino V.C., Sodora D.L., Douek D.C., Axthelm M. K., Grossman Z. and Picker L.J .Progressive CD4+ central memory T cell decline results in CD4+ effector memory insufficiency and overt disease in chronic SIV infection, *J. Exp.Med., 204 (9) (2007), pp. 2171-2185*

Omideyi, A. K. (1988). Family size and productivity of rural households in Nigeria. *Janasamkhya, 6*(1), 29.

Otsuka, K. (2000). Role of agricultural research in poverty reduction: lessons from the Asian experience. *Food Policy, 25*(4), 447-462.

Pencavel, J. (2015). The productivity of working hours. *The Economic Journal, 125*(589), 2052-2076.

Platt, E. (2012). How the Lack of Access to Safe Water and Sanitation Hampers Growth and Development: The Case of Peru. *Global Majority E-Journal, 86*.
PNUD Togo. (2011). Profil de pauvreté 2006-2011.
Poonyth, D., Hassan, R., Kirsten, J. F., & Calcaterra, M. (2001). Is agricultural sector growth a precondition for economic growth? The case of South Africa. *Agrekon, 40*(2), 269-279.
Ravallion, M. (2009). Are there lessons for Africa from China's success against poverty? *World Development, 37*(2), 303-313.
Ravallion, M., & Chen, S. (2007). China's (uneven) progress against poverty. *Journal of Development Economics, 82*(1), 1-42.
Ravallion, M., & Datt, G. (1996). How important to India's poor is the sectoral composition of economic growth? *The World Bank Economic Review, 10*(1), 1-25.
Sarris, A., Savastano, S., & Christiaensen, L. (2006). The role of agriculture in reducing poverty in Tanzania: A household perspective from rural Kilimanjaro and Ruvuma. *FAO Commodity and Trade Policy Research Working Paper, 19*.
Schneider, K., & Gugerty, M. K. (2011). Agricultural productivity and poverty reduction: Linkages and pathways. *Libraries Test Journal, 1*(1), 56-74.
Schultz, T. W. (1980). Nobel lecture: the economics of being poor. *Journal of Political Economy, 88*(4), 639-651.
Shaorshadze, I., & Miyata, S. (2010). *Foreign remittances and poverty reduction in Kosovo.* Paper presented at the Conference on Western Balkans Poverty and Inclusion.
Staatz, J. M., & Dembele, N. N. (2008). *Agriculture for development in sub-Saharan Africa*: Citeseer.
Suh, J. (2010). Decomposition of the change in the gender wage gap. *Research in business and economics journal, 1*, 1.
Tankou, C. M. (2013). *The interactions of human mobility and farming systems and impacts on biodiversity and soil quality in the Western Highlands of Cameroon*: Department of Conservation Biology, Institute of Environmental Sciences, Faculty of Science, Leiden University.
Thirtle, C., Piesse, J., & Gouse, M. (2005). Agricultural technology, productivity and employment: Policies for poverty reduction. *Agrekon, 44*(1), 37-59.
Thorbecke, E., & Jung, H.-S. (1996). A multiplier decomposition method to analyze poverty alleviation. *Journal of Development Economics, 48*(2), 279-300.
Timmer, C. P. (1995). Getting agriculture moving: do markets provide the right signals? *Food Policy, 20*(5), 455-472.
Tripathi, A., & Prasad, A. (2008). Agricultural productivity growth in India. *Journal of Global Economy, 4*(4), 322-328.
Udry, C. (1996). Gender, agricultural production, and the theory of the household. *Journal of political Economy*, 104 (5), 1010-1046.
Urgessa Tessema (2015), The Determinants of Agricultural Productivity and Rural Household Income in Ethiopia *, Ethiopian Journal of Economics*
Velazco, J. (2001). Agricultural Production in Peru (1950-1995): Sources of Growth: FAO Corporate Document Repository, Economic and Social Development Department,.
Virmani, A. (2007). The sudoku of growth, poverty and malnutrition: policy implications for lagging states. *Planning Commission, Working Paper*(2).
Wang, S. L., Heisey, P., Schimmelpfennig, D., & Ball, V. E. (2015). Agricultural Productivity Growth in the United States: Measurement, Trends, and Drivers. *Economic Research Service, Paper No. ERR-189*.
Wang, Y.-C. (2015). How ICT Penetration Influences Productivity Growth Evidence From 17 OECD Countries. *Economic Development Quarterly, 29*(1), 79-92.
Warr, P. (2001). *Poverty reduction and sectoral growth: evidence from Southeast Asia.* Paper presented at the WIDER Development Conference on Growth and Poverty, Helsinki.

World Bank. (2014). Rapport de la mission conjointe de la Banque mondiale pour la supervision des projets du PNIASA.

Yabi, J. A., & Afari-Sefa, V. (2009). Impact of rural development projects on agricultural productivity in selected regions of Benin. *African Journal of Agricultural Research, 4*(11), 1120-1128.

Zepeda, L. (2001). Agricultural investment, production capacity and productivity. *FAO Economic and Social Development paper*, 3-20.

Zewdu Ayalew Abro, Bamlaku Alamirew Alemu, and Munir a. Hanjra, (2014) Policies for Agricultural Productivity Growth and Poverty Reduction in Rural Ethiopia, *World Development Vol. 59, pp. 461–474, 2014*

Ziagonas, C. (1993). Structure and development of Greek agriculture before and after accession to the E.C. *Quarterly Journal of International Agriculture, 32*(2), 147-159.

Ziagonas, C. (1999). Structure of the supply of agricultural products until 2010.