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THE EFFECTS OF GENDER AND ITS DISTRIBUTION IN FARM PRODUCTION ON MAIZE PRODUCTIVITY: THE CASE OF NORTHERN GHANA

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DECLARATION

Student

I hereby declare that this thesis is the result of my original work, and that no part of it has been submitted for any degree in this University or elsewhere except where all authorities and other sources of information have been cited and duly acknowledge.

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Supervisor

I hereby declare that the preparation and presentation of the thesis was duly supervised in accordance with the guidelines on supervision of thesis laid down by the University for Development Studies.

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ABSTRACT

This research looked at the effects of gender and its distribution in farm production on maize productivity in northern Ghana. The role played by gender in terms of labor input in the agricultural production process is equally as important as the gender of the farmer. The study was conducted in Northern Ghana where three out of the five regions were selected randomly; Northern, North-East and the Savanna Regions. From each region two districts each were randomly selected making six districts in all; North Gonja, Kalba/Sawla/Tuna, Tamale Metro, Savelugu/Nanton, West mamprusi and East Mamprusi. The same random sampling was used to select two communities from each district and then in the selection of the maize farmers in each community, resulting in a total sample of 312. The study employed the Multinomial Endogenous Treatment Effect and the Kendall Coefficient of Concordance in the analysis of the data. The results of the study reaveals that, Men contribute about 61% of labour hours whiles women contribute 39% in the entire production process of maize. About 70% of farmers entire maize production process is dominated by both male and female labour hours. 24% and 6% of the farmers had their production dominated by male labour hours and female labour hours respectively. In terms of farm activities, men dominated in ploughing, weeding, chemical and pest management, whiles women dominated in only one activity; cooking for farm labor. The rest of the other activities were dominated by both genders. The results also reveal that female farm mangers are more productive compared to male farm managers. However, a farm that is dominated by male labour hours record higher yield than those dominated by female labour hours. By way of policy recommedation, the study suggests maize productivity improvement programs should have a segregated gender approach.

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DEDICATION

This thesis is dedicated to my family generally and specifically to my wife, Priscilla and little Jeffrey for their patience, encouragement and support.

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LIST OF ACRONYMS

FAO	Food And Agriculture Organisation
GIZ	German Agency for International Cooporation
GSS	Ghana Statistical Service
IFPRI	International Food Policy Research Institute
JICA	Japan International Cooperation Agency
LIM	Linear Probablity Model
MNP	Multinomial Probit Model
MNTREG	Multinomial Endogenous Treatment Effects
MOFA	Ministry of Food And Agriculture
MVP	Multivariate Probit Model
NGO	Non Governmental Organisation
OLS	Ordinary Least Square
SRID	Statistics, Research and Institute Directorate
UNDP	United Nations Developmen Program
WHO	World Health Organisation
WID	Women in Development

CHAPTER ONE

INTRODUCTION

1.0 Background

About 65-70 % of the population of Sub-Saharan Africa is classified as agricultural (Jayne et al., 2021). Food production has failed to keep pace with increase in demand for food by growing population in most Sub-Saharan African countries. Agriculture provides about one-fifth of Ghana's Gross Domestic Product (GDP) and employs almost half of the country's active labour force (World Bank, 2018).

Approximately 155,000 km^2 of Ghana's total land area is classified as agricultural land, of which 78,500 km^2 of this land is under cultivation, and 300 km^2 is irrigated (Dittoh, 2020). Smallholder rain-fed farming using rudimentary technologies dominates the agricultural sector accounting for 80% of total agricultural production. About 90% of smallholder farms are less than two hectares in size, and produce variety of crops. Larger farms and plantations primarily cultivate cocoa, oil-palm, rubber and coconut, and to a lesser extent, cereals and pineapples (Ministry of Food and Agriculture (MOFA), 2011).

Although maize is not native to Ghana, it has become the most widely cultivated staple crop in the country and accounts for a significant proportion of daily caloric intake (Akinola et al., 2007). Maize is the primary source of income for 45% of households in the northern savannah, and the second source of income for 21% (Abukari and Alemdar, 2019).

Maize is the most widely produced and consumed cereal crop in Ghana and its production has seen increasing trend. Maize production in Ghana, is predominantly done under rain-fed conditions by poorly resourced smallholder farmers (Darfour and Rosentrate, 2016). Its

production is worldwide and has been a staple food for most people in the different parts of the world. Averagely maize production has been increasing since 2011 to 2017 (MoFA, 2017). Maize accounts for over 50% of the total cereal production in Ghana, and annual yields have been reported to be growing around 1.1% (International Food Policy Research Institute (IFPRI), 2014).

There are countless number of literature in agriculture that have made attempts to analyse the effects of sex and gender on various variables like production, productivity, efficiency, food security, adoption etc. In these researches, there has been frequent use of the words 'sex' and 'gender' interchangeably.

However, these two terms are related but different; whiles gender refers to the characteristic of the sexes (women and men) that are socially created, sex refers to the biological composition of the human being (World Healh Organisation (WHO), 2009). According to FAO (2003), Gender refers to the social, economic and cultural roles and relations between women and men. In the context of agricultural production however, this would be understood as the economic roles assigned to the sexes (male and female) in the production process by way of their labour input. Since the production process is made up of farm activities, the roles each sex plays in each farm activity in terms of labour input is analysed and modelled to establish its effect on productivity.

In Ghana, women constitute majority of smallholder farmers and provide about 70% to 80% of farm labour. However, most of the labour provided by women is on farms belonging to male farmers because most often women have less access to farmlands (Duncan and Brants, 2004). Male and female farmers share many responsibilities and engage in varying economic activities geared towards increasing their economic benefits. They have different needs and

encounter different constraints because of their activities. In agricultural production, women are more constrained as compared to men in terms of access to inputs such as information technology and credit among other factors (Kinkingninhoun-Meˆdagbe´ et al., 2010).

The study therefore focused on maize which is a widely cultivated staple crop in the country and accounts for a significant proportion of daily caloric intake. In the study area, among cereals, it represents the highest output and planting area (MoFA, 2010). In addition, Choudhary et al. (2015) found that maize farming is the highest farm activity among household in the region. It is also the most consumed cereals among humans and livestock making it a good candidate to fighting food insecurity (Akramov and Malek, 2012). The above reasons are the justification for the selection of maize as the crop for this study.

Given the fact that women and men face different constraints and play varying roles in the production process, the study investigate the distribution of these roles interms of labour input and how it affects productivity. These roles are often not considered in the modelling of productivity in agriculture. Generally, it is often the dichotomous sex (male or female) of the farmer that is considered. The study therefore models both the conventional sex/gender of the farmer in addition to the roles played by the sexes (labour input) in the production process as well as its effect on productivity. Owing to the fact that the contribution of the sexes in the production process is defined by the different constraints each faces, the study further analysed the sex specific challenges facing the farmers in maize production.

1.1 Problem Statement

Men and women jointly contribute in all aspects of agricultural value chain (Clark, 2013). According to Fernando (1998), farm activities are significantly influenced by gender- that is, by the socio-economic and cultural dimension of being male or female. Moreover, different types of activities and tasks are generally allocated to women and men within the socio-cultural context of the type of work men and women should do.

Studies in agriculture have often tried to find the effect of sex or gender on various variables like production, productivity, efficiency, food security, adoption, marketing, etc. however, whether qualitative or quantitative analysis, there seem to be a mixed up concerning the operationalization of the words “sex” and “gender”. In these researches, there have been frequent use of the words ‘sex’ and ‘gender’ interchangeably, which in fact are related but different terms. This study uses these terms interchangeably in reference to whether the farm managers are males or females.

It is very common that modelling gender related studies in agricultural economics have often limit it to the sex or gender of the farmer or the farm manager. However, the gender dimension goes beyond the farmer to the labour that contributed in the whole production process. Like the farm manager, each individual labour in the production process is either a male or a female. Therefore, if the gender of the farm manager is that important in the production process, so must be the gender of labour that is used in the production process. Studies such Abay (2020), Charlton and Taylor (2020), Gilligan et al. (2020), Shrestha et al. (2020), Smith and Floro (2020), Broussard (2019), Aguilar et al. (2015), McCarthy and Kilic (2015) have analysed the effects of gender/sex on various agricultural outcome variables.

However, much is lacking on the effect in terms of labour input in the entire production process.

For studies that have made attempts at segregating the gender in terms of labour input in production, it is found that agricultural labour input is not homogenous (Gebre et al., 2021). On this basis others have concluded that male and female labor input in agricultural production is not substitutable (Doss, 1999). Following further, some other analyses have segregated the labour input by men and women in some studies (Sharma, 2013; Challa and Mahendran 2015). These sharp distinctions between the male and female labor input also denies the very important fact that there are cases where the two genders work together in equal measure to achieve the production of an output. Aside the effect of the gender of the farm owner on maize productivity, the study will further bring to bare the effect on productivity of the production process dominated by a specific gender and when they are both equal. This study therefore seeks to model effects of both gender as a farm manager and labor input on the productivity of maize, while taking care of the obvious endogeneity issue on the use of male and female labor in production process.

1.2 Research Questions

- What is the distribution of farm activities among gender in maize production process in northern Ghana?
- What are the effects of the gender distribution of farm activities on maize yield in northern Ghana?
- What are the sex specific challenges to agriculture in northern region?

1.3 Main Research Objective

To analyse the effects of gender and gender distribution of farm activities on the maize yield in northern Ghana?

1.4 Research Objectives

- To analyse the distribution of farm activities among gender in maize production process in northern Ghana?
- To analyse the effects of the gender distribution of farm activities on maize yield in northern Ghana?
- To identify the sex specific challenges to agriculture in northern Ghana

1.5 Justification of the Study

Despite the crucial role of the agricultural sector in the Ghanaian economy, studies on roles played by the various gender in the agricultural production process are relatively scarce. The main purpose of this study is to contribute to the knowledge base about the implications of modelling the effect of the various gender in agriculture productivity instead of relying on the sex/gender of the farm owner or manager.

In the production process of maize, a chain of activities are carried out, right from land preparation to marketing. The labour input in these production process are gender sensitive (Jackson, 2007). This research will help find out what activities in the maize production chain are dominated by women, men or both. The study would also contribute to literature on gender studies in agriculture. This study will further analyse challenges facing each sex in the maize production.

1.6 Operational Definitions

Gender refers to the social, economic and cultural roles and relations between women and men (FAO, 2003). In the agricultural production (economic) setting, gender roles refer to the roles assigned to the sexes (male and female) in the production process. In the context of this study the roles are quantified in terms of the contribution of each gender to labour input. Sex refers to the innate biological categories of male or female and is thus a fixed category rooted in biological differences (Quisumbing et al., 2014). Gender and sex have been used interchangeably in several researches. Many believe that the two concepts are the same and that there is no difference between them. Perhaps they are just different ways of describing the same thing. Many have conceded the confusing nature and used of the words 'gender' and 'sex' in research and practice, especially in agriculture (Quisumbing et al., 2014).

In agricultural production, both men and women jointly play roles in the execution of a farm activity. However, gender stereotypes in society has assigned some farm activities to certain sexes. It is rare to find a farm activity that is completely executed by a certain gender. On that basis, a farm activity (or entire production process) is designated a gender dominated when more than three quarters (75%) of the labour hours for that activity (or entire production process) is done by that particular gender. If none is able to cross the 75% for an activity (or entire production process), it is considered the normal case of both genders playing their combined roles for that activity (or entire production process). Therefore, based on the definition, a farm activity or the entire production process are classified into three;

- Male dominated (MD) farm activity or production process
- Female dominated (FD) farm activity or production process
- Mixed/Both dominated (BD) farm activity or production process

Maize yield is the maize output in kg per acre

1.7 Organization of the Thesis

The rest of the thesis is organized as follows. Chapter two deal with the reviews of relevant literature in respect to the study. Chapter three outlines the study area and methods used to address the various objectives; the sample size and sampling techniques, methods of data collection and data analysis. Chapter four presents the results of the study and chapter five presents the summary, conclusions, and policy recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

The chapter reviews literature on the definition of concepts used in the study including sex, gender and sex and gender roles, sex specific challenges to agriculture. It also reviews literature on research on gender in empirical agricultural literature (including production and productivity), maize production in Ghana and in northern Ghana (importance and regional production levels).

2.1 Gender and Gender Roles

Gender refers to the roles and behaviours society assigned to men and women; it refers to the social meaning of biological sex differences. Food and Agriculture Organization (1997) has indicated that "gender is not determined biologically, as a result of sexual characteristics of either female or male, but is the socially constructed relations between males and females, both perceptual and material". Gender is the standard made by society such that every member of the society is to maintain. These include identities, covert and overt behaviours ascribe to males and females (American Psychological Association Task Force on Gender Identity and Gender Variance 2009; West and Zimmerman, 1987).

It is the collective principles of every society, and it controls the processes of production, reproduction, consumption and distribution (Johnson-Welch et al., 2000). Reeves and Baden (2000) define gender as believes and practices that society sees a person as a man or woman. Gender role refers to the different tasks or roles that society ascribe to males and females (Buss, 1985). It forms the core or foundation of the division of labour between males and females in every society: the division between "productive", "reproductive" and

''communal'' activities. These roles are not biologically determined, but by the socioeconomic and cultural environment (ICA-ILO 2001; Mollel and Mtenga 2000). According to Njenga et al. (2011) "gender roles are the socio-cultural constructs of roles in terms of responsibilities, characteristics, attitudes and beliefs among men and women, including the young and old. These roles and relationships are learned, change over time, and vary widely within and between cultures". Gender forms a linkage between sex and the characteristics of individual behaviour of men and women in a society. For instance, men control the formation of laws, customs with property rights and control of resources while women are seen being physically weak and so much emotional attachments to do these things (Flora, 2001). Society have to some extend decided to differentiate these roles played by men and women in terms of quality of life, the amount of work done, kind and recognition of the type of work they do, health and literacy levels, economic, political and social standing (Flora, 2001). These differences also manifest in the area of patrilineal and matrilineal practices of Malawi as well as Dedza and Ntcheu where, control and decision making over cash cropping agricultural activities lies in the hands of men and women on the other hand control decision making in food crop activities (Chitsike et al., 2017). A survey conducted in Malawi confirms that female headed households and women in male headed households do more work than their male counterparts. The survey involved the elderly, adult male and female and children, who were interviewed on activities such as land preparation and planting; weeding, fertilizing, harvesting and other non-harvest activities (Chitsike et al., 2017).

Gender social relation focus on authority, access to and control of resources for production, reproduction, distribution of resources, remuneration for work including cultural and

religious activities that society generally engages every day as scheduled activities. Participation in these activities, have seen women involving in many responsibilities such as productive activities and reproductive activities (child bearing and child rearing) compared with their male counterparts (The Montpellier Panel, 2012). Aregu et al. (2010) posit that social differentiation of work, distribution of gains of production, use and control of resources and the relationship between men and women, is influenced by the roles society ascribe to the individuals. According to Bhagowalia et al. (2007), these roles impacts the investments household make in agriculture. For instance, households with more males is assured of generational transfer of land and other valuable assets to the family, since it is a norm in the northern part of Ghana for only males to inherit land. Labour too will not be a matter of worry to the family. In that regard, agricultural productivity may not depend on lack of technology and credit but also the valuable contribution of men and women to the agricultural sub-sector of the economy.

Ogunlela and Mukhtar (2009) noted that women have been denied far too long in the decision making process in the agricultural development because of gender roles and this has constraint development in developing nations. There is therefore the need for government and other responsible stakeholders to reconsider this practice so that women can be involved in all agricultural development policy frameworks. Peterman et al. (2011) emphasised on this assertion and that the important roles women play in the agricultural sector is not recognised by way of not giving women equal opportunities compared to their men counterparts. This situation of women contributes to their lower productivity level. Northern Ghana specifically, has received its share of the problem arising as a result of gender roles where hunger and poverty have engulfed the people with women being the

worse affected. Therefore women should be included in all decision making regarding the development of agriculture in Ghana (Bambangi and Abubakari, 2013).

2.2 Gender Roles in Agriculture

Agriculture remains the back bone of all developing nations. In these nations, women even though choked with so much domestic work, continue to provide a large proportion of the labour needs. Most of the effort women put in the agricultural and domestic sectors still remain unrecognised. Studies done by Okali (2002), Boserup (1970), Jackson (2007), Quisumbing (2003) and Whitehead (1981) on sex and gender roles in agriculture and in the household, have brought more insight empirically to the understanding and study of sex and gender roles in the field of research. Women compared with men have supplied more labour force and work more hours in all rural communities in Northern Ghana when their domestic tasks are accounted for (Doss, 2011). Though women are seen in almost all farm activities, their physical strength and other factors are not always considered in the development of modern technologies (Wodon and Blackden, 2006). The nature of women compared with their men counterparts, requires that more advance technologies should be developed in their favour to help reduce the burden they always go through (FAO, 2001). Traditionally, rural women do all domestic chores and at the same time certain specific roles in the farm are assigned to them with the remaining roles assigned to their men counterparts. This idea in society, dictated to them by gender roles end up putting more load on the shoulders of women (Grassi, et al., 2015). More than half of the population of women in sub-Saharan Africa and Eastern Asia are involved in active agriculture and on the extreme side, this figure become even higher reaching about 93% in Burkina Faso, 87% in Angola, 98% in Burundi, 96 in Malawi and 92% in Mali and Tanzania respectively (World Bank, 2001) and in India more

than 70% of the entire female workforce is involve in active agricultural (Satyavathi et al., 2010). In all these countries, the division of roles as discussed above follow the same trend where women are seen carrying much of the burden of work compared to men (Grassi, Landberg and Huyer, 2015).

Shehu (2010), reports that, since women are seen as subordinates in the rural and traditional society means that the roles that are assigned to them by society remain unchanged. However, this argument by Shehu is challenged by a report put out by the FAO (2011). They think that gender roles can change in any culture or traditional setting especially in the agricultural sector. Most rural young men have migrated to cities in search of what they refer to as better job remaining only the women to take over all farm activities including tasks that were formally dominated by these men. Again with the ever growing and advancement in technology, most tasks that were formally assumed to be women work are gradually taken by the men, for instance in the processing of some agricultural produce such as cassava. According to Doss, (2011) “sex and gender roles and responsibilities are dynamic and men and women respond to changing economic circumstances”.

Just as all other places in Africa and the world as a whole, women in Ghana are seen partaking in almost all activities in the farm and the household. At the household level, women prepare food for the family to eat, ensure that the house remain clean, care for the children, fetch water and gather fire wood. However, men in Ghana are supposed to aid the women to do some of the domestic work, but most men in Ghana will not do it with the excused that it is traditionally women task. When domestic tasks of women are considered in addition to the task they carry in the farm, they contribute higher to the labour force in Ghana compared to their male counterparts (MOFA, 2003). Ahmed and Hussain (2004)

noted that in the farm, women are seen doing all manner of work as soon as the production season sets in; from the period of land preparation to when the produce is brought home. They play major roles such as sowing, transplanting, irrigation, fertilizer application, plant protection, weeding, hoeing, harvesting, threshing, picking, winnowing, cotton stick collections, separation of seeds from fibre, storing etc. According to Choudhary and Singh, (2003), more than 70% of all farm tasks, women are seen playing major roles while the remaining 30% is performed by men. Women are not only engaged in purely activities that are carried out in the farm, but they also engage in taking care of animals and ensuring that where these animals are kept is clean by clearing all shed, collecting farm yard manure, collecting fodder, watering, preparation of dung cakes, milking, milk processing and preparation of ghee etc and also make some cash from the sales of the animal products (Lal and Khurana, 2011). Even though men help to carry out the tasks in the farm, women lead in terms of contributing to the labour requirements in all the activities that are carried out in the farm and other sub-sectors in the whole agricultural sector. They form more than 89% of the labour force in all food processing, 80% of food storage and transportation of harvested farm produce, 90% of hoeing and weeding and 60% of harvesting and marketing (Huvio, 1998). Women in rural areas have virtually taken up all tasks in the farm because of the absence of young males. Rural-urban migration has created a lot of scarce male labour force in farming communities and because of that rural women have taken up tasks formally dominated by male farmers in addition to what they are already doing (Huvio, 1998).

In Guinea, the economically active labour force in agriculture have become predominantly women (FAO, 1995) which could be due to high level of migrations of men to urban areas and death through HIV/AIDS. Because of the increase in the number young males moving

out of these communities, women are becoming increasingly responsible, not only for the family food supply, but for national food security.

2.2.1 Gender Segregated Activities

Men and women jointly contribute in all aspects of agricultural value chain (Clark, 2013). From land preparation to harvesting and selling, both men and women are seen performing one activity or the other. In the farm and also at the household level, some activities are dominated by either men or women. That notwithstanding, some other activities are neither dominated by men nor women. But in all women are seen doing the most labour-intensive activities such as, storage, processing, harvesting and weeding, which are predominantly female-dominated activities. On the other hand, land preparation, fertilizer application and chemical handling are mostly carried out by the men in the farm. According to Jackson (2007), "women also provide most of the labour for post-harvest activities, taking responsibility for storage, handling, stocking, processing and marketing. This is one of the major ways that distinguishes them from their male counterparts".

Good planting, spacing and maintenance of crops are also activities mostly done by women. These activities need much time and one need to also be careful in their execution, since the outcome of it will determine how much produce one will get at the end of the season (Hussein, 2008). Duncan and Brants (2004) noted that not all activities women dominates in the agricultural production chain, but for planting, weeding, watering, harvesting, transportation of farm produce, agro-processing and the marketing of small amounts of farm produce are mostly dominated by women. Whitehead (1996) posits that since women contribute more of the labour requirement of all agricultural activities than men, it will not be wrong for some farm activities to be classified as 'female' activities or female dominated

activities and some too as 'male' activities or male dominated activities rather than considering the whole industry as men job. For instance, because of the energy draining nature of some farm activities and for the fact that women physical strength cannot equal that of men, most women always hire labour to execute tasks such as ploughing, land clearing, etc. for them. It is however a fact that there are some activities that both men and women jointly execute and hence are considered as mixed dominated activities. That notwithstanding, women contribution to all farm activities compared to men is not debatable. Reports from Ghana, Malawi, Tanzania and Nigeria confirm to this assertion that women contribute more labour in all agricultural activities than men, when their domestic work is considered (Agarwal, 1985; Doss, 2011; Grassi et al., 2015). Time studies done in Ghana rural farming households indicate that within a week men work averagely 35.39 hours while their female counterparts work averagely 46.97 hours. A clear evidence that shows women work more in terms of labour hours than men (Agarwal, 1985; Doss, 2011). A similar study was also conducted in Tanzania where it reveals that men work averagely 152.42 hours a week and women work averagely 255.75 hours a week (Agarwal, 1985). However, in some other parts of Africa, for instance Zimbabwe, Nigeria and Uganda, results of the time studies in each of these countries, rather give a contrary view, and that men work more hours than women. But what these researchers left out is the time women spent on domestic tasks (Agarwal 1985; Herrera and Torelli, 2013). Marcelo et al. (2007) found evidence that "gender differences are characterized not only by who does one particular type of work, but even more so by how much work that person does. Women have entered the labour market and men have increasingly assumed responsibilities for domestic work. But for women this has resulted mostly in an increased workload. On average, women work more than men,

owing basically to a double shift of work. This is an accumulation of both paid and unpaid work responsibilities."

Usually tasks for men and women are different. While rural women in farming communities do all the domestic works in the household in addition to some of the task at the farm level, men concentrate in task mostly in the farm that will put money in their pockets (Wodon and Blackden, 2006). When men migrate from farming communities to the cities in search of higher incomes, most of the farm tasks that were formally executed by the men are taken over by women but the reverse is hardly said for men. Men only switch to take over women tasks when men know that those tasks can fetch them money. For instance, it is a norm to see women picking sheanuts in Burkina Faso but men have now fully involved themselves into sheanuts picking, often with the help of their wives because the crop has gain much more economic value that tend to be profitable. Also with technological advancements, tasks that were traditionally women tasks have almost been taken over by men. Examples are found in the processing of oil palm, cassava, etc. These frequent switching of tasks with time is usually unpredictable (Doss 1999).

Dicta et al. (2013) noted that often the best time men are needed in all farming activities is during ploughing and land preparation. This is because, these activities are tedious and more energy demanding and because of men physical strength compared to women, they are always there to do it. Even though most women try ploughing and preparing their lands, but the majority who cannot do it, always hire men to help them execute for a fee.

According to Vargas-Hill and Vigneri (2011), most often, it is the men that do all managerial work including managing the farm. But in Ghana, female farmers also manage cocoa farms and in comparison with their male farmers, cocoa farms that are managed by female farmers

yield more cocoa than the farms that are managed by the males. Equipping women with resource and time just as their male counterparts, they could contribute more to agricultural development. What this also means is that, the productivity gap between men and women cannot be attributed to just the fact that one is a man and the other is a woman. Studies by Clark (2013), Koru and Holden (2008), and Chavas et al. (2005), indicate that the development of agriculture to help the growth of the economy rest not in the hands of only men but a complementary effort of both sexes. Even with this fact, women are denied equal access to inputs and other resources that can give them equal opportunity to increase output. All this is dictated by sex, gender and gender roles.

2.2.2 Female Crops and Male crops

Crop production is surely a conduit for poverty reduction and plays a major role into ensuring food security in Africa and the world as a whole. Women are fully involved into food crop production such as maize, rice, wheat while their male counterparts concentrate more on cash crop production such as cotton, cocoa, etc (Lipton 2005; World Bank 2007). Legumes and vegetables are also crops that women produce second to cereals and they engage in legumes and vegetable production to supplement their nutritional needs and also in the event the main crops which are the cereals fail (FAO 2008). Relative to their male counterparts, women are equally capable into producing cash crop when given equal opportunity in terms of access to inputs and other resource. Gladwin et al. (2001) observed that some crops are associated to women because women always cultivate those crops which they use to feed the family. Men, the supposed breadwinners of the family, are expected to provide the cash needs of the family, and therefore are mostly involved into producing crops such as cash and export crops, and these crops are considered ‘men’ crop.

Doss (1999) noted however that one cannot emphatically say, the fact that women are known into producing food crops is merely their love and care for feeding the family and not that the inputs requirement into producing cash and export crops are not easily accessible to them. Maize production in Ghana is very productive and therefore generates money for farmers who produce it. However, most women at times prefer producing yam, cassava, etc. because they cannot afford to provide most of the inputs requirement such as fertilizer, herbicides, etc. to produce maize. So to them, maize cultivation is a risky business to venture into knowing very well that you don't have the necessary inputs (Adjei-Nsiah et al. 2007). According to Amaza (2000), food crops can be classified into 'gendered' crops and 'gendered neutral' crops. For him those crops that can be classified as 'gendered crops' include maize and yam and those which are classified are 'gender neural' crops are cassava, cowpea, vegetables and other cereals. Ajani (2001) noted that in Northern part of south western Nigeria there are more female maize farmers than there are female yam farmers.

The production of maize may sometimes be considered a cash crop or subsistence crop, depending on the variety of the maize. High yielding maize varieties is considered a cash crop and are referred to as 'men' crop and the low yielding variety, otherwise called the local variety is considered a subsistence crop and that it is 'women' crop (Badstue et al., 2007). When taste and preferences are given consideration into determining which maize variety is subsistence and which is cash, it becomes difficult for the resource poor farmer to make a decision as whether maize become a cash or subsistence crop since they only cultivate to feed the family.

Gender stereotype has gone beyond just calling women weak, but also associate women to poor yielding of farm produce. For instance, in Tanzania, whenever yields for groundnut is

good, it is attributed to the good management of men, but when yields become poor then women were the farm managers and with that it is the women that take charge of such low produce (FAO 2008).

If indeed some crops could easily be classified and truly be associated to men and women, then test of policies effectiveness and development of policies in the agricultural sector could be easy (Doss, 2002). A good number of works done on gendered crops is rooted in the work of Lawson (1995), when he proposed a feminist empiricist approach to gender. According to Jackson (1996) and Moser (2012), this approach is referred to as efficiency approach, where women that are easily subjected to developmental shocks and related stresses could be identified and appropriate measures taken to resolve all issues. Most literatures such as; Arndt & Tarp (2000), Cloud (1986), Doss (2002), Ezumah & Di Domenico (1995), Gladwin (1992), and others dealt much into men and women crops all agreeing to some extent the changing nature of classifying crops based on sexes.

2.3 Gender Roles in Empirical Agriculture Literature

The gender dimension to agriculture has not been given much attention until the work of Boserup (1970). She emphasized the need to not only concentrate on the biological distinction (sex), but rather the roles each sex play in production and economic development. It is a clear fact that both men and women contribute to the production of food. Based on the distinction of these two terms previously, the study reviewed empirical studies in agriculture focusing on sex, gender and roles played by the sexes, and has come out with three basic classifications of these studies; 1. Some studies have captured the word ‘gender’ in their title, but in actual fact their reference is to sex, 2. Some have used gender as a variable in a model, but in actual fact, the reference is to sex, and 3. Others present gender to mean women

or the vice versa. Collectively, these studies are selected from agricultural related fields comprising production, productivity, food security, households' welfare, efficiency, agricultural marketing and related fields of studies.

In the first category, titles of the study give the impression that the content of the study would be about gender, but the reality and the context is in fact sex of respondents. Starting with Smith and Floro (2020) who made an attempt to analyse food insecurity, gender, and international migration in low and middle-income countries found that food insecurity is a direct determinant of people's intentions and preparations to migrate. They further found that this relationship also influences by the gender. However, the variable in the study referred to and defined by the sex (male or female) of the respondents. Captioning the study as 'Decomposition of gender differentials in agricultural productivity in Ethiopia', Aguilar et al. (2014) sought to find that agricultural productivity could be segregated in terms of whether farmers are males or female (that is their sexes). However, gender is used in place of sex in the title. The basis under which the gender differentials were estimated is based on the dichotomous operationalization of gender as male and female, where the latter was coded 1, and the former 0. McCarthy and Kilic (2015) set out to establish a connection between gender, collective action for public goods and agriculture. After establishing the connection in theory and an empirical study, they failed to define and operationalized the gender variable in the study beyond sex. Like in the previous study, females were coded 1 against males 0. Crop choice and production decisions in the context of gender is what de Brauw (2015) investigated in Mozambique. Even though roles of women and their access to production resources are discussed, the ultimate gender factor expressed in the study is about ownership, control of production between males and females. Gender differences in household energy

decision-making are the object of the study conducted by Shrestha et al. (2020). But all analysis is in the context of male and female and their decisions in households' energy consumption. Gilligan et al. (2020) intended by the caption of their topic to study the role of gender in the adoption of orange sweet potato in Uganda. The results of the study are established on male-female dichotomy instead of the gender as captured in the topic. Even the gender-disaggregated indicators constructed by the authors did not go any further than a disaggregation pure based on sex. Gender differentials in agricultural production in Nigeria are what Aguilar et al. (2014) set out to investigate. Results however, was based merely on the differences in agricultural productivity across male and female plot managers, that is, the sex of plot managers. Other literature in this same category includes Ayala-Cantu and Morando (2020), Cunningham et al. (2008), Doss and Morris (2000), Gladwin (1992), Kieran et al. (2015), Slavchevska (2015), Smale and Heisey (1994), and Rice (2010).

Studies in this second category has to do with modelling the variable gender. It is found in most studies that the gender variable is captured and measured as sex variable. This is done coding the gender variable in the model as 0 and 1 for male and female or the vice versa. In discussing measurement errors in agricultural data and its implication, Abay (2020) used empirical data with the gender variable of the household head among the independent variables. This variable is recorded as 1 for male headed household and 0 for female. This variable as it is being captured is the sex of the household head not the gender. Analysing access to rural schools and its relation with agricultural transformation required that respondent gender should be controlled for in the model. Charlton and Taylor (2020) did this codding the variable as 1 for female and 0 for male, which gives an indication of sex and not gender as the variable portrays. Other include Abay and Jensen (2020), Hou et al. (2020),

Caputo and Lusk (2020), Abdul-Rahaman and Abdulai (2018), Porter (2016), Kondylis et al. (2015), Gladwin (1992), Urquieta and Alwang (2012), Aguilar et al. (2014), Griffiths et al. (2014), Melo-Becerra and Orozco-Gallo (2017), Singbo et al. (2014), Bachke (2019), Amadu et al. (2020), Bairagi et al. (2020), Yang et al. (2020) and Soomro et al. (2019).

In the third category, the use of gender is specifically refereeing to only women. Broussard (2019) attempted to find an answer to the question 'What explains gender differences in food insecurity?' which forms the exact wording of the research topic. However, every aspect of the research equates gender to mean women. They found that, despite the important roles women play in ensuring food security, women compared has a higher probability of being food insecure both in developed and developing countries. Other studies in this category include Raghunathan et al. (2019), Jimi et al. (2019), Narayanan et al. (2019), Seymour (2017), Karamba and Winters (2015), Urquieta and Alwang (2012), Liu and Myers (2009), Rao et al. (2019), Pucheta-Martínez et al. (2020), Nhamo and Mukonza (2019), Nhamo et al. (2018), Rice (2009), Shrestha et al. (2020) and Uduji et al. (2019).

This study has resolved to use these terms interchangeably as in the above scenarios. Notwithstanding these misrepresentations, some have made attempts at incorporating sex and their roles in studies. In terms of methodology, the review starts with the work of Ester Boserup (1970) who emphasized the need to not only concentrate on the biological distinction (sex), but rather the roles each sex play in production and economic development. In view of this, the work of Schneidhofer et al. (2010), exemplified this by operationalising gender and gender roles as independent variables thus overcoming the strict dichotomy of male/female and include gender. They used the mixed linear model to analyse the effect of time, sex and gender role type on income. What they found was that, over a period of time,

the effect of sex and gender role type is realized. And that the gender role type on income do not produce so much difference for women compared to their men counterparts. Uzokwe (2009), employed descriptive statistic, Focus Group Discussion (FGD) and Interview Schedule to examine the role of each member of the family in food production. He investigated the type of farming activities the farm families are engaged in, the gender specific roles and level of participation of the female gender. He found that, there were no gender specific roles or stereotypes. Men were more involved in all the food production activities except food processing. Tavva et al. (2013), used descriptive statistics in their analyses of gender roles in agriculture in the conservative patriarchal society of Afghanistan. Rapid appraisal through focus group discussion and participatory resource mapping, were used in the data analysis. What their study revealed was not much different from what Uzokwe (2009) found. Their study revealed that women involvement was less compared to their men counterparts in both livestock and crop related activities. Netsayi et al. (2017) use the gender relations approach to analyse the role of gender norms in access to agricultural training in Chikwawa and Phalombe, Malawi. Their study revealed that, the stereotypical perceptions of men being household heads and women as helpers has implications on women's ability to access training and information.

2.4 Sex, Gender and Productivity

Agriculture productivity is the foundation of growth of all developing economies and nations and forms the very basis into fighting food insecurity in these nations (Darku & Malla 2010). Report from the FAO (2011), indicate that women compared with their men counterparts are more productive, given that there is zero discrimination of inputs against women. Food production depends on inputs, and women in society do not have a say when it comes to who

gets what in terms of sharing of production resources. To an extend that women in some part of Uganda report that the only decision they have is which type of crop and the quantity of crop to sow in plots they manage, but the men think that even with that, they still control such plots because traditionally women do not own land (Berhman 2011).

Land does not grow and therefore increment of the cultivable land is not possible hence the need to talk about agricultural productivity (Evaluation Cooperation Group (ECG), 2011). Population growth worldwide does not correspond with worldwide growth in food production with the former being on the higher side (Siegel, 2021). Couple with agricultural diversification, intensification and advancement of agricultural technology is the way out for food production to catch up with increasing growth in population (Dixon et al., 2001).

Men and women record differences in their agriculture productivities, with women always recording lower productivity relative to men. Women physical and human capital, especially in Sub-Saharan African compared with men is what the lower level of women productivity is being accused of, however this believe is being refuted and that women are equally productive when access to productive resources such as land are not discriminated against women (FAO, 2011). The gap between what the farmer gets on a piece of land and what the land could potentially produce is an indication that food production can be enhanced by agricultural productivity (Zepeda, 2001). Agricultural productivity can enhance the income of rural men and women which further sustain the demands and market of the products of local industries (Dethier and Effenberger, 2011)

Women have often been offered lands that are infertile and when they cultivate the same crop with men even in the same household, the expectation is that they get the same yield with the men (Nkedi-Kizza et al., 2002, Tiruneh et al., 2001). Crop production differences

that exist between men and women may not only be limited to differences in cultivable lands but could also be through the choice of crop since not all crops have the same agricultural production function. Women compared with their men counterparts might lack other production supports such as fertilizer, herbicides, etc, that compelled them to choose such crops (Doss 2002). Udry and colleagues (1995) conducted a research in Burkina Faso. They estimated agricultural production function for men and women in the same household who cultivated the same crop within the same farming season. The research revealed that there could be yield increment by 10% to 15% by simply reallocating inputs from plots that belong to men to plots that belong to women. As indicated, the productivity gap between men and women has much to do with the discrimination against women when it comes to inputs and resource allocations.

In Ghana, Goldstein and Udry (2008) have found that there is a bigger profit margin between plots that are being managed by men and those also managed by women in consideration of the fallow period. Quisumbing et al. (2001) noted, though at 10% significance level, that, the margin of difference in cocoa yield between male managed plots and female managed plots was lower on the side of the latter in Ghana. Studies conducted in Ethiopia about the productivity difference between male-headed households and female-head household, saw a similar trend, where female-headed household frequently recorded lower productivity relative to their male-headed households (Bezabih and Holden 2006; Holden, Shiferaw, and Pender 2001; Tiruneh et al., 2001). Chavas, Petrie, and Roth (2005) and Thapa (2008) rather found contrary results after controlling for other inputs in the Nepal and Gambia. They report that the difference in productivity between female-headed households and male-headed households is just insignificant. Kinkkingninhoun-Mêdagbé et al. (2010) also found that

indeed there is productivity difference among the sexes in Benin. However, the differences came as a result of differences in access to rice farms, equipment and membership of the irrigation scheme.

Gilbert, Sakala, and Benson (2013) conducted a research in Malawi and found that, men and women are both productive in crop yield when all factors of production are equally accessible to both sexes, otherwise differences exist. Jacoby (1991) did a thorough analysis of productivity differences between men and women in Peruvian Sierra. He attributed the productivity differences between both sexes, to the different types of roles men and women play in the farm. In contrast, Hasnah and Coelli (2004) posit that there is no impact of the contribution of female labour input in the oil palm sector in Indonesia by way of technical efficiency. Aly and Shields (2010) "examine productivity differences of female and male labourers in Nepalese agriculture using two approaches: a Cobb-Douglas production function and a ray-homothetic function. They conclude that, although there is a gender gap in productivity, once differences in irrigation and type of seeds used by male and female farmers are included in the model, the magnitude of the difference is reduced and the estimated coefficient becomes insignificant. However, their study, although an improvement over those available in the literature, still assumes farmers to be fully efficient in their production technologies, which may bias the results". Oladeebo and Fajuyigbe (2007) reveals that in Nigeria, women often make good and maximum use of technology relative to their men counterparts in Osun State. Using a deterministic profit function analysis Adesina and Djato (1997) found that, men just as their women counterparts have the same level of efficiency in Cote d'Ivoire. They use a dummy variable approach to show the differences in productivity between men and women, which according to FAO (2011) is not a proper way

to measure the productivity difference between men and women. Bozoglu and Ceyhan (2007) also uses stochastic production frontier in Turkey and realised that when women are given the opportunity to partake in decision making process, especially in agriculture, it enhances their technical efficiency.

2.5 Sex Specific Challenges

Access to land still remains a serious challenge to women compared to their male counterparts in northern Ghana. Women unequal access to, control and ownership of land is merely attributable to customs and traditions. Men control land and can only release to women upon request. It is believed, that women cannot own land in the area and this has resulted to women cultivating on weaker lands.

Land is believed to be a spirit in Northern Ghana and the Frafras see it to be a source of pride and authority to the community as a whole. The fact that land is believed to be a spirit means that most at times sacrifices may be made and each time sacrifices are to be made, it is only men that can do that, since it is forbidden for women to offer sacrifices to gods (Agana, 2012). To Frafras, it is a taboo to sell land and anyone that does so will die or curse with some strange illness. It is the basis of all these that women are discriminated in land ownership.

Numerous literatures have elucidated the unique challenges women face in agricultural production compared to their men counterparts. Studies on Ghana include those that cover general assets like that of Oduro et al. (2011) and others such as Duncan (2004), Duncan and Brants (2004) as well as Apusigah (2009) focus on women in agricultural production. A substantial number however, examine gender and the land question, noting the significant role of land in agricultural communities in Ghana. Notable ones are Britwum et al. (2014),

Tsikata (2008), Minkah-Premo and Dwuona-Hammond (2005), Kotey and Owusu-Yeboah (2003), and Manuh et al. (1997). They all point to considerable differences in access to land for residential and agricultural purposes for women and men. The fact of women's unequal land access is sometimes contested (Britwum et al., 2014). The majority of authors writing on the subject like Tsikata (2008), Rünger (2006), Sarpong (2006), Kotey and Owusu-Yeboah (2003), and Aryeetey (2002) note that women's access is deeply constrained.

Monalisha et al. (2018) noted that just a hand full of women have access to land holdings. About 11%, event with that percentage, mostly nothing to write home about. This land situation of women compared to men become so serious to an extend that, getting access to credit from the bank and other sources become almost impossible just for the mere fact that they are not the rightful owners of the land, even if they claim to have land to cultivate. What commonly runs across these studies is the difficulty of women in accessing agriculture factors of production especially land.

Nicholas et al. (1999) define access as "the right or opportunity to use, manage or control a particular resource". To use or manage land has more to do with land tenure system. This system is governed by set of rules and regulations that directs how land should be used (Garvelink, 2012). In Ghana, institutional challenges, especially department of lands, continue to limit, if not prevent majority of women, from gaining access to secure land tenure rights. This development does not support the important role women play in agriculture in ensuring food security (Mauro and Pallas, 2009). "Norms and deeply entrenched patriarchal cultural practices deny women the opportunity to exercise their full rights as citizens (Koira, 2014). Women as a result, do not have equal access to productive resources for agricultural production."

In rural and urban areas in Zambia, and whether educated or not, women do not have equal opportunity to access, inherit and buy land in comparison with men (Ibid). Keller (2000) posits that in Zambia, married women in rural areas can only have access to land for cultivation, only from their husbands. It takes the customary law for them to continue the usage of such lands in the event of death of the husband or divorce. This does not mean that, they own the land. The land can be taken away from them at any point in time. When this happen, women who are willing to continue farming, can only do so by returning to their place of birth where they can access cultivated lands from their male kins. This situation for women cannot be said the same for men. A situation dictated to them by gender roles. This system has compelled women to avoid provocation and the risk of divorce even when they have the financial strength to buy or contribute for the purchase of land (Keller, 2000; Himonga and Munachonga, 1991). Wealthy and self-dependent women always face the challenge of getting husbands to marry, since it is believed by the men that, such women are not easy to control. This challenge by women may discourage them to own land even if they are allowed to do so by the laws and rules (Quansah, 2012).

Duncan and Brants (2004) report that, "men have greater control over land than women do, a situation strongly influenced by land ownership rights defined by custom. Land ownership is largely vested in lineages, clans and family units and its control is ascribed to men by lineage or clan heads. Land ownership among women is still an exception but is becoming conspicuous in recent times due to the increased purchase of land by women and an increased receipt of land by women as gifts from parents, grandparents and/or spouses" Fofie and Adu (2013) posit that not enough education or sensitisation is done with issues regarding land reforms and policies in Ghana. The high pricing of land and difficult issues likely to arise in

land transaction are major challenges women faces compared with their men counterparts in the urban cities.

In Northern Ghana, especially rural areas, the system of inheritance and control over resources is strictly based on traditional norms. This limit the land rights of women resulting in land affairs being completely managed by men. Property rights remain with male children who inherit their fathers (Adolwine and Dudima, 2010). However, urban land is not strictly within the influence of customary laws and practices as in rural areas where women mostly access land through husbands or other family relations. According to Bambangi and Abubakari (2013), "women in Northern Ghana rarely get the chance to cultivate virgin lands and even if they do, the ownership of such parcels of land would normally revert to men within a generation after the woman passes because of the leadership status of men over women. However, on the contrary the passing away of the man, does not give ownership of land to the woman but either to the eldest son in the family or to other men in the clan".

The gender division of labour defines the work or activity a particular sex can and should do. This definition is determined by society. They are the ideas and practices that are deemed appropriate for a certain sex (Reeves and Baden, 2000). In most developing countries, is not everyone that can take decisions for the family or the community. Certain tasks are considered to be carried out solely by either men or women. Domestic decisions are mostly done by women while the men also take charge of issues relating to the progress of the home or the community. These divisions of labour vary from place to place and is being determined by gender roles (Paris, 2013). These roles constraint women in their bit to venture into any activity that they potentially could carry out.

In Ghana, even as early as 12 to 14 years of age, responsibilities are divided for boys and girls. Girls work more hours than boys when it comes to domestics and productive activities (FAO,2012). This system is gradually challenging as men are now taking up responsibilities initially assume to be for women. There are attempts for some kind of shifts in the labour division, where women have entered the labour market and men have increasingly assumed responsibilities for domestic work. But for women this has resulted mostly in an increased workload. On average, women work more than men, owing basically to a double shift of work. This is an accumulation of both paid and unpaid work responsibilities "The gender relations such as division of labour that results in women generally working longer hours as they must combine reproductive and productive responsibilities makes it difficult for them to move from subsistence agriculture to more prominent positions in market-based agriculture" (Agricultural Learning and Impacts Network (ALINe), 2011).

Aregu et al. (2010), report that division of tasks between sexes in terms of farming systems, technology, wealth of the household, etc varies. Of course, inequality exist during the time of gains because of the varying nature of the division of labour, where women are being given something small compared to the work they have done. All these is because of gender roles society ascribe to the sexes.

Omwoha (2007) noted that, changes in the division of labour among the sexes results to women being burden the more, placing them at a disadvantage in terms of economic independence and social status, change in cropping patterns and technology. Women no longer have enough time to do their domestic work and to concentrate on their farm. This has compelled them to cultivate just smaller portions, even if land becomes a free input, hence decreasing their productivity.

Ibrahim and Ibrahim (2012) note that "women have additional work and less assistance and are therefore under greater pressure and the consequence of this is that many projects in development efforts ignore particularly rural women as the situation in which (rural women) find themselves are not understood. The multiple responsibilities and gender related constraints can mean that women are not able to take advantage of the opportunities provided by trade expansion to the same degree as men". The entrepreneurial spirit of women have made them particularly active in various sectors of African economies. If women multiple responsibilities are taken into consideration where they are empowered and encouraged in their limitations and weaknesses, they could contribute significantly to economic growth and development in the country and the continent as a whole (UNCTAD/UNDP, 2008). Omwoha (2007) is of the view that because of gender division of labour, productivity of food crop may reduce since women are mostly into food crop production while their male counterpart concentrates on cash crop production. When women are burden and no longer could contribute more labour to crop production, then food crop productivity will reduce, because of reduction of labour in the production of food crops. Although domestic chores absorb a large proportion of women's time, they still struggle to do something within their ability to ensure that they g et the most out of what they cultivate to feed the family. The nature of this division of labour is one that mare development because gender division of labour is tilted more on women, where they are given more tasks to work for more hours than their male counterparts (Sikod, 2007).

Extension officers owe it a duty to sensitise as well as educate farmers with issues related to agricultural production (German International Cooperation (GIZ), 2013). Extension service is so important to every farmer since it has something to do with information sharing.

Information on input supply, new technologies; early warning systems for drought, pests and diseases, credit and market prices are crucial to the farmer and need to be available at all time for farmers to access (Akpalu, 2013). The constraints women face in agricultural can be lesson through agricultural extension. It helps them to learn new technologies, improve productive techniques. Through the services, male and female farmers can orgnise themselves and apply for loan and also access other productive services such as access to market (GIZ, 2013). Even as important as it is to every male and female farmer, female farmers tend to face some challenges in trying to access the extension service in certain parts of the world including Ghana, because of cultural and religious believes. Certain cultures and religions do not allow the interaction between men and women. According to Ofuoku (2011), "the culture in some parts of the world allows only open and limited interaction of female with other people of the opposite sex and this has serious implications for the acceptance of technological change, dissemination of the results of research to farmers and conveying farmer's problems back to the research organization." Cohen and Lemma (2011), noted that, extension agents sometimes face problems in attempt to give out information to women farmers, because the local customs and some religions may not permit some married women to interact with men other than their husbands. This challenge may hinder the extension agents from delivery agricultural extension messages to female farmers, who may be prevented from interacting with male extension agents and those who prefer to interact with female agents (FAO, 2011).

According to Peterman et al. (2010), the means to which women can access inputs, is really the problem and not how they can use it. Agricultural extension continues to be crucial in the spread of technology and over the years have been more inclined towards participatory

approaches and the increase use of communication technologies. Lack of knowledge definitely lead to productivity gap. Agricultural extension services should therefore include appreciation and utilization of gender role analysis as an important part of planning, training and recruitment of more female extension agents to enhance adequate information and innovation flow to women farmers. Saito and Weidemann (1990) argue "that, many approaches to the development and dissemination of technology ignores the responsibilities and constraints of women farmers resulting in a highly inefficient use of resources by women and resulting in suboptimal levels of agricultural production". The argument by Saito and Weidemann buttresses the findings of Von Braun and Webb (1989) who concluded that because of the constraints women face in accessing extension and other services compared to their men counterparts, the design of traditional and modern technologies are not women friendly. Women have average productivity to their labour because most of the time, they have reduced access to labour-saving implements, hence they tend to grow crops that can only feed the family (Von Braun and Webb, 1989).

Japan International Cooperation Agency (JICA) (1999) observes that, "most rural women in Ghana still use the most rudimentary forms of technologies that are both time consuming and labour intensive. This limits their productive capacity and their ability to cultivate large acres of land." Gill et al. (2010), reiterate the observation by Von Braun and Webb (1989). They note that, women physical strength was not taken into consideration by most developers of some farm implements. For example, the design of animal-drawn ploughs is too heavy for women to handle and control well. Because of this woman are forced to use implements and methods that are more labour-intensive and could increase productivity.

Credit is an important input at every stage of the production chain and the absence of it has the potential impediment on farmer's ability to undertake any productive activities. Access to credit makes it possible for productive activities such as agriculture, which requires more cash for purchase of land and other inputs in order to be more productive before income gains could be realized. Both men and women need credit to undertake their productive activities. The question to ask is do men and women have equal access to credit? Women have been discriminated for far long even when it comes to who qualify to access credit compared to their men counterparts. Banks and other sources of credit providers require that farmers present some assurances before they can access credit. Women being vulnerable sometimes could not meet these conditions ie ownership of land. Monalisha et al. (2018) noted that just a hand full of women have access to land holdings. About 11%, even with that percentage, mostly nothing to write home about. This land situation of women become so serious to an extend that, getting access to credit from the bank and other credit sources become almost impossible just for the mere fact that they are not the rightful owners of the land.

Okurut et al. (2004) posit that credit is a crucial input in improving the welfare of the farmers. This can be made possible when the purchasing power of the farmer is heightened. Access to credit has the capacity to change women positively in that, it gives them control over their intensions and assets (Zaman, 1999). Fletschner (2008), reports that "women with less access to credit produce less than they could possibly do with consequences that are very substantial, an average of 11% loss in efficiency".

The removal of agricultural inputs subsidies due to credit reforms has contributed to a large extent, the decline in agricultural production and productivity in the sense that the main

victim of these reforms has been the rural population particularly women who depend on agriculture for livelihood (Mohamed and Temu, 2009). Vargas Hill and Vigneri (2011) noted that farmers ease of loans or credit repayment determines the lenders' willingness to give out loan or credit to them. Since credit is a key input in production, to be able to access credit all year round, farmers should be able to timely repay their loans without any failure. What this means is that, farmers should be able to produce in surplus such that, they can still make gains after loan or credit repayment. This assertion has more to do with the type and size of the land cultivated. Women ownership of land and control over other resource are widely limited. Because of this, women are perceived to produce only just to feed the family and no surplus to sale, hence causing women a harder time to access loans or credit.

Access to market is key to farmers after farm produces get to the house. Farmer most of the time do not get the best out of their gains. It is indeed a challenge to both men and women farmers. The burden nature of women makes them more vulnerable to this challenge compared to their men counterparts. The nature of market engagements varies greatly between men and women (Aregu et al., 2010). Koru and Holden (2008) argue that women have limited access to market compared with their men counterparts. Women have multiple roles and responsibilities both at the farm and household level, a constraint that limit their participation in market related issues. Morgan (2006), buttress the point made by Koru and Holden, that the multiple nature of women's roles in the family reduce their face-to-face engagement in input and output market. According to Vargas Hill and Vigneri (2011), "the gender disparity resulting from gender roles between men and women account for the difference in access to assets and markets. This has significant negative effects on the production and marketing of cash crops. These gender inequalities in resources result in

different levels of participation, methods of production and modes of marketing cash crops, and bear consequences for women's potential outcome in the cultivation of high value crops". It is therefore important for farmers to have access to markets to have better prices for their produce. This enhances farmer's income and welfare, which they could use in the future to invest back to the farming business (Benfica et al., 2006).

The fact that the financial capabilities of men outweighs that of women, enable them to be able to travel far to market their farm produce for higher prices (Aregu et al., 2010). In contrast to this development, women most of the time accept prices at local markets that they can easily reach on foot because they cannot afford marketing cost to distant market centres. In such circumstance, women are always more likely to sell directly to local consumers who pay less. The low prices they receive hinder their productivity as women earn less to reinvest in full capacity (Ibid). This results in reoccurrence of market inequality which clearly show the fundamentals of inequalities of power (Kabeer, 2012). This observation is reiterated by Gani and Adeoti (2011) "who identified high transportation costs, poor infrastructure and poor market participation as some of the variables that have positive linkages and influences with productivity that subsequently leads to poverty. Participation in markets stimulates wealth creation among those who can afford amidst production constraints and the costs of market participation. If poor farmers are unable to participate effectively, then it becomes obvious that they get below the market price of the produce they sell at the farm gate and hence cannot reinvest in full capacity to increase productivity".

2.6 Maize Production in Ghana and in Northern Ghana

Although maize as a crop do not originate from Ghana, but its cultivation is spread in all parts of the country. It has become the most staple crop in the country and accounts for a large proportion of daily caloric intake of the people making it a candidate for fighting hunger. (Akinola et al., 2007, Abukari and Alemdar, 2019).

After the introduction of maize as a crop in Ghana in the late 16th century, farmers have since become use to cultivating the crop which first started in the southern part of the country. The cultivation of the crop has been diversified in almost all the ecological zones in Ghana, including the forest zone, transition zone, southern regions, upper west, upper east, and northern Ghana (Akinola et al., 2007). Farmers in Ghana since the early 1960s have scaled up the production of the crop almost in every part of the country. Maize is used to prepare different kind of dishes, including but not limited to kenkey, banku, TZ, etc, which almost everyone consumes in the country (FAO, 2008). The production of the maize crop is mostly done by smallholder resourced poor farmers under rain-fed conditions. It is the cheapest source of food one can get in Ghana and the continent Africa as a whole, where majority of the people drive their daily caloric needs. About 70% of all smallholder farmers produce the maize in Ghana. The MoFA in 2013 register about 1.7 Mt/ha as against an estimated achievable yield of around 6Mt/ha of maize produce by these farmers (Facts and Figures by Ministry of Food and Agriculture, 2013). SRID-MoFA (2011) report that the crop is widely produced in the world, and in Ghana its production has almost taken over from sorghum and pearl millet as staple crops in northern Ghana.

According to Rondon and Ashitey, (2011), annually the production of maize between 2007 and 2010 stands at averagely 1.5 million MT, with an average yield of about 1.7 t/ha (SRID-

MoFA, 2011). Among all cereal crops, maize constitute more than half of the total cereal production in Ghana with yearly yields growing around 1.1% (IFPRI, 2014). The highest maize producing regions in Ghana has been in the middle southern part of the country, which include Brong Ahafo, Eastern region and Ashanti regions. These regions constitute about 84% of the total maize production in the country with just 16% being produced in northern part of the country.

That not withstanding, maize in comparison to other crops in th region takes the lead in household farm activities. According to Choudhary, 2015 maize takes up 75% of all household farming activities in the study area, followed by yam (38%), groundnut (28%) and rice (25%).

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This chapter focuses on the methodology for the study. It looks at the study area, population, sampling procedure and technique, sources and type of data and data analysis and presentation.

3.1 The Study Area

3.1.1 Geography

The study was conducted in Northern Ghana. Northern Ghana comprises Upper East, Savannah, Upper West, Northern and North-East regions. Northern Ghana lies between latitudes 8° N and 11° N with a land size of 97702 km². The study area is located in the sub-humid to semi-arid Guinea Savannah and arid Sudan Savannah zones of Ghana, where the annual precipitation ranges between 400 and 1200 mm (GSS, 2012).

As seen from the Figure 3.1, shows the map of the study area (Northern Ghana), which is made up of five (5) regions; Upper East, Savannah, Upper West, Northern and North-East regions. Three (3) out of these were selected randonly for the study; Northern, North-East and Savannah Regions. Two districts were then selected each from these regions. The regions of concentration, is located on the Latitude: 9° 29' 59.99" N and Longitude: -1° 00' 0.00" W. The selected region is bordered to the north by Upper East and Upper West, and to the south by Brong Ahafo, Bono East and Oti regions. The eastern and the western neighbours are countries; Togo and Ivory Coast respectively. It occupies an area of 70,384 square kilometres, which constitute about 31% of the total land area of Ghana. The population of the region as at 2010 was 2,479,461 (GSS, 2012).

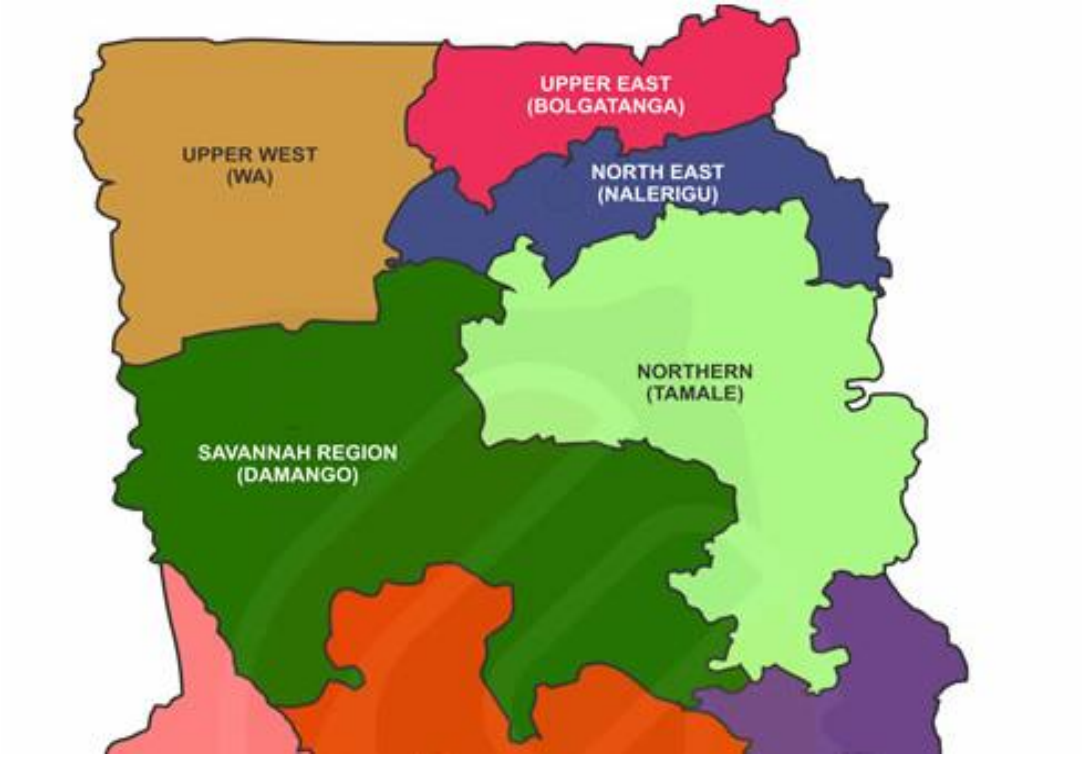

Figure 3.1: Map of Northern Ghana

Source: The Permanent Mission of Ghana to the UN (2020)

3.1.2 Agriculture and Climate

About 90% of the land in Northern Ghana is classified under the Guinea-Savannah zone while the remaining 10% is classified under the Sudan-Savannah. The difference between these two zones is almost insignificant. The average rainfall in these zones is about 1100mm with a unimodal rainfall pattern (single maximum rainfall in a year) (FAO, 2005). These zones experience long dry season of about seven months (September/October to April/May) with just five months of continuous rainfall (May to September), which is adequate for agricultural production. The zones sometimes record intermittent droughts/or floods during this five months' period in the cropping season. Temperatures range between 33°C to 35°C

with a minimum of about 22°C annually. Humidity reaches its highest in the rainy season and fair normal in the dry season (FAO, 2005). Because of the pattern of rainfall, agricultural activities are limited to once a year. Different varieties of crops are seen produced in these zones, ranging from Cereals crops (Maize, rice, sorghum and millet), starchy Crops (Yam and cassava), legume (Cowpea, groundnut and bambara), vegetables (Tomato, pepper, onion and leafy vegetable), tree crops (Sheanuts, dawadawa, mango and cashew) (FAO, 2005).

The target crop for the study is maize which is highly cultivated in the region and constitutes majority of household agricultural lands. For the three regions selected, maize has been been leading interms of area under caultivation among ceareals but lagging behing in terms of proudctivity or yield. (SRID-MoFA, (2018)

The soils in the Sudan and the Guinea savannah zones are known to be the poorest in the country recording low in certain essential nutrients such as nitrogen, phosphorous and calcium. These nutrients need to be incorporated in the soil before yields can be improved. The main occupation of the people in the region is rain-fed agriculture. A very negligible part of arable land in the region is under irrigation. During the period of the seven months of dry season, the farmers in the region are unemployed, hence food insecure (MoFA, 2017).

3.2 Research Design

Research design refers to the various strategies, methods and techniques employed by a researcher to analyse data in an efficient way (Johnson et al., 2007). These techniques or methods are spelt out from the beginning to guide the research throughout. With the help of the data and objective of the study, these techniques will help determine whether to employ quantitative or qualitative approaches. This study employs a mixed designed aimed at using both quantitative and qualitative approaches to analyse the data. According to Johnson et al.

(2007, p.112), "mixed methods research is the type of research in which a researcher or team of researchers combines elements of qualitative and quantitative research approaches (e.g., use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the broad purposes of breadth and depth of understanding and corroboration."

Even though a mixed research design is employed, the analytical tools used are quantitative. Some qualitative data were collected to support some empirical results that may come out of the quantitative models. Econometric models were employed to establish relationship among variables. Descriptive statistics were employed for some data analysis. In light of this, the questionnaire involves both close and open ended questions to be able to gather data for both quantitative and qualitative analysis.

3.3 Sampling Procedure and Techniques.

The sample frame is made up of smallholder farmers in Northern Ghana. The study employed a multistaged sampling procedure in arriving at the final respondents. Three of the five regions (Savannah, Northern and North-East) in northern Ghana were randomly selected. For each of these regions two districts were selected randomly; Savannah (North Gonja and Kalba/Sawla/Tuna), Northern (Tamale Metro, Savelugu/Nanton) and North-East (West Mamprusi and East Mamprusi). Obtaining a list of farmers from the district MoFA offices of the selected regions, a random sampling was then used to selected the targeted number of farmers. According to Yamane (1967)'s published tables, at 10% significance level, a population of more than 100,000 would require a minimum of 100 sample as appropriate. Israel (1992), however reiterated that the values on the Yamane's published tables represent the obtained responses, additional responses should be sought to cover up

for missing data and nonresponses. From the above assertion, the study targeted a minimum of 50 (25 males and 25 females) respondents each from the six (6) districts, because the population of each of these district is above 100,000. For instance, 139,283 for Savelugu/Nanton, 135,450 for North Gonja, 168,011 for Mamprusi West, 233,252 for Tamale metro, 121,009 for East Mamprusi and 110,798 for Sawla/Tuna/Kalba (GSS, 2012). This would mean a total of 300 respondents. Taking the recommendation of Israel (1992) into consideration, a total of two (2) interviews were added to each district resulting in a total sample of 312.

3.4 Sources and Type of Data

The study relied on primary data. The primary data were gathered from the selected farmers in the study area using questionnaires.

3.5 Data Analysis and Presentation

The objective one of the study was analysed using descriptive statistics and graphical presentations. Regression analysis, specifically the Multinomial Endogenous Treatment-Effects (MNTREG) model was employed in the analysis of objective two. The third objective was analysed using the Kendal Coefficient of Concordance. The software packages that were used for the analysis include STATA, SPSS and Microsoft Excel.

3.6 Theoretical Framework

The value of an object lies in the utility that people derive from it. People are willing to give more for the satisfaction they drive in an article (Taussig 2013). According to the classical economics, this concept is known as ‘homus economicus’ assumption. Which state that, the choices people make is solely base on the satisfaction they drive on whatever they wish to

consume (McFadden, 1981). This theory is normative as it is subject to the value judgment of the decision maker. Its application has formed the core of most discrete variable analysis, with most empirical studies in probabilistic choice modelling. Individuals (customers, farmers, households etc.) are normally presented with a choice to make from bundles (Hess et al., 2018).

In the context of this study, only objectives two is underpinned by this theory in the sense that farmers are exposed to bundles of various gender related labour input from which they make their decisions to have their farms dominated by a certain sex/gender.

For a bundle i, the random utility maximization is generally given as;

$$U_i = V_i + \varepsilon_i \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (3.1)$$

U_i is the total utility for a choice of an alternative, V_i is the vector of observed explanatory variables that affect consumer's utility. ε_i is the error term, which captures all the unobservable influences on utility. Under the utility maximization theory, the bundle i would be chosen over any other bundle j if and only if the probability of the utility from that choice is greater than or equal to that of other alternatives (Hensher et al., 2005). That is;

$$Pr_i = Pr(U_i \geq U_j) = Pr[(V_i + \varepsilon_i) \geq (V_j + \varepsilon_j)] \;\; i \neq j \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (3.2)$$

In terms of the error components

$$Pr[(\epsilon_j - \varepsilon_i) \leq (V_i - V_j)] \;\; i \neq j \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (3.3)$$

This probability is conditional on the value of ε_i, which is the chosen alternative. The unconditional probability that depends on the observed explanatory variables is found by

integrating the conditional probability using marginal densities. Depending on the distributional assumption of the error structure, it maybe logit or probit (Dow and Endersby, 2004).

3.7 Logit and Probit Models

It has become known and accepted that, data whose dependent variables are discrete, ordinal or categorical cannot be analysed using the Simple Linear Regression model. The linear probability models (LPM), the binary probit model, the binary logit model, complementary log-log model among others, are used in the analysis of this kind of data (Long, 1997). In view of this, the logit and probit models have proven to dominate in empirical studies involving these types of data. This is because the relationship between these dependent and their explanatory variables are not linear. It becomes challenging however, to analyse and interpret the results when Simple Linear Regression is used. The relation is sigmoidal (S-shaped) making it challenging to fit a linear regression line (Cramer, 2004).

Even though both have different histories, the logit models are much older in terms of empirical application. The logit model is a discovery from multiple sources, making it difficult to attribute it to one particular person. The discussion here is therefore chronological as each of these sources is presumed mutually exclusive to one another. The first in the history of the logit models can be traced to the decade work of Pierre-Francois Verhulst, who perfected the idea from his teacher, named it and adjusted the correction term; these were done in Verhulst (1838; 1845 and 1847). Then followed Ostwald's independent development of the same model in the analysis of an autocatalytic reaction in chemistry in 1883 (Cramer, 2004). Unaware of the work of Pearl and Reed (1920) independently and in

the same line of study (population growth) rediscovered the model, which popularized its usage in modern statistics.

The probit model in its basic form existed as far back in 1860, from the work of Gustav Fechner. Just like the logit model, it was repeatedly rediscovered until 1930s when the name was coined and given much prominence in statistics. The two researchers credited with this achievement in this period were Chester Bliss and John Gaddum. While Bliss is credit to coining the term probit (Probability Units) and following up with maximum likelihood estimations, Gaddum systemized the model (Cramer, 2004).

Considering the fact that origins of these models could be traced to around the same period, and the fact that their applications are similar leaves no doubt their studies influenced each other. In this sense, it is okay to say that the models were inadvertently competing from among different researchers in different parts of the world from diverse academic fields of study.

The work of Berkson (1944), openly exposed the substitutability of these two models. He demonstrated this by replacing the probit model with the logistic model. Now officially competing models he coined the term ‘logit’ to mimic ‘probit’ model. At that initial stage, probit enjoyed superiority until 1960s and 70s when the logit model achieved an equal footing with it (Cramer, 2004).

3.7.1 Models Presentation

The probit and logit models can be developed through the regression analysis of latent variable or as a nonlinear probability model (Long, 1997). Explaining from the latent variable approach, a latent variable (Y^*) is introduced which is assumed to linearly relate to

the explanatory variable instead of the nonlinear relationship that exists with the observed dependent variable(Y). The structural regression model used is given as;

$$Y_i^* = \beta_i X_i + \varepsilon_i \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (3.4)$$

Where Y_i^* is the latent variable, X_i is the vector of explanatory variables, ε_i is the error term, and β_i is the parameter to be estimated.

The following measurement equation links the latent variable Y_i^* to the observed dependent variable

$$Y_i = \begin{cases} 1 \; if \; Y_i^* > \tau \\ 0 \; if \; Y_i^* \leq \tau \end{cases} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (3.1)$$

τ is the cutoff point based on which the binary decision is coded. If the latent variable is less than or equal to, that is $(Y_i^* \leq \tau)$, then the observed takes zero $(Y_i = 0)$. If $Y_i^* > \tau$, then $(Y_i = 1)$. Even though the latent variable approach has succeeded in converting the dichotomous variable into a continuous variable does not guaranteed the use of Ordinary Least Square (OLS) because the variable is unobserved. With specified distribution of the error term, the Maximum Likelihood (ML) estimation is used instead. The choice of the probability distribution of the errors marks the point of divergence of the two models. The choice of a standard normal distribution results in a probit model, whiles that of a standard logistic distribution produces the logit model (Greene and Hensher, 2010). To fully cement the divergence of these models to their separate independent status, further assumptions on the expected mean and variance of the error term has to be made. The conditional expectation (mean) of the error term given the explanatory varies is equated to zero; that is $E(\varepsilon_i \mid X) = 0$. The nonobservance of the latent variable implies the variance of the error

term cannot be estimated. This results in assuming a variance of 1 for the probit model and 3.29 for the logit model; that is $Var(\varepsilon \mid X) = 1$ and $Var(\varepsilon \mid X) = \pi^2/3 \approx 3.29$ respectively.

Given all these and following the presentations of Long (1997) and Greene and Hensher (2010), the logit model is expressed as;

$$f(\varepsilon_i) = \frac{1}{\sqrt{2\pi}} exp\left(-\frac{\varepsilon^2}{2}\right), \quad -\infty < \varepsilon_i < +\infty. \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.2)$$

While that of the probit is;

$$f(\varepsilon_i) = \frac{exp(\varepsilon_i)}{[1 + exp(\varepsilon_i)]^2}, \quad -\infty < \varepsilon_i < +\infty \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.3)$$

In terms of application, both models are almost at par, even though some researchers have sort to take a side on which one is superior. The work of Chambers and Cox (1967) is among the earlier researches that attempted to discriminate between the two models. They concluded that in the absence of extreme independent variables and extremely large sample, the choice of the two models is inconsequential. Not even the five criteria studies by Chen and Tsurumi (2010) could yield a definitive discrimination between the two models. The difference between the two models has since been reduced to ease of interpretation and theory (i.e. through the link functions). The computation of marginal effects has since solved the issue with interpretation. In terms of theory, this link function as the name implies acts as a link between the estimated dependent variable and the actual one. The choice of the probability in modelling this link function lays the difference between the two. When normal distribution is used, then the model becomes a probit model, and when the logistic

distribution is chosen, it gives the logit model. The other theoretical difference between is that, the theoretical foundation of the logit model relies on the assumption of Arrow's Independence of Irrelevant Alternatives (IIA) (McFadden, 1973). This theory has been criticized for many reasons across various fields of study. Whiles some think it is too strong a requirement for collective choices (Patty and Penn, 2019), others consider it impotent when the objects of choice are close substitutes (McFadden, 1973). Some have considered unrealistic and erroneous in many empirical application, on which bases some have proclaimed the superiority of the probit model for not invoking IIA assumption (Currim, 1982; Kropko, 2008). It has to be noted that this conclusion premised on the fact that these models are in their most basic form (univariate logit and probit).

From the univariate forms of both models, there has been extensions and modification of the models to suit the structure of the data as well as the objective of the study. For example, in terms of dealing with more than one latent variable that are found to be correlated, the bivariate and multivariate logit and probit models were developed. When the need for categorical (nominal) dependent variable, with more than two classifications arose, a general case for each of the models was developed to take care of it. This gave birth to multinomial logit and probit models (Aurier and Mejia, 2014). The ordered and non-ordered, the conditional logit model, the mixed logit etc are some of the other extensions. With the advent of treatment effects, some of these models have been subjected to it. In this study only objective two would utilize some of these models; the multinomial endogenous treatment effect.

3.8 Multinomial Endogenous Treatment Effect Model (MNTREG)

The Multinomial Endogenous Treatment Regression model is used to analyse the objective two of the study. The objective seeks to analyse the effect of sex/gender distribution of farm activities in terms of labour input on maize yield.

3.8.1 Definition of Variables for the MNTREG Model

The estimation of Multinomial Endogenous Treatment Regression model involves two stages; the first stage is the treatment effects equation and the second stage is the outcome equation. Independent variables in the treatment equation is used in the outcome equation and not the opposite. The study seeks to investigate the effect of gender distribution of farm labour input on maize yield; hence the treatment is made on the gender labour input categorical variable. Most often than not, treatment effect model experienced the possibility of the treated variable being different from the untreated variable. This occurs when the sample units have a choice of which treatment to belong. This should not be the case since it will result to sample selection bias (Angrist, 2010). On the basis of the above and because of the randomised nature of the sampling, this study is not expecting such a problem.

Three (3) categories were established. T1, T2 and T3 is assigned to farmers who used male dominated labour input, female dominated labour input, and both or mixed dominated labour input respectively. Since the regression at the treatment level is multinomial farmers using both or mixed dominated labour were designated as the base category, since majority of the farmers have their farms being dominated by both or mixed labour input. These treatments are then included in the determinants of maize yield in addition to other variables as well as the traditional production inputs.

Table 3.1 presents the variables on the treatment equation which include family structure, indicating whether a famer belongs to extended or nuclear family system. Farmers who belong to any of the systems, may be influenced by the decision to use a particular sex in his/her farm. Marital structure refers to whether a farmer is practicing a monogamous or a polygamous system of marriage. Perceived agricultural activities indicate whether certain farm activities are considered to be the preserve of a particular sex and this influences a farmer decision to have his/her farm being dominated by that sex, hence its inclusion in the treatment equation. Male/female ratio, refers to the number of males to females in a family. Farm manager that are at the disposal of a particular sex would be compelled to have that sex dominating in most of the activities in the farm. Family/hire labour ratio also indicates whether the farmer used more of family or hired labour. The sex of the farmer indicates whether the farmer is a male farmer, female farmer or others.

In addition to the treatments, the other variables in the outcome equation are; labour hours, machine hours, fertilizer, pesticide use, improved seeds, marital status, number of dependents, education, improve seed, credit, farmer based organization (FBO), planting for food and jobs (PFJ) and experience.

Maize yield (the outcome variable) is defined as the number of maize bags (100kg) produced per acre of land. Fertilizer is the quantity (kg) of fertilizer used in the farm for the entire production season. Labour hours refers to the number of hours spent on an activity or the entire maize production processes while machine hours indicate the number of hours used by machine in executing a production activity.

Table 3.1 Determinants of Usage of a Particular Gender as Labour Input

Variable	Definition	Measurement
Treatment equation		
Family structure	This refer to a system of family a famer belongs	If nuclear family (1); extended family (0)
Marital structure	This indicates whether a famer practice monogamous or polygamous system of marriage	If monogamous (1); polygamous (0)
Perceived agricultural activities	This refers to whether farmers perceived some farmer activity to be preserve of a particular sex	If yes (1); if no (0)
Male/female ratio	This indicates the number of males to females in the household	Number of people
Family/hire labour ratio	This indicates how much a farmer uses family or hired labour	Labour hours
Sex	This indicates whether a farmer is a male or female	If male (1); if female (0)
Household head	This refer to whether the head of a household is a male or female	If male (1); if female (0)

Source: Constructed based on field survey (2019)

Pesticides used is in 1 liter cans indicating the number of litres a farmer used in spraying his or her farm in the entire production season. Education of a farmer refers to whether the farmer have been to school or not, since education enhances the farmer's ability to manager his or her farm well. Marital status of the farmer will indicate whether the farmer is married, single or divorced. Number of dependents refers to people under the care of the farmer. Improved seeds, PFJ, FBOs, and access to credit are dummy variables indicating whether a farmer used each of them in the production processes or not.

3.8.2 Empirical Model Presentation

The farmers are classified base on categories in the first stage of the model (treatment equation). These categories are T1 for those farmers that have their farms being dominated by male labours, T2 for those farmers that have their farms being dominated by female labours and T3 for those farmers that have their farms being dominated by mixed or both (male and female) labours. The base category or control treatment is T3. This presentation reflects the multinomial case as seen already.

The second stage of the model is the outcome equation in which the treatments are independent variables. It can therefore be seen that the formulation of the model is in two parts. The first is the determinants of which type of sex to use as a farm labour.

The multinomial endogenous treatment effect model is a product of the random utility model; each farmer chooses a treatment that maximizes his or her utility. Following from the originators of the model, Deb and Trivedi (2006), this is given by;

$$Y_{ij}^{*} = \alpha_j Z_j + \sum_{k=1}^{J} \delta_{jk} l_{ik} + \eta_{ij} \ldots\ldots\ldots\ldots (3.4)$$

Under the utility maximization theory, $\boldsymbol{Y_{ij}^{*}}$ is a latent variable that incorporates the expected maize yield resulting the usage of the sex type identified; $\boldsymbol{Z_j}$ is the vector of observed exogenous explanatory variables that explain the decision to use a particular gender labour input in an activity or the whole farming process. The gender labour input variable is suspected to be endogenous; $\boldsymbol{l_{ik}}$ is the latent factor that deals with the unobserved characteristics of farmers (such as passion, attitude, technical abilities etc.) that influences the outcome (maize yield), and at the same time correlated with the individual treatments (gender of labour input) (Nguyen and Connelly, 2014). η_{ij} represent the error terms which are independently and identically distributed (Deb and Trivedi, 2006). The α_j and δ_{jk} represent the corresponding coefficients to be estimated.

The controlled treatment (those using both or mixed dominated labour input) is defined when $j = 0$; implying

$Y_{i0}^{*} = \alpha_0 Z_0 + \sum_{k=1}^{J} \delta_{0k} l_{ik} + \eta_{i0} = 0$. To derive the probability of a treatment being used by a farmer, the observed binary treatment variables is represented by a vector $\mathrm{d_i} = [d_{1j},\ d_{2j}, \ldots\ldots d_{1j}]$, and the latent factor l_{ik} represented by $\mathrm{l_i} = [l_{1j},\ l_{2j}, \ldots\ldots l_{1j}]$. The probability therefore is

$$Pr(d_i \mid z_i, l_i) = g\left(\alpha_1 z_i + \sum_{k=1}^{J} \delta_{1k} l_{ik}\,, \alpha_2 z_i + \sum_{k=1}^{J} \delta_{2k} l_{ik}\,, \ldots, \alpha_J z_i + \sum_{k=1}^{J} \delta_{Jk} l_{ik}\right) \ldots\ldots (3.5)$$

$g(\,)$ is the specified multinomial probability distribution function. The study like Deb and Trivedi (2006) assumed a Mixed Multinomial Logit (MMNL) distribution, given by;

$$Pr(d_i \mid z_i, l_i) = \frac{exp(\alpha_i z_i + \delta_j l_{ij})}{1 + \sum_{k=1}^{J} exp(\alpha_k z_i + \delta_k l_{ik})} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.6)$$

The second stage has to do with the effect of gender of labour on maize yield. This equation is called the outcome equation. For each farmer, the expected outcome equation is given as;

$$E(y_i \mid \mathrm{d_i}, x_i, l_i) = \beta x_i + \sum_{j=1}^{J} \gamma_j d_{ij} + \sum_{j=1}^{J} \lambda_j l_{ij} \ldots\ldots\ldots\ldots (3.7)$$

The outcome variable y_i, maize yield is continuous variable. x_i represents the exogenous explanatory variables, γ_j measures the effects of gender of labour input (treatments) on maize yield relative to those who used both dominated or mixed gender labour input (the base treatment) . l_{ij} is the latent factor and Lambda (λ_j) is the factor loading parameter, which measures the correlation between the treatment and the outcome through the unobserved characteristics (+/-). When this parameter is positive, it indicates the treatment and outcome are positively correlated through unobserved characteristics. The opposite is the case when it is negative. The Maximum Simulated Likelihood (MSL) is used in the estimation of the model, and for the reason that maize yield is a continuous variable, the normal (Gaussian) distribution is assumed.

3.9 Kendall's Coefficient of Concordance

Kendall's coefficient of concordance is a Nonparametric statistical methods used to assess the challenges faced by farmers in the area of study. It is a normalization of the statistic of the Friedman test, and it is used to measure agreement among farmers. The statistic ranges between zero (0) and one (1), which correspond to 'no agreement' and 'complete agreement respectively. The coefficient is given by;

$$W = \frac{12S}{p^2(n^3 - n) - pT} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.8)$$

S is the sum-of-squares from row sums of ranks R_i, n is the number of objects, p is the number of judges and T is a correction factor for tied ranks (Chike, 2014)

$$T = \sum_{k=1}^{m} (t_k^3 - t_k) \ldots\ldots\ldots\ldots\ldots\ldots (3.9)$$

$$S' = \sum_{i=1}^{n} R_i^2 = SSR \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.10)$$

where S is the sum-of-squares from row sums of ranks R_i, m is the number of groups and t_k is the number of tied ranks in each (k) of m groups (Chike, 2014).

Seven challenges were presented to the farmers. These were access to land, access to credit, irrigation farming, access to market, fall armyworm, extension services and time constraint.

The constraints within institutions in Ghana forms parts of the problems women face in society. Majority of women relative to men are not able to access resources, including the right to own land because of the problems institutions are confronted with, especially institutions that matter to land ownership rights and this creates a lot of impediments to the key roles women play in society especially in the production of food (Mauro and Pallas, 2009). Traditionally, women in northern Ghana do not have the right to own land compared to men. Women can only have access to productive land upon request, a situation that is not guaranteed and even if so, they are always given marginalised plots of land, which when they cultivate such lands could yield nothing for them (Keller, 2000). Credit is very key to all farmers in northern Ghana. It enables farmers to have access to productive resources.

Men and women do not have equal opportunity to access credit. Credit has the potential of making women have access to, control over and ownership of assets and productive resources for themselves (Zaman, 1999). Vargas Hill and Vigneri (2011) noted that because of the fact that women are always challenged compared to their men counterparts in terms of access to production resources, they are not able to produce for the family and surplus for the market, a situation that may cause women a harder time in accessing credit.

Farmer gain income through the sale of their farm produce. They can do this through marketing their produce in the market and other important channels. Women as compared to men are always challenged with time because of their work load, and therefore do not always make time to the market to sell their produce (Koru and Holden 2008). This situation of women has limited their market involvement in terms of input and output marketing (Morgan, 2006). Agricultural extension service is a medium through which important information are shared to male and female farmers. Extension agents send information to farmers as well as receiving farmer's problems back to researchers and authorities. It is farmers own interest to be given important information such as early warning systems for drought, pests and diseases, credit and market prices which is so crucial for every farmer (Akpalu, 2013). Female farmers in most rural communities are always challenged of receiving the information because some customs and traditions in those communities will not allow female farmers to have contact with male extension agents.

Women as compared to men are challenged with time. Domestic tasks have taken almost all their time and they barely have time for their farms, unlike their men counterparts who invest almost all their time in the farm as well as concentrating on activities that fetch them money (Wodon and Blaskden, 2006) This situation of women placed them at a greater disadvantage

such that they could not compete fairly with the men. The fall armyworm is a serious challenge to all farmers in Ghana and the world as a whole. These worms feed on plants, including the maize plant and virtually destroying it at the end. Farmers whose farms are invaded by this fall armyworm losses so much yield, researching 40% in Honduras (Wyckhuys and O'Neil 2006) and 72% in Argentina (Murúa et al., 2006). Ghana and other Africa countries had the outbreak in 2016, where in the case of Ghana, almost all regions including northern Ghana have since been invaded (International Institute of Tropical Agriculture, 2016). In northern Ghana, there exist only one farming season which last within a period of five months. The dry season take seven good months, where farmers sit idle in their homes. Within this period of seven months, farmers who have irrigation facilities are engage in the farm and to them they observe two farming seasons. Most of the time only men are seen doing irrigation with just few women. The challenge here is that women are constraint compared to men in terms of access of the irrigation facilities. Women farm alongside men and share the same goals for improving their agricultural livelihoods and household wellbeing. The benefit of irrigation does not accrue equally to men and women, even when they are in the same household. Women face different challenges and unequal opportunities in accessing and benefiting from irrigation technologies. While men started utilizing drip irrigation and motor pumps, women in the community still relied on labour intensive manual irrigation methods like hauling water with buckets. In most parts of northern Ghana where, there is limited water for irrigation, men dig deep into the riverbed to access water to irrigate their plots. Women by their physical nature do not have the strength to even dig and sometimes will have to hire labour to dig for them at a fee in their husband's absence.

From these challenges, farmers are asked to arrange in order of ascendency; from the least of the challenges (1) to the most pressing of them all (7).

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Introduction

This chapter presents descriptive statistics of the respondents, distribution of farm activities among sexes, and all other relevant variables. The results of each analytical technique or model are discussed. Variables used under each model are also discussed.

4.1 Descriptive Statistics

4.1.1 Summary of Continuous Variables- Farmer Level

Table 4.1 below presents a summary of the following continuous variables; household size, farming experience, age, quantity of fertilizer used, labour hours, machine hours, proportion of sex in the family, proportion of family labour, chemical use and maize land area.

The household size of respondents ranged from 4 to 45 people. The household size indicates an average of about 11 people in the households of farmers in the region. A maximum of 45 people in a household can be considered extreme, but in the context of the study area, these extremes are normally with farmers who practice extended family systems as well as those from the royal homes in the community.

About 64% of farmers are within the active age bracket of 31-50 years. This age bracket is in conformity with some other studies such as, (Adesehinwa & Bolorunduro 2007, Oyegbami et al., 2010). This implies that more than half of the population of farmers are involved in active farm production. The average age of the farmers in the sample is about 40 years. Farmers over the age of 60 were actively engaged in farming, while the youngest was 20 years old. The average of 40 years suggests the low level of participation of the youth in maize farming. The low level of the youth in maize cultivation in part is attributable to

access to land. This has been a major challenge for youth in agriculture as compared with the older and experienced farmers (FAO, 2014).

Table 4.1 Summary of Continuous Variables

	Household size	Age	Experience	Labour hours	Fertilizer
Mean	11.36	40.47	11.08	711.498	4.184
STDEV	6.430	9.782	8.369	665.932	3.622
Min	4	20	1	52	0
Max	45	69	40	4888	25

	Proportion of sex in family	Prop. of Family labour	Machine hours	Chemicals used	Maize land area
Mean	0.48	0.794	7.189	4	3.817
STDEV	0.141	0.219	4.964	5.032	3.211
Min	0.095	0.029	0	0	0.5
Max	0.85	1	53	50	26

Source: Author's field survey (2019)

Majority of the farmers within the study area have vast experience in maize cultivation. Most of the farmers have since been cultivating maize between 6 years to 15 years. The mean years of farming experience in maize production is about 11years. This shows how stable

and sustainable maize farming has been in the study area. The maximum hours spent on an activity in the farm (or on a production process) was 4888 man hours while the minimum hours spent was also 52. Averagely farmers in the study area spent about 711 man hours on an activity or on a production process.

Farmers in the study area use fertilizer in their maize farms. Fertilizer usage in the study area ranges between 0 to 25 bags, where 1 bag is 50kg. This implies that there are some farmers who do not use fertilizer at all in their maize farms due to lack of purchasing power to enable them afford one. Averagely about 4 bags of fertilizer is used by maize farmers in the study area. 52% of households of respondent's/farm managers are females whilst the remaining 48% are made up of males. This clearly shows that we have more females serving as labourers than men in the study area. Majority (80%) of respondents use family labour in their farms, leaving the remaining 20% also engaging the services of hired labour. Farm managers would prefer to engage the services of family labour since that is cheap and available means of affording labour. Most often, farmers that practice nuclear family system do not have enough people to use as labourers hence, engaging the service of hire labour. Members from the extended family too may sometime hire labour, but that is necessary if the labour needed for that activity is beyond what the family can produce at that time.

Farmers that engage the service of machines to do their farm work, use hours ranging between 0 to 52. Some farmers do not engage the services of machines in their farms since we have some farmers using zero machine hours. Averagely about 7 hours of machine is being spent by farmers on an activity or on a production process. Farmers that use chemicals in spraying their farms, used between 0 to 50 litre. Again, there are some farmers who do not use chemicals in spraying their farms at all. The reason may be that they cannot afford

to purchase one hence the zero usage. Averagely 4 litres are being used by farmers to apply their maize farms.

Maize cultivated area in the study area ranges between 0.5 to 26 acres. Farmers who cultivated as low as 0.5 acre could premise their reason to access to land still being a challenge to them, since access to land is one of the major challenges identified in this research. Averagely farmers use about 4 acres in cultivating maize.

4.1.2 Summary of Dichotomous Variables- Farmer Level

Table 4.2. below presents summary of the following dichotomous variables; education, marital status, sex, household head, PFG, perceived agriculture activities, marital structure, family structure, credit, Pesticide use and the use of improved seeds used in the study.

The sample is made up of 50% males and females respectively. About 89% of the sample are married. This confirmation is typical of Northern Ghana, especially most people in rural part of Northern Ghana. It is not surprising again as the sample exhibited relatively older farmers, couple with the fact that people marry earlier in the study area as it is believed that, a large family is a major source of labour for farm actvities.

Majority of the farmers (65%) never had any formal education (i.e. never went to school) with about 35% of them fortunate to have been to school. Out of this 35% who have been to school, only 38% of the women have had some form of formal education compared to their male counterparts. Adesina and Djato (1994) concluded from a study in Cote d'Ivoire that the believe that farmers that are educated significantly enhances efficiency in production is yet to be proven. However, it is an undeniable fact that educated farmers are able to efficiently manage their farms well compared with the uneducated farmers, as educated

farmers are able to keep simple and good records. Only 39% of the respondents were household heads and of this number, 80% of them are males and the remaining are females. This situation confirms with that of the national data where majority (70.5%) of households in Ghana are male-headed (GSS, 2008). Just a few of the respondents (5%), were fortunate to be part of the government Planting for Food and Jobs (PFJ). The low patronage farmers in the PFJ could be that farmer were not given the opportunity to be part. Some farmers in the study area think that there were some farm activities that are preserve of a certain sex. This is confirmed by the research, when 88% of the respondents agree to this fact. These people confirmed that some farm activities are simply considered women job or men job. The used of improved seeds by farmers in the region has been low (Ragasa et al., 2012). The sample confirms that about 25% of farmer used improved seeds to plant during the 2019/2020 planting season.

About 84% of the respondents in the study area practice monogamous system of marriage. In this system, men marry only one wife. The dominant family structure in the study area is the extended family system. In this system, father, mother, aunties, uncles, etc, live in the same house.

Table 4.2: Summary of Dichotomous Variables

	Frequency	Percent
Sex		
Male (1)	156	50
female (0)	156	50
Education		
Educated (1)	108	34.6
Men	67	62
Women	41	38
Non educated (0)	204	65.4
Marital Status		
Married (1)	279	89.4
Not married (0)	33	10.6
Household head		
Yes (1)	123	39.4
Men	99	80.4
Women	24	19.5
No (0)	189	60.6
Planting for Food and Jobs		
Yes (1)	16	5.1
No (0)	296	94.9
Perceived agriculture		
Yes (1)	252	88.1
No (0)	60	11.9
Improved seed		
Yes (1)	131	25
No (0)	181	75
Credit		
Yes (1)	50	16
No (0)	262	84
Marital structure		
Polygamous (1)	49	15.7
Monogamous (0)	263	84.3
Family structure		
Nuclear (1)	121	38.8
Extended (0)	191	61.2
FBO		
Yes (1)	145	46.5
No (0)	167	53.5

Source: Author's field survey (2019)

About 62% of the respondents practice this system of family structure. Few of the respondents belong to FBOs. About 47% of the total respondents confirmed that they belong to one FBO or the other.

4.2 Distribution of Farm Activities Among gender

4.2.1 Distribution of Sexes for the Entire Maize production

Men and women jointly contribute in all aspects of agricultural value chain (Clark, 2013). However, gender stereotypes contributed to the misconception of designated gender activities. It is uncommon to find a farm activity that is completely executed by a certain sex. On that bases; a farm activity (or entire production process) is designated a sex dominated when more than three quarters (75%) of the labour hours for that activity (or entire production process) is done by that particular sex. If none is able to cross the 75% for an activity (or entire production process), it is considered the normal case of both genders playing their combined roles for that activity (or entire production process).

Table 4.3: Distribution of Labour Input by Gender for the Entire Maize Production

Labour input classification by gender	**Number of respondents**	**Percentage**
Male dominated (MD)	74	23.72
Female dominated (FD)	20	6.41
Mixed/Both dominated (BD)	218	69.87
Total	**312**	**100**

Source: Author's field survey (2019)

From Table 4.3, for the entire maize production process in the study area, two hundred and eighteen (218) respondents'/ farm managers representing about 70% of the sample have their

farms being dominated by mixed/both sexes. In these farms, the common case of men and women jointly contributing to execute a particular activity was witnessed at the end of the entire maize production season. What this means is that, these people (70% of the sample) have their farms being worked on by both men and women. However, the proportion of the total labour hours spent by either sex on these farms is not more than three quarters of the total labour hours spent on those farms throughout the production process. Seventy-four (74) respondents, representing about 24% of the sample, have their farms dominated by males. This implies that, these farmers used more male labour hours than female labour hours in all farm activities or in the production process. Twenty (20) respondents, representing 6% of the total respondents interviewed have their farms dominated by females. This also means that, these farmers used more female labour hours than male labour hours in all farm activities

4.2.2 Distribution of Farm Activities Among Gender

Table 4.4 summarises the distribution of farm activities among gender using the labour input. The proportion of labour hours provided during land preparation in the entire maize production process by either sex, is less than three quarters (75%) of the total labour hours spent on it, hence it is considered a normal case of mixed dominated activity. However, in terms of number of labour hours, it is considered a male dominated, since male labour hours (12711) provided are more than female labour hours (4370). This is consistent with some studies, for instance, land preparation such as land clearing, is energy demanding and draining as well, and women by their nature always finds it difficult executing such a task, and for that reason women will always hire men to help them prepare their lands (Whitehead, 1996). Even though some few women farmers try preparing their own lands, the majority of

them who cannot prepare or till the land because is a drudgery exercise, will always engage the services of men (Clark, 2013). Men provided more labour hours (2877 hours), representing 82%, compared to women (626), also representing 18% during ploughing of the land. This makes ploughing to be designated as men dominated activity. This is not surprising since ploughing the land is also considered an energy draining exercise (Clark, 2013).

Planting of maize as an activity is dominated by both men and women. Even though women provided the maximum labour hours (15576.5), the proportion of labour hours provided could not cross more than 75% of the total labour hours (28612.5) spent on it. Hence it is considered a mixed dominated activity. From the study, weeding is mostly dominated by men. Men provided more labour hours during weeding. Out of a total of 84855 labour hours spent during weeding, men provided 67973, which exceeds the 75% proportion of the total labour hours. Hence weeding is identified as male dominated activity. Chemical application is mostly dominated by men. A total of 3334 labour hours was spent during chemical application in the maize production process. Of this, men provided 2723.5 representing 82% of the total labour hours. This means that, chemical application is a male activity. This is evident in the studies of Tavvaet al. (2013) and Uzokwe (2009) . The total labour hours provided by either sex as at that time of this research, indicate that fertilizer application is an activity in the maize production process, that is mostly dominated by both sexes. Out of a total of 17982 labour hours spent during fertilizer application, men provided 8258 labour hours representing about 46%. This simply means that the proportion of labour hours provided by both sexes during fertilizer application is less than three quarters (75%) of the

total labour hours spent on it. Hence fertilizer application is designated a mixed dominated activity

Harvesting is mostly dominated by both genders. From the research, none of the sexes provided labour hours more than three quarters of the total labour hours spent on harvesting. Out of a total of 43001.5 labour hours spent on harvesting, 17308.5 labour hours was provided by males, representing just 40% of the total labour hours. Since none of the sexes crosses more than 75% of the total labour hours, harvesting is considered the normal case of a mixed dominated activity. From the research, it shows that storage of crops is a mixed dominated activity. Men provided 66% of the total labour hours (3693.75) spent on storage of crops. This is to say that, none of both sexes is able to provide labour hours that crosses more than 75% of the total labour hours. Hence storage of crop is a case of mixed dominated activity. Pest management of maize is dominated by both men and women. Even though men provided the maximum number of labour hours (1225), the proportion of labour hours provided could not cross more than 75% of the total labour hours (1625) spent on it. Hence pest management of maize is considered a normal case of mixed dominated activity.

Out of a total of 1267 labour hours spent on carting of crops, 511 labour hours was provided by males, representing just 40% of the total labour hours. Since none of the sexes provided labour hours that crosses more than 75% of the total labour hours spent on carting of crops, it is considered the normal case of a mixed dominated activity. Threshing is mostly dominated by males and females. A total of 2667.5 labour hours was spent during threshing in the maize production process. Of this, males provided 1256.5 representing 47% of the total labour hours. Since none of the sexes is able to provide labour hours more than 75% of

the total labour hours during threshing, means that, threshing of maize is considered a mixed dominated activity.

Table 4.4: Distribution of Farm Activities Among Gender

Farm Activity	Men	Women	Total	Pror M (%)	Pror F (%)	Labour input classification by gender
Land preparation	12711	4370	17081	74	26	BD
Ploughing	2877	626	3503	82	18	MD
Planting/sowing	13036	15576.5	28612.5	46	54	BD
Weeding	67973	16882	84855	80	20	MD
Chemical App.	2723.5	610.5	3334	82	18	MD
Fertilizing	8258	9724	17982	46	54	BD
Harvesting	17308.5	25693	43001.5	40	60	BD
Storage of crops	2429.75	1264	3693.75	66	34	BD
Pest management	1225	400	1625	75	25	BD
Carting of harvest	511	756	1267	40	60	BD
Threshing	1256.5	1411	2667.5	47	53	BD
Cooking farm labor	238.5	5129.5	5368	4	96	FD
Total	**130547.8**	**82442.5**	**212990.3**	**61%**	**39%**	

Source: Computation based on field survey (2019)

Cooking for farm labour was mostly dominated by females. From the research, females provided 96% of the total labour hours spent during cooking for farm labour. This implies

that, cooking for farm labour is a female dominated activity, since females provided more than 75% of the total labour hours (5368) during cooking for farm labour. Hence cooking is a female designated activity.

The results in Table 4.4, roughly shows that, men spend more labour hours in land preparation, ploughing, weeding, chemical application, storage of crops, pest management, while women spend more labour hours in planting/sowing, fertilizing, harvesting, carting of harvest/transportation, threshing and cooking for farm labour. Proportionally, females dominated in only cooking for farm labour, males dominated in ploughing, weeding and chemical application while land preparation, fertilizer application, harvesting, storage of crops, pest management, carting of farm harvest and threshing are dominated by mixed/both sex.

Dicta et al. (2013) noted that often the best time men are needed in all farming activities is during ploughing and land preparation. This is because, these activities are tedious and more energy demanding men dominate in those activities due to their physical strength compared to women. Even though most women try ploughing and preparing their lands, the majority who cannot do it, always hire men to help them execute for a fee.

During planting, weeding, watering, harvesting and post-harvest activities, such as transportation of farm produce, agro-processing as well as marketing, generally seems to be done by women as all these activities are seen not energy draining activities compared with land preparation, ploughing, etc (Duncan and Brants,2004).

Overall, men approximately provided the maximum labour hours (61%) in all activities/roles listed during the production process of maize and women contributed approximately 39

percent (see Table 4.4). Contrary to the claim that female labour input in agriculture is between 60 -80%, studies such as Palacios-Lopez et al. (2017) and Rahman (2010) have reviewed the numbers lower than the previously claimed; Nigeria (37%), Ethiopia (29%), and Niger (24%). This is well within the average found in this study. Rural women are stereotype as 'home keepers' where they must ensure that all their domestic works are completed before investing any time elsewhere. They manage to utilise the little time left within the available time, ensuring that they get something out of what they farm. This idea of society stereotype placed women at disadvantage compared to their men counterparts, hence constraints development of a country (Sikod, 2007). This stereotype have come about because of mere norms and customs of society (Ibid).

Ibrahim and Ibrahim (2012) posits that women household duties in society compared with their men counterparts put them under great pressure and therefore deny them the equal opportunity to compete with men for development projects. Hence women are constraint with time and therefore are not able to take advantage of the opportunities provided by society. A situation dictated to them by gender roles. The myriad of tasks and gender related challenges can mean that women are not able to take advantage of the opportunities given by trade expansion.

4.3 Effects of Gender of Labour Input on Maize Yield

Parameter estimates of the multinomial endogenous treatment-regression is presented in Table 4.5 below. The base category is mixed/both mixed dominated. The results of the model appear to have fitted the data very well as the Wald Chi Squared of 226.82, which is significant at 1%, rejects the null hypothesis that the regression coefficients are jointly correlated or equal to zero.

4.3.1 Treatments

Farmers usually engage the services of labourers on their farms, as these services would have serious effects on their yield. Some may prefer the services of only males, some too females and others may also prefer both genders. Whatever influence their choices in this direction is solely left to them to decide. However, their choices definitely have some effects on maize yield, and that is exactly what this research seeks to find.

The multinomial endogenous treatment effect was employed in analysing this objective. As mentioned already, there are factors that influence the choices of a farmer with regard to what type of sex/gender the farmer would prefer as labour. The study therefore finds the need to include those variables, which then reflect on maize yield (outcome variable). Sex/gender distribution labour input therefore become the treatment. Table 4.3 summarizes the distribution of labour input in terms of gender. Mixed/both dominated is used as the base category. About 70% of the farmers interviewed have their farms dominated by both sexes, while almost 24% and 6% respectively have their farms dominated by males and females.

Table 4.5 summarizes the effects of the treatment on the gender of labour input used. The results show that marital structure, male/female ratio, family/hire labour ratio and sex are found to be significant. What this means is that, farmers in polygamous homes are less likely to have their farms dominated by males relative to the normal case of both dominated (base category). These farmers may be exposed to both sexes, since polygamous families give birth to more children. Farmers living in a home dominated by males are more likely to have their farms dominated by male labours relative to both male and female labours. This is because, the available labour at their disposal at the time are only males. Farmers who live in a home with more family labour, are more likely to have their farms dominated by family

labour. Male farmers are more likely to engage the services of male labours than engaging the services of both sexes. Farmers who perceived some agricultural activities to be for females, are more likely to use female labours than both male and female labours. Farmers living in a nuclear family are more likely to have their farmers dominated by female labours relative to both male and female labours.

Table 4.5: Multinomial Endogenous Treatment Estimates (Treatment Equation)

Variables	**Male dominated (MD)**		**Female dominated (FD)**	
	Coefficient	**Std Err**	**Coefficient**	**Std Err**
Family Structure	0.271	0.380	3.309[a]	0.920
Marital Structure	-1.048[a]	0.393	-1.041	0.720
Perceived Farm Activities	0.520	0.447	2.207[c]	1.252
M/F Ratio	6.972[a]	1.353	-10.642[a]	3.437
FL/HL Ratio	2.422[a]	0.873	3.953[b]	2.045
Sex	0.945[b]	0.414	-4.776[a]	1.518
Household Head	0.224	0.397	1.057	1.073
Constant	-7.652	1.190	-4.675	2.656

Log likelihood = -2144.7397; Wald Chi Squared (31) = 226.82; Prob > Chi Squared =0.000

[a], [b], and [c] represent 1%, 5%, and 10% level of significance respectively.

Source: Author's field survey (2019)

Table 4.6: Multinomial Endogenous Treatment Estimates (Outcome Equation)

Variables	Coefficient	Std Err
Constant	193.864[a]	31.440
Male dominated (MD)	43.998[c]	23.826
Female dominated (FD)	-104.357[a]	43.847
Labour hours	0.047[a]	0.015
Fertilizer	7.736[a]	2.646
Chemical application	6.057[a]	1.996
Machine hours	3.853[b]	1.892
Seed	-1.288[c]	0.741
Marital status	7.088	25.751
No. of dependents	-3.158[c]	1.725
Sex	-30.668[c]	18.444
Education	48.099[a]	17.548
Improve seeds	76.483[a]	16.168
Extension	-3.111	5.798
Credit	-16.387	22.175
FBO	-20.195	23.285
Experience	1.028	1.030
PFG	109.289[a]	37.861
lnsigma	4.66[a]	0.156
lambda male dominated	-87.239[a]	22.840
Lambda female dominated	3.719	46.628
sigma	105.594	16.515

Log likelihood = -2144.7397; Wald Chi Squared (31) = 226.82; Prob > Chi Squared =0.000

a, b, and c represent 1%, 5%, and 10% level of significance respectively.

Source: Author's field survey (2019)

In the outcome model, presented in Table 4.6, all the treatments as well as some of the variables that influences the dependent variable (maize yield) are significant. Farmers that

have their farms dominated by male labour activities increases yield. Farmers who have their farms dominated by female labour activities record lesser yield compared to farms dominated by mixed labour. Labour hours from the results show positive and significant. From the results, the more labour hours spent on a farm result to more yield. Fertilizer follow a prior expectation. It is positive and significant. This implies that, farmers who apply more fertilizer in their farms record higher yields. Farmers who spray their farms with chemicals increase their yield. The results also show that, farmers who use machine on their farms increase their yield. Machine usage enable farmers to dwell more into commercialization of agriculture.

Farmers who have more dependents in their family record lesser yield. The results also show that, male farm mangers record lower yield than female farm managers. Yields depend on proper planting and maintenance of crops that usually is relegated to women and typically require more time, patience, and backbreaking as well (Hussein, 2008).

Farmers who are more educated, among the respondents record higher yields. This may be true for the fact that, educated farmer are easily convince to adopt new and high yielding technologies. This is supported by Paltasingh & Goyari (2018) and Reimers & Klasen (2013). Farmers that use improve seeds increase their yields. Farmers who participated in the planting for food and jobs (PFJs) program have their yield increased.

4.4 Gender/Sex Specific Challenges

Results in Figure 4.1, indicates male respondents ranking challenges based on which challenge is most pressing. Access to credit makes it possible for productive activities such as agriculture, which requires more cash to rent or purchase land and modern inputs to enhance productivity and income. Access to credit was ranked with a mean of 6.58 which is

the highest mean compared to all other constraints. The rsult indicates that access to credit was ranked top as the most pressing challenge among the male respondents. Results from Figure 4.2 shows a 5.63 mean of access to credit ranked by women. This mean ranked is second highest in the figure. It implies that female respondents rank access to credit as the second most pressing constraint..

The mean ranks of access to credit, ranked by men and women show a notable difference; 6.58 and 5.63, respectively. However, the ranks show that, access to credit as a challenge is more pressing to males compared to their female counterparts. However, Vargas Hill and Vigneri (2011), hold a contrary view and they noted that farmers ease of loans or credit repayment determines the lenders' willingness to give out loan or credit to them. Since credit is a key input in production, to be able to access credit all year round, farmers should be able to timely repay their loans without any problem. This implies that farmers should be able to produce surplus such that, they can still make gains after loan or credit repayment. This assertion has more to do with the type and size of the land cultivated. Women ownership of land and control over other resource are widely limited. Because of this, women are perceived to produce only just to feed the family, and definitely not enough to leave some for the market, hence causing women a harder time to access loans or credit.

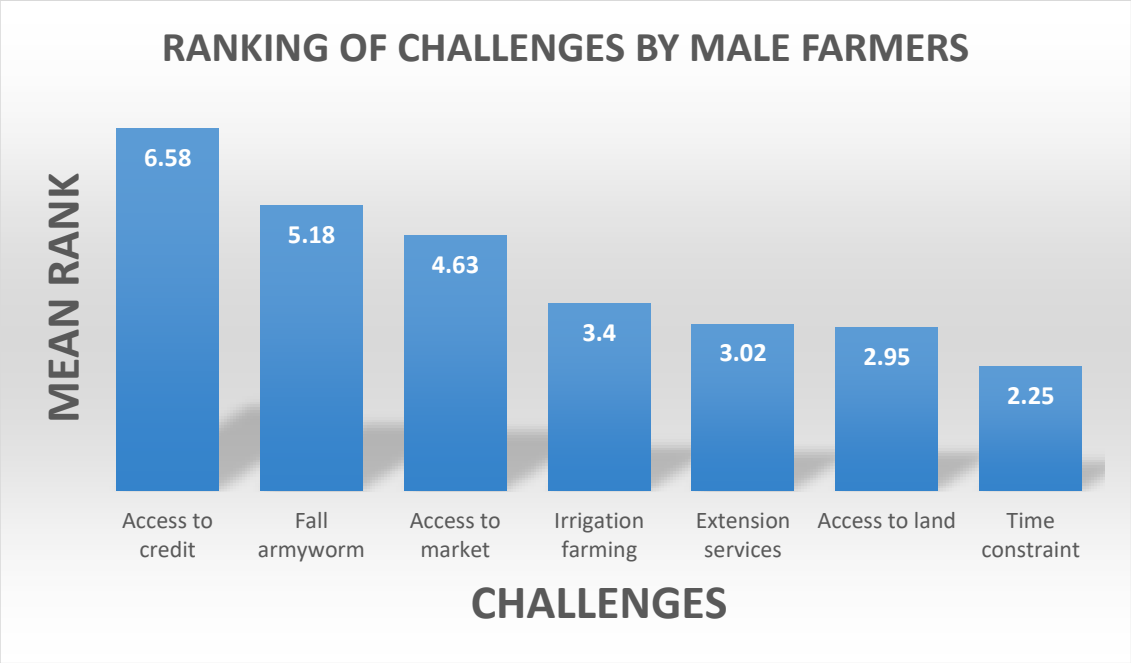

Figure 4.1: Ranking of Challenges by Male Farmers

Source: Author's field survey (2019)

Figure 4.1, shows the mean of fall armyworm as a challenge ranked by men. The mean, as observed from the figure is 5.18. This challenge is ranked second, among the list of challenges male respondents were given to rank in terms of most pressing. Figure 4.2, shows the mean rank of fall armyworm ranked by women. The mean as observed from the figure is 5.95. This mean ranked, is the highest in the figure. The ranking indicates that fall armyworm is the most pressing challenge among the list of challenges female respondents were given to rank. Observations from the two figures show a notable difference in mean ranked by women and men; 5.95 and 5.18, respectively. This implies that, women are highly challenged with fall armyworm compared to men.

Figure 4.1 shows 4.63 mean of access to market, ranked by men as the most pressing challenge. This rank is the third highest in the figure. It implies that access to market was

ranked third among the list of challenges male respondents were given to rank, in terms of most pressing. Figure 4.2 shows 3.17 mean of access to market, ranked by women. This mean is the fifth highest in the figure. It also implies, access to market was ranked fifth among the list of challenges female respondents were given to rank, in terms of most pressing challenge.

From the analysis above, mean of access to market is much higher in males compared to females. That is 4.63 and 3.17 respectively. This means that, access to market as a challenge is more pressing to males than female. That also explains that, men face more challenges when it comes to marketing their farm produce compared to their women counterparts. This finding is in contrary to what Koru and Holder found and their findings justified that fact that, women as compared to men are always challenged with time because of their workload, and therefore do not always make time to the market to sale their produce (Koru and Holden 2008). This situation of women has limited their market involvement in terms of input and output marketing (Morgan, 2006). According toVargas Hill and Vigneri (2011), gender roles have placed women at a disadvantage position such that women are not able to access assets and market the same way as men.

Irrigation farming as a challenge among the list of challenges male respondents were given to rank, was ranked fourth, with a mean of 3.4, as indicated in Figure 4.1. Female on the other hand, ranked the same irrigation farming seventh, as a pressing challenge, with a mean of 2.67. This is indicated in Figure 4.2. From the analysis, irrigation farming is more a challenge to men than their women counterparts.

Extension services was ranked by men among several challenges. It was ranked fifth, with a mean rank of 3.02. This is indicated in Figure 4.1. Women as indicated in Figure 4.2, ranked

extension service sixth, as most pressing challenge to them. This challenge comes with a mean rank of 2.85. This means that, among the list of challenges women respondents were given to rank, extension service was ranked sixth most pressing challenge to them, given that 7 is the maximum. From the analysis, men are seen to face more challenges in access to extension services than women. This challenge may be due to the farmer extension agent ratio which may be a huge limiting factor.

Figure 4.1 results indicate 2.95 mean of access to land, ranked by men. This mean rank is the sixth highest in the diagram. What this means is that, among the list of challenges male respondents were given to rank base on more pressing, access to land was ranked sixth. Women on the other hand, ranked the same challenge third, with a mean rank of 4.33, as seen in Figure 4.2. This means, access to land was ranked third among the list of challenges female respondents were given to rank.

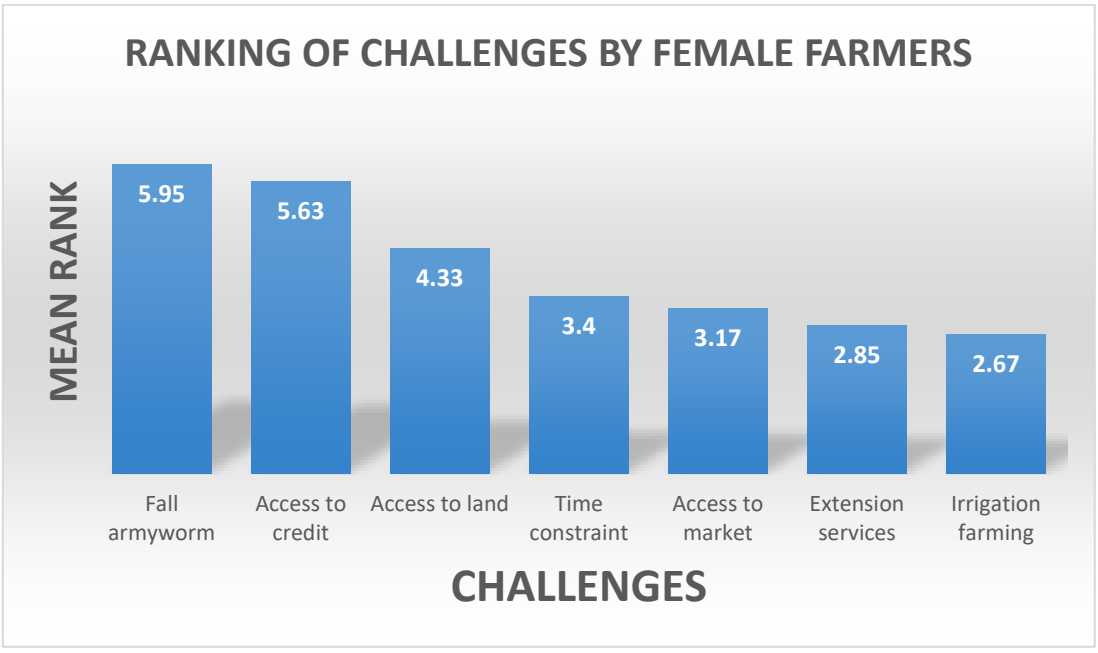

Figure 4.2: Ranking of Challenges by Female Farmers

Source: Author's field survey (2019)

From the above analysis, there is a notable difference in the mean ranks of women and men; 4.33 and 2.95, respectively. This implies that, women see access to land as most pressing challenge compared to their men counterparts. In Northern Ghana, especially rural areas, the system of inheritance and control over resources is strictly based on traditional norms. This limit the land rights of women resulting in land affairs being completely managed by men. Property rights remain with male children who inherit their fathers (Adolwine and Dudima, 2010). This is also much echoed by Monalisha et al. (2018) who found that women lack acess to land for farm production in India which extend to limit their access to credit because banks do not accept land as a gurrantee if it is not own by the applicant. It is much suprising that state institutions in Ghana could contribute in the exercebation of this problem as Mauro and Pallas (2009) found that Department of land put bottlenecks in the way of women to acquire land rights.

Results from Figure 4.1 indicate a mean of 2.25 of time constraint ranked by men. This mean is the seventh highest in the figure. Results from Figure 4.2, also indicate a mean of 3.40 of time constraint ranked by women. This mean is the fourth highest. This implies that, among the list of challenges female respondents were given to rank, time constraint was rank fourth, as most pressing challenge to them. Observations from the two figures show that women mean rank is higher than men; 3.40 and 2.25 respectively. This means that, women are more challenged with time compared to men. Domestic tasks have taken almost all women time and they barely have time for their farms, unlike their men counterparts who invest almost all their time in the farm as well as concentrating on activities that fetch them money (Wodon and Blackden, 2006). “The gender relations such as division of labour that results in women generally working longer hours as they must combine reproductive and productive

responsibilities makes it difficult for them to move from subsistence agriculture to more prominent positions in market-based agriculture" (ALINe, 2011).

The value of the Kendall's coefficient of concordance, with respect to Figure 4.1 is found to be 0.499, which is significant at 1% level of significance. This implies there is 50% agreement or concordance by male respondents in the order of ranking.

The value of the Kendall's coefficient of concordance, for Figure 4.2, has been found to be 0.382, which is significant at 1% level of significance. This implies, there is significant agreement by female respondents in the order of ranking in Figure 4.2, given that 7 is the maximum.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

This chapter presents a summary of the results that was generated in chapter four, using the proposed methodologies in chapter three. Following the summary of the results are the conclusions based on the results and the presentation of the proposed recommendation based on the conclusion.

5.1 Summary

This research sought to study the effects of gender/sex (of the farmer) and that of the labour input on maize yield in Northern Ghana. It first identified the various distributions of labour input by gender in the maize farming activities. This was operationalised by estimating the total number of hours both gender spend on farm activities and the entire production period. This is then used to estimate how this distribution of the sexes among the labour input affect maize productivity. The study further identified sex/gender specific challenges facing maize production. The respondents were selected through multistage sampling technique. Three regions were randomly selected out of the five regions in Northern Ghana. Out of these, two districts were randomly selected from each region and further, two communities were selected. subsequently, a total of 312 smallholder maize farmers were randomly selected and interviewed. The study sought to answer three research questions in an attempt to fully understand what the study sets out to do. The following paragraphs would chronicle the summarized version of the findings of the research in order of the objectives as stated in the study.

The mean age of the sampled farmers is about 40 years. About 65% of the sample do not have any form of formal education. In terms of number of labour hours, out of the twelve (12) farm activities, females dominated in planting/sowing, harvesting, carting of farm harvest, fertilizer application, threshing and cooking for farm labour while males dominated in land preparation, weeding, ploughing, chemical application, storage of crops and pest management. However, in terms of proportions (more than 75%) of labour hours spent on an activity or a production process, females dominated in only cooking for farm labour. Males dominated in ploughing, weeding and chemical application. Land preparation, harvesting, fertilizer application, pest management, storage of crops and threshing are mixed dominated activities. Farmers that have their farms dominated by male labour record higher yields while the reverse is the situation for those that have their farms dominated by female labours. Female farm managers are more likely to have their farms dominated by females while male farm managers are also more likely to have their farms dominated by males. Female farm managers are better managers of the farms than their male counterparts in terms of maize yield. Access to credit and the fall armyworm are reported to be most challenging among farmers in the study area. For instance, female farmers consider the fall armyworm to be the most pressing challenge of all the challenges, and therefore this challenge was ranked first. Male farmers on the other hand, consider the fall armyworm to be a serious problem which was ranked second among all the challenges given to them to rank in terms of most pressing. Similarly, access to credit was ranked top as the most pressing challenge to men, while their female counterparts rank the same challenge as the second top most challenging problem to them.

5.2 Conclusions

From the sample, men contribute more labour hours than their female counterparts. Men contribute about 61% (130547.8) of labour hours whiles women contribute 39% (82442.5). Men and women jointly play roles in more than half of farm production activities. Even though women play roles in all agricultural production activities, there is only one activity that their role is dominant; Cooking for farm labour. Men dominated in ploughing, weeding and chemical application activities. At the farmer level, about 70% of farmers entire maize production process is mixed dominated, indicating both sexes play a joint role in maize production. About 24% and 6% of the farmers had their production dominated by male and female respectively.

Farmers in nucleus family system are more likely to have farms that are female dominated and those in polygamous homes are less likely to be male dominated. The more a particular sex in a family, the more likely that sex will dominate in the production process.

The more a farmer uses family labour, the more likely their production would be dominated by male labour and at the same time female labour. However, the female would be more likely relative to the male. Furthermore, the sex of the farmer is likely to inform the sex that would dominate their maize farming activities. That is the farm of a male farmer is likely to be dominated by male hours in the entire production process, and the vice versa for female maize farmers.

On maize yield, all the traditional inputs increase yield except seed. However, in terms of magnitude of the impact on yield, there are great variations. It is found that fertilizer, chemical and machine hours used had a wide impact on yield relative to labour.

Farmer who are educated, use improved variety of seeds as well as those who participated in PFJs all experience increases in yield. On the other hand, the more dependents a farmer has and the more distance a farmer has to travel to farm negatively affect maize yield.

The sex of the farmer influences maize yield in favour of females, that is female farm owners are more productive than their male counterparts. However, when it comes to the distribution of the gender among the labour input in the entire production process of maize, those that are male dominated tend to be more productive than those that are female dominated relative to the mixed dominated.

Male and female farmers have different challenges as far as maize production is concern and in the order of descending, female farmers rank the following challenges; fall armyworm, access to credit, access to land, time constraint, access to market, extension services and irrigation. In a similar manner of ranking, male farmers rank the following; access to credit, fall armyworm, access to market, irrigation, extension service, access to land and time constraint.

5.3 Recommendations

The following are the suggested recommendations;

1. Farmers should take advantage of the PFJ progrmme as it greatly influences yield
2. Fertilizer and chemical application and the use of improved vairiety of seeds should be encouraged. PFJ which already include the provision of subsidised fertilizers should expand to include chemicals to the package.

3. Programs and projects which tend to target labour productivity of certain sexes should consider the sexes of farmer owners and the distribution of the labour hours of gender in the entire maize production process.
4. Improving maize production through mitigating the production challenges should have a segregated gender approach.
5. NGOs and government through the MoFA should make credit available for farmers to access as it is a serious challenge for both sexes in terms of maize production.
6. Communities, chiefs and other stakeholders should advocate for women to own and have access to lands as is still a major challenge for women as compared to men.
7. Fall armyworm prevention and control should be taken seriously by government as appeared to be a major challenge for maize farmers.

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APPENDICES

Appendix 1: Questionnaire

UNIVERSITY FOR DEVELOPMENT STUDIES, TAMALE

FACULTY OF AGRICULTURE, FOOD AND CONSUMER SCIENCES

DEPARTMENT OF AGRICULTURAL AND FOOD ECONOMICS

QUESTIONNAIRE

TOPIC: THE EFFECTS OF GENDER AND ITS DISTRIBUTION IN FARM PRODUCTION ON MAIZE PRODUCTIVITY: THE CASE OF NORTHERN GHANA

This Questionnaire is to help complete a study on Gender Roles and Maize Productivity: The Case of Northern Ghana for the award of Master of philosophy in Agricultural Economics

Your participation in this study would be very much appreciated and all your responses will be treated confidential.

SECTION A: BACKGROUND INFORMATION

1. Name: ……
2. Contact Number:

   ……
3. Name of community/District: ……

4. Age of respondent:

   ……...

5. Sex of respondent: Male [ ] Female [ ]

6. Marital Status: Married [ ] Single [ ] Divorced [ ] widowed [ ]

7. Number of dependents: ……..

8. Are you the household head? Yes [ ] No [ ]

9. What is your level of education?

   No formal education [ ] Basic education [ ] Secondary/Technical education [ ]

   Tertiary level [ ] Others

   (specify)……

10. Number of years in school: …….

11. Income level (monthly, GH₵): …….

12. What religion do you belong? Islamic religion [ ] Christianity [ ]

    Africa Traditional Religion [ ] Others

    (specify)……

SECTION B: LABOUR HOURS AND GENDER CLASSIFICATION LABOUR INPUT

Table: Labour Hours and Gender Classification Labour Input

Activity	Times	Male			Female			Total	Mach.	Proportion		Total		Gender classification of labour input	
		FL	HL	Total	FL	HL	Total			Male	Female	FL	HL	classification	No. of classification
Land preparation															MD=
Ploughing															FD=
Planting/sowing															BD=
Weeding															MD=
Chemical App.															
Fertilizing															

Harvesting															
Storage of crops															
Pest management															
Carting of harvest															
Threshing															
Cooking for farm labor															
TOTAL LABOR HOURS															

FL=Family Labor, HL=Hired Labor, MD=Male Dominated, FD=Female Dominated, BD=Both Dominated, G=Gender, Mach.=Machine

13. What family structure are you living? Nuclear [ ] Extended [ ]

14. What marital structure are you leaving? Polygamous [ ] Monogamous [ ]

15. Do you perceive some agricultural activities to be for certain gender? Yes [ ] No [ ]

16. Total number of people in your household; …… Male [ ] Female [ ]

17. Household male to female ratio:

……

SECTION C: MAIZE PRODUCTION AND PRODUCTIVITY

18. Total land for agriculture (total agricultural landholding):

……

19. What is the size of your maize farm?.....

20. Maize land ownership: Owned [ ] Rented [ ]

21. How did you plough your field? Tractor [ ] Bullock plough [ ] Hoe [ ]

22. How long have you been farming maize?

……...

23. Distance to farm:

……

24. Participation in Planting for Food and Jobs (PFJs): Yes [ ] No [ ]

25. Number of labor hours used: (refer to table)

26. What is the quantity of fertilizer used?

……...

27. Machine hours: (refer to table)

28. Chemicals used:

……..

29. Quantity of maize seeds:

…….

30. Did you use improved seeds? Yes [ ] No [ ]

31. Number of extension contacts:

……

32. Do you have access to credit? Yes [ ] No [ ]

33. Do you belong to a Farmer Based Organization (FBO)?

……...

34. What is the total output of maize harvested?

……

35. Quantity consumed (bags)

……...

36. How much sold?

.....

37. Quantity given as gifts (bags)

…….

38. What other crops did you cultivate and their outputs?

Crop	Output	Consumed	Sold

39. Non-farm income sources

Source	Estimated monthly income

SECTION D: GENDER SPECIFIC CHALLENGES

40. What challenges do you face in your maize farming? Arrange in order of 1 (least of challenges) to 7 (most pressing challenge)

Access to land

Access to credit

Irrigation farming

Access to market

Fall armyworm

Extension services

Time constrain