ECONOMETRIC MODELLING OF WOMEN EMPOWERMENT AND AGRICULTURAL PRODUCTION IN CAMEROON

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ABSTRACT

This study attempts to investigate the relationship between women empowerment and agricultural production in Cameroon and to verify the heterogeneity effect of women empowerment on agricultural production by household geographical place of residence. Methodologically, we used Cameroon household consumption survey via 2SLS and control function models. The results reveal that women empowerment positively and significantly affects agricultural production in Cameroon. The findings also revealed that empowering a married woman has a large positive effect on agricultural production than otherwise. The study recommends that empowerment strategies for women farmers be implemented and effectively monitored towards agricultural goal attainment.

Keywords: Women empowerment, Agricultural production, 2SLS, Control function, Cameroon

JEL Classification: O13 , J16

INTRODUCTION

Sustainable development goal number two (SDG2) is to end hunger, achieve food security and improved nutrition and promote sustainable agriculture while sustainable development goal number five (SDG5) is to achieve gender equality and empower all women and girls. This shows that women empowerment and agricultural development is of paramount importance in most development programs across the world today. Agriculture has been widely recognized by the international development community as an engine of growth and poverty reduction especially in countries where it is the main occupation of the poor. The avenue through which the potentials of agriculture are harnessed and unleashed to become beneficial to the wellbeing of the people is through food production (Bhargava, 2008). As it relates to agriculture, more than half of the world's women are involved in food production with studies revealing that they produce over 50 per cent of all food grown worldwide (FAO, 2012).

Nonetheless, women's role in the economy has often been underestimated, and their work in agriculture has long been invisible. Even though their contributions to social development have remained invisible in many countries of the world, it has been established that women contribute immensely to development through their productive activities (UN, 2010).Accordingly, it has been generally accepted that global food security is dependent on the work of rural women, as they are the major producers of food crops across the globe (IFAD, 2007).However, policy makers have often targeted population, health and nutrition programmes to women in their reproductive roles, but neglected them as productive agents. This situation however is changing with the growing evidence that income in the hands of women contributes more to household food security and child nutrition. Such knowledge about women's key role in agricultural production is essential to enhance their potential (Agnes et al., 1995).

The International Labour Organization (ILO) regards the gender issue as a universal matter which must be addressed in all international labour law sand conventions as well as in the recommendations and resolutions of the International Labour Conference (ILO, 2012). According to the ILO, women encounter difficulties in the four pillars which underpin the concept of social protection, rights in the workplace, creation of employment and social dialogue. The ILO has various instruments at its disposal for promoting both equality between men and women and the fight against discrimination. These include the Discrimination (Employment and Occupation) Convention of 1958 (ILO, 2012).It also has the 'Bureau for Gender Equality' to deal specifically with gender issues in the workplace. As regards actions for promoting non-discrimination in the rural domain, the ILO has launched various programs to highlight the importance of addressing gender issues within this sector. Firstly because discrimination against women constitutes a violation of human rights and secondly, because otherwise it will never be possible to eradicate extreme poverty (ILO, 2012).

In addition, the UN General Assembly has, on various occasions, acknowledged the pivotal role played by rural women in agricultural production, food security and the eradication of poverty. Amongst the resolutions approved by the UN General Assembly concerning the situation of rural women, it is worth highlighting A/RES/62/136 which calls on Member States to improve the situation of rural women by ensuring their political and socioeconomic empowerment and mainstreaming the gender perspective in the rural ambit into the planning, application, monitoring and assessment of development policies, as well as ensuring that rural women have access to social services. This resolution gave rise to the proclamation of 15th October as the annual International Day of Rural Women' (Resolutions A/RES/ 54/135 of 7 February 2000). Since its creation in 2010, the UN Women Entity has also focused on the promotion of rural women.

The UN Conference on Sustainable Development held in June 2012, known as Rio+20, also stressed the importance of the empowerment of women in rural areas as key players for improving agrarian and rural development as well as food and nutritional security (A/CONF.216/L1., 2009).Moreover, the specific UN organizations for the fight against poverty and hunger, namely the (FAO, 2009), the (IFAD, 2009) and the (WFP, 2009), undertake initiatives which specifically highlight the important role of rural women in reducing hunger and poverty. Examples of such measures are the 'Sourcebook on Gender in Agriculture' (World Bank, 2009) published by the World Bank, FAO and IFAD along with the FAO report on 'The State of Food and Agriculture, 2010-2011', focusing on the need to close the gender gap for the benefit of development and underlining that achieving gender equality and empowering women is not only the right thing to do but also crucial for agricultural development and food security.

Hunger is persistently on the rise with food crisis hurting the poor all over the world, hitting the landless and women the hardest. As such, the vast majority of urban and rural households in the developing world rely on food purchases for most of their food and stand to lose from high food prices. The sharpest rise came in 2007 with an increase of 75 million hungry since the period of 2003 to 2005. Asia-Pacific and sub-Saharan Africa accounted for 750 million of the hungry people in the world from 2003 to 2005. As a result of the global food crisis, an additional 41 million people in Asia-Pacific and another 24 million in sub-Saharan Africa have been plunged into hunger (FAO, 2009). But no continent or country has been spared; even in the United States for example, more than 38 million people were struggling to put food on the table as of 2006 (Learner, 2006). In this light, development agencies often focus on then availability of food through increased food production and laid emphasis on improving yields and high-potential productive areas to achieve and maintain sufficient food production to feed the growing world population. Such have however been regarded as misguided agricultural and trade policies which contributed to the food crisis, because of the failure to recognise women's crucial roles in agricultural production and household food security.

The case of sub-Saharan Africa underscores this claim as women grow up 80 to 90% of the continents' food (UNDP, 2013). The food crisis in this region has attracted attention to the recognition that human resources relating to issue of gender generally reflect an under-resourced subsistence sector that is female dominated (World Bank, 2009). Here, women and men farm separate plots, and women farmers have traditionally been responsible for food production. Estimates from the Food and Agriculture Organization of the United Nation (FAO), show that women account for more than half of the labour required to produce the food consumed in the developing world (FAO, 2009).

Aggregate data also suggest that African women perform about 90% of the work of processing food crops and providing household water and fuel wood, 80% of the work of food storage and transport from farm to village, 90% of the work of hoeing and weeding, and 60% of the work of harvesting and marketing. (World Bank, 2009).Women are therefore the key players of agricultural production and inevitable in overcoming food insecurity.

Empirical evidence suggests that increased empowerment could have positive effects on a number of important development outcomes, such as household agricultural productivity, food security, and nutrition security. In developing countries, particularly in rural communities, women are underserved by public services (Budlender 2010), expanding such services could bring about significant improvements. A study on the Indian state of Gujarat estimated that reducing to 1 hour a day the time spent fetching water by women would allow the women to increase their incomes by $100 yearly using the time saved (UNDP, 2013). Defining priorities for public services in a way that recognizes the imperative of relieving women and girls of these burdens is vital to their empowerment. In addition to the establishment or expansion of public services, improved access to cleaner energy sources for household needs should be central to such a strategy. This would not only save women time, but also reduce reliance on traditional cook stoves. These stoves are damaging environmentally and cause annually about 1.9 million deaths worldwide due to indoor pollution, disproportionately affecting women and children (WHO, 2012).

Worldwide, women and girls are overrepresented among those who are food-insecure. An estimated 60% of undernourished people are women or girls (WFP, 2009). This is without doubt unpleasant, and calls for a concerted effort to empower women. Expanding the opportunities of women and girls is a duty of states, which ratified various human rights instruments on the human rights of women in general and the rights of women at work. Fulfilment of these commitments matter to women and girls and should be seen as an objective in its own right, essential to full attainment by women and girls of their rights. However, it is not for their benefit alone. Women empowerment and gender equality can make a substantial contribution to a country's economic growth, and it is the single most important determinant of food security (World Bank, 2012).

Agriculture has been the main engine of the economic growth for Sub Saharan African countries yet feeding the increasing population is becoming a critical challenge for most of the countries in this area (Bahiigwa, 1999). The Comprehensive Food Security and Vulnerability Analysis (CFSVA) study carried out in May 2017 in Cameroon shows that about 16% of households are estimated to be food insecure (3.9 million people), including 1% that are severely food insecure (around 211,000 people).

More than a fifth of rural households (22%) are food insecure compared to 10.5% of urban households. In rural areas, the most common sources of income are agriculture and small businesses, while in urban areas; these are public or private skilled labour (37.1%) and traders (20.3%). Approximately 22% of households have inadequate food consumption, including 18% with borderline and 3% with poor food consumption. The situation has deteriorated compared to the 2011 CFSVA, which is an immediate call for concern. This study therefore seeks to address the following research objectives: (i) discuss the determinants of women empowerment in Cameroon, (ii) investigate the actual effects of women empowerment on agricultural production in Cameroon and (iii) to verify the heterogeneity effect of women empowerment on agricultural production by marital status.

LITERATURE REVIEW

Bahiigwa (1999) studied women's empowerment in agriculture and agricultural productivity in rural maize farmer households in western Kenya. They applied a cross-sectional instrumental-variable regression method to a data set of 707 maize farm households from western Kenya, and found that women's empowerment in agriculture significantly increases maize productivity. Furthermore, the results show heterogeneous effects with respect to women's empowerment on maize productivity for farm plots managed jointly by a male and female and plots managed individually by only a male or female. More specifically, the results suggest that female- and male-managed plots experience significant improvements in productivity when the women who tend them are empowered. These findings provide evidence that women's empowerment contributes not only to reducing the gender gap in agricultural productivity, but also to improving, specifically, productivity from farms managed by women. Sharaunga et al (2016) conducted a study on understanding the dimensions of women's empowerment that influence food security among rural households considered as crucial to inform policy. It was found that households headed by women with higher levels of economic agency, physical capital empowerment, psychological empowerment and farm financial management skills empowerment were more likely to be food secure due to increased agricultural productivity.

Slathia (2014) carried out a study on the participation of women in agriculture in India which is a developing and predominately agrarian economy. The study showed that 70% of its population is rural, and of those households, 60% engage in agriculture as their main source of income with about 63% of all economically active men engaged in agriculture as compared to 78% of women. He observed that women play a significant role in agricultural development and allied activities including main crop production, live-stock production, horticulture, post-harvesting operations etc.

His findings also revealed that about 70% of farm work is performed by women but these women farmers do not have equal access to productive resources which significantly limits their potential in enhancing productivity. Wouterse (2015) carried out a study on empowerment and agricultural production: evidence from rural households in Niger to assess the role of empowerment in agricultural production. Using new household- and individual-level Women's Empowerment in Agriculture Index data from Niger and regression analysis, it was observed that Women's Empowerment in Agriculture Index indicates that access to land is one important dimension of empowerment. In assessing the role of empowerment in agricultural production, his results showed that empowerment is important for agricultural production and those households in which adult individuals are more empowered are more productive. He concluded that other and possibly more effective pathways to agrarian intensification exist and important agricultural productivity gains could be made by empowering men and women in rural households.

Tambi, et al (2017) investigated the effects of women in agricultural production on food security in rural Cameroon, using the instrumental variable (2SLS) model and 2011 Demographic and Health survey data collected by the government's statistics office and Department of statistics of the Ministry of Agriculture and Rural Development. The results from their analysis showed that women in agricultural production are associated positively with food security, overall. Also, other variables that are associated significantly with food security in rural Cameroon are maternal participation in the labour market, mother's education, family size and father's presence in the household. Abrha (2015) in investigating the factors affecting agricultural production of farm households in the National Regional State of Tigray, Ethiopia used primary sources of data which included farm household surveys, focus group discussions and key informant interviews. His farm income model result showed that landholding size, possession of oxen, amount of fertilizer, improved seeds, irrigation, soil quality, village distance to the district market, average distance of plots from the homestead and crop rotation were significant determinant variables affecting agricultural production. It was also observed that farmers engaged in off-farm activities to fulfil the cash requirements in credit constrained conditions. The study recommended that if farmers are to use chemical fertilizers, they should be supplied with High Yielding Varieties and enough water through access to irrigation and farmers should be allowed to have long term off-farm employment to augment the farming sector.

Nyako, (2013) analysed the relationship between household heads' level of education and food security in Nigeria. He used regression models to control for a wide range of individual characteristics, household characteristics and community characteristics that were used to investigate this relationship.

The results of the analysis showed a negative, robust correlation between level of education and food security status among households in Nigeria. Agarwal (1997) conducted a study on the challenges and coping strategies of women food crops entrepreneurs in Fako Division, Cameroon and found that the country is experiencing high rural exodus and urban growth rates. The result is a continual reduction of the agricultural labour force in the face of an increasing demand for food and as such, women food crop entrepreneurs play an important role in filling the gap created by this phenomenon. This study also observed that because female food entrepreneurs have very few employment alternatives, they are forced to implement coping strategies, which although vital in maintaining them in the sector, do not usually measure up to the challenges. But since the activities of these women have impacts beyond micro levels, government and other agents of development cannot afford to abandon these women.

The above review of literature reveals that the majority of the studies have been conducted in this domain. However, very little has been done in less developed countries such as Cameroon. More over emphasis has been laid on agricultural production in attaining food security neglecting the role of the main actors who are women. This study therefore seeks to investigate this relationship between agricultural production and women empowerment other than empowerment in agriculture. The study also constructs an indicator to capture women empowerment which has not been done in other studies in Cameroon. This study will definitely bring about marginal value to the existing body of knowledge on the role of women to agricultural production.

METHODOLOGY OF STUDY

Women empowerment is an appropriate framework for analyzing agricultural production as conditioned by other complementary variables (UN, 2017). In our model, women empowerment (*WE*) and agricultural production (*AP*) are jointly determined, thus, considering the problem of variable omission in our data due to bias in the time of collection or treatment, the problem of endogeneity bias may arise. To resolve this problem of endogeneity bias, we sort for an instrument that will consistently estimate the contribution of women empowerment on agricultural production (Deschenes and Greenstone, 2004). The instrument, otherwise known as treatment variable, is that variable that can affect women empowerment without directly influencing agricultural production. Here, we are interested in using the cluster mean of costs of medical consultation. In fact the agricultural production generating functions may take the following structural form:

$$AP_i = \alpha_1 d_{AP} + m_1 WE_i + \mu_1$$

1

$$WE_i = \alpha_2 d_{WE} + m_2 AP + \mu_2$$

2

$$WE_i = \alpha_2 d_{WE} + m_2 (\alpha_1 d_{AP} + m_1 WE_i + \mu_1) + \mu_2$$

3

Whereby *APí* refers to Agricultural production as collected by the national institute of statistics respectively; for the purpose of this study, *WEí* is women empowerment as captured by an indicator created using multiple correspondence analysis expressed in percentage changes, showing the percentage changes in yields as a result of a percentage change in the *WE* indicators, also the variables impacting upon yields might not only be caused by women empowerment factors, this could be explained by changes in demand, consumption patterns and farmer behavior. From the equations above α_1; is a vector of exogenous variables that determine *AP*, while α_2 is a vector of exogenous variables that determine women empowerment and *d, m* are parameters to be estimated, while μ_1 and μ_2 are error terms in the structural equation.

From equation (1) we observed that climate change is determined simultaneously with *AP*. Factors such as farm size, agricultural occupation, household size, wind and location of household seem to be principal factors affecting climate change; hence we observed that women empowerment can positively or negatively influence *AP* if these factors are taken care of. Women empowerment in this case is hypothesized to correlate with omitted inputs that enhance *AP* which means *WEí* is correlated with μ_1 which leads to bias and inconsistency in OLS estimates and in the same way *WEí* is correlated with μ_2. Our interest here is to estimate equation (3), if the right-hand side of equation (1) is plugged in for *AP* in equation (2) we obtain equation (3) of women empowerment as shown above.

Considering equation (3), to solve for *WEí*, we assume that $m1 + m2 \neq 1$ however, irrespective of our assumption this is practically an empirical issue. This equation (3) will result to equation (4) and (5) as:

$$(1 - m_2 m_1) WE_i = m_2 \alpha_1 d_{AP} + \alpha_2 d_{WE} + m_2 \mu_1 + \mu_2$$

(4)

$$WE_i = \alpha_1 X_{AP} + \alpha_2 X_{WE} + \mu_3$$

(5)

Given that:

$$X_{AP} = (m_2 d_{AP}) / (1 - m_2 m_1)$$
$$X_{WE} = (d_{WE}) / (1 - m_2 m_1)$$
$$\mu_3 = (m_2 \mu_1 + \mu_2) / (1 - m_2 m_1)$$

Equation (5) expresses women empowerment in terms of the vector of exogenous variables X_{AP} and X_{WE} and the error terms, which is the reduced form equation for women empowerment. Also the vectors of parameters α_1 and α_2 are reduced form parameters which are nonlinear functions of the structural parameters in equation (1) and equation (2). The reduced form error, μ_3 is a linear function of the structural error terms; μ_1 and μ_2. Since μ_1 and μ_2 are each uncorrelated with α_1 and α_2, μ_3 is also uncorrelated with α_1 and α_2. Thus, the vectors of parameters X_{AP} and X_{WE} can be consistently estimated by the OLS this is input in to 2SLS estimation.

Following Wooldridge (1997) to account for potential endogeneity and heterogeneity of responses of unobservable that are complementary with women empowerment, equation (1) can be augmented to equation (6) which is the control function model:

$$AP = \lambda_0 + \alpha_1 d + \gamma_1 WE_i + \lambda_1 \hat{\mu}_3 + \ell \qquad (6)$$

Here $\hat{\mu}_3$ is fitted residual of climate change derived from equation (5) while ℓ is the error term, γ_1, λ_1 are parameters to be estimated. In addition, the IV (instrumental variable) estimates of equation (6) are unbiased and consistent only when: (a) the expected value of the interaction between women empowerment and its residual is zero or the interaction between women empowerment and its fitted residual is linear and (b) there is no sample selection problem. If the correlation is non-linear, the control function approach is required to purge the estimated coefficients of the effects of unobservable variables.

The potential endogenous instrument is cluster cost of medical consultation, while the exogenous variables to be used in the study include: household size, primary agricultural activity, socio-economic status, size of production farm, marital status, access to credit, access to agricultural financing, use of modern agricultural equipment, use of fertilizers, use of specialized seeds, cost of seeds, cost of fertilizers, formal agricultural training and location of household.

Generally, the variables used in this study will be captured at community level (cluster level) to avoid individual effects given that climate change is a global issue.

DATA PRESENTATION

To achieve our objectives, we will use secondary data from the 2014 Cameroon Household Survey 2014 (ECAM4), which was compiled by the National Institute of Statistics (NIS). The main objective of the fourth Cameroon household survey (ECAM4) is to provide indicators on living conditions of populations and to update the poverty profile. The survey is targeting a sample of 12 897 households broken down into 1 024 clusters and data collection is carried out through a questionnaire made up of 17 sections. It is the fourth of its kind to be undertaken in Cameroon after those of 1996, 2001 and 2007. It is part of the process to update the poverty profile, the monitoring and evaluation of the national strategy for growth and employment and the progress towards achieving the Millennium Development Goals (MDG).

The data can be used to study all aspects of poverty at national and regional levels; evaluating the effects of macro-economic policies; evaluate the demand for education and identify its principal determinants; evaluate internal tourism and analyse the labour market in Cameroon. it also provides information on socioeconomic status, health, environment, agriculture, infrastructure etc. This is therefore preferred as it is the most recent data base that contains all the components involved in this study. As such, data on the variables involved in the study will be extracted from the ECAM4 of the NIS. As concerning measurement issues, following World Bank (2012), in the context of this study, women empowerment is therefore constructed as a single indicator using the variables that directly influence woman such as: mother received formal education, mother has received technical\professional training, receives assistance from friends and family, support from religious group, is a shareholder and belongs to a professional or solidarity group. These variables are used to compute a single indicator for women empowerment using multiple correspondence analyses. Agricultural production will be captured in terms of quantity/kg of crops produced per year.

PRESENTATION OF FINDINGS

The results of the study is presented in an orderly manner following the order of the objectives: The result is presented and discuss as: the synopsis of women empowerment indicator, summary descriptive statistics, the reduced form estimators of women empowerment, the contribution of women empowerment to agricultural production and finally results of the heterogeneity effect of women empowerment on agricultural production by marital status of women.

Synopsis of the Women Empowerment Indicator

To construct the women empowerment indicator, the multiple correspondence analysis (MCA) method was used. Given the multifaceted nature of women empowerment, it was constructed using nine modalities which included; whether mother received higher education, received professional/technical training, is a shareholder, receives assistance from family members, has post of responsibility in a professional association, receives assistance from a solidarity association, receives assistance from friends and associates, receives assistance from religious group and has a savings account resulting in nine dimensions which were reduced to one by the MCA method as seen on Table 1 in the appendix

The various scores were generated and normalized to treat for the presence of negative values which may cloud the grouping of attribute and interpretation of results. It is observed that all the variables contributed to the first dimension except receives assistance from friends and associates. Higher education contributes about 18% to the total inertia, professional training about 15% to the total inertia while having a post of responsibility in a professional association, receives assistance from family, receives assistance from friends and associates, assistance from religious association, receives assistance from solidarity association, having a savings account and being a shareholder contributed 13.13%, 10.84%, 10.46%, 9.47%, 8.74%, 8.22% and 6.50% respectively. The results reveal that most of the dimensions significantly contributed to the total inertia given their values are closely related. However, the indicator was predicted from the first dimension (mother received higher education) as it has the highest contribution to total inertia. This may be due to the incident that formal education commonly aims at providing learners with skills, abilities and knowledge that make individuals capable of participating in the market and society as a whole.

Summary Descriptive Statistics

The statistics Table 2 provides the average values of all the variables used in the analysis of the relationship between women empowerment and agricultural production as well as their deviation from the mean. The household consumption survey descriptive statistics reveal that the mean of the log of agricultural production (the value of crops exploited on agricultural land) is 5.85 with a standard deviation of 1.64 indicating a small deviation of the observations from the mean. The average agricultural production by women is 5.74 with a standard deviation of 1.58 while that of the men sub sample is 5.88 with standard deviation of 1.66. It is thus observed that women's production is just slightly lower than that of men .This goes a long way to endorse Food and Agricultural Organization's (FAO's) estimates which show that women represent a substantial share of the total agricultural labour force, as individual food producers or as agricultural workers.

With regards to the endogenous variable (women empowerment), the mean value of the indicator is 0.098 with a standard deviation of 0.97 demonstrating that only about 9% of the women included in the sample are empowered. This shows the level of disempowerment faced by women farmers in terms of education, absence of capital, information and access to markets which prevents them from producing enough to fulfil their basic necessities. The scarcity of knowledge related to women's rights also exposes them to land grabbing and the loss of their heritage with one of the hindrances being the tradition of passing farms from father to son, while daughters were denied farm ownership (Alston, 2003). Consequently, as the contribution of women in the agricultural sector is vital, there is a need to clarify which such forms of disempowerment which stand as obstacles to their efficiency.

Given healthy women are more able to actively participate in society, the endogenous instrument (cluster mean cost of medical consultation) which affects the woman's ability to demand and consume health services and thus her empowerment presents an average value of 6.72 with a deviation from the mean of 0.96. In regards to the instruments used to construct women empowerment, the descriptive statistics shows that on the average only 5% of women have received formal education as opposed to a mean of 7% for the males indicating an inequality in terms of education. Education is believed to stimulate human capital by increasing the stock of competencies, knowledge and personality attributes embodied in the ability to perform labour so as to produce economic value. Thus education not only stimulates output growth but empowers the woman in terms of her productive capabilities, and thus her wellbeing. In the same line, only 31% of the women in the sample have received professional training as opposed to an average of 50% for the men. Other than receiving assistance from friends, family, religious group, and solidarity organisations, the men sample present average values larger than that that of the women.

Considering some exogenous characteristics, the descriptive statistics shows that about 57% of the population involved in agricultural production are married, with an average of about 21% and 70% for the women and men sub sample respectively being married. Marital status has been used as an important factor that may influence women's participation in income generating activities to support their husbands.

Table 2 Summary Descriptive Statistics

Variables	Full Sample		Women Sub Sample		Men Sub Sample	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Outcome Variable						
Log of agricultural prod	5.849	1.640	5.744	1.576	5.880	1.657
Endogeneous variable						
Women empowerment	.098	.977	.426	.881	-.014	.984
Instrument for the endogeneous variable						
Cost of consultation_mpu	6.738	.945	6.772	.909	6.722	.961
Variables used to construct Women Empowerment Indicator						
Formal edu (1= yes)	.066	.249	.052	.223	.071	.258
Professional edu (1= yes)	.457	.498	.312	.463	.507	.499
Responsibility in association	.125	.332	.099	.298	.135	.342
Assistance from family	.826	.378	.876	.329	.809	.393
Assistance from friends	.777	.415	.782	.413	.776	.416
Religious asso (1= yes)	.282	.449	.335	.472111	.263	.441
Support from association	.375	.484	.418	.493	.361	.480
Saving (1 = yes)	.038	.192	.034	.183	.039	.195
Shareholder (1= yes)	.256	.436	1	0	0	0
Exogeneous Characteristics						
Access to financing	.064	.303	.053	.254	.068	.318
Married (1 =yes)	.577	.493	.211	.408	.703	.456
Access to credit	31.842	1027.30	8.131	129.82	40.011	1188.6
Non poor (1= yes)	.709	.454	.743	.436	.697	.459
Log of fertilizer used	8.349	.455	8.286	.420	8.371	.465
Modern equipment	.0766	.265	.076	.266	.076	.265
Agric primary activity	2.301	3.210	1.819	2.211	2.467	3.474
Log of cost of seeds	1.806	1.165	1.707	1.053	1.83	1.194
Log of farm size	9.682	.602	9.585	.624	9.71	.590
Cost of fertilizer	8.967	126.16	3.899	49.851	10.713	143.2
Agricultural training	201.45	100.466	213.9	103.8	197.161	98.92
Household size	4.393	3.025	3.5877	2.357	4.670	3.17
Age	42.01	15.43	45.67	16.466	40.74	14.85
Use specialized seeds	.043	.203	.034	.181	.046	.209
Urban residence	.370	.482	.366	.482	.371	.483
Control Variables (Predicted residuals and interaction terms)						
Predicted women empowerment residual	1.94e-10	.963	.318	.903	-.138	.956
Women empowerment* Predicted women empowerment residual	.926	1.441	.868	1.237	.952	1.522
Observation	11391	11391	3041	3041	8350	8350

Computed by author from ECAM4, using STATA 14.2

However due to their physical demands of child-bearing and child-rearing responsibilities limit their ability to obtain and pursue formal employment, hence women become confined to economic activities in which the uncertainty of being able to work is relatively unimportant such as agriculture. This explains why the greater percentage of women are involved in agriculture are married.

The descriptive statistics also show that only about 7% of women use modern agricultural equipment, with an average of 5% only for women who have access to agricultural financing thus inhibiting their ability to be more productive. This relates to the fact that most women farmers are expected to produce subsistence food crops, to weed all crops, to cook and rear children having less time to allocate for the learning and use of intensive methods. Added to this is the discrimination outside the household, which limits their access to resources, modern equipment and information some of which may be deeply embedded in social customs.

As concerns the socio economic status, about 74% of the women's sample is non-poor and only about 3% of these women use specialised seeds as opposed to an average of about 5% for men. Age represents a proxy variable for the farming experience of farm operators given farmers are highly dependent on their previous knowledge of farm practices in cultivating different crops (Slathia, 2014). As such, experienced farmers are expected to enhance the productivity of their holdings. However, it is not without limit as older farmers may lack the required physical strength on the farm and also lowers the probability of technology adoption. The average age of the women is 45 years which is higher than the average age of men of 40 years. Agricultural training which is the process of acquiring specific skills to perform a job better and helps people to become qualified and proficient in doing some jobs has an average value of 201.45, 213.9 and 197.16 for the full sample, women and men sample respectively. This shows that the training has mostly benefitted the men more than women which enhances the productive capability of farmers as well as eliminate the customs that are contrary to growth such as traditional word-of mouth communication methods (Abrha, 2015).

Fertilizer is known as an essential input for increasing crop production. The descriptive statistics show that an average of 8.29 and 8.37 of fertilizer is being used by both men and women respectively. There is thus a very little variation in the amounts of fertilizer used by men and women on the farm. The amount of fertilizer used could be affected by demand and supply factors (Nyako, 213). On the demand side, farm households may not accept the profitability of fertilizer use; alternatively, they may accept it as profitable but too risky in financial terms while on the supply side, the high costs at the source by local manufacturers may limit the access to fertilizer. In regards to the cost of fertilizers, it is seen that women spend just an average of 3.89 as opposed to a mean of 10.71 by the men. This may be due to the inability of female farmers to pay as well limited access to credit to finance fertilizer purchases, and may also mean that most women farmers depend on their husbands to acquire fertilizers for them thus limiting their ability to produce greater outputs.

Other variables present deviations that is far less than their average values. These variables are therefore not too far away from the center of their distributions and are thus normally distributed. Nonetheless, some of the variables present deviations that are just slightly greater than their average values.

Reduced Form Estimates of Women Empowerment in Cameroon

To achieve the objective of the determinants of women empowerment in Cameroon, the Ordinary Least Square regression was conducted to obtain the reduced form estimates of women empowerment as presented on Table 3. Going by the results, it can be said that the model specified is reliable. This is indicated by the Prob>chi2, which show that the explanatory variables are globally significant in determining women empowerment, significant at 1% level of significance. However, R^2 reveals that only 16.37% of variation in women empowerment is being explained by the independent variables specified in our model. Thus other important variables that affect women empowerment were omitted though captured in the error term.

Based on the above results, we observe that the cost of medical consultation has an inverse relationship with women empowerment. A percentage increase in the cost of medical consultation will lead to a 6.95 decrease in women empowerment. This is statistically significant at 10% level of significance. Women empowerment entails the expansion of capabilities which enables them to perform labour so as to produce economic value. Inability to access health services such as maternal and reproductive health services due to high consultation cost may thereby inhibits women's well-being and as such better social outcomes for women. This is in line with many studies such as Agarwal (1997) that have associated higher levels of empowerment with positive reproductive health outcomes. This is also in conformity with Sen (1988) which indicate that women's well-being has been accepted as a necessary pathway to women's overall development.

Looking at marital status, it is observed that marriage has a negative influence on women empowerment. Being married will reduce women empowerment by 27% as opposed to a single woman. This is statistically significant at 1% level of significance. This finding may be attributed to the fact that most married women become ensnared with their triple role (reproductive, productive and community roles) aggravating the problem they face in terms of access to the basic factors of production. The finding corroborates with Agarwal (1997) who revealed that being married significantly influences empowerment of rural women negatively at 1%. This result is however dissimilar to Bahiigwa, (1999) who in the analysis of women empowerment in rural Nigeria showed that, most of married women are empowered as they involve themselves in business activities so as to provide for needs to their families.

Table 3. Reduced Form Estimates of Women Empowerment in Cameroon

Variables	Coefficient	Standard. Error	P-value
	Women Empowerment		
Cost of consultation_mpu	-.0690708*	.0387713	0.075
Access to agricultural financing	-.1149736	.100877	0.255
Marital status (1 = married)	-.2744878***	.0715876	0.000
Access to credit	1.14e-07	.0000138	0.993
Socio-economic status (1 = non poor)	-.2835463***	.0826475	0.001
Log of fertilizer used	.4798709***	.0875117	0.000
Use of modern agricultural equipment	.0806937	.0973491	0.407
Agricultural primary activity	-.0292124***	.0110895	0.009
Log of cost of seeds	-.105636***	.0300784	0.000
Log of farm size	-.1091168	.0695524	0.117
Cost of fertilizer	.0001522	.0003116	0.625
Formal Agricultural training	-.0010288***	.0003791	0.007
Household size	-.0317858**	.0129371	0.014
Age	.0011606	.0021097	0.582
Use specialized seeds (1= yes)	-.060088	.1037274	0.563
Place of residence (1= Urban)	-.3187917***	.0862248	0.000
Cons	-1.43611*	.8453429	0.090
R-squared = 0.1637 Chi^2= 11.44 (16, 935; 0.0000) Observation = 952			

Computed by author from ECAM4, using STATA 14.2

Note: Values in parentheses represent robust t-statistics while ***, **, * indicate 1%, 5% and 10% level of significance respectively.

With regards to socio economic status, women who are non-poor have a decreasing effect on empowerment with the results being statistically significant at 1% level of significance. This is contrary to expectations as women with better socioeconomic status have better access to resources that expands their capabilities, thus their empowerment. It disagrees with Bahiigwa (1999) who showed that household wealth is a positive and significant determinant of women empowerment However, this effect may be complex and ambiguous because of the work-leisure trade-offs. Furthermore, the results reveal that women whose primary activity is agriculture tend to disempowered as indicated by a decrease in women empowerment by 2%, significant at 1% level of significance. This may be because most of the women involved in agriculture depend solely on it for survival but use crude traditional methods and lack the necessary training and finance needed to boost the output as well as their wellbeing. Secondly, the reason may be because most women involved in agriculture tend to be associated with low levels of education which is also a limitation to women empowerment.

In regards to household size, the findings reveal that an increase in the household size by one person decreases women empowerment by 3%, statistically significant at 5% level of significance. This is in line with Budlender (2010) have found a negative relationship between family size and women empowerment. The bigger the family size, the more resources are needed to carter for the members. It may be the case because, a larger household size pose a restrain on the available recourses as well as time appropriated for profitable labour leading to women's disempowerment. However, Novarty (2005) differs in that larger households demands women, most especially the married to involve themselves in business activities so as to provide for needs to their families. Similarly, the findings show that a woman living in the urban area tends to decrease women empowerment by 31%, and is statistically significant at 1% level of significance. This may be attributed to the overcrowding of the unemployed in the labour markets of urban areas in Cameroon and the associated difficulty of getting a job in the face of such competition. The results are nonetheless in conformity with many studies such as Abrha, (2015) which reveal that women access to economic resources and control of products of their labor has been worsened by the trends of globalizing economy, where by competing high, requiring quality and large scale productivity is expected.

Considering agricultural inputs such as fertilizers and the use specialized seeds, the results demonstrate that a unit increase in the cost of seeds will lead to a 10% decrease in women empowerment while the a unit increase of fertilizer used leads to an increase in women's empowerment by 47%. Both findings are statistically significant at 1% level of significance. These findings are in conformity with Bahiigwa (1999) who showed that use of fertilizers not only increases productivity but also indicates an aspect of empowerment in terms of output management skills. The negative effect of the cost of seeds on the other hand may be because Women have a low priority in crop improvement research and little access to the benefits of research and innovation, especially in the domain of new high yielding seeds. As such as the cost increases their ability to purchase such seeds reduces which further leads to lower crop yields.
Conversely, formal agricultural training will rather lead to a decrease in women empowerment, statistically significant at 1% level of significance. Agricultural training which maybe in the form of internship, on the field training or through organizations is expected to bring about increase in cognitive ability, capacity building for women and thus their empowerment. The finding is different from Agarwal (1997) who revealed that education and training is a positive and significant determinant of women empowerment.

The results are but contrary and reason may be because most women in Cameroon are engaged in agriculture and allied activities and therefore do not fully take advantage of the training. This conforms to the study Agarwal (1997) who revealed that women who are engaged in agriculture and other activities as well, significantly reduces the probability of these women being empowered.

Furthermore, the findings disclose that women's access to credit will increase their empowerment while access to agricultural financing rather leads to a decrease in women empowerment by 11%. However both findings are statistically insignificant. Nonetheless, its insignificance could be attributed to the fact that very few women belong to formal credit associations through which access to formal financing is possible. As such, most women still depend on the long tradition of mutual aid among themselves and the emergence of informal financing credit arrangements such as rotating savings association. The above findings reveal that cluster mean cost of consultation, being married, non-poor, involved in agriculture as primary activity, the cost of seeds, receiving formal agricultural training, larger household and being resident in the urban region negatively and significantly affect women empowerment in Cameroon while use of fertilizer has a positive and significant effect on women empowerment in Cameroon. On the other hand, access to credit, use of modern agricultural equipment, and age or experience in main activity has a positive but statistically insignificant effect on women empowerment in Cameroon. The possible economic justification for the insignificance of the above is that studies focusing on women's empowerment itself as the outcome of interest are more likely to rely on primary data sources as opposed to those where empowerment is an intermediary factor in affecting other outcomes.

Estimate of Women Empowerment and Agricultural Production

Table 4 presents the results of OLS estimates, 2SLS estimates and the Control Function estimates without interaction (CFa) and with interaction (CFb). Columns 1 reveals OLS estimates of agricultural production with endogenous inputs which result in biased estimates, hence, the OLS result is not appropriate for inference. The 2SLS therefore solves the problem of endogeneity and presents consistent IV estimates of agricultural production. Columns 3 (A and B), presents the Control Function estimates, which solves the problem of endogeneity bias, simultaneity bias and heterogeneity bias congruently. The control function estimates seek to exogenize women empowerment by introducing residuals and interaction of residual with the endogenous regressor.

Table 4: The Effect of Women Empowerment on Agricultural Production

Variables	OLS	2SLS	Control Function	
			CFa	CFb
	Agricultural Production			
Women empowerment indicator	-.162*** (4.75)	1.668* (1.77)	2.496** (2.56)	1.153** (2.06)
Access to agricultural financing	-.142 (1.52)	.447 (1.73)	.452* (1.84)	-.253* (-1.84)
Marital status	-.046 (0.60)	-.735* (1.82)	-.802*** (2.71)	-.084*** (2.70)
Access to credit	.000*** (3.24)	.000 (1.16)	000 (1.34)	.000 (1.34)
Socio-economic status	.396*** (5.51)	-.332 (0.92)	-.564* (1.74)	-.165* (1.74)
Log of fertilizer used	.032 (0.52)	.777* (1.75)	1.292*** (2.61)	1.293*** (1.74)
Use of modern agricultural equipment	-.068 (0.68)	.079 (3.32)	.083 (2.45)	.283 (0.46)
Agricultural primary activity	.008 (0.85)	-.043 (-1.09)	.063* (1.92)	-.003* (1.91)
Log of cost of seeds	.302*** (10.30)	.230* (1.87)	.111 (0.90)	.311 (0.89)
Log of farm size	-.603*** (-7.11)	.432** (1.97)	.849*** (4.86)	-.449*** (4.86)
Cost of fertilizer	-.000 (-0.11)	.001 (0.71)	.001 (1.22)	.001 (1.21)
Formal Agricultural training	.001 (1.27)	.002* (1.81)	.003*** (2.87)	-.003*** (2.87)
Household size	.063*** (5.49)	-.012 (-0.29)	-.044 (-1.16)	-.044 (1.16)
Age	.012*** (5.44)	.016*** (2.58)	.016*** (4.31)	.016*** (4.30)
Use specialized seeds	.182* (1.78)	.002 (2.01)	.067 (2.37)	-.067 (-0.37)
Place of residence	.442*** (4.16)	-.010 (-0.03)	-.330 (-0.89)	-.332 (-0.89)
Predicted WE residual	n/a	n/a	2.387** (2.44)	2.391** (2.44)
WE* Predicted WE residual	n/a	n/a	n/a	-.004 (-0.08)
Constant	9.472645*** (11.04)	3.887025 (1.04)	4.482588* (1.93)	4.484* (1.93)
R-squared	0.2435	0.8935	0.1863	0.1848
F test of excluded instruments/Joint F/ χ^2	40.38[16, 1941; 0.0000]	4.06[16, 570; 0.0000]	8.89[17, 569; 0.0000]	8.38[18, 568; 0.0000]
Sanderson-Windmeijer F-test	n/a	4.72[1,570; 0.0302]	n/a	n/a
Cragg-Donald F-Stat	n/a	4.723[16.38]	n/a	n/a
Sargan statistic	n/a	0.0000	n/a	n/a
Durbin-Wu-Hausman χ^2 test	n/a	6.085[0.0136]	n/a	n/a
Observation	1958	587	587	587

Computed by using author, using STATA 14.2 Note: Values in parentheses represent robust t-statistics while ***, **, * indicate 1%, 5% and 10% level of significance respectively.

Source: Author

The R^2 of the OLS is 0.2435 which implies that the regression explains about 24% of the variation in agricultural production. The coefficient on women empowerment in the OLS estimation is smaller than that of the 2SLS and statistically significant but is likely to be biased and inappropriate for inference as the model violates the first OLS assumption. This explains why women empowerment is negatively significant in the OLS model, as such we limit our discussions to the 2SLS and Control function estimates. We assume unobservable variables are uncorrelated with excluded instruments or that the correlation in linear and the estimation sample is randomly selected from the given population of interest. In order to proceed with the 2SLS estimation technique, we test for instrument strength and validity. The Durbin-Wu-Hausman χ^2 test of endogeneity of women empowerment, tests the null hypothesis that the regressor is exogenous. As expected rejection of the null hypothesis (p-value=0.0136) indicates that women empowerment is endogenous, and therefore use of IV 2SLS is appropriate.

The F-test that the coefficients on the control variables are zero is supported and this appears consistent with the fact that the disturbances are homoskedastic. The instrument is thus valid, signifying instrument validity as it satisfies the conditions of instrument relevance and exogeneity.

The implication is that we can rely on both the IV 2SLS and the control function approach estimates. Other test such as the Sargan statistic (over identification test of all instruments) was conducted which was statistically significant at 1% level of significance. As such, we reject the null hypothesis of over identification and accept the alternative of exactly identified model. This also conforms to the rule of thumb of the model being exactly identified when the number of instruments equals the number of endogenous regressors. However, the Cragg-Donald Wald F-statistic (14.723) indicates weak identification since it less than 16.38 Stock-Yogo values. Thus the instrument is valid but weak. The 2SLS coefficient for the effect of women empowerment on agricultural production is 1.67 which is far higher than the OLS but less than the control function estimates. The coefficient is however positive in both the 2SLS and Control Functions models indicating that an increase in women empowerment leads to positive and significant increases in agricultural production. Given the effect and magnitude of women empowerment effect is greatest in CFa (control function without interaction), discussions will be based on the control function without interaction since the coefficients of the women empowerment is strongly and positively correlated with agricultural production at 5% level of significance.

This implies women play a critical role in agricultural production in Cameroon. This is consistent with the findings of Tambi et al (2017) who revealed that rural households headed by women with physical capital and farm financial management skills empowerment were more likely to be more productive and food secure. This is also in line with the Nyako (2013) who revealed that the gains against hunger in developing countries within 1970–1995 years were due to the improvement of women's situation within the society during that period. Sharaunga et al (2016) also ascertains that, to achieve agricultural development, empowerment which enhances human capital should be added to the investment in production techniques and technology because information and knowledge are prerequisites for farmers to adopt technology, access input, change ways of doing things and market their produce. The effect of agricultural financing which is positive and insignificant in the 2SLS, has a positive and significant effect on agricultural production at 10% level of significance in the control function model. A unit increase in agricultural financing will lead to a 45% increase in crop yield. This finding corroborates with Agnes et al (1995). This is also in line with expectation as agricultural finance from the both governmental and nongovernmental organisations is expected to boost the resources required as inputs to improve on crop yield and also reduce the working capital constraints to adopting new inputs for the farm.

In the relation to socioeconomic status, it is observed that households that are non-poor have a negative effect on agricultural production. This is insignificant with the 2SLS and significant at 10% with the control function model which demonstrates that non poor households will decrease agricultural production by 56%. The finding is similar to Budlender (2010). This also confirms with a priori expectations since the socio economic status shows the relative standards of living of various household and as such reveal that the poor who have less access to basic necessities will be mostly involved in agriculture rather than the wealthy with better living standards and access to the basic necessities of life. In relation to formal agricultural training, the results of both models reveal that training which may be agricultural workshops; on the field training; and training by agricultural organisations, have a significant and positive effect on agricultural production in Cameroon. This is in line with a priori expectations as this training includes skills to improve productivity, increase adaptability to deal with change and crisis, and facilitate the diversification of livelihoods to manage risks. The training in new sets of skills which can be applied to farming is therefore an important source of support to agricultural development.

Further, marital status has a negative relationship with agricultural production. Those married tend to decrease agricultural production by 30%, statistically significant at 1% level. This finding is different from Novarty (2005) and Wouterse (2016) who showed that agricultural productivity increase with respect to female and male controlled farms as opposed to males only and females only. The negative relationship can be attributed to the male dominance is households in Cameroon, most especially in the rural areas which may discourage wives from fully participating in the farming process as their husbands will siphon all profits. Moreover, Bahiigwa (1999) reveal that this negative relation is as a result of interpersonal gender dynamics within the household, emanating from marriage systems, which are responsible for much of women's social exclusion.

With regards to age, the findings reveal that a one year increase in the age will increase agricultural production by about 1.5% for both models and both statistically significant at 1% level of significance. Since age reflects the experience accumulated in both farming and non-farming, it may, therefore, be associated with better income opportunities leading to increase in skills and knowledge and thus better crop yield. Moreover, the positive relationship between age and crop yield may be because such households tend to have adult children who become part of the labour force in agricultural production. Furthermore, the ability of a woman to employ crude implements in farming is highly determined by age. The younger women are more likely to be physically fit enough to utilize these crude tools. Consequently if the number of women farmers who are old is higher than those who are young, then a potential decline in farming is imminent and this will culminate in low food production. This justifies the increase in agricultural production as the mean age of the population is middle aged.

In terms of agricultural inputs, the findings reveal that at 10% level of significance, a unit increase in the use of fertilizer will lead to a 77% increase in crop yield for the 2SLS model and a greater positive impact in the control function, significant at 1% level of significance. In addition, ICRW research has also found that fertilizer helps women increase their productivity. Those kinds of outcome empower women to become stronger and to more effectively contribute financially to their families, communities and countries. The findings also reveal that a unit increase in the size of the farm will lead to 43% and 85% increases in agricultural output, significant at 5% and 1% given the 2SLS and control function model respectively. The higher value and significant level of the control function estimate emphasizes the positive impact of farm size on agricultural production. Land is the most fundamental asset in agricultural production and stands in line with Wouterse (2016) who conceptualized that households that have larger land area, a number of sources of non-farm income, are likely to be more productive than their counterparts who either do not have the factors or have poor amounts and qualities of them.

With regards to agricultural training, the finding reveals that an increase in agricultural training will increase agricultural yield by 0.3%, statistically significant at 1% level of significance. There is general agreement that training increases productivity, and a number of literature exist documenting the positive effects of the training on human capital development. This therefore explains the positive effect of training. Furthermore, the results show that households who primary activity is agriculture leads to an increase in crop yield by 6%, statistically significant at 10% level of significance. The results may therefore mean farmers with agriculture as primary activity tend to devote their resources to ensure maximum productivity as it is their main source of livelihood.

Furthermore, the results show that a unit increase in the use of modern agricultural equipment will increase agricultural production by 7% and 8% in the 2SLS and control function models respectively. However, the results are statistically insignificant. The place of residence, access to credit, use of modern agricultural equipment, cost of fertilizers, use of specialised seeds and household size also presents statistically insignificant results. The control function without interaction R^2 reveals that only 19% of variation in agricultural production is being explained by the independent variables specified in our model. This may be due to the absence of data on some observable characteristics of agricultural production that have not been controlled for in the regression due to unavailability of data, other unobservable characteristics unknown to the researcher that influence agricultural production such as soil quality as well as measurement errors both random and systematic.

Women Empowerment Effect on Agricultural Production by Marital Status

Agriculture is one of the most stable jobs one may have though time consuming and stressful job in Cameroon, hence those involved may always want to marry as their spouse act as a complement in executing their duties.

Table 5 Parameter Estimates of Agricultural Production by Marital Status

Variables	**Married**	**Single**
	Agricultural Production	
Women empowerment indicator	3.154655*** (2.74)	-.9296176 (-0.50)
Access to agricultural financing	-.6349956** (-2.20)	.0096868 (0.02)
Access to credit	.0004289** (-2.20)	-.0000978 (-0.30)
Socio-economic status	-.8513269** (-2.24)	.3696589 (0.56)
Log of fertilizer used	1.682935*** (2.88)	.5842975 (0.62)
Use of modern agricultural equipment	-.0010663 (-0.01)	.5750325 (1.40)
Agricultural primary activity	-.0926833** (-2.34)	-.006068 (-0.10)
Log of cost of seeds	.118958 (0.81)	.0538587 (0.23)
Log of farm size	-1.077332*** (-4.86)	-.4320971 (-1.49)
Cost of fertilizer	.000611 (1.21)	-.0027883 (-0.49)
Formal Agricultural training	-.0047743*** (-3.12)	-.0007309 (-0.35)
Household size	-.0498231 (-1.12)	-.0030258 (-0.04)
Age	.0184325*** (4.05)	.0125009 (1.59)
Use specialized seeds	-.0469867 (-0.22)	.0506734 (0.14)
Place of residence	-.7467064* (-1.69)	.5186846 (0.75)
Predicted women empowerment residual	2.980143** (2.58)	1.022517 (0.55)
Constant	3.136583 (1.06)	4.536254 (1.01)
Adjusted R-squared	0.2473	0.0874
Wald chi2(df): Prob>chi2	9.34[16, 390; 0.0000]	2.07[16, 163; 0.0118]
Observation	407	180

Computed by author, using STATA 14.2. Note: Values in parentheses represent robust t-statistics while ***, **, * indicate 1%, 5% and 10% level of significance respectively.

From table 4.5, it is observed that, a unit increase in the empowerment of single women will lead to a 93% decrease on agricultural production, even though statistically insignificant. Moreover, the results reveal that only 8% of variation in agricultural production is cause by the variables of single women. Furthermore all the other variables are statistically insignificant and cannot be used for inference. On the other hand, the empowerment of married women will bring about a positive increase in agricultural production, statistically significant at 1% level of significance. The results have therefore shown that agriculture is a critical source of livelihoods for married women in Cameroon and a key pathway out of poverty especially in the rural area. This is seen the empowerment of women in the urban area rather brings about a 74% decrease in agricultural production, significant at 10% level of significance. It also portrays that women in rural areas who are especially constrained by a lack of access to inputs, productive resources, and services will be more productive if they are empowered to gain such access.

The findings tie with Malhotra et al (2002) who revealed that married women may face more socio-cultural inhibitions even to participate well in agriculture due to interpersonal gender dynamics within the household, emanating from marriage systems, which responsible for much of women's social exclusion. Hence, the empowerment of such women uplifts them from cultural norms and consequently makes them more productive especially if they draw on support from husbands. Also, following Novarty (2005) it is observed that, married couples are likely to be more engaged in income generating activities than single women due to labor reinforcement in accomplishing farm and non- farm activities hence the married women are likely to be in a more agriculturally productive situation. This finding is however dissimilar to Grantham (2012) who revealed that marriage strongly negatively affects women's labour force participation and productivity. This may be due to the fact that the women were not empowered as in the case of our findings. As such, most all of them had limited access to land, finance and farm inputs as they depend upon their husband's land.

Going by the results presented in table 4.5 above, it can be said that the model specified for married women is reliable, indicated by the Wald chi2 (df): Prob>chi2, which show that the explanatory variables are globally significant in determining agricultural production. Thus, together all the regressors have a significant effect on agricultural production, as the Wald statistic is significant at 1%. The R^2 also reveals that about 25% of variation in agricultural production is been explained by the independent variables specified in our model, while other variables are captured in the error term.

CONCLUSION

The study had as main objective to measure the contribution of women empowerment on agricultural production in Cameroon, with specific objectives; to discuss the determinants of women empowerment in Cameroon; investigate the actual effects of women empowerment on agricultural production; and to verify the heterogeneity effect of women empowerment on agricultural production by family status. To achieve these objectives, secondary data related to the variables under study were extracted from the 2014 Household Consumption Survey data set produced by the National Institute of Statistics. The data were analysed using both descriptive and inferential statistical tools. The descriptive tool used summary descriptive statistics while the inferential statistic tool involved the OLS estimation, the 2SLS estimation and the Maximum Likelihood Control function estimation technique.

To create the women empowerment indicator, a multiple correspondence analysis was conducted. The results reveal that woman has higher education, has a post of responsibility in a professional association, receives assistance from family, receives assistance from friends and associates, assistance from religious association, receives assistance from solidarity association, having a savings account and being a shareholder contributed significantly contributed to the total inertia. The indicator was predicted from the first dimension (mother received higher education) as it has the highest contribution (about 18%) to total inertia. To attain the objective of the determinants of women empowerment in Cameroon, the reduced form model of women empowerment was estimated and the results revealed that the cost of medical consultation, marital status, socioeconomic status, fertilizer used, agricultural primary activity, cost of seeds, farm size, formal agricultural training, household size and place of residence significantly affect women empowerment in Cameroon. The model specified was reliable, indicated by the Prob>chi2, which show that the explanatory variables are globally significant in determining women empowerment, significant at 1% level of significance. Nonetheless, the R^2 revealed that only 16.37% of variation in women empowerment is being explained by the independent variables specified in our model. Thus other important variables that affect women empowerment were omitted though captured in the error term.

The OLS, 2SLS and Control Function regression was also estimated to address the objective of investigating the actual effects of women empowerment on agricultural production in Cameroon. The 2SLS estimation reveals that 89% of variation in agricultural production is caused by the variables specified in the model. However, both models are globally significant at 1% level of significance.

The low R^2 with the control function model may be due to the absence of data on some observable characteristics of agricultural production that have not been controlled for in the regression due to unavailability of data, other unobservable characteristics unknown to the researcher that influence agricultural. The control function model without interaction showed that women empowerment, access to agricultural financing, access to credit, use of fertilizer, agricultural primary activity, farm size, agricultural training and age have positive and significant effect on agricultural production in Cameroon while marital status (being married) and socio-economic status (non-poor) has a negative and significant effect. And lastly to verify the heterogeneity effect of women empowerment on agricultural production by marital status, the findings revealed that a married who is empowered will leads to a large positive and significant effect on agricultural production as opposed to empowering a single which has a negative and insignificant effect of agricultural production in Cameroon.

On the bases of the above findings the following general conclusions can be made: (1) empowering women by improving the sense of agency especially through education and strengthening their access and control over resources and farm inputs is critical for improving agricultural production and the food security status of their household. (2) Women make up large per cent of economically active population in agriculture. As such, the productivity and empowerment of women is a logical priority of agriculture programs and policies that seek to promote agricultural development. (3) Important agricultural productivity gains and massive increases in agricultural production could be made by increasing farmers access agricultural financing, formal agricultural training, use of fertilizers. This applies most to the poor as well as those whose primary activity is agriculture and (4) empowering married women will bring about significant increases in agricultural production.

The study recommends that when empowering women, most especially women farmers for food production, every aspect of food production must be considered and proper resources allocated to each such as land availability, access to credit and agricultural financing, fertilizers etc. Comprehensive and intensive agricultural trainings should be organized for women farmers. This step is vital because no matter the sophistication of farming transformation programmes instituted by the government or any multilateral agency, if the farmers are not aware or enlightened on those provisions, they cannot benefit from them. As such the expected positive impact of those programmes on food production cannot be achieved.

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Categories	mass	Quality	Scores		correlations		Contributions		% Total inertia
			First axis	Second axis	First axis	Second axis	First axis	Second axis	
Received formal education							0.035		17.83
Yes	0.009	0.131	-2.917	-0.034	0.131	0.000	0.032	0.000	
No	0.102	0.131	0.252	0.003	0.131	0.000	0.003	0.000	
Received professional/technical education							0.060		14.82
Yes	0.057	0.247	-1.098	0.329	0.230	0.017	0.029	0.002	
No	0.054	0.247	1.175	-0.353	0.230	0.017	0.031	0.003	
Has a post of responsibility in a professional association							0.163		13.3
Yes	0.015	0.522	-4.239	-0.542	0.515	0.007	0.117	0.002	
No	0.096	0.522	0.681	0.087	0.515	0.007	0.019	0.000	
Receives assistance from family							0.007		10.84
Yes	0.091	0.412	0.180	-0.756	0.026	0.385	0.001	0.020	
No	0.412	0.091	-0.817	3.439	0.026	0.385	0.006	0.091	
Receives assistance from friends and associates							0.000		10.46
Yes	0.086	0.462	0.053	-0.953	0.002	0.460	0.000	0.030	
No	0.025	0.462	-0.182	3.258	0.002	0.460	0.000	0.103	
Receives assistance from religious association							0.001		9.47
Yes	0.031	0.333	-0.279	-2.383	0.005	0.328	0.001	0.068	
No	0.333	0.031	0.109	0.928	0.005	0.328	0.000	0.027	
Receives assistance from solidarity association							0.133		8.74
Yes	0.046	0.535	-2.014	-0.510	0.508	0.027	0.078	0.005	
No	0.065	0.535	1.414	0.358	0.508	0.027	0.055	0.003	
Has a savings account							0.038		8.22
Yes	0.005	0.153	-4.280	-1.216	0.143	0.010	0.036	0.003	
No	0.106	0.153	0.188	0.053	0.143	0.010	0.002	0.000	
Shareholder							0.012		6.50
Yes	0.030	0.144	0.825	-1.357	0.044	0.099	0.009	0.021	
No	0.081	0.144	-0.300	0.494	0.044	0.099	0.003	0.008	

Appendix 1: Synopsis of Computed Synthetic Variable for Women Empowerment
Computed by author from ECAM4, using STATA 14.2