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Interventions and Women Agricultural Productivity in Benue State, Nigeria

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Abstract: This study investigates the effect of interventions on women agricultural productivity in Benue State, Nigeria. The study employs a robust ordinary least square (OLS) regression model to analyse this relationship using a cross-sectional data obtained from a sample of 421 women participating in agriculture drawn from eight local government areas in Benue State. The result of the analysis revealed that interventions such as training, credit, seedlings, pesticides, tools and machineries had no significant effect on women agricultural productivity in Benue State. Similarly the result showed that, the percentage share of female labour in agricultural activities had no effect on women's agricultural productivity. However, years of education, farm size and age of the respondents were found to have a significant effect on women agricultural productivity in the study area. The findings of this study reveal that, present intervention approach does not impact women agricultural productivity in any form in Benue State. Hence, a better intervention approach that enables women to have access to more farm lands and other productive resources should be incorporated. Furthermore, interventions strategies that will encourage girl child education and adult education for women mostly in the rural areas should be prioritized by government and non-government agencies. The findings of this study are relevant in understanding the effect of interventions and the type of interventions that should be delivered.

Keywords: Women, Intervention, Agricultural Productivity, Benue State

1. Introduction

Agriculture has been identified as a major source of employment, empowerment, food security, and economic development in Nigeria [1, 3, 4, 18]. The Food and Agricultural Organization of the United Nation [13] noted that agriculture contributes immensely towards a sustainable societal development, because it ensures the continuous production of food and provision of raw materials required for meeting the needs of rapid expanding industries. Globally, women are identified as key players in agricultural production. The activities of women in agriculture cannot be over-emphasized. The International Labour Organization [17] estimated that 78% of women in Africa including Nigeria are active in agriculture compared with only 64% of the men. Women's participation in agriculture gives women the enabling ability to claim resources, exercise their rights and voice, and make quality decisions on food production capable of enhancing agricultural productivity [8, 19, 20, 27, 37, 38]. Women in Nigeria account for 75 percent of the farming population in Nigeria, working as small farm holders, farm managers and suppliers of labour to enhance food security [24].

Benue State, one of the 36 states in Nigeria, located in the North-central region of Nigeria and the study area for this research, has exceptionally high account of agricultural activities ranging from Crop farming, fish farming and animal husbandry [39]. Benue State is essentially one of the major food hubs of Nigeria, agriculture forms the backbone of Benue State economy, engaging more than 70 percent of the working population with women in the forefront of agricultural production [24, 30]. Despite the increase in agricultural activities, Benue State has been classified among other Northern States in Nigeria faced with increased cases of low agricultural productivity; most commonly among rural farmers [30], which has become an alarming threat to national food security and woman productivity.

The major causes of the low agricultural productivity in the

North central region of Nigeria including Benue State has been attributed to increase in poverty, illiteracy, use of crude methods of farming, absence of adequate financial resource, flood, and most notably the farmers- herders men crisis that has left a lot of farmers in the region internally displaced [12, 39]. This implies that poor agricultural productivity in Benue State is still a major problem capable of hindering the achievement of Sustainable Development Goals in Nigeria. Although the government of Nigeria has identified the implication of low agricultural productivity on the economy [38] some intervention measures have been set up by the government and non-government agencies in Nigeria towards reducing food insecurity mainly caused by the low agricultural productivity of farmers.

One of the interventions scheme identified to improve women agricultural productivity and boost the Nigerian economy includes the Nigeria Strategy Support Programme (NSSP) developed by the Nigerian government to reduce the incidence of food insecurity. This policy was a major landmarks in government effort to deal with the scourge of poverty and food insecurity [25]. The policy identified improvement in food security at both the household and aggregate levels as the major pathway to improving human nutrition; which can be achieved through increased agricultural productivity. This is because agriculture is critical and necessary for food security, food supply, and the development of human productivity [23]. The overall objective of the NSSP program has been to conduct research and advice on strategic policy options needed to support agricultural growth, rural development, and economic transformation in Nigeria.

One notable intervention program in Benue State is the Global Food Security Strategy [GFSS] developed in 2016 by the United State Agency for International Development [USAID] in collaboration with the Benue State government. The GFSS program was launched in Benue State among some States in the country to identify the primary drivers of food security and agricultural productivity and explore the potential strategies for strengthening food security in Benue State. These strategies addressed the case of food security through increased agricultural production; which has the potential of generating opportunities for income growth among the poor, improving education, employment, and empower girls and women in the State through enhancing their participation in agriculture [24, 39, 33].

Despite these steps taken, there has not been much significant improvement in women agricultural productivity in Benue State. The high rate of poverty, and unemployment in the state shows that there is a missing link in the intervention effort by government and international organisations and the agricultural productivity of female farmers in Benue State. It is therefore imperative to evaluate intervention schemes in relation to women agricultural productivity in Benue State. Hence, this study solicits primary data from household women participating in agriculture in selected communities in Benue State to examine the effect of intervention on women's agricultural productivity in Benue State, Nigeria.

The data used in this study were solicited from 421 farm households across some selected local government areas in Benue State. The data were analysed and corrected for outliers that may affect the outcome of the study. To control for heteroskedasticity, the study employs Ordinary Least Square (OLS) robust regression and carried out a number of robustness checks to encapsulate the effect of interventions on women's agricultural productivity in Benue State. The rest of this paper is organised as follows: the theoretical framework and relevant literature as discussed in section 2. The choice of model evaluation and choice of sampling design are discussed in section 3. The discussion of main findings and the conclusion drawn as presented in section 4 and 5 respectively.

2. Literature Review and Theoretical Framework

2.1. Conceptual Clarification

2.1.1. Concept of Intervention

Two concepts are worthy of clarification in this study: intervention and agricultural productivity.

Intervention as defined by Oladejo et al. [28] is a proactive step taken to assuage the effect of a difficult situation such as challenges limiting increased agricultural productivity among farmers. Similarly, Olowa, O. W. *et al.* [32] defined intervention in agriculture as actions put in place by the government or Non-government organizations (NGOs) which could be in form of policies and programs structured to assist farmers increase their agricultural productivity. This intervention could be in form of loans, credit, seedlings, fertilizers, insecticides, modern machinery, and equipment as well as training of farmers by agricultural extension workers. Interventions, as used in this study, involve both short and long-term interventions by the government and NGOs on female farmers' agricultural productivity. However, in examining the effect of interventions on the agricultural productivity of female farmers, the study groups interventions received by respondents into inputs and skills acquired. Interventions received in form of cash/ credit, seedlings, herbicides and pesticides, machinery and equipment are grouped as input, while all training by agricultural extension workers is grouped under skills/training received.

2.1.2. Concept of Productivity

Productivity is defined as the effectiveness with which factors of production are converted into output per time [15]. Productivity is the ratio of the volume of output to the input employed in a production process [3]. In agriculture labour is an input into the production process, hence, labour productivity serves as an economic indicator used to measure the level of agricultural productivity in a country [38].

Labour productivity in agriculture as defined by Djoumessi [11] is the total agricultural output divided by labour hours. Because labour hour varies with seasonal farm activities, this makes it difficult to measure output per hour in agricultural production [15]. Dharmasiri [10] recommended the use of man-day (instead of man-hour) in measuring agricultural labour productivity. This study considered output

per day in the calculation of productivity. Given that productivity is the total output divided by the total labour hour employed in the production process [10]. Productivity in this study is the total agricultural output per year divided by the average number of days (in a year) employed in the production process or farm activities.

2.2. Review of Literature

Several studies have discussed intervention and women agricultural productivity from various perspectives.

For instance, [6] studied the effect of agroforestry intervention on agricultural productivity, ecosystem services, and human well-being in low and middle income countries. Employing a Meta-analysis techniques to synthesize the effect of response from donors, governments, and nongovernmental organizations on agroforestry in low and middle-income countries. The findings from the result showed that intervention overall had a large, positive impact on yield. But there was no significant impact of agroforestry intervention on environmental outcomes, and there were no consistency with the environmental indicator variables According to the study, the responses of the government and non-government agencies towards the agroforestry were geared towards soil fertility replenishment practices, including incorporating trees in agricultural fields and improved fallow practices on fields where there were severe soil fertility issues; this accounted for the positive effect of the intervention on yield outcome. The finding of [6] is common among developing countries. Most of the government and non-government interventions geared towards improving the agricultural sector are mainly in form fertilizers, improved seedlings and insecticides needed to improve the soil quality and yield. Those offering this interventions seem to neglect the other aspects of the agricultural chain such as food processing, marketing, storage and distribution.

Quisumbing and Pandolfelli [34] examined some agricultural intervention policies between the year 1998 and 2008 develop to increase poor female farmer's access and control over productive resources in Sub-Saharan Africa and Southern Asia. The study examined intervention or policy changes in the areas of water, land, and soil fertility, new varieties of seedlings, extension, human capital and technologies to enhance labour productivity, access to markets, credit and financial services, and social capital and infrastructure support services in Sub-Sahara Africa. From the findings of the study, the study concluded that only few intervention policies were geared towards increasing female farmer's access to productive resources. The study observed, however, that the interventions were designed in ways that did not pay attention to the alternative delivery mechanisms trade-off between practical and strategic gender needs, and to culture and context specificity of gender roles. The study reiterated the need for interventions to be designed in a flexible manner that could capture strategic gender need and cultural norms of the female farmers in sub-Saharan Africa Countries.

Olowa and Olowa [32] analyzed the effect of agricultural reform program on national agricultural productivity using descriptive statistics such as mean, variance, and percentages. The result from the findings revealed that a negative relationship exist between this intervention programs and agricultural productivity. The study further revealed that within the period of this intervention programs or projects, agricultural food supply short fall increased drastically and retail food prices increased. Olowa and Olowa [32] argued that there also existed a negative environmental effect of these policy reforms during these periods, which includes increased deforestation of the rain forest reducing cash crop production as well as the loss of biodiversity of indigenous plants and wildlife. The study thus recommended that there is a need to sharpen the use and accountability of public funding of agricultural sector in Nigeria, and also the need for agricultural agencies to increasingly demonstrate effectiveness and efficiency in achieving their set objectives. The study provides empirical evidence on the effect of some intervention programs on national agricultural productivity and food supply. However, the study falls short in linking this intervention to small farm holder's productivity most specifically rural women agricultural productivity whose collective efforts make up the national agricultural productivity.

In assessing the effect of innovative agricultural research intervention on the livelihood and productivity of rural female smallholder farmers in Nigeria, Adebayo [2] employed the use of propensity score matching technique to access this relationship. The study found that rural female farmer's income and output were significantly affected by agricultural research intervention that are agriculturally innovative driven. The study further revealed that households had better livelihood and productivity and more diversified income portfolios during the implementation of the innovative research intervention as a result of greater linkages to markets and capacity building opportunities. But the phasing out of the research program reduced the diversity of income portfolios and lead to the erosion of livelihood. The study concluded that agricultural research intervention that are innovative driven had the potentials to positively impact the livelihood of rural female smallholder farmers in Nigeria. However, there is a need to mainstream local extension agents and increase budgetary support to ensure understanding application of agricultural innovation system concepts to ensure rural innovation and robust livelihood and productivity outcomes. Although the work of [35] is apt in relating the effect of innovative intervention on agricultural productivity of rural female farmers in Nigeria, the study does not provide a robust analysis that shows the extent to which such innovative interventions affected the productivity of female farmers faced with resource and educational constraints necessary for adapting new innovations in farming.

Daneji [9] examined the effect of agricultural development intervention programs from 1960 to date on the agricultural output of Nigeria. Using a top-down approach, the study found that all the agricultural and rural development initiatives had significant effect on agricultural productivity in Nigeria. The result also revealed that the annual production of crops like maize, rice and sorghum had continue to increase in the Savannah ecological zones of Nigeria. The study also found that although the increase in

agricultural productivity is traceable to policy and agency-based development initiatives of successive government in Nigeria over the last two decades; these policies have not made a vibrant effect on rural agricultural transformation because of insecurity and various crises. The study advocated that monitoring and evaluation should be fully integrated into intervention projects, and targeted beneficiaries should form the cardinal point of the evaluation process. Also, the gains and outcome in both economic and social perspectives should form the principal indicators in the process of evaluation. Although the suggestions of [9] are appropriate, the study lack specific details on how the government, private sector and non-government organizations could get involved in developing the agricultural output of rural female farmers. This is because the driving force of most non-governmental agencies and private intervention programs are geared towards profit making. Also the increase in national insecurity is capable of limiting non-government and private sector participation in rural agricultural development.

Mgbenka *et al*. [22] studied the role of Local Government Council rural farmer's transformation in Nigeria. The study argued that Local government [LG] as the closest tier of government to the people had a key role to play in bringing agricultural intervention to rural farmers. The study pointed out certain challenges that militate the efficient performance of LG functions especially in rural agricultural productivity. Chief amongst them are: inadequate planning and poor implementation of projects; mismanagement of intervention resources; lack of autonomy; lack of commitment on the part of LG government worker; inadequate man power, and lack of participation and involvement by local farmers. Mgbenka *et al.* [22] recommended that for local government interventions to be effective on rural agricultural productivity, there is the need for transparency and accountability of intervention funds and resources. The study also recommended that motivating Local Government workers through increased welfare, training and education could change their attitude towards their job and improve their efficiency.

Oladejo *et al.* [28] analysed women participation in agricultural production in the Egbedore local government area of Osun State, Nigeria. The study used descriptive, inferential statistics, probit regression analysis to investigate women's access to economic resources and determine the influence of selected socio-economic characteristics of women's participation in agricultural production. The empirical results obtained showed that household size, local taboos, and marital status had a significant impact on women participation in agricultural production. The result further revealed that most of the respondents were illiterates with non-formal education which directly informed their participation in agricultural production. The study concluded that the rate of women participation in agriculture was very high in the study area because socio-economic variables such as social capital, cash, landed property and savings greatly influence women's participation in agricultural production. The findings of [28] suggested that if women have access to agricultural production resources such as credit, cash, land and capital, these factors are capable of increasing women's participation in agriculture and national output. Although the findings of this study is important; what this study failed to identify are the means through which women can access these factors especially women found in rural communities.

Ghosh and Ghosh [14] analyzed the participation of Indian women in agriculture. The study examined the trend of women participation in agriculture across various Indian States. The study employed the descriptive and inferential statistical techniques to study the growth trend of agricultural workers between the periods of 1961-2002. Conclusions drawn from the study showed that women were actively more involved and participated in the agricultural sector in almost all states with few exceptions in Kerela, Junjab, and West Bengal where women are actively participating in non-agricultural activities such as the service sector, household industry, etc. The study further revealed that the introduction of favorable government policies such as no-interest loans for farmers and free agricultural extension services were the key determinant of increased women's participation in agriculture in India. Implicit in the work of [14] is the fact that women's participation in agriculture is increasing with time and women are now acknowledged with the status of ''agricultural worker''. The study also identified the need for government to introduce policies like interest-free loans to increase female participation in agriculture in most developing countries where access to credit is the major challenge faced by farmers.

Olawepo and Fatulu [31] studied the earnings of rural female farmers in relation to food productivity in Ekiti State, Nigeria. The paper aimed at identifying the factors that determine female farmers' productivity and increase in earnings from agriculture. The study employed the use of maximum likelihood, simple tabulations, multiple regression and inferential statistics. The findings from the result revealed that while 75.5% of the respondents had access to farmlands, the remaining 24.5% of the respondents did not have personal farmlands, but were either dependent on family lands or leased land for agricultural purposes. The result further revealed that women that had their own land recorded more agricultural output and income than women farming on family land. In addition, the result from the multiple regression revealed that about 75.69% of the variation in women's participation in agriculture is explained by three variables which are: debt servicing measures, food security and supplementing income earnings from agricultural activities which are generally low as a result of the subsistent nature of their production.

The study recommended that rural women cooperative societies could be created and rural women's agricultural productivity. This helps women access credit facilities, and helps orient women on the use of extension services and moderate farming systems. This forum could also serve as a medium for women's exposition to alternative ways of land management systems that can improve food security and nutritional development. The work of [31] is one of the earliest pieces of literature that provide an estimate of the economic effect of women's cooperative societies on women's agricultural

productivity. Apart from the financial benefits of participating in such groups, women could easily air their challenges faced in agriculture and other issues in such forums.

Sireeranhan [40] examined the participation of family women in agricultural production in the Jaffna district of Sri Lanka. The study pointed out that women in the urban areas who had access to agricultural extension services, credit and improved seedlings had more agricultural productivity and output than their other counterparts. The study used a survey design to obtain information on 185 households randomly selected through a proportionate random sampling technique. The results of the probit model analyses employed showed that women's contribution to agricultural production is higher among family-women. Family-women income level, ages, and tenure right have an inverse relationship with their level of participation in agriculture production. Whereas, women's level of education, the distance of the woman's farm from the homestead, years of experience, extension services, cooperative bodies women belong to and level of contribution had a positive significant relationship. The findings in [40] work suggest that extension services, cooperative assistance years of experience and educational level can increase women's contribution to agriculture.

Nwosu [26] theoretically studied gender role perceptions and the effect on women's participation in agriculture in Nigeria. The paper examined the effect of the traditional norm and perception in Nigeria on women's participation in agriculture. According to [26] over the years women were marginalized and subordinated to an inferior position vis-à-vis men. The study observed that menace of gender discrimination has significantly affected the participation of women in agricultural production and other economic activities. The study recommended the need for Nigerian society to accept the challenging role of Nigerian women as part of the dynamics of change in a globalized world. The study further recommended the need for government to provide the legal framework and create the enabling environment that would enable women to consolidate their new-found roles in agriculture and other economic sectors. Although the study by [26] gives an insightful view of the effect of traditional beliefs and perceptions on women's participation in agriculture; however, the study failed to provide empirical facts on whether such restrictions and perceptions still exist in Nigeria.

3. Methodology

3.1. Study Area

The Benue State consist of 23 local government areas classified under three senatorial districts, the senatorial districts includes: Benue North East, Benue North West and Benue South Senatorial District with an estimated population of about 5,787,706 (NBS, 2019). This study focuses on eight (8) local government area with high rate of agricultural activities ranging from crop farming, fish farming and animal husbandary [21, 29]. These local government areas includes: Ushongo, Vandeiky, Makurdi, Gwer East, Otukpo, Agatu, Apa, and Gboko. According to the [24], the estimated population of the eight (8) selected local government areas as at 2019 was 2,331,600 million people. The choice of these local government areas is in formed by the high rate of crop and fish farming [41].

The study focuses on women agricultural productivity in Benue State. Agriculture is the main occupation in most of the communities in Benue State, about 70% of the entire female population are predominantly subsistent farmers, cultivating yams, millet, cassava, and guinea corm and livestock management and Fish farming are great source of commercial farming, because of the situation of most of these communities by the River Benue bank. (Women Environmental Programme [41].

Figure 1. *Map of Benue State and the Local Government Areas.*

3.2. Sample Size Determination and Sampling Method

The data used for this study was obtained from a cross sectional survey conducted from November 2022 to January 2023 of 440 respondents across Benue State. The sample size for the study was determined using [7] which is employed when the required sample size (n) is unknown. In this study the number of women participating in agriculture in Benue State is unknown. Hence, the sample size was determined from the estimated population of women in Benue state (N) specified as 2,813,489 which is 49% of the entire population as given by National population commission [24]. The method has been used in similar studies like [2, 4].

Hence to determine the required sample size, the calculation formula of Cochran is presented as follow:

$$n = \frac{Z^2\,PQ}{e^2} \quad (1)$$

Where
n = sample size required
N = Population Size
Z = Confidence level 95% = 1.96
P = Proportion of the population = women constitute 49% of the estimated population in Benue state.

Q = (1-P) is the estimated proportion of non-women in the population 51% of Benue State

e = allowable error (%) or the level of precision

Given a 95% confidence interval, the level of precision (e) = 0.05

$$\frac{1.96^2 \times 0.49 \times 0.51}{0.05^2} = \frac{3.84 \times 0.2499}{0.0025} = 385 \quad (2)$$

Based on the sample size formula, the minimum numbers of respondents required are 385. However, for the robustness of analysis and to improve precision, the sample size will further be increased by 14 per cent making the total number of respondents to be 440. The 14 per cent increase in the number of respondents covers cases of missing values.

The targeted local government areas in each senatorial district of Benue state were selected based on the systematic sampling method, this is to ensure that at least one local government is chosen from each senatorial district since Benue State has three senatorial districts. Table 1 shows the number of LGA selected from each senatorial district.

Table 1. *Generating Sample for Selected LGA from each Senatorial District of Benue State.*

Benue Senatorial Districts	Number of LGA	Cumulative	Selected LGA	Number of LGA selected in each Senatorial District
North East	7	7	2, 5	2
North West	7	14	8, 11, 14	3
South	9	23	17, 21, 23	3
Total	23			11

Sampling interval = Cumulative/propose number of site ➔ 23/8 ≈ 2.9 approximately 3; Random start = 2

In North East Senatorial District, the local government areas selected were Ushongo and Vandeikya local government area. In Benue North West Senatorial District, the selected local government areas included Gwer East, Gboko and Makurdi local government area. In Benue South Senatorial District the selected local government areas were, Agatu, Otukpo, and Apa Local government area. In the Second stage, four villages were randomly selected from each of the chosen local government, the allocated questionnaires to each local government area were shared equally among the communities in each villages, since there are data at village level that could warrant a proportionally distribution of the allotted sample. In the third stage of selection, the respondents (women) were selected using the fish bowling technique in the villages, after counting the number of houses with women participating in agriculture in each villages.

Semi-structured questionnaires were issued to sampled respondents. The content of the questionnaire was in part guided by previous studies on women's agricultural productivity [36, 5]. Majority of the questions were moderated to meet the objective of the study. The questionnaire was made up of 4 sections. The questionnaire solicit information of respondent's socio-demography, child nutrition, women participation in agriculture and information on women economic status. The description of the variables used in the model is given in table 2.

Table 2. *Description/ coding of variables.*

S/N	Variable name	Description	Coding
Household Characteristics			
1	Age	Age of household woman i	15-19 years =1 20-29 years =2 30-39 years =3 40-59 years =4 60 years and above =5
2	Level of education (EDUCi)	Level of education by household i.	No Education = 0 Primary Education = 1

S/N	Variable name	Description	Coding
			Secondary education = 2 Tertiary education = 3
3	Type of Farming	Present type of farming by respondent	Crop = 1 Animal = 2 Fishing = 3 Others = 4
4	Marital status	Marital status of respondent	Married =1 Single = 2 Divorced =3 Widow = 4
5	Status in family	Status of respondent i	Household head =1 Dependent on husband = 2 Dependent on others = 3
6	Family size (Famsize)	Number of children and adults in household i.	Open ended
	Independent Variables		
7	Farm Size (Hectares (ha)) cultivated (Fa_i)	Size of the farm land cultivated	Open Ended
8	Share of female labour to total labour (%) (SFL_i)	Percentage of female labour in the total labour put into agricultural activities in each household	(%)Percentage
9	Training/skills (TS_i)	Training/skills received by woman from extension workers for agricultural purpose in household i (Trainings, education, sensitisation by extension workers)	Yes = 1 No = 0
10	Inputs (INPi)	INPi = Inputs received by women from interventions on agricultural production (improved seedlings, Herbicides and pesticides, Tools/machineries, credits/loans)	loan = 1 seedlings = 2 Herbicides and pesticides = 3 Farm tools/ machineries = 4 Others = 5
	Dependent Variable		
11	Woman agricultural yield or output (WAYi)	yield (in Kilogram (Kg)) last farming season in househils i	Open ended

Source: Authors Computer, 2023

3.3. Model Specification

The empirical study underpin this study is anchored on the study of [5]. Which emphasized that interventions affect the efficiency of agricultural production and increases productivity. According to this study interventions could be inform of the use of modern machinery and equipment, finance, improved seedlings, farmers training, education and improved agricultural extension services to improve agricultural productivity. To achieve objective (1A) of examining the effect of interventions on women agricultural productivity, the study employs the robust ordinary least square regression technique. The OLS robust estimation method has an advantage over the Ordinary Least Square (OLS) method especially when there is evidence of heteroskedasticity among the variables. The explicit regression function of objective (1A) is stated below:

$$WAY_i = \beta_0 + \beta_1 FA_i + \beta_2 SFL_i + \beta_3 TS_i + \beta_4 INP_i + \beta_5 EDU_i + \beta_6 AGE_i + \varepsilon_i \quad (3)$$

Where; WAYi = Agricultural productivity/ output (in Kilogram (Kg)) last farming season in household i. FAi = Farm Size (Hectares (ha)) cultivated in household i. SFLi = Share of female labour to total labour (%) in household i. TSi= Training/skills received by woman from extension workers for agricultural purpose in household i (Trainings, education, sensitization by extension workers). INPi = Inputs received by women from interventions on agricultural production (improved seedlings, Herbicides and pesticides, Tools/machinery, credits/loans). EDUi= Mother's level of education in household i. AGEi = Mother's Age in household i. ε_i = the random term that includes other variables that are not included in the equation. ε_i is assumed to be independently and identically distributed. βs = parameters to be estimated.

4. Results and Discussions

4.1. Descriptive Statistics

440 questionnaires were distributed to respondents within the various selected Local government areas in Benue State. Out of which 421 were returned and certified suitable for statistical analysis in this study. The data was entered into the STATA software and checked for outliers and/or errors during the inputting process. Corrections were made on all outliers affected by wrong data entering. Table 4 displays the socioeconomic and demographic characteristics of respondents.

Table 3. *Demographic and socioeconomic characteristics of respondents.*

Variable	Frequency	Percentage
Local Government Area		
Gboko	55	13.06
Vandeikya	53	12.59
Ushongu	51	12.11
Gwer east	50	11.88
Makurdi	59	14.01
Otukpo	51	12.11
Agatu	52	12.35
Apa	50	11.88
Ages		

Variable	Frequency	Percentage
Age less than 14	2	0.48
Age 15 to 19	7	1.66
Age 20 to 24	36	8.55
Age 25 to 29	89	21.14
Age 30 to 34	97	23.04
Age 35 to 39	73	17.34
Age 40 to 44	54	12.83
Age 45 to 49	41	9.74
Age 50 above	22	5.23
Marital Status		
Married	312	74.11
Single	27	6.41
Divorced	21	4.99
Widow	61	14.49
Level of Education		
No Education	60	14.25
Primary Education	106	25.18
Secondary Education	160	38.00
Tertiary Education	95	22.57

Source: Field Work, 2023.

Table 3 shows the demographic and socioeconomic information of respondents. The results from the table reveals that from the Benue North West senatorial district, 55 (13.06 per cent), 59 (14.01 per cent) and 50 (11.88 per cent) of the respondents are from Gboko, Makurdi and Gwer east local government area respectively. While in Benue North East senatorial district 51 (12.11 per cent) and 53 (12.59 per cent) of the respondents are from Ushongu and Vandeikya local government are respectively. The table also shows that from the Benue South senatorial district, 51 (12.11 per cent), 52 (12.35 per cent) and 50 (11.88 per cent) of the respondents are from Otukpo, Agatu and Apa local government areas respectively. This shows that in percentage points there is a fairly representation of responses from each of the Senatorial Districts of the State.

In terms of age distribution, the responses in Table 3 reveals that 2 (0.48 per cent) are less than 14 years, 7 (1.66 per cent) are between the ages of 15 and 19 years, 36 (8.55 per cent) are between the ages of 20 and 24 years, 89 (21.14 per cent) are between the ages 25 to 29 years, 97 (23.04 per cent) are between the ages of 30 and 34, 73 (17.34 per cent) are between the ages of 35 and 39 years, 54 (12.83 per cent) are between the ages of 40 and 44 years, 41 (9.74 per cent) are between the ages 45 and 49 years, while 22 (5.23 per cent) of the respondents were 50 years and above. The table shows that majority of the respondents are between the ages of 25 to 29 and 30 to 34. This is the average age of active population of most household women in terms of productivity in rural communities in Nigeria.

Table 3 further indicates that 312 (74.11 per cent) of the respondents are married, 27 (6.41 per cent) are single, 21 (4.99 per cent) are divorced, while 61 (14.49 per cent) are widows. This shows that majority of the respondents are married women having their husbands as the head of the family. In regards to respondents' level of education, Table 3 also shows that 60 (14.25 per cent) had not attended any form of formal education, 106 (25.18 per cent) had primary school level of education, 160 (38 per cent) have secondary education, while 95 (22.57 per cent) of the respondents had attained tertiary level of education. The responses imply that most of the respondents (85.75 per cent) had formal education at various levels. The level of education to a significant extent is helpful to the researcher in terms of dissemination and interpretation of the reason and content of the questionnaire as it is quite easy for those who achieved some form of formal education to understand the content of the questionnaire.

To understand the effect of interventions on women agricultural productivity, the study classified the forms of interventions received by farmers into various categories as highlighted in table 4. The Table shows the type of training and inputs indicated by the respondents.

Table 4. *Types of interventions received by respondents for agricultural production.*

S/N	Types of interventions	Frequency	Proportion
1	Training	113	26.84
2	Credit (loan)	20	4.74
3	Seedlings	60	14.24
4	Herbicides/ pesticides	22	5.21
5	Tools/ Machineries	4	0.98
6	Others	26	6.18
7	None	289	68.64

Source: Field work, 2023

Table 4 shows the total number of respondents that benefited from training, credit, seedlings, herbicides, farm tools and any other intervention from the government and/or non-governmental organizations. The outcome shows 26 respondents benefited from training by agriculture extension workers, 20 respondents benefited from loans, 60 respondents were given improved seedlings, 22 respondents benefited from herbicides and pesticides, while 4 respondents benefited from farm tools and machinery. The findings from the result in table 4 shows that in total only about 58% of the respondents had received assistance for agriculture purposes, the implication of this result is that over 40 percent of the respondents had never received any form of intervention for agricultural production. The responses corroborate the reports of [18] which states that farm production by small farm holders in sub Saharan African countries is limited by constraint in accessing resources, which should have been made readily available by the government and non-government organizations to boost agricultural production.

4.2. Results of Correlation Analysis

To evaluate the linear relationship between the variables of interest, the study employs the correlation analysis. The bivariate also known as correlation analysis is also used to identify the magnitude and action of this relationship [16]. Table 5 depicts the result of the linear relationship (correlation) of the effect of intervention on women's agricultural productivity. Some interesting findings in table 5 reveals that all the independent variables (TS, INP, EDU, AGE, FA, SFL) are weakly related to women agricultural productivity/ outcome (WAY). Although there exit a

negative correlation between agricultural productivity (WAY), percentage share of female labour in agricultural activities (SFL) and training/skills (TS). The result further shows that percentage share of female labour in agricultural activities (SFL) has a negative but weak relationship with most variables, such as training/ skills (TS), inputs (INP), Education (EDU) and farm size (FA). Also, the result shows a weak relationship among all variables, except for a strong relationship found to exit between the two types of intervention (training/skills (TS) and input received (INP).

Table 5. *Correlation analysis result.*

Variable	Agricultural productivity / output (WAY)	Farm Size (FA)	Input received (INP)	Trainings / skills (TS)	Share of female labour (SFL)	Age (AGE)	Education level (EDU)
Farm Size (FA)	0.404	1.000	_	_	_	_	_
Share of female labour (SFL)	-0.264	-0.352	-0.094	-0.055	1.000	_	_
Training/skills (TS)	-0.016	0.043	0.751	1.000	_	_	_
Input received (INP)	0.093	0.106	1.000	_	_	_	_
Education level (EDU)	0.069	0.177	0.1814	0.1656	-0.226	-0.206	1.000
Age(AGE)	0.0967	0.142	0.090	0.1304	0.0533	1.000	_

Author's computation, 2023

4.3. Results of Regression Analysis

To evaluate the effect of intervention on women agricultural productivity in Benue State, the study employs robust ordinary least square (OLS) regression. Among all linear regression estimator OLS estimate is considered the best and most efficient estimator as long as the Gauss-Markov theorems are met [16]. One of such assumptions is homoscedasticity that assumes the residuals are independent and identically distributed. In practice, it is not usual for heteroskedasticity to be present especially in cross sectional data analysis. As such, the use of OLS estimates although unbiased produces less efficient standard errors that may result in poor statistical test. [16] suggested the use of robust regression as it is apt in addressing heteroskedasticity with efficient standard error. Table 6 shows the output of robust OLS regression model for the combined data and variables stated.

Table 6. *Estimates of the impact of interventions on agricultural Productivity (output).*

Variable	Dependent Variable: Women agricultural Productivity/output (WAY)			
	OLS	Z- statistics	Robust OLS	Z-statistics
Farm Size (FA)	3.213*** (0.463)	6.93	1.838 (0.114)***	16.12
Share of female labour (SFL)	-0.406** (0.134)	-3.029	-0.718 (0.330)**	-2.18
Training/skills (TS)	-13.707** (5.379)	-2.548	-0.621 (1.323)	-0.47
Input received (INP)	4.156** (1.648)	2.522	0. 423 (0.405)	1.04
Education level (EDU)	-0.470 (1.723)	-0.273	0.909 (0.424)**	2.14
Age(EXP)	1.259* (0.958)	1.314	0.432 (0.235)*	1.83
Constant	5.582 (7.743)	0.721	0.265 (1.905)	0.14
F-test	17.00		65.27	
Observation	421		421	
R-squared	0.1977			

Source: Field work 2023. Note: standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The results in column 1 and 3 examines the effect of the independent variables on women's agricultural yield (output)

Table 6 depicts the result of the effect of interventions on women agricultural productivity. The t-values of the Robust OLS (column 3) shows that farm size (FA) is significant at 1 percent, share of female labour (SFL) and Education (EDU) are significant at percent 5 percent, while age (AGE) is significant at 10 percent when corrected for heteroskedasticity. Concerning the interventions received, table 5 (column 3) shows that training/skills (TS) and input (INP) received have insignificant effect on women agricultural productivity with training received having a negative relationship. A look at the signs of the coefficient shows that FA, INP, EDU and AGE are in consonance with the expected sign, while TS and SFL are not. The result in table 6 shows that women agricultural productivity or output will increase by 1.8 bags when the respondents size of farmland increases by one hectare. The result also shows that holding other variables constant, a percentage increase in the share of female labour in the agricultural production process decreases the respondents agricultural output by 0.7118 holding. Table 6 further indicates that agricultural output of respondents increases by 0.909 with additional level of education holding other variables constant. Table 6 also reveals that as the age of the respondents increases agricultural output increases by 0.432 holding other variables constant. The t-value in the result shows that training/skills (TS) received and Input (INP) received are statistically not significant. Thus, the result are not different from zero. This implies that interventions received do not influence respondent's agricultural productivity.

The estimated outcome of the regression in table 6 are robust and pass all estimation test. One important assumption is the homoscedastic regression of constant variance of unobserved

error conditional on explanatory variables. If the homoscedastic assumption is violated, the OLS estimates remains unbiased as long as the other Gauss Markov assumptions of no perfect collinearity among variables linearity in the parameters, zero conditional mean and random sampling are not violated. However, the test statistics such as standard errors and t-statistics will be incorrect. Thus, the researcher is likely to draw false conclusion on the data. The robust OLS regression standard error are robust thus controls for heteroskedasticity. On the test for multicollinearity among variables of a model a Vector Inflation Factor (VIF) of 5 and above implies the existence of multicollinearity among the variables. In this study the test for multicollinearity shows a VIF of 1.56 which connotes that there is no multicollinearity among the variables in the equation.

The result in table 6 implies that there is limited effect of intervention on women agricultural productivity. The provision of credits, seedlings, herbicides, pesticides, tools and machineries, although helpful in meeting the needs of the respondents, does not significantly determine women agricultural productivity in the study area. In addition, the intervention efforts in form of training of farmers are not relevant to increasing their productivity as shown in table 6. The analysis of this study shows that although interventions are necessary to meet the needs of female farmers, their agricultural productivity is not affected by intervention but instead affected by the percentage share of female labour, education, age and farm size of the respondents. This is an indication that women agricultural productivity will eventually increase even when there are no external incentives (interventions) from Government or non NGOs.

5. Conclusions

The findings of this study established that interventions have insignificant effect on women agricultural productivity in Benue State; suggesting that the provision of any form of intervention such as training, credit, tools, machinery, seedlings still remain very insignificant; as the result shows that the effect of intervention on women's agricultural productivity is not significant. This study also provides evidence that education, farm size and age significantly determine women agricultural productivity rather than intervention. The paper provides evidence that female farmer's productivity is capable of increasing even in the absence of assistance or interventions. Hence, the result of this analysis suggest that government and non-governmental organizations should look beyond just meeting the basic farming needs for women participating in agriculture but ensure deliberate effort is made to: increase women access to more land for farming purpose; encourage girl child education most especially in the rural areas of the country, and create conducive learning platforms for adult education for uneducated women.

This study is however not without limitations. First is the unknown number of the target population used for the study (women in agriculture). There are no proper records available for women participating in agriculture in Benue State. As a result of this limitation the study employed sample size determination for the unknown population. A second limitation of this study is that while it would have been robust to carry out a study such as this on a national level, however taking into consideration the inadequacy of resources in terms of finance, human and time limits this study to Benue State. Hence, further research should consider national representative survey so as to overcome the problem of limited data and provision of larger coverage.

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Conflicts of Interest

The authors declare no conflicts of interest.

Appendix

A: Result of the OLS Regression Analysis and the Multicollinerity Test

```
. reg Output100KG1bag Farmsize TypAssist Training offemallabour Age Education

      Source |       SS       df       MS              Number of obs =     421
-------------+------------------------------           F(  6,   414) =   17.00
       Model |  103877.153     6  17312.8589            Prob > F      =  0.0000
    Residual |  421535.094   414  1018.20071            R-squared     =  0.1977
-------------+------------------------------           Adj R-squared =  0.1861
       Total |  525412.247   420  1250.98154            Root MSE      =  31.909

------------------------------------------------------------------------------
Output100K~g |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    Farmsize |    3.213554   .4634169     6.93   0.000     2.302611    4.124498
   TypAssist |    4.156964   1.648761     2.52   0.012      .9159776   7.397951
    Training |   -13.70798   5.379526    -2.55   0.011    -24.28257   -3.133392
offemallab~r |   -.4060982   .1340949    -3.03   0.003    -.6696899   -.1425065
         Age |    1.259683   .9587631     1.31   0.190    -.6249682    3.144334
   Education |   -.4701453   1.723917    -0.27   0.785    -3.858866    2.918576
       _cons |    5.582169    7.74371     0.72   0.471    -9.639723    20.80406
------------------------------------------------------------------------------
```

```
. vif
```

Variable	VIF	1/VIF
Training	2.35	0.425597
TypAssist	2.34	0.426753
Farmsize	1.21	0.825530
offemallab~r	1.19	0.842265
Education	1.17	0.856018
Age	1.12	0.892507
Mean VIF	1.56	

B: Result of the Correlation Analysis

```
. pwcorr Output100KG1bag Farmsize TypAssist Training offemallabour Age Educatio
> n
```

	Output~g	Farmsize	TypAss~t	Training	offema~r	Age	Educat~n
Output100K~g	1.0000						
Farmsize	0.4042	1.0000					
TypAssist	0.0932	0.1064	1.0000				
Training	-0.0158	0.0433	0.7518	1.0000			
offemallab~r	-0.2639	-0.3523	-0.0937	-0.0551	1.0000		
Age	0.0967	0.1419	0.0902	0.1304	0.0533	1.0000	
Education	0.0690	0.1769	0.1814	0.1658	-0.2262	-0.2059	1.0000

C: Result of the Robust OLS Regression

```
. rreg Output100KG1bag Farmsize TypAssist Training offemallabour Age Education

   Huber iteration 1:  maximum difference in weights = .9154919
   Huber iteration 2:  maximum difference in weights = .54585088
   Huber iteration 3:  maximum difference in weights = .1761388
   Huber iteration 4:  maximum difference in weights = .11067439
   Huber iteration 5:  maximum difference in weights = .0433764
Biweight iteration 6:  maximum difference in weights = .2909033
Biweight iteration 7:  maximum difference in weights = .12222074
Biweight iteration 8:  maximum difference in weights = .09119903
Biweight iteration 9:  maximum difference in weights = .05894778
Biweight iteration 10:  maximum difference in weights = .03428229
Biweight iteration 11:  maximum difference in weights = .00978439

Robust regression                                     Number of obs =     421
                                                      F(  6,   414) =   65.27
                                                      Prob > F      =  0.0000
```

Output100K~g	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Farmsize	1.838918	.1140462	16.12	0.000	1.614736	2.0631
TypAssist	.4232451	.4057577	1.04	0.298	-.3743571	1.220847
Training	-.6214607	1.323894	-0.47	0.639	-3.223852	1.980931
offemallab~r	-.0718261	.0330006	-2.18	0.030	-.1366957	-.0069566
Age	.4323345	.2359502	1.83	0.068	-.0314753	.8961444
Education	.9097395	.4242534	2.14	0.033	.0757802	1.743699
_cons	.2657694	1.905716	0.14	0.889	-3.480316	4.011855

Questionnaire

Federal University Lafia

PMB 146, Lafia, Nasarawa State, Nigeria

PROJECT: Women Agricultural Productivity and Intervention in Benue State

Introduction

Dear Respondent,

I am a Postgraduate student of the Federal University of Lafia, Nasarawa State. I wish to crave your indulgence by requesting you to provide candid answers to the questions below. This questionnaire seeks to assess the effects of women's agricultural productivity and intervention in Benue State, Nigeria. The information you will provide will contribute to a better understanding of the effects women empowerment and child health in Nigerian economy. You are therefore, assured that your responses will be treated confidentially and strictly for academic purpose. If this is acceptable to you, we can then proceed to receive your responses to questions. Please provide answers to the question by ticking (√) all relevant boxes. If you have any question, please do not hesitate to ask the Researcher.

Thank you very much for your help.

Ehigocho Peace Aimua

Section A: Socio-Demographic Information

Local Government Area……..……

Name of Village……..……

Age: Less than 15 ( ), 15-19 ( ), 20-24 ( ), 25-29 ( ), 30-34 ( ), 35-39 ( ), 40-44 ( ), 45-49 ( ), 50 and above ( )

Marital Status: Married ( ) Single ( ) Divorced ( ) Widow ( )

Status in the family: Head of the family ( ) Dependant on husband( ) Dependent on other family members ( )

Type of farming: Crop farming ( ) Animal farming ( ) fishing ( ) others please specify ……..

Highest level of education: No education ( ) Primary education ( ) Secondary ( ) Tertiary ( )

Total number of persons in the family…….

Number of children……

SECTION B: Women Participation in Agriculture

17A. on an average, how many hours a day do you spend in the farm? ……

17B. How many members of your household joined you in faming on your farm last farming season?.....

17C. How many workers outside your household did you employ on your farm?.....

17D. How many females in your household joined you in farming?.....

18A. what was your total agricultural output (income or yield IN KG) last farming season?

Crop/ livestock/ income	Unit (yield in KG)	Quantity (no of bags)

18B. Do you use improved seedlings for farming? …….

18C. Did you sell some of your crops? (a) Yes ( ) (b) No ( )

18D. if yes to (18C) how many bags of crops did you sell in last farming season? ……..

18E. How much did you generate from the sale of your crops? …….

19A. Aside from farming do you have extra source of income on your own? (a) Yes ( ) (b) No ( )

19B. If yes to (19A) what is the source of this income? (a) Business or self-employed ( ) (b) Civil servant ( ) (c) Private worker ( )

19C. If yes to (19B) on an average how much do you earn in Naira Per month? (a) 1,000 to 20,000 ( ) (b) 21,000 to 40,000 ( ) (c) 41,000 to 60,000( ) (d) 61,000 to 80,000 ( ) (e) above 81,000 ( )

19D. What is your total household income monthly? ……

20A. Have you benefited from any form of government or Nongovernment assistance to help your agricultural production? (a) Yes ( ) (b) No ( )

20B. If yes to (20A) what are the form of this assistance (a) loan ( ) (b) seedlings ( ), (c) Herbicides and pesticides ( ), (d) farm tools and machineries ( ), (e) others (specify) ……

20C. Have you have ever benefited from any training to assist you in improving your agricultural production? (a) Yes ( ) (b) No ( )

20D. Was the training helpful in increasing your agricultural output? (a) Yes ( ) (b) No ( )

20E. Last year what was your total agricultural crop yield in bags (100kg =1 bag) ……

21. What is the estimated size of your farm land in hectares? ----------

22. On the average what quantity of your agricultural products is been consumed in the household (either in Kg or other forms)? ……..

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