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#### IMPACT OF CLIMATE CHANGE ADAPTION AND AGRI-BUSINESS SUPPORT PROGRAMME PARTICIPATION AMONG THE MAIZE FARMING HOUSEHOLDS IN KATSINA STATE, NIGERIA

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#### ABSTRACT

The study investigates the impact of the Climate Change Adaption and Agri-business Support Programme on the welfare of maize farming households in Katsina State. A multi-stage sampling technique was used to collect data from 430 smallholder maize farming households using a structured questionnaire. Data analysis was carried out using descriptive statistics, probit regression analysis; independent t-test analysis, and propensity Score-matching techniques. Results of descriptive statistics show that the average age was 48.30 years and 50.52 years for participating and non-participating households respectively. The average household size was 9 persons for participating and non-participating households. It also indicates that the most (89.75%) of participating household heads and 94.85% of the non-participating households were male with only 10.25% and 3.16% respectively being female. Probit model results show that the pseudo-R<sup>2</sup> value was 21% and likelihood ratio (LR) statistic indicated by chi-square was significant (P>0.000). It was discovered that age, household size, years of formal education, extension contact, access to credit, and participation in the productivity trail revealed positive relationships and significantly influenced participation in the program. Overall, the empirical result of Propensity Score matching indicate a robust, positive impact of CASP participation on Maize farmers Net farm income, food security at 1% level of significance and per capita assets value at 5% level of significance. This confirms the potential direct role of participation in climate change adaptation programs in improving rural household welfare, as higher income from climate change adaptation strategies translates into lower poverty and food-secured households Therefore, this study recommends policy measures to increase participation of climate change adoption through mainstreaming climate change strategies into productive systems and productive land scape to improve food security, income and households assets among farmers in the area. Keywords: Adaption, Agri-business Change, Climate and Investigates

#### **INTRODUCTION**

Agriculture is key to Nigeria's economy after crude oil. Agricultural activities provide livelihood for many Nigerians with about 70% of households participating in crop farming activities. The major crops are maize and cassava, which are grown by almost 50% of farming households (Kamer, 2023). It employs over 60% of Nigerians and contributes up to 23.11% of the country's gross domestic product (GDP) (Polycarp, 2018). The potential of the Nigerian agricultural sector is huge with a substantial base to build upon given the abundant natural resources including 80 million hectares of arable land of which only 34 million hectares have been cultivated (PWC, 2017). Climate adaptation and resilience is a key component of any healthy system, particularly in vulnerable countries especially in SSA that depend heavily on climate-sensitive natural resources and traditional agricultural practices for subsistence and livelihoods (UNDP, 2018). According to Abu (2020), change in climatic factors has significant consequences for the agricultural sector. The adverse impacts of climate change are expected to lead to

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<u>ISSN (Print): 2651-6144; ISSN (Online): 2651-6365</u> <u>Website: http://www.jasd.daee.atbu.edu.ng</u> production losses in the sector, compromising the attainment of the Sustainable development goals.

This scenario provided strong justification for the Federal Government and the International Fund for Agricultural Development (IFAD) to implement the climate change adaptation and agribusiness support program (CASP) to support smallholder farming households (2015-2022). The program was designed to ensure that all its activities align with the agricultural transformation agenda, the policy document defining the future direction of agriculture in Nigeria. If the program can enhance the productivity of small-scale farmers in the region by promoting the practices of climate resilience agriculture and strengthening the business/entrepreneurial capacities of producer organizations, small-scale enterprises, and other value chain actors, then rural poverty will be reduced, food security will be increased and economic growth will be accelerated on a sustainable basis, the income of smallholder farmers and rural entrepreneurs that are engaged in the production, processing, storage, and marketing of the priority commodity value chains will also increase (Zubairu, 2016).

Maize as one of the stable meals in the area is threatened by changing climatic conditions and this reduction of yield as a result of climate change over the years will ultimately affect food prices and make households spend more on food consumption which according to Ekpa *et al.* (2017) reported that this will ultimately culminate in nutritional shortage and insufficient access to foBased on IFAD supervisory team reports and outcome surveys, CASP interventions have been seen as successful, especially in terms of increasing farmers' productivity, and linkage between farms and markets of high-value crops. However, the program's impact on selected value crops farming households in the state has not been rigorously analyzed. It is also not clear whether the CASP interventions had any effect on farmer's welfare and well-being in Katsina State. Furthermore, previous studies such as FRAYM, (2020) and Sanchi (2022) on IFADsCASP did not utilize a rigorous technique to evaluate the impact of the program.

It is therefore pertinent to bridge the gap in the literature by finding answers on the impact of the intervention on farming households' welfare on one of the significant selected value change crops in the state. This study therefore described the socioeconomics characteristics of participating and non-participating households in the study area; determine factors influencing a household's decision to participate in the program and assess the impact of participation in CASP on the wellbeing outcomes of maize farming households.

#### MATERIALS AND METHODS

#### The Study Area

The study was conducted in Katsina State. The state has a projected population of 7,831,783 people by 2017 (National Population Commission NPC, 2017) and an annual growth rate of 1.5%. This reflects a population density of 196.6 persons per square kilometer. The state has a total area of 24,192 Km<sup>2</sup> out of which about 2.8 million hectares are devoted to the cultivation of crops. The state lies entirely within the tropics (latitude  $11^0 07$ " N to  $13^0 22$ " N and  $6^0 45$ 'E to  $9^0 05$ 'E) with a distinct rainy season between May and October and a dry season between November and April. The extreme northern part lies within the Sahel Savannah with rainfall on average of less than 600mm per year. The northern part lies within the Sudan Savannah with a rainfall average of about 800mm per year and the southern part in the Guinea Savannah with rainfall averages of 1000mm per annum (Bishir *et al.*, 2018). A predominantly agrarian state with more than 800,000 farming families and cultivating more than 1.5 million hectares of farmlands



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is among the largest producers of cotton and maize in the country. The state has about 415,000 Maize farming households, those households make up about 33 percent of the smallholders in the state (Fraym, 2020). Ibrahim and Saminu (2018) reported that agriculture employed about 5.6 million people in the state directly or indirectly involved in one form of agricultural activity or another.

The state made up of thirty-four Local Government areas out of which twelve (17) Local Government Areas participated in the IFAD-CASP. The participating LGAs are Danja, Daura, Kafur, Faskari, Mani Bakori, Musawa, Kusada, Dutsin-ma, Dutsi, Bindawa, Baure, Kurfi, Batsari, Zango, Jibia, and Kaita. The population of this study is made up of the Maize farming households in the IFAD–CASP participating Local Government Areas in Katsina State.

#### Sampling technique and sample size

A multi-stage simple random sampling technique was employed for the selection of respondent's households. The first stage involved the random selection of six (6) local government areas from the list of participating LGAs in the state. (With two LGAs per each of the agricultural zone of the state). The selected local governments are Jibia and Mani in the Ajiwa zone, Danja and Musawa in the Funtua zone, and Dutsin-Ma and Kusada in the Dutsin-Ma zone. The second stage involved the random selection of two participating villages and two non-participating villages from each selected LGA through balloting, making a total of 24 villages (12 participating and 12 non-participating). In the third stage, and last stage was the application of the simple random sampling technique to select 215 participating and 215 non-non-participating Maize farming households from all the selected communities giving rise to a total sample size of 436 respondents.

#### Method of Data Collection:

Data were collected through the use of structured questionnaire, administered to household heads by trained enumerators. The questionnaire captures quantitative data about the production and production decisions made by participating and non-participating Maize farming households. In addition, data was collected on socioeconomic variables, income and expenditure, poverty variables, and production characteristics for the 2022 season. These variables make up the dependent and independent variables that are included in the analytical models.

#### Analytical tools

Descriptive statistics; probit regression and Propensity Score Matching (PSM) methods were used to achieve the objectives of the study. However, to analyze the five outcome variables employed in this study (Net farm income, food security, poverty status, per capita household expenditure, and per capita asset value) Descriptive statistics, Household Food Insecurity Experience Assessment Scale (HFIAS), Foster Greek Thorbecke index (FGT) and farm budget techniques were employed.

**Probit Regression model**: was used to determine factors influencing a household's decision to participate in the program. Pi = P<sub>i</sub> (Y<sub>i</sub>=1) = Q (Xi, e) (i =1, 2 ....n). The model assumed that the probability of i<sup>th</sup> household participating in the CASP. Pi (Yi=1), is a function of explanatory, Xi shown and the unknown parameter vector. The implicit form of the model is expressed below: P<sub>i</sub> =  $\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_{11} X_{11} + ui$  .... (1)

Where; Y = Binary variable (1 = Participating and 0 = non-participating) a = Constant 0 b - b Coefficients of variables  $X_1 - X_{11}$ 

 $X_1 = Age of respondents (years)$ 

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 $X_2 =$  Gender of Respondents (Male=1, Female=0)

X<sub>3</sub> = Marital Status (Married=1, otherwise=0)

 $X_4$  = Household size (Number of household members)

 $X_5 =$  Highest Educ. Level

X<sub>6</sub>= Years of formal education (Years)

 $X_7 =$  Farm size (ha)

 $X_8 =$  Farming experience (years)

X 9= Membership of Association (Member=1, Non-Member=0)

X<sub>10</sub>= Access to Credit (Yes=1, No=0)

X11 Participation in productivity trail. (Yes=1, No=0)

#### **Propensity Score Matching (PSM)**

Propensity Score matching was used to evaluate the impact of participation in CASP on the selected outcome indicators (Food security, Net farm income, Monthly per capita expenditure, per capita asset value, and Poverty gap index). Propensity score matching was chosen among the different methods of impact evaluation because of is the non-experimental method, it is appropriate for this study because the program does not have an experimental household that acts as the control (Kiratu, 2014). By using the propensity score-matching (PSM) method that summarizes the socioeconomic characteristics of each subject into a single index variable, and then uses the propensity score to match similar individuals (Rosenbaum and Rubin, 1983).

Estimating the treatment effects using propensity score requires two assumptions. The first is the Conditional Independent Assumption (CIA). A second condition is that the average treatment effect for the treated (ATT) is only defined within the region of common support. This assumption ensures that persons with the same X values have a positive probability of being both participants and nonparticipants (Becerra and Abdula, 2009).

 $ATE = () \{ EZ = 1, (X) - EZ = 0, P(X)$ ...(2)

The ATT can then be estimated as	
$ATT = (\sum H1 \ D=1) - (\sum Ho \ D=1)$	(3)
$(z) = \Pr(D = 1 \ z \) = \sum (D \ Z)$	(4)
$ATT = (\sum H1 - H0 D = 1)$	(5)
$ATT = \sum (\sum H1 - H0 \ D = 1, P(Z))$	(6)
$ATT = \sum \{ \sum H1 \ D = 1, P(Z) \} - \sum \{ \sum H0 \ D = 0, P(Z) \} \}$	(7)
	1 0

Where, H1= value of the outcome for participants in maize farming households, Ho = value of the outcome for non-participation in Maize farming households, D= Participation (1 for participants in CASP and 0 otherwise), Z= socioeconomic characteristics of the farmers

#### **RESULTS AND DISCUSSION**

#### Socio-economic characteristics of the respondents

The socioeconomic characteristics of Household heads of participating and nonparticipating CASP maize farming households are presented in Tables 2 and 3 These include age, sex, marital status household size, education attainment years, extension contact per capita assets value, years of farming experience, farm size. The difference between the socioeconomic characteristics of participating and non-participating is also tested for significance using the Chisquare test and t-test. The average age of Participating households was 48.30 years while for nonparticipating was 50.52 years old. The age difference (2.22) between the two household groups is statistically significant (<0.05) which indicates that participating household heads are younger than their non-participating counterparts. These younger age participants in the program may be active

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in all the activities. This is in agreement with the findings of Gambo et al. (2016). His study on socioeconomic factors Influencing the Participation of the Marginalized and Vulnerable Farmers in the IFAD – Community Based Agriculture and Rural Development Programme in Katsina State, Nigeria indicates the younger age of the participants of the program. Furthermore, the mean household size of participating households is 9.22 while for nonparticipating households is 9.11 and the pooled households' group is 9.17, and the mean difference between the two groups is -0.11 which indicates that households with high size participate more in CASP intervention and similarly the years of formal education. This is contrary to the findings of Makama et al. (2022) who reported that Household size was equally found to significantly reduce maize production and indicated that as households increase, farmers face more financial constraints, thus diverting resources off the farm. The table shows that participating household has an average of 1.92 ha while the non-participating households have 1.82 ha and these slight differences in farm size among the maize farming households corroborate the work of Okunlola (2019), which asserted that a characteristic feature of the agricultural production system in Nigeria is the disproportionately large fraction of the agricultural output that is in the hands of smallholder farmers

Variables (n=430)	NPHH (215)Mean (Standard Deviation)	PHH Mean (215)(Standar d Deviation)	Pooled Mean Standard Deviation	Mean Difference	t-value	P-value
Age	50.52(10.91)	48.30 (10.59)	49.27 (10.77)	2.22	2.1354	0.0166
Household Size	9.11 (6.22)	9.22 (6.31)	9.17 (6.26)	-0.11	0.189	0.5750
Years of Formal Education	10.45 (5.52)	11.67 (5.63)	11.15 (5.59)	-1.22	2.2639	0.0120
Years of Farming experience	23.83(11.73)	21.10 (11.08)	22.29 (11.43)	2.73	-2.476	0.0136
Years of Maize Farming experience	15.19(12.26)	14.12 (10.28)	14.45 (10.61)	1.07	-2.236	0.0129
Farm Size	1.82 (1.23)	1.92 (1.47)	1.88 ( 1.37)	-0.13	-0.750	0.7733
G						

#### Table 2: Socio-economic characteristics

Source: Field Survey, 2023

#### Socio-economic characteristics of household head (Categorical Variable)

The result in Table 3 indicated that the majority (89.75%) of participating household heads and 94.85% of the non-participating households were male with only 10.25% and 3.16% respectively being female-headed households and the finding is in line with the World Bank, (2018) which reported that among Nigerian small family farms, men usually have the decisionmaking power and only a little share of farms. The majority (95.75% and 94.21%) of Maize farming households are married which implies the immense responsibilities of households towards meeting the income needs of their household members. On education level attainment, the results revealed that household heads attain different levels of education with non-formal as the higher this implied that Maize farming household heads among the two groups had attained a certain level of education.

#### Variable Categories Non-participating participating **P-Value** Household % (215) Household % (215)3.16 10.25 Sex Female 0.656 96.84 89.75 Male Marital Status Single 5.79 3.28 0.800

#### Table: 3 Socio-economic Characteristics (Categorical Variable)

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	Married	94.21	95.08	
	Divorce	0.00	0.41	
	Widow	0.00	1.23	
Highest Level of	Non-Formal	43.68	45.08	0.907
Education Completed	Primary	17.89	17.21	
	Secondary	20.00	23.77	
	Tertiary	15.26	12.70	
	Others	3.16	1.23	
Extension Contact	No	19.47	8.20	0.160
	Yes	80.53	91.80	
Membership of	No	19.47	13.93	0.077**
Cooperative	Yes	80.53	86.09	
Access to Credit	No	44.74	30.33	0.000***
	Yes	55.26	69.67	
Participation in the	No	43.16	22.95	0.022**
Productivity trail	Yes	56.84	77.05	

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Source: Field Survey, 2023

### Determinants of Participation of Climate Change Adaptation and Agribusiness support program among Maize farming households.

The results of the binary probit model of the determinants of household participation in the CASP program (Table 4) show that, collectively, all the estimated coefficients were statistically significant, since the likelihood ratio (LR) statistic as indicated by chi-square was highly significant (P>0.000), suggesting that the probit regression model has a strong explanatory power. The pseudo- $R^2$  value is 21%, which is acceptable for cross-sectional data, confirming that the model fits the data well. Among the variables, Age, household size, years of formal education, extension contact, access to credit, and participation in the productivity trail revealed positive relationships and significantly influenced participation in the program.

The result shows that the age of the respondent household head is statistically significant (at 1% level) and positively influences CASP participation decisions. This means that as the age of the participating household head increases, it facilitates the chance of participation decision. However, this was in line with the findings of Gambo *et al.* (2016) who found out was a positive and significant contribution in that as age increases, the probability of participating in the IFAD-CBARDP increases in Katsina state.

The results also showed that the factor that significantly determined the farmers' participation in CASP is the household size (0.351) with a positive coefficient (at 5% level) which implies that as household size increases, the probability of participation increases, This corroborates the work of Yusuf *et al.* (2022) who find out the significant influence of household size in rice farmers 'participation in contract farming and attributed it with an increase in household size will provide available of family labor, which could serve as a driving force to seek for intervention to expand farm production. Furthermore, education was observed to positively influence households' participating decisions, in this finding years of formal education were positive (0.0522) and significant at 1% which implied that as farmers acquire formal education it increases their participation in the program. This is explicable as such years of formal education are bound to help farmers adopt better farming practices and acquire skills that will improve their performance. The foregoing would no doubt impact positively on decisions that will improve his productivity and welfare. Alabi *et al.* (2021), found similar results among smallholder farmers in Abuja, Nigeria. Access to credit has a positive and significant influence (p<0.05) on Participation

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in the program. From the result of this study, access to credit facilities leads to a 44.7% increase in participation. This can be attributed to the fact that the availability of credit in farming increases the chances of purchasing improved seed, fertilizer, and other inputs. This is in agreement with Abdullahi (2015) who all reported that access to credit influences participation in a project. Participation in the productivity trial has a positive and statistically significant influence (p<0.001) on participation in the program by 91.2%.

However, farming experience was reported with negative coefficient but was also statistically significant at 1%. It implies that even though farming experience is an important asset, it does not serve as a requirement for participation in the CASP program in the study area. Maize farm size had negative coefficient and significant at a 10% level. This implies that the more the farm size the less probability of participation. It is an indication that farmers with large farm sizes are not likely to participate more in the program than those with small landholdings, this finding agreed with that of Mani (2022) that a hectare increase in farm size decreases the probability that a farmer produces maize in Kaduna State, Nigeria and further explain that the bigger the farm size the higher the tendency that a farmer diversifies or intercrop maize with other crops.

Destisienties				D. /7/
Participation	Coefficient	Robust Std Error	L	P>/Z/
Age	0.00035	0.00904	0.02	0.997
Gender	-0.912246	0. 343122	0.2.54	0.011**
Marital Status	-0.217336	0.3252	1.61	0.543
Household Size	0.035954	0.0147	2.51	0.012 **
Highest Educ. Level	-0.13873	0.06632	-2.02	0.043
Years of formal education	0.052293	0.6632	-2.02	0.043**
Years of farming experience:	-0.034931	0.01519	3.53	0.001
Farm size	-0.132699	0.06884	-1.94	0.052
Membership of Cooperative	-1.195793	0.2233137	-1.60	0.109
Contact with an extension agent	0.177353	0.2462241	2.01	0.044 **
Access to credit	0.447401	0.174466	2.56	0.010
Participation in productivity trials	0912898	0.211929	4.31	0.000 ***
Constant	1.807046	0.784452	2.38	0.017
Log Likelihood	-228.98606			
LR $Chi^2(12)$	127.38			
Prob> Chi <sup>2</sup>	0.0000			
Pseudo R <sup>2</sup>	0.2176			
G				

I WOLD I I WOULD HILLWOULD I WILLWOULD I OF AN ALL AND ALL	<b>Table: 4 Factors</b>	influencing	Partici	pation of	CASP b	v maize	farming	household
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Source: Field survey 2023

#### **Impact of CASP Participation**

The result presented the treatment effects estimated from the PSM models. Based on the probit estimation of equation 1, propensity scores were obtained for the matching. The validation of PSM models depends on the quality of the matching. Table 5 provides the overall covariate balancing test Comparison of groups in a matched analysis requires appropriate statistical tests for matched data. High total bias reduction, significant p-value of likelihood ratio test after marching, low pseudo R<sup>2</sup>, and the significant reduction in mean standardized bias are good signs of successful balancing. Three matching algorithms which include nearest neighbor, Caliper or radius and Kernel marching were used. These methods reach different points on the frontier of the trade-off between the quality and quantity of the matches, and none of them is a priori superior to the others but their joint estimations offer a way to sufficiently assess the robustness of the estimates. However, Kernel matching gave the best matching and balance covariate. According to Becerra

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and Abdula (2009) the kernel-based method, all treated subjects are matched with a weighted average of all controls, using weights that are inversely proportional to the distance between the propensity scores of treated and control groups. The result revealed that the standardized mean difference for all covariates used in the PSM is reduced from 10.5% to 3.2% post-matching; the result also shows the matching reduction bias by 96.3%. In addition, the joint significance of covariates post-matching was also rejected (p-value=0.963). These results indicate that the required balancing property of the distribution of propensity scores is satisfied.

Table 5: C	Covariate	balancing a	and matching	quality test
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Sample	Pseudo R2	LR chi2	p>chi2	Mean Bias	Med Bias
Unmatched	0.026	15.52	0.017	10.5.	8.8
Matched	0.002	1.44	0.963	3.7	2.4

Source: Field Survey, 2023

Figure 1 presents the histogram distribution of the propensity scores among maize farming households who participate and those not participate. It shows the distribution of participating and non-participating households concerning estimated propensity scores. The figure illustrates the estimated propensity distribution for treatment and control households. The upper half of the graph refers to the propensity score distribution of treatment groups, while the bottom half shows the control groups. The y-axis represents the densities of estimated propensity scores.



Figure:1 Distribution of estimated propensity distribution for treatment and control groups and common support area

Impact of CASP participation on maize farming households was positive and significant on Net farm income and food security status in the study area. Average treatment on treatment (ATT) is the parameter of interest because it provides the estimated amount of Net farm income, food security status, per capita monthly expenditure, per capita assets value, and poverty gap between the treatment and the control groups. The result in Table 6 reveals that ATT was 627,457.998/ha of maize cultivated. While the ATE was 623120.395/ha. This implies that on average, the Net farm income of randomly selected maize farmers in the study area will increase by 623,120.395/ha. About untreated farmers, ATU is valued at 617,486.226 implying that if this category of respondent participates in to the program, their Net farm income from Maize production would increase by 617,486.226.

The ATT figure indicates that from the net income value participation in CASP would significantly increase the farm net income of Maize farming households. Also, the finding of food security results revealed that ATT was 4.27 HFIAS while the ATE was 4.34 which implies that a household randomly selected in the study area's food security score will decrease by 4.34. On the



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non-participating household, the ATU score indicated that if they were treated their HFIAS would reduce by 4.43. This means participation in CASP will improve the household score by lowering insecurity status through the provision of enough food for the household. According to the IFAD/CASP (2022) final assessment report on household food security though the impact was mild, participating in the program had reducing effects on food shortage, skipping of meals, and reductions of meals among project beneficiaries. The finding was in line with Tchegoun *et al.* (2021) who reported a decrease in household food insecurity experienced score (HFIES). The findings underscore the importance of the adoption of drought-tolerant maize varieties for the improvement of food security in Benin.

Variable	Sample	Participating	Non-Participatin	Difference	S.E	t-value
NFI	Unmatched	895380.205	228716.901	666663.304	192293.516	3.47***
	ATT	845871.389	218413.391	627457.998	163672.297	3.83***
	ATU	226510.478	843996.704	617486.226		
	ATE			623120.395		
Food Security	Unmatched	1.81	6.18	4.37	0.3122	14.02***
	ATT	1.8	6.07	4.27	0.361	11.83***
	ATU	6.23	1.80	4.43		
	ATE			4.34		
Per Capita Exp	Unmatched	163093.77	187428.27	-24334.50	18072.626	-1.35 NS
	ATT	163,459.74	188147.18	-24687.43	19913.804	-1.24NS
	ATU	189,145.65	167342.50	-21803.14		
	ATE			-23432.80		
Poverty Severity	Unmatched	1.8009095	1.68800254	0.112906966	0.59329	0.19NS
	ATT	1.71774521	1.60121259	0.11653262	0.60611	0.33NS
	ATU	1.72811234	1.92391851	0.195806164		
	ATE			0.199606522		
Per Capitan Ass	Unmatched	809,658.664	208661.77	600,996.894	585017.03	2.18**
	ATT	740919.852	180,170.1	560,749.752	694602.49	1.53
	ATU	215,979.59	758097	140,169.89		
	ATE			1,209,081		

#### Table 6 Propensity score matching: welfare impact of CASP Participation.

Source: Field Survey, 2023 \*\*\*, \*\*, and \* significant at the 1, 5, and 10

Furthermore, results on the per capita expenditure of the household indicate a reduction in the amount spent on per capita consumption of the participating household by  $\mathbb{W}2,884:29$  every week. This reduction could be attributed to many factors such as an increase in income, inflation recession. According to IFAD (2022), gains achieved through CASP are under threat due to COVID-19. During the lockdown, there was no opportunity for smallholders to sell their agricultural produce and generate income for their households. Thus, they have to rely on last

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year's harvest, including seeds and other productive assets, to cope with the liquidity crisis that came with the national lockdown.

The poverty severity index indicates the difference between the poverty line and the income/expenditure of those below the poverty line. The result indicates that the causal effect of CASP participation on the poverty severity index was positive although not statistically significant. The differential impact of an 8% reduction in the poverty severity index was recorded as a result of CASP participation in the study area. This finding correlates with Girma *et al.* (2023) who conclude that households that adopted more CSA practices experience better welfare.

The ATT shows that household per capita assets value for the treated is positive and statistically significant with a value of 560,749.752. This shows that participating households would have lost their per capita assets had they not participated in CASP. The finding corroborates with Oyetunde (2021) who reported an increase in per capita assets of the participating households and a significant increase in welfare on organic fertilizer usage that not only improves soil but also mitigates against climate impact.

#### **CONCLUSIONS AND RECOMMENDATION**

The study concluded that CASP participation significantly improved the welfare outcomes. The result shows a significant increase in the mean of Net farm income, food security and per capita assets of the households. However the results do not show strong evidence concerning the positive causality between CASP participation on per capita expenditure and poverty severity index. This perhaps may be because of the other unobservable factor that PSM cannot account on. The study utilizes cross-sectional farm household level data collected in 2023 using a multi-stage random sample of 436 households in Katsina state. We estimate the causal impact of participating using the propensity score matching method. Given the non-experimental nature of the data used in the analysis, a propensity score-matching model was used to account for selectivity bias. The finding generally confirms the potential direct role of participation in climate change adaptation programs in improving rural household welfare, as higher income from climate change adaptation strategies translates into food-secured households. Overall, the findings in this study confirm the widely held view development partners supported climate change adaptation programs are developing methodologies and approaches for reducing vulnerability and increasing resilience to climate change menace and contributing to stronger human development outcomes.

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