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EFFECTS OF CLIMATE VARIATIONS AND ADAPTATION STRATEGIES ON TOMATO YIELD. IN IMEKO AFON LOCAL GOVERNMENT, OGUN STATE, NIGERIA.

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ABSTRACT

Climate variability is one of the most serious environmental threats facing mankind worldwide. It affects agriculture in several ways, including its direct impact on food production such as production of tomato. This study assessed smallholder farmers' observable effects of climate variations on tomato yield and adaptation strategies in Imeko Afon. Random sampling technique was used to select 294 tomato farmers from 12 rural communities. The study area was purposively chosen due to its highest number of tomato farmers. Well-structured interview Schedule was used to obtain data on the observable effects of climate variations on tomato yield, various adaptation strategies used by the farmers and also socio-economic characteristics of tomato farmers. Data were analysed using descriptive statistics and Pearson's Chi-square test. The findings revealed that 88.4%, 71.1%, and 68.0% of the respondents strongly agreed that negatively affected planting season,unpredictable timing of harvest and reduced yield of tomato resp ectively were common observable effects of climate variation on tomato production. Chi-square test reveals that there is significant ($p \leq 0.05$) relationship between socio-economic characteristics and adaptation strategies used. Therefore, climate variations negatively affected tomato production leading to poor yield and high financial loss in the study area. Using of irrigation system, improved varieties,provision of training, and keeping the farmers informed about climate variation were recommended.

1. INTRODUCTION

The major environmental problem affecting us in this 21st century is the issue of change in climate all over the world (1), (2) revealed that, there is a change in climate when direct and indirect changes in the composition of the global atmosphere, which supports the natural climate variability, occurred over certain periods of time. Climate variability occurs under the range between a year to twenty nine years (1- 29yrs).

Climate variation had significant effects on the standard of living of the rural farmers in underdeveloped countries. The Fourth Assessment Report of the (3) found that agricultural productions in many African countries were drastically affected by climate variation.

Report from (4) says that small scale farmers are the farmers whose production capacity falls between 0.1 and 4.99 hectares holding.

Tomato; (Lycopersicon esculentum) belongs to the family Lycopersicon (5) reported that, if there is regular supply of water, tomato will grow anywhere in Nigeria. Tomato does well in the savanna zone comparing to the forest zone due to less prevalent diseases and pests.

(6) revealed that tomato fruit contained different nutritional value such as vitamin C, crude fat (22-29%), crude protein (23-34%), crude fibre (15-28%)and ash content (5-10%).

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According to (5), tomato is popularly classified into five botanical varieties based on their flowers, they are commune (common tomato), cercisiforme (cherry tomato), periforme (pear tomato), garandiforme (potato leave tomato) and validum (upright tomato),
(3) reported that, Climate adaptations are ways or methods used in reducing the natural and human activities against the climate change effects. Adaptation can also be defined as the way of adjusting to climate variability in order to reduce the damages and to make use of opportunities or to cope with the effects. This paper assesses smallholder farmers' observable effects of climate variations on tomato yield in Imeko Afon local Government Area of Ogun State.It also determines the level of significant relationship between adaptation strategies and socio-economic characteristics of tomato farmers.

2. METHODS

2.1 Study Area
The study was carried out in Imeko Afon Local government area of Ogun State, South West of Nigeria. Imeko Afon Local Government Area was purposively chosen because she is the major producer of tomato, in Ogun State, Nigeria.

2.2 Sampling techniques
Random sampling technique was used to select 294 smallholder tomato farmers from twelve rural communities in the study area.

2.3 Sources of data
Data were collected from the smallholder tomato farmers with a well-structured interview schedule, Information on age, sex, household size, major occupation, educational level, years of experience..Also, information on farmers observable effect of climate variation on tomato yield, adaptation strategies of tomato used by smallholder tomato farmers, relationship between adaptation strategies and socio-economic characteristics of the tomato farmers were collected.

2.4 Analytical Techniques
Data were analyzed with descriptive statistics and Pearson's Chi-square test. Descriptive statistics such as frequencies, percentages and mean were used. Pearson chi-square was used to test the significant relationship between the socio-economic characteristics and the adaptation strategies.

3. RESULTS AND DISCUSSSION

3.1. Socio economic characteristics of tomato farmer
Table 1 shows that majority (70.8%) of the respondents were within the working ages of 31 -50 years, and less than a quarter (23.8%) of the respondents were between age range of 51 -70 years, while very few (5.4%) were between age range of 21 -30 years. This implies that many of the respondents were middle aged and in their active years, being actively involved in tomato production as they experienced climate variation. The mean age was 46years; this shows that few youths show interest in tomato production. Almost all (96.9%) the respondents were male while 3.1% of the respondents were female. This shows that male dominated the population of tomato farmers in the study area and majority of the women were supporting their husbands in the production of tomato. More than half (51.0%) of the respondents had 6-8 household members while 40.8% had 3-5 members of household. The mean of the household was seven (7) persons. With the mean of the household, the farmers were not capable of meeting the requirement of the household needs.
Moreover, most (95.2%) of the respondents indicated that tomato farming is their major occupation. This implies that majority of the respondents in the study area were tomato farmers. Less than half (47%) of the respondents had no formal education, while more than half (53%) had formal education at primary, secondary or tertiary levels. The results indicated that, majority (73.1%) of the farmers had more than ten (10) years in farming experience im tomato production, while the means of years of experience was 18 years (table 1). This implies that the respondents had long years of experience in tomato farming, which by implication had experienced climate variations on tomato yields.

Table 1: Socioeconomic characteristics of the respondent (n=294)

Variables	Frequency	Percent	Mean
Age			
21-30	16	5.4	
31-50	208	70.8	
51-70	70	23.8	46 years
Sex			
Male	285	96.9	
Female	9	3.1	
Household size			
Less than3	8	2.72	
3-5	120	40.8	7 persons
6-8	150	51.0	
Above 8	17	5.8	
Major occupation			
Farming	280	95.2	
Artisans	4	1.4	
Trading	2	0.7	
Driving and riding	8	2.7	
Educational level			
No formal education	138	47	
Primary	95	32.3	
Secondary	36	12.2	
Tertiary	25	8.5	
Years of experience in operation			
1-5	16	5.4	
6-10	23	7.8	
11-15	93	31.6	18years
16-20	122	41.5	
20andabove	40	13.6	

Source: Field survey, 2019.

3.2 Farmers Observable Effect of Climate Variations on Tomato Yield

Table 2 shows the result of farmers' observable effect of climate variations on tomato yield. Most (68.0%) of the respondents strongly agreed, while one third (32%) agreed that climate variation reduced the yield of tomato. This implies that none of the respondents disagreed that climate variation reduced the yield of tomato. This report is in line with the assertion of (7) who reported that climate variability and change in Kano State caused decline in crop yield, which are identified by farmers as one of the major impacts of an increase in temperature, high rainfall variability. Majority (85.4%) of the respondents agreed that climate variation made the tomato to be vulnerable to harmful diseases and pest, since the climate variation favours the disease to do more havoc on the crop. None of the respondents disagreed that climate variation caused more disease harm to tomato crop. These findings are corroborated by (8), observed that which shows that smallholder farmers in Kenya perceived increased incidence of crop diseases as a result of climate variability.

More than half (52.0%) of the respondents strongly agreed, and less than half (48%) agreed that climate variation caused dehydration in tomato crop. This shows that the tomato crops lost a lot of water which affected the growth and fruiting of the crop. Majority (71.77%) of the respondents strongly agreed that climate variation made timing of harvest unpredictable. The reason for this is that the onset of rainfall will determine the period of planting and the period of planting will determine the period of harvesting. Since there is variation, it was no more predictable, which in turn really affected the tomato yield.

Furthermore, 88.4% of the respondents strongly agreed that climate variation negatively or adversely affected planting season. This implies that the onset of rainfall determined the planting season. Majority (70.1%) of the respondents strongly agreed that climate variation made tomato farming enterprise is unprofitable. The result in table 2 revealed tha on the average, less than half (47.0%) of the farmers strongly agreed that climate variation had adverse effect on tomato yield, while 53% of them agreed that climate variation had adverse effect on tomato yield.

Table 2: Farmers Observable Effect of Climate Variation on Tomato Yield

*SA-Strongly Agreed, A-Agreed, U- Undecided, SD-Strongly Disagreed, D- Disagreed

Observable effects	SA %	A %	U %	SD %	D %
Reduced the yield of tomato	68.0	32	0	0	0
Caused more diseases & pest					
Harmful to tomato crop	14.6	85.4	0	0	0
Caused dehydration in tomato crop	52.0	48.0	0	0	0
Made timing of harvest unpredictable	71.7	28.3	0	0	0
Negatively affected planting season	88.4	11.6	0	0	0
Made tomato farming enterprise					
Unprofitable	70.1	29.9	0	0	0
Mean ``	47	53	0	0	0

Source: Field survey, 2019

3.3 Adaptation Strategies to Effects of Climate Variations

The adaptation strategies used by the tomato farmers are; altering planting date, switching to tomato variety, planting pest and disease resistance, altering of tillage methods and use of mulching system. Majority (88.8%) of the respondents always altered planting date, while, most (66.7%) of them often switched to more adaptable tomato variety in adapting to climate variations.

Majority (73.1%) of the respondents always planted pest and disease resistance variety as an adaptation strategy to climate variation while more than one quarter (26.9%) often planted pest and disease resistance as an adaptation strategy to climate variation. More than one third (37.4%) of the respondents often, while less than a quarter (20.4%) used altering of tillage method as an adaptation strategy against climate variations. All (100%) of the respondents made use of mulching system especially in the nursery stage in adapting to climate variations. One out of five (20.1%) of the respondents do planted tomato crop on fadama lands occasionally as an adaptation strategy, because of the scarcity of fadama lands and the tedious aspect of tillage system, hence majority (79.9%) of the respondents never planted tomato on fadama lands because they believe that tomato do not like too much water and due to the problem of climate variation. Majority (88.8%) of the respondents reported that altering of planting date is very effective while 81.6% of the respondents said switching to tomato variety is very effective in adapting to climate variation. This report is concur with the assertion of (9) who reported that, in Kenya, farmers employed adaptation strategies such as changing crop variety, changing planting date and the rest. Majority (73.1%) of the respondents showed that planting pest and disease resistant varieties are very effective (especially 'omo oko', 'kerewa', plum and cherry tomato varieties) as an adaptation strategy. More than a quarter (26.9%) of the respondents shows that planting of pest and disease resistant variety is effective as an adaptation strategy on climate variation. This shows that planting of pest and disease resistant varieties is one of the adaptation strategies that were very effective against climate variations. Less than half (42.5%) of the respondents shows that altering of tillage method is very effective as an adaptation strategy on climate variation while more than half (57.5%) of the respondents indicated that altering of the tillage method is effective as an adaptation strategy on climate variation. This report is in agreement with the assertion of (3) who reported that land preparation should involve enough tillage operations to make soil suitable for seedlings or transplanting and to provide the best soil structure for root growth and development. All (100%) of the respondents used mulching system and claimed that it was very effective as an adaptation strategy against climate variation. Less than a quarter (20.1%) of the respondents shows that using fadama lands for tomato production is "effective" while majority (79.9%) of the respondents shows that it is "never effective" as adaptation strategy against climate variation.

Table 3: Adaptation strategies of tomato used by smallholder tomato famers
*AL- Always, OF-Often, OC-Occasionally, SE-Seldom, NE- Never. VE-Very Effective, E- Effective, NE- Never Effectives

Adaptation	**AL**	**OF**	**OC**	**SE**	**NE**	**VE**	**E**	**NE**
Strategies	**Percentage**					**Percentage**		
Altering planting date	88.8	11.2	0	0	0	88.8	11.2	0
Switching to tomato variety more adaptable	17.0	66.7	16.3	0	0	81.6	18.4	0
Application of irrigation	0	0	8.5	0	91.5	0	21.8	78.2
Planting drought resistant Tomato variety	0	0	0	0	100	0	0	100
Planting early or late maturing tomato variety	0	0	0	0	100	0	0	100
Planting pest & disease resistance	73.1	26.9	0	0	0	73.1	26.9	100
Altering of tillage methods e.g riding	8.2	37.4	20.4	0	0	42.5	57.5	0
Use of mulching system	100	0	0	0	0	100	0	0
Application of green manure or organic manure	0	0	0	0	0	0	0	0
Planting tomato crop on Fadama lands	0	0	20.1	0	79.9	0	20.1	79.9

Source- Field survey 2019

Table 4 shows the significant relationship between adaptation strategies and socio-economic characteristics of tomato farmers. The chi-square result shows that significant relationship existed between altering planting date and extension visits ($X2 = 12.092$; $p = 0.01$). Switching to tomato variety more adaptable was significantly related to education levels, farming experience and extension visits ($X2 = 12.092$; $p = 0.01$), ($X2 = 2.85$; $p = 0.04$), and ($X2 = 15.013$; $p = 0.001$), respectively. Planting pest and disease resistant variety was significantly related to education and farming experience ($X2 = 10.850$; $p = 0.013$), ($X2 = 10.034$; $p = 0.040$). Altering of tillage method had significantly relationship with education, farming experience and extension visits ($X2 = 18.877$; $p = 0.004$), ($X2 = 31.663$; $p = 0.000$), ($X2 = 11.733$; $p = 0.003$).
These results show that significant relationships therefore existed between adaptation strategies and some socio-economic characteristics such as age, household size, farming experience and training from extension agents.
This report is in line with assertion of (10) in Ondo State, Nigeria on farmers' adaptation to climate change found that age to larger extent has some level of positive relationship with with adaptation practices.

Table 4: Results of Chi-Square Analysis Showing Relationship between Adaptation Strategies and Socio-Economic Characteristics of the Farmers

Variables	**APDT**		**STV**		**APIRR**		**PELMT**		**PTCFL**		**PPDR**		**ATM**		**AGOM**	
	X^2	**P – value**	**X^2**	**P – value**	**X^2**	**P – value**	**X^2**	**P – value**	**X^2**	**P - value**	**X^2**	**P- value**	**X^2**	**P- value**	**X^2**	**P- value**
Age	7.234	0.124	4.346	0.825	2.978	0.562	9.963	0.041*	0.618	0.961	7.730	1.02	12.170	0.144	1.417	0.841
Sex	1.174	0.279	0.282	0.868	0.863	0.353	1.547	0.214	1.018	0.313	0.102	0.749	0.498	0.780	0.860	0.354
Marital Status	0.394	0.821	1.859	0.762	1.062	0.588	4.080	0.130	0.616	0.735	1.562	0.458	6.063	0.195	0.423	0.809
Education	10.618	0.14	21.311	0.002*	14.482	0.002*	21.696	0.000*	0.113	0.990	10.850	0.013*	18.877	0.004*	1.941	0.585
Household Size	5.303	0.15	3.941	0.685	1.366	0.714	14.940	0.02*	0.864	0.834	6.811	0.078	10.471	0.106	1.403	0.705
Farming Experience	13.188	0.10	22.857	0.04*	28.981	0.000*	15.545	0.04*	3.334	0.504	10.034	0.040*	31.663	0.000*	4.624	0.328
Extension Visits	12.09	0.01*	15.013	0.001*	10.165	0.001*	1.292	0.256	0.933	0.334	0.219	0.640	11.733	0.003*	0.243	0.622

Note: APDT = Altering planting Date; STV = Switching to Tomato Variety; APIRR = Application of Irrigation; PELMT = Planting Early or Late Maturing Tomato Variety; PTCFL = Planting Tomato Crops on Fadama Lands; PPDR = Planting Pest and Disease Resistance; ATM = Altering of Tillage Methods; AGOM = Application of Green or organic Manure.

Source: Field Survey, 2019

***represent significant level (p-value) at 5%**

4. CONCLUSION AND RECOMMENDATIONS

Indeed, climate variations in Ogun State really have harmful effect on tomato farmers in the study area. It is based on the findings in this study that it is hereby recommended that Ogun State Government should encourage the farmers to make use of the improved varieties that are drought resistance by making it available to the farmers. Government should encourage the farmers to use irrigation system by making irrigation service available to the farmer. Extension agents should provide training on different adaptation strategies against effect of climate variation, for tomato farmers in the state. In addition, Extension Agents should keep the tomato farmers informed about predictions of climate variations from time to time, as transmitted by NIMET.

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