Farm-Level Adaptation Strategies to Weather Variability and its Perception by Smallholder Farmers in Osun State

Muritala Oyedele Jabaru[1*], Ismaila Muritala[2], Mufutau Oyedapo Raufu[3], Olayinka Wole Agbogunleri[4], Abdssalam Akorede Miftaudeen-Rauf[5] and Jamiu Oluwaranti Olalere[6]

[1]Agricultural and Resource Economics Department, Federal University of Technology, P.M.B. 704, Akure 340110, Nigeria

[2]Department of Agriculture, Faculty of Science, Agriculture and Engineering, University of Zululand, Kwa Dlangezwa, South Africa

[3,4&6]Agricultural Economics Department, LadokeAkintola University of Technology, P.M.B. 4000, Ogbomoso, Nigeria

[5]Department of Economics, University of Ilorin, Kwara State, Nigeria

***Correspondence Author**

DOI: https://dx.doi.org/10.47772/IJRISS.2024.8100046

Received: 13 September 2024; Accepted: 03 October 2024; Published: 30 October 2024

ABSTRACT

The prevailing ideas about adaptation are vague, conducting focused research on potential adaptation practices and formulating appropriate advice for implementing new practices is difficult. Therefore, the debate about the adaptation of small-scale farmers in Africa to Weather Variability has occurred in the absence of knowledge about existing and potential adaptation practices. This study examines the various Adaptation Strategies to Weather Variability and its Perception by Smallholder Farmers in Osun State Nigeria.

The analytical techniques adopted include descriptive statistics and adaptation Strategies Used Index (ASUI), The results of the study showed that Use of fertilizer to replenish the soil was paramount out of fourteen adaptation strategies employed by the farmers. The t-test indicated that there were significant differences between pairs of socio-economic characteristics and adoption of adaptation strategies. The result from the Analysis of Variance ($F_{(13,\ 2255)\ df}$=26.79; $p<0.01$) showed that there were significant differences among the costs of adaptation strategies employed by the smallholder farmers. Smallholder farmers in Osun State have problem of capital to effectively combat Weather Variability.

The study concludes that the use of adaptation strategies available and accessible in the study area is a function of their personal characteristics and other socio-environmental factors.

Keywords: Weather Variability; Adaptation Strategies Used Index (ASUI), Socio-environmental factors

INTRODUCTION

Agricultural production remains the main source of livelihood for most rural communities in developing countries and sub-Saharan Africa in particular (Ogunpaimo and Dipeolu, 2023). In this part of the world, agriculture provides a source of employment for more than 60 percent of the population and contributes about 30 percent of Gross Domestic Product (GDP) (Ogunpaimo and Dipeolu, 2023).

Weather variability refers to the fluctuations and differences in weather conditions experienced over short periods, such as days or weeks. It encompasses changes in temperature, precipitation, humidity, and other weather elements that can differ from day to day or week to week in a particular location.

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VIII Issue X October 2024

Weather Variability is expected to influence crop and livestock production, hydrologic balances, input supplies and other components of agricultural systems. However, the nature of these biophysical effects and the human responses to them are complex and uncertain (Lobell *et al*, 2008; Wolfe *et al*, 2019; Fischer *et al*, 2019).

Poorer farm households will experience more significant adverse effects from weather variability due to their limited capacity to adapt to such changes (NEST and GCSI, 2024). The impact of weather variability, notably in Nigeria, encompasses various sectors, including agriculture, land use, energy, biodiversity, health, and water resources. Nigeria, like many Sub-Saharan African nations, remains highly susceptible to the consequences of weather variability (IPCC, 2021). It is worth highlighting that Nigeria, in particular, faces heightened concerns regarding weather variability due to its substantial vulnerability, attributable to its extensive 800-kilometer coastline, which is exposed to sea-level rise and the threat of severe storms.

Addressing this issue effectively necessitates a consideration of local communities and their unique understanding of weather variability. These communities perceive weather as having profound spiritual, emotional, and physical dimensions. Consequently, it is assumed that these communities possess an innate reservoir of adaptive knowledge, which they can draw upon to endure high-stress ecological and socio-economic conditions. Thus, human responses play a critical role in comprehending and analyzing the impacts of weather variability on crop production and food supply therefore facilitating adaptation efforts.

MATERIAL AND METHODS

Source of data

The data used for this research was sourced primarily with the use of a well-structured questionnaire collected from 300 Smallholder farmers. The information elicited from the respondents involved socioeconomic and demographic variables, production data, weather adaptation data, type of adaptation measures used and their financial implications. weather related data in term of rainfall pattern (low, high, delayed), wind, cloud air dust, losses and shock related events and occurrences, etc.

Sampling Technique

A multistage sampling procedure was used to select 300 respondents from the state. Firstly, Osun state was purposively chosen because Osun state has a larger percentage of smallholder farmers in southwestern Nigeria. In the second stage, two local government areas were selected from each of the three agricultural zones (Ife/Ijesha, Iwo and Osogbo). The third stage was the random selection of villages from farming communities/localities based on the proportional numbers of villages in the communities/localities and listing of households from the selected villages was done. The final stage involves the random selection of the required number of respondents which were interviewed. Overall, three hundred (300) respondents were selected across the three agricultural zones.

Analytical tools

Descriptive statistics was used to describe: socioeconomic characteristics of the Smallholder farmers and farmers' perceptions towards Weather Variability adaptation measures taken; Farm-level adaptation strategies to Weather variability was captured using the Adaptation Strategy Used S Index (ASUI).

Empirical Model Specification

An adaptation strategy Used index (ASUI) was developed by ranking. The extent of use of the ASI was expressed using a four-point scale with the scoring order 3, 2, 1 and 0 for frequently used, occasionally used, rarely used and not used respectively. This formula was adapted from (Islam and kashem, 2019) where the use of Ethno-Veterinary medicine in livestock management and rearing was estimated. The formula was modified to obtain:

$$ASUI = N_1 \times 3 + N_2 \times 2 + N_3 \times 1 + N_4 \times 0 \quad (1)$$

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VIII Issue X October 2024

Where;

ASUI = Adaptation strategies use index

N_1 = Number of respondents using a particular adaptation strategies index frequently

N_2 = Number of respondents using a particular adaptation strategies index occasionally

N_3 = Number of respondents using a particular adaptation strategies index rarely

N_4 = Number of respondents not using any of the adaptation strategies.

Number 3, 2, 1, and 0 represent frequently used, occasionally used, rarely used and not used respectively.

RESULTS AND DISCUSSION

Socio-Economic Characteristics of Smallholder Farmers

The socioeconomic characteristics of the respondents in the study area are presented in Table 1.0 The average age of the respondent in the study area is 40years, and this implies that Smallholder farmers are still relatively active and have the potential of being productive.65 percent of the smallholders are male while only 35 percent are female. This shows that farming is mostly done by men in the study area and probably that women are engaged in processing of farm output. Similar descriptions of gender distribution farmers in humid tropical environment have been discussed in(Adebayo et al 2020). Over three – quarters (68.67%) of the smallholders were married, showing that most of the respondents would want to take the responsibility of adapting weather risk mitigation measures to ensure food security.83.33 percent of the smallholder farmers has formal education, their exposure to education should assist in the learning process of adaptation techniques and also should help in understanding and adapting of new technologies as rightly observed by (Akinbode and Bamire, 2022). Education enhances farmers' capacity to comprehend complex information related to weather variability, as well as the technicality of modern adaptation strategies especially the use of fertilizer and irrigation which are dominant adaptation strategies reported by small holder farmers in the study area. Farmers with formal education are more likely to engage in strategies that require technical skills or knowledge, such as using improved seeds, applying fertilizers correctly, or managing irrigation systems. This may explain why the use of fertilizers (9.4%) and irrigation (8.2%) are common strategies, as these require a basic understanding of agronomic principles that educated farmers are more likely to possess. In addition, it is more likely for educated farmers to find it easier to access and interpret weather forecast report to guide their farming activities when compared with farmers with no formal education. However, education alone does not guarantee sustainable practices. Farmers may choose sustainable practices like organic manure or crop diversification provided that there are enough financial resources to support the practice. This therefore highlight the necessities of supporting small holder farmers with financial and technical resources is crucial to encourage the adoption of environmentally sustainable adaptation strategies.

The adaptation of new technology could also help in mitigating Weather Variability effects. About three-quarters (75.68%) of the respondents have household sizes of between 1-5 members. It has been established in a study (Oluwatayo and Ayodeji, 2019) that large household size is usually associated with a greater incidence of poverty, as measured by low household consumption or income per capita. However, large household size could be to the advantage to the family as it can be used as an avenue for providing family as family labour can be used in place of hired labour in other to reduce the cost of hired labour. Also, large families can easily diversify which could help in mitigating the effects and risks of weather variability. As revealed from Table 1.0 39.67 percent of the respondents have about 20 years farming experience; these years of experience could be an advantage for the farmers to withstand the risk of weather variability in the study area. More than three – quarters (93.67%) of the respondent have access to information about Weather Variability while only 6.33 percent of the respondents have no access to information about Weather Variability at all. This implies that information on Weather Variability is paramount in the study area therefore the level of adaptation is expected to increase. Also, smallholder farmer’s access to information about weather variability allows them to optimize

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VIII Issue X October 2024

the timing of interventions, making adaptation strategies more effective. For instance, when the farmer foresee drought through weather forecast report, they will be able to plan ahead how to mitigate the risk such as improvising with irrigation system. Access to weather information enables farmers to make proactive decisions, such as adjusting planting schedules, choosing appropriate crops, or preparing for potential droughts or floods. However, it is important to note that access to information about adaptation to Weather Variability does not necessarily result in the use/adoption of adaptation strategies. Which means that farmers may have access to weather forecasts but still lack the financial resources, technical support, or labor to fully implement sophisticated strategies like irrigation or crop diversification.

Table 1.0: Socio-Economic Characteristics of Smallholder Farmers in the Study Area

Age (years)	Frequency	Percentage
≤40	106	35.33
Gender		
Male	195	65.00
Female	105	35.00
Marital Status		
Married	206	68.67
Level of Education		
Formal Education	250	83.33
Household Size		
≤ 5	227	75.68
Year of Experience		
≤ 20	283	94.34
Weather Information		
No Access	19	93.67
Access	281	6.33

Source: Field survey Data: 2024

Perception towards Weather Variability

Table 2.0 revealed that 16.48 percent of the small holders reported too much of rainfall while 14.10 percent as an indication of changing Weather conditions and this influences their cropping pattern type of crops grown and the types of crops selected to be combined on a particular plot of land. This is closely followed by high

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VIII Issue X October 2024

temperature (14.10%). Generally, the results implied that crops that are resistant to water will be planted all year round in the study area to withstand the variability in weather. High humidity indicates that moisture content of the grains on the field will continuously increase which will lead to delay in harvest. high drought, destructive wind and dusty air which were reported indicate that fibrous root crops which are loosely rooted may not survive in the study area. The findings are in support of the (Maddison, 2023)

Table 2.0: Distribution of Respondents by Perception of Weather Variability.

FARM SIZE (Ha)	FREQUENCY	PERCENTAGE
Too much rainfall	138	16.48
Too low rainfall	107	12.78
Delay rainfall	97	11.59
High temp / hot weather	118	14.10
High humidity	102	12.19
Destructive wind	84	10.04
High drought	94	11.23
Cloudy / dusty air	97	11.59
Total	837	100.00

Source: Field survey Data: 2024

Weather Variability Adaptation Strategies Employed by Smallholders in Osun state

Assessing the different Weather Variability adaptation strategies employed by smallholders in Osun state, revealed that a number of strategies were considered based on the responses from the sampled households as shown in Table 3.0. A four – point scale was used in scoring households' responses. These scores are 3, 2, 1 and zero for frequently used, occasionally used, rarely used and not used respectively. The scores in the bracket were used to multiply the number of responses in each type of adaptation strategies, and then an addition was made to have adaptation strategies used in the study area (ASUI). The percentage of households who used each adaptation were estimated. Results showed that 9.4% of smallholders used fertilizer, 8.2% used irrigation, and 7.9% used organic manure and cover crop. About 7.5% used mulching, 7.4% used fallowing and 7.3% engaged in paid work as adaptation strategies. Also, 7.1% used crop rotation, 6.9% used personal savings, and 6.8% usually sold assets as adaptation strategies. Meanwhile, 6.6% used diversification, 6.1% used credit, 5.7% borrowed from cooperative society as adaptation strategies while only 5.2% obtained loans from bank as adaptation strategies. The result of the assessment shows that use of fertilizers to replenish the soil is the most widely used of all the Weather Variability adaptation strategies in the study area. This can be attributed to several key factors, including accessibility, cost-effectiveness, and immediate benefits, as well as the broader financial constraints faced by smallholders in Osun state, which drive their preference for strategies that offer short-term gains over long-term sustainability. Fertilizers are widely available and relatively easy to access in most rural markets, making them a convenient option for smallholder farmers in the study arear. Fertilizer suppliers are often well-established in agricultural communities, ensuring farmers can obtain the product without significant logistical barriers. Unlike more complex strategies such as crop diversification, which may require specialized knowledge and equipment, the application of fertilizer is straightforward and requires minimal technical expertise.

The use of fertilizers to replenish the soil as an adaptation strategy is closely followed by the use of irrigation and the growing of cover crops to protect the soil from excessive heat and evaporation of soil moisture especially during the dry season (Adebunmi et al., 2019). Irrigation systems can be set up using locally

available materials and knowledge, especially in areas with existing infrastructure like boreholes or rivers, making it an accessible adaptation strategy for water-stressed periods.

Fertilizer use and irrigation are cost-effective and offers immediate benefits for crop productivity. Fertilizers boost soil fertility, leading to faster plant growth and higher yields, especially in nutrient-depleted soils. This helps smallholders in Osun state produce more crops in a single season, allowing them to sell quickly and reinvest in the next planting cycle. Irrigation maintains consistent crop growth, mitigating risks from erratic rainfall, and enhances plant health, resulting in higher yields and better marketability. These strategies require less upfront financial commitment. Smallholder farmers in Osun State face financial challenges like limited credit, insurance, and fluctuating market prices, making long-term planning difficult. This insecurity leads to short-term strategies like fertilizer use and irrigation, which require minimal upfront investment, compared to long-term strategies like crop diversification or organic manure, which require more labor-intensive practices and a learning curve.

Farmers' preference for short-term gains is further driven by the need to meet immediate household consumption needs and to mitigate the risks posed by weather variability. Quick-yielding strategies allow them to sell surplus produce or reinvest profits into the next cropping season without enduring a prolonged waiting period. These benefits are particularly important in a context where savings are low and access to formal financial institutions, as indicated by the low percentage (5.2%) of farmers using bank loans, is highly limited. In contrast, organic manure (7.9%), mulching (7.5%), and crop diversification (6.6%) require a longer-term commitment and deeper knowledge of soil health and environmental sustainability. Organic manure, while beneficial in improving soil structure and long-term fertility, does not offer the immediate nutrient boost that chemical fertilizers provide. Its effectiveness can also be dependent on the type and quality of organic materials available, which may not always be sufficient or easily accessible for all farmers.

Financial constraints significantly influence farmers' adaptation strategies, The low percentages of farmers using credit (6.1%), borrowing from cooperatives (5.7%), and taking loans from banks (5.2%) illustrate the limited access to formal financial systems. This limits the investment in capital-intensive measures like large-scale irrigation systems and advanced organic farming techniques. Short-term solutions like fertilizers and small-scale irrigation are used, financed through personal savings or seasonal harvest profits. The lack of financial resources also prevents farmers from absorbing the risk of adopting new or experimental strategies, as they may not be sustainable in the long run.

While fertilizer use and irrigation provide immediate benefits in terms of yield increases and income generation, they may come at a cost to long-term sustainability. Over-reliance on chemical fertilizers can lead to soil degradation over time, reducing the soil's natural fertility and resilience to weather shocks. In contrast, strategies like organic manure and crop diversification help to build long-term soil health and ecosystem resilience, but these are not prioritized due to the immediate financial pressures faced by smallholder farmers. However, the use of Weather Variability adaptation strategies such as selling assets, obtaining a loan from the bank, and borrowing from the cooperative society or micro-credits agencies were conspicuous with low response. Thus, the result of the analysis presented clearly shows the relative importance of fertilizer as a veritable strategy in Weather Variability adaptation strategies. This is because use of fertilizers is the most accessible means of replenishing the available land for agriculture also, the relative importance of irrigation, use of organic manure as well as planting of cover crops have played an important role in adaptation to Weather Variability in the study area. The study was in support of Bradshaw et al, 2018.

Table 3: Ranking of Weather Variability Adaptation Strategies by Frequency of usage

Adaptation Strategies	Frequently Used (3)	Occasionally Used (2)	Rarely Used (1)	Not Used (0)	Asui % of Households	Rank
Irrigation	122	64	23	51	8.2	2
Use of fertilizer	122	96	37	38	9.4	1

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VIII Issue X October 2024

Use of organic manure	72	98	86	37	7.9	3
Mulching	85	75	70	68	7.5	5
Planting cover crop	90	83	62	69	7.9	3
Diversification practice	64	85	58	93	6.6	11
Crop rotation	74	76	76	71	7.1	8
Fallowing	90	83	38	88	7.4	6
Engage in paid work	82	78	57	79	7.3	7
Sell assets	75	77	52	100	6.8	10
Take loan from the bank	60	53	43	131	5.2	14
Borrow from cooperatives	60	63	54	121	5.7	13
Borrow from microcredit	71	65	40	113	6.1	12
Withdraw from personal saving	91	59	45	82	6.9	9
Total	**122**	**595**	**498**	**474**	**6325**	

Source: Author's Computation from Field Survey Data 2024

Where ASUI = N_1 X 3 +N_2 x 2 +N_3 x 1 + N_4 x 0

N_1 = Number of respondents using a particular adaptation strategies.

Number 3, 2, 1 and 0 represent frequently used, occasionally used, rarely used and not used respectively.

Summary of One-Way Anova Showing the Significant Difference Among Adaptation Strategies (Bonferroni)

The result from the Table 4 shows that there are significant differences among adaptation strategies employed by the smallholders ($F_{(13,\ 2255)\ df}$=26.79; $p<0.01$). This implies that the benefit derived from adaptation strategies such as fertilizer irrigation, fertilizer, organic manure, mulching, over cropping, diversification, crop rotation, fallowing, paid work, sell assets, loan acquire, cooperatives, micro credit and personal savings varies.

However, the direction of significant differences is not available from the result presented in Table 22. Therefore, in other to know the direction of differences, a post-hoc analysis of multiple comparison of the mean was done using Bonferroni, scheffe and sidak test. Bonferroni test has the highest number of adaptation strategies that have significant difference the result is presented in Table 23.

Table 4.0. :-Summary of One-Way Anova Showing the Significant Difference Among Adaptation Strategies (Bonferroni)

Source	SS	DF	MS	F	P
Between	504830	13	3.8833	26.79	<0.01
Within	326900	2255	1.4E+08		
Total	377390	2268	1.7E+08		

Source: Author's computation from survey data; 2024

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VIII Issue X October 2024

Multiple Comparison Showing Significant Differences among Adaptation Strategies

The result from Table 5.0 shows that the benefit derived from mulching (4564.59), cover cropping (1447.36), loan acquired (8976.32), Cooperative (1087.4), microcredit (10878.4) and personal saving (20464.9) are higher than that of irrigation. This implies that use of irrigation as adaptation strategies is less productive compared to aforementioned adaptation strategies.

The use of fertilizer as adaptation strategies was compared with the other adaptation measures. This shows that organic manure (3965.69), mulching (5951.23), cover cropping (5534), diversification (4998.89) crop rotation (4253.07), loan acquired (7589.68), cooperative (9440.53), micro credit (9491.76), and personal saving (19078.3), have higher benefit which add to the productivity of land labour and capital than the use of fertilizer labour and capital than the use of fertilizer.

Generally, among the adaptation strategies used in the study area, there are no significant difference in the use of fertilizer, bush fallow, irrigation, paid work and selling of assets. Meanwhile, despite the high usage of fertilizer as an adaptation strategies in the study area, there are significant difference between fertilizer and other adaptation strategies such as organic manure, mulching, planting of cover crop, diversification, crop rotation, loan, cooperative, micro credit, personal saving which have higher net benefit than use of fertilizer as discussed by Deressa et al 2018.

Table 5.0: multiple comparison showing significant differences among adaptation strategies

Adaptation strategies	Use of:													
	Irrigation (1)	Fertilizer (2)	Organc manure (3)	Mulching (4)	cover crop (5)	Diversification (6)	Crop rotation (7)	Fallowing (8)	Paid work (9)	Sell assets (10)	Bank loan (11)	Cooperative (12)	Microcredit(13)	Saving(14)
Irrigation														
Fertilizer	1386.64													
Organic manure	2579.06	3965.69*												
Mulching	4564.59*	5951.23*	1985.53											
cover crop	4147.36*	5534***	1568.31	417.224										
Diversification	3612.25	4998.89*	1033.2	952.334	535.11									
Crop rotatio	2866.43	4253.07*	287.375	1698.16	1280.93	745.824								

n														
Fallowing	1445.13	2831.77	1133.92	3119.46	2702.23	2167.12	1421.3							
Paid work	142.034	1528.67	2437.02	4422.56**	4005.33	3470.22	2724.4	1303.1						
Sell assets	1419.97	33.3333	3999.02	5984.56*	5567.33*	5032**	4286.4	2865.1	1562					
Bank loan	8976.32*	7589.68*	11555*	13540.9*	13123.7*	12588*	11842*	10421.5*	9118.35*	7556.35*				
Cooperative	10827.2*	9440.53*	13406*	15391.8*	14974.5*	14439*	13693*	12272.3*	10969.2*	9407.2*	1850.85			
Microcredit	10878.4*	9491.76*	13457*	15443*	15025.8*	14490*	13744*	12323.5*	11020.4*	9458.43*	1902.08	51.2315		
saving	2046.9*	19078.3*	23044*	25029.5*	24612.3*	24077*	23331*	21910*	20606.9*	19044.9*	11488.6*	9637.74*	9586.51*	

source: Author's computation from survey data; 2024

* Coefficient significant at 1%;

** Coefficient significant 5%

In summary, respondents in the study area perceived excessive rainfall as an indication of changing weather conditions. Use of fertilizer to replenish the soil is paramount out of fourteen adaptation strategies which are very conspicuous in their responses. Weather information and index of adaptation strategies play an important role in the adoption of adaptation strategies.

CONCLUSION

The study reveals that smallholder farmers in Osun State use various adaptation strategies to cope with weather variability, with fertilizers and irrigation being the most common. These strategies are often favored due to their accessibility, cost-effectiveness, and immediate benefits. However, they may not be sustainable in the long run. Financial constraints and short-term gains often lead farmers to prioritize these quick-yielding methods, while alternative practices like crop diversification and organic manure offer greater long-term resilience and environmental benefits. It's crucial not to overestimate the superiority of any single strategy, as each has its own advantages and trade-offs. Also, the use of adaptation strategies available and accessible in the study area is a function of their personal characteristics and other socio-environmental factors. Further research is needed to evaluate the long-term effectiveness of these strategies and explore how socioeconomic factors influence their choice and success. Policy interventions should focus on providing financial and technical support for a broader range of adaptive measures.

RECOMMENDATION

1. Efforts should be further intensified in developing the capacity of the farmers through education. This is because education helps in improving technology thereby adopting adaptation strategies to mitigate Weather Variability effect.
2. Weather Variability information mechanisms should be upgraded to benefit more smallholder farmers. This might reduce the risk of Weather Variability on smallholder farmers' productivity.

Contribution to the Knowledge

The study has both public and private (farm-level) policy implication: At farm-level, smallholder farmers should not depend solely on use of fertilizer as the only adaptive strategies, use of irrigation, planting of cover crop and use of organic manure can also be used in the study area.

Osun state government should include weather variability adaptation policies in their development agenda. This should include supporting farmers in increasing these adaptation measures through the provision of necessary resources such as credit, information and the provision of extension workers to train farmers on Weather Variability strategies and technology.

Potential Biases and Limitations in the Study

The study acknowledged potential biases and limitations that could impact the accuracy of its findings and generalization beyond Osun State. These include reporting bias and challenges in generalizing findings due to regional variations in climate, resources, and farming practices. Climate variations in Osun State may not be applicable or effective in other regions for instance the northern part of Nigeria, and general variation in the farming practices across Nigeria. The sampling method used may introduce limitations, such as underrepresentation of certain farmer groups and overlooking less visible or harder-to-measure adaptation strategies. Data collection methods may also limit understanding, as farmers may provide responses based on options presented to them, which may not fully capture their decision-making processes. The information provided by the farmer may be influenced by irregular seasonal changes, as farmers may report different adaptation strategies based on the specific challenges they were facing at that time. Open-ended interviews or participatory methods could offer more insights into farmers' decision-making processes.

REFERENCES

1. Adebayo, et al (2020)**.** Perception of farmers towards private forest plantation establishment in osun state. Journal of Research in forestry, wildlife and environment. Vol.12(3).
2. Adebunmi, O. A., Olatunji, O. J., & Luke, O. (2019). Effects of land management practices on food insecurity among farming households in Osun State, Nigeria. Journal of Food Security, 7(3), 97-102.
3. Akinbode, W. O., & Bamire, A. S. (2015). Determinants of adoption of improved maize varieties in Osun State, Nigeria. Journal of Agricultural Extension and Rural Development, 7(3), 65-72.
4. Bradshaw B., H. Dolan, and B. Smit. 2018. Farm-Level Adaptation to Climatic Variability and Change: Crop Diversification in the Canadian Prairies. Climatic Change 67: 119–141.
5. Deressa, T., R. Hassen, T. Alemu, M. Yesuf, and C. Ringler. 2018. Analyzing the determinants of farmers choice of adaptation measures and perceptions of Climate change in the Nile Basin of Ethiopia.
6. IPCC. (2001). Climate change 2021: Impacts, Adaptation and Vulnerability. In J. J. McCarthy,O. F. Canziani, N.
7. Islam, M. M. and M. A. Kashem. 2019. Farmers' use of ethno-veterinary medicine (EVM) in the rearing and management of livestock: An empirical study in Bangladesh. Journal of Sustainable Agriculture, 13 (4): 39-56.
8. Maddison, D. 2023. The perception of and adaptation to Climate change in Africa. CEEPA. Discussion Paper No. 10. Centre for Environmental Economics and Policy in Africa. Pretoria, South Africa: University of Pretoria.
9. Nigerian Environmental Study Team (NEST) and Global Change Strategies International (GCSI) (2024) Executive Summary of Five Multi-Sector Surveys on Nigeria's Vulnerability and Adaptation to Climate change.
10. Ogunpaimo O. R., & Dipeolu A. (2023). Determinants of Factors Affecting Adaptation Strategies to Climate Change of Cassava Processing in Southwest, Nigeria. Fudma Journal of Sciences, 3(3), 281 - 292. Retrieved from https://fjs.fudutsinma.edu.ng/index.php/fjs/article/view/1571.
11. Oluwatayo, I.B. and Ayodeji Ojo, (2019). Walking Through a Tightrope: The Challenge of Economic Growth and Poverty in Africa. The Journal of Developing Areas 52(1): 59-69.