



**EVALUATION OF CLIMATE CHANGE ADAPTATION STRATEGIES AMONG  
MAIZE FARMERS IN IDEMILI NORTH LOCAL GOVERNMENT AREA,  
ANAMBRA STATE, NIGERIA**

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**ABSTRACT**

This study evaluated climate change adaptation measures in maize growing households in Idemili North Local Government Area of Anambra State in Nigeria. A total of 120 maize growers were selected through stratified random sampling technique. Data were obtained using a structured questionnaire and analyzed using descriptive statistics. Results indicated that majority of the respondents belonged to the age group 30-39 years (37.5%), female sex (55.8%), and never married (35.8%). About half of them (48.3%) had secondary school education while 37.5% had 11-14 years of farming experience. Major adaptation measures include early planting (35.0%), crop rotation (34.2%), use of fertilizer (8.3%), use of organic manure (8.3%), improved maize seeds (6.7%), and greenhouses (7.5%). Major factors that hindered adoption include lack of climate information (60.8%), lack of credit facilities (59.2%), and poor extension services (61.7%). Majority of the respondents (42.5%) experienced increase in maize output due to adoption while 69.2% of them reported increased food security due to the adaptation measures.

**Keywords:** Climate-change, Adaptation, Strategies, Maize, Farmers, Food-security.

**INTRODUCTION**

Climate change has become one of the major threats to agricultural production all over the world especially in the developing countries that depend heavily on the weather for agricultural production. The Intergovernmental Panel on Climate Change IPCC (2023) states that there has been an average temperature increase of 1.2oC from the pre-industrial era due to which there have been irregular rainfall patterns, droughts, floods, and many more weather-related disasters. Climate change has affected agricultural production adversely and especially in the Sub-Saharan Africa region where over 80 percent of agricultural production is dependent on rainfall (FAO, 2023). Small-scale farmers have become vulnerable owing to the inability to adapt to the changing climatic condition due to lack of financial, technical, and institutional capacity (Dahiru *et al.*, 2025). One of the key sectors contributing to the economy of Nigeria in terms of employment, income, and food security is the agriculture sector. Maize (*Zea mays*) is one of the staple foods commonly grown in Nigeria. Maize accounts for approximately 20% of the calorie intake of Nigerians. The use of maize can be for consumption, for feeding livestock, and for agro-based industries (NBS, 2023). However, maize production is quite responsive to changes in weather parameters like rainfall and temperature and hence it is quite vulnerable to the effects of climate change. In recent years, Nigeria has been facing a number of cases of droughts and floods, which have led to crop failures. For instance, the case of flood in Anambra state saw several farmlands in Idemili North Local Government Area being flooded, thereby leading to low yields of maize and rising prices of foods (Jimoh, 2023).

Further adding to the risks faced by maize cultivation in Nigeria is the high dependence on rain-fed farming where approximately 60% of maize fields are rain-fed (Ibidapo & Ale, 2025). The problems caused by warming, irregular rainfall, shortened growth periods, and pest invasions have resulted in decreased productivity of maize (Ibrahim *et al.*, 2025a; Jimoh, 2023). According to some studies, pest-related factors may cause mean losses up to 73% for fall armyworms and 75% for white grub, with loss



from pest invasion being higher than losses caused by climate change (Ibrahim *et al.*, 2025a). Despite the development of various measures aimed at climate change adaptation such as drought-resistant maize seeds, irrigation, agroforestry, conservation agriculture, and organic soils, they have not been extensively used among smallholder farmers (Ibidapo & Ale, 2025).

However, factors such as lack of adequate credit facilities (Ogunleye & Kehinde, 2026), poor extension services (Dahiru *et al.*, 2025; Ogunleye & Kehinde, 2026), lack of climate information (Jimoh, 2023), poverty, problems associated with land tenure (Dahiru *et al.*, 2025), among others, have continued to impede the adoption of these practices. Major challenges include inadequate technical knowledge (82.6%), problems associated with land tenure (82.1%), lack of access to market (79.6%), and sociocultural challenges (79.6%) (Dahiru *et al.*, 2025). Such challenges not only lower the efficiency of agricultural production but also put the lives of farming families and the entire country's food security at risk. However, despite all the efforts put forth by governments and development agencies in promoting climate-smart agriculture, there are still some research gaps on the climate change adaptation strategies used by farmers. Thus, this research seeks to explore the climate change adaptation strategies of maize farmers in Idemili North Local Government Area of Anambra State. Specifically, the study sought to:

- i. determine the adoption of climate change adaptation strategies by maize farmers.
- ii. determine barriers to adoption of climate change adaptation strategies.
- iii. ascertain the socio-economic impact of climate change adaptation strategies on maize farming systems.

## **METHODOLOGY**

### **The Study Area**

The study was carried out in Idemili North Local Government Area. Idemili North Local Government Area (LGA) is one of the twenty-one LGAs in Anambra State, located in the North-Central part of Anambra State, within the state's commercial axis. The LGA is geographically positioned between latitude 6.08° N to 6.23° N and longitude 6.82° E to 6.97° E, sharing boundaries with Idemili South LGA to the south, Oyi LGA to the north, Enugu State to the north east, and Delta State and parts of Imo State lying farther west across the Niger River region. It covers a land area of approximately 66 km<sup>2</sup> (National Bureau of Statistics, 2012). The terrain is predominantly an undulating lowland plain, characterized by a series of low ridges, gentle slopes, and shallow valleys. The economy is predominantly driven by commerce and retail trade, small- and medium-scale manufacturing, agriculture including the cultivation of cassava, yam, maize, vegetables, oil palm, and fruits and transportation and logistics, supported by its strategic proximity to Onitsha.

### **Sampling Procedure and Sample Size**

Multistage sampling procedure was used for the study. In the first stage, Idemili North LGA was purposively selected as the study area due to the importance of maize production among farming households in the area. In the second stage, ten maize-producing communities were selected from the LGA and grouped into three clusters based on their geographical locations. The selected communities included Abatete, Eziowelle, Ideani, Nkpor, Obosi, Ogidi, Oraukwu, Uke, Umuoji, and Abacha. In the third stage, a list of maize farmers was compiled from the selected communities to serve as the sampling frame. The total population of maize growers in the selected communities was estimated to be 2,400. A sample size of 120 maize growers was obtained from this population using proportionate sampling. This was done in such a way that the number of maize growers sampled in each community was proportional to the population of maize growers in that particular community. The sample size constituted 5% of the total population of maize growers.



**Table 1:** Distribution of Maize Farmers across Communities in Idemili North LGA

| Community Group    | Communities           | Sample frame | Sample size (5%) |
|--------------------|-----------------------|--------------|------------------|
| Group 1            | Abatete               | 320          | 16               |
|                    | Eziowelle             | 260          | 13               |
|                    | Ideani                | 220          | 11               |
| <b>Group Total</b> |                       | <b>800</b>   | <b>40</b>        |
| Group 2            | Nkpor                 | 440          | 22               |
|                    | Obosi                 | 500          | 25               |
|                    | Ogidi                 | 200          | 10               |
|                    | Oraukwu               | 100          | 5                |
| <b>Group Total</b> |                       | <b>1,240</b> | <b>62</b>        |
| Group 3            | Uke                   | 120          | 6                |
|                    | Umuoji                | 140          | 7                |
|                    | Abacha                | 100          | 5                |
| <b>Group Total</b> |                       | <b>360</b>   | <b>18</b>        |
| <b>Grand Total</b> | <b>10 Communities</b> | <b>2,400</b> | <b>120</b>       |

### Method of Data Collection

Data were collected from primary sources through the use of a structured questionnaire. The questionnaire was structured into three (3) sections based on the specific objectives of the study. Section A sought information on adoption of climate change adaptation strategies by maize farmers in the study area. Section B focused on barriers to adoption of climate change adaptation strategies in the study area while Section C centered on socio-economic impact of climate change adaptation strategies on maize farming systems.

### Method of Data Analysis

Descriptive statistics such as frequency distribution, percentages, and mean were used in analyzing the data collected.

## RESULTS AND DISCUSSION

### Socio-Economic Characteristics of the Respondents

Results in Table 2 indicated that 55.8% of the respondents were females and 44.2% were males, implying that both females and males were actively involved in maize farming. Even though the female farmers represented the majority of the participants, the high percentage of female farmers signifies the major role played by women in agricultural production in the study area. This is consistent with the findings reported by FAO (2019) on the importance of women in small-scale agricultural practices despite the existence of gender disparities in the utilization of productive resources. Results on the age composition of respondents demonstrated that most (75.0%) of the participants belonged to the age group of 30–49 years, implying that maize production in the study area was dominated by relatively young farmers. This implies that most farmers practicing maize farming in the study area had the potential to adopt improved agricultural technologies. This finding is consistent with the studies conducted by Ozor & Nnaji (2011), and Ezech *et al.* (2020).

Moreover, the findings showed that majority (35.8%) of the respondents were single, and 21.7% of them were married, suggesting that maize cultivation activities are mostly performed by persons having different family responsibilities. Farmers who are married have higher chances of investing in agricultural production for their livelihood and food security. This research finding is consistent with Adeagbo *et al.* (2021), who found that 86.17% of small-scale maize farmers in southwestern Nigeria are married, and Nwoye *et al.* (2022) who stated that 63% of maize farmers in Anambra State are married. In terms of educational qualification, 48.3% of the respondents had secondary education, 31.7% were having tertiary education, and 20.0% of them had primary education. The moderate literacy level found in the farmers indicates that they have the potential of accessing agricultural information and adopting new technologies. The finding corroborates the assertion by Ndaghu *et al.* (2018) that approximately 70% of maize farmers in Adamawa State were educated, thus improving the likelihood of using good farming practices. The result shows that the majority (37.5%)



of the farmers had farming experience in maize farming ranging from 11 to 14 years. This implies that many of the farmers had gained extensive knowledge and skills in maize farming through experience. The finding is consistent with the findings by Ainembabazi and Mugisha (2014), who found out that experience was important in the adoption of agricultural technology because experienced farmers could evaluate both the strengths and weaknesses of new technologies over time.

Furthermore, it was evident from the findings that 46.7% of the respondents planted about one hectare of maize, 28.3% planted two hectares and 25.0% of the respondents were farming below one hectare. This distribution is a clear indicator that the production of maize in the study area is done mostly by smallholder farmers, an attribute that is usually noted in agricultural practices in southeastern Nigeria. This result is in line with the Food and Agriculture Organization (2015) report, which highlighted the fact that majority of farmers in sub-Saharan Africa plant less than two hectares of land and depend on family labour in their farming practices. In similar findings, Oluwatayo (2019) highlighted that most rural farming households in Nigeria were smallholder farmers planting between one and two hectares of farmland. Further findings show that 65.0% of the respondents were from a family size of four people, while 21.7% were from a family size of five people and 13.3% of the respondents were from a family size of one to three people. It is evident that the majority of maize growing families have a family size of four people, implying that there is moderate labor available for the farm operations. This finding supports the view by Food and Agriculture Organization (2017) which states that family labor is still the main labor resource for smallholder agriculture in Africa.



**Table 2.** Socioeconomic Characteristics of Respondents (N = 120)

| Socioeconomic Characteristics | Frequency  | Percentage (%) |
|-------------------------------|------------|----------------|
| <b>Age of Farmers</b>         |            |                |
| 18–29 years                   | 19         | 15.8           |
| 30–39 years                   | 45         | 37.5           |
| 40–49 years                   | 45         | 37.5           |
| 50 years and above            | 11         | 9.2            |
| <b>Total</b>                  | <b>120</b> | <b>100.0</b>   |
| <b>Gender</b>                 |            |                |
| Female                        | 67         | 55.8           |
| Male                          | 53         | 44.2           |
| <b>Total</b>                  | <b>120</b> | <b>100.0</b>   |
| <b>Marital Status</b>         |            |                |
| Married                       | 26         | 21.7           |
| Single                        | 43         | 35.8           |
| Divorced                      | 34         | 28.3           |
| Widowed                       | 17         | 14.2           |
| <b>Total</b>                  | <b>120</b> | <b>100.0</b>   |
| <b>Educational Status</b>     |            |                |
| Primary Education             | 24         | 20.0           |
| Secondary Education           | 58         | 48.3           |
| Tertiary Education            | 38         | 31.7           |
| <b>Total</b>                  | <b>120</b> | <b>100.0</b>   |
| <b>Farming Experience</b>     |            |                |
| 1–5 years                     | 21         | 17.5           |
| 6–10 years                    | 45         | 30.0           |
| 11–14 years                   | 36         | 37.5           |
| 15 years and above            | 18         | 15.0           |
| <b>Total</b>                  | <b>120</b> | <b>100.0</b>   |
| <b>Farm Size</b>              |            |                |
| Less than 1 hectare           | 30         | 25.0           |
| 1 hectare                     | 56         | 46.7           |
| 2 hectares                    | 34         | 28.3           |
| <b>Total</b>                  | <b>120</b> | <b>100.0</b>   |
| <b>Household Size</b>         |            |                |
| 1–3 persons                   | 16         | 13.3           |
| 4 persons                     | 78         | 65.0           |
| 5 persons                     | 26         | 21.7           |
| <b>Total</b>                  | <b>120</b> | <b>100.0</b>   |

### **The Adoption of Climate Change Adaptation Strategies**

From Table 3, it is evident that there are various methods that maize farmers use for coping with climate change. The two most common approaches in use by maize farmers in the study area include early planting (35.0%) and crop rotation (34.2%). These results indicate that most farmers prefer low-cost, locally sourced and experience-based practices rather than capital intensive and modern approaches. This result is in line with IPCC (2023), which found that most smallholder farmers in developing countries rely on low-cost agronomic approaches, including changes in planting time, crop diversification and soil management, as a response to increased climate variability. Table 3 further shows that only 6.7% of the respondents had adopted improved varieties of maize, 8.3% had used fertilizers, 8.3% organic manure and 7.5% engaged in greenhouse farming. Low level of adoption of these climate smart technologies can be explained by high costs of agricultural inputs, lack of access to improved seeds, inadequate extension services and poor access to agricultural financing. As FAO (2024) notes, these factors are the most significant barriers that prevent smallholder farmers in developing countries from adopting improved agricultural technology.



However, the findings show that early planting (57.5%) and crop rotation (42.5%) were the methods considered by the farmers to be the most effective. Effectiveness in this context takes into account not only yields but also risk mitigation and cost effectiveness (Below *et al.*, 2012). Furthermore, the results of the study show that 58.3% of the farmers made their decisions based on certain factors that could include information availability, financial ability or ecological situation. The importance of such factors in choosing adaptation strategy shows another general conclusion about adaptation being not a universal process but a context-based one, depending on the resources, institutions and agroecology (IPCC, 2014; Jost *et al.*, 2016). Also, it should be noted that 53.3% of the farmers were fully satisfied with the chosen adaptation methods while 45.8% were partially satisfied. The lack of dissatisfaction (0.8%) shows the overall positive attitude towards adaptation methods, implying that even simple measures can increase farmers' resilience and confidence. Other research has shown that the farmers' satisfaction and perceived effectiveness of the strategy play an important role in the sustainability of the adaptation practice, as it influences future implementation and knowledge sharing.

**Table 3: Adoption of Climate Change Adaptation Strategies by Respondents (N = 120)**

| Questions                                                                                  | Frequency  | Percent (%)  |
|--------------------------------------------------------------------------------------------|------------|--------------|
| <b>1. What adaptation strategies do you currently use to combat climate change impact?</b> |            |              |
| Early planting                                                                             | 42         | 35.0         |
| Crop rotation                                                                              | 41         | 34.2         |
| Improved maize varieties                                                                   | 8          | 6.7          |
| Use of fertilizers                                                                         | 10         | 8.3          |
| Organic manure                                                                             | 10         | 8.3          |
| Greenhouses                                                                                | 9          | 7.5          |
| <b>Total</b>                                                                               | <b>120</b> | <b>100.0</b> |
| <b>2. Which adaptation strategy is mostly effective to you?</b>                            |            |              |
| Early planting                                                                             | 69         | 57.5         |
| Crop rotation                                                                              | 51         | 42.5         |
| <b>Total</b>                                                                               | <b>120</b> | <b>100.0</b> |
| <b>3. Is there any factor influencing your choice of adaptation strategies?</b>            |            |              |
| Yes                                                                                        | 70         | 58.3         |
| No                                                                                         | 50         | 41.7         |
| <b>Total</b>                                                                               | <b>120</b> | <b>100.0</b> |
| <b>4. How satisfied are you with the effectiveness of the adaptation strategies?</b>       |            |              |
| Fully satisfied                                                                            | 64         | 53.3         |
| Partially satisfied                                                                        | 55         | 45.8         |
| Not satisfied                                                                              | 1          | 0.8          |
| <b>Total</b>                                                                               | <b>120</b> | <b>100.0</b> |

### **Barriers to Adoption of Climate Change Adaptation Strategies by Respondents**

The findings indicate that the farmers in this study area encounter serious challenges in adapting to climate change. About 60.8 percent of the respondents cited lack of information about climate change and adaptation techniques, while only 39.2 percent were informed about climate change and had access to the required information. Thus, inadequate dissemination of climate information seems to be an important challenge for maize farmers. The same situation prevails in other areas of Nigeria and the whole sub-Saharan Africa, where ineffective extension services and poor infrastructure for disseminating information about climate prevent the delivery of relevant information to smallholder farmers (Ozor & Nnaji, 2011; Nhemachena & Hassan, 2007).

One more barrier is related to financial access. Over half (59.2%) of the respondents did not have access to credit or any financial sources needed to implement the adaptation activities. Indeed, access to credit proves to be a key factor determining the ability of farmers to adopt new agricultural innovations and practices (Deressa *et al.*, 2009; Maddison, 2007). Lacking appropriate funding opportunities, farmers have to continue using traditional approaches and cannot implement capital



intensive practices, such as irrigation, greenhouse agriculture, or improved seeds (Ayanlade & Radeny, 2020).

More so, results showed that the availability of extension services was low since only 38.3% of farmers received technical help on adaptation to climate change. The lack of such extension services poses a big problem as they play a vital role in linking research and practices, giving customized advice to farmers and making it possible for farmers to adopt new technology (Anderson & Feder, 2007).

It is also interesting to note that 61.7% of farmers stated that there were no constraints limiting their further adaptation efforts while 38.3% noted particular constraints. It shows the heterogeneous adaptive capacity of farmers as while some of them are hindered in their adaptation process by the lack of resources and institutional support, others depend on their indigenous knowledge and social network, as well as available resources to respond to the climate challenges (Below *et al.*, 2012). This reflects the presence of systematic institutional constraints to adaptation. The result conforms to the literature that shows that poor extension services, lack of access to credit and insufficient climate information dissemination are major hindrances to adaptation in Nigeria and other developing countries (Maddison, 2007; Nnadi & Akwiwu, 2008; Below *et al.*, 2012).

**Table 4: Barriers to Adoption of Climate Change Adaptation Strategies by Respondents (N=120)**

| Questions                                                                                                     | Frequency  | Percent (%)  |
|---------------------------------------------------------------------------------------------------------------|------------|--------------|
| <b>1. Do you have access to information about climate change and adaptation strategies?</b>                   |            |              |
| Yes                                                                                                           | 47         | 39.2         |
| No                                                                                                            | 73         | 60.8         |
| <b>Total</b>                                                                                                  | <b>120</b> | <b>100.0</b> |
| <b>2. Do you have access to credit or financial resources to implement adaptation?</b>                        |            |              |
| Yes                                                                                                           | 49         | 40.8         |
| No                                                                                                            | 71         | 59.2         |
| <b>Total</b>                                                                                                  | <b>120</b> | <b>100.0</b> |
| <b>3. Do you have access to Extension service or technical assistance related to climate change Adoption?</b> |            |              |
| Yes                                                                                                           | 46         | 38.3         |
| No                                                                                                            | 74         | 61.7         |
| <b>Total</b>                                                                                                  | <b>120</b> | <b>100.0</b> |
| <b>4. Are there any constraints that prevents you from adapting more climate change Adoption strategies?</b>  |            |              |
| Yes                                                                                                           | 46         | 38.3         |
| No                                                                                                            | 74         | 61.7         |
| <b>Total</b>                                                                                                  | <b>120</b> | <b>100.0</b> |

### **Socio-economic Impact of Climate Change Adaptation Strategies on Maize Farming Systems**

The results presented in Table 5 show that climate change adaptation measures have brought about positive socioeconomic benefits for most of the maize farmers. In particular, 42.5% of the respondents reported increase in maize yield as a result of adoption of the adaptation measures, 30.0% did not experience any change in yield and 27.3% experienced decrease in yield. The relatively higher percentage of the respondents experiencing increase in yield shows that the adaptation measures have helped improve agriculture productivity even under the difficult condition of climate change. According to Rezaei *et al.* (2023), adaptation practices such as use of improved crop varieties, efficient management of nutrients, water management and climate smart agronomic practices have a great impact in enhancing productivity and mitigating the negative impacts of climate variability on maize cultivation. In addition, Abramoff *et al.* (2023) reported that climate adaptation measures can significantly help reduce future yield losses through increasing resilience of the agricultural system. However, the higher number of the respondents who either experienced no change or decrease in yield



shows that adaptation measures largely depend on various aspects like access to extension services, financial capacity, quality farm inputs, irrigation services and climate among others.

Moreover, from the results of the study, it was found out that 69.2% of the respondents believed that adaptation to climate change had enhanced their household food availability while 30.8% reported no effect. This means that successful adaptation has led to improved household food security through increased maize production and more reliable food supplies during the production period. According to Ocwa *et al.* (2023), climate-smart agriculture plays an important role in enhancing food security through increased crop productivity and resilience against any kind of climatic shocks like droughts and irregular rainfall. Similarly, the Food and Agriculture Organization (FAO, 2023) pointed out that adaptation enhances the four dimensions of food security, which include food availability, accessibility, utilization, and stability of food security, especially for small farming households. The lack of food availability experienced by the respondents may be due to the ongoing production problems like drought, floods, pests, ineffective storage methods, and lack of agricultural support services.

In relation to the household income, 67.5% of the respondents indicated that climate change adaptation strategies had increased their incomes, while 31.7% said there was no impact. In this case, it is evident that adaptation measures which have brought about increased productivity of maize has contributed positively to income for most households. As per Abramoff *et al.* (2023), good adaptation strategies not only improve crop productivity but also increase the profitability of farms by reducing the risk associated with climate on agricultural production. Likewise, Rezaei *et al.* (2023) observed that adaptation helps farmers to become more economically resilient through improving the agricultural production under varying climatic conditions. Higher incomes allow farmers to acquire better farming inputs, adopt advanced farming technology, diversify their livelihoods and withstand climatic changes in future. However, the large number of people who did not experience any impact in their income implies that the adaptation impacts are limited by several factors such as varying prices of commodities, high production costs, poor rural infrastructure, lack of agricultural credit and low market integration.

All in all, the results show that adaptation measures adopted to deal with climate change have brought benefits to socio-economic welfare of maize cultivation farmers by enhancing the productivity of crops, increasing household availability of food products, and creating new sources of income. The results of the present study are corroborated by the research results of Rezaei *et al.* (2023), who state that adaptation is one of the most efficient ways of maintaining agriculture under climate change conditions. At the same time, Ocwa *et al.* (2023) note that increasing the adaptive capacity of farmers is a key element in ensuring food security in developing countries. However, Abramoff *et al.* (2023) stress that adaptation alone cannot guarantee complete removal of the adverse effects of climate change without additional efforts to develop irrigation system, seed systems, agricultural extension services, financing options, and favorable government policies. Thus, ongoing institutional support is required in order to help more farmers adapt to climate change.

**Table 5: Socio-economic Impact of Climate Change Adaptation Strategies on Maize Farming Systems (N=120)**

| Questions                                                | Frequency  | Percent (%)  |
|----------------------------------------------------------|------------|--------------|
| <b>1. How has this change affected your maize yield?</b> |            |              |
| Increase Change                                          | 51         | 42.5         |
| No Change                                                | 36         | 30.0         |
| Decrease Change                                          | 33         | 27.3         |
| <b>Total</b>                                             | <b>120</b> | <b>100.0</b> |
| <b>2. Is there impact on food availability?</b>          |            |              |
| Yes                                                      | 83         | 69.2         |
| No                                                       | 37         | 30.8         |
| <b>Total</b>                                             | <b>120</b> | <b>100.0</b> |
| <b>3. Is there change in household income?</b>           |            |              |
| Yes                                                      | 81         | 67.5         |
| No                                                       | 38         | 31.7         |
| <b>Total</b>                                             | <b>120</b> | <b>100.0</b> |



## CONCLUSION AND RECOMMENDATIONS

This study sought to investigate the extent of adaptation strategies adopted by maize farmers in Idemili North Local Government Area of Anambra State as well as the socio-economic effects and constraints related to the adoption of the strategies. It was found out that the practice of maize farming is mostly done by young, educated, and experienced small-scale farmers farming between one and two hectares of land. The low-cost adaptation measures were used by the farmers such as early planting and crop rotation, whereas climate-smart technology such as improved maize seed, fertilizer use, and greenhouses were not used widely. The study also identified lack of climate information, extension services, and credit facilities as the main constraints to adopting the adaptation measures. In spite of all these, there were some positive contributions of adaptation practices to maize cultivation, whereby most of the people surveyed showed an improvement in their maize yields, food availability in their households, and also household income. From the above findings, it is clear that while farmers have shown adaptive capacity in using indigenous and cheap practices, there are still some institutional and financial barriers preventing them from using effective climate-smart technologies. Therefore, it will be very essential to enhance institutional support mechanism in order to increase the farmers' resilience. From the above results, the following recommendations can be made:

- i. There is need for enhancing agricultural extension services in order to ensure awareness and adoption of climate-smart agriculture among farmers.
- ii. The government and the financial sector should work towards improving access to affordable credits and subsidized agriculture inputs for smallholder farmers, such as improved maize seeds and fertilizers. This would help in overcoming the financial constraint inhibiting the application of efficient climate change adaptation technologies.
- iii. Absorption of climate information can be improved through proper collaboration among extension services, NiMet and local media to avail location-based weather forecasts and climate information which would be helpful to farmers in making informed decisions about planting and other farm operations.
- iv. There is need for government and development organizations to invest in agricultural support services in rural areas, such as irrigation infrastructure, better input availability and delivery of extension services to increase the positive impacts of climate change adaptation on maize production, incomes and food security.

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