



EFFECTS OF CLIMATE CHANGE ON GULLY EROSION ADAPTATION STRATEGIES IN ORUMBA NORTH LGA, ANAMBRA STATE

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Abstract

This study aims to investigate effects of climate change on gully erosion adaptation strategies in Orumba North Local government area of Anambra State. To achieve this aim, three objectives were formulated to guide the study. Relevant literature was reviewed based on the topic. The study adopted a descriptive design with a population size of 11,250. The random sampling technique was adopted to select a sample size of hundred (100) from the study area. A structured questionnaire was used to obtain data from the respondents. The completed copies of the instrument were collated and analyzed using mean and standard deviation. The results amongst others show that climate change led to heavy rainfall, high temperature, changes in seasonal rainfall, increase flash storms and soil degradation all increased the severity of gully erosion, poor agricultural practices, heavy rains, urbanization and certain soil all contribute to the causes of gully erosion and reforestation initiatives, soil conservation techniques, community awareness programs, construction of check dams and collaborative projects with NGOS and stakeholders to develop and implement erosion management plans are possible strategies used by the local government to mitigate and manage gully erosion in Orumba North local government area of Anambra State. It was there recommended that the policy makers should develop policies that address the impacts of climate change on gully erosion, focusing on infrastructure improvements to manage heavy rainfall and runoff, encourage sustainable farming practices to reduce soil degradation and mitigate erosion causes and strengthen partnerships with NGOs to implement reforestation and erosion management initiatives effectively.

Keywords: Climate Change, Gully Erosion, Sustainable Agriculture, Reforestation, Community engagement

Introduction

Modern society faces climate change as its most vital worldwide threat that deeply impairs natural environments while disrupting human communities and economic systems (Haider, 2019). Soil erosion triggered by gullies maintains its status as a severe threat to agricultural sustainability and land stability because increased greenhouse gas emissions result in elevated global temperatures together with altered weather patterns (Elum and Momodu, 2017). When pure surface water moves with high intensity it removes soil to form deep ravines that immediately expand and cause significant land damage and destroyed crop fields. According to Jellason (2019) worldwide soil fertility losses from erosion amount to 24 billion tons of soil per year thus creating severe food security and agricultural sustainability problems.

According to Ayadiuno et al (2022) the mechanism linking climate change to gully erosion remains complex since transformed precipitation patterns combined with increased storms and heightened temperatures serve as contributing factors to erosion. According to Egbueri and Igwe (2022) in that southern regions prone to higher rainfall intensity demonstrate enhanced vulnerability to gully erosion while recording annual erosion rates

exceeding 20 tons per hectare annually during heavy rainfall periods. Changing land usage and clearing forests worsen erosion risks because it undermines soil stability through vegetation removal thus creating an interdependent link between environmental destruction and climate change and poor land management (Ayanlade, 2017).

The frequency of severe weather events including heavy rainfall and water flooding increases because of climate change which results in elevated runoff quantities coupled with increased amounts of soil erosion (Okenmuo, 2021). Research conducted in sub-Saharan Africa documented how intense precipitation occurrences have escalated by twice their number since the last fifty years leading to notable increments in gullies and their growth. The continuous loss of vegetation during droughts releases soil to erosion and triggers damaging landscape changes creating destabilization that proves hard to stop. A World Bank projection indicates land degradation together with reduced agricultural productivity will make 100 million more people experience poverty by 2030 (Adeleke et al, 2018).

The economic conditions and social aspects of gully erosion represent major financial problems for rural populations who live by farming activities (Ayadiuno et al, 2022). The deterioration of productive land leads to lower agricultural harvests which both decreases farmer incomes and creates food shortages for rural communities. Data from the Food and Agriculture Organization (FAO) (2021) indicates that agricultural activities generate primary income for 1.5 billion people worldwide thus they face increased risk from gully erosion that climate change intensifies. Water quality near rivers and lakes suffers degradation because of erosion-produced sedimentation which impacts human water supply and aquatic ecosystems and makes the situation more difficult for communities.

Multiple adaptive methods has been introduced to fight gully erosion since climate change heightened this threat throughout different geographical areas (Thakural et al, 2018). Various methods including contour plowing together with terracing and cover crops affect a successful reduction of runoff and improve soil stability. Studies verify that implementing these methods cuts erosion rates down by fifty percent which increases both soil quality and farm production effectiveness (Nnadi et al, 2019). Afforestation together with reforestation allows nature to create barriers against water flow and protects vulnerable areas from heavy rain exposure by stabilizing the soils (Okenmuo, 2021).

Effective adaptation strategies need both community education and engagement because these components give people on the ground active roles in controlling erosion and sustain the longevity of these projects according to Ufot et al (2016). Sustainable land management awareness programs demonstrate a successful approach for gaining community participation which produces better land protection results and lessened soil erosion. Projects throughout East Africa experienced a breakthrough in local community involvement which reached 30% thus achieving better land quality and production outcomes (Adeleke et al, 2018).

The implementation of these adaptation techniques faces implementation obstacles when implemented in developing areas due to insufficient resources and technical skills of local populations. Lack of financial resources coupled with insufficient information availability prevents the effective implementation of necessary erosion control measures thus increasing the susceptibility of communities toward climate change effects (Ufot et al, 2016). Ongoing climate change introduces uncertainties that make researchers struggle to understand projected erosion patterns in addition to evaluating present-day adaptation plans. Research continues in parallel with land management strategies and community programs because experts have established that modifications in precipitation patterns lead to heightened extreme weather events and worsening soil erosion (Adeleke et al, 2018). These strategic approaches provide the means to cut down gully erosion effects while strengthening both

agricultural frameworks and vulnerable population ecosystems against climate changes. This problem requires immediate attention because it shapes the environmental sustainability of our planet and delivers security for our food production and economic stability during unpredictable times. The study seeks to generate vital knowledge which will help authorities make policies and implement sustainable practices to protect future safety. Its specific objectives include to;

1. Assess the impact of climate change on the severity of gully erosion in Orumba North local government area of Anambra State.
2. Analyse the causes of gully erosion in Orumba North local government area of Anambra State.
3. Examine strategies used by the local government to mitigate and manage gully erosion in Orumba North local government area of Anambra State.

The following research questions guided the study:

1. What are the impacts of climate change on the severity of gully erosion in Orumba North local government area of Anambra State?
2. What are the causes of gully erosion in Orumba North local government area of Anambra State?
3. What are the strategies used by the local government to mitigate and manage gully erosion in Orumba North local government area of Anambra State?

The following have been hypothesized by the researcher:

1. Favorable climate change significantly affects gully erosion adaptation strategies in Orumba North local government area of Anambra State.
2. Gully Erosion Adaptation Strategies significantly affects agricultural farming practices in Orumba North local government area of Anambra State.
3. Sustainable farming strategies used by the local government positively impacts the mitigation of gully erosion in Orumba North local government of Anambra State.

It is noteworthy to ascertain that the project also poses some significant importance to the people of Orumba North local government area of Anambra State. The need to understand climate change impacts on gully erosion demanded attention because climate change moves faster while endangering farming output along with local community subsistence. This investigation targets the particular climate change effects on erosion patterns to deliver vital knowledge for both leaders and stakeholders. The evaluation of present adaptation tools will show successful techniques along with unaddressed areas needing attention. This research evaluates the social and economic consequences of gully erosion together with everything necessary to develop sustainable land management practices. The research results will help create recommendations which increase the resistance of vulnerable communities while ensuring food security alongside environmental sustainability.

Literature Review

Concept of Climate Change

Scientists define climate change as extended modifications of temperature along with precipitation patterns and atmospheric elements across Earth's surfaces (Adeleke et al, 2018). Global surface temperature levels have increased by 1.1 degrees Celsius throughout the 19th century according to IPCC (2019). The atmospheric CO₂ concentration has grown more than 45% since the pre-Industrial Revolution period (National Emergency Management Agency (NEMA) 2018). Researchers measured this increase at 280 parts per million (ppm) before the Industrial Revolution to its modern value of over 410 ppm. The increase in GHGs follows industrial development and urban growth which produces more dangerous and more prevalent weather disturbances.

Climate change effects become visible throughout all parts of society. Strong evidence shows that hurricanes and droughts occur more often today than in earlier times. NOAA reports that weather and climate disasters causing at least \$1 billion in damage have grown substantially in the United States during 2020 through 22 separate events which resulted in damages surpassing \$95 billion. The worldwide system that provides food faces severe threats because of climate change. Rise in agricultural output deficits to a potential 10-25% by 2050 can be predicted by Akanwa and Ezeomede (2018) unless adaptation mechanisms are deployed. Cropping productivity of staple foods like wheat and maize becomes lower as temperatures rise and rainfall transforms because of climate change.

Concept of Gully Erosion

Gully erosion causes land degradation through deep narrow channel formation in the landscape which professionals define as gully erosion (Ayadiuno et al, 2022). Steps that accelerate erosion occur mainly because of excessive rainfall along with deforestation and weak land management techniques. Substantially understanding gullies plays an essential role for sustaining soil conditions together with agricultural production as well as ecological equilibrium. Gully erosion serves as one of the leading factors that cause worldwide soil degradation according to statistical analysis. According to the Food and Agriculture Organization (FAO) (2018) soil erosion affects 33% of Earth's land and gully erosion establishes itself as a significant root cause among these cases. Annually the regions of sub-Saharan Africa experience an estimated 10–30-ton soil loss per hectare due to gully erosion.

There has been an increase in severe rainfalls due to climate change that serves as a main cause of gully erosion occurrence. According to NOAA (2019) heavy rainfall events in the United States have risen by 20% during the past 70 years. The rising intensity of rainfall creates larger runoff amounts that worsens the soil erosion conditions. Gully erosion leads to serious financial losses which affect a wide range of economic activities. The expenses caused by soil erosion surpass \$1 billion annually in certain regions according to Ayanlade (2017).

Impact of Climate Change on the Severity of Gully Erosion

Climate change makes gully erosion worse due to powerful rainfall and changed precipitation rates. Heavy rainfall events will grow 10-20% in many regions throughout the upcoming 2100 period based on IPCC (2019). The increased runoff from heavy precipitation operates at a pace that erodes soil more sharply. Research published in Earth Surface Processes and Landforms demonstrates that areas dealing with 10% more intense rainfall will experience erosion levels which increase by a maximum rate of 30% (Ideki and Weli, 2019). The rising temperature levels cause land degradation through the loss of protective vegetation which keeps soils stable. Climate changes may result in a predicted 20% rise of gully erosion rates in vulnerable areas during the next 50 years according to research by the Food and Agriculture Organization (FAO) (2018). Gully formation becomes more severe along with increasing frequency due to the combined impact of higher rainfall and less vegetation cover.

Causes of Gully Erosion

Several natural conditions together with human-influenced elements cause gully erosion. Two major factors behind gully erosion are heavy rainfall together with improper land management combined with deforestation. NOAA (2019) reports that increased heavy rainfall events by 20% over the past 70 years caused both greater runoff and more detached soil (National Oceanic and Atmospheric Administration). Land management practices that include overgrazing along with monoculture farming systems destroy soil-stabilizing vegetation therefore worsening the situation. The Food and Agriculture Organization (FAO) (2018) shows that gully erosion affects approximately 70% of mundial agricultural land while reporting total land degradation at this level. The development of urban areas generates more non-soil surfaces which produce intensive surface runoff and erosion. The environmental challenges created by climate change led to changes in precipitation patterns and heavier rainfall frequency occurrences as described by Dioha and Emodi (2018). The combination of these environmental

elements builds a suitable setting for gully development hence threatening agricultural production alongside erosion hazards to land stability.

Strategies to Mitigate and Manage Gully Erosion

The mitigation and management of gully erosion depends on combining sustainable land practices with engineering solutions together with community participation. The primary sustainable techniques for addressing this issue include tree planting and shaped field techniques along with the construction of dams that control water flow. Reforestation conducted according to the research of Haider (2019) achieves soil erosion reductions of up to 50% in degraded areas. Tracing the land along contours becomes an efficient erosion strategy which decreases both surface water movement and maintains topsoil content to minimize the loss of earth material. Engineered technologies with check dams serve dual functions to control water flows and protect soil from degradation thus blocking gully formation according to Egbueri and Igwe (2022). Public education addressing sustainability practices and vegetation preservation must have community engagement as its core because local public awareness enables stronger resilience. Soil erosion management requires integrated land management according to the United Nations Convention to Combat Desertification (UNCCD) (2018). Elemental to the implementation of such methods is proper funding and adequate resources. When different strategies merge communities achieve better results in minimizing gully erosion while protecting their soils for better conservation.

Methodology

The research design applies descriptive methodology to study how climate change influences adaptation methods against gully erosion in Orumba North LGA Anambra State. The selected research design suits this project because it establishes a structured system to understand both community adaptation practices and present gully erosion conditions.

The residents of Orumba North LGA who experience direct impacts from both gully erosion and climate change make up the target population of this study. The study includes the participation of all three groups: farmers from the area and community leaders and representatives representing environmental concerns. A total of 11,250 residents are the population of study

Multiple demographic groups from the population will be adequately represented through stratified random sampling. The survey includes three strata consisting of 50 local farmers and 20 community leaders and 30 environmental experts for a total of 100 participants.

A structured questionnaire with established questions aims to gather relevant quantitative data for the study purposes. A section of fifteen (15) fixed-response survey items will pose questions regarding the three (3) research question using the summated rating system with Strongly Agree (SA) and Agree (A) and Disagree (D) and Strongly Disagree (SD). The rating scale will include Strongly Agree (SA) = 4, Agree (A) = 3, Disagree (D) = 2 and Strongly Disagree (SD) = 1.

The study conducted its statistical data evaluation through descriptive and inferential methods which operated through SPSS software. The research used multiple regression analysis as part of inferential analysis to evaluate hypotheses about the relationships between climate change and gully erosion adaptation alongside mitigation strategies. ANOVA tests determined the statistical relationships between the study variables (Nasheeda et al., 2019).

RESULTS

The bio data are analyzed using bar and pie charts, while the test of hypothesis were done using regression analysis. The results are shown below.

Bio data Analysis

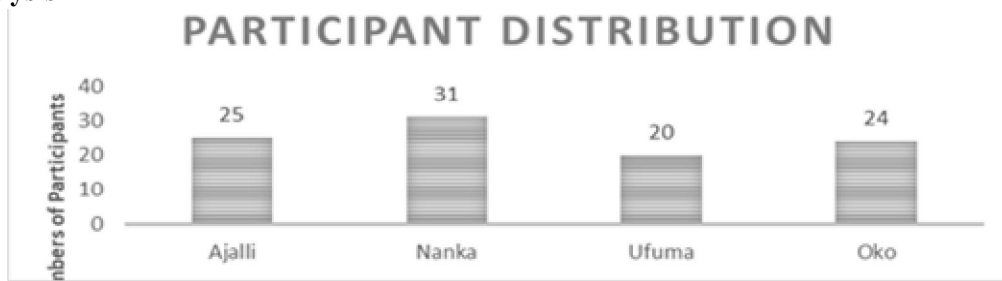


Fig 1: Participant geographical local government distribution

Fig 1 above shows the number of participants for the study from the chart, 25 were from Ajalli, 31 from Nanka, 20 were from Ufuma and the remaining 24 participant were from Oko area.

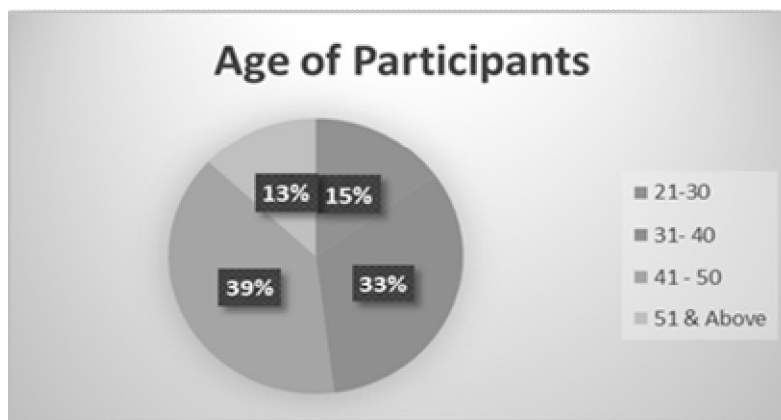


Fig 2: Age of Participants

The fig above represents the age distribution of the respondents. The highest was participants between the ages of 41 – 50yrs while the least was participants between the ages of 51 & above years.

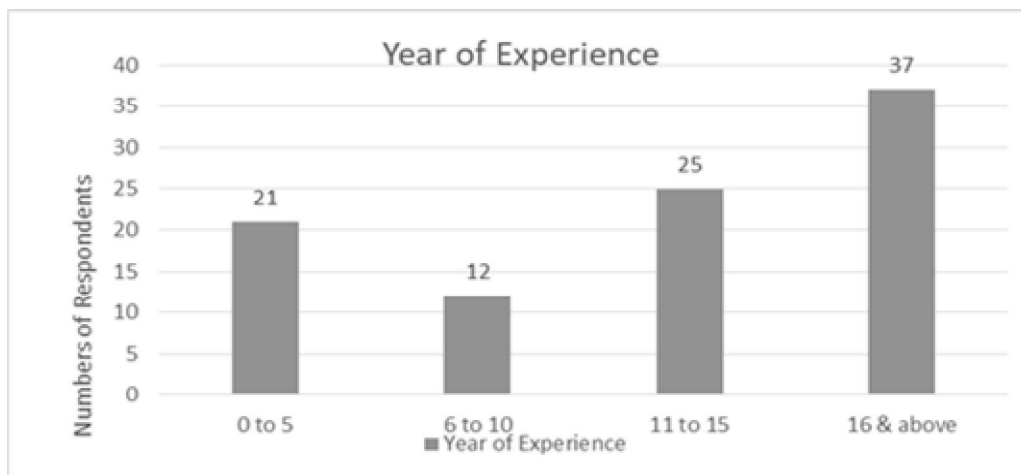


Fig 3: Year of Experience

From the fig above, 37 respondents had the highest experience in farming, while the least is 12 who had between 6 to 10 years of experience.

Descriptive Analysis

Research Question One: What are the impacts of climate change on the severity of gully erosion in Orumba North local government of Anambra State?

Table 3.1 Mean and Standard deviation on the impacts of climate change on the severity of gully erosion in Orumba North local government of Anambra State

S/N	Items	SA	A	D	SD	Mean \bar{x}	SD	Decision
1	More frequent heavy rainfall events lead to greater runoff, exacerbating soil erosion.	37	34	20	9	2.97	0.99	Accepted
2	Rising temperatures can reduce vegetation cover, which is crucial for soil stabilization.	39	26	26	9	2.98	1.08	Accepted
3	Changes in seasonal rainfall can lead to unpredictable erosion patterns, affecting local agriculture.	32	20	34	16	2.76	1.02	Accepted
4	More intense storms can cause flash floods that deepen existing gullies and create new ones.	44	31	19	6	3.14	0.99	Accepted
5	Climate change contributes to soil degradation, making it more susceptible to erosion	37	25	27	12	2.96	1.09	Accepted
	Weighted Mean					2.96		Accepted

Strongly Agreed (SA) = 4, Agreed (A) = 3, disagreed (D) = 2, and Strongly Disagreed (SD) = 1.

Decision=Weighted Mean = 14.81/5 = 2.96

Table 3.1 reviewed the opinion of the respondents on the impacts of climate change on the severity of gully erosion in Orumba North local government area of Anambra State. From the analysis all the items were accepted having a combine weighted mean of 2.96 which is greater than the criterion means of 2.5. This indicated that climate change led to heavy rainfall, high temperature, changes in seasonal rainfall, increase flashed storms and soil degradation all increase the severity of gully erosion in Orumba North local government area of Anambra State

Research Question Two: What are the causes of gully erosion in Orumba North local government area of Anambra State?

Table 3.2 Mean and Standard deviation on the causes of gully erosion in Orumba North local government area of Anambra State?

RQ2	Items	SA	A	D	SD	Mean \bar{x}	Standard Deviation	Decision
6	Deforestation like the removal of trees reduces soil stability and increases vulnerability to erosion.	33	20	36	13	2.79	1.01	Accepted
7	Poor Agricultural Practices like overgrazing and monoculture farming strip the land of protective vegetation.	33	25	30	12	2.83	1.01	Accepted
8	Heavy rains contribute to surface runoff, which erodes soil and creates gullies.	40	34	20	6	3.14	1.15	Accepted
9	Urbanization like Increased impervious surfaces from construction lead to higher runoff and erosion rates.	36	17	30	17	2.76	1.06	Accepted
10	Certain soil types in the region are more prone to erosion, especially when saturated.	41	24	23	12	2.95	1.09	Accepted
	Weighted Mean					2.88		

Strongly Agreed (SA) = 4, Agreed (A) = 3, disagreed (D) = 2, and Strongly Disagreed (SD) = 1.

Decision=Weighted Mean = 14.43/5 = 2.88

The table above represents the responses of the respondents on the causes of gully erosion in Orumba North local government of Anambra State and revealed that deforestation, poor agricultural practices, heavy rains, urbanization and certain soil all contribute to the causes of gully erosion in the local government. This is evident since the weighted mean used for decision making had 2.88 mean rating indicating that greater percentage of the sample size agree to the statements.

Research Question Three: What are the strategies used by the local government to mitigate and manage gully erosion in Orumba North local government area of Anambra State?

Table 3.3 Mean and Standard deviation on strategies used by the local government to mitigate and manage gully erosion in Orumba North local government of Anambra State

S/N	Item	SA	A	D	SD	Mean \bar{x}	Standard Deviation	Decision
11	Reforestation Initiatives like planting trees to restore vegetation cover and stabilize soils.	45	30	17	8	3.12	0.99	Accepted
12	Soil Conservation Techniques like contour farming and terracing to reduce runoff.	38	33	25	4	2.99	0.91	Accepted
13	Community awareness programs like educating residents about sustainable land practices to prevent erosion.	30	16	39	17	2.61	1.02	Accepted
14	Construction of Check Dams to slow water flow and reduce erosion in vulnerable areas.	43	35	16	4	3.05	0.92	Accepted
15	Collaborative Projects with NGOs and stakeholders to develop and implement erosion management plans.	41	32	21	6	3.06	0.97	Accepted
	Weighted Mean					2.97		Accepted

Strongly Agreed (SA) = 4, Agreed (A) = 3, disagreed (D) = 2, and Strongly Disagreed (SD) = 1.

Decision = Weighted Mean = $14.83/5 = 2.97$.

Table 3.3 reviewed the response of the respondents on the strategies used by the local government to mitigate and manage gully erosion in Orumba North local government area of Anambra State. From the analysis all the items were accepted having a combine weighted mean of 3.04 which is greater than the criterion means of 2.5. The study revealed that reforestation initiatives, soil conservation techniques, community awareness programs, construction of check dams and collaborative projects with NGOs and stakeholders to develop and implement erosion management plans are possible strategies used by the local government to mitigate and manage gully erosion in Orumba North local government of Anambra State.

Inferential Analysis

Table 1: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	0.606	0.315	0.273	0.318	1.902

Source: SPSS v25

Table 1 indicates that climate change and gully erosion adaptation strategies share a moderate 0.606 positive relationship with sustainable farming. The 31.5% portion of business sustainable farming in Agricultural farming stems from climate change and gully erosion adaptation strategies while 68.5% comes from unexamined elements

in this study. The gully erosion adaptation strategies related variables explain 27.3% of Agricultural farming performance changes, thus producing a slightly lower but stable model fit according to the Adjusted R^2 value of 0.273. The tested Durbin-Watson statistic valued at 1.902 meets the acceptable criteria of 1.5–2.5 which proves there is no significant autocorrelation in the model

Table 2: ANOVA Table

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	14.213	3	4.268	29.412	0.000
Residual	36.502	97	0.089		
Total	48.001	100			

Source: SPSS v25

An ANOVA test in Table 2 above demonstrated the statistical significance of the overall regression model. The ANOVA table establishes the statistical significance of the overall model through the F-statistic value of 29.412 together with the p-value of 0.000. Climate change and gully erosion adaptation strategies in Orumba North local government of Anambra State strongly relate to their sustainable farming practices. The p-value below 0.05 leads to null hypothesis rejection thus proving the reliability of the constructed regression model.

Table 3: Regression Coefficients

Model	Unstandardized Coefficients (B)	Std. Error	Standardized Coefficients (Beta)	t	Sig.
(Constant)	2.114	0.203		11.012	0.000
Favorable Climate Change	0.510	0.062	0.491	7.592	0.000
Gully Erosion Adaptation Strategies	0.591	0.071	0.278	7.918	0.000
Sustainable Farming	0.271	0.080	0.110	0.481	0.06

Source: SPSS v25

According to Table 3, a 0.510 increase in sustainable farming results from every unit increase in favorable climate change ($p = 0.000$). Farmers achieve better farming yield levels through favorable gully erosion adaptation strategies as indicated by the regression coefficient ($B = 0.591$) with $p = 0.000$. The statistical relationship between climate change and gully erosion adaptation strategies and sustainable farming reveals a positive correlation based on the coefficient value ($B = 0.271$, $p = 0.06$).

Research findings are strengthened by t-values which confirm the positive effects of gully erosion adaptation strategies ($t = 7.918$, $p = 0,000$) and favorable climate change ($t = 7.592$, $p = 0,000$) on agricultural farming. The analysis shows sustainable farming as an element that positively impacts agricultural farming because their statistical significance reaches $p = 0.06$ ($t = 0.481$).

Discussion

H₁: Favorable climate change significantly affects gully erosion adaptation strategies in Orumba North local government area of Anambra State.

The regression analysis demonstrates that farmers in Orumba North local government area of Anambra State will experience optimal financial performance when the climatic condition in the area is favorable for farming activities through their significant relationship leading to a 0.510 coefficient value with zero statistical probability. Elum and Momodu (2017) confirm the same finding through their research that shows farmers will achieve optimal financial performance when favorable climatic conditions prevail like adequate rainfall, suitable temperatures, and minimal extreme weather enhance crop yields and reduce losses. This stability allows farmers to invest confidently, ensuring food security and improved livelihoods, ultimately boosting the local economy and

community resilience. The study results verify that favorable climate change measures account for a substantial portion of gully erosion adaptation strategies through their moderate R-value of 0.606 which correlates with an R² value of 0.273.

H₂: Gully Erosion Adaptation Strategies significantly affects agricultural farming practices in Orumba North local government of Anambra State

The analysis shows that gully erosion adaptation strategies create positive statistically significant effects on agricultural farming because the coefficient stands at 0.591 and the p-value equals 0.000. Egbueri and Igwe (2022) confirmed this by stating that implementing techniques like terracing, planting cover crops, and building barriers not only mitigates erosion but also enhances soil health and productivity. These improvements lead to higher crop yields and increased farmer income, demonstrating a meaningful positive impact on agricultural sustainability. The analysis of data through ANOVA shows that gully erosion adaptation strategies lead to better agricultural performance since $F = 29.412$ and $p = 0.000$. Dioha and Emodi, (2018) along with other researchers found that Practices such as contour farming, reforestation, and drainage management prevent soil loss, fostering healthier crop growth. These measures result in increased yields and more resilient farming systems, ultimately contributing to greater food security and farmer livelihoods.

H₃: Sustainable farming strategies used by the local government positively impacts the mitigation of gully erosion in Orumba North local government of Anambra State.

The research findings demonstrate that sustainable farming strategies implemented by the government can be used to mitigate or curb gully erosions through a statistically significant factor of 0.271 with a $p=0.06$. The increase in sustainable farming strategies among farmers produces a direct positive impact on their likelihood mitigation of gully erosion in Orumba North local government of Anambra State. Haider. (2019) support these findings because believed that sustainable farming practices like crop rotation, agroforestry, and cover cropping improve soil structure and water retention. This proactive approach not only reduces erosion risk but also enhances agricultural resilience, ensuring better land management and long-term productivity for farmers. A Durbin-Watson statistic value of 1.902 indicates that severe autocorrelation does not affect the validity of the results. Farmers face gully erosion problems partly because the reused to adopt sustainable farming strategies that will impact the severity of gully erosion in the region.

Conclusion and Recommendation

The gully erosion in Orumba North LGA, Anambra State experiences major changes from climate change through three key elements: heavier rainfall events, elevated temperatures and modified precipitation patterns. Local factors of deforestation and poor agricultural practices together with these environmental influences worsen the state of soil degradation and increase erosion risks. The local government uses three essential strategies involving reforestation together with soil conservation practices and community education to reduce these effects. Community engagement combined with proper management strategies will enable Orumba North LGA to develop resilience against climate change impacts which will defend its agricultural territory and natural resources for upcoming generations.

Recommendation with Policy Implication

From the results it was therefore recommended that

1. Government authorities need to establish measures that handle climate change impacts on gully erosion by building infrastructure systems to control rainfall and runoff.
2. Authorities need to support sustainable agriculture practices because these methods help stop soil degradation while reducing erosion sources.
3. NGO partnerships require strengthening by policy makers for achieving successful implementation of forest restoration and erosion control programs.

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