



## Climate Change Adaptation and Mitigation Measures in Rural Farming Communities in Agbani Agricultural Zone, Enugu State, Nigeria

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### ARTICLE INFO

### ABSTRACT

#### Key Words,

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The research examined the climate change adaptation and mitigation measures in rural farming communities in Agbani agricultural zone, Enugu state Nigeria. Specifically, the research work examines the socio-economic characteristics of farmers, the level of awareness of farmers on climate change adaptation and mitigation measures, determines the effects of climate change on agriculture in the rural farming communities and identifies the adaptation and mitigation measures in rural farming communities in the study area. The sampling technique used was random sampling where ninety (90) respondents were used from the sampled frame. Data were collected from mainly primary source with well-structured questionnaires. The data obtained were analyzed using descriptive statistics and 4-point likert-scale. From the result, the mean age of 32 years were the average age of the respondents interacted with in the study area. It also showed that majority 50% interacted with are married. The research further found out that higher percentage of respondents in the study area is illiterate. The farming experience of the farmers in the study area is 7 years just as the number of their house hold size is 7 persons. From the results obtained from the 4-Point Likert Scale used, with 2.50 as the cut-off, which implies that any mean score that is below 2.50 is regarded as areas with no occurrence of climate change, climate change adaptation and mitigation. Meanwhile from the research, majority 3.64 stated that climate change exists, while minority 2.37 said that rising concentration of human produced greenhouse gases (GHGs). The research recommend among others that there is need for advance research of indigenouse methods of coping techniques with regards to climate change adaptation and mitigation measures as well as provision of adequate awareness.

## 1.0 Introduction

The earth's climate is changing with temperatures rising, and rainfall patterns shifting with more extreme condition as a result of climate events like heavy rainstorms, hurricanes, flooding, tornadoes and high record of temperature. Many of these observed changes are linked to the rising levels of carbon (IV) oxide and other Green House Gases in our atmosphere, caused by human activities according to the United States Environmental Protection Agency (UN EPA, 2016).

With the earth's average temperature which has risen by 1.5<sup>0</sup>F over the past century, and is projected to rise another 0.5 to 8.6<sup>0</sup>F over the next hundred years; these changes in the average temperature of the planet can

translate to large and potentially dangerous shifts in climate and weather. The evidence is clear that as these and other changes become more pronounced in the coming decades, they will likely present challenges to our society and our environment (UN EPA, 2017). The seasonal global land and ocean temperature for June-August 2017 was third highest since global records began in 1880 at 0.81<sup>0</sup>C (1.46<sup>0</sup>F) above the 20<sup>th</sup> century average of 15.6<sup>0</sup>C (60.1<sup>0</sup>F). This value falls behind the record year 2016 by 0.08<sup>0</sup>C (0.14<sup>0</sup>F) and 2015 by 0.05<sup>0</sup>C (0.09<sup>0</sup>F) (NOAA, 2017).

Globally, climate change is considered as one of the serious threats to sustainable development, with adverse impacts expected on the environment, human



health, food security and physical infrastructure (Africa-Wide Civil Society Climate Change Initiative for Policy Dialogues (ACCID), 2010). Climate change affects all aspects of the climate, making rainfall less predictable, changing the character of the seasons, and increasing the likelihood or severity of extreme events such as floods.

The Intergovernmental Panel on Climate Change (IPCC) defines climate change as a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer). According to the United Nations Framework Convention on Climate Change (UNFCCC), climate change is attributed directly or indirectly to human activity that alters the composition of global atmosphere which is in addition to natural climate variability observed over comparable periods (IPCC, 2007).

Scientists agreed that rising concentrations of human-produced greenhouse gases (GHG) in the earth's atmosphere are the causes of climate change. For example, the increased industrialization in the developed nations emits large quantities of greenhouse gases (GHGs), including carbon (IV) oxide (CO<sub>2</sub>), methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O) into the atmosphere. These GHGs are the primary causes of global warming (IPCC, 2007a).

Nigeria is in the tropics, where the climate is seasonally damp and very humid. It has a variety of ecosystem from mangrove and rainforests on the Atlantic coast in the South to the savannah in the North bordering the Sahara (Nairu, 2009). These, couple with variety on elements of climate such as rainfall and temperature exposes the country to the impact of climate change.

Nigeria as a country practicing rain-fed agricultural system is highly dependent on climate because, sunlight, water, relative humidity are the main drivers of crop growth and yields (Adejuwon, 2004). It is currently experiencing increasing incidence of diseases, declining agricultural productivity, increasing number of heat waves, unreliable or erratic weather patterns, flooding, declining rainfall in already desert-prone areas in the north causing increasing

desertification, decreasing food production in critical regions, and destruction of livelihoods by rising waters in coastal areas where people depend on fishing and farming. Climate change threatens to undermine the progress that has been achieved till date in the agricultural activities of the rural farming communities of Enugu State and that of Agbani agricultural zone where the study area is done.

In Enugu State and the study area, the most significant effects of climate change experienced by farmers are; soil erosion, lack of portable water for human consumption and livestock use, loss of vegetation or pastures, intense weed growth, incidence of pests and diseases distortion and destruction of wildlife ecosystems, decrease in soil fertility and health related issues of climate change which can affect production, drudgery and stress from heat, etc (Ozor and Nnaji, 2011).

According to Enete *et al* (2011), the biggest effect of climate change in the state include reduced farm yield and income, drying up of streams or rivers, reduction in storage quality of crops, loss of pastureland or vegetation and destruction of wildlife ecosystem which perhaps is attributable to the fact that Enugu State has a drier weather; being closer to the North, and hence inherent insufficient rain water for maximum crop yield (Nzeh and Eboh, 2011). It remains unclear however, what the character of the new climates will be when they become fully established. The key uncertainty, therefore for agricultural outlook in the country is the climate (IPCC, 2007).

Therefore, knowledge of the effect of climate change on rural farming communities, adaptation and mitigation measures will solve the issues that climate change imposed on farmers in Enugu state. Among other havocs, those recorded and not recorded, not fewer than three hundred (300) families have been rendered homeless in Ameke Ngwo and Ngwo-uno communities in Udi local government area of Enugu state following the destruction of their houses and economic trees worth millions of naira by a wind storm which caused havoc in the area due to climate change as reported by (BNRCC, 2009).

### Research Objective

The broad objective of the study is to examine climate change adaptation and mitigation measures in rural farming communities in Agbani agricultural zone, Enugu State, Nigeria.

The specific objectives are to;

- i. examine the socio-economic characteristics of the respondents in the study area;
- ii. identify the level of awareness of farmers on climate change in the study area;
- iii. determine the effects of climate change in rural farming communities in the study area;
- iv. Identify the various farmers' adaptation and mitigation measures to climate change in the study area.

### 2.0 Research Methods

The study was carried out in Agbani agricultural zone. Geographically, it comprises of three (3) local governments areas of Nkanu West, Nkanu East and Enugu South. Nkanu West is made up of thirty seven (37) communities, while Nkanu East is made up of thirty two (32) communities and Enugu South is made up of nine (9) communities.

From the formed sampling frame, purposive selections of two communities each from the three LGAs that make up the agricultural zone were done. These communities are: Agbani and Akegbe Ugwu communities for Nkanu West; Nara and Ugbawka communities for Nkanu East whereas Amechi Uno and Obeagu Uno communities for Enugu South. From the selected communities, fifteen (15) respondents each were selected, giving a total of ninety (90) respondents. Data were collected with the use of well-structured questionnaires. Descriptive statistics and 4-Point Likert scale to examine the effect of climate change on rural farming communities were used to analyze data collected.

### 4.0 Results and Discussion

#### 4.0. 1. Socio-Economic Characteristics of Farmers

The socio-economic status considered in this study include sex, age, marital status, level of education, major occupation, minor occupation, types of farming

activities carried out, size of farm land among others. Amongst the ninety (90) farmers reached and interviewed, the results and analysis are presented and shown below;

**Table 1: Distribution of respondents according to their socio-economic characteristics (n= 90)**

Variable	Frequency	Percentage (%)	Mean
<b>Sex</b>			
Male	18	20	
Female	72	80	
<b>Age in Years</b>			
< 20	10	11.11	
21-30	37	41.11	
31-40	19	21.11	32
41-50	19	21.11	
>50	5	5.56	
<b>Marital Status</b>			
Single	35	38.89	
Married	45	50	
Widowed	10	11.11	
<b>Educational Qualification</b>			
No formal education	37	41.11	
Primary school certificate	17	18.89	
O level certificate	16	17.78	
OND	11	12.22	
B.Sc.	8	8.89	
Ph.D.	1	1.11	
<b>Others</b>			
<b>Occupation</b>			
Farmers	51	56.67	
Trader	11	12.22	
Civil servant	9	10	
Artisan	5	5.56	
Others	14	15.56	
<b>Household Size</b>			
< 5	26	28.89	
6-10	51	56.67	
11-15	12	13.33	7
>15	1	1.11	
<b>Years Of Farming Experience</b>			

< 5	40	44.44	
6-10	34	37.78	
11-15	15	16.67	7.58
>15	1	1.11	
Farm Size in Plot			
< 5	20	22.2	
6-10	28	31.11	
11-15	28	31.11	
16-20	9	10	10.83
21-25	3	3.33	
26-30	2	2.22	
Religion			
Christianity	75	83.33	
African traditional religion	15	16.67	

**Source: Field Survey, 2017**

The table 1 above shows that the majority 80% of the farmers interacted with in the study was females, while male farmers interacted with in the study constituted the minority 20%.

Also, from the table 1 above, one can see that the mean age of 32 years were the average age of the respondents interacted with in the study area. This shows that youths are slowly returning back to agricultural activities as agriculture requires young and vibrant categories of people for its success as well as to create much needed employment opportunities hence agriculture is today taking as business across the nation.

According to the marital status from the same table 1 above, it shows that majority 50% interacted with are married; the single constitutes 35% but minority of 11.11% constitutes the widowed. From the result, it shows that married people are more in farming activities in the study area hence they use such to take care of their families.

Education is the bedrock of knowledge. Generally, it increases the horizon of human activities, operations and understanding of his environment including farming activities. Result from the table above indicates that majority 41.11% of the respondents reported they had no formal education, which means they are mostly illiterate farmers. The scenario above indicates that reduced agricultural productivity in the state may be as a result of lower educational levels of

the respondents. This consequently affects farming activities at a higher percentage in the study area.

From the table 1 above, it shows that mean household size of 7 persons is obtainable in the study area. This large family size suppose to help farming activities in the stay area, hence each family will have more hands to work in any stage of farming operations.

Findings from this research show that experience of those in the study area regarding farming on the average is 7 years. Although these farmers have less acres of land to work with, these experience will help them to have adequate knowledge on how to handle any agricultural challenge they are faced with including climate change.

#### 4.0.2 Level of awareness of climate change by farmers

**Table 2: Level of Awareness of Climate Change by farmers in the study area**

S/No	4 = S.A	3 = A	2 = D	1 = S.D	Fx	Mean	Decision
1	67	19	3	1	328	3.64	Accepted
2	49	26	10	5	299	3.32	Accepted
3	38	39	7	6	289	3.21	Accepted
4	39	29	10	12	275	3.06	Accepted
5	20	23	25	14	213	2.37	Rejected
6	29	33	14	14	257	2.85	Accepted
7	24	36	15	15	249	2.76	Accepted
8	29	23	25	13	248	2.75	Accepted
9	37	27	18	8	273	3.03	Accepted
10	30	22	24	14	248	2.75	Accepted
11	36	26	19	9	269	2.99	Accepted
12	35	24	24	7	267	2.97	Accepted
13	35	32	15	8	274	3.04	Accepted
14	26	41	15	8	265	2.94	Accepted
Grand mean						41.68	

**Source: Field Survey, 2017**

**Table 2:** 4-Point Likert table showing the level of awareness of farmers on climate change, climate change adaptation and climate change mitigation.

SA = Strongly Agree

A = Agree

D = Disagree

SD = Strongly Disagree

**Decision Rule:** Cut off point = 2.50

>2.50 is regarded as there is occurrence of climate

change, climate change adaptation and climate change mitigation. Values <2.50 are regarded as having no occurrence of climate change, climate change adaptation and climate change mitigation.

From table 2 above, it shows that the majority mean score = 3.64 believe that climate change exists. The mean score of 3.32 represents respondents that said climate change is now a serious and long term threat in the global world. The mean score of 3.21 shows respondent believes that climate change refers to any change in climate overtime, whether due to natural variability or as a result of human activity. Meanwhile, the mean score of 2.75 indicates the respondents that believe that unpredicted change in the pattern of rainfall is climate change and unstoppable solar radiation and quality is climate change.

#### 4.0.3 Climate change sources of information

**Table 3: Sources of information on climate change in study area**

Variable	Frequency	Percentage (%)
Fellow farmers	24	26.67
Personal information	22	24.44
Radio	19	21.11
Television	14	15.56
Extension Agents	4	4.44
Others	7	7.78
Total	90	100

*Source: Field Survey, 2017*

The table 3 above shows that majority 26.67% of the respondents get information on climate change, climate change adaptation and climate change mitigation from their fellow farmers. Furthermore, from the same table 3, it shows that only 24.44% of the respondents source their own information by personal views and feelings whereas 21.11% source their own information of climate change from radio. Critical analysis of the above table 3 shows that as 15.56% of the respondents' source information of climate change from television, 4.44% of them got information from extension agents.

The lower percentage of those that source their information from extension agents shows that inadequate motivation of change agents in the state affect their work across the state and the study area especially as it concerns climate change.

#### 4.0.4 Climate change effects in agriculture

**Table 4: Effects of climate change on agriculture in the rural farming communities.**

Variables	Frequency	Percentage (%)
Increased erosion		
Yes	63	70
No	27	30
Drying up of rivers		
Yes	41	45.56
No	49	54.44
Loss of pastures		
Yes	53	58.89
No	37	41.11
Harsh weather conditions		
Yes	59	65.56
No	31	34.44
Poor yield of crops		
Yes	50	55.56
No	40	44.44
Reduction in soil nutrient		
Yes	45	50
No	45	50
Increased flooding		
Yes	76	84.44
No	14	15.56
Reduction in soil fertility		
Yes	49	54.44
No	41	45.56
Solar radiation and quality		
Yes	62	68.89
No	28	31.11
Bush burning		
Yes	67	74.44
No	23	25.56



Increase in pest and diseases		
Yes	37	41.11
No	53	58.89
Landslides		
Yes	69	76.67
No	21	23.33
Heat stress		
Yes	61	67.78
No	29	32.22
Increased use of generator emitting Co2		
Yes	48	53.33
No	42	46.67
Total	90	100

**Source: Field Survey, 2017**

From table 4 above, it shows that the majority 70% said that the effects of climate change on agriculture is through increase in erosion while 30% said it has no effect on erosion.

Majority 54.44% said that there is no effects of climate change on agriculture results to drying up of rivers while minority 45.56% said there is an effect that results to drying up of rivers. Furthermore, from the same table 4, 58.89% said that the effects of climate change on agriculture are attributed to loss of pastures while only 41.11% said that it does not result to pastures loss.

Critical analysis of table 4 indicted that 65.56% of the respondents from the study area said that the effects of climate change on agriculture results to harsh weather conditions whereas 34.44% said it does not results to harsh weather conditions. Added to this, from table 4 above, 55.56% said that the effects of climate change on agriculture results to poor yield of crops but 44.44% said it does not results to poor yield of crop.

Table 4 above also shows that 50% agreed that the effects of climate change on agriculture results to reduction in soil nutrient while 50% said it does not result to reduction in soil nutrient. Majority 84.44% of the respondents agreed that the effects of climate change on agriculture results to increase in flooding which confirms the 2013 recent flooding around the globe while 15.56% said it does not result to flooding. This also confirms the fact that prolong of its effect

leads to drought and desertification. According to FAO (2016), an estimated 12 million hectares of land is lost to drought and desertification each year. The adverse effects of bush burning has been overemphasized ranging from loss of vegetative cover that aids photosynthesis for food production to loss of beneficial microbial biological activities and interaction of the soil and soil structure.

In this findings from table 4, majority 74.44% of the respondents said that bush burning contributes to climate change on agriculture while 25.56% said it does not result to bush burning. Majority 58.89% said that the effects of climate change on agriculture does not results to increase in pest and diseases while minority 41.11% said it results to increase in pest and diseases which in turn results to low yield in food crops.

#### 4.0.5 Climate Adaptation measures.

**Table 5: Adaptation Measures**

Variable	Percentage (%)
Benefited from adaptation measures	13.3
Climate change occurs due to the gods punishment	45
Use of short crops periods	75
Incorporation of black charcoal (biochars) on soil	60
Afforestation	100
Adequate supply of electricity or solar power	100

**N=12**

The result of the analysis reported in table 5 above indicates the distribution of respondents according to the Focus Group Discussions (FGDs) on the types of adaptation measures identified for climate change in the study area. Some of the identified adaptation measures by the rural farmers include; altering of the timing of cropping activities against heavy/ irregular rainfall, construction of concrete flood barriers against flooding, information on climate events and response against solar radiation and other climate events, altering inputs varieties and species for resistance to heat shock and drought against erosion. Others are desertification, diversifying income through the

integration of activities e.g. livestock forest conservation, agroforestry against erosion, introducing forest conservation against deforestation, planning landscapes to minimize fire against bush burning, adequate land tenure system against land slide, formation of youth and women cooperatives against flooding events while others said they will do nothing as a result of their cultural belief.

According to their perceived cultural belief, climate change is as a result of sacrilege that defiled the land which only appeasing of their gods will be a remedy to cleanse their land to be productive.

A total of twelve (12) participants were randomly selected for the FGD; two representatives from the six communities each. The result also shows that 13.33% of the respondents agreed that the adaptation measures aforementioned were beneficial to them in adapting as well as mitigating climate change effects. Also from the FGD report 45% believed that there is climate change and stated that these climate change events occur as a result of punishment of their gods. FGD report indicated that 75% agreed that they used short crop period as an adaptation measure.

#### 4.0.6 Climate mitigation measures.

**Table 6: Mitigation Measures**

Variables	Frequency	Percentage (%)
Irrigation		
Yes	57	63.33
No	33	36.67
Land tenure system policy		
Yes	66	73.33
No	24	26.67
Occupational diversification		
Yes	55	61.11
No	35	38.89
Change in the timing of farm operation		
Yes	52	57.78
No	38	42.22
Adjustment of cultural practices		
Yes	61	67.78
No	29	32.22

Use of improved/resistant crop		
Yes	34	37.78
No	56	62.22
Afforestation		
Yes	60	66.67
No	30	33.33
Weather forecasting models		
Yes	42	46.67
No	48	53.33
Incorporation of residues into the soil		
Yes	66	73.33
No	24	26.67
Provision of adequate power supply		
Yes	72	80
No	18	20
Use of bio gas and less CO <sub>2</sub> energy emitter		
Yes	47	52.22
No	43	47.78
Climate smart agriculture		
Yes	45	50
No	45	50
Education / extension delivery		
Yes	59	65.56
No	31	34.44
Health facilities		
Yes	61	67.78
No	29	32.22
Increase in agricultural research and development		
Yes	57	63.33
No	33	36.67
Total	90	100

*Source: Field Survey, 2017*

A higher percentage of the respondents agreed that reduced productivity is the major effect of climate change in their farming activities. This further confirms the reaction from the farmers in the study area during



FGDs that for many years now that there is reduction in outputs from their farm due to climate change; 60% of the respondents agreed that the incorporation of black charcoal (biochars) in the soil to produce terra preta will enhance crop yield as well as increase soil sequestration in combating climate change. All the 12 respondents suggested afforestation as well as adequate supply of electricity or solar power to reduce carbon dioxide gas emission on the ecosystem as the way forward to these climate change events.

Table 6 shows the response of the respondents to their respective mitigation measures. From the table 6, only 63.33% of the respondents agreed that irrigation can help mitigate climate change effects. The issue of land fragmentation has rendered large scale agricultural productivity difficult to achieve.

In the result of this findings as shown in table 6, majority 73.33% said that land tenure system policy can help mitigate climate change events as it will reduce the effect of erosion a major climate factor in the study area while minority 26.67% said it cannot help solve climate change effects as land are communally owned and shared.

It was observed that during this year's planting season in Agbani Agricultural zone that there was a shift in the rainfall pattern as farmers already cultivated their farmlands but waiting for the first shower of the rain which took a bit longer. Hence, in response to the above, majority of the respondents 63.33% agreed that change in the timing of farm operations can help mitigate climate change effects of irregular pattern of rainfall while minority 36.67% said it cannot help solve climate change effects. To mitigate climate change, 67.78% of the respondents opted for the adjustment of cultural practices such as planting of cover crops, construction of barricades to prevent bush burning, bush fallowing etc. in order to combat climate change effects whereas only 32.22% of the respondents said it yields no result.

In Agbani Agricultural Zone, findings from table 6 above shows that 37.78% of the respondents stated that use of improved or resistant crop can help mitigate climate change effects but only 36.67% said it cannot help solve climate change effects as these

improved yield and resistant varieties has been adulterated. In support of plant- a- tree- movement, majority 66.67% of the respondents agreed that afforestation is a favourable mechanism that can help mitigate climate change effects while minority 33.33% said it cannot help solve climate change effects.

From the findings, it was observed that there is little or no adequate weather forecasting model readily available for these farmers in the study area. Hence, minority 46.67% said that weather forecasting models can help mitigate climate change effects while majority 53.33% said it cannot help solve climate change effects due to negligence of the weather forecast section in the country be the government. Majority 73.33% said that incorporation of residues into the soil can help mitigate climate change effects since it has proved effective in the time of their forebears while minority 26.67% said it cannot help solve climate change effects.

Climate –smart- agriculture has proved to be effective in recent times especially in some of the developing nations. Result from table 6 above shows that 50% of the respondents reported that climate smart agriculture can help mitigate climate change effects as 50% of them disapproved such because of low level of awareness. Majority 65.56% said that extension delivery can help mitigate climate change effects but 34.44% said it cannot help solve climate change effects as they are not always available to assist as at when they are needed.

The health status of farmers are inadequately poor as some of them cannot afford their health services fees. From table 6 above, 67.78% of the respondents' reported that provision of health facilities at a subsidized rate, can help mitigate climate change effects but 32.22% said it cannot help solve climate change effects. It is unavoidably beneficial to provide adequate agricultural research and development centers at grassroots for these farmers to boost their standard of living as well as sustainable livelihood. In the findings, majority 63.33% said that increase in agricultural research and development can help mitigate climate change effects while minority 36.67% are not in support as it will rob them their cultural practices and core beliefs.





## 5.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

The study was carried out in Agbani Agricultural zone of Enugu State, Nigeria. The result shows that the majority 80% of farmers interviewed were female within the mean age of 32 years. Also the result shows mean household size of 7 persons.

The study concluded that in order to address the climate change impacts on agricultural farming systems and beyond, there is need for significant improvement in agricultural research and extension systems in the rural farming communities. Although farmers adopted numerous adaptation strategies to climate change effects, some of the farmers noted that some of the indigenous tasking might not stand the test of time. Also, there is need to implement mitigation measures that will promote low carbon as well as sustainable and high economic growth. From the same perspective, there is also need to enhance national capacity to adapt to climate change which should begin from the grassroots as well as significantly increase the public awareness and involvement of private sector participation in addressing the challenges of climate change.

Reduction of the impacts of climate change on key sectors and vulnerable communities should be effected where possible for the impact of climate change presents new and evolving challenges to livelihoods, demanding new approaches to build resilience and adaptive capacity, particularly for farmers.

Based on the findings of the study, the following recommendations were made to increase agricultural production as well as effective and efficient adaptation and mitigation measures.

There is need for agricultural extension workers to be mandated by governments to accommodate issues of climate change in their duties since they are people that can reach farmers on any innovation in agriculture.

Furthermore, government should provide hybrid crops and animals (if any), that are resistant to climate change to farmers to motivate them as

regards diversification in various farming activities. Added to this, there is need to utilize the power of media such as radio, television, newspapers, posters and internet etc. in strengthening climate change awareness and communicating effective response strategies to climate change.

Also, there are indigenous methods of coping with climate change adaptation and mitigation. Hence, advance research into these indigenous practices and methods of climate change adaptation and mitigation with the view to establishing and documenting any underpinning science, and possibly integrating them into conventional practices, is highly recommended for sustainable livelihood.

Finally, the Enugu State and Agbani agricultural zone must adopt strategies and policies that will encourage improved farming practices and agricultural methods that will protect the cherished agricultural activities which is the mainstay of our economy.

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