Nigerian Journal of Agriculture and Agricultural Technology (NJAAT)
Volume 5, Number 1A, March, 2025
ISSN (Print): 2811-1885; ISSN (Online): 2811-1893

LEVEL OF RICE FARMERS EARLY WARNING INFORMATION ON FLOOD ADAPTATION STRATEGIES IN HADEJIA AGRICULTURAL ZONE, JIGAWA STATE, NIGERIA

[1]Muhammad, A., [2]Mohammed, A. M.,[1]Muktar, B. G.,[2] Bala, A. H., [3]Aliyu, Y. M and [1]Makinta, U.
[1]Department of Agricultural Extension and Rural Development, Federal University Duste, Jigawa State, Nigeria.
[2]Department of Agricultural Extension and Rural Development, Abubakar Tafawa Balewa University Bauchi, Bauchi State, Nigeria.
[3]Department of Agricultural Extension Services, Faculty of Agricultural University of Maiduguri;
Corresponding Author's Email: bukarbaba51@gmail.com, **GSM:** 08060019008, 09079309799

ABSTRACT
The study examines the level of rice farmer's early warning information on flood adaptation strategies in Hadejia agricultural zone, Jigawa state, Nigeria. Multi-stage sampling procedure was employed in the selecting of 278 respondents for the study. Data were collected using structured questionnaire and analyzed using descriptive and inferential statistics. The results showed that almost all (96%) of the respondents were male and over half (53%) of the respondents were in the age bracket of 25 - 40 years and majority (79%) of the respondents were married. The finding indicated that 48% of the respondents had household size of 1-5 persons and 42% of the respondents had formal education and majority (60%) of the respondents had more than 11 years of farming experiences. Also, majority (70%) of the respondents had 0.1 - 2.5 hectares of land for cultivation. The result indicated that the use of early maturing crop had high adaptation to flooding as early warning information while shifting of land had low adaptation among rice farmers in the study area. However, the study revealed that flood preparedness was the highest regarded factor, with a mean of 64.3 and timeline for early warning had a mean of 56.1 while frequency of alerts received the lowest with a mean of 51.7 which indicated variability in its perceived importance. The study concludes that farmers had positive respond on the use of adaptation strategies against flood incident in the study area. Based on the results, the study recommend that farmers training, improved in communication strategies, and infrastructure development are crucial for boosting the resilience of rice farmers in flood-prone areas.

Keywords: Adaption, Warning, Information, Flood, Strategies, Rice.

INTRODUCTION
Early warning systems (EWS) are crucial coping mechanisms that enable farmers to prevent the loss of life and property by providing timely information about impending hazards such as floods. These systems form part of a broader communication network that works together to identify and convey risk information to users before the onset of a hazard. By disseminating this information, EWS enable farmers to respond proactively, thereby minimizing the negative impacts on human lives, properties, and agricultural land. Various scholars and organizations have different definition to early warning systems. The United States Climate Risks and Early Warning System Initiative (2015) describes it as an adaptive measure for climate change, using integrated communication systems to assist farmers in preparing for adverse climate impacts and related risks. Similarly, the United Nation Office for Disaster Risk Reduction (UNDRR) defines early warning as a process that includes risk assessment, communication, and public awareness, which are essential for reducing vulnerability to natural hazards (UNDRR, 2017). An effective EWS typically includes four essential components: risk analysis, monitoring, warning, dissemination and communication responses. These components help mitigate the likelihood of injury, death, agricultural damage, and property loss by ensuring that individuals and communities can respond to risks in a timely manner (Birkmann *et al.,* 2015). In the context of flood risk management in Nigeria, key components of flood early warning include data collection and transmission, flood forecasting, warning dissemination, communication, and

Nigerian Journal of Agriculture and Agricultural Technology (NJAAT)
Volume 5, Number 1A, March, 2025
ISSN (Print): 2811-1885; ISSN (Online): 2811-1893

emergency responses, all of which were managed by various agencies and institutions across the country. For example, before the rainy season in 2022, the Nigerian Meteorological Agency (NiMET) and the Nigeria Hydrological Services Agency (NIHSA) issued warnings about heavy rainfall in 18 states between August and September 2022, urging communities to take precautionary measures (Vanguard News, 4 September, 2023).

Climate change and its related extreme events like flood and drought are incessantly affecting rice farmers and agricultural activities in Jigawa state. This is adjudged to further exacerbate the vulnerability of the rural poor who relies heavily on agricultural production activities for livelihood, with attendant spiraling effects on the economy of the state. The research on the adaption of early warning information for flood by rice farmers reveals several knowledge gaps that require further exploration. While previous studies have highlighted the importance of early warning systems (EWS) in mitigating flood risks, there is limited research on how effectively these systems are adopted by rice farmers, especially in relation to the perceived effectiveness of the adaptation strategies. For example, Choudhury *et al.* (2020) which demonstrated that flood-tolerant rice varieties, when combined with early warning systems, help reduce crop damage, yet the study does not delve into the broader adaption dynamics and the underlying reasons for their effectiveness. Similarly, research by Islam *et al.* (2017) who emphasize trust in early warning systems in Bangladesh but lack a deeper exploration of how economic incentives, such as insurance programs, influence adaption behavior of farmers in the study area.

The gap lies in understanding the specific factors that drive the adoption of EWS, including the roles of social, institutional, and economic factors, as well as the integration of traditional knowledge with modern forecasting. While studies like those of Sritong *et al.* (2017) in Thailand show the effectiveness of flood insurance programs, the research does not examine the combined effects of these programs with other adaptation strategies. Furthermore, there is a need to explore the context-specific barriers to adoption in diverse regions, as the effectiveness of early warning systems can vary significantly depending on local infrastructure, communication channels, and farmers' experiences with flooding. Addressing these gaps can offer a more holistic understanding of how EWS can be improved for better adaptation outcomes. This informs the need to carry out a study on adaption level of early warning information for flood adaptation strategies by rice farmers in the study area. It is in view of the above that the study will seek answers to the following research questions:

What are the socio-economics characteristics of rice farmers in the study area?
What are the levels of early warning information for flood adaptation strategies?
What are the flood early warning indicators use rice farmers in the study area?

METHODOLOGY

The Study Area

Jigawa state is located in the North-western part of the country. It lies between Latitudes 12^0 - 13^0 North and Longitudes 10^0 - 10 50^0 East of the meridian. Jigawa state borders Yobe state to the North-east, Bauchi to the South-east and South, Kano to the South-west and Katsina to the North-west. Jigawa state also shares an international border with the republic of Niger. According to the Nigerian Population Commission (NPC) (2006) Jigawa state had a land mass of approximately 22,410 square kilometers and the state had a total population projection of 9,907,877.1 with the growth rate of 3.5% by the year 2022. Garba *et.al* (2019) reported that about 80% of the populations of Jigawa state were found in rural areas, with about 90% of that engaging in subsistence farming and other rural based livelihood activities. Jigawa state is also blessed with large expense of agricultural land, rivers, and flood plains suitable for crops, livestock and fish production. Based on this over 80% of the state's total land mass is considered arable. And this makes it one of the most agriculturally endowed states in Nigeria.

Method of Data Collection

Primary data were obtained directly from the respondent through the use of structured questionnaire complemented with interview schedule. However, the questionnaire was pre-tested on few selected respondents. Both the researcher and trained enumerators were engaged in data

Nigerian Journal of Agriculture and Agricultural Technology (NJAAT)
Volume 5, Number 1A, March, 2025
ISSN (Print): 2811-1885; ISSN (Online): 2811-1893

collection. The questionnaire sought information on climate change information and farmers' adaptation to flood in the study area.

Sampling Procedure

Multi stage sampling procedure was used in the selection of respondents for this study. In the first stage; the eight (8) Local Government Area of Jigawa Rice Farmers Association of Nigeria (RIFAN) Hadejia zonal offices were considered. In the second stage; five (5) Local Government Areas were selected randomly out of eight local government areas and the rice farmers list was collected from Rice Farmers Association of Nigeria (RIFAN) Hadejia zonal office. In the third stage; five communities (Auyo, Guri, Hadejia, Kiri Kasamma and Malammadori) from each local government area were selected purposively due to their intensity of rice production (wet and dry season farming). In the fourth stage; a total number which forms the population's size of the sample was 918. The number was compared in the table for determining sample size from a given population (Kreijcie and Morgan, 1970) according to the table 274 respondents was selected as sample size at 95% level of confidence

Method of Data Analysis

Data were analysed using both descriptive and inferential statistics. The descriptive statistics used were frequency distribution, mean, percentage and standard deviation.

Descriptive Statistics

Descriptive statistics such as frequency, means, percentages and standard deviation were used. The mean is expressed as:

$\bar{X} = \Sigma fx / n$

With

$\bar{X}$ = mean

Σfx = sum of individual observations

n = sample size

Likert Scale

Likert scale will be used to identify the constraints faced by farmers in accessing the services of cooperatives societies.

$X = \Sigma xi / N$

Where:

i = 1, 2, 3, 4 and 5. X assigned constraints (Note: SA = strongly agree, A = agree, N = Neutral, SD = strongly disagree, D= disagree).

RESULT AND DISCUSSIONS

Socio-economic Characteristics of the Respondents

The results in Table 1 showed that almost all (96%) of rice farmers in the study area were found to be male. This implies that female farmers do not fully participate in rice production. Like their male counterpart in the study area. This may be as a result of both religious and cultural reasons of the people living in the area. The result is in line with Abdullahi, *et al* (2018) which shows that almost all of the respondents were male. Also, the result is similar with that of Garba (2015) in Hadejia valley irrigation project, Jigawa state which indicated that, all the respondents in the study area were male. Men are the head of household and are responsible for all family needs including feeding, clothing, shelter among many others while females were responsible for most of the activities at home like taking care of children, cleaning and cooking among many others.

Respondents age distribution reveal that over half (52.2%) of the respondents were in the age bracket of 25 - 40 years. This implies that age group is expected to contribute more in agricultural production activities than the other groups, because the group constituted active people capable of farming activities. The result agree with Abdullahi, *et al.,* (2018) which revealed that, the average age of the respondents in their area of study was 40 years. Age distribution in most rural society determines the sharing responsibilities of agricultural production activities, in addition to that, age distribution also determine farmers working experiences in Agricultural production activities. Older

Nigerian Journal of Agriculture and Agricultural Technology (NJAAT)
Volume 5, Number 1A, March, 2025
ISSN (Print): 2811-1885; ISSN (Online): 2811-1893

age farmers have long term farming experiences unlike younger age farmers. Age is an important factor in production, especially in African agriculture where human labour is extensively used in production; younger persons tend to be stronger and agile. They have the capacity to contribute so much to the high needed energy for farm activities.

Also, the finding indicates that majority (79%) of the respondents were married with just 21% who were unmarried. The result indicates the importance of marriage institution in the study area which is also in conformity with the culture, tradition and religion of the people in the study area. The result corresponds with that of Abdullahi *et al.,* (2018) which indicated that majority of the respondents were married. The result revealed that 48.2% of the respondent household size ranged between 1-5 persons. The finding implies that, majority of the respondents have small size household of five and below. The result corresponds with Adamu *et al.,* (2018) which reported similar findings that household size in rural areas determines work force of a particular family. Those families with larger household size are expected to produce more compared to those with small size household.

Table 1: Socio-economic Characteristics of Respondents

Variables	Frequency	Percentage
Sex		
Male	266	95.7
Female	12	5.3
Age (Years)		
Below 25	19	6.8
25 – 40	145	52.2
41 – 55	98	35.2
Above 55	16	5.8
Marital Status		
Married	220	79
Single	58	21
Household Size		
1 – 5	134	48.2
6 – 10	77	27.7
11 – 15	44	15.8
Above 15	23	8.3
Educational Level (Years)		
Non- Formal Education	48	7.3
Adult Education	21	7.6
Primary Education	32	11.5
Post – Primary	91	32.7
Post – Secondary	86	30.9
Farming Experience (Years)		
1 – 5	37	13.3
6 – 10	72	25.9
11 – 16	65	23.4
Above 16	104	37.4
Farm Size		
0.1 - 2.0	199	71.6
2.1 – 3.0	53	19.0
3.1 - 4.0	14	5.0
Above 4.0	12	4.3
Total	278	100

Source: Field Survey, (2024)

The results of educational levels of the respondents indicated that 11.5%, 32.7% and 30.9% of the respondents had primary, post-primary and post-secondary school certificate, respectively. The

Nigerian Journal of Agriculture and Agricultural Technology (NJAAT)
Volume 5, Number 1A, March, 2025
ISSN (Print): 2811-1885; ISSN (Online): 2811-1893

result goes in line with Adamu *et al.,* (2018) which shows that majority of the respondents have acquired formal education in their area of study. Also, the result is in line with that of Garba, (2019) which indicates that over 80% of the respondents possessed formal education. This implies majority of the respondents in the study area can read and write and this situation could help them in accessing and utilizing climate information in the study area. Also, educational attainment is often used as one of the most important social and economic indicator to ascertain the state of development educations also help to elevate the mind and intellectual horizon of the people.

The results in Table 1 also revealed that 37.4% of the farmers had farming experience of above 16 years while 25.9% and 23.4% had rice farming experience of 6 - 10 and 11-16 years, respectively. The result shows that majority of the respondents had more than 11 years of farming experiences. This implies that, majority of the respondent in the study area have been farming for a long time and could be aware of the negative effect of climate change and its related risks, particularly flood disaster. The result agrees with the finding of Adamu *et al.,* (2018) which showed that majority of the respondent had above 15 years farming experiences. Long term experiences of farmers make it possible for them to predict future weather conditions such as flood, drought, climate variability and other climate related events and makes sound conclusion. The results further revealed that majority (70%) of the respondents had 0.1 - 2.5 hectares of land conversely, only 4% of the respondents had above 6 hectares of land. Thus, the result implies that majority of respondents had small size farms (small scale farmers). The result agrees with the findings of Falakemi, (2022) which reported that majority of the Nigerian farmers owned less than two hectares of land. Thus, practice subsistence farming system.

Adaption Level of Early Warning Innovation Strategies on Flood of the Respondents in the Study Area

The result in Table 2 result below shows that majority (85%) of the respondent agrees that creating and opening of drainage had high adaptation level on early warning strategies on flood with a mean value of 2.6. The findings go in line with Victor *et al.,* (2020) whose result shows statistical differences between farmers that use early climate change information and those that did not, where those that used climate change information were found to be having high adaptation level than those that did not.

Also, majority (98%) of the respondents' agree that early planting had high adaptation level to early warning information on flood by rice farmers with a mean value of 2.5. The result agrees with the findings of Jha and Gapta (2021) which reported that, a number of institutional factors such as extension services, access to climate change information and early warning information on flood increases probability of adaptation strategies of farmers.

Table 2: Level of Early Warning Innovation Strategies on Flood by the Respondents

Variables	Rating					Mean	Decision
	SA	A	ND	DA	SD		
Use of early maturing crop97	74	29	45	3	2.3		High Adaption
Early planting	111	98	18	36	15	2.5	High
Adaption							
Irrigation alternative	96	83	42	29	28	2.2	Low
Adaption							
Shifting of land	116	71	37	36	18	2.2	Low
Adaption							
Creating and opening drainage	59	85	24	70	38	2.6	High
Adaption							

Source*:* Field survey, 2024.
Note: SA = strongly agree, A = agree, N = Neutral, SD = strongly disagree, D= disagree.

Flood Early Warning Indicators used by Rice Farmers in the Study Area

The results in Table 3 shows that effectiveness in flood preparedness has the highest mean score of 64.3, indicating that this variable is perceived as the most important or most effective aspect

Nigerian Journal of Agriculture and Agricultural Technology (NJAAT)
Volume 5, Number 1A, March, 2025
ISSN (Print): 2811-1885; ISSN (Online): 2811-1893

of the early warning system by rice farmers in the study area. The relatively high standard deviation of 9.4 suggests that there is some variation in how respondents view its effectiveness, with some farmers strongly agreeing that flood preparedness is effective, while others may be less convinced. This could be attributed to varying experiences with flood events and preparedness measures. Farmers who have experienced successful flood preparedness may rate it more positively, while those who faced challenges in past floods might be more skeptical. Additionally, farmers in different geographical regions or those with varying levels of resources may have different perspectives on the effectiveness of preparedness measures.

The timeliness of early warning had a mean of 56.1, indicating that farmers generally perceive the timeliness of early warnings as an important factor in flood preparedness. The low standard deviation of 1.3 further supports this, showing that respondents were largely in agreement about the importance of timely warnings. Timeliness is crucial for effective flood management, as early warnings allow farmers to take necessary actions to protect their crops and property. The high level of consensus suggests that farmers recognize the value of receiving warnings in a timely manner, enabling them to make informed decisions and reduce potential damage. The small variation in responses may indicate that most farmers experience similar early warning systems, thus aligning their views on timeliness.

On the other hand, the clarity of early warning information had a mean of 50.7 and a standard deviation of 4.1, reflecting moderate importance. Some farmers may find the early warning messages clear and understandable, while others may experience confusion or feel that the information is not sufficiently detailed or relevant to their specific situation. This could be due to varying levels of literacy, language barriers, or the complexity of the information provided. For example, some farmers might struggle with technical jargon or feel that the messages are too general and not tailored to their local context. Inconsistent communication channels or methods could also contribute to this variation. While the impact on crop losses had a mean of 51.2 and a standard deviation of 4.3, indicating that while farmers perceive the early warning system as somewhat effective in reducing crop losses, there is a notable amount of disagreement. The variation in responses could reflect differences in how well the early warning system works for different farmers. Some farmers may have taken preventive actions based on early warnings, leading to reduced crop losses, while others may feel that the early warnings were not effective enough in preventing damage. The level of preparedness and resources available to each farmer likely influences the perceived impact. For instance, farmers who have access to better irrigation systems or protective infrastructure may feel that early warnings have a greater impact, while those with fewer resources may not experience the same level of benefit.

Finally, the frequency of alerts scored the lowest mean of 51.7, with a standard deviation of 3.1, suggesting that while frequency is seen as moderately important, there is some disagreement among respondents regarding the optimal number of alerts. Some farmers may feel that frequent alerts are necessary to stay informed and prepared, while others may perceive them as excessive or unnecessary, especially if they feel that the alerts do not lead to meaningful actions or if they are not adequately targeted. This discrepancy could be influenced by factors such as the farmers' proximity to flood-prone areas, their previous experiences with floods, or their level of trust in the warning system. Farmers in areas less prone to flooding might feel that alerts are more frequent than needed, while those in more flood-prone areas might appreciate the extra information.

Table 3: Flood Early Warning Indicators used by Rice Farmers in the Study Area

Variables	*Mean	SD
Effectiveness in Flood Preparedness	64.3	9.4
Timeliness of Early Warning	56.1	1.3
Clarity of Early Warning Information	50.7	4.1
Impact on Crop Losses	51.2	4.3
Frequency of Alerts	51.7	3.1

Source: Field survey, (2024). * Multiple Responses Mean

Nigerian Journal of Agriculture and Agricultural Technology (NJAAT)
Volume 5, Number 1A, March, 2025
ISSN (Print): 2811-1885; ISSN (Online): 2811-1893

CONC LUSION AND RECOMMENDATIONS

The study concludes that farmers had positive respond on the use of adaptation strategies against flood incident in the study area and the results reveal that effectiveness in flood preparedness is the most highly regarded factor in the early warning system, with farmers placing significant value on its role in helping them mitigate flood damage. Based on the findings of this study, the following recommendations were made;

i. Farmers should be encouraged to actively engage in training and awareness programs that focus on improving their understanding of early warning systems and their role in flood preparedness.
ii. Farmers should be trained on how to interpret early warning messages effectively and how to implement appropriate flood mitigation strategies, such as land management and crop selection. This would enable them to act promptly and with greater confidence when alerts are issued, thereby reducing crop losses.
iii. Government should prioritize the timeliness and frequency of alerts.
iv. Government should invest in infrastructural improvements, such as drainage systems and flood control measures, which would complement the early warning system.

REFERENCES

Abdullahi, S., Danwanka, H. A. and Haruna, U. (2018) Contributions of Fadama II in the provision of rural infrastructure in Shira local government area of Bauchi State, Nigeria. *Journal of agripreneurship and sustainable development,* **1**(1): 67 - 73.

Adamu A.A., Danwanka H.A. and Sani R.M. (2018) Analysis of resource use efficiency of millet production in Dukku local government area of Gombe State, Nigeria. *Journal of agripreneurship and sustainable development,* **1**(1): 74 - 83.

Birkmann, J., kadur, S. M. N and Khatun, R. (2015). "Making Communities Resilient: A Handbook for Practitioners." United Nations Office for Disaster Risk Reduction (UNDRR).

Choudhury, R., Das, S. and Gupta, N. (2020). Flood Tolerant Rice Varieties and Early Warning Systems in India: Adoption and Impact. *Environmental Science and Policy*, **2**(3): 112 - 19.

Falakemi Ajala (2022). When floods threaten Nigerians food security every one suffers. Nigeria health watch. Retrieved online on 3/9/2023 and available at htpp://www.nigeriahealhwatch.com

Garba U., Salisu A., Abdullahi Y., Fatima I.B. and Samira M. (2019) Population based multicentric survey on the attitude and knowledge of HIV/AIDs among youth of the three Senatorial Distric Jigawa State, Nigeria. *International Journal of current microbiology and applied science*, **8**(4): 1911-1919.

Islam, S. M. N., Khatun, R and Mahmud, A. (2017). Adoption of Flood Early Warning Systems: A Study of Farmers in Bangladesh. *Climate Risk Management*, **7**(4): 45 - 56

Jha, A. and Gupta, R. (2021). Factors influencing the adoption of flood adaptation strategies among farmers in rural India. *International Journal of Climate Change Strategies and Management,* **13**(4): 612-629. https://doi.org/10.1108/IJCCSM-03-2020-0056

Pham, H. T., Nguyen, T. T and Le, P. T. (2019). Integrating Traditional Knowledge with Early Warning Systems for Climate Adaptation in Vietnam's Rice Farming. *Agriculture and Human Values,* **5**(9): 34 – 45.

Reyes, D., Serna, R. R and Amado, S. (2018). Early Warning Systems and Their Role in Disaster Risk Reduction: Case Study from the Philippines. *International Journal of Disaster Risk Reduction.* **2**(4): 77 – 87.

Rogers, D and Rojas, A. (2017). Performance evaluation of early warning systems in Latin America: A case study on flood preparedness and response. Journal of *Disasters management,* **41**(3): 537-558. https://doi.org/10.1111/disa.12172

Sritong, S., Kittikajorn, P and Chalermthan, P. (2017). Effectiveness of Flood Insurance Schemes In Thailand: Insights from the Rice Sector. *Journal of Environmental Economics*, **2**(5): 17 - 26

Stern, P., Jørgensen, A and Corral, C. (2016). Assessing the effectiveness of early warning systems in reducing flood risks in rural communities. *Environmental Hazards,* **15**(2): 87- 101. https://doi.org/10.1080/17477891.2016.1170295

UNDRR. (2017). "The Sendai Framework for Disaster Risk Reduction 2015–2030." United Nations Office for Disaster Risk Reduction.

Victor, M., Olorunfemi, F and Abdulsalam, S. (2020). The use of climate change information and adaptation strategies among rural farmers in Sub-Saharan Africa. *Environmental Science Policy,* **8**(10): 87-94. https://doi.org/10.1016/j.envsci.2020.03.010

Yadav, P., Shrestha, S and Sharma, S. (2020). Role of Local Cooperatives in Early Warning D Dissemination and Flood Risk Management in Nepa*l*. *Journal of Rural Development*, 3(4): 34 - 45