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An Assessment of Farmers' Training Needs on Drought Management Strategies for Improved Crops and Livestock Production in Northern Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The study assessed the farmers' training needs on drought management strategies for improved crops and livestock production in Northern Nigeria Six Nigerian northern states were sampled based on the intensity of drought. 792 farmers were randomly selected for the study. Primary and secondary data were collected using questionnaire with trained enumerators. Validation of questionnaire for data collection and reliability test were carried out. The results revealed 38.5 years as the farmers' mean age with household size of 9 persons. 84.5% of the farmers had formal education and average of 5.27ha of cultivated farm land. 80% of the farmers experienced reduction in crops' yields and livestock production with higher income loss in livestock production. This is based on Adopter Perception Theory which argues that the adoption process starts with the perception that there is need to innovate. Researches had established that drought affect almost all agricultural activities. Finding revealed that the mean annual yield for the crop sector before drought occurrence varied between 1.12 tons/ha and 0.41 tons/ha, with a maximum of 50 tons/ha. Tuber

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crops production ranked first, while legumes took the last position for the period under consideration in this study. Therefore, under the crop sector, cereal crops' farmers suffered the highest loss (0.43tons/ha) due to drought occurrence, while Tuber crop followed closely with 0.35tons/ha loss. In case of livestock, the mean annual loss is 13 and maximum of 330 birds but in terms of income loss, livestock was more than crop. Most farmers require training in the maintenance of water supply systems, drought risk management and access to drought-related information. This study provides basis for tackling the effects of drought in Northern Nigeria. It identifies training needs of farmers with a view to mitigate the menace of drought to enhance yield in the areas of crops and livestock production.

Keywords: Agriculture; drought; drought early warning; crop yield; income; forecasting model.

1. INTRODUCTION

The challenge of universal climate change is giving scientists a great concern as a result of its negative effects on the livelihoods of smallholder farmers who are into crops and livestock production [1,2,3]. Specifically, significant changes in climatic indicators such as rainfall and the intensity of the temperature can affect agricultural production, food security and household economy [4,5] (Haque and Khan 2020). Evidence shows that the effects of climate change are predominantly very large and far-reaching in the Tropical Zones of the developing countries with precipitation ranging from semi-arid to humid [6,7].

Water shortages as a result of changes in rainfall can affect soil erosion and moisture contents of the soil. Therefore, increase in temperature along with reduced precipitation will likely result in the loss of arable land due to decreased soil moisture [8], increased acidity and groundwater depletion [9]. According to He et al. [10] and Nhemachena et al. [11], reduction in available good quality water for agricultural production, especially crops and livestock, as a result of drought, at certain times of the year will affect food security negatively. Drought affects crop production through direct impacts on the bio-physical factors such as plant and animal growth [12,13].

Mitigation and adaptation, according to Grafakos et al. [14] and Amarasinghe et al. [15], can both be used to reduce the negative impacts of drought. Though mitigation is necessary to reduce the rate and magnitude of drought occasioned by climate change, adaptation is important to decrease the associated damages that cannot be avoided. Adaptation is a process by which strategies to moderate, cope with and take advantage of the consequences of climatic events are enhanced, developed and implemented [16,17]. Also, adaptation to climate change is the process through which people reduce the adverse effects of climate on their health and well-being, and take advantage of the opportunities that their climatic environment provides [18] (Balogun et al., 2020). In crop production, available options include altering of the timing or location of cropping activities; improved water management, conservation of soil moisture (for example crop residue retention; altering inputs such as crop varieties and species; effective pest and diseases management and using climate forecasting tools such as drought early warning system among others [19]. It is pertinent to point out that a solution to the problems of drought as a result of climate change will require a proper understanding of the phenomenon through training as well as increasing farmers' levels of awareness.

Training is a process of continuous education which aims to develop knowledge, skills and attitudes of people with a view to solving their problems through personal efforts. This is quite applicable to drought management strategies for improved crops and livestock production in Northern Nigeria, where farm families could be well informed of drought early warning systems [20]. This study is therefore designed to address the training gap for drought management strategies among farmers through the following objectives: To describe the socio-economic characteristics of the farmers; to determine farmers' knowledge about drought and their risk assessment capabilities, to ascertain level of drought vulnerability among farmers, to identify drought spot areas in Northern Nigeria, to examine different drought management strategies for improved agricultural production and to assess farmers' training needs on drought management strategies for improved crops and livestock production in Northern Nigeria.

1.1 Theoretical Framework

This study is premised on two relevant Theories namely Training and Behaviour Theories as well as Organisational Behaviour Modification Theory.

i. Training and Behaviour Theories and explained by Luthans (1998), considered that training can help organisations to change employees' behaviour and that one technique of behaviour modification, encouraging desired behaviours and discouraging unwanted ones.

ii. Also, Organisational Behaviour Modification Theory stated the five mains steps concerning training needs and are related to: identifying the critical, observable and measurable performance-related behaviours to be encouraged; measuring the current frequency of those behaviours; providing a baseline against which to measure improvement; developing an intervention strategy to strengthen desired behaviours and weaken dysfunctional behaviours through the use of positive reinforcement (money, recognition) and corrective feedback and systematic evaluation of the effectiveness of the approach in changing behaviour and improving performance over the baseline [21-23].

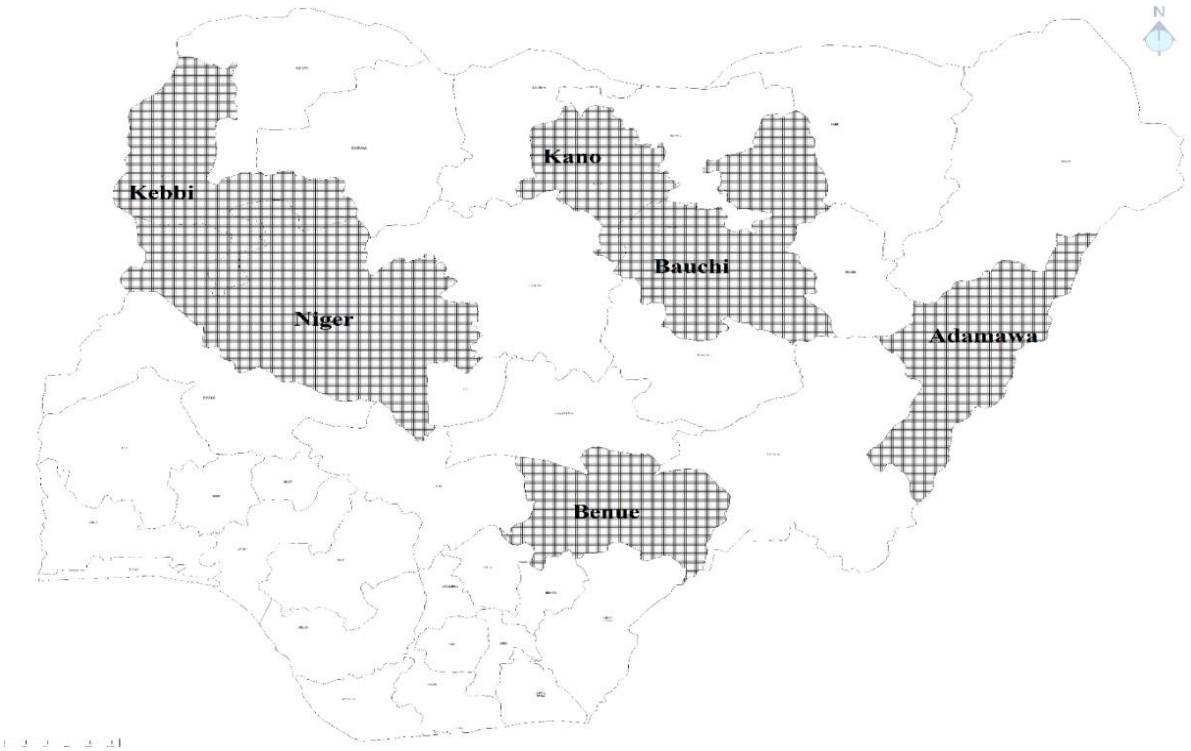
2. METHODOLOGY OF THE STUDY

2.1 Population of the Study Area

The study areas comprised 19 Northern States of Nigeria with the states categorised into North East, North West and North Central. The major occupation of people in these States is farming. Six out of the nineteen Nigerian northern states were used in the study as shown in map 1. The states comprise Adamawa, Bauchi, Benue, Kano, Kebbi, and Niger Niger States.

2.2 Sampling Procedures and Sample Size

Multi-stage sampling procedure was employed in this study. Specifically, six States out of 19 Northern States (Adamawa, Bauchi, Kano, Kebbi, Benue and Niger States), representing North West, North West and North Central geographical Zones of Nigeria, were sampled purposively based on the intensity of drought in the States. Based on Spot analysis, 16 Local Government Areas, LGAs of the sampled States (Table 1) were purposively sampled and a total of 792 farmers were randomly sampled from the selected LGAs as respondents for the study.



Map 1. Locations of study areas showing the sampling points

Table 1. Summary of sampling procedures and sample size

States	No. of LGAs	No. of Sampled LGAs	Sampled farmers
North East States			
Adamawa	22	3	114
Bauchi	20	3	184
North West States			
Kano	44	3	179
Kebbi	22	2	101
North Central States			
Benue	22	2	106
Niger	24	3	108
Total	154	16	792

2.3 Validation and Reliability Test of Research Instrument

Questionnaire was used as research instrument for this study to elicit relevant information from the respondents.

The questionnaire for data collection was validated by relevant experts, while Reliability test was also carried out using Test-retest method (r=0.75). Reliability co-efficient of 0.75 was considered high and acceptable.

2.4 Methods of Data Collection

Primary data on socio-economic characteristics, farmers' knowledge about drought and their risk assessment capabilities, farmers affected by droughts in the previous farming seasons, respondents' annual crop mean yield before and after drought, livestock owned and farmer's income before and after drought occurrence, losses by farmers due to drought occurrence, farmers' awareness of drought management strategies and their training needs were collected from the sampled respondents with the aid of questionnaire and interview schedule. Trained enumerators from State Agricultural Development Projects and River Basin Development Authority were employed as enumerators for data collection. Secondary data were also collected from relevant publications of Federal and States' Ministries, Departments and Agencies. Focus Group Discussion, FGD and Rural Participatory Approach, PPA were used to elicit information on the training needs of the respondents for this study.

2.5 Methods of Data Analysis

Descriptive statistics (means, percentage distribution, mode, Pie Chart and Bar Chart) while inferential statistics like Chi-Square, Person Product Moment Correlation and t-test. Specifically, all the objectives were analysed using descriptive Statistics, while hypotheses i and iii were tested using Chi-Square and Pearson Products Moment Correlation respectively. Hypotheses ii, iv and v were tested using t-test.

3. RESULTS AND DISCUSSION

3.1 Socio-economic Characteristics of Respondents

The socio-economic characteristics considered in this study were age, sex, marital status, household size, highest formal educational attainment of respondents and total years spent in formal schooling. Others include major occupation, farming experience, total farm size and contact with Extension Agents.

According to findings on socio-economic characteristics of farmers (Table 2), the mean age of the respondents was 38.5years which implies that most of the respondents were relatively young and within active productive age. Since age was reported to affect adoption of improved agricultural technologies, the respondents were most likely in need of training on how to manage drought [24].

In addition, majority of the respondents were males (86.5%), mostly married with mean household size of 9 persons. These imply that agriculture is dominated by male farmers and married with larger household size. Large household size could facilitate the need for training in drought management for improved crops and livestock productions because of the number of household members to be catered for economically.

Acquisition of formal education facilitates farmers' access to agricultural information and technical-know-how of innovation with a view to increasing agricultural productivity. Findings on Table 2 show that majority of the respondents had formal education (84.47%), with 12 years as mean year of formal schooling and average of 5.27ha of cultivated farm land. Access to relevant knowledge and technology is crucial to improving productivity significantly. This implies that in the events of droughts due to climate change, knowledge acquire through training could facilitate decision-making on how to diversify or strategize.

Moreover, training of farmers is very important in this study because majority of the respondents indicated farming as their major occupation and despite the fact that their mean farming experience is 20 years, the farmers are bound to have challenges in tackling the menace of drought. Therefore, farmer's contact with Extension Agents for training and dissemination of improved agricultural information, especially drought management strategies cannot be over emphasised. Results in Table 2 indicated that majority of the respondents (72.1%) had regular and relevant contact with Extension Agents. This implies that they are ready to learn new things through training and acquisition of knowledge.

3.2 Farmers' Knowledge about Drought and their Risk Assessment Capabilities

3.2.1 Farmers' knowledge about drought

Drought is highly variable in its severity and magnitude. One of the basic reasons for this variability is the lack of a clear and concise definition of drought that is applicable to all disciplines. Based on the farming experience of farmers (Table 2), it was expected that some of the farmers that had experienced drought in farming should be able to have clear knowledge of drought. Fig. 1 shows that majority of the farmers had one way or the other been affected significantly by drought in the past (75%), while others experienced little or no drought effect on their agricultural production activities. The implication of this is that most of the farmers had knowledge about drought in their different locations based on their experiences.

Table 2. Socio-economic characteristic of the respondents (n= 792)

Variable	Frequency	Percentage	Mean	Mode
Age (years)			38.48	
Sex				
Male	685		86.49	
Female	107		13.51	
Marital Status				
Married	603	76.14		
Single	174	21.97		
Widow/Widower	12	1.52		
Divorced/Separated	3	0.38		
Household size			9	6
Highest educational attainment				
Tertiary education	210	26.52		
Senior Secondary school	228	28.79		
Junior Secondary School	42	5.3		
Primary School	189	23.86		
No formal Education	123	15.53		
Years of formal schooling			10.23	6
Major occupation				
Farming	673	84.97		
Others	119	15.0		
Farming experience (Yrs)			20.00	
Total farm size (Ha)			5.27	2
Contact with Extension Agents (EAs)				
Contact with EAs	571	72.1		
No Contact with EAs	221	27.9		

Source: Field Survey, 2020

Specifically, findings revealed that farmers have different definition attributes of drought. However, majority of the respondents indicated that drought is a protracted period of water deficiency which aptly implies that they had experienced drought in their farming activities. Nevertheless, very few of the respondents had little or inadequate awareness of drought. This implies that only very few of them had not experienced any devastating effect of drought in their farming activities (Fig. 2).

Furthermore, findings in Table 3 showed that majority of the farmers described drought as an extended period of months or years when there is a deficiency in water supply. Therefore, from all indications, majority of the respondents had clear knowledge about drought and this might be based on individual experience of the effects of drought on farming activities. According to Khanal et al. [25], farmers' awareness of change in climate attributes and the resultant effect, such as drought is important to adaptation decision-making. This implies that farmers should be given relevant training based on individual needs with a view to managing drought for improved crops and livestock production.

3.3 Crop Yield, Livestock Owned and Farmer's Income before Drought Occurrence

3.3.1 Respondents' annual crop mean yield before drought

The crops grown by the respondents are categorised into Cereal, Legumes, Tubers and Vegetables. Finding in Table 4 shows that the mean annual yield for the crop sector before drought occurrence vary between 1.12 tons/ha and 0.41 tons/ha, with a maximum of 50 tons/ha. Tuber crops production ranked first, while legumes took the last position for the period under consideration in this study.

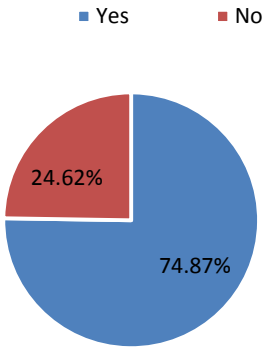


Fig. 1. Distribution of farmers affected by droughts in the previous farming seasons

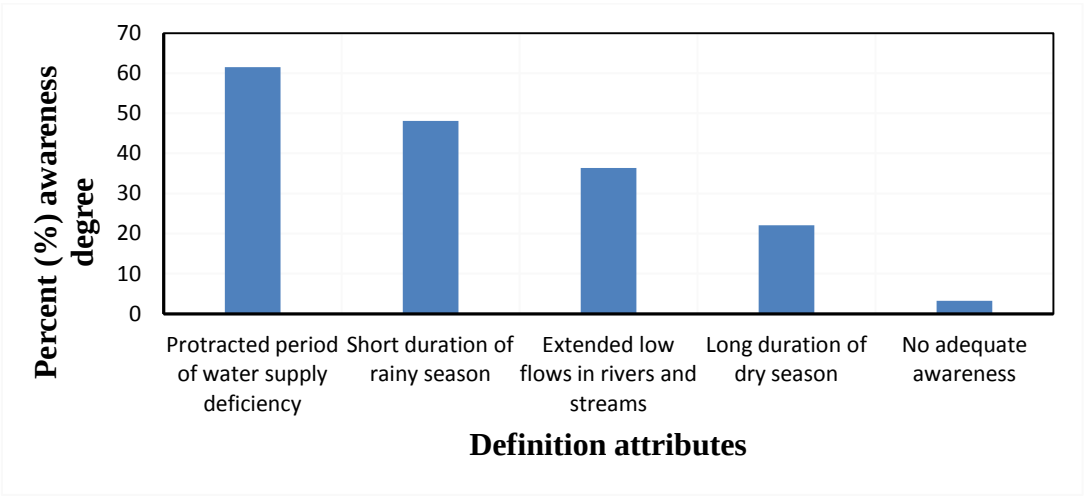


Fig. 2. Farmers' knowledge about indicators of drought

Table 3. Farmers' knowledge of drought effect (n=792)

Variables	Frequency*	Percentage
An extended period of months or years when there is a deficiency in water supply	487	61.49
Short duration of rain season	381	48.11
Periods of consecutive months of scarcity of precipitation or low flow rates in rivers and streams.	288	36.36
Long duration of dry season	175	22.1
Changes in land use and land degradation can affect the magnitude and frequency of hydrological droughts.	303	38.26
Natural phenomenon, but it may be exacerbated by human activities.	285	35.98
Persistently low discharge and/or volume of water in streams and reservoirs, lasting months or years**.**	281	35.48
Hydrological droughts are usually related to meteorological droughts, and their recurrence interval varies accordingly	125	15.78

**Multiple responses allowed*
Source: Field Survey, 2020

Table 4. Annual yield of crops (tons/ha) of farmers before drought occurrence

Type of crop	Mean yield (tons/ha)	Min.	Max.	Rank
Tubers	1.12	0.33	36	1st
Cereal	1.03	0.05	50	2nd
Vegetables	0.59	0.02	4.8	3rd
Legumes	0.41	0.02	5	4th

Source: Field Survey, 2020

3.3.2 Respondents' annual mean number of livestock owned before drought occurrence

Apart from crop production, farmers also keep livestock and involve in fish farming. This is very important for the diversification of farm incomes. It is no more new that farmers are involved in income-generating activities. Livestock production can serve as source of protein and additional income with a view to tackling protein deficiency and alleviating poverty among farmers in the rural areas of Northern Nigeria. Result in Table 5 revealed that the respondents owned a number of livestock, such as goat, sheep, poultry birds, cow and pigs. Also, a few numbers of them are involved in fish farming with a mean pond size of 106 square metres and mean number of 12. Though, many of the respondents were mostly involved in goat keeping but mean number of poultry birds owned by the farmers constitutes the highest when compared with other livestock. Piggery accounted for the lowest in the livestock sector and this might be due to the preponderance of Muslims in the Northern States of Nigeria except for the North Central States where we have mixtures of other religions. The livestock sector and fisheries require water and their production could be affected by inadequate level of water supply. Drought affects crop production through direct impacts on the bio-physical factors such as plant and animal growth [12,13].

Table 5. Respondents' annual number of livestock owned before drought occurrence

Type	Frequency	Percentages	Mean number owned	Mode	Min.	Max.
Goat	255	32.2	12	10	1	100
Sheep	208	26.26	12	5		
Poultry Birds	188	23.74	57	20	2	2,200
Cow	159	20.08	11	2	1	120
Pigs	14	1.77	19	3	2	10
Fish Ponds	7	0.88	12	2	1	60

Source: Field Survey, 2020

3.3.3 Respondents' annual mean farm incomes before drought occurrence

Annual farm income is the amount of money received by farmers over a period of one farming season. Based on the results obtained in Table 6, crop farmers earned almost twice as much as livestock farmers before drought occurrence. Incomes from crop and livestock production are complementary in agriculture because of farmers' needs to diversify their sources of incomes due to unforeseen circumstances or natural disasters such as diseases outbreak, fire incidence, flooding and drought among others. Fish farming appears to bring in more income than livestock production despite the few number of fish farmers. Generally, the relationship between the income of individual farmers and adoption of new practice through training by Extension Agents has been found to be significantly positive [26,27,28].

3.4 Risk's Assessment Capabilities of Farmers

3.4.1 Risks' assessment capabilities of farmers

Farmers need to understand agricultural risks and acquire risk management skills through regular and continuous training to better anticipate problems and reduce its aftermath on agricultural production. Risks associated with drought due to climate change and the incidence of pests and diseases can affect crop and livestock production [29-31]. The five main types of agricultural risk include Production Risks (Impact production yield or quality); Financial Risks (Impact cash flow, opportunities for expansion, estate and retirement planning); Marketing Risks (Impact price and income) and Human Risks (Relate to family, labour resources, and personal health and safety). This paper is mainly concerned with risks associated with crops and livestock production due to drought occurrence and farmers' assessment of it when compared with the absence of drought. Finding in Fig. 3 shows that over 80% of the farmers experienced reduction in crops' yields due to the occurrence of drought. Livestock and fish farmers were not left out the adverse effect of drought as assessed by them. This situation had engendered immediate and extreme food scarcity among some of the farmers. This implies that the farmers might have suffered varied levels of losses in terms of yield, number of livestock and incomes due to drought occurrence [32].

3.5 Level of Drought Vulnerability among Farmers

3.5.1 Effects of drought on agricultural activities of respondents

Generally, it is a known fact that drought usually have negative effects on agricultural production. Specifically, based on result obtained in Fig. 3, 84% of the respondents had significant reduction in total crop yield. The results further show that between 32 and 40% of the respondents experienced significant reduction in farm incomes, shortage of water supply for irrigation, livestock use, fish ponds and domestic uses as well as having adverse effect on livestock health due to drought occurrence (Table 7). The results imply that drought affects most agricultural activities including forest products which could serve as source of incomes and medicinal benefits.

3.5.2 Losses by farmers due to drought occurrence

Researches had established that drought affect almost all agricultural activities. Therefore, findings in Table 8 show that under the crop sector, cereal crops' farmers suffered the highest loss (0.43tons/ha) due to drought occurrence, while Tuber crop followed closely with 0.35tons/ha loss. In case of livestock, the mean annual loss is 13 and maximum of 330 birds but in terms of income loss, livestock was more than crop. This might be due to the low patronage of livestock for fear of high mortality during drought periods. This result implies that farmers might have poor purchasing power due to low income. In order to solve this problem, there is need for farmers to undergo relevant training on drought management. Moreover, respondents indicated that almost 30 percent of their streams and rivers which served as water sources for irrigation and domestic uses were lost due to drought occurrence. The consequences include loss of some community members who died either as a result of frustration and health issues associated with drought or relocated to other States due the drought effect (Table 8).

Table 6. Annual farm income of respondents before drought occurrence

Type of farm income	Annual mean farm income (Naira)	Min.	Max.	Rank
Crop production	472,213:08	305,000	5,000,000	1st
Fisheries	335,120:70	100,000	7,000,000	2nd
Livestock production	241,018:09	300,000	2,500,000	3rd

Source: Field Survey, 2020

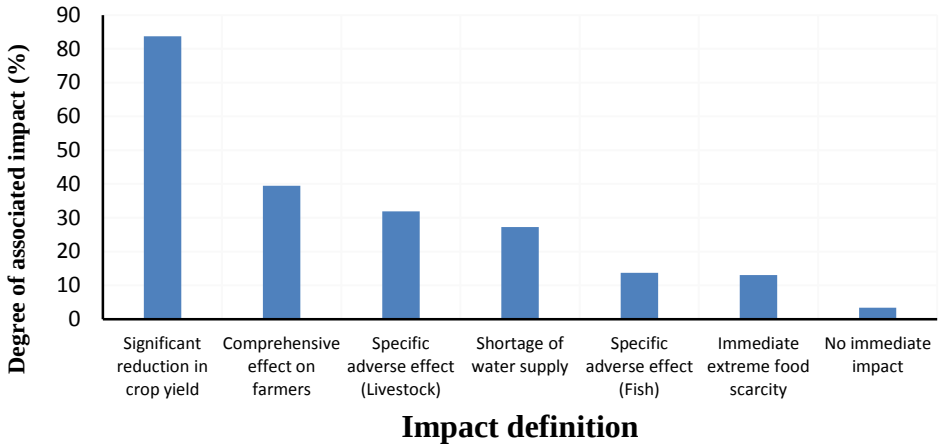


Fig. 3. Farmers' risk assessment capabilities of socio-economic impact of drought

Table 7. Effects of drought on agricultural activities of respondents

Drought effects	Frequency	Percentage
Significant reduction in total crop yield	663	83.71
Significant reduction in farm incomes	313	39.52
Adverse effects on livestock health	253	31.94
Significant shortage of water supply for irrigation, livestock, fish ponds and domestic uses	216	27.27
Negative effects on fish and fishing activities	109	13.76
Adverse effects on forest products	103	13.01
No significant effect	27	3.41

Multiple responses
Source: Field Survey, 2020

Table 8. Annual mean losses by farmers due to drought occurrence

Variable	Mean	Std. Dev.	Min.	Max.	Rank
Crop (tons/ha)					
-Cereal	0.43	1.68	0.0	40	1st
-Tuber	0.35	0.84	0.0	9.7	2nd
-Vegetable	0.15	0.16	3	0.88	3rd
-Legume	0.15	0.32	0.0	4	4th
Livestock(Number)					
-Poultry Birds	13	34	0	330	1st
-Sheep	3	5	0	36	2nd
-Goat	2	4	0	30	3rd
-Cow	2	4	0	25	4th
Income(Naira)					
-Livestock	174,727	258,347	0	2,250,000	**1st**
-Crop	40, 105:85	95,717:43	0	800,000	2nd
-Fisheries (Naira)	91,424:14	369,079:60	0	280,000	

Source: Field Survey, 2020

Table 9. Estimated percentage losses of other natural components by farmers due to drought

Variable	Percentage Loss due to drought
Number of streams and rivers for irrigation purposes	29.2
Community population (Number)	24.9
Forest Products (Naira)	13.15

Source: Field Survey, 2020

3.6 Awareness of Drought Management Strategies for Improved Agricultural Production

There had been indications that respondents were aware of some drought management strategies for improved agricultural production as revealed during Focus Group Discussion, FGD. For instance, between 33% and 50% of the respondents were aware of Conventional Early Drought warning System, Drought awareness campaign, application of recommended fertilizers and construction of Dams and water reservoirs in the rural areas among other practices as shown in Table 10. The issue is that few or none of the respondents probably practised these strategies, and this might be largely due to lack of technical-know-how or relevant expertise required and the available technical opportunities through regular and continuous training.

Table 10. Awareness of drought management strategies for improved agricultural production aware by farmers

Area of awareness	Frequency	Percentage
Conventional Early Drought Warning Systems	393	49.62
Implementation and use of irrigation infrastructure for water supply systems(e.g. dams)	370	46.72
Drought awareness campaign	284	35.86
Construction of Dams and water reservoirs in the rural areas	259	32.7
Application of fertilizer and manure as recommended by Extension Agents	109	13.76
Provision of better access to credit facilities by forming cooperatives	108	13.64
Water harvesting when in excess supply	83	10.48
Implementation of farm insurance schemes against farming risks due to drought	74	9.34
Effective implementation of water management policies	71	8.96
Effective drought, water and climate change adaptation plans and policies by the government	69	8.71
Control of the indiscriminate use of pesticides and herbicides	66	8.33
Soil conservation practices	66	8.33
Incorporating indigenous and local knowledge of farmers into policy planning with a view to mitigating the effect of drought	56	7.07
Coordinated drought emergency response and preparedness (i.e. qualified personnel, equipment, facilities, adequate funding)	54	6.82
Changing farming practices (e.g. crop diversification, adjusting planting dates, climate- smart agriculture, horticulture, intercropping, crop rotations and agro-forestry etc.	52	6.57
Changing farming practices (e.g. crop diversification, adjusting planting dates, climate- smart agriculture, horticulture, intercropping, crop rotations and agro-forestry etc.)	43	5.43
Expanding the number and coverage of protected natural reserved areas (Improved Forest reserves, Forest degradation, use of chemicals for fishing, bush burning. etc.)	37	4.67
Reclamation of degraded land for agricultural activities	21	2.65

Source. Field Survey, 2020

3.7 Farmers' Training Needs on Drought Management Strategies for Improved Crops and Livestock Production in Northern Nigeria

The important of training is associated with the need for individual to acquire knowledge, skill and change in attitudes with a view to overcoming specified problems. Therefore, the farmers' training needs represent the gap of what they know and what they ought to have known or expected to have known. This study becomes necessary because of the need to identify this gap for solutions. Table 11 indicates that most of the respondents required training in the maintenance of water supply systems such as desalinisation, waste water treatment plants and mending of water leakages, while training in soil and water conservation methods and drought risk management were ranked second and third respectively. Despite ranking methods of accessing information relating to drought warning in the rural areas using Drought Forecasting Model as forth, it is very clear that many of the farmers might not be able to appreciate the emerging Information and Communication Technologies due to higher educational limitations. Moreover, most farmers do not have adequate technical exposures and are fatalistic in nature, that is, a submissive mental attitude resulting from acceptance of the philosophical doctrine holding that all events are predetermined in advance for all time and human beings have no power to change them, and that everything that happens is predetermined by the supreme God or gods and inevitable as the case may be (Rashid, S.A. et.al. 2021).

3.8 Results of the Hypotheses Tested

A total of 5 hypotheses were tested in this study. All the hypotheses were tested at 5% significant level**.** Results shown in Table 15 indicate that variables 2 & 3 were significant. This implies that the higher their educational levels, the more they will need training in the two significant areas. In addition, Table 9 shows that variables 2, 3, 4 & 6 had positive and significant relationship with Extension contacts. This implies that the more the number of contacts with Extension Agents, the higher the demands for training in the four significant areas. Also, Table 15 reveals that age had no significant relationship with training needs. This implies that age is not a barrier to training, which is a continuous process in life.

Results for t-test analysis in Table 16 show positive and significant difference in all the paired variables. This implies a significant difference in crop yield (Cereals, Tuber, Legumes and Vegetables) before and after the drought occurrence. In the same vein, positive and significant difference in farm incomes (Crop, livestock and fisheries) before and after the drought occurrence was also established.

For results in Table 16, the correlation coefficient (r), of between 0.68 and 0.83 was considered high, thereby confirming that significant reduction in livestock owned by farmers is most probably associated with drought occurrence.

Table 11. Farmers' training needs on drought management strategies in Northern Nigeria

Area of training needs	Frequency	Percentage	Rank
Maintenance of water supply systems (desalinization and waste water treatment plants, reducing leakage rates)	455	57.45	1st
Soil and water conservation methods & appropriate farming practices	407	51.39	2nd
Drought risk management strategies	344	43.43	3rd
Methods of accessing information relating to drought warning in the rural areas using Drought Forecasting Model	228	28.79	4th
Diversification of livelihood strategies to cope with the effects of drought	216	27.27	5th
Efficient methods of rain water harvesting and safety for domestic	198	25	6th

Source: Field Survey, 2020

Table 12. Chi-Square results showing the relationship between farmers' educational levels and their training needs

S/N	Educational level VS Training needs	Chi-Square Value	df	P-value	Decision
1	Maintenance of water supply systems	4.19	4	P>0.05	NS
2.	Soil and water conservation methods & appropriate farming practices	2.52	4	P<0.05	S
3.	Drought risk management strategies	10.64	4	P<0.05	S
4.	Diversification of livelihood strategies to cope with the effects of drought	3.71	4	P>0.05	NS
5.	Methods of accessing information relating to drought warning in the rural areas using Drought Forecasting Model	4.66	4	P>0.05	NS
6.	Efficient methods of rain water harvesting and safety for domestic uses	5.63	4	P>0.05	NS

NS= Not significant, S= significant
Source: Field Survey, 2020

Table 13. Chi-Square results showing the relationship between farmers' contact with Extension Agents and their training needs

S/N	Contact with EAs VS Training needs	Chi-Square Value	df	P-value	Decision
1	Maintenance of water supply systems	5.90	6	P>0.05	NS
2.	Soil and water conservation methods & appropriate farming practices	13.46	6	P<0.05	S
3.	Drought risk management strategies	11.81	6	P<0.05	S
4.	Diversification of livelihood strategies to cope with the effects of drought	18.18	6	P<0.05	S
5.	Methods of accessing information relating to drought warning in the rural areas using Drought Forecasting Model	5.54	6	P>0.05	NS
6.	Efficient methods of rain water harvesting and safety for domestic uses	18.74	6	P<0.05	S

NS= Not significant, S= significant
Source: Field Survey, 2020

Table 14. Chi-Square results showing the relationship between farmers' age and their training needs

S/N	Farmers' age VS Training needs	Chi-Square Value	df	P-value	Decision
1	Maintenance of water supply systems	7.29	5	P>0.05	NS
2.	Soil and water conservation methods & appropriate farming practices	5.50	5	P>0.05	NS
3.	Drought risk management strategies	10.02	5	P>0.05	NS
4.	Diversification of livelihood strategies to cope with the effects of drought	3.26	5	P>0.05	NS
5.	Methods of accessing information relating to drought warning in the rural areas using Drought Forecasting Model	7.62	5	P>0.05	NS
6.	Efficient methods of rain water harvesting and safety for domestic uses	3.20	5	P>0.05	NS

NS= Not significant, S= significant
Source: Field Survey, 2020

Table 15. Results for t-test analysis

Paired Variable	t-value	df	P-value	Decision
Crop yield (tons/ha)				
-Cereals	15.88	672	P<0.05	S
-Legumes	10.10	321	P<0.05	S
-Tuber	5.15	189	P<0.05	S
-Vegetables	6.14	83	P<0.05	S
Incomes (Naira)				
-Crops	20.21	792	P<0.05	S
-Livestock	13.66	385	P<0.05	S
-Fisheries	2.81	57	P<0.05	S

NS= Not significant, S= significant

Table 16. Results of Pearson Products Moment Correlation analysis

Type of livestock	r-coefficient value
Cow	0.68
Goat	0.70
Poultry birds	0.83
Sheep	0.76
Pig	0.82

4. CONCLUSION AND RECOMMENDATION

The study is limited because of the incessant attacks on farmers in the study area which limited our access to many intended farmers that we would have included in the study. More so, curfews and restrictions by the Federal Government of Nigeria at that time affected the training of enumerators and other research assistants for data collection as well as inclusion of some States and communities in the study. This implies that more States and communities should be included in the nearest future, all things being equal. Based on the findings of this study, it can be concluded that most of the farmers had experienced drought and its negative effects on their agricultural activities, especially in the production of crops, livestock and fisheries. Despite their awareness of drought management strategies for improved agricultural production, most farmers do not have adequate technical training and exposures to emerging Information and Communication Technologies, ICTs that could have assisted them with information on any impending drought since is a natural occurrence. It is therefore, recommended that farmers should be trained regularly and continuously based on the training needs identified in this study. The training can be done using trained Extension Agents or Training the Trainers by Experts, especially in the area of Drought Early Warning Systems, DEW because prevention is better than cure.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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