International Journal of Agriculture, Environment and Bioresearch

Vol. 09, No. 03; 2024

ISSN: 2456-8643

WATER INSECURITY AND FOOD INSECURITY NEXUS AMONG LIVESTOCK FARMERS IN ZAMFARA STATE, NIGERIA

Akinyemi Mudashiru, Sulaiman Muhammad Gusau and Ojoko Emmanuel Ada
Department of Agricultural Economics, Federal University Dutsin-Ma Katsina State, Nigeria.

https://doi.org/10.35410/IJAEB.2024.5907

ABSTRACT
The study divulges the connection between food insecurity and water scarcity among livestock farmers in Zamfara State. Nigeria. A total of 360 respondents were sampled using multi-stage sampling technique. The primary data collected for the study were analyzed using descriptive statistics, Household water insecurity scale, food security index and logit regression model. Analysis of socioeconomic characteristics of the farmers shows that majority were married (98%), 53.6% of the respondents fell within the range of 41–50 years; suggesting that majority of livestock farmers were youthful and physically fit. Herd size indicates that 90.6% keep less than 61 livestock. The average household size was 9 person. Education of the farmers reveals that 30.06% had formal education and 69.04 % attended informal education. The HWISE scale analysis of water insecurity shows that 54.4% were water insecure, while 45.6% of the livestock farmers were water secured. This implies that water insecurity was predominant and adversely affects livestock farmers in the study area. The Food security index revealed that 65% of the livestock farmers were food insecured, while 35% were food secured. The result of logit model indicates that among the hypothesized variables, household size, herd size, farming experience, education status, extension visit and water scarcity were the factors influencing food security status of the livestock farmers in the study area. The study concluded that water scarcity has a negative relationship with the food security status of the livestock farmers. The study recommends that governments construct more subterranean water resources in order to increase water access and lessen shortages and Livestock farmers are urged to make investments in infrastructure for rainwater harvesting.

Keywords: Food security, Water scarcity, Livestock farmers, Zamfara-state.

1. INTRODUCTION
Water scarcity in sub-Saharan Africa, especially in the semi-arid areas, is posing a threat to security of livestock farmers, because of unsustainable water use, unequal distribution, unstable political environments, and climatic fluctuations. Godde *et al.* (2022) opined that 80% of the water needed by livestock comes from feed; the remaining twenty percent comes from drinking water. Animal development and productivity might be adversely affected by adequate water. Competition for both water and grazing land occasioned by water scarcity in Nigeria's rural areas remain challenging issue for both present and past administration, despite centuries of interdependent coexistence, productivity of farmers and pastoralists still remains at low ebb.
Nigeria experiences frequent droughts and flooding that destroy crops and reduce the country's food supply, resulting in food shortages. Food scarcity is a result of less rainfall, poor rainfall capture techniques, and a lack of water. Although individuals lack the resources to irrigate fields,

water crops, and provide water for cattle, water is crucial for the security of the nation's food supply especially in livestock industry.

In Nigeria, violence and instability in the region are caused by water scarcity. The shortage affects more than 90% of rural and 60% of urban areas. Poor people's ability to use water is hampered by rivalry from other industries, which has an impact on their livelihoods and food security. Water scarcity forces the majority of rural communities to live as transhumance pastors and nomads. About 60% of the world's population living in water-stressed areas, water scarcity is a significant global issue. Living in sub-Saharan Africa, more than 50% share household water supplies with animals. Libya, Somalia, Pakistan, Morocco, Niger, and Jordan are among the vulnerable places. Water constraint is forcing agricultural production systems, which are essential to food security, to adapt, especially in Africa. New diets sensitive to the effects of water and land usage have resulted from this. By 2050, the world's water use may quadruple, posing a threat to food supplies.

Lack of water drives wastewater use for agricultural production, affecting over 10% of global food consumption. The low productivity of livestock, livelihoods, and national income are caused by water scarcity. People store water as a result of population growth, urbanization, household and industrial use, and the increased risk of contamination and mosquito breeding. Millions of people die each year in Nigeria's semi-arid region from water-related diseases, malnourishment, political unrest, and environmental damage as a result of water scarcity. River basins are altered by dams, and around half of all wetlands have been lost. Every year, the Nigerian desert converts 3,500 square kilometers of land, forcing pastoralists and farmers to leave their farms. In addition, a drought has an adverse effect on the environment, social development, and cattle populations. Since pastoralists produce 85% of all livestock in Northern Nigeria, their livelihood is severely impacted by the lack of freshwater. Their survival is threatened by global issues and climate change, which will result in decreased output and dwindling cattle herds. This has an impact on crop and livestock output, the environment, and social development.

In Zamfara State, population expansion and insecurity put a strain on natural resources, especially pasture and water, which are necessary for the production of livestock. The need for water to support human consumption and livestock production rises with population development. The purpose of this study is to establish a link between food security and water shortage, particularly as it relates to the livelihood of livestock producers. Specifically, this research seeks to determine the effect of water scarcity on the choice of livelihood strategies engaged by livestock farmers and determine the effect of water scarcity on food security status of livestock farmers in the study area.

2. METHODOLOGY

Study Area

The study focused on Zamfara State, Nigeria. The state was established in 1996 and has 14 local government areas. It has a population of 3,260,000 and a 3.5% annual growth rate, the state covers 38,418 square kilometers and shares borders with Sokoto, Niger, Kebbi, Katsina, and Kaduna. The state experiences two distinct seasons, dry and rainy, with an annual temperature

ISSN: 2456-8643

range of 25–42 °C and 550–900 mm of rainfall. Harmattan occurs between November and February each year. Zamfara State, with over 3.5 million hectares of land, is primarily cultivated for agriculture, providing livelihoods to over 80% of its population. The Bakalori irrigation scheme has grown over 8,000 hectares of land for various crops, including wheat, rice, tomatoes, and sweet potatoes. The livestock population in Zamfara is over 9 million heads. The dry season spans from November to April, with Harmattan occurring between November and February each year.

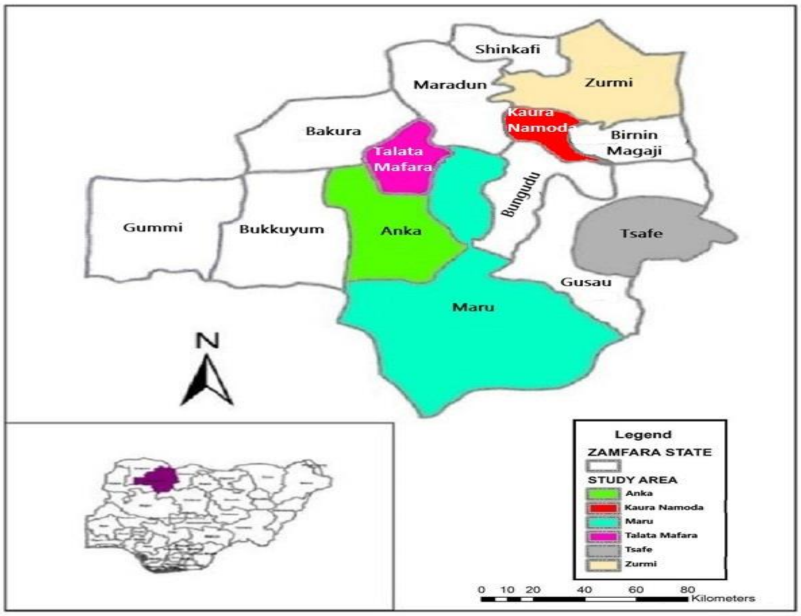

Figure 1: Map of Zamfara State showing the study Area

Population of the study and sampling procedure

The population for the study are all the livestock farmers registered with Ministry of Animal Health and Livestock Development Zamfara State. Multi-stage sampling procedures was used in deriving the samples for this study. First stage involved the purposive selection of six (6) LGAs from three (3) administrative zones of Agricultural Development Project (ADP) in Zamfara State, because of the intensification of livestock farming in the area. The selected LGAs were Maru, Tsafe, Zurmi, Kaura, Mafara, and Anka. Second stage also involved the purposive selection of three (3) communities each from the six (6) selected LGAs which were; Mayanchi, Jabaka, Kanoma, Yandoto, Danjibga, Magazu, Maguru, Kurya, Dogon Kade, Dauran, Moriki, Dutsi, Bagega, Wuya, Matseri, Morai, Jangebe and Kagara, because they were among the major livestock producing communities in the state. Third stage involved random sampling of 360 livestock farmers across the 18 communities selected in the 6 LGAs.

Raosoft sample size calculator was used to determine the sample size, using a confidence interval of 95% (i.e. 5% LOS) and response distribution of 50% with a population of 5600, the results indicated minimum sample size of 360 respondents required for the study. The sample size (360) was selected across eighteen (18) communities of the six (6) LGAs proportionally.

The Raosoft® incorporated tool was built on the formula below to get the sample size:

The sample size *n* and margin of error *E* are given by;

Vol. 09, No. 03; 2024

ISSN: 2456-8643

$$X = Z(^{c}/_{100})^2 r(100\text{-}r) \text{ -- } (1)$$

$$N = {}^{N\,x}/_{((N\text{-}1)E^2 + x)} \text{ --}(2)$$

$$E = \text{Sqrt}[^{(N - n)x}/_{n(N\text{-}1)}] \text{ --}(3)$$

Where;

N is the population size
r is the fraction of responses that you are interested in; and
Z(*c*/100) is the critical value for the confidence level *c*.

However, simple proportional formula was used to calculate the number of respondents in each communities selected.

nc= $\frac{n}{N}\ xNc$ -- (4)

Where:
N is sampling frame for whole population,
Nc is the total sample size for the study.
n is sampling frame for the community, and
nc is the sample size for the community.

For community level sample size nc= $\frac{communitySample\ Frame}{Total\ sample\ frame} \times Total\ sample\ size$

Example of Mayanchi community: nc = $\frac{289}{5600} \times 360 = 19$

Table 1: Summary of sample frame and sample size of the respondents.

Zones	Selected LGAs	Selected communities	Sample frame	Sample Size
Gusau Zone	Maru	Mayanchi	289	19
		Jabaka	362	23
		Kanoma	276	18
	Tsafe	Yandoto	334	21
		Danjibga	381	24
		Magazu	329	21
Kaura Zone	Zurmi	Dauran	278	19
		Dutsi	394	25

Vol. 09, No. 03; 2024

ISSN: 2456-8643

		Moriki	287	18
	Kaura	D/kade	312	20
		Kurya	293	19
		Maguru	240	15
Gummi Zone	Anka	Bagega	296	19
		Wuya	300	20
		Matseri	250	16
	Mafara	Kagara	266	17
		Morai	358	23
		Jangebe	355	23
Total	**6**	**18**	**5600**	**360**

Source: Recognizance survey, 2022

Household water insecurity experiences (HWISE) scale

The Household Water Insecurity Experience (HWISE) scale was constructed and validated as a cross cultural household water insecurity scale using data collected between 2017 and 2018, from 22 countries. The HWISE has been presented as a revolutionary tool in monitoring and evaluating water-related interventions as an adjunct to the UN standard metrics (Stoler *et al.*, 2021). Household water insecurity scale (HWISE) was used to describe respondents experience in the face of water insecurity (part of objective 1) Household water insecurity has been difficult to measure equivalently across cultures. Household Water Insecurity Experiences (HWISE) Scale was developed to address this global challenge. This tool is cross-culturally validated and produces equivalent scores across diverse ecological settings in order to identify where and when water insecurity occurs, as well as who is water insecure and to what extent. The HWISE scale asks respondents to reflect on experiences of water availability, accessibility, use, acceptability, and reliability throughout the period of four weeks.

The HWISE scale assumes that households with greater water insecurity will affirm more experiences and/or affirm greater frequency of experiences. There are 12 HWISE items, Worry, Interrupt, Clothes, Plan, Food, Hand, Body, Drink, Angry, Sleep, None, Shame. HWISE Scale scores are calculated by summing responses to each question (item). Responses to items are: never (0 times), rarely (1–2 times), sometimes (3–10 times), often (11-20 times), and always (more than 20 times). Never is scored as 0, rarely is scored as 1, and sometimes is scored as 2, Often and always are both scored as 3.

Calculating proportion of water-insecure households. HWISE scale scores require the summation of all 12 items/questions.

Proportion of water-insecure households.

$$\text{Proportion of water-insecure households} = \frac{\text{Number of households with HWISE scores} \geq 12}{\text{Total number of households}} \quad \text{---(5)}$$

The proportion of water-insecure households is calculated by dividing the number of households with scores of 12 or higher by the total number of households.

Food Security Index

The methods used for this study were food security index and FGT model. This way of measuring food security involves the construction of a food security index. Following the research of Adepoju & Obayelu (2018). The food security index is as shown below:

$$Fi = \frac{\text{per capita monthly food expenditure for the } i^{th} \text{ household}}{2/3 \text{ mean per capita monthly expenditure of all household}} \quad \text{-------------------------------- (6)}$$

Where: Fi = Food security index.

When:

$Fi \geq 1$, it implies that the household is food secure

$Fi \leq 1$, it implies that the household is food insecure

Therefore, a food-secure household is one whose per capita monthly food expenditure is at least two-thirds of the mean per capita monthly food expenditure of all the households. On the other hand, a food in-secure household is one whose per capita monthly food expenditure is less than two-thirds of the mean monthly per capita food expenditure of all households.

The next step involved estimation of food insecurity status. The procedure of Foster – Greer & Thorbeke (1984) was used in the computation of incidence, depth and severity of food insecurity.

The model is stated as;

$$P_{\alpha} = q / n \sum_{1}^{q} [(Zi - Yi)/Z] \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(7)}$$

Where the variables are redefined as follows:

Z = food security line

q = number of livestock farmers below the food security line in the study area

n = total number of livestock farmers in the study area

Y_i = food expenditure of the livestock farmers in the study area

α = Foster – Greer and Thorbeke index which takes the value 0, 1 , 2.

The components and derivations of the Foster-Greer and Thorbeke model are:

(i) Simple Head Count Ratio: this gives the percentage of sample living in the household with food expenditure less than food security line. In other words, it measures the number of food insecure household as a percentage of the total population. The food security aversion parameter equal zero. From equation 6,

if α = 0, the food security index becomes

$P = q / n$ ………………………………………………………………………… (8)

(ii) Food insecurity Depth: The food insecurity gap index measures the extent to which individual falls below the food security line. It indicates the relative shortfall of the food insecure from the threshold. It can be used to determine the percentage of expenditure required to bring every household below the food security line up to the food security line. A useful index is obtained when the food security aversion parameter is equal to one.

$P1 = q / n \sum_1^q [(Zi - Yi)/Z]$ ……………………………………………(9)

(iii) Severity of food insecurity Index: This is the mean of squared proportion of food insecurity gap expressed as:

$P_2 = q / n \sum_1^q [(Zi - Yi)/Z]^2$ ……………………………………………………(10)

Logistic regression model

Logistic Regression model was used to analyze the effect of water scarcity on food security status of livestock farmers in the study area. However, prior to the utilization of Logit model, food security index (FSI) and FGT model were used to determine the food security status of livestock farmers in the study area.

The model is specified as:

$Li = (P_i/1-P_i) = \alpha + \beta1X_1 + \beta2X_2 \ldots + \beta10X_{10} + e_i$ .... (11)

Where: Li =Logit; P_i = Food secure; $1-P_i$ = Food insecure;

β1 to β10= Coefficients to be estimated;

α = Constant term;

e_i = Error term;

X_1 = Age of the household head (years)

X_2 = Household size (number);

X_3 = Herd size (TLU);

X_4 = Farming experience (years);

X_5 = Education (years of schooling);

X_6 = Monthly income (Naira);

X_7 = Extension contact (number of visit)

X_8 = Experience of water scarcity HWISE index (water secure =1, water in secure =0).

3. RESULTS AND DISCUSSION

Socio-economic Characteristics of the Household Heads

Table 2 presented the Socio-economic characteristics of the household heads. These includes age, marital status, educational status, livestock farming experience, household size, household members, age, livestock herd size and income of the respondents. The table showed that 66.9% of livestock farmers were aged 31-50 years, with 28.8% aged 51-70. The remaining 4.2% were aged 20-30 years. This indicated that most farmers were within their active stage. Age plays a significant role in agricultural production activities, as it influences farmers' decision-making regarding livelihood strategies and production-related decisions. This finding aligned with Ogbe, *et al*. (2017)'s research, which found that most farmers in South Eastern Nigeria are between the productive age of 31 and 50. It was also showed in the table that 98% of household heads were married, while only 1.9% of livestock farmers were single. This indicated that most livestock farmers had more responsibilities, making marital status crucial in societal change programs. Water scarcity could negatively impact married farmers' ability to provide basic needs and manage family responsibilities. According to Ogunremi *et al*. (2016), married people were responsible and willing to spend profits on their families. The level of education among livestock farmers significantly impacts their livelihood strategies, food security, and poverty reduction. The majority of livestock farmers (69.4%) had acquired Qur'anic education, 13.6% had adult education, and only 17% had acquired western education. This low level of formal education indicated that western education was not a priority among these farmers. This lack of western education makes it difficult for them to acquire modern water saving techniques. This is in line with Barrett & Aboud (2002) findings that formal education could enhance managerial ability and cognitive capacity in acquiring new technology. A higher educational status encourages innovation, which can increase farm productivity and income, ultimately improving food security for households.

Livestock farmers' long-term farming experience significantly impacts productivity and income levels. This experience can lead to improved livelihood strategies, enabling older farmers to combine various activities, improving their income and food security. Experience also influences farmers' participation in agricultural programs, as their performance greatly influences their participation. Farmers prioritize their farming experience over education to increase efficiency, resulting in significantly influenced livelihood strategies and income levels. The table shows the distribution of livestock farmers based on monthly income earned. The majority of households (56.1%) earned between N11,000 and N40,000, followed by those in the N41,000-N70,000 range (28.1%). Higher income households are expected to implement measures to protect against water scarcity. The majority of livestock farmers (96.6%) maintain a herd size of less than 60 livestock, aligning with Iro's recommendation of 80-100 cattle.

The study reveals that livestock farmers in Nigeria have a large household size, with 44.2% having 11-15 members and 30.6% having 6-10 members. This is due to the polygamous nature of the households and the perception that large families provide cheap labor and more hands for farm work. The majority of households rely on water sources such as rivers, streams, wells, tap/boreholes, ponds/reservoirs, and rainwater. Water scarcity is more prevalent during the dry season, leading to reduced productivity, lower income, and increased expenditure on water and food. 54.7% of livestock farmers worry about insufficient water for household needs, while 38.6% become upset due to water sources drying up or interrupted services. Water scarcity also affects hygiene, with 59.2% and 43.1% struggling to wash hands and bathe after dirty activities.

Vol. 09, No. 03; 2024

ISSN: 2456-8643

Table 2: Socioeconomic characteristics of the Household Heads

Variable	Class Interval	Frequency	Percentage (%)
Age (years)	21 - 30	15	4.2
	31 - 40	48	13.3
	41 - 50	193	53.6
	51 - 60	88	24.4
	61 - 70	16	4.5
Marital status	Single	07	2.0
	Married	353	98.0
Level of education	Quranic education	250	69.4
	Adult education	49	13.6
	Primary education	42	11.7
	Secondary school	19	5.3
Experience	1-10	53	14.7
	11-20	110	30.6
	21- 30	129	35.8
	31-40	57	15.8
	>40	11	3.1
Income (₦)	11,000-40,000	202	56.1
	41,000-70,000	103	28.6
	71,000-100,000	37	10.3
	≥100,000	18	5.0
Herd size	1-30	195	54.2
	31-60	131	36.4

ISSN: 2456-8643

	61-90	22	6.1
	Above 90	12	3.3
Household size	1- 5	11	3.1
	6 - 10	110	30.6
	11 - 15	159	44.2
	16 - 20	48	13.3
	>20	32	8.9
Water source	Tap/Borehole	21	5.1
	Open Well	101	58.1
	Pond/Reservoir	6	1.7
	River/Stream/Spring	208	57.8
	Rain Water	24	6.7
	Total	**360**	**100**

Source: Field Survey, 2023

Water security status of the livestock farming household

The water security status of the livestock farming household were presented in Table 3. The result showed that 54.4% were water insecure while 45.6% of the livestock farmers were water secure based on the HWISE scale constructed (that is number of households with HWISE scores ≥12/ Total number of households = proportion of water-insecure households). This implies that most of the livestock farmers were water insecure as result of engagement in different livelihood activities that lead to increase in water utilization. The effect of water scarcity could infringe on their social life, education and well-being of household where there is severe water shortage. Some society have deprived female children right to formal education because of unmeasurable time that have to be spent on sourcing water (Adejumo, 2018). Furthermore, Nounkeu, *et al.*, (2022), used Water Insecurity Experience Scale for assessment of drinking water access and household water insecurity: A cross sectional study in three rural communities of the Menoua Division in West Cameroon. The study showed that majority of the household 94.2% were water insecure.

Table 3: Water Security Status of the livestock farming household

Water security status	Frequency	Percentage
Water insecure household	196	54.4
Water secure household	164	45.6
Total	360	100

Source: Field Survey, 2023

Food Security Status of the Livestock Farmers

The food security status were estimated by measuring the wellbeing of the livestock farmers in terms of their total food-expenditure and their household size. The Foster-Greer and Thorbeck model was used. Having established the individual members of the household food-expenditure per month based on the food security index constructed (that is 2/3 mean per capita food expenditure. Two-third (2/3) of the mean per capita food expenditure was used to establish a food security line of ₦10,294. These measures of food security lines were in accordance with Foster-Greer and Thorbeck model. Table 4 showed the households' monthly food expenditure, it was found that per capita food expenditure of the livestock farmers in the study area, amounted to ₦ 5,559,215. The study revealed that the monthly mean per capita food expenditure for the total household was ₦ 15,442 and the 2/3 mean per capita food expenditure for all the households was ₦10,294. Also as indicated, not all household responded to have consumed all the items. From the results presented in Table 4, the food commodities with high expenditure included rice, maize, and sorghum. Its implied that, the livestock farmer's total expenditure on food were on high starch food items like rice, maize, and other cereals. Therefore, the livestock farmers consume high energy giving foods to be able to meet up with the high labour demands for their farm operations.

Table 4: Distribution of livestock farming household by their monthly food expenditure pattern

Commodity	**Food Expenditure Pattern (₦)**
Rice	1,980,000
Maize	946,000
Sorghum	658,125
Other Cereals	329,250
Cowpea &Soybean	269,157
Tubers	234,942
Meats	177,780
Poultry products	142,424
Fish & Sea Food	166,620
Milk & dairy products	72,187
Vegetables	118,571
Fruits	36,590
Oil & fat	186,751
Spices & Condiments	86,292
Sugar/Confectionary	154,556
Total	**₦ 5,559,215**

Source: Field Survey; 2023

The food security index which is per capita food expenditure for the ith household divided by 2/3 mean per capita food expenditure of all households was used to determine the food security status. A household with a food security index (F_1) greater or equal to one was considered food secure, while household with less than one was food insecure.

This study found that per capita food expenditure of the livestock farmers in the study area, amounted to ₦ 5,559,215. The study revealed that the monthly mean per capita food expenditure for the total household was ₦ 15,442 and the 2/3 mean per capita food expenditure for all the households was ₦10,294. The result showed that 65% were food insecure while 35% of the

ISSN: 2456-8643

livestock farming household were food secure based on the food security index constructed (that is 2/3 mean per capita food expenditure). The result agrees with the findings of Ijatuyi, Omotayo & Nkonki-Mandleni, (2018), Muhammad-Lawal & Omotesho (2008) who reported in their studies among cereals farming households in Kwara State, about 60% of the households were food insecure. While 43.4 % and 56.5 % for food secure and food insecure respectively, for agricultural households in the Platinum Province of South Africa.

Table 5: Food security status of the livestock farming household

Food security status	Frequency	Percentage (%)
Food insecure	233	65
Food secure	127	35
Total	360	100
Mean per capita household food expenditure (MPCHFE) is ₦ 15,442		
Food security line (2/3 of MPCHFE) is ₦10,294		

Source: Field Survey, 2023

The result of Foster-Greer and Thorbeck measure of food security for livestock farmers in Table 6, showed that 65% of the livestock farmers were living below the line of food security while 35% were above the food security line. The food insecurity head count, depth and severity were 65 %, 14 % and 28 % respectively. Food insecurity head count (P_0) represents the proportion of household below the food security line. Food insecurity depth (P_1) represents the expenditure proportion required to allow households below the food security line acquire the minimum food expenditure that moves them out of food insecurity. The food insecurity severity index (P_2) represents how severe the food insecurity situation among the households was. This implied that 65 % of the livestock farmers were below the food security line of N10, 294 per capita food expenditure while 14 % of food expenditure is needed to bring them up to the food security line. The severe food insecure livestock farmers accounted for 17 %. The high percentage of food insecure households could be attributed to the reliance on one livelihood strategy as the source of their livelihood. The findings of this study was similar to Omotesho, Adewumi, Mohammad & Ayinde, (2010) who observed 75% and 25% headcount ratio for food insecure and food secure households, respectively in their studies carried out among rural farming households in Kwara State, Nigeria. The finding of this study was contrary to Tshediso (2017) who classified food security status based on the Household Food Insecurity Access Scale (HFIAS) and found out that nearly 62.7% of the households were food secure.

Table 6: Foster-Greer and Thorbeck measure of food security for livestock farmers

Estimate	Food secure	Food insecure	Pool
Household Head (Number)	127	233	360
Percentage Household (%)	35	65	100
Total per capita for all household food expenditure (₦)			5,559,215
Mean per capita household food expenditure (₦)			15,442
Food security line (2/3 MPCHHFE) (₦)			10,294
Total expenditure of food insecure household (₦)			1,873,133
Average expenditure of food insecure household (₦)			8,039
Head count ratio (%)			0.65
Food security gap ratio (%)			0.22
Food security depth (%)			0.14
Food insecurity severity (%)			0.28

Source: Field Survey, 2023

Estimate of the Effect of Water Scarcity on Food Security Status of Livestock Farmers in Zamfara State.

The estimates logit regression model of the effect of water scarcity on the food security status of livestock farmers in the study area is presented in Table 7. The model had a high negative log likelihood of -301.513 suggests that the estimated model as a whole is statistically significant. In addition, the coefficient of determination, R^2 was 0.455 indicating a 45.5% probability of the food security status being explained by the logistic model. The marginal effect for some of the variables are negative while others are positive. The negative sign of the variables indicates that an increase in it will cause the level of food security status to decrease.

From the results household size of the livestock farming household significantly influenced food security status at $p<0.05$ with the odd-ratio of being food secure decreasing by 0.931.

Herd size in (TLU) was positive and significantly influenced food security among livestock farming household at $p<0.10$, with odd-ratio revealed that increasing in herd size by one TLU increases the likelihood of those who are food secure by 1.055.

Education also significantly influence food security among the livestock farming household at $p<0.05$, with odd-ratio increasing the likelihood of being food secure by 0.942. However, the odd-ratio in support of the farming households' food security status increased by 1.340 as frequency of the extension contact increased. As the water scarcity experience of the household increased, the households' food security status also decreased by 2.911 in odd-ratio.

Marginal Effect Estimate of the Effect of Water Scarcity on Food Security Status of Livestock Farmers.

The study found that, household size had a significant negative effect on food security status at $p<0.05$ and it decreased the household's probability of being food secure by 0.057. The implication of the result is that the smaller the household the likelihood of the household being food secured. This is in line with the findings of Amurtiya (2015) who found out that an increase in household size by one member increased the chance of the household not being food secure by indirectly reducing income per head, expenditure per head and per capita food expenditure all things being equal.

The finding reveals that, herd size was positive and significant at $p<0.10$. The marginal effect of the model showed that as the herd size increases the likelihood of a household being food secure increases by 0.706. The result implied that a household with more herd size are likely to have more income/revenue from the sales of the livestock. This will consequently result in more expenditure on food for the household, which will consequently improve their food security status. The result agrees with the findings of Okon, Frank, Etowa & Nkeme, (2017) who reported that there is hope for increasing output by increasing farm size.

Farming experience had positive and significant effect on food security status of the household at $p<0.01$. The marginal effect of farming experience showed that as the household head farming experience increases the probability of household to be food secured increases by 0.031. An experienced household head is expected to have more insight and ability to diversify his production to minimize risks of food insecurity. This agrees with the findings of Oluyole, Oni, Omonona & Adenegan, (2009) who found a positive relationship between farming experience and food security status.

The level of education (years of schooling) was positive and significant at $p<0.05$. The marginal effect of year of schooling showed that one extra year of education increases the probability of household to be food secured by 0.066. This is similar to the findings of Akukwe (2020) who found that food security increases with higher level of education in southeastern Nigeria ceteris paribus, but the result contradict with the findings of Yusuf, Balogun & Falegbe, (2015) and Djangmah (2016), who found food security to decrease with increasing number of years spent in education in Nigeria and Northern region of Ghana.

Extension contacts was positive and significant at $p<0.05$. This implies that a unit increase in extension contact will lead to an increase in the probability of the household being food secured by 0.297. This is because extension agents assist the livestock farmers to make decisions that would guide them against the consequences of water scarcity and exposing them to latest information and technical skills that will boast their production despite the challenges of water scarcity. This result is in line with Asogwa, Ihemeje and Ezihe, (2011) who found that increase in extension visit leads to increase in farms productivity, income and standard of living of farmers. Fatuase, Aborisade and Omisope, (2015) also found that access to extension agent was

ISSN: 2456-8643

significant in influencing the rate of utilizing adaptation measures. They added that the more the farmer has access to extension services, the more the chance of utilizing many adaptation measures.

The water scarcity problems experienced by the livestock farmers was also found to be negative and significant at p<0.10. The marginal effect of the model showed that the lesser the water scarcity problems experienced by households the more the likelihood of being food secured by 0.038. The result implied that, socio-economic life of the livestock farmers is incomplete without adequate water. This result corroborates with the findings of Adejumo, (2018), who reported that, at the household level, water is critical in sustaining livelihood, ensuring food and nutrition security.

Table 7: Logit Regression Result of Effect of Water Scarcity on Food Security

Variables	Coefficients(β)	Z statistics	Odd ratio	Marginal effect
Age	-0.063	0.89	0.955	-0.004
Household Size	-0.242	-1.96	0.931	-0.057**
Herd Size	0.920	1.66	1.055	0.706*
Farming Experience	0.535	3.44	1.054	0.031***
Education (years of schooling)	0.162	2.52	0.942	0.066**
Monthly Income	0.434	0.80	1.032	0.0030
Extension contact	0.510	2.04	1.34	0.297**
Water scarcity experience	-0.754	1.65	2.911	-0.038*
Log likelihood	-301.513			
Pseudo R^2	0.455			

Source: Field Survey, 2023 *** = Significant at 1%,** indicates significant at 5%,* indicates significant at 10%

4. CONCLUSION AND RECOMMENDATIONS

In light of the research findings, analysis of the socioeconomic characteristics of the farmers shows that majority were married, fell within the range of 41–50 years, have a herd size less than 61 livestock, had informal education with an average household size of 9 persons. The HWISE scale analysis of water insecurity showed that majority of the livestock farmers were water insecure and food insecure. Also, the factors influencing the food security status of the livestock farmers include household size, herd size, farming experience, education status, extension visit and water scarcity. The study concludes that water scarcity has a negative relationship with the food security status of the livestock farmers. The study therefore recommends that governments build subterranean resources such as wells, dams, and boreholes in order to enhance water availability, and that livestock farmers make investments in infrastructure for rainwater harvesting.

REFERENCES

Abera, A., Yirgu, T., & Uncha, A. (2021). Determinants of rural livelihood diversification strategies among Chewaka resettlers' communities of southwestern Ethiopia. *Journal of Agriculture & Food Security*. 1(2), 10-30 https://doi.org/10.1186/s40066-021-00305-w

Adejumo, S. A. (2018). Urban household water security in Ibadan, Nigeria, *Unpublished Ph.D Thesis submitted to the Department of Urban And Regional planning, university of Ibadan, Nigeria.*

Adepoju, A.O., & Obayelu, O.A. (2013). Livelihood diversification and welfare of rural households in Ondo State, Nigeria. *Journal of Development and Agricultural Economics, 5*(12), 482-489. https://dx.doi.org/10.5897/JDAE2013.0497

Adepoju, A.O. & Adejare, K.A., (2013). Food insecurity status of rural households during the post-planting season in Nigeria. *Journal of Agriculture and Sustainability*, 4(1), 16–35.

Akukwe, T. I. (2020). Household food security and its determinants in agrarian communities of southeastern Nigeria. *Journal of Tropical Agriculture, Food, Environment and Extension, 19 (1), 54 – 60.*

Dinku, A.M. (2018). Determinants of livelihood diversification strategies in Borena pastoralist communities of Oromia regional state Ethiopia. *Agriculture and Food Security*.7:41.

Fatuase A.I; Aborisade A.S., & Omisope, E.T. (2015). Determinants of adaptation measures to climate change by arable crop farmers in Owo Local Government Area of Ondo State, Nigeria, *World Rural Observations*;7(1) Available at http://www.sciencepub.net/rural

Okon, U.E., Frank, N.N., Etowa, E.B., & Nkeme, K.K. (2017). Household level food security states and its determinants among rural farmers in Akwa Ibom State, Nigeria. *Agricultural Science Journal 7 (10): 297-303.*

Oluyole, K. A., Oni, O. A., Omonona, B. T. & Adenegan, K. O. (2009). Food security among cocoa farming households of Ondo State, Nigeria. *ARPN Journal of Agriculture and Biological Sciences*, 4(1): 7-13.

Omotesho, O.A., Adewumi, M.O., Mohammad-Lawal, A. & Ayinde, O.E. (2010). Determinants of food security among the rural farming households in Kwara State, Nigeria. *Africa Journal of General Agriculture, 2(1):7-15*

Stoler, J., Miller, J.D., Adams, E.A., Ahmed, F., Alexander, M. & Asiki, G. (2021). The Household water insecurity experiences (HWISE) Scale: comparison scores from 27 sites in 22 countries. *Journal of Water Sanitation and Hygiene Development.*11(6):1102–10. https://doi.org/10.2166/washdev.2021.108

Tshediso, J.S. (2017). Association of Food Security and Household Demographics in South African Township. *International Journal of Social Sciences and Humanity Studies*, 9(2): 157 – 168.