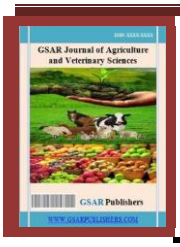

GSAR Journal of Agriculture and Veterinary Sciences
ISSN: 3048-9075 (Online)
Abbreviated key title: Glob.J. Agri.Vet.Sci.
Frequency: Monthly
Published By GSAR Publishers
Journal Homepage Link- https://gsarpublishers.com/journal-gjavs-home/

POTENTIALS OF AQUACULTURE PRODUCTION TO FOOD SECURITY IN WUKARI LOCAL GOVERNMENT AREA, TARABA STATE, NORTH EAST, NIGERIA

By

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Article History

Received: 01/032025
Accepted: 11/03/2025
Published: 13/03/2025

Vol – 2 Issue – 3

PP: -01-10

Abstract

This study examined the potentials of aquaculture production to food security in Wukari Local Government Area of Taraba State. A sampling frame was drawn from 200 respondents, through Cluster random sampling technique was analyzed using descriptive and inferential statistics; frequency distribution and percentage, while chi-square was used to test the hypothesis at P<0.05 significant level; T test for mean condition difference and mean separation with Pearson's correlation at 0.05 level (2-tailed). Most of the respondents were educated (83%) with house size of 10-14 (37%). Majority of the respondents considered the potentials of aquaculture providing source of livelihood/income (70%), source of employment (75.5%), provide food security, fish mortality (90%) and high cost of fish production (80%) were the major constraints to the respondents. The analysis of Variance ANOVA, P<0.05) for Physio-Chemical characteristics among WN, WS, WE and WW; Water Temperature showed significant difference between zones; dissolved Oxygen showed no significant difference between the zones; power of Hydrogen showed significant difference between zones; Electrical Conductivity showed significant difference between zones and Turbidity showed no significant difference between zones/sampled stations. The reliable source of water was borehole and river. Hence, it is recommended that the department of Fisheries and Aquaculture, under the Faculty of Agriculture and Life Sciences, Federal University Wukari should lunch a fish farming training progamme to alleviate hunger and poverty, food insecurity and malnutrition among the populace.

KEYWORDS: *Water Quality, Fish Farming, Food Security, Empowerment, First Class Protein, poverty alleviation*

Introduction

Aquaculture is the world's fastest growing food-production technology. This development has changed profoundly how fish is produced, traded, and consumed. It has also redefined the role of fish in world food production. Globally, fish (wild-caught and farmed) is a larger source of animal protein than other major meat source. Fish is the main animal protein source in many parts of the world, particularly developing countries (FAOSTAT. 2016a; 2016b). Aquaculture can be important for food security directly through domestic consumption, or indirectly through economic growth from export trade (Smith *et al*., 2010). Aquaculture is also changing the pattern of global food consumption and has important implications for public health (Mozaffarian and Rimm, 2006).

Fish has been an important source of food for centuries and contributes around 50 percent of total animal protein in the diets of many Africans (FAO. 2003b). However, as the industrialized world's fish stocks depleted, the fish trade increasingly turned to developing countries for fish (Wilson, 1997). At the global level, aquaculture helps to fill the gap between the rising demands for fishery products and the current capture fisheries production and it could therefore make a significant contribution to food security in sub-Saharan Africa. (NEPAD. 2003).

The United Nations define food security as "People having at all times, physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life". Both food

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security and health are strongly linked with available household income. Another factor that Influences food security is the availability of a variety of nutritious foods at the local, regional, and national level. The availability of foods at the national level depends on local production for local consumption, as well as on the ability to import a variety of healthy and nutritious foods (Pérez-Escamilla and Segall-Corrêa, 2008).

In Wukari, foods insecure in households are typically rural households with few adult household members, and who mainly depend on agricultural daily labour, their own agricultural production or external support for their livelihoods. Food insecure households engaged in agriculture, they typically have less livestock; farm small amounts of agricultural land, grow fewer crops, have lower food stocks and consume more of their own production at home. Given its dependence on subsistence agriculture as the primary means of livelihood for the majority of the population; Wukari faces the challenges of providing all the inhabitants with enough food all times leading to prevalence of nutritional deficiencies (Allison, 2011).

The food and agriculture organization FAO. (2003b) studied capitalized and the inadequacy in food provision on high population density, enormous decrease in land fertility across the country and a shift to cash crop production to earn foreign exchanges. Many studies argued that aquaculture contributes significantly to food security and livelihoods in many parts of the world, particularly in developing countries, either as a standalone activity or in association with other income generating activities, such as crop agriculture and livestock rearing (Zuberi and Thomas, 2012; Allison *et al*., 2011). Fish provides a good source of first class proteins and essential micronutrients needed for normal growth, development and an active and healthy life (Williams and Poh-Sze, 2003). In addition to the nutritional advantages of increased fish production, aquaculture provides opportunities for employment and income generation essential for household and national food security (FAO. 2008). Millions of people around the globe are employed in aquaculture industry and depend on aquaculture for their livelihoods (FAO. 2003a). In countries endowed with valuable natural fisheries or conditions favoring aquaculture development, fish can also provide important contributions to the National economy through trade, tax revenues value added tax on its products, and license fees (Allison *et al*., 2011).

Aim and Objectives

The aim of this research work was to ascertain the potentials of aquaculture production to food security in Wukari Local Government Area, Taraba State.

This study was carried out to principally achieve the following objectives, thus to:

- determine the socio-economic characteristics of the respondents in Wukari;
- determine the water quality characteristics in the research area;
- determine whether water quality affects fish mortality.

Agriculture is regarded as the engine of development in most developing countries and agricultural information is a major tool for the development of small-scale farmers and it contributes to the livelihood of people both in urban and rural areas, agriculture with its positive impact on the Nigerian population is faced with a multiple of problems among which is low utilization of technologies (Okoedo-Okojie, 2015). However, majority of aquaculture farmers are male thus showing that the male are actively involved in fish production (Salau *et al*., 2014).

Wali (2020) researched on population growth as a problem to unemployment and economic development in Nigeria and opined that efficient producer and exporter of her commodities what else defines economic growth than this with a sustained industrialization and favourable balance of trade that trickles down to the large populace economic development which is already incubated. He stated that Nigeria with her current population of approximately (200 million) people; shows that Nigeria is the most populous black country in the globe. Although, arguments are ripe whether her ever growing population is the sole factor responsible for her continuous growth of unemployment.

Ugboma (2010) stated that data gathering in agriculture, is crucial in enhancing agricultural development which cannot be overemphasized. Information is vital for increasing production and improving marketing and distribution strategies. Access to adequate information is very essential to proper agricultural production and contribution to any given economy. Information on fish farming includes and covers the whole process from the construction of the fish pond, the technology needed for farming, stocking rate, breed selection water management, spawning, sorting, harvesting, processing, storage, recordkeeping and the marketing. Williams *et al*. (2012) researched on economic analysis of catfish production in Ile-Ife, Osun State, Nigeria. They stated that majority of their respondents had little experience in fish farming (aquaculture).

Ogunremi *et al.* (2019) researched on the demographic characteristics and potentials of fish farming in Ibi local government area, Taraba state in Nigeria. They reported that most of the respondents were educated (67.2%) with household size of 1-5 (59.8%). They stressed that majority of the respondents involved in fish farming; providing a source of income (98.7%), source of employment (95.30%), provide food security (93.80%) and foreign exchange (70.6%). They recommended that more uneducated persons be encourage to go into fish farming and greater awareness should be created by the government on fish farming which has potential for eradicating poverty in Nigeria.

MATERIALS AND METHODS

Study Area

The study was carried out in Wukari Local Government Area (LGA). The LGA is one of the sixteen (16) Local Government Areas of Taraba state, Nigeria, and one of the five LGAs in

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southern Taraba Senatorial Zone. Wukari LGA is located at longitudes 9°46'38"E and latitudes 7°50'18"N of the equator of the Greenwich Meridian, covering an area of 4,391.812Km^{2}and It is bounded to the north by Gassol LGA, to the east by Donga LGA, to the south by benue state (Ukum and Logo LGAs) and to the west by Ibi Local Government Area and Nassarawa State. It had a population of 238, 283 with 124, 285 males and 113, 998 females, according to the 2006 National population census (NPC. 2006). The research was carried out in Wukari LGA., comprising of four sampling stations: A = Wukari North (WN), B = Wukari South (WS), C = Wukari East (WE) and D = WukariWest (WW).

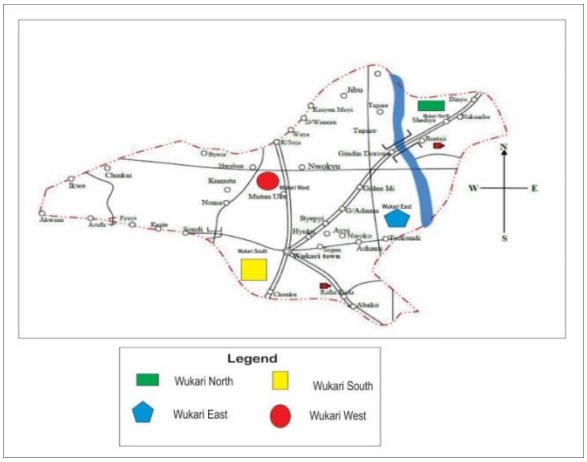

Figure 1: Map of Wukari Local Government Area, Showing Sampled Stations.

Physico-Chemical Characteristics

The following water parametres such as pH (power of Hydrogen), Water Temperature, Electrical Conductivity, Dissolved Oxygen and Turbidity were measured in-situ with scientific meters (APHA. 2005).

Data Collection

Data is collected using a well-structured questionnaire with schedule review. The distribution of this questionnaire was administered in A: Wukari North, B: Wukari South, C: Wukari East; D: Wukari West. A total of 200 questionnaires were administered, 50 copies in each zone, which are zone A, B, C and D.

Statistical Analysis

Cluster sampling techniques was used to select the respondents for the study. This captured the four sub-sets, WN, WS, WE and WW among the population that is uncertain. Data from the study were collected through structured questionnaire administered to interview schedules. Data were analyzed using descriptive and inferential statistics. It considered frequency distribution and percentage, while Chi-square was used to test the hypothesis at $P<0.05$ significant level. Analysis of variance (ANOVA, $P<0.05$), T test was used to test mean condition difference and mean separation with Pearson's correlation at 0.05 level, (2-tailed) were analyzed.

RESULTS

Respondent Demographic Characteristics

Result showed the demographical characteristics of fish farmers in Wukari Local Government Area (table 1.1). Gender: 120 (60%) of the respondents were male and 80 (40%) were female. Marital status: 90 (45%) of the respondents were married; 75 (35.5%) were single; 24 (12%) were widow/widower and 11 (5.5%) were divorced. Age: 80 (40%) were between 15-29 years; 60 (30%) were aged 30-40 years; 35 (17.5) were aged 41-50 years and 25 (12.5) were aged 50 and above. Qualification: 14 (7%) had No education; 26 (13%) had primary education and 70 (35%) had tertiary education. Years of experience in fish farming: 70 (35%) were within 1-5; 55 (27.5%) were within 5-9; 35 (17.5%) were within 10-14; 25 (12.5%) were within 15 and above and 15 (7.5%) No experience at all. Household size: 36 (18%) were within 1-4; 32 (16%) were within 5-9; 74 (37%) were within 10-14 and 58 (29%) were 15 and above.

Table 1.1: Respondent Demographic Characteristics

S/N	RESPONDENTS	FREQUENCY	PERCENTAGE (%)
1	GENDER		
	Male	**120**	**60**
	Female	**80**	**40**
			100%
2	MARITAL STATUS		
	Single	**75**	**37.5**
	Married	**90**	**45**
	Divorce	**11**	**5.5**
	Widow/er	**24**	**12**
			100%
3	AGE		
	15-29	**80**	**40**
	30-40	**60**	**30**
	41-50	**35**	**17.5**
	50 and above	**25**	**12.5**
			100%
4	Qualification		
	No education	**14**	**7**
	Primary	**26**	**13**
	Secondary	**70**	**35**
	Tertiary	**90**	**45**
			100%
5	Year Of Experiences In Fish Farming		
	1-5	**70**	**35**

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	5-9	**55**	**27.5**
	10-14	**35**	**17.5**
	15 and above	**25**	**12.5**
	No experiences at all	**15**	**7.5**
			100%
6	HOUSE SIZE		
	1-4	**36**	**18**
	5-9	**32**	**16**
	10-14	**74**	**37**
	15 and above	**58**	**29**
			100%

Potentials Of Fish Farming To Respondents

Result showed that the potentials of fish farming to the respondents in Wukari Local Government Area (table 2). It reveals that majority, that is, 151 (75.5%) of respondents have potentials or benefits in fish farming, while 49 (24.5%) of respondents have no potentials or benefit in fish farming. And for benefits, it showed that 74 (49%) send children to school; 46 (30%) build houses; 21 (13.5%) raised capital for other businesses; 5 (3.3%) bought cars and 5 (3.3%) were philanthropy (made good will to their neighbors) through fish farming.

Table 2: Potentials Of Fish Farming To Respondents

S/N		FREQUENCY	PERCENTAGE (%)
1	Any potential or benefit achieved due to fish farming?		
	Yes	**151**	**75.5**
	No	**49**	**24.5**
			100%
2	If yes, which of these:		
	Send children to school	**74**	**49**
	Build house	**46**	**30**
	Capital other business	**21**	**13.9**
	Buy car	**5**	**3.3**
	Philanthropy	**5**	**3.3**

Empowerment For Aquaculture

In (table 3) showed individuals empowered in fish farming: 135 (67.5%) were empowered, while 65 (32.5%) were not empowered; 44 (32.6%) were empowered by government; 36 (26.7%) were empowered by non-governmental organizations; 35 (25.9%) were empowered by friends and 20 (14.8%) were empowered by family. Thus means of empowerment: 40 (29.6%) were given cash, while 95 (70.4%) were given fish seed and mobile ponds; 100 (74.1%) were trained; 35 (25.9%) were not trained; source of capital: 22 (33.8%) personal savings; 12 (18.5%) loan from relatives; 7 (10.8%) bank loans and 24 (36.9%) cooperative societies.

Table 3: Empowerment For Aquaculture

S/N		FREQUENCY	PERCENTAGE (%)
1	Were you empowered into the business of fish farming:		
	Yes	**135**	**67.5**
	No	**65**	**32.5**
			100%
2	If yes, by who?		
	Government	**44**	**32.6**
	Non-Government organization	**36**	**26.7**
	Friends	**35**	**25.9**
	Family	**20**	**14.8**
			100%
3	If yes, by what means:		
	Cash	**40**	**29.6**
	Seed fish and mobile ponds	**95**	**70.4**
			100%
4	If yes, were you trained?		
	Yes	**100**	**74.1**
	No	**35**	**25.9**
			100%
5	If no, what is your source of capital		
	Personal saving	**22**	**33.8**
	Loan from relatives	**12**	**18.5**
	Bank loans	**7**	**10.8**
	Cooperatives societies	**24**	**36.9**

Fish Farming Efficiency Of Respondents

The fish farming efficiency of respondents in Wukari local government area (table 4), the result showed that 134 (67%) are members of fish farmers' association, while 66 (33%) are not members of fish farmers' association. Source of water 85 (42.5%) were using borehole source of water, 60 (30%) were using well source of water; 22 (11%) were using river source of water and 33 (16.5%) were using stream/lake source of water; Well source of water, 50 (83.3%) dries off while 10 (16.5%) does not dry off, it runs throughout the year water supply; 20 (40%) of well water dries off from November-January; 25 (50%) of the well water supply dries off from February- April while 5 (10%) of well water supply dries off

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from May-July; 144 (92%) of respondents experienced many of their fish dying, while 16 (8%) of fish respondents does not experienced many of their fish dying; 75 (40.8%) of fish dying were small ones;87 (47%) of fish dying are medium ones, while 22 (12%) of fish dying are big ones. What stopped the death?: 90 (48.9%) were stopped by a fish doctor/expert; 40 (21.7%) were stopped by fellow fish farmer; 54 (29.3%) stopped by nobody (naturally); 85 (42.5%) farmed fish about 50-100; 55 (27.5%) farmed at fish about 120-200, 31 (27.5%) farmed fish about 150-450, while 29 (14.5%) farmed fish about 450 and above; 36 (18%) produce their own fish feed, while 164 (82%) do not produce feed; 58 (35.4%) buy their fish feed from Wukari; 36 (22%) buy their fish feed from Jalingo; 35 (21.3%) buy their fish feed from Zaki-biam, while 35 (21.3%) buy their fish feed from elsewhere; 75 (37.5%) respondents are still farming fish, while 125 (62.5%) are not farming fish; 22 (29.3%) farm fish within 3-4 months before selling; 19 (25.3%) farm fish within 4-6 months before selling, 25 (33.3%) farm fish within 5-6 months before selling, while 9 (12%) farm fish 6 months and above before selling; 140 (70%) sell their fish fresh; 20 (10%) sell their fish smoked, while 40 (20%) sell their fish fresh/smoked; 60 (30%) expected income after every sale was within less than ₦5,000.00; 95 (47.5%) expected income after every sale was within ₦5,000.00-15,000.00; 26 (13%) expected income after every sale was within ₦15,000.00-50,000.00, while 19 (9.5%) expected income after every sale was within ₦50,000.00 and above; the people of Wukari eats every fish in their water body.

Table 4: Fish Farming Efficiency Of Respondents

S/N	VARIABLE	FREQUENCY	PERCENTAGE (%)
1	Are you a member of any fish farmers' association?		
	Yes	**134**	**67**
	No	**66**	**33**
			100%
2	What is your source of water?		
	Borehole	**85**	**42.5**
	Well water	**60**	**30**
	River	**22**	**11**
	Stream/lake	**33**	**16.5**
			100%
3(a)	If well water, does it dry off?		
	Yes	**50**	**83.3**
	No	**10**	**16.7**
			100%
3(b)	If yes, when?		
	November-January	**20**	**40**
	February-April	**25**	**50**
	May-July	**5**	**10**
			100%
4(a)	Do you experience many of your fish dying?		
	Yes	**144**	**92**
	No	**16**	**8**
			100%
4(b)	If yes, what size?		
	Small ones	**75**	**40.8**
	Big ones	**22**	**12**
	Medium ones	**87**	**47**
			100%
4(c)	If yes, who stopped the death?		
	Fish Doctor	**90**	**48.9**
	Fellow fish farmer	**40**	**21.7**
	Nobody	**54**	**29.4**
			100%
5	Is there any fish that people do not eat here?		
	Yes	**00**	**00**
	No	**200**	**100**
6	If yes give the name in your tongue or English		
7	If no, how many fish have you farmed?		
	50-100	**85**	**42.5**
	120-200	**55**	**27.5**
	250-450	**31**	**15.5**
	450 and above	**29**	**14.5**
			100%
8	Do you produce your own fish feed?		
	Yes	**36**	**18**
	No	**164**	**82**
			100%
9	If no, where do you buy		
	Wukari	**58**	**35.4**
	Jalingo	**36**	**22**
	Zaki-biam	**35**	**21.3**
	Else where	**35**	**21.3**
			100%
10	Are you still farming fish?		
	Yes	**75**	**37.5**
	No	**125**	**62.5**
			100%
11	If yes, how long do you farm before selling off?		

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	3-4 months	**22**	**29.3**
	4-6 months	**19**	**25.3**
	5-6 months	**25**	**33.3**
	6 and above	**9**	**12**
			100%
12	How do you sell your fish?		
	Fresh	**140**	**70**
	Smoked	**20**	**10**
	Fresh and smoked	**40**	**20**
			100%
13	Is there market for fish in Wukari?		
	Yes	**157**	**78.5**
	No	**43**	**21.5**
			100%
14	What is your expected income after every sale?		
	Less than ₦5,000.00	**60**	**30**
	₦5,000.00-₦15,00.00	**95**	**47.5**
	₦15,000.00- ₦50,000.00	**26**	**13**
	₦50,000.00 and above	**19**	**9.5**
			100%
15	What is your actual gain or profit after each sales?		
	Less than ₦5,000.00	**60**	**30**
	₦5,000.00-₦15,00.00	**85**	**42.5**
	₦ 15,000.00-₦50,000.00	**30**	**15**
	₦50,000.00 and above	**25**	**12.5**
			100%

Percentage Of Fish Mortality

The pie chart showed the fish mortality of 184 respondents out of 200. It showed that fish species comprising of small ones, medium ones and big ones; thus, 75(40.8%), 87(47%) and 22(12%) respectively (Fig. 2). Hence, 16 respondents do not battle with fish mortality issues. Although, most respondents stocked juveniles more than fingerlings (finger-sized fish) due to cost of production.

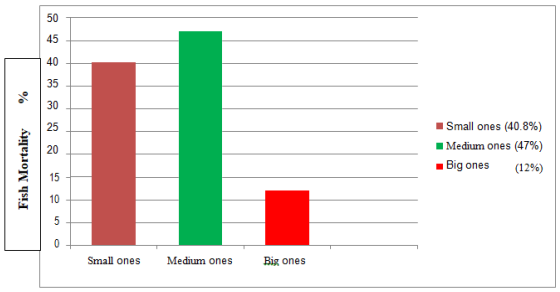

Figure 2: Bar chart showing percentage of fish mortality.

4.1 Source Of Water For Aquaculture

The bar chart showed the sources of water from two hundred (200) respondents comprising of boreholes, wells, river and stream/lake, thus; 85(42.5%), 60 (30%), 22 (11%) and 33 (16.5%) belonging to boreholes, wells, river and stream/lake respectively (Fig. 3).

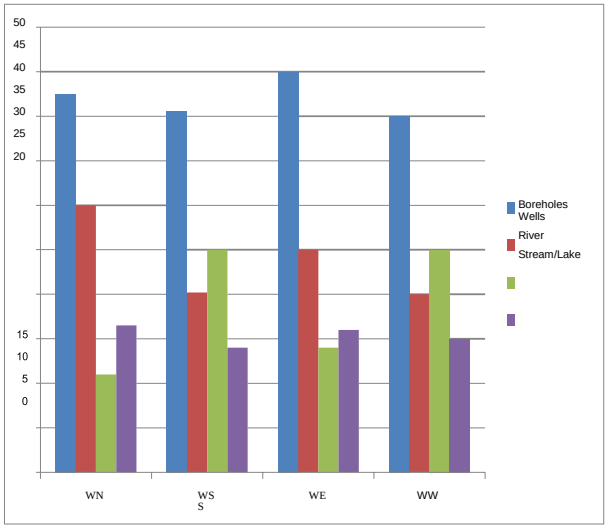

Figure 3: Bar chart Showing Sources of Water in the Study Area (*WN=> Wukari North; WS=> Wukari South; WE=> Wukari East; WW=> Wukari West).

Constraints to Fish Farming Among the Respondents

The respondents were asked to respond on the constraints to fish farming among the structured questionnaire. The results as shown in (table 5) revealed that there are many constraints to fish farming among the respondents in the study area. Under severe 160 (80%) were high cost of production; 180 (90%) were fish mortality; 70 (35%) were feed production; 2 (1%) were water supply; 45 (25.5%) were water management; 86 (43%) were availability of fish seed; 50 (25%) were fish drugs/medication; 95 (47.5%) were availability of fish experts; 90 (45%) were cost of fish education, while 13 6.5%) were no market for fish; under mild 40 (20%) was high cost of production, 5 (2.5%) were fish mortality; 110 (55%) feed production, 34 (17%) water supply, 118 (59%) were water management; 99 (49.5%) were availability of seed fish;126 (63%) were fish drugs/medication; 75 (37.5%) were availability of fish experts; 65 (32.5%) were cost of fish education, while 37 (18.5%) were no market for fish; under not a constraints 0 (0%) was high cost of production; 15 (7.5%) were fish mortality;20 (10%) fish feed production; 164 (82%) were water supply;37 (28.5%) were water management; 15 (77.5%) were availability of fish seed, 24 (12%) were fish drugs/medication;30 (15%) were availability of fish experts;45 (22.5%) were cost of fish education, while 15 (7.5%) were no market for fish.

Table 5: Constraints To Fish Farming Among The Respondents

CONSTRAINTS	SEVERE	MILD	NOT A CONSTRAINT(S)

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	Frequency	Percentage (%)	Frequency	Percentage (%)	Frequency	Percentage (%)	Total (%)
High cost of production	160	80	40	20	0	0	100
Fish mortality	180	90	5	2.5	15	7.5	100
Feed production	70	35	110	55	20	10	100
Water supply	2	1	34	17	164	82	100
Water management	45	25.5	118	59	37	18.5	100
Availability of seed fish	86	43	99	49.5	15	7.5	100
Fish drugs/medication	50	25	126	63	24	12	100
Availability of fish experts	95	47.5	75	37.5	30	15	100
Cost of fish education	90	45	65	32.5	45	22.5	100
No market for fish	13	6.5	37	18.5	15	7.5	100

Physico-Chemical Parameters Of Wukari North, South, West And East Wells

The physico-chemical characteristics of the sampling area are presented in (table 6), the result showed that water temperature were within the acceptable limit (29°C-30°C) set by World Bank ranged for freshwater aquaculture (Ronald et al., 1999); the highest value was recorded in WukariNorth (29.325^{a}±0.22°C) and the least was in Wukari South (27.45^{b}±0.30°C); dissolved oxygen were within the acceptable limit (>5.0-6.0mg/l) set by World Bank ranged for freshwater aquaculture (Ronald et al., 1999). the highest value was recorded inWukari West (8.04^{a}±0.18mg/l) and the least was (7.49^{a}±0.23mg/l) recorded in Wukari South; pH value ranging within the acceptable limit; (6.5-9.0) set by World Bank ranged for freshwater aquaculture (Ronald et al., 1999); the highest value was recorded in Wukari East (7.06^{a}±0.15) and the least was in Wukari North (6.54^{a}±0.12); Electrical conductivity ranging below the acceptable limit (30-5000 **(µs/cm)**) set by World Bank ranged for freshwater aquaculture (Ronald et al., 1999); the highest value was recorded in Wukari North (0.31^{c}±0.01**(µs/cm)**) and the least was in Wukari West (0.23^{b}± 0.01 **(µs/cm)** and turbidity ranging above the acceptable limit; the highest was recorded in Wukari East (59.69^{c}±3.54cm) and the least in Wukari North (44.45^{a}±4.86cm).

The analysis of variance (ANOVA, P<0.05), for physico-chemical characteristics among WN, WS, WE and WW. Water temperature showed significant difference between the zones; dissolved oxygen showed no significant difference between the zones; power of Hydrogen showed significant difference between the zones; electrical conductivity showed significant difference between the zones and in turbidity showed no significant difference between the zones/sampled stations.

Table 6: Physico-Chemical Parameters Of Wukari North, South, West And East Wells

Water parameter	Wukari North	Wukari South	Wukari West	Wukari East
Temperature (°C)	29.325^{a}±0.22	27.45^{b}±0.30	28.77^{a} ±0.26	28.85^{a}±0.40
DO (mg/l)	7.83^{a}±0.19	7.49^{a}±0.23	8.04^{a}±0.18	7.53^{b}±0.31
pH	6.54^{a}±0.12	7.03^{a}±0.13	6.89^{a}±0.15	7.06^{a}±0.15
EC (µs/cm)	0.31^{c}±0.01	0.49^{a}±0.04	0.23^{b}±0.01	0.25^{b}±0.01
Turbidity (cm)	44.45^{a}±4.86	45.20^{a}±4.45	53.95^{a}±4.84	59.69^{c}±3.54

^{abc} mean having the same superscript are not significantly different at (p<0.05)

Chi-Square Test Showing Association Between The Demographic Characteristics Of The Respondents And Potentials Of Fish Farming.

From table 7 it was observed that there was a significant association between the demographic characteristics of (age and marital status); potentials of fish farming and (years of farming experience, house size and benefits achieved) in the study area at P<0.05.

Table 7 Chi-Square Test Showing Association Between The Demographic Characteristics Of The Respondents And Potentials Of Fish Farming

Variables	Chi-Square value	Df	P-Value	Remarks
Gender	3.449	1	0.063	Not sig.
Marital status	86.792	3	0.000	Sig.
Age	13.918	3	0.003	Sig.

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Qualification	73.549	3	0.000	Sig.
Year of experience in fish farming	85.157	4	0.000	Sig.
House size	11.306	3	0.010	Sig.
Any potential or benefits achieved due to fish farming	146.574	1	0.000	Sig.
	42.691	4	0.000	Sig.
If yes, which of these				

Sig. at 0.05 level

Pearson Correlation Of Mortality, Years Of Experience Water Sources And Physico-Chemical Characteristics In Wukari: North, West, East And South

There was positive correlation with all the physico-chemical characteristics and mortality in Wukari North except water temperature and dissolved oxygen, which showed negative correlation while year of experience and source of water showed negative correlations, except water temperature and pH showed positive correlations (table 7); source of water and mortality in Wukari West showed positive correlations in all the physico-chemical characteristics except water temperature and electrical conductivity showed negative correlations(table 8); source of water and mortality in Wukari East showed positive correlations in water temperature, dissolved oxygen and electrical conductivity showed negative correlations in pH and turbidity, while source of water and years of experience showed positive correlations in all the physico-chemical characteristics (table 9); source of water and mortality in Wukari South showed negative correlations in water temperature, dissolved oxygen, pH and turbidity, while electrical conductivity showed positive correlation; source of water and year of experience showed positive correlations in water temperature, pH and turbidity, while it also showed negative correlation in dissolved oxygen and electrical conductivity (table 4.10).

Discussion

Personal characteristics of the respondents in the study area, the result showed that majority (60%) of the respondents were male while the remaining (40%) of the respondents were female, thus, showing that the male are actively involved in fish production/aquaculture (Salau *et al*., 2014). Majorities (45%) of the respondents were married, 35.5% of the respondents were single, 12% of the respondents were widows/widowers and 5.5% of the respondents were divorced. Getting married is a highly cherished value among the respondents in the study area (Ronald *et al*., 2014; Okoedo-Okojie, 2015). Age range showed that 40% of the respondents were aged between 15 and 29 years. About 30% aged between 30 and 40 years, while 17.5% were aged between 41 and 50 years, which are regarded as the fairly old. Only 12.5% were 50 and above (Ugboma, 2010). Farming experience revealed that, 35% of the fish farmers had between 1 and 5 years of experience in fish farming, about 27.5% had between 5 and 9 years, 17.5% had between 10 and 14 years, 12.5% had between 15 and above while 7.5% had no experience in fish farming. This implied that majority of the fish farmers in the study area were new entrants into fish production/aquaculture (Williams *et al*., 2012).

The physico-chemical characteristics of Wukari source of water ranging from highest to the least such as water temperature ($29.325^{a}\pm0.22$ and $27.45^{b}\pm0.30$), dissolved oxygen ($8.04^{a}\pm0.18$) and ($7.49^{a}\pm0.30$), pH($7.06^{a}\pm0.15$ and $6.54^{a}\pm0.12$), electrical conductivity ($0.49^{a}\pm0.04$) and ($0.23^{b}\pm0.01$) and turbidity ($59.69^{c}\pm3.54$ and $44.45^{a}\pm4.86$) (Ajibade *et al*., 2006). The Chi-square test showing the association between the demographic characteristics of the respondents and potentials of fish farming. The P-value showed that there was a significant association between the demographic characteristics of (age and marital status); potentials of fish farming of (years of farming experience, house size and benefit achieved) in the study area at $P<0.05$ (Ogunremi *et al.*, 2019).

Conclusion

The study observed that majority of the respondents were males and most of the farmers in the study area fall between the ages of 15-29 years, which is considered the most active age group in terms of productivity. About 45% of the respondents were married; 7% of the respondents were illiterate and most of them (45%) were tertiary scholars, while in terms of farming experience, majority of the respondents (35%) had little experience of just between 1 – 5 years as compared to the few (12.5%) that had fish farming experience of between 15years and above. Although, aquaculture technological adoption up to date has been very poor in wukari local government area, increasing numbers of food insecure rural poor, persistent land degradation pollution and overuse of traditional fishery resources suggests that aquaculture should be revived as a potential development pathway to steady food security. A serious constraint to an increased per caput consumption of fish is the low purchasing power of the rural population. Therefore planning for fish culture development with the aim of countering the deficit of animal protein in the rural diet will have to envisage small, family-based units, which provide fish for home consumption only on a limited scale. The major input apart from family labour and agriculture wastes would be the fingerlings (fish seeds) needed for initial stocking of the pond. Eliminating hunger and malnutrition can save millions of lives every year and it lies with productive aquacultures which house the needed first class protein for children, adults and the aged.

Recommendations

In the above findings, it is recommended that, most of the respondents were educated (83%) with a household size of 10-14 (37%); majority of the respondents considered the potentials of aquaculture providing source of livelihood or income (70%), source of employment (75.5%), provide food

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security, fish mortality (90%) and high cost of fish production (80%) were the major constraints to the respondents, thus, fish farming should be for all and sundry. The physico-chemical characteristics per water quality encourage aquaculture (fish farming) activities in the research area. The Department of Fisheries and Aquaculture, under the Faculty of Agriculture and Life Sciences, Federal University Wukari, Taraba state should lunch a fish farming/aquaculture training programme to the existing few fish farmers and other persons that will be willing to make a living out of aquaculture as source of empowerment and poverty alleviation to boost food security on fish consumption.

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