

Impact of Temperature on Aqua Culture in Birnin Kebbi Local Government

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Abstract

Among the various physical factors influencing the aquatic environment, temperature is of great importance and it plays a critical role in the life of aquatic poikilotherms, temperature is considered as abiotic master factor. Therefore, temperature exerts a major influence on the biological activity and growth of aquatic organisms. Fish, insects, zooplankton, phytoplankton and other aquatic species all have chosen temperature ranges. As temperatures get too far above or below this preferred range, the number of individuals of the species decreases until finally there are few, or none. A thriving trout (fresh water fish) fishery in ponds or shallow lakes is rarely seen because the water is too warm throughout the ice-free season. Temperature is also important because of its influence on water chemistry. The rate of chemical reactions generally increases at higher temperature, which in turn affects biological activity. An important example of the effects of temperature on water chemistry is its impact on oxygen. Warm water holds less dissolved oxygen than cool water, so it may be saturated with oxygen but still not contain enough for survival of aquatic life. Some compounds are also more toxic to aquatic life at higher temperatures. Changes in temperature affect aquatic life as it determines which organisms will thrive and which will diminish in numbers and size. For each organism there is a thermal death point. Also there is a range of temperature of that produces optimal abundance. The effects of temperature upon life of a cold blooded are profound. These animals have coped with temperature problems in different ways. Not only the organism survival, but growth and reproduction of each organism have critical temperature ranges. Each organism must be favored by the proper temperature if the individual or their populations are going to survive.

Key words: *Temperature, Fish, Insects, Zooplankton, Phytoplankton and Birnin Kebbi*

INTRODUCTION

Among the various physical factors influencing the aquatic environment, temperature is of great importance and it plays a critical role in the life of aquatic poikilotherms. Temperature is considered as abiotic master factor (Gardon 2005). Physical processes of fish such as food consumption, digestion, immunity, etc. are influenced by water temperature. Five major effects of temperature on fish physiological processes are controlling, masking, limiting, directing and acting as a lethal agent (Dalviet *et al.*, 2009). Temperature beyond the optimal limit of a particular species adversely influences fish health by increasing the metabolic rate, oxygen consumption

and the invasiveness and virulence of pathogens, which in turn may cause a variety of pathophysiological disturbances that can lead to the death of the species (Dalvin et al. 2009). Low environmental temperature show profound immunosuppressive effects on ectothermal animal like fish. Temperature of the aquatic environment is important for survival, distribution and normal metabolism of fish. The failure to adapt to temperature fluctuations result in fish mortality (Cnaani 2006). Temperature adaptation is an essential physiological phenomenon and is strongly dependent on acclimation episode and temperature of the environment (Des *et al.*, 2004).

All marine and aquatic invertebrates (mollusks, crustaceans, worms etc.) and fish are poikilotherms; their internal temperature varies directly with that of their environment. This makes them very sensitive to changes in the temperature of their surrounding environment. When changes do occur they move to areas where the external temperature allows them to regain their preferred internal temperature. This “behavioral thermoregulation” (Roessiget *al.*, 2004) is resulting in rapid migrations pole ward or into cooler bodies of water (FAO, 2009a), corresponding to the pole ward shift of climatic zones. As a result, benefits are likely to accrue at higher latitudes and losses will be experienced in the tropics. Some species will also shift from shallow coastal waters and semi-enclosed areas, where temperatures will increase fastest, into deeper cooler waters (Cheung *et al.*, 2009a). Recent predictions suggest this migration alone could reduce maximum catch potential in some areas of the tropics by up to 40% (Cheung *et al.*, 2010), but this may be a conservative estimate as it does not take into account predicted negative effects of climate change on coral reefs or the impact of ocean acidification (Cheung *et al.*, 2009b). Recruitment is also strongly affected by climate variability (Walther *et al.*, 2002) and some stocks may become vulnerable to overfishing at levels of fishing effort that had previously been sustainable (Easterling *et al.*, 2007). Where fish continue to inhabit warming bodies of water the increases in temperature will increase their metabolic rate slowing growth and reducing maximum size (Roessiget *al.*, 2004).

There are likely to be local extinctions of fish species at the edges of their ranges, especially among freshwater and diadromous species (IPCC, 2007a). However, overall extinction rates for marine species are lower than those predicted for terrestrial species (15–37%), in part due to their higher potential for migration (Cheung *et al.*, 2009b). 1–3°C temperature rise relative to 1990–2000 would result in the bleaching and possible death of most of the world’s coral reefs (IPCC, 2007a). This would have serious negative effects on coastal reef fisheries. It would also increase the risk of Ciguatera, a form of poisoning contracted by eating fish that have grazed on the toxic algae that grow on dead coral reefs (IPCC, 2007a). Changes in biophysical characteristics of the aquatic environment and frequent occurrence of extreme events will have significant effects on the ecosystems that support fish. However the benefits gained from the development of aquaculture are significant. From local to global levels, aquaculture play important roles in food supply, income generation and nutrition (Cochrane *et al.*, 2009). In contrast, aquaculture is viable due to increased temperatures and rising sea levels. However, these benefits may be tempered by reduced water quality and availability, increased disease incidence and damage to freshwater aquaculture by salinization of groundwater

Temperature has been recognized as the foremost environmental problem of the twenty first century and has been a subject of considerable debate and controversy. It is predicted to lead to adverse, irreversible impacts on the earth and the ecosystem as a whole. Although it is difficult to connect specific weather events to temperature, increases in global temperature has

been predicted to cause broader changes, including glacial retreat, arctic shrinkage and worldwide sea level rise. Temperature has been implicated in mass mortalities of several aquatic species including fish, plants, corals and mammals. Based on the backdrop, the present study tends to examine temperature on aquaculture by identifying the causes and potential impact of temperature on aquaculture in Birnin Kebbi. The study sought to assess the impact of temperature on aquaculture in Birnin Kebbi.

MATERIALS AND METHODS

The study was carried out in Birnin Kebbi, metropolis Kebbi State, Nigeria. Kebbi State is one of the 36 states of the Federal Republic of Nigeria. It has an approximate land area of 37,699 square kilometers with co-ordinates $10^{\circ} 8' N$ $13^{\circ} 15' E$ this is not enough coordinating and a population of 4.4 million (NPC 2006). The state is made up of 21 Local Government Areas (LGAs). It lies in the tropics and the temperature condition is of two distinct seasons; the rainy season (May - October) and dry season (November –April). The State is also one of the Rice producing states in Nigeria. Figure 1 shows the map of the study area.

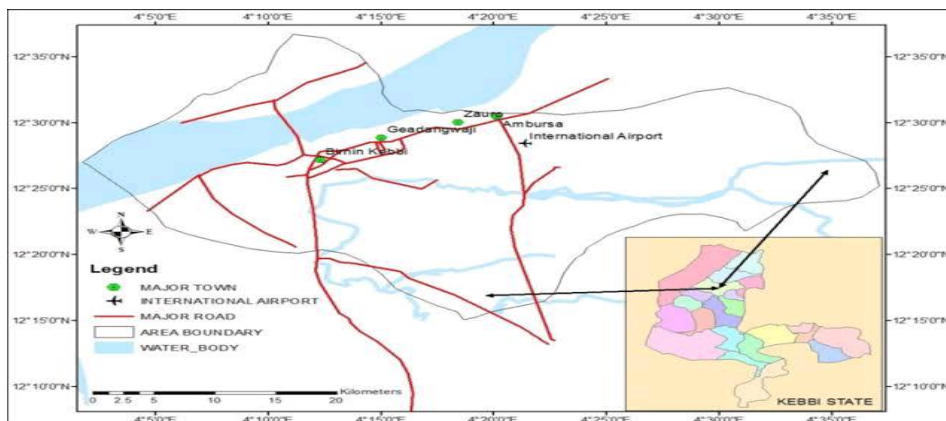


Figure 1: Map of the Study Area.

Sample Techniques

The multistage random technique was used. Four Farms was randomly selected from Birnin Kebbi metropolis; Dan yau fish farm, fisheries department, ministry of animal health husbandry and fisheries, Maidaji farm, and Em-jeh fish farm, ten respondents were selected randomly from each of the farms, making a total of forty respondents.

Data collection

Data was analyzed by using mean and percentage to describe the socioeconomic characteristics of the respondents, and also to compare two or more statistical data set. Likert's scale was used to determine the perception of the respondents on temperature. Both primary and secondary data were used.

RESULTS AND DISCUSION

Socio-economic characteristics of respondents

Table 1 shows that 95% of the respondents were men while only 5% were female. The reason might have been due to the risk and drudgery nature of fish farming or some of the females were involved in other business-like trading, teaching as additional occupation. This implies a great prospect in fish production since more men were involved. According to respondent of 31-40 aged was 45% while 21-30 are 30%, above 40 are 15% and 10-20 are 10% respectively. 55% of the respondents were married while 45% were single. This indicates that the married were more into fish farming than the single. It implies that they were involved in fish farming for income and livelihood in order to support their family. The unemployed youths could also venture into it. Respondents in secondary education are 55%, primary school are 25%, higher school and Islamic education 10% respectively. As presented in Table 1 more of the respondents (75%) were into fish farming to improve household per capital income, 25% started up a fish farm because of personal interest. This also indicates that most of the respondents had diverse reasons for starting a fish farm business.

Table 1 show the socio-economic characteristic of the respondent

<u>Sex</u>	Frequency	Percentage
Male	38	95
Female	2	5
Total	40	100
<u>Age</u>	Frequency	Percentage
10-20	4	10
21-30	12	30
31-40	18	45
40 Above	6	15
Total	40	100
<u>Marital status</u>	Frequency	Percentage
Single	15	45
Married	25	55
Total	40	100
<u>Educational level</u>	Frequency	Percentage
Primary school	10	25
Secondary school	22	55
Higher school	4	10
Islamic education	4	10
None	00	00
Total	40	100
<u>Purpose</u>	Frequency	Percentage
Support/improve income	30	75
Personnel interest	10	15
Total	40	100

PERCEPTION OF FISH FARMERS ON THE EFFECT OF TEMPERATURE ON FISH GROWTH

likers scale result in table 2 revealed that the respondents agreed that increase in temperature has a positive impact on fish growth and this agrees with the findings of adebayo (2012) on temperature perception and adaptation strategies on catfish farming in birninkebbi, kebbi state, Nigeria, that increase in temperature has a positive impact on fish growth. from table 4.2, 70% of the respondents agree that an increase in temperature has a positive impact on fish growth, 30% disagree. This implies that an increase in temperature has a positive impact on fish growth. 75% of the respondents agreed, that in dry season fish grow bigger than raining season, while 25% said in rainy season fish grow bigger than in dry season. Plus, from the research, 35% of the respondents stock, then harvest their fish in six (6) months time during the rainy season, while 25% in four (4) months, while 25% in five (5) months, while 15% in three (3) months. While 45% of the respondents stock and then harvest their fish in four (4) months, 25% in five (5) months, 15% in three (3) months, and also 15% in six (6) months.

Table 2 Perception of Farmers on effect of temperature on fish growth

Does the increase in temperature has positive impact on fish growth	Frequency	Percentage%
Yes	28	70%
No	12	30%
Total	40	100%
Which season do your fish grow bigger	Frequency	Percentage
Rainy	10	25
Dry	30	75
Total	40	100
How many month will you stock and then harvest your fish during the rainy season	Frequency	Percentage
3 months	6	15%
4 months	10	25%
5 months	10	25%
6 months	14	35%
Total	40	100%
How many month will you stock and then harvest your fish during the dry season	Frequency	Percentage
3 months	6	15%
4 months	18	45%
5 months	10	25%
6 months	6	35%
Total	40	100%

PERCEPTION OF FISH FARMERS ON THE EFFECT OF TEMPERATURE ON FEEDING RATE

From Table 3, 85% agreed that an increase in temperature has a positive impact on fish feeding rate, 15% disagree. This implies that an increase in temperature has a positive impact on fish feeding rate. Also, 85% of the respondents agreed that in dry season fish consume food more,

while 15% disagreed with the submission made by the former. They are of opinion that fish consume much food during the rainy. However, from the study conducted, 55% of the respondents feed their fish during hot/dry season three (3) consecutive time, 25% two (2) times in a day, and 10% four (4) times, respectively. During the rainy season, 45% of the respondents, feed their fish twice a day, 30% three (3) times, 15% two (2) times, and 5% four (4) times, respectively.

Table 3 Perception of Farmers on the Effect of Temperature on Feeding Rate

Does the increase in temperature has positive impact on feeding rate	Frequency	Percentage%
Yes	34	85%
No	6	15%
Total	40	100%
Which season do your fish consume food more	Frequency	Percentage
Rainy	6	15
Dry	35	85
Total	40	100
How many time do you feed the fish per day in rainy season	Frequency	Percentage
1 Time	6	15%
2 Time	18	45%
3 Time	12	30%
4 Time	4	10%
Total	40	100%
How many time do you feed the fish per day in dry season	Frequency	Percentage
1 Time	0	0%
2 Time	10	25%
3 Time	22	55%
4 Time	8	20%
Total	40	100%

DISCUSSION

Socio-economic characteristics of respondents

Finding from this research showed that 95% of the respondents were men while only 5% were female. Reason might have been due to the risk and drudgery nature of fish farming or some of the females were involved in other business like trading, teaching as additional occupation. This implies a great prospect in fish production since more men were involved. According to the result 31-40 aged was 45%, this may be indicated that the majority of fishermen in the study area are not old men. Finding from this research showed that the 55% of the respondents were married. This indicates that the married were more into fish farming than the single. It implies that they were involved in fish farming for income and livelihood in order to support their family. The unemployed youths could also venture into it. Plus respondents in secondary

education are 55%. This indicate that most of the farmers are not illiterate. As presented more of the respondents (75%) were into fish farming to improve household per capital income. This also indicates that most of the respondents had diverse reasons for starting a fish farm business.

Effect of temperature on fish growth

The result revealed that the respondents agreed that increase in temperature has a positive impact on fish growth and this agrees with the findings of adebayo (2012) on temperature perception and adaptation strategies on catfish farming in birnin kebbi, kebbi state, Nigeria, that increase in temperature has a positive impact on fish growth. From the result 70% of the respondents agreed that increase in temperature has a positive impact on fish growth. This implies that an increase in temperature has a positive impact on fish growth. Also finding that 75% of the respondents agreed, that in dry season fish grow bigger than raining season. Plus, from the research, 35% of the respondents stock, then harvest their fish in six (6) months time during the rainy season. This showed that the temperature has effect on fish growth. While 45% of the respondents stock and then harvest their fish in four (4) months, during rainy season. This showed that during dry season fish grow bigger than rainy season.

Effect of temperature on feeding

From the result 85% agreed that an increase in temperature has a positive impact on fish feeding rate. This implies that an increase in temperature has a positive impact on fish feeding rate. Also, 85% of the respondents agreed that in dry season fish consume food more, due to the warm of the water. However, from the study conducted, 55% of the respondents feed their fish during hot/dry season three (3) consecutive time. During the rainy season, 45% of the respondents, feed their fish twice a day. This showed that fish consume food more during the rainy season and also showed the significance effect of temperature on feeding rate. Also indicate that the high the feed the faster the fish grow.

CONCLUSION AND RECOMMENDATIONS

CONCLUSION

From the results, it shows that temperature has impacts on aquaculture based on their growth and feeding rate because of the strong variations in climatic variables experienced in recent year. At low latitudes these are likely to be largely negative for aquaculture, damaging important ecosystems. The impacts of temperature to freshwater aquaculture in tropical and subtropical region is difficult to predict as marine and freshwater populations are affected by synergistic effects of multiple climate and nonclimatic stressors. If such nonclimatic factors are identified and understood then it may be possible for local predictions of temperature impacts to be made with high confidence (De Silva and Soto, 2009).

RECOMMENDATIONS

- a. Communities themselves must be strengthened through provision of services such as insurance and weather warnings to reduce risk
- b. Further researches should be conducted with different climate change to compare the effectiveness of each for aquaculture

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