CHAPTER 6: DISCUSSION

Comparison between fish farming practices Socio Economic Status of Purulia and Bankura:

In the present study regarding and Socio economic status of fish farmer of both the district like Purulia and Bankura few parameter are more or less similar but few parameter differ each other in two districts. First of all in case of fish farming status first parameter is pond size and depth, in case of Purulia district average pond size was 1 to 5 bigha and depth of the pond is 2 to 5 meter. In case of Bankura district it has been found that the pond size varies from 10 kathas to 12 bighas and depth of the pond was 10 to 12 ft. In Purulia district 60% of the ponds are seasonal and rests of the ponds (40%) are perennial in nature and 35% pond are single ownership and rest of the 65% pond are joint or multiple ownership. In case of Bankura district 20% of the ponds are seasonal and rests of the ponds (80%) are perennial and 70% are single owner and rest of the 30% pond are joint or multiple owner. In case of culture practices, cultured fish species and stocking density some differences was observed between these two districts. In case of Purulia district most of the fish farmers of the district traditionally cultured different variety of fishes in polyculture system where species ratio and water quality management is not maintained scientifically throughout the culture period. They mainly cultured three Indian Major carp and exotic carps. But in case of Bankura district culture practices was somewhat different here most of the farmers doing their culture in semi intensive type. About 50 % of the farmer in the study site commercially adopted multiple stocking and multiple harvesting technologies. They cultured wide variety of fish species like Indian Major carp, Exotic carp and other fish species like Sar punti (*Puntius sarana*), Pangus (*Pangasius sutchi*), Chital (*Chitala chitala*), Magur (*Clarias batrachus*), Monosex Tilapia etc. Other Parameter i.e fertilization and manuring practices in case of Purulia district it has found that no specific fertilization and manuring schedule have been followed by the fish farmers during culture period. In case of Bankura district this scenario is quite different here most of the farmer has maintained fertilization and manuring schedule during pond preparation and the culture period also. They often used raw cow dung and poultry manure as organic manure and use urea and single super phosphate as inorganic fertilizer during pond preparation and culture period. In case of feed and feeding practices in Purulia district that 90 % farmer depends on natural food found in the culture system and rest of the 10 % farmer applied supplementary feed such as rice bran, mustard oil cake and commercially manufactured feed. But in case of Bankura district here40 % farmer depends on natural food found in the culture system and rest of the 60 % farmer applied supplementary feed such as rice bran, mustard oil cake and commercially manufactured feed. In Purulia district the yield of fish was found to be 2000 to 2500 kg/ha/yr. and in Bankura district the average yield of fish was found to be 3000 to 4000 kg/ha/yr. Total no of fishing village in Puruia district 142 but in case of Bankura district total no of fishing village 982 and

fishermen population is more Bankura district in respect of Purulia district. In Purulia district there was one Central Fishermen Co operative Society and 6

76 Primary Fishermen Co operative Society Ltd but in case of Bankura district there was two Central Fishermen Co operative Society and 48 Primary Fishermen Co operative Society Ltd . Fish seed production and Inland fish production was much higher in Bankura district than in respect of Purulia District. Another important parameter i.e dams and reservoir fishery resources of the district which has been significant impact regarding fish production as well as economic upliftment of rural people of the district. The district Purulia having total 36 no's reservoir covering 5557.74 ha water area. There are fourteen reservoirs in Bankura district. The problem faced by fish farmer of Purulia district are diseases, financial problem, multi ownership pond, market price fluctuation and non availability of good quality fish seed were the major ones. In case of Bankura district these problems are diseases, financial problem, multi ownership pond, market price fluctuation and non availability of good quality fish seed were the major ones.

Livelihood status:

In case of Purulia district the maximum percentage of fish farmers were within medium age group (i.e. between the age group 36 to 45 years). The involvement of the age group of 36-45 years is mainly due to unemployment. But in case of Bankura district. Regarding educational status of fish farmers in Purulia district most of the farmer involved in fish farming are class V pass. But in case of Bankura district

Social status:

In Purulia district most of the people engaged in fish farming are in the category of SC community (50%) and their sub caste is 'Dhibar' and 'Jelia kaibarta'. But in Bankura district most of the people engaged in fish farming activities are general category (70%) and 30% people are belonging to SC community. In both the district participation of women in fish farming is less than male. In the present study it depicts that in both the district joint family was predominant and the highest no of respondent had 4 to 6 family member.

Financial Capital:

In Bankura district that most of the farmers (60%) used their own money for fish farming, and few farmers (40%) received loan from bank for farming activities. But in Purulia district most of the farmers (80 %) used their own money for fish farming, and very few farmers received loan from bank for farming activities. From the present study it reveals that in Purulia district 25% to 30% of fish farmer were engaged in fish farming as their main occupation but in Bankura district it is 40%. Fish farming experience is more in fish farmer of Bakura district than the fish farmer of Purulia district. In Purulia district maximum no of fish farmers having annual income Rs 25001 – Rs. 50000.00. But in case of Bankura district maximum no of fish farmers having annual income Rs. 50001 – Rs.75000.00.

Physical Capital:

From the study it depicts that in both the district maximum no of fish farmers are having earthen roof house. Health facilities and drinking water source are quite similar in both the district. In both the district most of the fish farmers sold their fish products first in the local markets. If the catch is more then they brought their product to main market. In Bankura district fish seed are sold in all over West Bengal and outside of West Bengal.

Physico-chemical parameter of both the district Purulia and Bankura:

Temperature is one amongst the foremost necessary and essential parameter of aquatic habitats as a result of the majority the physical, chemical and biological properties are ruled by it ((Barnabe, 1994). Water temperature usually depends upon climate, daylight and depth. The intensity and seasonal variation in temperature of water directly affect the productivity of lakes. All organisms possess limits of temperature tolerance. The seasonal fluctuation of temperature influences the feeding habits of the fish. All biological activities like consumption, reproduction, movement and distribution are greatly influenced by water temperature (Boyd, 1998).

Temperature additionally affects the speed of chemical changes in soil and water. Indian major carps are able to tolerate a wide range of temperature (20 to 37^0C), below 16^oC and above 40^0C prove fatal to them (Subhendu Dutta). During the study the mean water temperature of pond water of Purulia District varied from 17.19 ±1.146 in winter season and maximum 28.066 ± 0.974 in Pre Monsoon months. The water temperature range of pond water of Purulia district is suitable for fish culture. During the study period, the mean water temperature of pond water of Bankura district varied from minimum 20.21^0C in winter season and maximum 25.85^0C in Pre Monsoon months. The water temperature range of pond water of Bankura district is suitable for fish culture.

The ph of the water is indicative of its fertility or potential productivity. Fish have an average blood pH of 7.4, a little deviation from this value, generally in between 7.0 to 8.5 is more optimum and conducive to fish life. pH between 7 to 8.5 is ideal for biological productivity , fishes can become stressed in water with a pH ranging from 4.0 to 6.5 and 9.0 to 11.0 and death is nearly bound at a ph of but 4.0 or greater than 11.0 (Ekubo and Abowei, 2011). The average pH value of the water bodies of the Purulia District during the study period varies from

minimum 6.933 ± 0.242 in winter season to maximum 7.45 ± 0.273 in pre monsoon month. The average pH value of pond water bodies of Purulia district are in between 6.933 to 7.45 that means the water bodies are medium productive in nature.(Subhendu Dutta). The water with pH values ranging from about 6.5-9.0 at daybreak is most suitable for fish production (ICAR, 2011).

During the study period the minimum average pH value of pond water of Bankura District was 7.08 and maximum value was 7.78. The pH value of pond water of Bankura district shows productive in nature. This is the most important factor governing the carrying capacity of pond or lake. According to Bhatnagar and Singh (2010) and Bhatnagar et al. (2004) DO level >5ppm is crucial to support good fish production.

Bhatnagar et al. (2004) also suggested that 1-3 ppm has sublethal effect on growth and feed utilization; 0.3-0.8 ppm is lethal to fishes and >14 ppm is lethal to fish fry, and gas bubble disease may occur. DO less than 1- Death of Fish, Less than 5 -Fish survive but grow slowly and will be sluggish, 5 and above- Desirable. During the study period the mean value of DO ranges from 3.8 to 4.5 mg/lt. So the pond water of Purulia District is average productive in nature. During the study period the dissolved oxygen concentration of water bodies of Bankura District varied from 4.01 mg/lt to 4.51 mg/lt.

According to Bhatnagar et al. (2004) turbidness range from 30-80 cm is nice for fish health; 15-40 cm is nice for intensive culture system and < 12 cm causes stress. According to Santhosh and Singh (2007) the secchi disk (fig.1) transparency between 30 and 40 cm indicates optimum productivity of a pond for good fish culture. During the study period the transparency value was observed minimum 22.955 + 3.011 to maximum 34.511 ± 1.704. The result obtained from the study it indicates that the Secchi disk transparency of pond water is good for pond productivity as we know transparency value 20 – 60 cm is ideal for good productivity. The transparency value of pond water of Bankura district ranged from 23.57 (cm) to 30.75 (cm). The result obtained from the study it indicates that the Secchi disk transparency of pond water is good for pond productivity as we know transparency value 20 – 60 cm is ideal for good productivity. Alkalinity is that the water's ability to resist changes in ph and could be a measure of the entire concentration of bases in pond water including carbonates, bicarbonates, hydroxides, phosphates and borates, dissolved calcium, magnesium, and other compounds in the water.

Bhatnagar et al. (2004) suggested that <20ppm indicates poor status of water body, 20-50 ppm shows low to medium, 80-200 ppm is desirable for fish/prawn and >300 ppm is undesirable due to non- availability of CO2. Stone and Thomforde (2004) advised 50-150 mg L-1 (CaCO3) as fascinating range; an appropriate range of higher than 20 mg L-1 and less than 400 mg L-1 for ponds and above 10 mg L-1 for hatchery water.

According to Santhosh and Singh (2007) the perfect value for fish culture is 50-300 mg L-1. In the present investigation alkalinity values varied from 59.54 – 65.36 mg L-1 during the four seasons, of which maximum value was observed during pre monsoon month 65.36 mg L-1 and minimum value was observed during monsoon month 59.54 mg L-1. The alkalinity values of water body of Purulia district shows medium productive in nature.

The range of alkalinity as 0-20 ppm for the low production, 20-40 ppm for medium production and 50 200 ppm for high production are considered. Influence of alkalinity isperhaps disguised by different additional necessary factor likedissolved nitrogen and phosphorus (Rath, 1993). During the study period the alkalinity values varied from 77.42 mg/lt to 102.92 mg/lt. The alkalinity value of water bodies of Bankura district shows productive in nature.

Hard water contains high concentrations of alkaline earth metals while soft water has low concentrations. Total Hardness value ranged from 86.41 – 103.47 mg L^{-1} in different seasons of which higher value (103.47 mg L^{-1}) in Pre Monsoon and lowest (86.41 mg L^{-1}) in Post Monsoon season. The result obtained from diff water bodies of Purulia district indicate that the water body are moderate productive in nature.

In the present investigation the total hardness value of water body Bankura district ranged from 103.75 mg/lt to 138.33 mg/lt. The result obtained from diff water bodies of Bankura district indicates that the water bodies are productive in nature.

Nitrate- Nitrogen is an important water parameters and influence productivity of aquatic system. Welch opined that nitrate in natural water exists in a continuous changing state due to the relation of nitrate with nitrifying bacteria and demand by nitrate consuming organisms such as

phytoplankton and higher aquatic plants. Nitrate-Nitrogen value varied considerably during the study period. Generally higher values observed during summer month and ranged from 0.125-0.336 ppm with a peak value in April, may be due to mineralization process at higher temperature. Saha et al. 1990 reported a nitrate value from 0.08-1.80 ppm at Kulia beel during 1981- 82. A similar trend was observed by Bhoumik (1998) in beels and bours of West Bengal. . During the study period the Nitrate Nitrogen Concentration of pond water of Purulia District varied from 0.0108 to 0.0350 mg/lt.

During the study period the Nitrate Nitrogen Concentration of pond water of Bankura District varied from 0.02 to 0.01 mg/lt.

Phosphorus mainly occurs in the form of orthophosphates and is the most critical factor in maintaining pond productivity. Phosphate value did not show any seasonal variation. A more favorable growth response of plankton population was observed at the time of higher concentration of phosphates in pond water. Higher value of phosphorus observed during March-April month (1.82-1.73 ppm) and minimum value was observed during January (0.423 ppm). A productive pond passes a phosphorus concentration of 0.02-0.05 ppm (Ghosh et., al 1974). During the study period the available phosphate concentration of the water body of Purulia District varied from 0.0029 to 0.0044 mg/lt.

According to the report of Southern Regional Aquaculture Centre (SRAC) recommend desirable phosphate level for fish culture of 0.06mg/L, and the typical range for surface water is 0.005–0.5mg/L. A. Bhatnagar and P. Devi, 2013 reported an optimum range for phosphorus of 0.01–3.0mg/L.

During the study period the available phosphate concentration of the water body of Bankura District varied from 0.0022 to 0.0015 mg/lt.

Soil Quality Parameter

Productivity of any aquaculture system depends on the suitable environmental condition and abundance on availability of fish food organism. The natural abundance of these fish food organism in the pond ecosystem largely depends on the availability of nutrients in water. Availability of nutrients in water and maintenance of its relevant chemical condition depends largely on the nature and properties of bottom soil where a series of chemical and biochemical

reactions continuously take place resulting in release of different nutrients in overlying water and also their absorption in soil mass. In other words soil plays an important role in determining the fertility of a fish pond.

pH of the soil sediment is a measure of their acidity or alkalinity and is one of the stable measurements. In the present investigation in Bankura District the soil pH range varied from 6.12 to 6.83. The pond soil pH range of Bankura district shows slightly acidic to near neutral condition. In the present investigation pond soil pH ranges varied from 6.15 to 6.31 in case of Purulia District. This range shows that slightly acidic condition of pond soil. However, pH range of soil from 6.5-8.0 has been considered favorable for fish ponds.

In the present investigation the organic carbon value of pond soil of Bankura District varied from 0.85 mg/100gm of soil to 0.61 mg/100 gm of soil, but in case of Purulia District the organic carbon value of pond soil varied from 0.77 mg/100gm of soil to 0.45 mg/100 gm of soil. Organic carbon value in the range 0.5 – 1.5 % are means water body are medium productive in nature.

Water quality parameter and plankton production

During the study the mean water temperature of pond water of Purulia District varied from 17.19 ±1.146 in winter season and maximum 28.066 ± 0.974 in Pre Monsoon months. During the study period, the mean water temperature of pond water of Bankura district varied from minimum 20.210C in winter season and maximum 25.850C in Pre Monsoon months. During the study period for both the district the ANOVA of water temperature shows significant differences between seasons ($P<0.01$). According to Jhingran, 1991; Begum et al., 2003 the observed temperature range for plankton production in water body was varied from18.3-37.8°C. The water temperature range in the pond water of both the district shows medium plankton production.

In the present investigation Bacillariophyceae were the most dominant group among the phytoplankton. The average pH value of the water bodies of the Purulia District during the study period varies from minimum 6.933 ± 0.242 in winter season to maximum 7.45 ± 0.273 in pre monsoon month. During the study period the minimum average pH value of pond water of Bankura District was 7.08 and maximum value was 7.78. The phytoplanktonic group Bacillariophyceae was more dominant in pond water of Bankura district than Purulia district.

Patrick (1973) observed that the acidic waters do not support an abundance of Bacillariophyceae, while in alkaline waters with pH above 8.0, their density is more.

In the present investigation alkalinity values varied from 59.54 – 65.36 mg L-1 during the four seasons in case of Purulia District. But in case of Bankura District the alkalinity values varied from 77.42 mg/lt to 102.92 mg/lt. High value of alkalinity triggers more phytoplankton production in pond water of Bankura district than Purulia district. Similar findings are also reported by Islam et al. (2017) and Seenayya (1971) .

Physico-chemical parameters and quantity of nutrients in water play a significant role in the distribution patterns and species composition of plankton. All the metabolic, physiological activities and life processes, such as feeding, reproduction, movements and distribution of organisms are greatly influenced by water temperature. A rise in the temperature results in the quick chemical and biochemical reactions. The dynamics of the biological oxygen demand is regulated to some extent by water temperature. In this study, higher water temperature was recorded in summer and pre-monsoon, which accounted for more plankton productivity. The natural water is mostly basic in nature because of the presence of carbonates and bicarbonates. The pH is due to the presence or absence of free carbon dioxide (aqueous CO2) and carbonates. The higher photosynthetic activity will increase production of flora, which support an increase in pH. The higher pH is also attributed to anthropogenic activities like washing of cloths with detergents and mixing of sewage. In this study, the higher pH recorded in summer and pre-monsoon accounts for good primary and secondary productivity. The DO is one among the foremost necessary parameters that reflect the physical and biological processes prevailed in water. The DO level in natural water depends upon the atmospheric pressure, photosynthetic activity, temperature, salinity and turbulence.

The solubility of oxygen will increase with decrease in temperature. The minimum DO recorded in summer was because of its utilization for decomposition of organic matter and respiration of organisms as well as fauna.

Phytoplankton density and pond productivity

Maintenance of a healthy aquatic environment and production of sufficient fish food organisms (plankton) in ponds are two factors of primary importance for successful pond culture operation. Zooplankton is an important component of nutrition and protein source for both larvae and adults of many

aquaculture species cultured in all three main types of production systems: extensive, semi-intensive and intensive. As live feed, they have crucial role in nutrition of early life stages of many fish species particularly for first exogenous feeding, but also play an important role as natural food for juveniles, adults and marketable size fish. The main groups of zooplankton that are found in the culture pond of Bankura district are rotifer, copepoda, cladocera, protozoa and ostracoda. Zooplankton production in culture pond depends on primary production of phytoplankton that is determined by nutrient content in pond water body, mainly phosphorous and nitrogen. Indian Major Carp at their early fry stage consumes smaller zooplankton like rotifer and naupliar larvae of Copepods. After that they switch to consume bigger pray such as Cladocerans and Zoobenthic organisms. According to Billard (1999) at one month of agecarp juveniles show strong dietary preference for Cladocerans.

In the culture pond of Bankura district the average zooplankton production was 666 no's/lt which is compare to Purulia water body. Three main groups of zooplankton those are dominant in the water body of Bankura district are copepoda, rotifera, and cladocera. These zooplanktonic groups enhance the fish production of water body of Bankura district. The average fish production of the district is 4 to 5 tons /ha/yr.

The change in the zooplankton population and their diversity may also affect the growth, development and maturity of fish (Dewan et al., 1977; Qasim, 1977; Jhingran, 1991). Zooplankton constitutes important food items of carnivorous fishes. The larvae of most fishes feed on zooplankton (Peterson and Ausubel 1984).

Most of the fish at their larval stage feed mainly three types of zooplankton Rotifers, Copepods and Cladocera. Fish production of any culture system depends mainly on plankton production. The newly hatched fry or small fingerlings feed on small zooplankton like Rotifers. Copepods are the main prey items for the large fingerlings. The fish production data of the selected water body of the study area shows that average fish production was 4 -5 quintal /ha/yr. The total fish production of the district is 2000 to 2500 kg/ha/yr. The production rate of the most of the water body is average or below average.

Panov et. al., (1973) calculated that the number of zooplankton organisms in carp rearing ponds, and found that 1500 no's / lt must be in carp rearing pond. In the present investigation the average of total zooplanktonic organisms was found 584 no's /lt which is less than that of required for optimum fish production.

Total zooplankton production data of pond water body shows that ponds are not so much productive. The farmers are not applying fertilizer and manure at regular interval for better plankton production as well fish production. They are doing mainly traditional culture some of them are doing semi intensive fish farming very few farmers are practicing composite fish culture.

For better plankton production and to get optimum fish production it is necessary to apply both organic and in organic fertilizer at 15 days interval and liming fish pond monthly basis depending upon the pond water pH and lastly application of conventional fish feed like MOC (Mustard Oil Cake) and rice bran.