Assessment of Physico-Chemical Parameters under Different Management Practices of Prawn Farms

MANUARA BEGUM

Fisheries and Marine Resource Technology Discipline

Khulna University

Khulna, Bangladesh

December, 2012

Assessment of Physico-Chemical Parameters under Different Management Practices of Prawn Farms

A Thesis

By

Manuara Begum

Examination Roll No: MS-120614

Session: 2011-2012

A thesis submitted to the Fisheries and Marine Resource Technology Discipline, Khulna University, Khulna, in partial fulfillment of the requirements for the degree of

Masters of Science

In

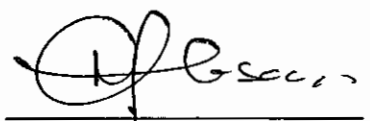
Aquaculture

December, 2012

Assessment of Physico-Chemical Parameters under Different Management Practices of Prawn Farms

Approved as to style and content

By



Professor Dr. Md. Nazmul Ahsan,

Head

Fisheries and Marine Resource Technology Discipline

Khulna University, Khulna

Bangladesh

Declaration

Assessment of Physico-Chemical Parameters under Different Management Practices of Prawn Farms

The results submitted in this thesis are entirely of the candidate's own investigations and no part of the results has been accepted for any degree, nor it is being concurrently submitted for any degree.

Manuara Begum

(Signature of the candidate)

Manuara Begum

Examination Roll No: Ms-120614

Session: 2011-2012

(Signature of the co-supervisor)

Dr. Khandaker Anisul Huq

Professor

(Signature of the supervisor)

Dr. S. M. Bazlur Rahaman

Professor

Fisheries and Marine Resource Technology Discipline

Khulna University, Khulna, Bangladesh.

DEDICATED TO

MY BELOVED PARENTS

ACKNOWLEDGEMENT

At first all my admiration goes to the supreme creator and ruler of the universe, Allah, for His great mercy to create me alive and enables me to pursue my education in Fisheries & Marine Resource Technology Discipline and to complete my thesis for the degree of MS in Fisheries and Marine Resource Technology.

I feel proud to express my deepest sense of gratitude and indebtedness to my respected supervisor **Dr. S. M. Bazlur Rahaman,** Professor, Fisheries & Marine Resource Technology Discipline, Khulna University, Khulna for his enthusiastic supervision and continued advice throughout the field survey and during writing of the thesis.

I am particularly grateful to all teachers of Fisheries & Marine Resource Technology Discipline, Khulna University, Khulna for their technical assistance, immeasurable advice, constructive criticism and suggestions, constant inspiration during the study period.

I convey my thanks to **S. K. Shaheenul Islam** for his cordial help in the survey for the collection of data about Assessment of Physico-chemical Parameters under Different Management Practices of Prawn Farms.

I want to thank the entire **pond owners and labors** who helped me in the time of survey for collection of sample and data.

Finally, I am deeply indebted and grateful to my parents and all of my family members for their encouragement sacrifice, affection and blessing that paved the way to my higher education.

Manuara Begum

December, 2012.

Abstract

This thesis deals with the study of identification of different physico-chemical and biological parameters in mono and integrated culture of prawn ponds. The experiment was conducted in the villages of Solua and Ramkrishnapur, Dumuria Upazila, Khulna district, south-west region of Bangladesh. Eight ponds were selected for the experiment of which four were under monoculture and the rest four were under integrated culture of fresh water prawn. Pond sizes were between 1.0 and 2.5 ha. The study was conducted during the period of July to October, 2012. In-situ measurement and sample collections were done at 15 days interval. Various water quality parameters *eg* temperature, DO, pH, alkalinity, ammonia, nitrite, salinity, transparency, acidity, hardness and total phosphorus which are thought to have significant impact on the growth of *M. rosenbergii* were measured during the study period. The water temperature was found to vary between 29 to 33 °C in mono culture system while in integrated culture it was between 30 to 32 °C. The pH of the water was slightly alkaline (5 to 8 both in monoculture and integrated culture). Water salinity varied from 0 to 6 ppt in mono culture and 0 to 5 ppt in integrated culture. The values of DO, alkalinity, ammonia, nitrite, transparency, acidity, hardness, total phosphorus and chlorophyll were found to vary between 4.7 to 5.8 mg/l, 115 to 169 mg/l, 0 to 0.066 mg/l, 0 to 0.03 mg/l, 20 to 28 cm, 75 to 90 mg/l, 29 to 45 mg/l, 0.14 to 0.52 mg/l, 0 to 0.005 mg/l respectively, in prawn monoculture system, while in integrated culture system the values varied between 100 to 168 mg/l, 0 to 0.02 mg/l, 0 to 0.231 mg/l, 18 to 28 cm, 60 to 88 mg/l, 22 to33 mg/l, 0.15 to 0.9 mg/l, 0.001 to 0.02 mg/l respectively. No significant variations in water quality parameters were noticed between the two culture systems however a little variation in one parameter influenced the other factor during the culture period.

Table of Contents

List of contents	Page No
Acknowledgement	I
Abstract	II
Table of Contents	III-V
List of Maps	VI
List of Figures	VII
List of Tables	VIII
Chapter-1: Introduction	**1-3**
1. Background of the study	1-3
1.1. Objectives of the study	3
Chapter-2: Review of Literature	**4-6**
Chapter-3: Materials and Methods	**7-19**
3.1 Study Area	7
3.1.1 Location of the Study Area	8
3.1.2 Duration of Study Period	8
3.2 Sample and Sampling	8
3.2.1 Sampling Frequency	8
3.2.2 Sample Collection	9
3.2.2.2 Sample Collection for Chemical Analysis	9
3.2.3 Parameters Analyzed for the study	9
3.2.3.1 Physical Parameters	10-11
3.2.3.2 Chemical Parameters	11-16

Chapter-4: Results **20-30**

4.1. Physico-Chemical Parameters 20

4.1.1 Water Temperature 21

4.1.2 Water Transparency 21

4.1.3 Water pH 24

4.1.4 Dissolve Oxygen 25

4.1.5. Alkalinity 26

4.1.6. Acidity 27

4.1.7. Hardness 27

4.1.8. Ammonia 28

4.1.9. Nitrite 29

4.1.10 Salinity 29

4.1.11 Chlorophyll-a 30

Chapter-5: Discussion **31-35**

Chapter-7: Conclusion **36**

Chapter-8: References **37-39**

List of Maps

SL. Code	Title	Page No.
Map 1	Map of Dumuria Upazila. (Source: Banglapedia, Internet)	7

List of Figures

SL. Code	Title	Page No.
Figure 1	Water temperature in different ponds.	21
Figure 2	Water transparency in different ponds.	22
Figure 3	Water pH in different ponds.	24
Figure 4	Dissolved oxygen in different ponds.	25
Figure 5	Total alkalinity in different ponds.	25
Figure 6	Water acidity in different ponds.	26
Figure 7	Total hardness in different ponds.	27
Figure 8	Water ammonia in different ponds.	27
Figure 9	Nitrite in different ponds.	28
Figure 10	Salinity in different ponds.	29
Figure 11	Total phosphorus in different ponds.	29
Figure 12	Water chlorophyll-a in different ponds.	30

List of Tables

SL. Code	Title	Page No.
Table 1	Sampling spots in the study area.	8
Table 2	Analytical methods used for the determination of water quality parameters	10
Table 3	Minimum and Maximum Values of Different Physical Water Quality Parameters	20
Table 4	Minimum and Maximum Values of Different Chemical Water Quality Parameters	22-24
Table 5	Minimum and Maximum Values of a biological Water Quality Parameters	30

Chapter One

INTRODUCTION

CHAPTER 1

INTRODUCTION

Background of the study

In fish culture, water quality is usually defined as the suitability of water for the survival and growth of fish, and it is normally governed by only a few variables. Most fish culturists are aware of these variables and are acquainted with relationships between them and fish production. Water quality is somewhat nebulous and often used term that is seldom defined adequately. Any characteristics of water in production system that effects survival, reproduction, growth and production of aquaculture species, influences management decision, causes environmental impacts or reduces product quality and safety can be considered a water quality variable (Boyd, 1979a). Other factors being equal, aquaculture species will be healthier, production will be more efficient, environmental impacts less and product quality better in culture systems with "good" water quality than in those with "poor" water quality. Knowledge of water quality principles will help aqua culturists determine the potential of a body of water to produce aquaculture species, to maintain or to improve water quality in the culture system, to minimize problem of fish stress and fish health, to produce higher quality aqua cultural products, to reduce environmental impacts of effluents and to realize more efficient production and greater profits (Chatson, 1984).

Aquaculture is a very old endeavor whose roots can be traced back for more than 2000 years in China. However, water quality did not become a major issue until more intensive production systems were developed during the second half of the 20th century. Most of the research and practical experience in water quality and its management have resulted from attempts to reduce risk and improve the efficiency of commercial production system during the past 20-25 years.

There are basically four levels of water quality restrains in aquaculture. When one is selecting a site for an aquaculture project, the quality of the source of water should be carefully evaluated. Natural water quality may not be adequate and treatment may be necessary to correct water quality problems. For example, if ponds are built on highly acidic soils, water in ponds may be so acidic that heavy liming is required. Water sources also may be highly polluted from anthropogenic sources and this pollution can have serious effect on production. Investor should

consider water quality limitations at a prospective site and estimate the cost of overcoming these limitations. If the cost is too great, the site should not be developed for aquaculture. It is better to never become an aqua culturist than to become a failed aquaculture.

Once it is decided to start an aquaculture project at a given site, the next problem with water quality arises from water quality deterioration caused by management inputs to enhance production. The most common and problematic inputs are manures, fertilizers and feeds needed to increase production. These nutrient sources result in greater production, but they also lead to dense phytoplankton blooms, dissolved oxygen depletion and increased concentrations of toxic metabolites. As the production level increases and water quality deteriorates, water treatment methods such as aeration, water circulation and water exchange must be used to maintain tolerable culture conditions. Each with water quality management inputs, the efficiency of production cannot be maintained at a constant level as production rises. Thus the cost of production normally increases as production increases and the most profitable production level are well below maximum production. Unfortunately many aqua culturists seem to equate high production with good profits. Whereas this is true within a certain range of production, because of increasing costs in maintaining water quality as production increases, many aqua culturists go beyond the plateau in profit.

The effluents aquaculture ponds can result in eutrophication, sedimentation and other environmental perturbations in receiving water. Good water quality management in ponds can be a powerful tool in reducing the volume and enhancing the quality of pond effluents to minimize adverse environmental effects. Treatment methods also are available for improving the quality of effluents before their final discharge from aqua cultural operations. Unfortunately, some researchers are attempting to develop very complex solutions to this rather simple problem. This phenomenon is driven by the quest for research funds rather than by a sincere desire to develop simple, cost effective waste management procedures for the benefits of the aqua cultural industry. Many areas of aquaculture too much emphasis is placed on novel ideas and high-tech solutions rather than on well-conceived, realistic solutions. In fact, granting agencies usually fail to fund projects that suggest a simple, low-tech solution in favor of necessary, novel, complex approaches. It should be remembered that pond aquaculture is rather low-tech endeavor and we should first seek simple solutions to problems. Finally, certain substances that are applied to

ponds in management inputs, produced by pond biota or admitted to ponds in the water supply may enter the flesh of fish and other aquaculture species. Examples are antibiotics used in feeds, water quality amendments applied to ponds, toxins and flavor compounds produced by algae and pesticides and heavy metals. Accumulation of certain compounds in aquatic animals may impact discoloration or off flavor to the flesh, making it unacceptable to the consumer. Accumulation of microbial toxins, antibiotics, pesticides or heavy metals in aqua cultural products may even pose a food safety hazard to the consumer (Boyd, 1990).

Hundreds of water quality variables may affect the well being of fish or crustaceans but fortunately only a few normally play a decisive role (Boyd, 1990). Some variables, such as salinity and water temperature are important when assessing the suitability of a site for the culture of a particular species. Other properties, such as alkalinity, turbidity and compounds of nitrogen are important because they affect plant productivity, which in turn may influence aquaculture production. Dissolved oxygen, carbon dioxide, ammonia and other factors come into play during the grow-out period because they are potential stressors of the animal under culture. The study will carry out in different prawn farms both in monoculture and integrated culture systems in Khulna region. Proposed investigation will be an attempt to get information about water quality parameters at the prawn farms. The result will provide ecological baseline information for future studies in this region.

Objectives of the Study:

The major aims of the study are-

1. To measure various physical and chemical parameters of the prawn farm.
2. To know the variations of different physico-chemical factors between monoculture and integrated culture of prawn.

Chapter Two

REVIEW OF LITERATURE

CHAPTER 2

LITERATURE REVIEW

Enough research reports on water quality of prawn culture are not available. Some authors have given several reports on water quality of prawn culture, those are cited below.

Hoq *et al.* (1996) measured a few water quality parameters in five prawn farmers' ponds in Kolaroa thana under Satkhira district. They recorded that temperature ranged from 27.5-30.5°C, pH from 7.5-8.0 and DO from 4.0-5.9mg/l.

Environmental stresses including a variety of factors such as the presence of large number of bacteria associated with larvae, temperature, pH, DO, salinity, overcrowding, physical handling etc were considered by different workers (Nash *et al.*, 1987 and Hameed, 1993).

Apud *et al.* (1981) stated that growth of PL's in the nursery is highly dependent on water management and depth as well as on quantity of supplementary feed or formulated diet used. On the other hand, he also mentioned that stocking densities for intensive nursing systems range from 100,000 to 400,000 PL/ha with the optimum of 150,000 to 250,000 PL/ha as practiced by most intensive growers where the survival vary from 60-80%.

Apud *et al.* (1985) reported that the minimum dissolved oxygen level of prawn is 3-4mg/L. However, below 2 mg/L of oxygen prawn exhibit an initial period of hyperactivity with swimming at the surface and jumping followed by mortality. Sandifer and Smith (1985) reported that satisfactory temperature for prawn culture ranged from 26-31°C and optimum temperature was 28-30°C.

Jia-Mo *et al.* (1988a) conducted a monoculture experiment on *M. rosenbergii* in earthen ponds and found the total yield was 547.7 kg/ha with average yield 91.28 kg for 142 days culture period when the survival rate was 57.68% and the average size of the prawn was 17.58g. They also reported that the food conversion rate was 3:1 with "Camaronina" (35% protein), the water temperature fluctuated from 28.5-33°C, the pH from 7.5 to 8.5 and the dissolved oxygen was 4.5 ppm.

Thai *M. rosenbergii* hatchery management results in a stocking density of 30-50/L (New, 1990) and Hawaiian hatcheries expect 50-70% survival to achieve a post-larval production of 30/L. For *M. rosenbergii* larval rearing, a salinity range of 10-15 ppt is generally practiced. Optimum temperature range of 26-31°C or above 35°C cause retarded development or mortality. Newly hatched brine shrimp nauphlii (artemia), fish flesh, mussel flesh, squid flesh and egg custard are frequently used. Artemia nauplii are maintained at 1 nauplii/ml and increased to about 5 nauplii/ml while feeding in Thailand but Hawaiian hatcheries trend to use 5-15 nauplii/ml (New,1990). Modify the fatty acid content of artemia nauplii have proved effective (Sorgeloos *et al.*, 1996). Post larval production rates have been reported as 10-20/1 nauplii/ml in Thailand, 30/1 in Hawaii, (New, 1990) and by using intensive antibiotic aided techniques in France hatcheries production of up to 50/1 has been achieved (AQUACOP,1970).

Freshwater prawns *(M. rosenbergii)* have been grown to market size in a variety of conditions, both by scientists and farmers in up to 25 ppt salinity in pens and cages and in ponds. Ang *et al* (1992) concluded that when PL *M. rosenbergii* were reared in cages for 24 weeks, a stocking density of 10/m² gave better growth and survival than 2/m² although final biomass was the highest and the greatest stocking density.

Kanit *et al.* (1992) conducted research work on variation physico-chemical properties of water and phytoplankton in intensive shrimp pond at Amphoe Ronot, Songkhala in Thailand and reported that the major genus of *Trichodesmium* which increased from 5,665 cells/L to 1,28,541 cells/L and 11.94 million cells/L from the 6th and 12th week, respectively, After the 12th week, it had decreased to 203,262 cells/L. They also stated that the second week to 2.19-million cells/1 in the 18th week.

Sadek and El-Gayar (1993) evaluated the effect of used agricultural drainage water with salinity from 4-6 ppt, total hardness from 900 -1500 ppm and total alkalinity from 170-180 ppm on the growth rate of *M. rosenbergii* in earthen ponds at different stocking densities (1 or 2 prawns / m²) and observed an average weight of 52.8±0.7 g and 50.8±2 for the two densities 1 & 2 prawns /m², respectively with individual daily increments of 318±0.5 and 319±5.5 mg/day after 155 days culture period. They also reported that the survival rates varied from 62 to 80 % at stocking densities between 1 or 2 prawns /m² and no difference was observed in feed conversion rate, calculated as 4.1±0.2 and 4.6±0.3 for the two densities of 1 and 2 prawns / m² respectively.

Chen and Chen (2003) investigated the effects of pH on survival, growth, molting and feeding of giant freshwater prawn and found that 24,48,72 and 96 h LC 50s (median lethal concentrations) of pH of juveniles (0.13± o.o1g) following 56 days exposure to pH 8.2, 7.4, 6.8, 6.2, 5.6 were 100%, 88.9%, 94.4%, 94.4% and 94.4% respectively. The body weight, total length, feed ingrate and molting frequency of prawns were significantly lower ($P<0.05$) in acidic pH. Finally they concluded that the minimum acceptable pH levels were 6.2 and 7.4 based on growth and feeding, respectively. Asaduzzaman, *et al.* (2006) conducted an experiment to evaluate the effect of control of Carbon/Nitrogen ratio by addition of low cost carbohydrate to the water column on water quality and pond ecology in fresh water prawn *M. rosenbergii* post-larvae nursing system. According to the results of this experiment control of C/N ratio by the addition of low cost carbohydrate to the pond water column benefited the freshwater prawn nursing practices in three ways increased heterotrophic bacterial growth supplying bacterial protein augment the prawn post-larvae growth performances reduced demand for supplemental feed protein and subsequent reduction in feed cost and reduced toxic NH_3-N and NO_2 levels in pond nursing system.

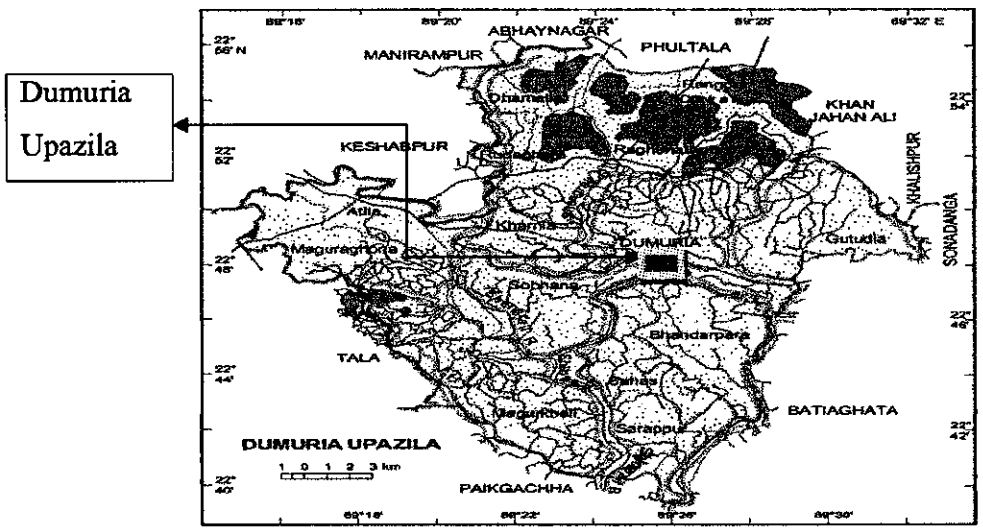
Chapter Three

MATERIALS AND METHODS

CHAPTER 3

MATERIALS AND METHODS

3.1 Study Area



Map 1: Map of Dumuria Upazila. (Source: Banglapedia, Internet)

3.1.1 Location of the Study Area

The study areas were located in the villages Solua and Ramkrishnapur, Dumuria, southwest region of Khulna district. Eight ponds, four were under monoculture (1 acre, 2.5 acre, 2 acre and 1.5 acre) and other four were under integrated culture (1.7 acre, 2 acre, 1 acre and 1.5 acre). The study was conducted fifteen days interval during the period of July to October. The water source of the pond was rain and underground water. Feed type for monoculture Mega Starter, Mega grower, Own Processed Feed, Mustard oil cake and feed type for integrated culture Quality & CP Feed, Snail, Rice Bran, Wheat Bran, Dal, Mustard Oil Cake etc. The selected ponds were with adequate aquaculture facilities, such as necessary water depth (5-6ft) with clay loamy soil, well constructed dikes, free from flood or water logging, sunny, available sources of water supplies, easy to access etc. The ponds were more or less equal in depth, basin, configuration and pattern.

Table 1: Sampling spots in the study area.

Ponds number	Location	Culture system	Latitude	Longitude
Pond 1	Solua, Dumuria, Khulna	Monoculture (Without rice)	N-22°52'13.2''	E-89°29'01.3''
Pond 2	Solua, Dumuria, Khulna	Monoculture (Without rice)	N-22°52'14.5''	E-89°29'04.7''
Pond 3	Solua, Dumuria, Khulna	Monoculture (Without rice)	N-22°52'18.4''	E-89°29'01.9''
Pond 4	Solua, Dumuria, Khulna	Monoculture (Without rice)	N-22°52'08.7''	E-89°28'34.6''
Pond 5	Ramkhrisnapur, Solua, Dumuria, Khulna	Integrated culture (With rice)	N-22°51'38.9''	E-89°26'31.1''
Pond 6	Ramkhrisnapur, Solua, Dumuria, Khulna	Integrated culture (With rice)	N-22°51'33.2''	E-89°26'22.4''
Pond 7	Ramkhrisnapur, Solua, Dumuria, Khulna	Integrated culture (With rice)	N-22°51'31.1''	E-89°26'18.0''
Pond 8	Ramkhrisnapur, Solua, Dumuria, Khulna	Integrated culture (With rice)	N-22°51'31.2''	E-89°26'14.9''

3.1.2 Duration of Study Period

The duration of the study period was 4 (four) months from July to October, 2012.

3.2 Sample and Sampling

Random sampling method was used for collecting water sample from the above prawn culture ponds.

3.2.1 Sampling Frequency

Samples were collected after every 15 days interval.

3.2.2 Sample Collection

3.2.2.2 Sample Collection for Chemical Analysis

For the analysis of physic-chemical aspects of water quality, samples were collected in both types of culture ponds. After collection samples were stored in plastic bottles, and kept in a box for temperature control.

3.2.3 Parameters Analyzed for the Study

In this study different physicochemical and biological water quality parameters were investigated. The analysis was done both in the field and laboratory.

3.2.3.1 Physical Parameters

- Water temperature
- Transparency/ Turbidity

3.2.3.2 Chemical Parameters

- pH (Hydrogen Ion Concentration)
- DO (Dissolved Oxygen)
- Salinity
- Alkalinity
- Acidity
- Ammonia
- Nitrite
- Hardness
- Total Phosphorus

3.2.3.3 Biological Parameters

- Chlorophyll-a

3.2.4 Analytical Methods

Different analytical methods were adopted for the determination of different physical, chemical, and biological parameters those are enlisted in table 2.

Table 2: Analytical methods used for the determination of water quality parameters

Category of Parameters	Parameters	Units	Methods/Instruments
Physical Parameters	Temperature	°C	Centigrade Mercury Thermometer
	Transparency	cm	Secchi disc
Chemical Parameters	pH	N/A	Microprocessor pH meter(HANNA instruments, pH 211)
	DO	mg/L	Chemical analysis
	Acidity	mg/L	Chemical analysis
	Alkalinity	mg/L	Chemical analysis
	Hardness	mg/L	Chemical analysis
	Ammonia	mg/L	Chemical analysis
	Nitrite	mg/L	Chemical analysis
	Salinity	ppt	Chemical analysis
	Total Phosphorus	mg/L	Chemical analysis
Biological Parameters	Chlorophyll-a	mg/L	Chemical analysis

3.2.5 Data Collection

3.2.5.1 Primary data

Primary data was collected by physical, chemical and biological analysis of samples. This information was collected by laboratory analysis and in-situ measurement at the study area.

3.2.6 Analytical procedures of Measured Parameters

3.2.6.1 .Physical Parameters

3.2.6.1.1 Water Temperature

Temperature of the river water samples were measured in the field, immediately after collection.

Measurement Procedure

Water temperature was measured with a mercury-filled Celsius thermometer ranging 0°C to 150°C. To measure temperature the thermometer was dipped in to the water for one minute and the reading from the thermometer was recorded in situ.

3.2.6.1.2 Transparency

Transparency of the river water was measured at the time of sample collection.

Measurement Procedure

A Secchi disc was used to measure the transparency of river water. First the Secchi disc was lowered into the water until it has just disappeared, and the depth was recorded from its elongated scale. Then the disc was raised until it has just reappeared. In this time the depth was also noted. The average of two depths gave the transparency value in centimeter unit.

3.2.6.2 Chemical Parameters

3.2.6.2.1 pH

pH of the water samples were also measured in the field, immediately after sample collection.

Measurement Procedure

Water pH was measured from collected samples using a bench top digital pH meter (Model No pH 211.Labor-pH/mV/0C- Meter unit Microprocessor, HANNA instruments) nearest to 0.01. Before using the instrument it was calibrated with pH 7 and pH 10 buffer solutions. Before taking each pH reading, the electrode was washed well by distilled water.

3.2.6.2.2 Acidity

Acidity of water was measured using titration method following (APHA, 1976).

Apparatus

Electrometric titrate, Titration vessel, magnetic stirrer, pipettes, volumetric Flasks (1000, 200,100ml), burettes, borosilicate glass (50, 25, 10ml) and polyolefin bottle 1L.

Reagents

Carbon dioxide-free water

All stock and standard solutions and dilution water for the standardization procedure were made with distilled water that was freshly boiled for 15 minutes and cooled to room temperature before use.

Potassium hydrogen phthalate solution

Approximately 0.05N Fifteen to twenty grams of primarily standard $KHC_8H_4O_4$ was crushed with 100 mesh net and dried at 120^0C for 2 hours and cooled in a desiccators and 10.0±0.5g (to the nearest mg) of this was transferred to a 1l volumetric flask and was diluted to 1000ml.

Standard sodium hydroxide titrate, 0.1N

The solution was prepared approximately 0.1N as indicated under preparation of Desk-Reagents. It was standardized by titrating 40.00mL $KHC_8H_4O_4$ solution, using a 25ml burette. Titrate to the inflection point, which should be close to pH 8.7. Normality of NaOH was calculated,

$$\text{Normality} = \frac{A \times B \times 50{,}000}{C}$$

Where, A=g $KHC_8H_4O_4$ weighed into 1L flask; B=ml $KHC_8H_4O_4$ solution taken for titration; C= ml NaOH solution used.

Phenolphthalein indicator solution, alcoholic, pH 8.3 indicator

Dissolve 2.5gm Phenolphthalein into 250ml 95% ethyl alcohol and added 250ml of distilled water was added to it.

Procedure

Rinse the burette with distilled water and then rinsed with 0.1N NaOH by pipette. Clamp the burette and fill with 0.1N NaOH solution up to mark. Standardize the NaOH solution by standard potassium hydrogen phthalate solution. Take the 10ml sample into 250ml conical flask and added 2 drops of phenolphthalein indicator solution and titrate with 0.1N NaOH solution until a permanent pink color appears.

$$\text{Total acidity, as mg } CaCO_3/l = \frac{\text{ml standard NaOH} \times N \times 50{,}000}{\text{ml sample}}$$

3.2.6.2.3 Dissolve oxygen (DO)

Dissolve oxygen (DO) of water was measured using azide modification method following (APHA, 1976). Modified Wrinkler method was used to determine the amount of DO.

Reagents

Manganous sulfate solution

Four hundred eighty gram $MnSO_4.4H_2O$ was dissolved in distilled water, filters and dilute to 1L.

Alkali-iodide-azide reagent

Seven hundred gram KOH and 150g KI was dissolved in distilled water and diluted to 1L and 10g sodium azide was added to it.

Sulfuric acid, H_2SO_4, conc.

Starch

To prepare an aqueous solution, 1g laboratory-grade soluble starch was added in 100ml hot distilled water.

Standard sodium thiosulfate solution

6.205g $Na_2S_2O_3.5H2O$ was added in distilled water and added 0.4g solid NaOH and was diluted to 1000ml.

Procedure

Sample preparation

Sample water was collected in a 250ml DO bottle, 1ml of $MnSO_4$ solution was added, followed by 1ml alkali-iodide-azide reagent was made. Stoppard used carefully to exclude air bubbles and mix by inverting bottle a few times. When precipitate had settled sufficiently (to approximately hall the bottle volume) to leave clear supernatant above manganese hydroxide flock and 1ml concentrated H_2SO_4 was added.

Titrate with 0.025N $Na_2S_2O_3$

The whole solution then transferred into a conical flask and a few drops of starch solution were added and continued titration to 1st disappearance of blue color.

Calculation

For titration of 200ml sample,

1ml 0.025 N Na2S2O3= 1mg DO/L

$$DO\ (\text{in mg/l}) = \frac{y \times 200}{x}$$

Where, y = mg of the titrant
x = mg of the sample

3.2.6.2.4 Alkalinity

Alkalinity of water was measured using Neutralization Titration Process method following (APHA, 1976).

Apparatus

Electrometric titrate, Titration vessel, magnetic stirrer, pipettes, volumetric Flasks, volumetric (1000, 200,100ml), burettes, borosilicate glass (50, 25, 10ml) and polyolefin bottle 1L.

Reagents

Sodium carbonate solution, approximately 0.05N

Five gram primarily standard Na_2CO_3 was dried at 250^0C for 4h and cooled in desiccators. Weight 2.5±0.2g (to the nearest mg) of this transferred to a 1L volumetric flask and dissolved with 1000ml distilled water.

Standard sulfuric acid or hydrochloric acid 0.02 N

This was prepared by dissolving 200ml 0.1N standard acid to 1000ml with distilled.

Phenolphthalein indicator solution, alcoholic, pH 8.3 indicator

2.5gm phenolphthalein was dissolved into 250ml 95% ethyl alcohol and added 250ml of distilled water.

Methyl orange indicator solution:

500gm methyl orange free acid powder was dissolved in distilled water and diluted it to 1L.

Sodium thiosulfate, 0.1N.

Procedure: Rinse the burette was first rinsed with distilled water and then rinsed with 0.1N H_2SO_4 was standardized by Na_2CO_3 solution. 10ml sample was taken in a 250 ml conical flask and added 5drops of the phenolphthalein indicator solution in to it. 5drops methyl orange indicator was added to the sample and titrated with 0.1N H_2SO_4 to a light pink color and the volume of titrate was recorded. Alkalinity of the sample was determined with following formula:

$$\text{Alkalinity, mg } CaCO_3/L = \frac{A \times N \times 50{,}000}{\text{ml of sample}}$$

Where, A = ml standard acid used and N = Normality of standard acid

1.2.6.2.5 Hardness

Hardness of water was measured using EDTA titration method.

Apparatus

Electrometric titrate, Titration vessel, magnetic stirrer, Pipettes, volumetric flasks (1000, 200, 100ml), Burettes, borosilicate glass 50, 25, 10ml and polyolefin bottle 1L.

Reagents

Buffer solution

This was prepared by dissolved 16.9g ammonium chloride in 143ml conc. ammonium hydroxide.

Indicators: It was prepared by dissolved 0.5g Erichrom black-T dye in 100ml 80% ethyl alcohol.

Standard EDTA solution, 0.01M: 3.723g EDTA was dissolved in 1000ml distilled water to prepare 0.01M EDTA solution. This solution was standardized against calcium solution.

Standard calcium solution

1.000g anhydrous $CaCO_3$ powder (primary standard or special reagent low in heavy metals, alkalis and magnesium) was taken into a 500ml Erlenmeyer flask and in a little at a time, conc. HCL was added until all $CaCO_3$ has dissolved. 200ml distilled water was added and boiled for a few minutes to expel CO_2 cooled added a few drop of methyl red indicator and adjust to the intermediate orange color by adding 1N NH_4OH or 1+1HCl as required. Transfer quantitavely and dilute to 1000ml with distilled water.

Standard hydroxide, NaOH, 0.1

Procedure

0.800M EDTA titration cartage was set into the selected place of the titrator. By moving the knob of the titrator the liquid was taken at the end of the delivery tube. Then the reading was taken of the titrator at 0. 10ml sample water was taken and 90ml mineral water was taken into the 250ml or limere flask. 2ml buffer solution was taken (Hardness-1) was taken into the sample

water. Titration was done with 0.800M EDTA until the color change from red to blue. Titration was carefully done at the end point and the temperature was kept under 200C. Total hardness was calculated with the following formula:

$$\text{Hardness (EDTA) as mg } CaCO_3/L = \frac{A \times B \times 1000}{\text{ml of sample}}$$

Where, A= ml titration for sample and B= mg CaCO3 equivalent to 1.00ml EDTA titrant.

3.2.6.2.6 Salinity

One drop of sample water was taken on the plate of the temperature compensated refractometer of the meter. Before inserting the water sample, the prism of the meter was rinsed with distilled water and adjusted the meter scale to opt.

3.2.6.2.7 Ammonia

Apparatus

a. Colorimetric equipment: It includes the following

1. Spectrophotometer, for use at 400 to 500 nm and providing alight path of 1 cm or long.
2. Filter photometer, providing a light path of 1 cm or longer and equipped with a violet filter having maximum transmittance at 400 to 425nm. A blue filter could be used for higher NH_3-N concentration.

b. pH meter equipped with a high pH electrode.

Reagent

Ammonia free water was used for preparing all reagents, rinsing and making dilution.

a. Zink sulfate solution: 100 gm $ZnSO_4.7H_2O$ was dissolved and diluted to 1L water.
b. Stabilizer reagent: Rochelle salt was used to prevent calcium or magnesium precipitation in undistilled samples after addition of alkaline nesser reagent. EDTA solution may also be used here.

1. Rochelle salt solution: 50 gm potassium sodium titrate tetrahydrate, $KNaC_4H_4O_6.4H_2O$ was dissolved in 100 ml water. Ammonia usually present in the salt was removed by boiling off 30 ml of solution. After cooling it was diluted to 100 ml.

2. EDTA reagent: 50 gm disodium ethylenediamine tetraacetate dehydrate has to be dissolved in 60 ml water containing 10 gm NaOH. Gently heat has to be applied to complete dissolution. Then it has to be cooled to room temperature and diluted to 100 ml.

c. Nessler reagent: 100 gm HgI_2 and KI was dissolved in a small quantity of water and this mixture was added slowly with stirring to a cool solution of 160 gm NaOH dissolved in 500 ml water then it was diluted to 1L.

d. Stock ammonium solution: 3.819 gm anhydrous NH_4Cl dried at 100° C was dissolved in water and was diluted to 100ml; 1 ml=10 mg N=1.22 mg NH_3

e. Standard ammonium solution: 10 ml stock ammonium solution was diluted to 1000 ml with water; 1ml=10 µg N=12.2 µg NH_3.

Procedure

- Treatment of impure sample: residual chlorine was removed from the freshly collected sample by adding an equivalent amount of decholorinating agent. Then 1ml $ZnSO_4$ solution was added to 100 ml sample and mixed thoroughly.
- Color Development: 50 ml sample or a portion diluted to 50 ml with water was used and 1 drop EDTA reagents or 1 to 2 drops Rochelle salt was added and solution was mixed well. Then 2 ml nessler reagent was added in case of EDTA reagent or 1ml nessler reagent was added in case of Rochelle salt.
- Photometric measurement: Absorbance or transmittance of the sample was measured with a spectrophotometer. In the spectrophotometer the sample was read at 420 nm. Then the calibration curve was prepared at the same temperature and reaction time used for sample.
- Then absorbance or transmittance of the unknown sample was measured with spectrophotometer at 420 nm and the value of the sample was determined by the curve.

3.2.6.2.8 Total Phosphorus

Determination of phosphorus by vanodomolybdophosphoric acid colorimetric method.

Principal

In adilute orthophosphate solution, ammonium molybdate reacts under acid conditions to for a heteropoly acid, molybphosphoric acid. In the presence of vanadium yellow

vanodomolybdophosphoric acid is formed. The intensity of the yellow color is proportional to phosphate concentration.

Apparatus

a. Colorimetric equipment: It included the following

1. Spectrophotometer, for use at 400 to 490 nm.
2. Filter paper, provided with a blue or violet filter exhibiting maximum transmittance between 400 and 470 nm.

b. Acid washed glassware.

c. Filtration apparatus and filter paper.

Reagent

a. Phenolphthalein indicator aqueous solution.

b. Hydrochloric acid, HCl, 1+1. H_2SO_4, $HClO_3$ or HNO_3 may be substituted for HCl. The acid concentration in the determination is not critical but a final sample concentration of 0.5N was recommended.

c. Activated carbon: Final precipitate was removed by rising with distilled water.

d. Vanadate-molybdate reagent:

1) Solution A: 25gm ammonium molybdate $(NH_4)_6Mo_7O_{24}.4H_2O$) was dissolved in 300 ml distilled water.

2) Solution B: 1.25 gm ammonium metavanadate, NH_4VO_3, was dissolved in 300 ml distilled water by heating to boiling. The solution was cooled and 330 ml conc. HCl was added. Then solution B was cooled to room temperature and solution A was poured into solution B. Finally it was mixed and diluted to 1 ml.

3) Standard phosphate solution: 219.5 mg anhydrous KH_2PO_4 was dissolved in distilled water and diluted to 1000 ml; 1 ml=50 µg PO_4.

Procedure

- Sample adjustment: 0.5 ml (1 drop) phenolphthalein indicator was added to 50 ml sample when sample pH was greater than 10 and the red color was discharged with 1+1 HCl before diluting to 100 ml.
- Color removal from sample: Excess color in the sample was removed by shaking about 50 ml with 200 mg activated carbon in an Erlenmeyer flask for 5 minutes and was filtered

to remove carbon. Each batch of carbon for phosphate because some batches produced high reagent blanks.

- Color development sample: 35 ml or less of sample was placed in 50 ml volumetric flask containing 0.05 to 1.0 mg P. 10 ml venadate-molybdate reagent was added and diluted to the mark with distilled water. A blank was prepared in which 35 ml distilled water was substituted for the sample. After 10 minutes or more, absorbance of sample was measured versus a blank at a wavelength of 430 nm (400 to 490) depending on sensitivity desired. The color was stable for days and its intensity was unaffected by variation in room temperature.
- Preparation of a calibration curve: A calibration curve was prepared by using suitable volumes of standard phosphate solution and proceeding as in c.
- Then absorbance or transmittance of the unknown sample was measured with spectrophotometer at 430 nm and the value of the sample was determined by the curve.

3.2.6.3 Biological Parameters

3.2.6.3.1 Chlorophyll-a

Calculation/equation:

Chlorophyll-a (mg/L) = 11.87 x RPM (A664-A750) x 10 ÷ 250

Here,

RPM A664= Spectophotometry which measures the absorbance of light by chlorophyll-a at 664 nm

RPM A750= Spectophotometry which measures the absorbance of light by chlorophyll-a at 750 nm

11.87 are fixed, RPM is the value from spectrophotometer (after centrifugation), 10 is for Acetone concentration, 250 (divided wholly) is for water sample weight).

Chapter Four

RESULTS

CHAPTER 4

RESULTS

4.1. Physicochemical and Biological Parameters

A total of twelve different water quality parameters were collected every after 15 days such as temperature, transparency, pH, salinity, DO, ammonia, nitrite, alkalinity, hardness, acidity, total phosphorus and chlorophyll during the study period. The parameters were found to vary from station to station. The minimum and maximum values of different water quality parameters are given below.

Table 3: Minimum and Maximum Values of Different Physical Water Quality Parameters.

Physical Parameter	Culture type	Pond Number	Minimum	Maximum.
Water temperature (°C)	Mono culture	Pond-1	29	33
		Pond-2	29	32.5
		Pond-3	29	32.5
		Pond-4	29	33.6
	Integrated culture	Pond-5	29	32
		Pond-6	29.5	32
		Pond-7	29.5	32.5
		Pond-8	29.5	32.5
Transparency (cm)	Mono culture	Pond-1	21	26
		Pond-2	20	28
		Pond-3	20	28
		Pond-4	19	26
	Integrated culture	Pond-5	19	28
		Pond-6	18	22
		Pond-7	20	26
		Pond-8	21	28

4.1.1. Water Temperature

The temperature was found to vary in different ponds at different months of the study period between 29°C and 33.6°C in the mono and integrated culture systems. The maximum water temperature was recorded 33.6°C at the pond4 in the month August. The mean water temperature in different months at different ponds is shown in fig-1.

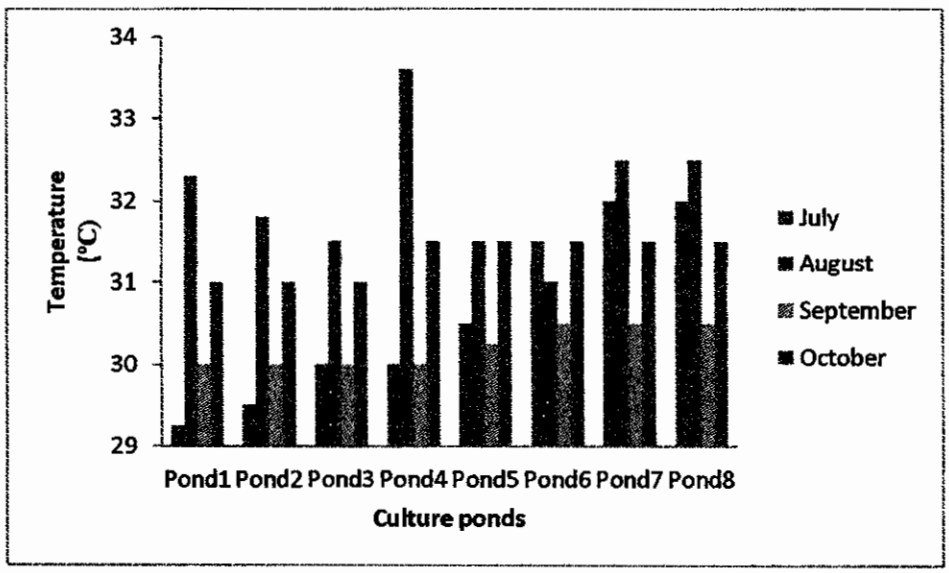


Figure 1: Water Temperature at different ponds.

4.1.2. Water Transparency

Transparency of the mono and integrated culture system was also observed during study period. It fluctuated from 18 to 28 cm. The maximum transparency was recorded at pond2, pond3, pond5, pond8 and the minimum value was found at pond6. The mean Transparency values of water in different months at eight different ponds are shown in fig-2.

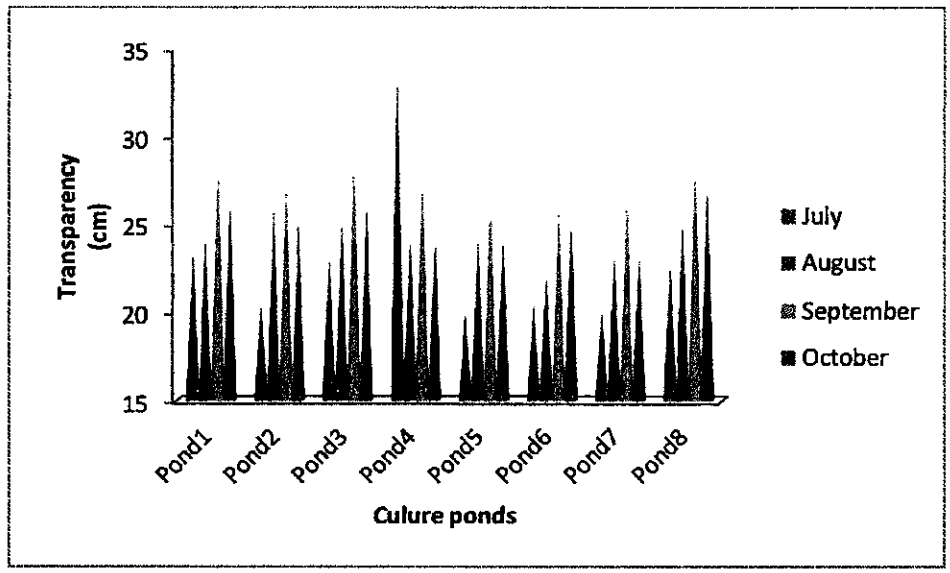


Figure 2: Water transparency at different ponds.

Table 4: Minimum and Maximum Values of Different Chemical Water Quality Parameters.

Parameter	Culture type	Pond Number	Minimum	Maximum.
Total alkalinity (mg/L)	Mono culture	Pond-1	135	170
		Pond-2	132	157
		Pond-3	130	161
		Pond-4	100	163
	Integrated culture	Pond-5	100	163
		Pond-6	137	167
		Pond-7	129	168
		Pond-8	130	160
Ammonia (mg/L)	Mono culture	Pond-1	0.000	0.01
		Pond-2	0.000	0.0008
		Pond-3	0.004	0.02
		Pond-4	0.000	0.01
	Integrated culture	Pond-5	0.000	0.01
		Pond-6	0.001	0.02
		Pond-7	0.000	0.02
		Pond-8	0.000	0.02
Nitrite (mg/L)	Mono culture	Pond-1	0.000	0.033
		Pond-2	0.000	0.33
		Pond-3	0.016	0.03
		Pond-4	0.000	0.231
	Integrated culture	Pond-5	0.000	0.231
		Pond-6	0.000	0.033

		Pond-7	0.000	0.060
		Pond-8	0.000	0.060
Salinity (ppt)	Mono culture	Pond-1	0.5	2.5
		Pond-2	0.0	2
		Pond-3	0.5	2
		Pond-4	0.0	5.0
	Integrated culture	Pond-5	0.0	2
		Pond-6	0.0	2.5
		Pond-7	0.5	4
		Pond-8	0.0	3
pH	Mono culture	Pond-1	5.2	8.0
		Pond-2	5.0	8.5
		Pond-3	5.3	8.0
		Pond-4	5.0	7.9
	Integrated culture	Pond-5	5.0	7.9
		Pond-6	5.3	7.9
		Pond-7	5.1	7.8
		Pond-8	5.3	8.0

Acidity (mg/L)	Mono culture	Pond-1	83	90
		Pond-2	68	75
		Pond-3	69	85
		Pond-4	69	85
	Integrated culture	Pond-5	60	73
		Pond-6	64	77
		Pond-7	71	77
		Pond-8	75	88
Dissolved oxygen (DO)	Mono culture	Pond-1	4.8	5.7
		Pond-2	5.2	5.7
		Pond-3	5	5.8
		Pond-4	4.6	5.73
	Integrated culture	Pond-5	4.6	6.02
		Pond-6	4.6	5.8
		Pond-7	5.3	5.87
		Pond-8	5.5	5.9
Total hardness (mg/L)	Mono culture	Pond-1	36	45
		Pond-2	29	37
		Pond-3	30	33
		Pond-4	26	35
	Integrated culture	Pond-5	19	29
		Pond-6	22	30
		Pond-7	25	37
		Pond-8	30	42

Total Phosphorus (mg/L)	Mono culture	Pond-1	0.24	0.49
		Pond-2	0.18	0.34
		Pond-3	0.14	0.39
		Pond-4	0.32	0.52
	Integrated culture	Pond-5	0.24	0.9
		Pond-6	0.2	0.3
		Pond-7	0.17	0.81
		Pond-8	0.15	0.87

4.1.3. Water pH

The present study showed that pH values varied slightly with time, place and depth of water layer. The average pH value was found to vary from 5.0 to 8.5 at eight different ponds in different months (fig-3). The highest pH of water recorded was 8.5 in August and lowest pH of water was recorded in September. The mean pH values of water at eight different ponds are shown in fig-3.

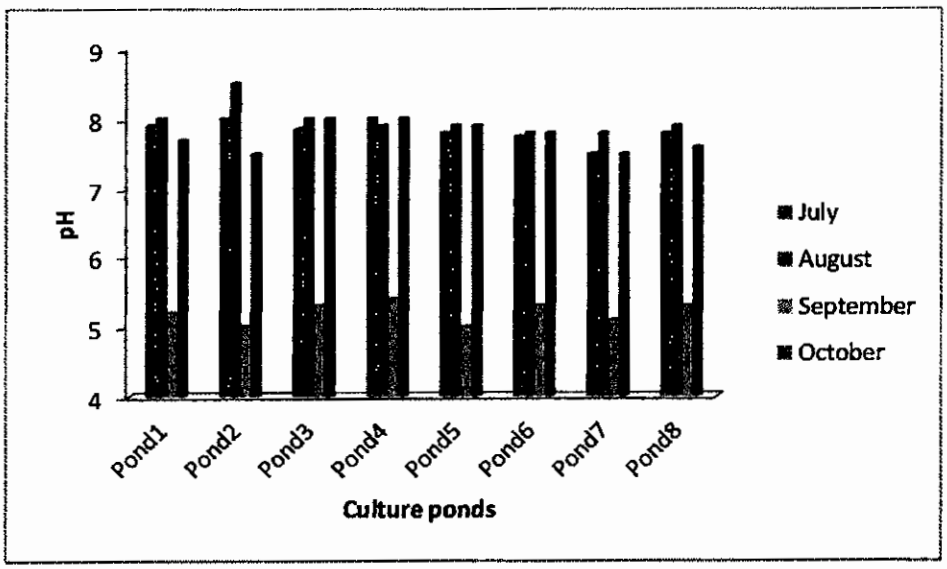


Figure 3: Water pH at different ponds.

4.1.4. Dissolved Oxygen (DO)

The values of dissolved oxygen content of water under different ponds are presented in fig-4. The dissolved oxygen content of water ranged from 4.6 to 6.02 mg/l. The highest dissolved oxygen content was recorded 6.02 mg/l from pond5 in August. The lowest dissolved oxygen content (mg/l) was recorded 4.6mg/l in September. The average of dissolved oxygen content (mg/l) of water was more or less similar among different ponds.

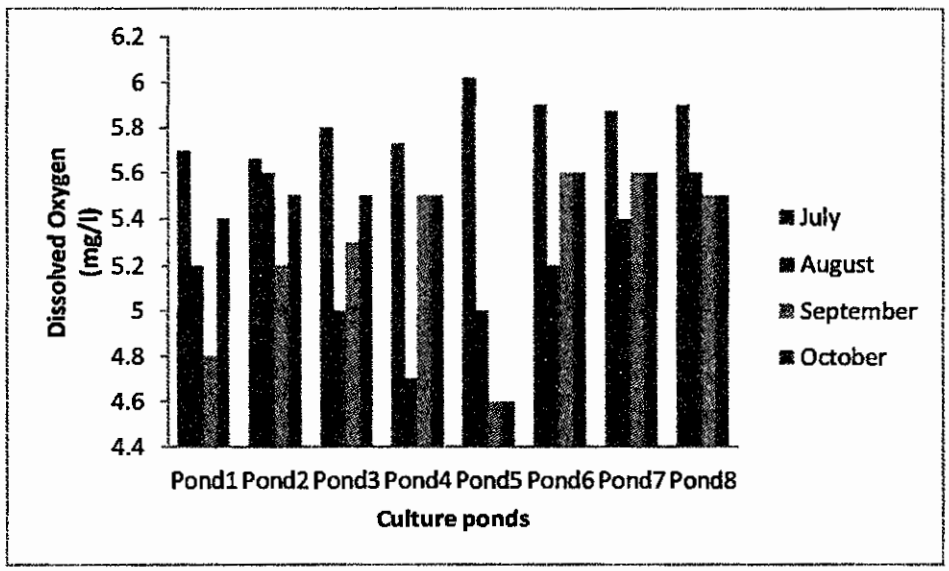


Figure 4: Dissolved oxygen at different ponds.

4.1.5. Total alkalinity

Total alkalinity in the study area was found to vary from 100mg/l to 170mg/l in different ponds. The highest value of total alkalinity was recorded (170 mg/l) at pond 1 in August and the lowest (100 mg/l) at pond 5 in September. The average values are shown in fig-5.

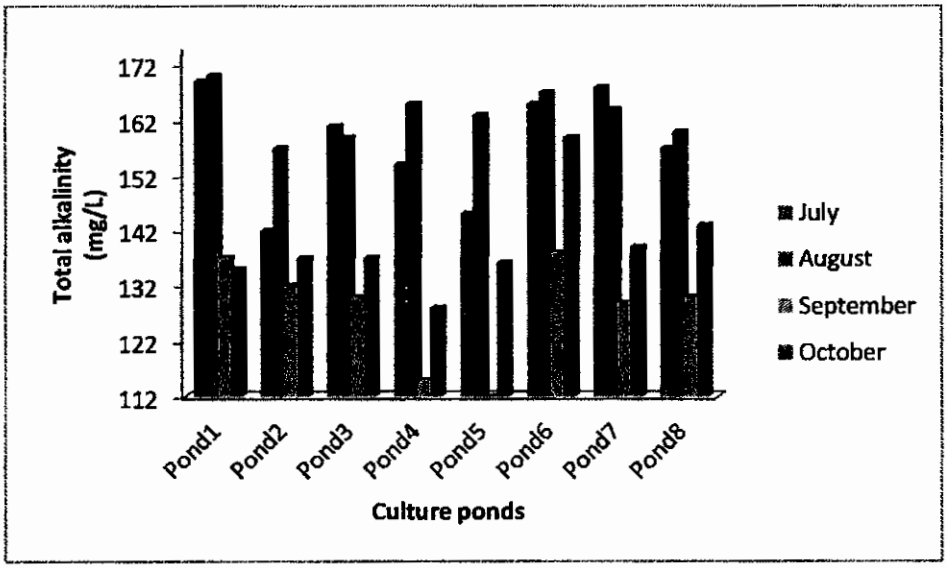


Figure 5: Total alkalinity at different ponds.

4.1.6. Acidity

Total acidity in the study area was found to vary from 60 mg/l to 90 mg/l.The highest value of total acidity was recorded (90 mg/l) at pond 1 in August and the lowest (60 mg/l) at pond 5 in October. The average values are shown in fig-6.

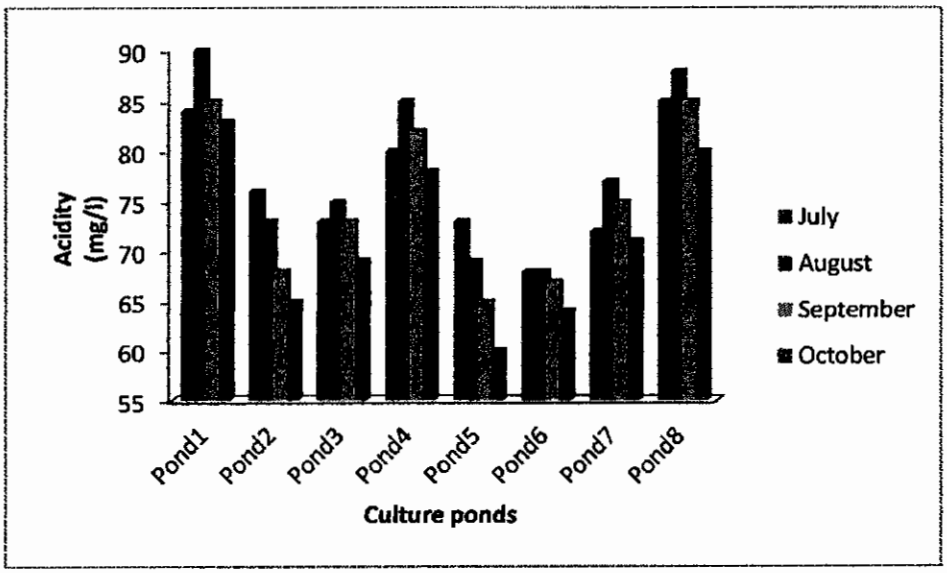


Figure 6: Water acidity at different ponds.

4.1.7. Total hardness

The values of hardness content of water from different ponds in different season are presented in fig-7. The hardness content of water in the study area was found to vary from 22mg/l to 45mg/l in different ponds. Fig:7 shows us the average value of hardness in different months at different stations.

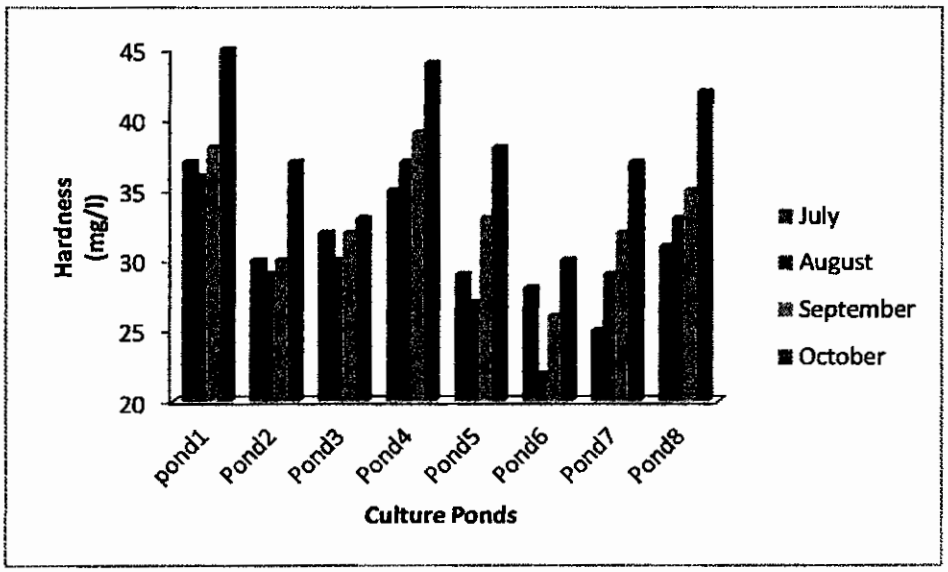


Figure 7: Total hardness at different ponds.

4.1.8. Total Ammonia

The present study showed that ammonia values varied slightly with time, place and depth of water layer. The average ammonia value was found to vary from 0.000 to 0.066 at eight different ponds in different months (fig-8). The highest ammonia of water recorded was 0.066 in pond4 in August and lowest pH of water was recorded in pond1, 2, 7, 8 in September. The mean ammonia values of water at eight different ponds are shown in fig-8.

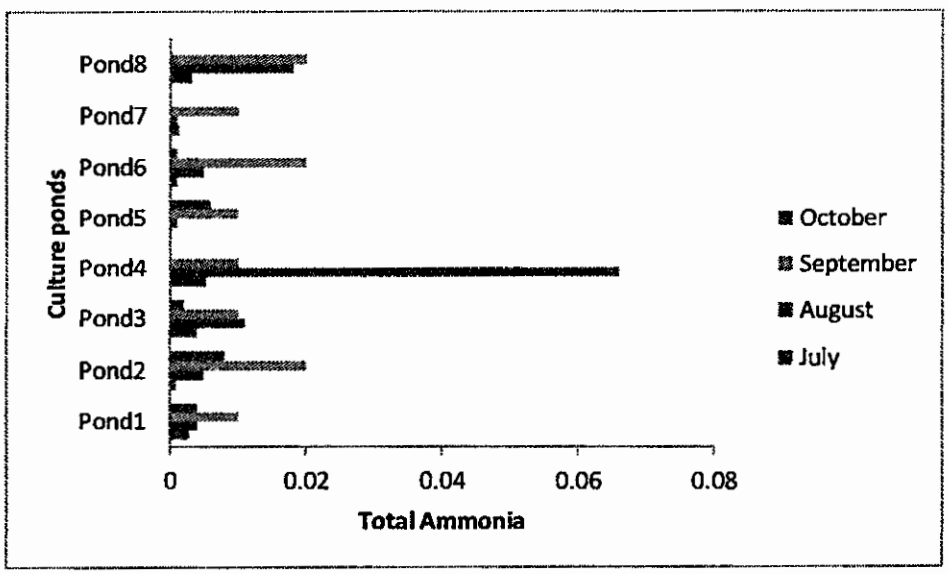


Figure 8: Total ammonia at different ponds.

4.1.9. Nitrite

The present study showed that nitrite values varied slightly with time, place and depth of water layer. The average nitrite value was found to vary from 0.000 to 0.231 at eight different ponds in different months (fig-9). The highest nitrite of water recorded was 0.231 in pond5 in July and lowest pH of water was recorded in pond 2, 3, 6 in September. The mean nitrite values of water at eight different ponds are shown in fig-9.

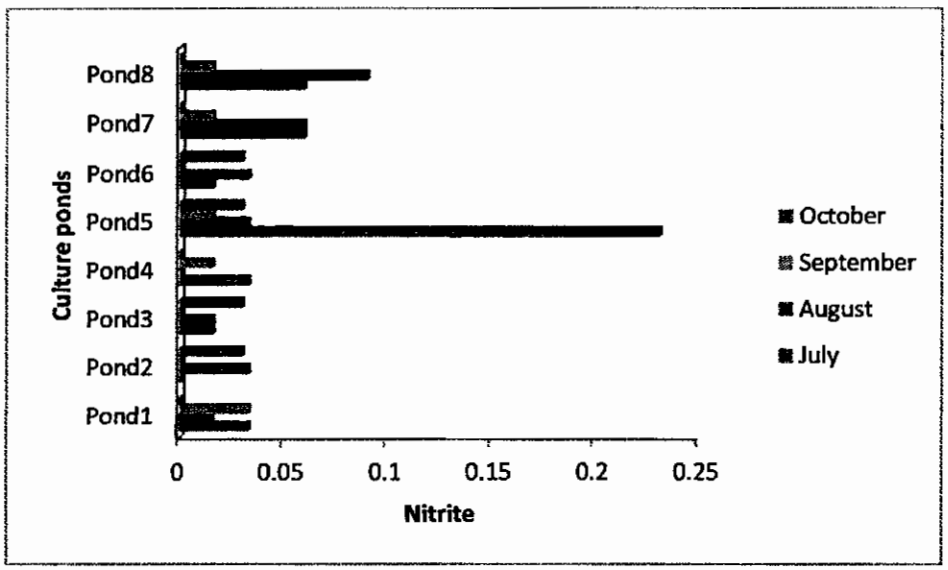


Figure 9: Nitrite at different ponds.

4.1.10. Salinity

The present study showed that salinity values varied slightly with time, place and depth of water layer. The average salinity value was found to vary from 0.0 to 6 at eight different ponds in different months (fig-10). The highest salinity of water recorded was 6 in pond 4 in July and lowest salinity of water was recorded in pond 2, 5, 6 in October. The mean salinity values of water at eight different ponds are shown in fig-10.

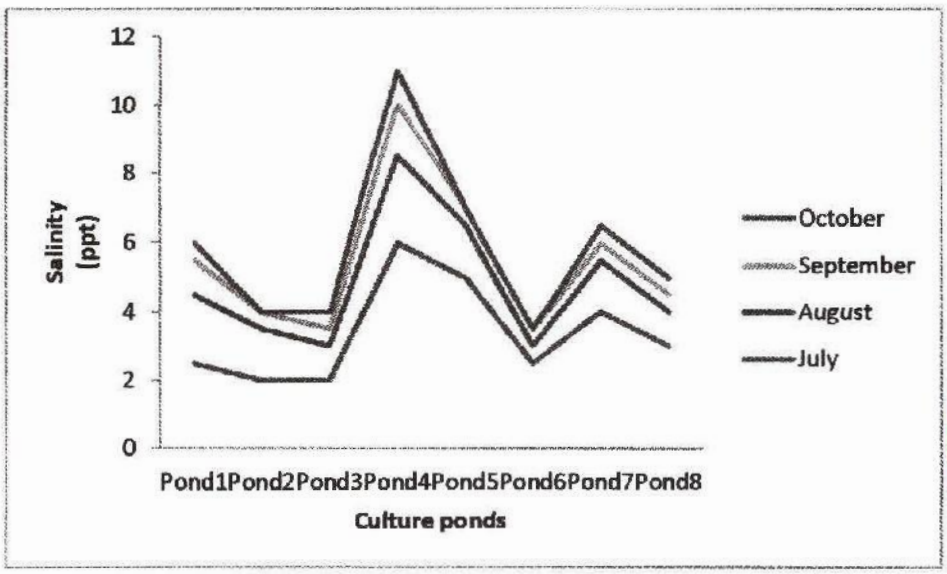


Figure 10: Salinity at different ponds.

4.1.11. Total Phosphorus

The present study showed that total phosphorus values varied slightly with time, place and depth of water layer. The average total phosphorus value was found to vary from 0.14 to 0.9 at eight different ponds in different months (fig-11). The highest phosphorus of water recorded was 0.9 in pond 5 in October and lowest phosphorus of water was recorded in pond 3 in August. The mean phosphorus values of water at eight different ponds are shown in fig-11.

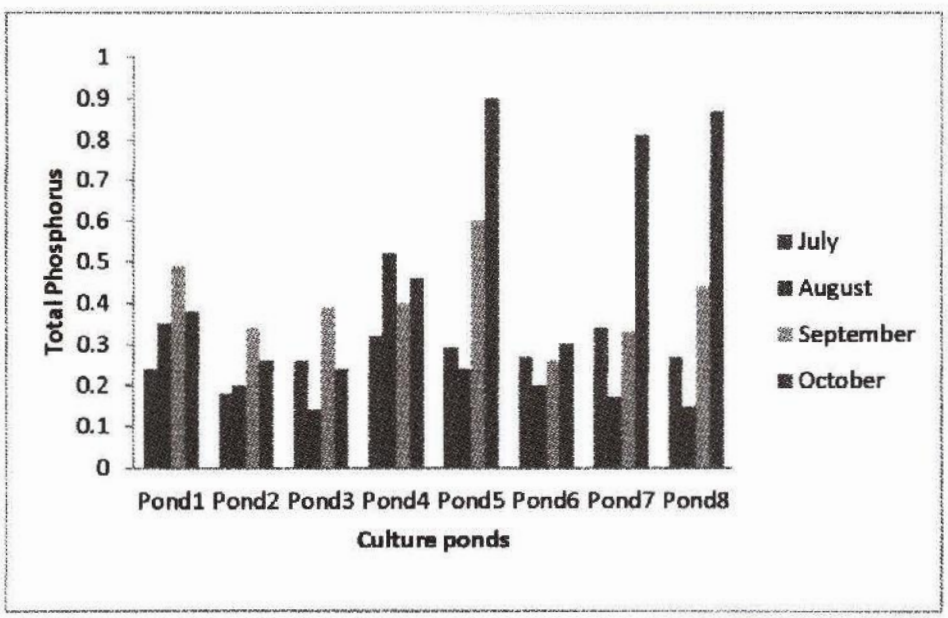


Figure 11: Total phosphorus at different ponds.

Table 5:

Biological Parameter	Culture type	Pond Number	Minimum	Maximum.
Chlorophyll-a	Mono culture	Pond-1	0.000	0.001
		Pond-2	0.001	0.002
		Pond-3	0.002	0.005
		Pond-4	0.002	0.01
	Integrated culture	Pond-5	0.002	0.02
		Pond-6	0.006	0.008
		Pond-7	0.001	0.002
		Pond-8	0.002	0.003

4.1.12. Chlorophyll-a

The present study showed that chlorophyll values varied slightly with time, place and depth of water layer. The average chlorophyll value was found to vary from 0 to 0.02 at eight different ponds in different months (fig-12). The highest chlorophyll value of water recorded was 0.02 in pond5 in October and lowest chlorophyll value of water was recorded in pond 1 in October. The mean chlorophyll values of water at eight different ponds are shown in fig-12.

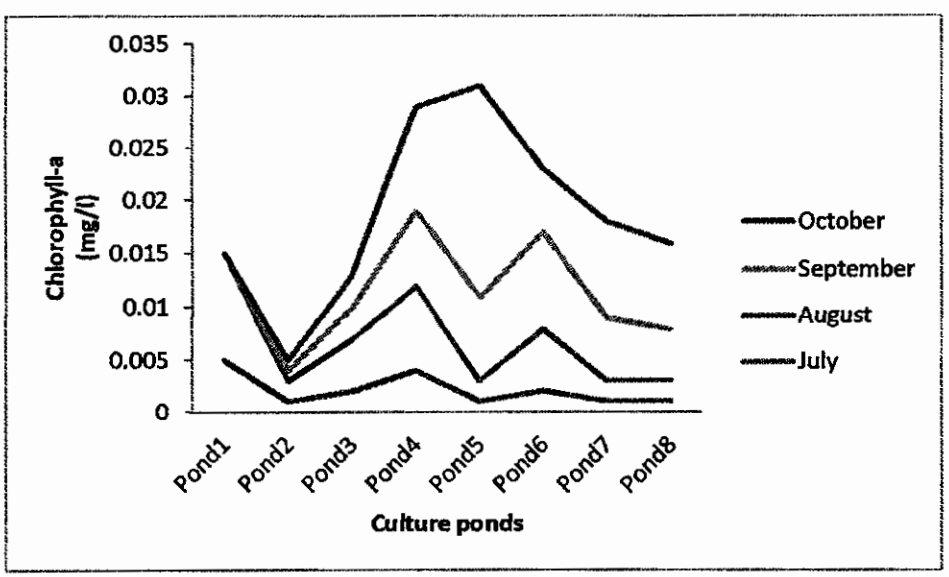


Figure 12: Water chlorophyll-a in different ponds.

Chapter Five

DISCUSSION

CHAPTER 5

DISCUSSIONS

Good aquaculture practice depends on providing animals with a satisfactory environment in which to grow. Good initial conditions for aquaculture can be assured by selecting a site with suitable soil and high quality water supply. There is a difference between tolerance levels, in which the fish will survive and optimum levels of water quality, in which fish will achieve the best health and growth. Optimum water quality criteria are dependent upon species of fish, age/size of the fish and prior exposure of the fish. Growth of fish and prawn are normally governed by few environmental factors (Fry, 1971).

5.1. Physical Parameters:

5.1.1. Water Temperature:

Temperature has the most outstanding and biological influence on the activities of the flora and fauna of a pond system. This phenomenon of aquatic environment was found in the relationship between water and air temperature as expressed by seasonal variations. A rise in temperature of the water leads to the spreading up of the chemical reactions in water reduces the solubility of gases and amplifies the taste and odors as well as the biological activities of aquatic organisms. Water temperature varied from 29°C to 33.6°C in mono culture and 30°C to32.5°C in integrated culture within the study period may be attributed to the position of the sun and day length, presence of aquatic weeds etc. The rainfall and air temperature had the direct influence on the variation of water temperature (Michael, 1968). The surface water temperature showed an increasing trend in August.

5.1.2. Water Transparency:

Water transparency of culture ponds represents the primary productivity of a water body. In this study, water transparency ranges between 20 to 28 cm in mono culture and 18 to 28 cm in integrated culture showed good productivity of the ponds. Another study said that pond natural productivity ranged from 31.0 to 33.29 cm for *M. rosenbergii* culture (Hasanuzzaman, 2009).

5.2. Chemical Parameters:

5.2.1. Dissolved Oxygen:

Dissolved Oxygen in the water body comes from two sources. Most of it comes as a by-product of photosynthesis. The other source is from the diffusion of atmospheric air. The amount of dissolved oxygen in the pond water is affected by many factors particularly water temperature, respiration and the level of organic matters. In the present study the mean concentration of DO for the pond systems were found to be moderately higher (varies from 4.7-5.8 mg/l in mono culture and 4.66.02mg/l in integrated culture). According to recommended standard (WHO, 2003) DO level reflecting better water quality. Hoq *et al.* (1996) recorded DO ranging from 4 to 5.9 mg/l in five prawn farms, which were suitable. Jia-Mo *et al.* (1998b) reported that the DO was 4.5mg/l, where *M. rosenbergii* were cultured in earthen ponds.

5.2.2. Water pH:

The pH of a solution refers to its hydrogen ion activity and is expressed as the logarithm of the reciprocal of the hydrogen ion activity at a given temperature. The pH varied from 5 to 8 in both type of culture during study period. The pH value ranged from 6.1 to 7.70, which were suitable for culture of *M. rosenbergii* in earthen ponds (Jia-Mo *et al.*,1988a). Hoq *et al.* (1996) reported that pH ranged from 7.5 to 8 in five prawn farmers ponds. Hossain *et al.* (2000) reported that pH ranged from 6.8 to 8.4 was suitable for *M. rosenbergii.* The suitable range of pH for prawn culture is 7 to 8.5.

5.2.3. Water Alkalinity:

Total alkalinity has little direct effect on fishes but indirectly the well being of fish may be affected by total alkalinity, because ponds of low values of alkalinity are generally biologically less productive than those with high values. Water alkalinity varied from 115 to 169mg/l in mono culture and 100 to 168 mg/l in integrated culture within the study period. Total alkalinity may be several hundred ppm in natural water bodies. According to Alikunhi (1957) total alkalinity more than 100 mg/l should be presented in, highly productive water bodies. According to Boyd (1990) total alkalinity should be more than 20 ppm in fertilized ponds as fish production increases with the increase of total alkalinity.

5.2.4. Water Hardness:

Hardness is a measure of the concentrations of calcium and magnesium particularly as divalent cation in the water. Most fresh water aquatic animals grow well over a wide range of total hardness values but may be more susceptible to adverse water quality conditions when hardness values (particularly calcium concentration) are low. In the present study the mean hardness for the pond systems were found to be moderately lower (varies from 29-45 mg/l in mono culture and 22 to 33 mg/l in integrated culture). Harder water (above150 mg/l) is better for fish health, because it provides needed calcium and reduces the need for osmoregulation (Boyd, 1998).

5.2.5. Water Salinity:

Salinity means containing or impregnated with salt. Dominant salts in water are sodium chloride and sodium sulphate but seldom sodium nitrite, magnesium sulphate or magnesium chloride. The salinity ranges between 0 to 6 ppt in mono culture and 0 to 5 ppt in integrated culture. Salinity decrease during the rainy season. Salinity of freshwater ponds usually varies between almost 0.05ppt to 1.0ppt (Boyd, 1990). Most of the fresh water fishes usually grow well under water salinity up to about 3.0 ppt.

5.2.6. Water Ammonia:

Ammonia containing inorganic fertilizers or organic manures (which decompose to release ammonia and other nutrient) are often added to stimulate plant growth in ponds in relying upon natural foods to support aquaculture production. But it is also a toxic gas, which is very much harmful for the growth and survival of the PL of *M. rosenbergii*. Waste material of the PL, excess feed etc produces this toxic gas after decomposition if excess feed is delivered to the ponds. If the ammonia level of the pond crosses its tolerable limit the ammonia level in the blood is increased and the PL stopped food intake and consequently leads to death due to malfunctioning of blood of the PL (Ali and Mazid, 2005). In the study, total ammonia ranges from 0 to 0.066mg/l in mono culture and 0 to 0.02 mg/l in integrated culture. According to Das B. (1989), for fish or shrimp culture total ammonia of pond should bel ppm or less than 1ppm and free ammonia of water should be less than 0.25 ppm. If ammonia increases to 2.5 or more then it becomes too much harmful for prawn culture.

5.2.7. Total Phosphorus:

Phosphorus in cultural ponds is important because they affect plant productivity, which, in turn, may influence aquaculture production. Therefore, the measurement of phosphate is assumed considerable importance (Chapman, 1992), In fact, Hutchinson (1957) and Lee (1970) indicated that most natural waters respond to addition of phosphorus with greater plant production. Experience with pond fertilization also suggests that addition of phosphate fertilizers will increase fish production in most ponds (Mottimer, 1954; Hickling, 1962). Usually phosphorus in pond water exits in little amount. If phosphorus increases in excess in pond water plankton cannot grow as usual. For fish or shrimp culture the suitable range of PO_4 should be 0.5 to 1 ppm (Das B., 1998) in pond water. Total phosphorus ranges from 0.14 to 0.52mg/l in mono culture and 0.15 to 0.90 mg/l in integrated culture.

5.2.8. Water Acidity:

Total acidity in the study area was found to vary from 75 to 90 mg/l in monoculture and 60 to 88 mg/l in integrated culture system. According to Das B. (1989), for fish or shrimp culture total acidity of pond should be 150 mg/l or less than 100 mg/l. If acidity increases to 250mg/l or more then it becomes too much harmful for prawn culture.

5.2.9. Water Nitrite:

In the present study, the values of nitrite were found to vary between 0 to 0.03 mg/l in monoculture and 0 to 0.231 mg/l in integrated culture system. Azim *et al.* (1995) stated that near about 0.5 mg/l nitrate-nitrogen was suitable for fish culture. The ranges of nitrate-nitrogen concentrations were obtained to be 0.12-0.88 mg/l was found by them. Nitrite concentrations also remained well below the upper limits for shrimp culture (<0.2 mg/L N_NO2). (Ferreira *et al.*, 2011).

5.2.10. Chlorophyll-a:

In the present study, chlorophyll ranges from 0 to 0.005 mg/l in mono culture and 0.001 mg/l to 0.02 mg/l in integrated culture. Chlorophyll-a concentrations increased in the warmer months, i.e., in spring in the effluent water (average: 0.007 mg/L; maximum: 0.047 mg/L), and in the

summer in the inlet water (average: 0.005 mg/L; maximum: 0.009 mg/L) and ponds (average: 0.026 mg/L; maximum: 0.060 mg/L). The higher average chlorophyll-a concentration in the ponds is a result of the contribution from feed and fertilizers input that enhance primary production (Ferreira *et al.*, 2011). The values of chlorophyll-a were found to range between 10.3 µg/l and 61.5 µg/l among the treatments. Higher chlorophyll-a values obtained in fish culture plots might be due to lower grazing pressure of fish on phytoplankton. (Nahar, 2010). Frei and Becker (2005) recorded chlorophyll-a concentrations ranged from 10 to 90 µg/l in rice-fish farming plots.

Chapter Six

CONCLUSION

CHAPTER 6

Conclusion

In water quality management, the environmental conditions are regulated so that they are within a desirable range for survival and growth of prawn. Water quality includes physical, chemical and biological units. Maintaining all these parameters is necessary for sustainable production. The study was carried out in mono and integrated culture prawn ponds in Khulna region. Though the culture systems are different but the parameters of the water in the ponds are quite similar. There is no significant variation among the parameters between the two types of culture system. Present study was an attempt to know the different parameters of the prawn ponds during the culture period. However, more studies are required to make a complete list of water quality parameters, their impact on prawn growth in different aquatic culture systems of Bangladesh.

Chapter Seven

REFERENCES

References

Ali, M.L. and M.A. Mazid, 2005. Improved Management Technology of Golda Chingri (*Macrobrachium rosenbergii)*. Extension Manual No. 32. Bangladesh fisheries Research Institute, Mymensingh, Bangladesh. 48pp.

Alikunhi, K.H., 1957. Fish culture in India. Fm. Bull. *Indian council of Agricultural Research,* 20: 144.

Ang, K.J., C.S. Komilus and S.H. Cheah, 1992. Culture of *Macrobrachium rosenbergii* in cages. An abstract. In: Third Asian Fisheries Forum, 26 October, 1992, Singapore, (Abstract OSC- 07). Asian Fisheries Society, Manila, Philippines. 127p.

Apud, F.D., J.H. Primavera and J.P.L Terres, 1985. Farming of prawn and shrimp. 3d Ed. Aquaculture Extension manual No. 5. Tigbauan, loilo, Philippines, SEAFDEC Aquaculture department. 67 p.

Apud, F.D., N. Deatras and K. Gonzales, 1981. Feeding behavior and food preference of *Penaeus monodon* Fab with scrap *Tilapia mossambica*. *Fisheries Research Journal, Phillippine,* 6:27-31

AQUACOP, 1997. *M. rosenbergii* (De Man) culture in Polynesia: Progress in developing a mass intensive larval rearing technique in clear water. *Proceedings of World Mariculture. Soc.* 8:311-326.

Asaduzzaman, M., M. A. Salam, M.A. Wahab, M. Kunda, and M.B. Rahaman, 2006. Effects of control of Carbon/Nitrogen ratio by low cost carbohydrate addition on water quality and pond ecology in fresh water prawn *M. rosenbergii* post larvae nursing system. *Bangladesh Journal of Fisheries Research,* 10(2):121-130.

Boyd, C.E., 1998. *Pond Aquaculture Water Quality Management,* Kluwer Academic publishes, London. 700 pp.

Boyd, C.E., 1990. *Water Quality in Ponds for Aquaculture*. Birmingham publishing Co., Birmingham, Albama. 482 pp.

Chapman, I., 1984.Business Management in Fisheries and Aquaculture. Fishing News Books Ltd., England, 128p.

Chatson, I., 1984. Business Management in Fisheries and Aquaculture. Fishing News Books Ltd., England, 128p.

Chen, S.M. and J.C. Chen, 2003, Effects of pH on survival, growth, molting and feeding of giant fresh water prawn (*M. rosenbergii) Aquaculture*, 218 (1-4): 613-623.

Das, B., 1998. *Chingri Chas O Bebastapona* (vol-1), Bangla Academy, Dhaka, ISBN No. 984-07-3736-5 pp 128-166.

Ferreira, N.C., C. Bonetti and W.Q. Seiffert, 2011. Hydrological and Water Quality Index as management tool in marine shrimp culture, *Aquaculture*, doi: 10.1016/j. pp.4-12.

Frei, M., Becker and K. Kemmon, 2005. A greenhouse experiment on growth and yield effects in integrated rice-fish culture. *Aquaculture*, 244:119-128.

Fry, F.E.L., 1971. The effect of environmental factors on the physiology of fish. In: Fish physiology. Haor, W.S., D.R. Randall and J.R. Brett (eds.). Vol. 6. Academic press, New York. pp. 1-98.

Hasanuzzaman, A.F.Md., 2009. Optimum Replacement of Fishmeal with Soyabean Meal in Diet for *Macrobrachium rosenbergii* (De-Man 1879) Cultured in Low Saline Water.*Turk. J. Fish. Washington DC. Aquat. Sci.* 9: 17-22.

Hickling, C.F., 1962.Fish Cultures. London:Faber and Faber.

Hoq, M.E., M.M. Islam and M.M.Hossain, 1996. Polyculture of freshwater prawn *(M. rosenbergii)* with Chinese and Indian carps in Farmers pond. Journal of Tropical Aquaculture., 11: 135-141.

Hossain, M.A., M.A.L., Siddique and M.A.H. Miaje, 2000. Development of low cost feed for culture of giant freshwater prawn, *M. rosenbergii*(de Man) in ponds. Bangladesh Journal Fisheries Research., 4(2): 127-134.

Hutchinson, G.H., 1957. *A Treatise on Limnology*: Vol. I. Geography, Physics and Chemistry. New York: John Wiley and Sons.213pp.

Jia-Mo, P., L. Zhi-Guo, Y. Zi-Hao, L.E.Martimes-Silva, D. Osorio-Dualiby and M. Torres-Virviescas, 1988a. The intensive culture of freshwater prawn *M. rosenbergii* (De-Man). In: Trianea, 1988(1): 45-55.

Kanit, C., S. Puth and T. Dusit, 1992. Variation physico-chemical properties of water and phytoplankton in intensive shrimp pond and amphone Ranot, Senghala. National Institute for coastal aquaculture, Songkhala, Department of Fisheries, Ministry of Agriculture. Technical Paper,(4).

Lee, G.F., 1970. Eutrophication. Occasional Paper No.2. Madison, WI: University Wisconsin/Water resource center.pp.4-14.

Mortimer, C.H., 1954. Fertilizers in Fish Ponds. London: Her Majesty's Stationary Office.

Michel, R.G., 1968. Studies on the zooplankton of a tropical fish pond. *Hydrobiol.*32:47-68.

Nahar, A., 2010. Department of Fisheries, Patuakhali Science and Technology University, Dumki, Patuakhali-8602, Bangladesh. J. Bangladesh Agril. Univ. 8(1): 179–185.

Sadek, S.S. and F.M.H. El-Gayer, 1993. Production of the giant freshwater prawn *(M. rosenbergii)* reared in brackish water ponds (Egypt). In: Proceedings of the First International Symposium on Aquaculture Technology and Investment Opportunities. Ministry of agriculture and Water, Riyadh, Saudi. Pp: 296-303.

World Health Organization, 2003. Guidelines for safe recreational water environments. Coastal and Fresh Waters, Geneva, 1, pp: 1-33.