Declaration

Changes of water quality due to jute retting and its impact on the fingerlings of rui (*Labeo rohita)*

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

(Signature of the candidate)
Md . Abdullah Al Shahin
Examination Roll No.: MS- 050606
Session: 2004-2005

Supervisor

Dr. Md. Rezaul Haque
Associate Professor
Fisheries and Marine Resource Technology Discipline
Khulna University
Khulna-9208, Bangladesh

August, 2007

Acknowledgement

First of all, all my praises are due to the Omnipresent and Almighty ALLAH Who enabled me to pursue my education and complete as well as submit the project thesis. I remember Him at first from core of my heart. I am also gratefully express my gratitude, heartfelt appreciation and indebtedness with due solemnity to my venerable supervisor **Dr Md. Rezaul Haque**, Associate Professor, Fisheries and Marin Resource Technology Discipline, Khulna University, Khulna, Bangladesh for his scholastic guidance, constructive criticism and continual effective help to execute this thesis work successfully and for patience in going through manuscript. I would like to express my profound gratitude to **Dr. Khandaker Anisul Huq**, Professor and Head, Fisheries and Marine Resource Technology Discipline, Khulna University, Khulna, for his helpful motivation to complete this project thesis. I recall with warm appreciation and great indebtedness for his support, guidance and suggestion extended to me by all of my respected teachers in Fisheries and Marine Resource Technology Discipline, Khulna University. I like to bestow appreciation to all of my friends especially to Amitosh and Aniq for their sincere help during collecting the research data to complete the research work fruitfully.

Finally, I would like to express my deepest sense of gratitude and cordial thanks to my parents for their encouragement, sacrifice affection and blessing that paved the way to my higher education.

Md. Abdullah Al Shahin.
Khulna University
August, 2007.

Abstract

This project thesis deals with the study of degradation of jute (retting practice) in fresh water environment and its effects on water chemistry and consequently on aquatic organisms of fresh water environment. Six ponds named P-1, P-2, P-3, P-4, P-5 and P-6 and each with (18×12×4) feet in size were selected for rearing the fry of *Labeo rohita* at an initial weight and length of 2.29 ± 0.05 gm and 6.21 ± 0.05 cm respectively and also with a stocking density of 40fry/pond. The fry were reared in the experimental ponds without supplementary feeds. After five days of *Labeo rohita* fry stocking jute plants with leaves were collected as bundles. Each bundle consisted of 60 plants weighting 25 Kg. Jute bundles steeped into water in heaps for retting at the rate of 7 bundles in the experimental ponds P-4, P-5, P-6. The retted bundles were collected from the ponds after 21 days and fibre was separated from stalks at a time manually. The water quality parameters namely pH, temperature, salinity, dissolved oxygen (DO), hardness, alkalinity, chloride (Cl^-) and free CO_2, survivility of fry were determined six times with nearly weekly intervals. The study supports the degradation jute plants followed by reduction of dissolve oxygen and evolution of free CO_2. The present study reported that the fluctuation of above water parameters due to jute retting practiced in the experimental ponds have lethal effect to the *Labeo rohita* fry. This might be due the rapid change of water parameters in the 2^{nd} week when fry in P-4, P-5, P-6 were subjected to death. The parameters of stagnant water environment fluctuate highly at 2^{nd} week due to the jute fibre decomposition and it come back to the prior stage slowly.

Contents

List of Tables

List of Figures

List of Abbreviations and non-English Words

BOD	Biological Oxygen Demand
P	Pond
cm	Centimeter
ppt	Parts Per Thousand
ppm	Parts Per Million
Mg	Milligram
c	Centigrade
l	Litre
DO	Dissolve Oxygen
Co_2	Carbon di oxide
Kg	Kilogram
N	Normality
ml	Milligram

Chapter 1

Introduction

1.1. Background of the study

Jute is the name of the plant as well as fibre crop of international eminence. The bast fibre jute is obtained from the bark of mainly two cultivated species of the genus Corchorus namely, *C. capsularis* and *C. olitorius* of the family Tiliaceae. Jute is bio-degradable, strong, non-toxic and hygroscopic, less extensible, coarse and cheap fibre and Carbon, hydrogen and oxygen are the major cellose elements of jute fibre. Jute plant produces jute fibre and jute stick in the proportion of 1:2. Cellulose, hemi-cellulose, lignin, protein and some colouring materials are the constituents of jute fibre and sticks (Chen and Saad, 1981). The experiment was carried out into the six ponds where the fry of *Labeo rohita* at the rate of forty were rearing in each pond. The three ponds (P-4, P-5 and P-6) were treated to kept jute bundles by using White or Deshi pat and the rest three (P-1, P-2 and P-3) were without jute plants. The seven bundles of jute with leaves are carried to retting for each pond and steeped in water in heaps. Retting of jute plants for seperation of fibre is a complex biochemical process, which is one of the vital activities of fibre extraction. Retting takes place due to the activity of bacteria. Processes of jute retting, fibre extraction and washing have drawn some concerns regarding solid residue and gaseous emissions that arise from such processes. Complaints about the unpleasant smell of gaseous emissions caused retting are quite common.

1.2. Problem Statement

Water chemistry is concerned with the jute retting processes affecting the distribution and circulation of chemical compounds in natural waters. A large part is devoted to the demonstration of the elementary principles of physical chemistry that can be used to identify some of the pertinent variables determining the composition of natural water systems. Natural waters acquire their chemical characteristics by dissolution and by chemical reactions with solids, liquids, gases with which they have come into contact during the various parts of the hydrological cycle.

Organic wastes are initially decomposed in water by aerobic, that is oxygen using, bacteria. The decomposition process reduces the amount of dissolved oxygen available to flora and fauna in the receiving water body. In extreme cases the biochemical oxygen demand, BOD, of the waste is so large in relation to the available oxygen that the water is completely de-oxygenated and the flora and fauna are killed, as are the aerobic bacteria. Decomposition then involves anaerobic bacteria, which produce noxious and toxic products, such as hydrogen sulfide, in the water. Nutrient wastes are phosphates and nitrates. Primary productivity in aquatic ecosystems is often limited by the availability of nutrients - usually phosphorous in freshwater systems and nitrogen in fresh water. Waste materials of jute after retting contain phosphates and nitrates. Cultural eutrophication is the effect of nutrient wastes on water bodies leading to the death of aquatic plants, animals and as well as fishes. The consequent accumulation of dead organic matter creates BOD problems. Water quality is a somewhat nebulous and often used term that is seldom defined adequately. Water quality is the summation of all physical, chemical, biological, and aesthetic characteristics of water that influence its beneficial use. Any characteristics of water in production systems that effects survival, reproduction, growth, and production of aquatic species influences management decisions, causes environmental impacts, or reduce product quality and safely can be considered as water quality parameters or variables. In order to understand the pertinent variables out of a bewildering number of possible ones; it is advantageous to compare the real systems with their idealized counterparts. Any change in chemical or physical varieties will affect different fish species differently and thus will shift the species abundance. The distribution of chemical species in water and sediments is strongly influenced by an interaction of mixing cycles and biological.

1.3. Hypothesis Setting

The chemical composition of water is determined by the entity of interacting chemical, physical and biological factors, which are intensity factors (activity, concentration, redox potential, temperature, velocity gradient). These intensive variables, above all the activities of the chemical constituents, determined primarily the type of community of organisms present in the water. Water quality criteria are scientifically established requirements about intensity factors; these criteria form the bases for judgment with respect to the compatibility of a water composition with ecological objectives or designated water uses. It is difficult to evaluate objectively and to codify water quality because the effect of water composition on the various ecological consequences is little understood and very difficult to quantify and it is difficult to define a reference state, that is, a hypothetical pristine state of the water.

1.4. Objectives of the study

1. To know the hydrological change due to jute retting in the stagnant water body.
2. The general impact of jute retting practiced in confined water on fishes.

Chapter 2

Materials and Methods

2.1 Study Area and Period

The study was conducted on six ponds as experimental ponds of Fisheries and Marine Resource Technology Discipline, Khulna University, Bangladesh which situated behind the Engineering school building. The experiment was carried out during the period of 12 September, 2006 to 16 October, 2006.

2.2 Experimental Design / system

The fry of *Labeo rohita* of initial weight and length of the fry was 2.29 ± 0.05 gm and 6.21 ± 0.07 cm, respectively were collected from Gallamari at Khulna and transferred to experimental ponds by plastic bucket without oxygenation. The select six experimental ponds were ($18 \times 12 \times 4$) feet in size respectively. Collected fry were reared in the pond without supplemental feeds at a stocking density of 40fry/pond. The fry were then kept for five days in the experimental ponds for acclimatization. After five days jute plants were collected from the field beside the Rupsa bridge road and tied into bundles consisting of 60 plants which weight 25 Kg for each bundle and carried out to the experimental ponds. The initial reading of water parameters were recorded before jute retting in the ponds. The seven bundles with leaves were taken for retting and steeped in water in heaps. Among the six ponds three ponds (P-4, P-5 and P-6) were treated with jute bundles and the rest three (P-1, P-2 and P-3) were kept free. The heaps were covered with water hyacinth and tied with log for keeping them immersed under water. Dipping of the harvested jute plants were done in fairly deep, clean but gently flowing stagnant water. The retted bundles were collected from the ponds after 21 days of steeping in water. After retting, bundles of retted plants are taken out from water then the fibre is extracted from individual plants at a time manually.

Flow chart of jute retting practiced in the experiment

Jute plants in a jute field

↓

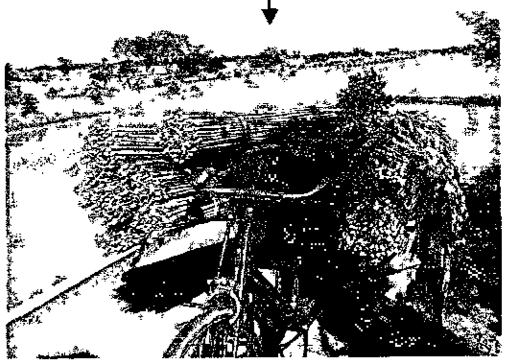
Cutting and bundling of matured jute plants

↓

To be continued

Bundle of jute plants

↓



Jute bundle carried by van

↓

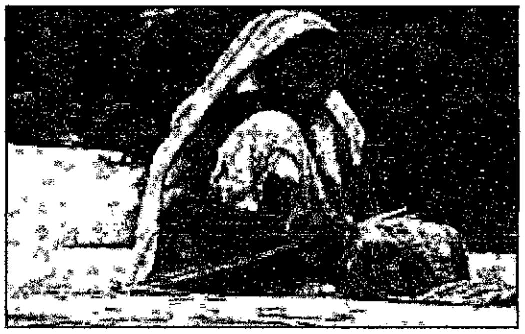
Experimental ponds beside engineering school at Khulna University.

↓

To be continued

Retting of Jute

↓



Woman engaged in Fibre Extraction

2.3 Retting

It is a process by which fibres in the ponds get loosened and separated from the woody stalk due to the removal of pectinals and other mucilaginous substances. This is usually affected by the combined action of water and micro-organisms. The bundles are dipped in water at least 60 to 90cm in depth. When retting is complete, fibres are ready for extraction. Fibre must be extracted as quickly as possible otherwise the quality will suffer.

2.4 Fibre extraction

This is a process of removing the fibres from the stalk after the completion of retting. Generally the fibres are removed from the stalk by method single plants are taken and their fibres are taken off. This method though very slow, results in good quality of fibres as it is free from pith.

2.5 Washing and drying

Before hanging for drying the extracted fibres are washed in the respected ponds water.

2.6 Sample collection

The water samples were collected in 1 litre screw cap plastic bottles which were previously soaked with a mixture of distilled water, 2% HNo_3 and 0.5% H_2O_2 for about 24 hours. On the next day the bottles were scrupulously washed several times with distilled water, rinsed with double distilled water and dried in an oven. The bottles were then ready for sample collection. All the water samples that needed were preserved into Khulna University laboratory and tested them with appropriate strength and opportunity. The experiment was conducted for six weeks from September to October.

2.7 Measurement of Water quality parameter

Water quality parameters such as temperature, dissolved oxygen (DO), pH, alkalinity, hardness, chloride, free carbon dioxide were recorded daily throughout the experiment period but the result is presented in weekly basis in this study. Before starting the experimental works, some of the important analytical methods in some cases with some modification were setup in the Water Chemistry Research Laboratory of Fisheries and Marine Resources Technology Discipline.

2.7.1 Temperature

Water temperature was measured on site by using a mercury thermometer (0-50^{0}c) by dipping the thermometer bulb 3-4 cm in water. Air temperature was also recorded by same thermometer.

2.7.2 pH

pH was measured on site with a Hanna Instrument Model ISO 9001 pH meter. Calibration of the instrument was done immediately before measurement by using standard buffer of pH 4.0 and 7.0 or 4.0 and 10.0.

2.7.3 Dissolved Oxygen (DO)

Dissolved Oxygen was measured on site using the azide modification of Winkler method

Principle:

Manganous (Mn^{2+}) ions form manganous hydroxide ($MnOH_2$) under highly alkaline condition. This $MnOH_2$ reacts with DO of water and an equivalent amount of Mn^{+2} is oxidized to higher valency states. On acidification, in presence of iodide, the oxidized manganous (Mn^{+4}) again reverts to divalent Mn^{+2} and iodide is liberated in equivalent amount of DO. This I_2 estimated by titration with sodium thiosulphate ($Na_2S_2O_3$) indicates the amount of DO in water sample.

Materials:

- Manganous sulfate ($MnSO_4.4H_2O$).
- KOH, KI and NaN_3
- Starch and

- Sodium thiosulfate. ($Na_2S_2O_3$)

Procedure:

Laboratory Preparation:

- Manganous sulfate solution: 120gm $MnSO_4.4H_2O$ (or 100gm $MnSO_4.2H_2O$ or 91gm $MnSO_4.H_2O$) was dissolved in distilled water and diluted to 250ml.
- Alkali-iodide-acid reagent: For a saturated or less than saturated sample; 700gm KOH and 150gm KI were dissolved in distilled water and diluted to 1L. 10gm NaN_3 was added into it dissolved in 40ml distilled water.

- Starch solution: 2gm laboratory grade soluble starch and 0.2gm salicylic acid were dissolved as a preservative, in 100ml hot distilled water.
- Standard sodium thiosulfate titrant: 6.205gm $Na_2S_2O_3$. $5H_2O$ was dissolved in distilled water and 0.4gm NaOH was added and diluted to 100ml.

Field Work:

- 1ml $MnSO_4$ solution was added followed by 1ml alkali-iodide-azide reagent to the sample collected in a 250 to 300ml BOD bottle.
- The bottle was stoppered carefully to exclude air bubbles and mixed by inverting bottle a few times.
- When precipitate had settled sufficiently to leave clear superannuate above the manganese hydroxide floc, 1.0ml conc. H_2SO_4 was added.
- The bottle was restoppered and mixed by inverting several times until dissolution was completed

- The sample (10ml) was titrated with 0.025 $Na_2S_2O_3$ solutions to pale straw color by adding a few drops of starch solution and continued titration to first disappearance of blue color.

Calculation:

DO in $mg/L = \frac{y \times 200}{x}$

Here y = ml of the titrant and x = ml of the sample.

2.7.4 Alkalinity of the water samples were measured in the laboratory by titration method.

Principle:

Water samples containing measurable OH^- and or CO_3^{2-} ions turn pink to phenolphthalein indicator. This water becomes colorless at pH below 8.4, when titrated with acid to covert theses ions to HCO_3^- form. Again, water sample with only HCO_3^- can be titrated to the critical pH level of 5.3 with acid by using yellow to faint orange color change of methyl orange indicator. Both of the indicators are used for determining total alkalinity, expressed as ppm of calcium carbonate ($CaCO_3$) and also the concentrations of OH^-, $CO_3^{2-}$and HCO_3^-ions in water samples.

Materials:

- Burette (25ml),
- Pipette (10ml),
- Funnel,
- Conical flask (250),
- Measuring flask(100ml),

- Beaker (250ml),
- Spatula, Burette stands etc.

Reagent:

- H_2SO_4,
- Na_2CO_3,
- Phenolphthalein indicator,
- Methyl orange indicator.

Reagent Preparation:

- 0.1N H_2SO_4 solution: 2.8ml H_2SO_4 (95-98%, sp gravity=1.84) was taken into 1 litter volumetric flask and diluted it to 1000ml mark of the flask.
- 0.1N Na_2CO_3 solution: 2.65gm Na_2CO_3 was taken into 500ml volumetric flask and diluted it to 500ml mark of the flask.
- Phenolphthalein indicator solution: 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 1 liter.

Procedure:

- The burette was rinsed with distilled water and then rinsed with 0.1N H_2SO_4 by pipette.
- The burette was clamped and filled with 0.1N H_2SO_4 solution up to mark.
- The H_2SO_4 was standardized by $NaCO_3$ solution.
- The sample (10ml) was taken into 250ml of conical flask and added 5 drops of methyl orange indicator solution into it and titrated with 0.1N H_2SO_4 to a light pink (pH 4.5) color as required by the sample composition.

Calculation:

Alkalinity, $mgCaCO_3\ /L = \frac{A \times N \times 50000}{ml\ Sample}$

A = ml standard acid used and N = normality of standard acid.

2.7.5 Hardness of the water samples were measured by complexometric titration (EDTA titration).

Principle:

For determining hardness of waters, concentration of Ca and Mg in water are first determined. The values are then converted to respective equivalents of $CaCO_3$and added to get total hardness of water.

Materials:

Glassware, volumetric flask, burette, pipette, conical flask etc.

Reagents:

0.01N calcium solution, ammonium purpurate (murexide) indicator, erichrome black T indicator, 4N sodium hydroxide, ammonium chloride, 0.01N EDTA solution.

Procedure:

(a)Standardization of EDTA solution:

- 5ml 0.01N Ca solution was taken in a 100ml conical flask and dilutes it to about 25ml with distilled water.
- Then 5ml 4N NaOH solution was added and about 25mg of murexide indicator was added.
- The content was mixed well to get a orange red coloration.

- Then it was titrated with 0.01N EDTA solution against a white background until the color changes to purple.
- The color changes were not very distinct and hence the titration during end point was carried out cautiously.
- The strength of EDTA solution was determined by using the following relationship.

Strength factor = S/V

Where, V = volume of EDTA solution.

Titration:

- 10ml of water sample was taken in a 100ml conical flask.
- Then 1ml of NH_4Cl-NH_4OH buffer solution and 1drop of eriochrome black T indicator was added to get a wine red color.
- It was then titrated against0.01N EDTA solution until the color change to blue.

Calculation:

Hardness = (AxBx1000)/ml sample.

Where, A = ml of titrant and B = 1.0

2.7.6 Chloride (Cl^-) was measured by Mohr Titration method (Argentometric Method).

Principle: The Mohr method employs a solution of silver nitrate as the titrant and potassium chromate as the indicator. In a neutral or slightly alkaline solution, potassium chromate can indicate the end point of the silver titration of chloride. In the titration the chloride ion is precipitated as white shitte chloride.

$$Ag^{+} + Cl^{-} \rightleftharpoons AgCl \ (Ksp = 3x10^{-10})$$

The end point can not be detected visually unless an indicator capable of demonstrating the presence of excess Ag+ is present. As the concentration of chloride ions approaches extinction, the silver concentration increases to begin to form a reddish –brown precipitate.

$$Ag^{+} + CrO_4^{-2} \rightleftharpoons Ag_2CrO_4 \ (Ksp = 5x10^{-12})$$

.Since an excess of Ag+ is needed to produce a visible amount of Ag_2CrO_4,the indicator error or blank must be determined and subtracted from all the titration .

Apparatus:

- Erlenmeyer flask ,
- 250 ml ,Burette ,
- Pipette ,
- Beaker etc.

Chemicals:

- Potassium Chromate(K_2CrO_4) ,
- Silver nitrates ($AgNO_3$).

Reagent Preparation:

Potassium chromate (K_2CrO_4)indicator solution: 12.50gm K_2CrO_4 was dissolved in one liter distilled water . $AgNO_3$ solution was added until a definite red precipitate was formed. Standard silver nitrate titrant; 0.0141M(0.0141N) :2.39gm $AgNO_3$ was dissolved in water and was diluted to 1000ml.1.00ml=0.5gm Cl^{-}

Procedure:

- 10ml of the sample was taken into 250ml conical flask .
- 1.0ml K_2CrO_4 indicator solution was added .
- The sample water was titrated with standard silver nitrate titrant to a pinkish yellow end point .

Calculation:

Cl^- mg/l = AxNx35450/ (ml sample)

Result: Express the in ppm (ml)

2.7.7 Free CO_2 was measured by titration method.

Principle:

Waters having more than 8.3 pH does not contain appreciable amount of free CO_2. Therefore, phenolphthalein indicator, which has end point at this pH value, is used for estimating the amount of free CO_2 in a water sample for titration with a standard alkali.

$$2NaOH + CO_2 = Na_2CO_3 + H_2O.$$

Materials:

- Burette (10ml),
- Pipette (10ml, 25ml),
- Funnel,
- Conical flask (250ml),
- Measuring flask (100),
- Beaker (250ml),
- Spatula,

- Burette stand etc.

Reagents:

- NaOH,
- Phenolphthalein indicator,
- Standard potassium hydrogen thalate.

Reagent preparation:

- NaOH (0.1N) solution: Cautiously 4gm solid NaOH was dissolved in 1000ml volumetric flask and dissolved it by shaking and filled with dilute water to the mark.
- Standard potassium hydrogen phthalate solution: 10.0+0.5gm potassium hydrogen phthalate (to the nearest mg), was weighted and transferred it to 1L volumetric flask and diluted it to 1000ml.
- Phenolphthalein indicator solution: 2.5gm Phenolphthalein was dissolved into 250ml 95% ethyl alcohol and added 250ml of distilled water was added to it .

Procedure:

- The burette was rinsed with distilled water and then rinsed with 0.1N NaOH by pipette.
- The burette was clamped and filled with 0.1N NaOH solution up to mark.
- The NaOH solution standardized by standard potassium hydrogen phthalate solution.
- The sample wads taken into 250ml conical flask and added few drops of phenolphthalein

- indicator solution and titrated with 0.1N NaOH solution until a permanent pink color appears.

Calculation:

$$\text{Free } CO_2 \text{ as } mg/L = \frac{ml\ NaOH \times N \times 44{,}000}{ml\ sample}$$

2.8 Data Analysis

Graphs were plotted to explain the recorded data by using Microsoft Excel.

Chapter 3

Results and Discussion

The causal and reciprocal relationship between organisms and the environment must be considered in understanding an aquatic habitat. Temporal and local distribution disturbances of the stationary state of photosynthesis and respiration lead to chemical and biological changes that often may be interpreted as pollution. Energy rich bonds are produced as a result of photosynthesis, thus distorting the thermodynamic equilibrium. Bacteria and other respiring organisms catalyze the redox process that tends to restore chemical equilibrium. A steady state between photosynthesis and respiration is a prerequisite for the maintenance of constant chemical composition and thus for a relatively constant structure of the population organisms.

Ultimately most of the jute retting wastes discharge in to an aquatic system is degraded by a combination of biological, physical and chemical process. Actual degradation rates depended on great many factors, including the characteristics of the jute, temperature, availability of nutrients, degree of physical mixing and so forth. Nitrogen and phosphorus are frequently liquating to microbial activity in fresh waters. The biodegradation is carried out by oxygen concentration reduction and free CO_2 evaluation. To evaluate the effect of jute retting, due to degradation the pertinent water quality parameters were determined by microcosm apparatus setting. The results obtained in the following table.

Water Parameters	Ponds	1st week	2nd week	3rd week	4th week	5th week	6th week
pH	Ponds without jute	7.2	6.9	7	6.9	7	7.1
	Ponds with jute	7.2	6.5	6.7	6.8	6.9	7
Temperature (^{0}c)	Ponds without jute	29	30	30	30	30	30
	Ponds with jute	29	29	29	29	30	30
Salinity (ppt)	Ponds without jute	<1	<1	1	1	1	1
	Ponds with jute	<1	<1	1	1	1	1
Dissolve Oxygen (DO) ppm	Ponds without jute	6	5	5	5	5	6
	Ponds with jute	6	2	3	4	4	5
Hardness (ppm)	Ponds without jute	313	303	302	300	300	303
	Ponds with jute	322	223	227	240	255	277
Alkalinity ($mgCaCO_3/l$)	Ponds without jute	192	185	182	170	180	181
	Ponds with jute	193	128	146	158	160	169
Chloride (Cl^-) ppm	Ponds without jute	60	69	61	53	55	58
	Ponds with jute	62	71	61	45	55	58
Free CO_2 (ppm)	Ponds without jute	5.5	5.2	5.1	5	5.2	5.4
	Ponds with jute	5.2	7.9	7.5	6.9	6.6	5.5

Table-1: Mean values of water Quality parameters of the ponds.

3.1 pH

The pH expresses the intensity of the acidic or basic character of water. A high pH indicates a low hydrogen ion concentration and a low acidity. A pH of 5.5 is 10 times more acidic than water at a pH of 6.5. So it is important to determine the pH level of water in the culture ponds.

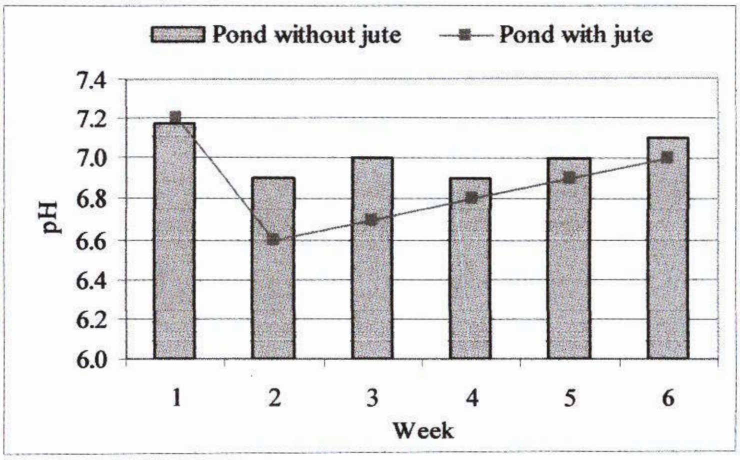


Figure-1: pH differences between ponds without jute and with jute.

The present study showed that mean water pH in the experiment was observed in the range of 6.5-7.2 with a fluctuation level during the study period. The variations pH (6.9-7.2) in the ponds of without jute were marginal and were almost similar throughout the study period. But in case of ponds with jute the variations in the values of pH (6.5-7.2) were high. The pH level was fall rapid to 6.5 in the 2nd week and then was improving towards 3rd, 4th, 5th and 6th week respectively throughout the study period. The water pH value of the ponds with jute during 2nd week fluctuates highly and that was stressful to the aquatic organisms. Thus, changing the pH by a small amount (suddenly) is more of a chemical change (and more stressful to fish!) than might first appear. A pH measurement will help us determine if our water is a proper of place to put the fish. Michael (1968) reported that the best pH for fishes is 7.5 to 8.5 as observed in the experimental period. On the other hand Alam *et al.* (1996) reported that pH values ranged from 6.65 to 7.80 suitable for fish culture. He stated that the higher value of pH was found in early August which might be due to the increased rate of photosynthetic activities of phytoplankton with concomitant decrease of carbon dioxide. The decreased value of carbon dioxide and precipitation of $CaCO_3$ might increase the values of pH. Swingle (1967) considered a pH of 6.5 to 9.0 as satisfactory for fish culture. Ali *et al.* (1982) observed a pH range of 7.5 to 9.5 in a freshwater pond at the BAU campus. From the above discussion it might be concluded that the values pH obtained in these experimental ponds without jute were suitable for the culture but ponds with jute were stressful to the fishes.

3.2 Temperature

The aquatic environment has a stable temperature range, fluctuating little from daytime to night time. This characteristic is due to the high thermal coefficient (specific heat) of water. Thus extremes of ambient temperature for short periods have only minimal effect upon the temperature of ponds, lake or reservoir. Increase in water temperature accelerates the decomposition of organic matter and increases the removal of dissolved oxygen by that process. Together with the reduced solubility of oxygen in water at increased temperature, depletion of dissolved oxygen occurs more rapidly and anaerobic conditions commence. The toxicity of Ammonia increases as the temperature rises and the amount of Dissolved Oxygen that the water can hold decreases. Temperature also influences metabolism, respiration, behavior and distribution, migration, feeding rate, growth and reproduction of the fishes.

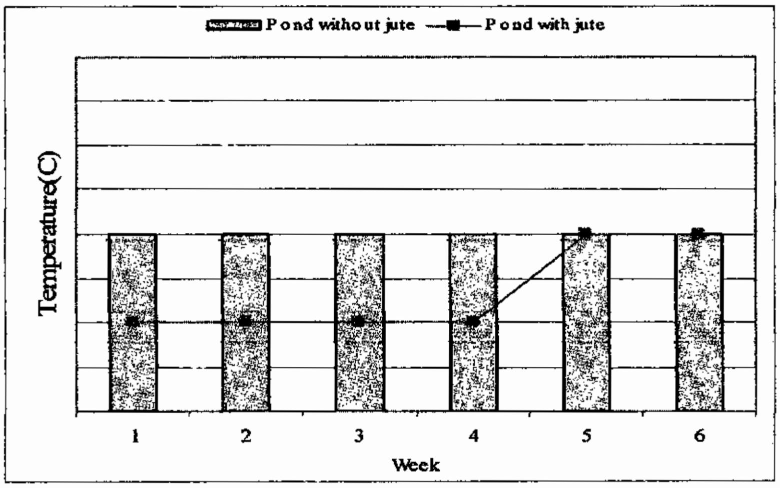


Figure-2: Temperature differences between ponds without jute and with jute.

During the experimental period the range of mean temperature were 29 -30 ^{0}C in both ponds without jute and with jute. There was a little change in the ponds without jute and was similar in the 2nd, 3rd, 4th, 5th and 6th week that was 30 ^{0}C. But in case of ponds with jute 29^{0}C temperature remain in the 1st, 2nd, 3rd and 4th weeks and 30^{0}C temperature remain in the 5th and 6th weeks during study. New (1995) reported that temperatures above 35 ^{0}C or below 14 ^{0}C are generally lethal, temperatures around 18-22 ^{0}C markedly retard growth and temperatures of 29-31 ^{0}C are the optimal levels for growth. Dewan *et al.* (1991) reported a temperature range from 30.2 to 34.0^{0}C (June-August) while Wahab *et al.* (1996) recorded a temperature range 28.5 to 31.3^{0}C (August-November) in their experiment with carps. Ali *et al.* (1982) recorded the temperature fluctuations between 31.62^{0}C and 30.71^{0}C. Fujimura (1974) reported that the optimum temperature for growth is in between 28 and 31^{0}C and temperature below 23^{0}C is lethal to young juveniles. Sandifer and Smith (1979) maintained water temperature at 27 ^{0}C to 29 ^{0}C and obtained the best growth of juveniles in nursery ponds. Therefore the mean temperatures of the pond were satisfactory. However, no detrimental affect of high temperature was observed on the fishes in the experiments and temperature was within acceptable limit.

3.3 Salinity

Salinity refers to the total amount of dissolved substances. The major ions contributing to salinity are calcium, magnesium, sodium, potassium, bicarbonate, chloride and sulfate. The absolute and relative concentrations of these ions vary greatly among different water. Some freshwater fish tolerate (or even prefer) a small amount of salt (it stimulates slime coat growth). Moreover, parasites (e.g., ick) do not tolerate salt at all. Furthermore the salinity range presented in the above table is more or less same and about 1ppt. Pond water salinity changes during periods of high precipitation or evaporation Boyd, (1978).when the salinity of water is changed by more than 10% in a few minutes or hours, fish and crustaceans may be unable to compensate and will be severely stressed or may die from osmoregulatory failure. But in case of salinity there was no observable fluctuation among the ponds.

3.4 Dissolved oxygen

During the experimental period the range of mean DO were 5-6 mg/l and 2-6 mg/l in the ponds without jute and with jute respectively. There was no marked able change in the ponds without jute .But in case of ponds with jute DO level deceased markedly to 2 ppm in the 2nd week and was increasing towards 3rd , 4th, 5th and 6th weeks due to the nature of water. The degradation process, though, is slower was happened through oxygen reduction due to absence of enhanced biodegradation and the photosynthesis process is hampered.

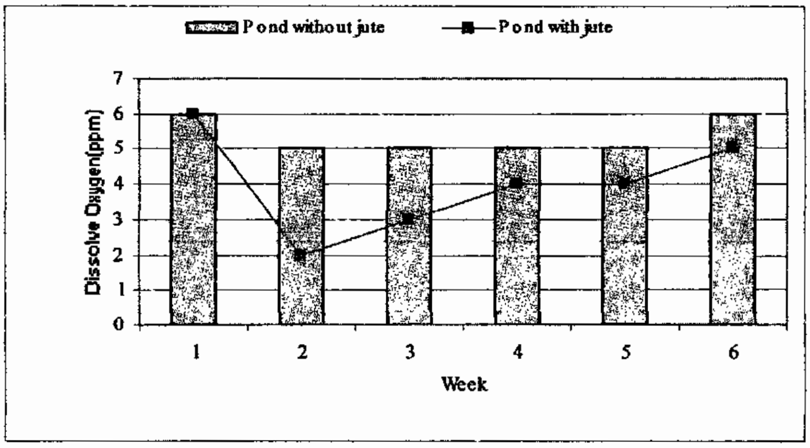


Figure-3: DO differences between ponds without jute and with jute.

Bhuyan (1970) reported that dissolved oxygen content from 5.0 mg/l to 7 mg/l is required for high production. Rahman (1997) stated that oxygen concentration is higher in winter season and lower in summer season due to inverse relation of dissolved oxygen with temperature due to cold temperature of water as the cold water has the greater oxygen holding capacity. Abramo and Brunson (1996) reported that dissolved oxygen concentrations of 3 mg/l are stressful, and lower concentrations can be lethal. Chronically low levels of dissolved oxygen result in less than anticipated yields at the end of the growing season. Islam *et al.* (1998) found higher dissolved oxygen content (7.92 mg/l) in August while the low DO content (4.37 mg/l). In general, an acceptable environment for aquatic life must contain not less than 5 ppm of oxygen. Various observations have been made on critical as well as optimum level of DO in pond water. Ellis (1937) indicated that 3.0 ppm DO or less should be regarded as hazardous for fish and suitable DO level should be 5.00 ppm or more. Mckee and Wolf (1963) stated that DO for worm water fish habitat should not be less than 5 ppm at least 16 hour of any day. Boyed (1982) stated that dissolved oxygen content of 5 to 7 ppm is good for pond fish culture. Further the minimum tolerable concentration of DO will be varying species and size of fish's physiological condition, concentrations of solutes and other factors. Swingle (1947) made a similar assessment in the following table which had been widely accepted by different workers.

Table

DO (ppm)	Effects
<1	Lethal on exposure for more than a few hours.
>1---5	Fish will survive but reproduction and growth will be poor.
>5	Normal survival and growth.

The minimum limiting oxygen concentrations for a fish is dependent upon its genetic makeup, water temperature, level of activity, long term acclimation, and stress tolerance. Water with an oxygen concentration of less than 3 mg/l will generally not support fish. So it might be concluded that the values of dissolve oxygen obtained during study period were suitable for ponds without jute but harmful to the ponds with jute.

3.5 Hardness

The primary determinants of water hardness in natural waters are calcium and magnesium cations (positively charged particles). Ponds water may be divided into various categories viz, soft, hard, very hard etc depending on their hardness (Sawyer and McCarthy, 1967) However, such classifications had little relevance to biological productivity fish ponds. It was usually believed that the idea range for hardness of pond water was 50 to100 ppm.

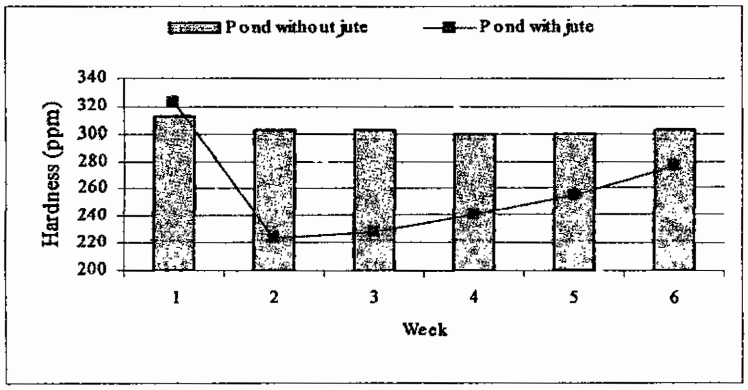


Figure-4: Hardness differences between ponds without jute and with jute.

During the investigation the hardness of the ponds without jute in the range of 300-313 ppm (mg/l).The value of hardness was 313 ppm (mg/l) in the 1st week and was comparatively high in respect of the value in the 2nd, 3rd, 4th, 5th and 6th weeks. But in case of the ponds with jute the value of hardness in the range of 223-322 ppm (mg/l) where highest value was 322 ppm was found in the 1st week and it was retard rapidly to 223 ppm in the 2nd week. Hardness values were increasing towards 3rd, 4th, 5th and 6th week in the jute treated ponds. Low hardness was due to deposition of Ca^{2+}. This might be due the complex formation with hydrocarbon, which is insoluble in water. Although the three properties namely general hardness, calcium carbonate and pH are distinct, they all interact with each other to varying degrees, making it difficult to adjust one without impacting the other. That is one reason why beginning aquarists are advised not to tamper with these parameters unless absolutely necessary.

3.6 Alkalinity

Alkalinity is important for fish and aquatic life because it protects or buffers against rapid pH changes. During the experimental period the range of mean alkalinity were

170-192 mg $CaCO_3$/l and 128-193 mg $CaCO_3$/l in the ponds without jute and with jute respectively. There was no marked able change and was downward direction due to seasonal variation in the month of August-September in the ponds without jute. But in case of ponds with jute alkalinity level deceased suddenly to 128 mg $CaCO_3$/l in the 2nd week and was increasing towards 3rd, 4th, 5th and 6th week during the period of study.

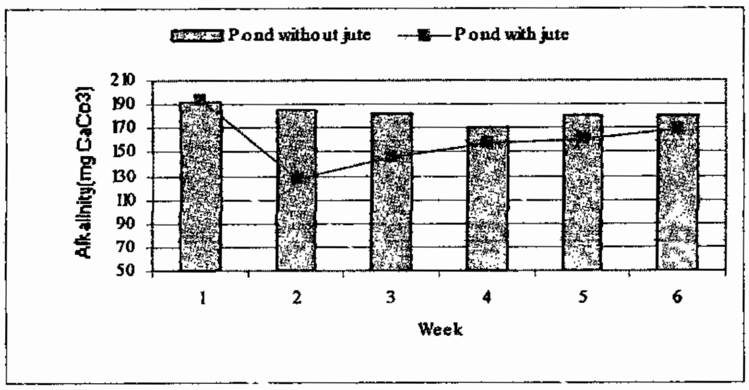


Figure-5: Alkalinity differences between ponds without jute and with jute.

The increased value of alkalinity indicates that there is an involvement of CO_2 in equilibrium process. The uptake or release of CO_2 by organism may be changed the proportion of CO_3^{-} and HCO_3^{-} ions in water (Boyd, 1974). Alkalinity is naturally decreased over time through bacterial action which produces acidic compounds that combine with and reduce the alkalinity components. Alikunhi (1957) reported that the highly productive water bodies should have more than 100mg/l alkalinity. Chisty and Rahman (1999) stated that total alkalinity of 100 mg $CaCO_3$/l to 175 mg $CaCO_3$/l indicates good water quality. Since hard water contains metal carbonates (mostly CaCO3) it is high in alkalinity. Conversely, unless carbonate is associated with sodium or potassium which don't contribute to hardness, soft water usually has low alkalinity and little buffering capacity. But, during experiment it was not evaluate weather the water is soft or hard. So, generally, soft water is much more susceptible to fluctuations in pH from acid contamination. Therefore the mean alkalinity of the ponds was satisfactory. Furthermore, alkalinity was within acceptable limit during experiment.

3.7 Chloride (Cl^-)

Detailed studies on optimum concentration Cl^- ions in freshwater aquaculture were lacking .Chloride content of freshwater ponds usually varies between almost 260 ppm to 537ppm (.05 to 1.0 ppt salinity). Most of fresh water fishes usually grow well under water chloride up to about 1645 ppm (3.0 ppt salinity).

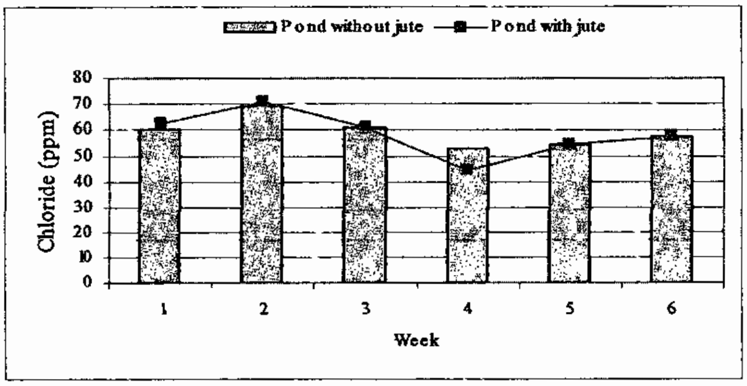


Figure-6: Chloride differences between ponds without jute and with jute.

During the experimental period the range of mean chloride was 58-69 ppm in the ponds without jute and was 58-71 ppm in the ponds with jute. There was no markedly change in the ponds without jute and ponds with jute. In this study; there was no effect on chloride contents

3.8 Free CO_2:

The experiment showed the range of mean free CO_2 were 5-5.5 ppm and 5.2-7.9 ppm in the ponds without jute and with jute respectively. There was no marked able change in the ponds without jute .But in case of ponds with jute free CO_2 level increased markedly to 7.9 ppm in the 2nd week and was decreasing towards 3rd , 4th, 5th and 6th weeks.

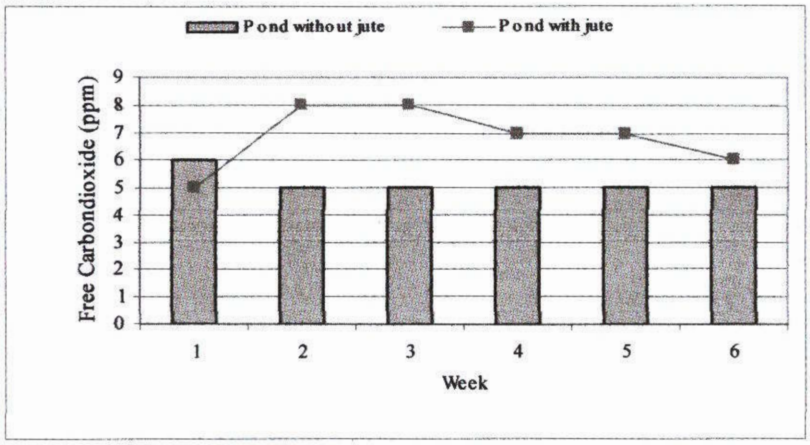


Figure-7: Free CO_2 differences between ponds without jute and with jute.

The maximum (7.9 ppm) free CO_2 content was found in the ponds with jute which indicate the degradation of hydrocarbon. Various critical levels of free CO_2 in aquatic habitat had been suggested by many workers. Ellis (1937) stated that the water supporting good fish population usually contains less than 5ppm of free CO_2. Therefore, ponds without jute contain free CO_2 which was slightly high to the acceptable limit. In case of ponds with jute contain free CO_2 which was high to the acceptable limit and was hazardous to the fishes. Though, presence of free CO_2 in natural fresh water also plays a role for regulating carbonate and bicarbonate concentration in aquatic system.

3.9 Survivility of fish fry

The survival rate (98%) of the experiment was observed in the groups of the ponds without jute at the end of the 6th week. But in case of ponds with jute all fry of *Labeo rohita* were died in the 2nd week.

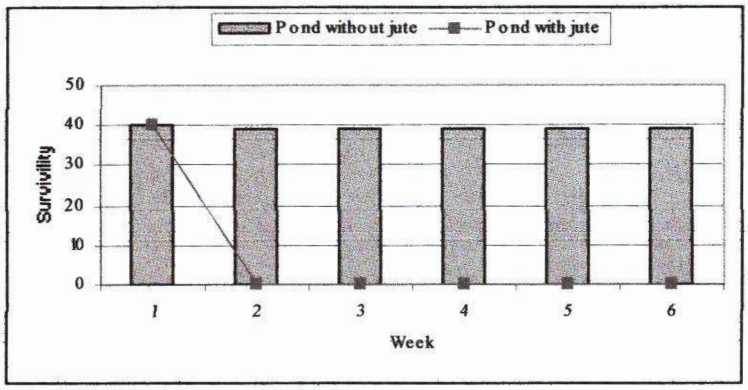


Figure-8: Suvivility differences between ponds without jute and with jute.

Further more, it was seen that the fry of slightly large were grasping near surface water and subjected to die at first during the period of 2nd week. Haque *et al.* (1998) recorded 88.89 to 93.93% survival of rohu, catla and mirror carp in their experiment. Hussain *et al.* found the survival rate of *P. gonionotus* in three ponds ranged from 91 to 97% and the average survival rate was 94%. So, it can be concluded that survivility of the fry in the ponds without jute was acceptable range by considering above discussion. The higher fluctuation of water quality parameters in the ponds with jute influences the fry to death rapidly.

Chapter 4

Recommendation

In the present study, it could be summarized with light of findings the following points should be considered for rearing of fish fry during jute retting practiced in the confined water environment.

1. This jute retting practiced results in water quality deterioration, making fish culture impossible in waters in stagnant environment.
2. Water deterioration due to jute decomposition comes back to the prior stage in time being matter for its nature.

Chapter 5

Conclusion

The present study was conducted in laboratory where temperature, dissolve oxygen, free carbon-die-oxide is not likely as the freshwater environment. But the reactions involved into system in laboratory are same as in nature. Furthermore, it is difficult to study in the field level such as into the freshwater due to vast water area and constrained environment. In order to study this distribution or alternation of chemical composition due to jute retting in the selected ponds and all sorts of activities are involved in water chemistry and the effects on fish species. The present study reported that the fluctuation of water parameters due to jute retting practiced in the experimental ponds have lethal effect to the *Labeo rohita* fry as well as most of the aqua organisms. This might be due the rapid change of water parameters in the 2nd week when fry were subjected to death. This experiment also recommended that the parameters of stagnant water environment in P-4, P-5, P-6 fluctuate highly at 2nd week due to the jute fibre decomposition and it come back to the prior stage very slowly. As water has the distinction of being an almost universal solvent due to its di-polar nature. So available information or too many research are essential about this subject. To identify this effect high tech. techniques or apparatus are necessary which was not available in the laboratory. There are also some important water quality parameters that we cannot measure in the laboratory for some lacking. But by developing a mathematical modeling it is possible to estimate the possible value of the parameters.

Chapter 6

References

Abramo D., Heinen L.R., Robinette J.M. and Collins J.S., 1996. Production of the freshwater prawn *Macrobrachium rosenbergii* stocked as juveniles at different densities in temperate zone ponds. J. World Aquaculture, 20: 81-89.

Alam M.S., Amin M.R., Hasan M.R., Rahmatullah S.M. and Miah M.I., 1996. Effects of fertilizers and supplementary feeds on physicochemical parameters of ponds. Bangladesh J. Fish, 19(1-2): 9-16.

Ali S., Rahman A.K.A., Patwary and Islam K.H.R., 1982. Studies on the diurnal variations in physico-chemical factors and zooplankton in a fresh water pond. Bangladesh J. Fish, 2-5(1-2): 15-23.

Alikunhi K.H., 1957. Fish culture in India, Farm bull, Indian Council of Agriculture Research, 20: 144.

Bhuyan B.R., 1970. Physico-chemical qualities of water of some ancient tanks in sibsagar, Assam. Environ. Health, 12:129-134.

Boyd C.E., 1978. Water Quality in Warm water Fish Ponds .Agril. Expt Stn, Auburn, pp 24.

Boyd C.E., 1982. Water quality management for pond fish culture. Development in Aquaculture and Fisheries Science, Vol. 9. Elsevier, Amsterdam, pp. 318.

Chen T.S. and Saad S., 1981. Folic acid in Egyptian vegetables: The effect of drying method as storage on the folacin content of mulukhiyah (Corchorus olitorius). Ecol. of Food & Nut., 10: 249-255.

Chisty M.A.H. and Rahman S.M., 1999. Effect of low cost feed on the growth performance of prawn, (*Macrobrachium rosenbergii*) in gher farming system. *Khulna Univ. Stud.*, 1 (2): 245-249.

Dewan S., Wahab M.A., Beveridge M.C.M., Rahman M.H. and Sarke B.K., 1991. Food

Edward A. Laws, Aquatic Pollution, pp. 39,517.

Eills, 1937 .Water Quality and its Control, pp 56.

Fujimura T., 1974. Development of a prawn culture industry in Hawaii. Hawaii Subproject number H-14-D. Job completion report to United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, pp. 17.

Haque M.S., Wahab M.A., Wahid M.I. and Haq M.S., 1998. Impacts of Thai silver barb (*Puntius gonionotus* Bleeker) inclusion in the polyculture of carps. *Bangladesh J. Fish. Res.,* 2 (1): 15-22.

Islam M.S., Kabir A.K.M.A., Wahid M.I. and Hoq M.E., 1998. Evaluation of duckweed as supplemental feed for Thai silver barb (*Puntius gonionotus* Bleeker) Maricul. Soc., 10: 369-384.

McKee J.E. and Wolf H.W., 1963. Water quality criteria. State of Calif. State Water Quality control Board. Publ. No. 3-A Sacramento, pp. 548.

Michael R.G., 1968. Studies on the bottom fauna in tropical freshwater fish pond. *Hydrobiologia*, 31: 203 -230.

New M.B., 1995. Status of freshwater prawn farming: a review. Aquacult. Res., 26: l-54.

Provas das, Adonk Padotitay Fasal Chas, pp. 126-142.

Rahman M.A., 1997. Effects of artificial feed on the growth and production of fishes in polyculture. M. S. Thesis. Bangladesh Agricultural University, Mymensingh. Univ., 359 pp.

Sandifer P.A. and Smith T.I.J., 1979. Development and potential of nursery systems in farming of Malaysian prawns *Macrobrachium rosenbergii* (deMan).Proc.World Maricul.Soc., 10: 369-384.

Sandifer P.A. and Smith T. I. J., 1979. Development and potential of nursery systemsin the farming of Malayasian prawns, *M. Rosenbergii* (deMan). Proc. World selection, electivity and dietary overlap among planktovorous Aquaculture and Fisheries Management, 22: 277-294.

Sawyer, Perpy L. Mccarthy, Clarin, Gene F. Parkin, 1967, 4th edition. Chemistry for environmental Engineering, pp. 458-515.

Swingle, 1947. Freshwater fishes from the Gambia River .Results of the Swedish exoedtion, 1931.*K.Sven.Vetenskapsakad.Handl.*, 12, pp. 1-102.

Swingle H.S., 1967. Standardization of chemical analysis for water and pond muds. FAO Fish. Rep., 44 (4): 397-421.

Wahab M.A and Ahmed Z.M., Islam M.A. and Rahmatullah S.M., 1996.Effect of Chinese and Indian Major carps fry and fingerlings grown in extensively managed, rainfed ponds in Bangladesh. Bangladesh J.Zool., 26(2): 29-36.

Appendices

Tables of different parameters:

6.1 Table: Values of water pH parameter of different ponds.

Parameter	Ponds	Ponds Sl.	1st Week	2nd Week	3rd Week	4th Week	5th Week	6th Week
pH	Ponds without jute	1	7.2	6.9	7	6.9	7	7.1
		2	7.1	7	7	6.8	6.9	7
		3	7.2	6.9	7	6.9	7	7.1
	Ponds with jute	4	7.2	6.5	6.7	6.8	6.8	6.9
		5	7.1	6.7	6.8	6.8	6.9	7
		6	7.2	6.5	6.7	6.8	6.9	7

6.2 Table: Values of water temperature of different ponds.

Parameter	Ponds	Ponds Sl.	1st Week	2nd Week	3rd Week	4th Week	5th Week	6th Week
Temperature (^{0}c)	Ponds without jute	1	29	30	29	30	30	30
		2	30	29	30	29	30	30
		3	29	29	30	30	29	29
	Ponds with jute	4	30	30	29	29	30	29
		5	29	29	30	29	30	30
		6	30	30	29	30	29	30

6.3 Table: Values of water salinity of different ponds.

Parameter	Ponds	Ponds Sl.	1st Week	2nd Week	3rd Week	4th Week	5th Week	6th Week
Salinity (ppt)	Ponds without jute	1	< 1	< 1	1	1	1	1
		2	< 1	< 1	1	< 1	1	1
		3	< 1	< 1	< 1	1	1	1
	Ponds with jute	4	< 1	< 1	< 1	1	< 2	1
		5	< 1	< 1	1	1	1	1
		6	< 1	< 1	1	< 1	1	1

6.4 Table: Values of DO parameter of different ponds.

Parameter	Ponds	Ponds Sl.	1st Week	2nd Week	3rd Week	4th Week	5th Week	6th Week
Dissolve Oxygen (ppm)	Ponds without jute	1	6	5	5	6	5	6
		2	6	6	6	5	6	5
		3	6	5	5	5	6	5
	Ponds with jute	4	6	2	3	4	4	5
		5	6	3	2	3	5	6
		6	6	2	3	4	4	5

6.5 Table: Values of water hardness of different ponds.

Parameter	Ponds	Ponds Sl.	1st Week	2nd Week	3rd Week	4th Week	5th Week	6th Week
Hardness (ppm)	Ponds without jute	1	322	317	320	300	310	317
		2	320	305	315	306	315	303
		3	297	286	270	295	270	289
	Ponds with jute	4	308	203	205	235	255	290
		5	334	225	230	235	250	268
		6	323	220	220	229	259	274

6.6 Table: Values of water alkalinity of different ponds.

Parameter	Ponds	Ponds Sl.	1st Week	2nd Week	3rd Week	4th Week	5th Week	6th Week
Alkalinity (mg $CaCO_3$ /l)	Ponds without jute	1	195	184	180	172	170	178
		2	183	188	182	170	177	180
		3	198	184	184	168	175	185
	Ponds with jute	4	196	130	151	141	161	170
		5	183	120	148	159	155	165
		6	201	135	150	158	165	172

6.7 Table: Values of Chloride (Cl^-) parameter of different ponds.

Parameter	Ponds	Ponds Sl.	1st Week	2nd Week	3rd Week	4th Week	5th Week	6th Week
Chloride (Cl^-) (ppm)	Ponds without jute	1	57.34	75.5	60.3	57.65	58.65	58.5
		2	62.58	79.97	65.12	53.32	55.69	59.5
		3	58.54	73.5	58.24	47.65	49.5	55.15
	Ponds with jute	4	55.03	79.5	55.2	45.75	50.09	54.17
		5	63.48	81.47	65.32	40.48	55.05	56.79
		6	66.47	85.57	61.5	47.65	59.55	61.85