CHAPTER-III

MATERIALS
AND
METHODS

Page 35-49
Topography of the Area:

The study area, Balrampur district, is situated in North Terai region of Uttar Pradesh adjacent to Indo-Nepal border at 27° 16’N to 27° 32’, North altitude and 82°03’ E to 82° 22’ East longitude and an altitude of about 113 meters above the mean sea level. Rapti is the main river traversing in the area and plays a vital role in the topography and causes serious flood havoc in the rainy season. The slope of the area is from north-west to south-east. Sugarcane is one of the major crops of the district which requires large amount of water. There are three sugar factories: Balrampur Chini Mills, Bajaj Chini Mills and Tulsipur Chini Mills, situated at about 5 Km., 18 Km. and 30 Km. away from Balrampur city, respectively.

The district Balrampur lies between Nepal in the north and district Gonda in the south. Its eastern and western boundaries are common with Siddharthanagar and Shravasti districts, respectively (Figures 1 and 2).

Meteorology of the study area:

A climatological data i.e. temperature and rainfall data for the period of January 2008 to December 2009 were obtained from Department of Climate, Government of India, situated near Rapti Bridge at Balrampur.

The climate of the study area is hot and dry in summer, mild and free from frost in cold season. The monsoon commences from the second week of June and continues till mid-October. July and August are months of maximum rainfall (In July 2008, rainfall was as much as 538.1 mm and in August 2008, rainfall was 396.5 mm). About 90% of the annual rainfall is obtained during the monsoon months.
The monthly average of minimum temperature ranged between 4.0 to 26.5 °C and that of maximum temperature between 21.8 to 37.5 °C. During the study period maximum temperature was recorded in June and minimum in January.

**Morphometry of study site- Bhagwanpur reservoir:**

Bhagwanpur reservoir is a medium freshwater reservoir of eastern Uttar Pradesh, situated in village Bhagwanpur, Tulsipur block of district Balrampur. The morphometric characteristics of Bhagwanpur reservoir are as follows:

- **year of construction**: 1960-61
- **Maximum depth**: 9 m
- **Mean depth**: 3 m
- **Height of reservoir**: 14.5m
- **Catchments area**: 6.4 km²
- **Reservoir area**: 4.5 km²
- **Capacity**: 345Mcf
- **Silt Level**: 400Feet
- **Total Canal**: 4
- **Length of all the Canal**: 29.5km
- **Source of water**: Naktee Nallah

**Physicochemical analysis of Bhagwanpur reservoir water:**

Water samples were collected monthly in glass/plastic stoppered bottles from three different sites (Photograph 2-4). Temperature and transparency were recorded and samples were analysed for dissolved Oxygen, pH, free carbon-di-oxide, total alkalinity, chloride, calcium, magnesium, nitrogen and phosphorus. Analyses were made at field as well as in the laboratory as per standard methods. A short description of the methods used for various parameters is given here:
1. Temperature:

Water temperature was recorded directly in the field with the help of the portable water Quality Analyser kit (Naina-Electronics (P) Ltd., Type NPC 360 D).

Range - 0° to 100°C
Resolution - 0.1°C
Accuracy - ± 0.5°C ± 1 digit.

2. Transparency:

Transparency of water was determined by the use of Secchi disc. The Secchi disc is a circular disc of metal, 20cm in diameter and painted alternately white and black in a radial fashion.

3. Hydrogen ion concentration or potentio hydrogenii (pH):

pH of the samples was determined directly in the field with the help of pH meter.

Range - 0 to 14 pH
Resolution - 0.01
Accuracy - 0.01 pH ± 1 digit.
Temp. compensation - 0 to 100°C (Manual).

4. Free Carbondioxide:

Estimation of free CO₂ was done by standard titrimetric method with standard alkali solution (0.0227 N NaOH) or N/44 NaOH) using phenolphthalein as indicator.

5. Dissolved Oxygen:

The dissolved oxygen estimation was done by standard titrimetric method with standard sodium thiosulphate solution (0.02N) using starch solution as indicator (APHA, 1998).

The dissolved oxygen content of all the samples was also determined electrometrically using membrane electrode (Naina Electronics (P) Ltd., Type NPC 360 D).
Range - 0 – 20 ppm.
Resolution - 0.1 ppm
Temp. Compensation - ± 0.3 ppm ± 1 digit.

Sensor Amphoteric gold/silver membrane type.

6. **Total alkalinity (Carbonate and Bicarbonate):**

The carbonate and bicarbonate from water samples were estimated by simple acidimetric titration and methyl orange indicators which work in alkaline range of pH > 8.2 or in acidic range of pH < 6.0 (Richards, 1954). The values are expressed in ppm.

7. **Chlorides:**

Chloride concentration was estimated by titration with standard silver nitrate solution using potassium chromate as indicator (DPD) (APHA, 1992).

Chloride (Mg/L) = \[
\frac{(ml \times N) \times 35.5}{ml \text{ Sample}}
\]

8. **Total Nitrogen:**

The total nitrogen was estimated by the kjeldahl’s method and values are expressed in mg/L.

9. **Calcium:**

The divalent cations were also estimated by Versenate (EDTA), titration method as described by APHA (1998).

The calcium from water samples was determined by titrimetric method by EDTA as described by APHA (1998) using Mureoxide (Ammonium purpurate) as indicator and values are expressed in mg/L. Because of the high pH used in this procedure, the titration was done immediately after addition of alkali (NaOH) and indicator.
10. Phosphates:

The determination of phosphate was estimated by colorimetric method employing ammonium molybdate and stannous chloride. The optical density of the colour was taken on Elico digital Spectrophotometer model CL27. The amount of phosphorus was taken by comparing standard curve and values are expressed in mg/L.

11. Total Solids (TS):

Total solids are the amount of all kinds of solids (suspended, dissolved etc.) in the water sample. Total solids determined as the residue left after evaporation of unfiltered sample (Trivedy et al. 1998).

Total solids are calculated by using this formula:

\[
\text{Total solids, mg/L} = \frac{(a-b) \times 1000 \times 1000}{V}
\]

Where,
- \(a\) = Final weight of the beaker in gm.
- \(b\) = Initial weight of the beaker in gm.
- \(V\) = Volume of sample evaporated in ml.

12. Total Dissolved Solids (TDS):

Total dissolved solids denote mainly the various kinds of minerals present in water. It does not contain any gas and colloids. These can be determined as the residue left after evaporation of the filtered sample. It is calculated by the above mentioned formula.

13. Total Suspended Solids (TSS):

These solids denote the suspended impurities present in the water sample. In most of the cases, they are organic in nature and pose severe problems of water pollution. It was the difference between total solids and total dissolved solids.

\[\text{TSS} = \text{TS} - \text{TDS}\]
Collection of soil samples:

The mud samples were collected monthly with the help of Ekman-dredge from 3 sites and were dried to constant weight in an oven at 105°-110°C to analyse the pH, organic matter, organic carbon, available phosphorus, available nitrogen, total nitrogen, calcium and chloride. A short description of the methods used for various parameters is given here:

1. Hydrogen ion Concentration (pH):

The soil water suspension was prepared by thorough mixing of the two in 1:5 ration. The pH of the supernatant suspension was recorded by Elico Digital pH meter.

2. Total Nitrogen:

A little amount of soil undergone wet digestion in H₂SO₄ in the presence of catalyst mixture. The digested aliquot was distilled in kjeldahl assembly in presence of NaOH. The liberated ammonia was collected on boric acid which was quantified by titration with an acid following the procedure of piper (1966). The amount of nitrogen was calculated using the formula;

\[
\text{Nitrogen (\% N) = } \frac{(TB) \times N \times 1.4}{S},
\]

where,

- \( T \) = Sample filtration, ml standard acid.
- \( B \) = Blank titration, ml standard acid.
- \( N \) = Normality of standard acid.
- \( S \) = Weight of soil sample.

3. Available Phosphorus:

The available phosphorus was extracted from soil in the dilute acid. The phosphorus from this acid extract was determined using method of Olsen et al., (1954).
4. Organic Matter:

Organic carbon was determined by Walkley and Black’s (1934) rapid titration method as described by Piper (1966). The organic carbon from soil was oxidised with excess amount of standard potassium chromate in the presence of H$_2$SO$_4$. The amount of unutilized potassium chromate was estimated by titrating with standard ferrous ammonium sulphate in the presence of diphenylamine as indicator. The organic carbon was determined using the formula:

$$\text{Organic Carbon} = \frac{V_1-V_2}{W} \times 0.003 \times 100,$$

where

- $V_1 =$ Volume of K$_2$Cr$_2$O$_7$
- $V_2 =$ Volume of ferrous ammonium sulphate.
- $W =$ Weight of dry soil

The amount of organic matter was calculated by multiplying the value of organic carbon with 1.724 assuming that organic matter in soil contains 58% carbon.

**Qualitative and Quantitative Estimation of Plankton:**

The samples were collected with the help of truncated cone shaped plankton net made by No. 25 nylon. A graduated specimen tube was tied at the end of the cone.

Forty-five liters of reservoir water was strained through the net after submerging the net into the water while its handle and the metal ring was kept above the water surface. Planktons were collected in specimen tube and few drops of formaline water added to kill the plankton, while settled at the bottom of the tube. The quantity of plankton collected was measured by using Sedwick-Rafter plankton counting cell and quantities are expressed here as units per litre of the
pond water. Further, few drops of glycerine were added to avoid from getting dry and qualitative study was undertaken using a light microscope. Standard microscopic slides and cover slips were used for all microscopic studies. Planktons were identified with the help of ‘A guide to the study of fresh water Biology’ written by Paul R. Needham.

**Identification of Aquatic Weeds:**

Aquatic Macrophyte (AM) diversity and its role in understanding the wetland ecosystem dynamics have tremendous significance. Studies on aquatic plant community composition were made according to method described by Puri et al. (1968) by recording presence (+) or absence (-) of different species occurring in the inundation prone and bank area of the reservoir. Identified and frequency of distribution was worked out according to the method described by Misra (1968), Gupta (1979) and Aquatic Angiosperm by Subramanyam (1962).

**Identification of Fish Fauna:**

Fishes were collected from time to time during netting and identified with the help of the book-Fauna of British India by F. Day (1889) and Fishes of U.P. and Bihar by Gopal Ji Srivastava (1988).

**Mean and Standard Error of Mean:**

Mean of various physico-chemical parameters were calculated with the help of following formula given below (Biradar, R. S., (1988):

\[ \bar{X} = \frac{\sum X}{N} \]

where \( \bar{X} = \) Mean

\( \Sigma = \) Summation
\[ X = \text{Observation} \]
\[ N = \text{Total number of observations} \]

Standard error of mean is the ratio of standard deviation of the sample divided by the square root of the total number of observations.

\[ SE_M = \frac{\text{Standard deviation}}{\sqrt{N}} \quad \text{or} \quad \frac{\sigma}{\sqrt{N}} \]

where,

\[ SE_M = \text{Standard error of mean} \]
\[ \sigma = \text{Standard deviation} = \sqrt{\frac{\sum X^2}{N}} \]

\[ \sqrt{N} = \text{square root of the total number of observations.} \]

**Correlation Coefficient:**

Correlation coefficient ‘r’ among various physico-chemical and biological parameters (variables) were calculated from the equation given below (Biradar, R. S., 1988):

\[ r = \frac{\sum xy - \left( \frac{\sum x}{N} \right) \left( \frac{\sum y}{N} \right)}{\sqrt{\left( \frac{\sum x^2}{N} - \left( \frac{\sum x^2}{N} \right)^2 \right) - \left( \frac{\sum y^2}{N} - \left( \frac{\sum y^2}{N} \right)^2 \right)}} \]

where, X and Y denote the measurements on Variables X and Y. ‘n’ is the number of pairs of observations i.e. the sample size.
Figure 1: Location of study area in Uttar Pradesh.
Fig. 2: Map of Balrampur district showing Bhagwanpur reservoir in Tulsipur block.
Photograph 1: Barrage on Bhagwanpur Reservoir.

Photograph 2: View of Bhagwanpur Reservoir showing sampling site $S_2$ (Pelagic).
Photograph 3: View of Bhagwanpur Reservoir showing sampling site $S_1$ (Littoral).
Photograph 4: View of Bhagwanpur Reservoir showing sampling site S₃ (Polluted zone).
Photograph 5: Bhagwanpur Reservoir – Bank view showing aquatic plants.

Photograph 6: Angles planted on the bank of Bhagwanpur Reservoir for traditional fishing.