Synopsis of the Thesis entitled

ASSESSMENT OF NUTRIENT DYNAMICS AND PHYSICO-CHEMICAL STATUS OF FRESHWATER RESERVOIRS OF VADODARA DISTRICT, GUJARAT, INDIA

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INTRODUCTION:

Water is one of the central component of every living being on Earth. With variety of aquatic systems, there is immense diversity inhabiting depending upon their ecological amplitudes. Out of the total water resources available on the planet, the freshwater resources in surface water bodies are of immense importance. This is due to their ready availability and easy access. Humans are dependent upon such water bodies for the uses not only restricted to drinking, but also such waters are put to use for irrigation of agricultural fields, industrial processes, aquaculture, flood control and management, recreation and tourism etc. Their property of being readily available has rendered them exposed to various anthropogenic pressures. Lakes and reservoirs, being the stagnant water bodies compared to the rivers and streams are largely affected by various human activities. Continuous entry of various elements and compounds from surrounding area and a very limited exit of such compounds is the prime reason due to which their vulnerability is higher. Monitoring of quality of such system and keeping a check on excess entry of foreign materials in the system may help in extending the life span of such water bodies. The reservoirs taken up for studying the nutrient dynamics and physico-chemical status are being used for irrigation, aquaculture, for drinking water as well as for recreational purpose as they harbour wetland birds, too. Understanding effects of various environmental variables as well as human activity on the variability of water and sediment quality will help in developing the cause effect relationship on a holistic basis. Some of the important components of the study is presented in this synopsis and the details will be presented in the Thesis.

REVIEW OF LITERATURE:

Knowing the importance of freshwater bodies, numerous research and developmental activities have been carried out till date in the field of limnology, freshwater ecology, water and sediment

quality etc. Researcher opine that such systems are quite complex and while studying the structure and function of such systems, a holistic approach should be adopted (Aprile et al., 2013; Shapiro et al., 1975). Freshwater bodies are globally distributed and based on the existing environmental conditions they largely vary in properties.

In India, during post independence period, much of the research is done in this field and researchers have carried out study on various aspects of such systems (Gopal & Zutshi, 1998). Water quality parameters have been studied and various statistical tools are employed for data analysis. Primarily attempts were made to find the correlation among various water and sediment quality parameters. The physical and chemical parameters and variations therein has been found to be affecting the biotic components of such systems which was observed by field studies as well as a number of models that were developed also showed similar results (Greer and Ziebell, 1972). Studies have concluded that excess nutrients in such systems leads to increase in productivity of the system. Accelerated increase in the productivity appears to be having negative effect on the Dissolved Oxygen (DO) content of lakes and reservoirs. Since DO is one of the limiting factor of aquatic systems, this leads to cascading effect on the health of the system. Anoxic conditions are also associated with generation of end products of anaerobic decomposition such as Hydrogen Sulphide (H_2S), Methane (CH_4) etc. (Shapiro et al., 1975). The study on fish diversity of a dam in Maharashtra suggested that the productivity was maximum in summer season which was positively correlated with the pH (Theurkar et al., 2013). In the hydro-biological study of Tehri Dam in Garhwal, the authors found the temperature to be the most influencing parameter which in turn governs a majority of physico-chemical as well biological parameters (Ayoade & Agarwal, 2012). The study of physico-chemical parameters of water carried out in Jhansi exhibited that the temperature of the water showed a strong positive correlation with the Dissolved solids. The results of the same study also suggested that the DO is negatively correlated with the parameters such as Hardness,

Alkalinity and chloride (Arya et al., 2013). A study on a freshwater lake in Turkey concluded that the density and diversity of plankton as well as the chlorophyll – a content was largely dependent on the concentration of Nitrogen and Phosphorous. Nitrogen and Phosphorus have also been identified as limiting factors for various phytoplankton groups (Yilmaz and Aykulu, 2010). In a limnological study carried out in Brazil where certain water quality parameters such as temperature, density, oxygen, morphometry etc. were assessed, it was identified that the physical, chemical and biological processes were greatly dependent on the temperature and oxygen of the lake (Aprile et al., 2013). It was identified by the researchers that Nitrogen alters the ecological processes and as its removal is not easy from an aquatic ecosystem, their impacts are long term in such ecosystems (Jones et al., 2014).

Limnological study of a pond in Vadodara city showed that the dissolved salts' concentration remains highest in the summer months. This may be attributed to evaporation of water during the same period (Parikh & Mankodi, 2012). In another study in the same area found that the water bodies with constructed boundaries partially mitigated the inflow of nutrients and contaminants. It was also suggested in the same study that such boundaries may be useful in restricting the eutrophication of such lentic water bodies where anthropogenic pressure is more (Tailor & Mankodi , 2013). A study on the water quality assessment of freshwater pond in Central Gujarat which is surrounded by human settlements showed elevated levels in contaminants. The study suggests that anthropogenic activities are by large responsible for higher trophic status of the fresh water bodies (Pathak & Mankodi, 2013; Tailor & Mankodi, 2013).

AIM AND OBJECTIVES:

The research work was aimed at assessment of seasonal dynamics in water and sediment quality, nutrient levels and biodiversity. Following objectives were set to achieve the same.

a) Assessment of nutrient dynamics

b) Assessment of sediment carbon & nutrient concentrations and their Spatio-temporal variations

c) Assessment of faunal and floral diversity of the reservoirs

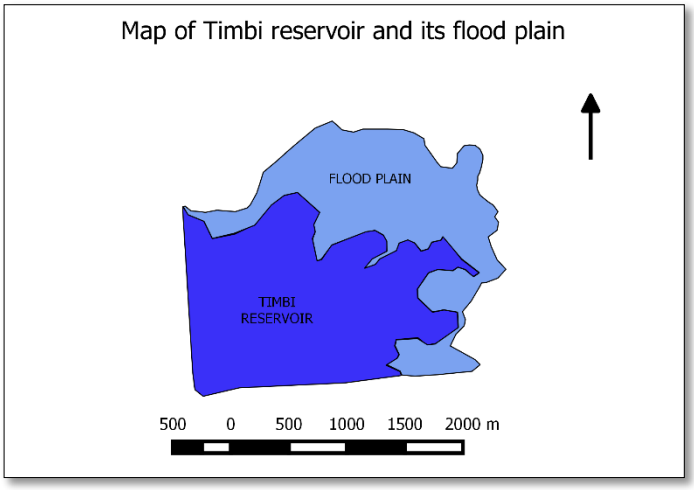
d) Evaluation of water bodies with reference to water and sediment quality.

APPROACH AND METHODOLOGY:

Study area:

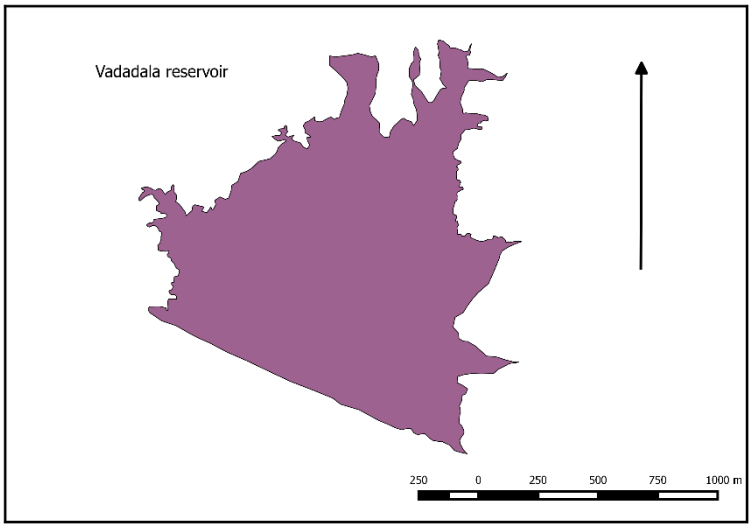
Gujarat state is located in the western India between 20° 6'N to 24° 42' N north latitude and 68° 10'E to 74° 28'E east longitude. It has an area of approximately 19.6 thousand km². Vadodara District in central Gujarat has a geographical area of 7.8 km². and population of 4,165,626 according to 2011 Census. Three freshwater reservoir; namely, Timbi Reservoir, Vadadala Reservoir and Dhanora Reservoir, of Central Gujarat are selected for the proposed research work. The description of the same is as follows

1. **Timbi reservoir:** It is located in the East of Vadodara city between 22º19’19”N to 22º18’28”N latitude and 73º16’42” E to 73º17’46” E longitudes, The reservoir is characterised by an approximate area of 1.6 square km and Approximate Perimeter: 5.6 km at full water capacity. The major source of water for the reservoir is rain-water, however, it also fed by canals from Ajwa Reservoir in minor quantity. The western and southern boundary of the reservoir is elevated northern and eastern parts are having natural gradient with a gentle slope. The water of the reservoir is supplied to surrounding agricultural fields by canals and is a major source of

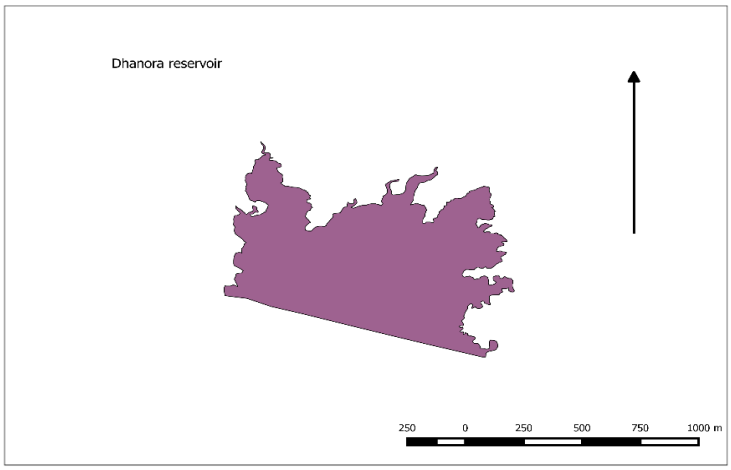


irrigation water in the vicinity. Fishing is also carried out in the reservoir and when the water recedes in summer months, the inundated area is used for grazing of cattle. Apart from its importance to human settlements, the reservoir also provides habitat for a variety of wetland birds, both native and non-native species. This makes it an important reservoir both from an economic as well as ecological point of view.

2. **Vadadala:** Located between 22°28’27”N - 22°28’38” N latitudes and 73°18’39” E – 0 73°19’ 15” E longitudes in the North - East of Vadodara city. This reservoir is made by constructing an earthen dam. Major source of water for the reservoir is rainwater. During the summer season, the water is fed to this reservoir by a canal system. Major water use is for agriculture. However, the reservoir is also used for fishing. The western, Northern and Eastern periphery of the reservoir is gentle slope and agriculture is carried out on such lands from where the water has receded.



3. **Dhanora (Bodidra):** This reservoir is located between 22°28’13”N - 22°28’16” N latitudes and 73°21’09” E – 73°21’58”E in longitudes the North East direction of Vadodara city. The reservoir,



similar to Vadadala reservoir, is mainly used for irrigation purpose as well as fishing as half of the year the reservoir is used for fishing. Grazing of cattle is a common sight at the end of the reservoir where the water has receded. The southern boundary is an earthen dam which holds the water. The other three boundaries are open and have gentle slope. When the water recedes, agriculture is carried out on such lands similar to Vadadala.

Methodology (Sampling and Analysis):

a) Water Quality Assessment:

I. Sampling:

Water samples were collected on monthly basis from different locations including the centre of the lakes in pre-cleaned plastic bottles except for dissolved oxygen (DO) where DO bottles will be used for collection of water samples. Appropriate labelling was done on all the sampling bottles.

II. Analysis:

Temperature, pH and Electrical conductivity of the water samples were assessed on the site. The DO was fixed at the site just after collection of water sample using Manganese Sulphate and Alkali-Iodide-Azide reagent. Rest of the parameters were assessed in the laboratory within 4-6 hours after collection. For rest of the times the samples were stored at 4^{o}C temperature and were brought back to room temperature before analysis. Following is the list of parameters and assessment methodology proposed to be used for assessment **(Table 1)** (APHA, 1998; Sharma L.L. & V. P. Saini, 2003, Maiti S. K., 2004).

Sr. No.	Parameter	Adopted Methodology
1	Temperature	Mercury Thermometer
2	pH	Electrometric Method (Digital pH meter)
3	Electric Conductivity	Electrometric method (Conductivity meter)
4	Dissolved Oxygen (DO)	Wrinkler's method
5	Chlorophyll	Acetone Method
6	Phosphorous	Stannous Chloride Method
7	Nitrogen	Ultraviolet Spectrophotometric Screening Method

8	Total Suspended Solids (TSS)	Filtration and Gravimetric Method
9	Total Dissolved Solids (TDS)	Evaporation and Gravimetric Method
10	Transparency	Secchi Disc method

Table 1: Water Quality Parameters and Proposed Assessment Methodology

b) Sediment Quality Assessment:

I. Sampling:

A total of six sediment samples were collected in pre monsoon and post monsoon season from different locations of the lakes. All the sediment samples were collected in clean zip lock polythene bags with appropriate labelling. To avoid major variation in temperature of the samples, they were put in insulated ice boxes till they are brought to the laboratory.

II. Analysis:

The samples were air dried and sieved with 2 mm sieve. The finer fraction thus collected was used for subsequent analysis. Following is the list of parameters and assessment methodology to be used for assessment (Maiti S.K., 2004) (**Table 2)**.

Sr. No.	Parameter	Adopted Methodology
1	pH	Electrometric Method and Digital pH meter
2	Electric Conductivity	Electrometric method (Conductivity meter)
3	Organic Carbon	Oxidation and Titrimetric method
4	Organic Matter	Incineration and Gravimetric Determination
5	Phosphorous	Bray's Method
6	Nitrogen	Kjeldalh Reflux method

Table 2: Sediment Quality Parameters and Proposed Assessment Methodology

RESULTS:

The water quality parameters and sediment quality parameters were analysed as scheduled which fetched the result as mentioned in **Table 3A and 3B**. The water quality parameters indicate the oligo-trophic to meso-trophic status of the water bodies under investigation. For phytoplankton diversity and bird diversity were studied during the study period and will be expressed as species richness in the final thesis.

Sr. No.	Water Quality Parameters	Timbi reservoir	Dhanora Reservoir	Vadadala Reservoir
1	Water Temperature (°C)	19.6 - 25.7	18.9 - 24.6	19.2 - 24.9
2	pH (Unit less)	7.54 - 8.57	7.42 - 8.31	7.48 - 8.38
3	Electrical Conductivity (µS/cm)	253 - 436	266 - 389	249 - 412
4	Dissolved Oxygen	4.28 - 5.79	4.38 - 5.66	4.35 - 5.38
5	Chlorophyll -a (ug/l)	10.68 - 36. 85	17.12 - 34.71	17.36 - 36.38
6	Nitrate	1.08 - 1.49	1.12 - 1.43	1.3 - 452
7	Phosphate	0.11 - 0.28	0.15 - 0.26	0.3 - 452
8	TDS	260 - 439	320 - 488	323 - 452
9	TSS	26 - 59	24 - 62	22 - 59
10	Total solids	286 - 484	344 - 550	345 - 511
11	Chloride	55.3 - 83.9	60.9 - 81.9	52 - 91

Table 3 A: The range of values of water quality parameters (all values in mg/l unless mentioned)

Sr. No.	Sediment Quality Parameters	Timbi reservoir	Dhanora Reservoir	Vadadala Reservoir
1	Temperature (°C)	22.3 - 24.9	21.5 - 24.6	21. 3 - 24.2
2	pH (Unit less)	7.55 - 7.96	7.69 - 8.02	7.72 - 8.16
3	Electrical Conductivity (µS/cm)	324 - 396	348 - 412	317 - 397
4	Organic Carbon (%)	1.06 - 1.36	1.19 - 1.28	1.12 - 1.33
5	Organic Matter (%)	1.72 - 2.06	2.08 - 2.23	2.11 - 2.41
6	Phosphate	0.23 - 0.31	0.27 - 0.33	0.23 - 0.35
7	Nitrate	1.47 - 1.62	1.39 - 1.57	1. 41 - 1.60

Table 3 B: The range of values of sediment quality parameters (all values in ppm unless mentioned)

The data will be analysed using various statistical tools and regression analysis will be carried out to attempt modelling the water quality. Geospatial analysis will be done for land use study and holistic maps will be prepared for the study area. Any inference based on correlation among the geophysical parameters and quality of reservoirs will be reported after detailed data analysis.

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