

Water Quality Assessment During Summer And Rainy Season Of Palair Reservoir

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Abstract:

Palair reservoir is a major source of fresh water in Khammam district of Telangana state. It is located at the Palair village in Kusumanchi mandal of the district and is about 30 kilometers away from district head quarters of Khammam. The reservoir is an important tourist attraction in the district and water based adventure, sports and recreational facilities have been provided at the reservoir in recent years to develop it as a tourist site. Electrical power is also generated using palair reservoir water. The reservoir quality provides drinking water and meets irrigation water requirements in the region. Besides it also recharges ground water level in the immediate geological area. The agriculture runoff also plays as important role in its contamination. Hence the continuous quality assessment of the reservoir is required. For this study 6 samples are collected particularly summer and rainy seasons from different point of the reservoir. The quality of the reservoir is assessed in terms of physio-chemical parameters like pH, dissolved oxygen, conductivity, total dissolved solids, total suspended solids, biochemical oxygen demand, nitrates, phosphates, hardness, alkalinity, sulphates and chemical oxygen demand.

Keywords – Reservoir, agriculture, run off, contamination, ground water, oxygen.

INTRODUCTION

1.1 General

Water is an essential production factor in agriculture, both for crops and for livestock. Water is one of the most indispensable resources and is the elixir of life and primary cause for the organ of life on the planet Earth. Water constitutes about 70% body weight of almost all living organisms. Life is not possible on this planet without water. It exists in there as a median for both chemical and bio chemical reactions and also has an internal and external medium for several organisms. About 97.2% of water on earth is salty and only 2.8% is present as fresh water in which about 20% consists of ground water. The main source of water in the earth is through rivers, reservoirs, oceans and the subsurface ground water aquifers. Ground water is highly valued because of certain properties not possessed by surface water. Water can be used for various purposes like domestic, agricultural and industrial and etc.

Water of good quality is required for living organism. Basically the quality of water described according to its physical, chemical and biological parameter. The physico-chemical methods are used to detect the effects of pollution on the water quality. Changes in the water quality are reflected in the biotic community structure. Water is the most abundant and most useful compounds in the world. Life is not possible without water, the 2/3 mass of our body is water and 70% surface of the plane earth is covered by the water[1]. Water pollution occurs when the water body is adversely affected due to the addition of undesirable materials to the water. When it is unfit for its intended uses water is considered polluted. Reservoirs serve as an important life support system by helping in recharging of aquifers and regulating hydrological regimes[2]. Recharge of water table is possible due to the reservoirs, so the reservoirs play an important role in our lives. Present study deals with a Palair reservoir which is located in Khammam district.

1.2 Significance of the problem

Reservoir water quality is determining day by day to rapid growth in urbanization and excessive use of pesticides and fertilizers in agriculture areas, therefore, it is vital to study the reservoir water quality for drinking and irrigation use in problematic area. In order to assess the reservoir water quality for irrigation and drinking usage at palair reservoir about some distance from Khammam was selected for assessing the reservoir water quality.

1.3 Scope of study

In recent years environmental issues are become critical issues of the agenda of different forums of civil society in most of the countries .People are becoming more concerned about environmental issues like contamination quality and quantity of waste waters joining into the fresh water bodies of surface water bodies has become one of the priority tasks of local governments ,as the need for safe drinking water has become the top priority in both urban and rural areas.

1.3.1 Objectives of the present studies

The main objective of the work is to assess the reservoir water quality for drinking, agriculture use and the factors affecting the water quality. In these aspects from Palair reservoir sample were collected and analysis for various parameters conducted.

Palair reservoir it is located at

Palair village, Kusumanchi mandal, Khammam district, Telangana state, India.

latitude: 17°12'52.0"n+79°54'21.8"e

longitude: 17°12'52.0"n+79°54'21.8"e

EXPERIMENTAL

Materials

2.1 Glassware

ALL the glassware used in the present study was PYREX quality, manufactured by BOROSIL glassware Ltd, Mumbai.

2.2 Water:

Distilled water was used for all the experiments in the laboratory, with pH 7.0 – 7.2 and electrical conductivity 10 mho / cm.

2.3 Chemicals:

Analytical reagent (AR) grade chemical were used for the present study.

2.4 Reagents:

Reagents were prepared form analytical grade chemicals, using double distilled water.

2.5 Equipment/instruments:

The instrument used for carrying out the present study included digital pH meters (MKVL systronics) for pH measurement and conductivity meters (systronics 304) for conductivity measurement, UV –visible spectrophotometer (analytikjean SPEKOL 1200), microscope (Olympus, USA), Kjeldhal assembly (kjel plus, India), hot air oven, muffle furnace, Hach –COD reactor for COD measurement , Laminar Air Flow (Clas, India) etc.

2.6 Methodology:

The water samples were collected from (summer and rainy session) six different sampling locations. The sample from each location is collected from three different depths viz surface, medium and bottom. The sample were analyzed for (26) parameters. The standard procedure of sampling techniques was followed for the sample collection and they were brought to the laboratory within a day.

2.7 Sample analysis:

After collection, the samples were transported to the laboratory and analyzed for physical, chemical and biological parameters according to standard method [3] . A brief detail of the method and equipment used in the study were given in table 1.

TABLE:1 Methods and equipment used in the study

| S.NO | Parameter | Method | Instrument |
|------|----------------|--------------------------|------------------------------|
| 1. | pH | Electrometric | pH meter |
| 2. | Conductivity | Electrometric | Conductivity meter |
| 3. | TDS | Gravimetric | --- |
| 4. | Alkalinity | Titration by H2SO4 | --- |
| 5. | Total hardness | Titration by EDTA | --- |
| 6. | Ca hardness | Titration by EDTA | --- |
| 7. | Mg hardness | Titration by EDTA | --- |
| 8. | Chlorides | Argentometric | --- |
| 9. | Turbidity | Turbidimetric | UV-visible spectrophotometer |
| 10. | Sulphates | Turbidimetric | UV-visible spectrophotometer |
| 11. | Phosphates | Stannous chloride method | UV-visible |

| | | | |
|-----|------------------|---|------------------------------|
| | | | spectrophotometer |
| 12. | Nitrates | UV spectrophotometric Screening | UV-visible spectrophotometer |
| 13. | Nitrites | Colorimetric method | UV-visible spectrophotometer |
| 14. | Sodium | Flame emission | Flame photometer |
| 15. | Potassium | Flame emission | Flame photometer |
| 16. | Total COD | Digestion followed by titration using FAS | Reflux method |
| 17. | Dissolved COD | Digestion followed by titration using FAS | Reflux method |
| 18. | Dissolved oxygen | Iodometric | --- |
| 19. | BOD | 5 days incubation Followed by titration | BOD incubator |

RESULT and DISCUSSION

3.1 Physico-Chemical analysis:

The physico-chemical characteristics of water and sediment samples collected from the lack has been analyzed for different parameters physico-chemical, trace metal and microbiological and the result of these analyses are discussed below in detail the physical and chemical parameters evaluated are like pH, Dissolved oxygen (DO), conductivity, turbidity, total Dissolve solids (TDS), total suspended solids (TSS), biochemical oxygen demand (BOD), Nitrate, Phosphate, Hardness, Alkalinity, Sulphates, carbon dioxide (CO₂), chemical oxygen demand (COD) and trace metals. Micro-biological analysis has been carried out along with the identification of flora and fauna present in the reservoir. The concentration obtained for various physicochemical parameters are given in table-2. The values are compared with the standard values given by BIS standards.

TABLE: 2 Physico-Chemical analysis of palair reservoir in summer and rainy season

| Parameter Name | Sample-A1 | | Sample-A2 | | Sample-A3 | |
|----------------|-----------|-------|-----------|-------|-----------|-------|
| | Summer | Rainy | Sumer | Rainy | Sumer | Rainy |
| pH | 7.1 | 7.5 | 7.2 | 6.9 | 7.0 | 7.1 |
| Conductivity | 1055 | 1450 | 1470 | 1190 | 1195 | 985 |
| DO | 1.2 | 2.1 | 1.3 | 1.5 | 1.3 | 1.9 |
| TS | 875 | 856 | 415 | 850 | 920 | 782 |
| TDS | 850 | 755 | 806 | 751 | 827 | 724 |
| Alkalinity | 280 | 315 | 320 | 275 | 255 | 235 |
| Total hardness | 395 | 365 | 375 | 340 | 325 | 275 |
| Ca hardness | 255 | 230 | 246 | 215 | 160 | 140 |
| Mg hardness | 135 | 115 | 135 | 125 | 150 | 115 |
| Chlorides | 180 | 165 | 155 | 185 | 210 | 215 |
| Sulphates | 75 | 65 | 58 | 62 | 65 | 55 |
| Phosphates | 1.5 | 1.5 | 1.6 | 1.7 | 1.2 | 1.1 |
| Nitrates | 35 | 36 | 37 | 39 | 34 | 32 |
| Sodium | 175 | 185 | 195 | 160 | 190 | 185 |
| Potassium | 32 | 42 | 41 | 50 | 36 | 32 |
| COD | 655 | 665 | 690 | 680 | 650 | 550 |
| BOD | 140 | 135 | 132 | 125 | 146 | 143 |

3.1.1 pH:

The pH is the measure of the intensity of acidity or alkalinity and the concentration of hydrogen ion concentration. The adversely affect on skin and eye irrigation at acidic and basic condition [4]. The result showed in summer and rainy season that all of the samples ranged between 6.9 to 7.5 in rainy season and 7.0 to 7.2 in summer season. The sample A1 in rainy season has been found to be pH-7.5. pH of the reservoir water is within the acceptable limits.

3.1.2 Electrical conductivity:

Electrical conductivity is due the dissolved cation and anions of the water [5]. EC of the palair water sample has range from 1055-1470 us/cm in summer season and 985-1425 us/cm in rainy season.

3.1.3 Turbidity:

Turbidity is a measure of water clarity, which measures the suspended material in water. With increase in the turbidity of water the passage of light decreases. The turbidity of the reservoir water has ranged from 3.0 NTU to 16.5 NTU. This might be due to the human interference which is because of water level decrease and fishing activities. High turbidity can significantly reduce the aesthetic quality of reservoirs and streams, having a human impact on recreation and tourism. It can increase the cost of water treatment for drinking and food processing.

3.1.4 Water temperature:

Water temperature is an important factor which influences the chemical, biochemical and biological characteristics of water body. In the present study the water temperature ranged from 24.5 degree centigrade to 27 degree centigrade.

3.1.5 Alkalinity:

Alkalinity is a measure of the capacity of water to neutralize acids. It is due to presence of bicarbonates, carbonates and hydroxide. The alkalinity of the reservoir has been observed to be in the range from 235 mg/l to 320mg/l rainy season and 256 mg/l to 364 mg/l in summer season. The inlet sample alkalinity observed to be more (364mg/l). then the outlet sample and it may be under permissible limits [6].

3.1.6 Hardness:

When water passes through deposits of limestone, the level of Ca^{2+} , Mg^{2+} , and HCO_3^- ions concentration in the water greatly increase and causes the water as hard water. Total hardness is defined as the sum of calcium and magnesium. The total hardness ranged from 275 mg/l in summer season and 310 mg/l to 410 mf/l in rainy season, which had not exceeded the permissible limits of the BIS standards. At end of reservoir maximum hardness has observed.

3.1.7 Calcium and magnesium:

Calcium is an important component of cell walls of aquatic plants, and of the bones or shells of aquatic organisms. Calcium concentration of the reservoir ranged from 140mg/l to 240mg/l in summer season and 140mg/l to 255 mg/l in rainy season where as the magnesium found to be 98mg/l to 140mg/l in summer season and 115 mg/l to 150mg/l in rainy season respectively.

3.1.8 Chloride:

Chloride are not usually harmful to people, however the sodium part of table salt has been linked to heart and kidney disease. Chloride concentration id observed to range from 145mg/l – 210mg/l in summer season and 155mg/l to 215mg/l in rainy season. Which fall under the standard permissible limit of the drinking water standard. Sodium chloride may impart a salty taste to water at 250 mg/l however,

3.1.9 Flouride (f):

High fluoride content in the reservoirs which could amount to a health risk, diseases of fillet, skin gills and bones which may contain high concentration of fluoride. The reservoir water sample fluoride concentration range from 0.6mg/l to 0.18 mg/l in the reservoir sample. Two sample were observed to 1.8mg/l and 1.7mg/l. the fluoride concentration of reservoir sample is in permissible limits of drinking water standards.

3.1.10 Sulphate (SO_4^{-2}):

Sulphate helps in determination of water quality. While sulphate imparts a slightly smilder taste to drinking water than chloride, no significant taste effect are detected below 300 mg/l. the sluphate concentration in reservoir water range from 55mg/l to 75mg/l in rainy season. The sluphate concentration observed at inlet is 105 mg/l in summer and 88 mg/l in rainy season. The sulphate concentration in reservoir water is observed to be within permissible limits of drinking water standards.

3.1.11 Dissolved oxygen:

Dissolved oxygen analysis measure the amount of gaseous oxygen (O_2) dissolved in an aqueous solution. The dissolved oxygen level in natural water and wastewaters depend on physical, chemical and biological activities in the water. A high level of dissolved oxygen means a low BOD and indicates a low level of organic contaminant or pollutant in the water [7]. The dissolved oxygen in reservoir water is found to range from 1.4 mg/l- 2.2 mg/l in summer and 1.2 mg/l to 1.9 mg/l in rainy season.

3.1.12 Biochemical oxygen demand:

The biochemical oxygen demand, abbreviated as BOD, is a test for measuring the amount of bio-degradable organic material present in water. Which microorganisms, samples is observed to range from 90mg/l-154mg/l in summer and 115mg/l -146mg/l in rainy season and it may be due to the entering of domestic waste water agriculture runoff.

3.1.13 Chemical oxygen demand:

Chemical oxygen demand is a rapid two hours test which measure the oxygen required for the oxidation of all the substances present in water. COD is a reliable parameter for judging the extent of pollution in water. The COD of water increases with increasing concentration of organic matter. Chemical oxygen demand concentration in the reservoir water is observed to range from 410mg/l to 690mg/l in summer and 570mg/l to 680mg/l in rainy season recorded. The highest concentration of 680mg/l and 690mg/l of COD is observed in the sample in both seasons and it may be due to the entering of domestic waste water.

3.1.14 Nitrate:

Nitrate concentration demand on the activity of nitrifying bacteria which in turn gets influenced by the presence of dissolved oxygen. In the present study, the values of nitrate in the range from 21mg/l to 45mg/l in summer and 32 mg/l to 39mg/l in rainy season respectively.

3.1.15 TS and TDS:

In natural water, dissolved solids are composed mainly of carbonates, bicarbonates, chlorides, sulphates, phosphates, nitrates, calcium, magnesium, sodium, potassium, iron, and manganese. They originate from dissolution or weathering of the rocks and soil, including dissolution of lime, gypsum and other slowly dissolve soil minerals. The total solids are observed to range from 965mg/l to 1082mg/l in summer and 415mg/l to 920mg/l in rainy season and total dissolved solids range from 625mg/l to 926mg/l to in summer and 724mg/l to 850mg/l in rainy season respectively. Maximum permissible limit of water sample is 2000mg/l.

3.1.16 Sodium and Potassium:

Sodium and potassium are non-toxic metals. The principle source of sodium and potassium is the weathering of igneous rock and salt deposits, as well as the leaching of soils. Concentration of sodium is observed to range from 135mg/l to 221mg/l in summer and 160mg/l to 195mg/l in rainy season, and at sample A2 (230mg/l) in summer, sample A2 (245mg/l) in rainy season points, concentration of sodium is observed to be high. The potassium concentration ranged from 21mg/l to 45mg/l in summer and 32mg/l to 50mg/l in rainy season respectively and at sample A5 (50mg/l) in summer, sample A2(48mg/l) in rainy season it's concentration is observed to be high.

3.2 Sediment quality analysis:

Sediment is a naturally occurring material and that is broken down by processes of weathering and erosion by strong. Movement of solid particles (sediment), typically due to a combination of the force of gravity acting on the solid particles, and/or the movement of the fluid in which the solution. So the parameters of the water may present in sediment quality. This enhanced the sediment quality assessment. The sediment quality assessment included parameters like pH, EC, Moisture contain, organic matter, phosphates etc.[8].

Table: 3 Sediment Physico-Chemical Analysis

| Parameter Name | Sample-A1 | | Sample-A2 | | Sample-A3 | |
|------------------|-----------|-------|-----------|-------|-----------|-------|
| | Summer | Rainy | Summer | Rainy | Summer | Rainy |
| pH | 7.8 | 6.8 | 7.2 | 7.3 | 7.6 | 7.4 |
| EC | 1385 | 1295 | 1522 | 1362 | 1186 | 1110 |
| Moisture Content | 8.5 | 8.7 | 8.2 | 8.9 | 9.1 | 9.3 |
| Chlorides (mg/l) | 2.1 | 1.9 | 2.3 | 2.2 | 2.1 | 2.0 |
| Organic Matter | 12.5 | 11.3 | 12.9 | 12.2 | 10.0 | 9.8 |
| Phosphate | 1.6 | 1.4 | 1.7 | 1.5 | 1.4 | 1.3 |

3.2.1 pH:

pH of the sediment sample ranged between 6.8 to 7.9 in rainy and summer seasons, which is slightly alkalinity. The maximum pH has observed 7.9 at sample A5.

3.2.2 Electrical conductivity:

Electrical conductivity of the sediment sample ranged between 1110-1522 us/cm.

3.2.3 Phosphates:

Phosphates gives general physical appearance of sediment which strongly influence its properties like porosity, permeability, bulk density and organic matter [9]. The phosphates concentration of the reservoir sediment ranged from 1.1gm/kg to 1.7 mg/kg.

3.2.4 Chlorides:

Chloride is used only slight increases in concentration of chloride occur with increasing depth in the sediment. Chloride is a common constituent in animals and human wastes, potash fertilizers and often a component of road deicing agents. The palair reservoir sediment sample in summer and rainy seasons, the chloride ranged between 1.9 mg/l to 2.5mg/l of sediment samples. The A6 sediment observed to be more that is 2.5 mg/kg.

3.2.5 Organic matter:

Organic matter influences many of the physical, chemical, biological properties of soil. Some of the properties influenced by organic matter include soil structure, soil compressibility and shear strength. In addition, it also affects the water holding capacity, nutrient contributions, biological activity, and water and infiltration rates the organic matter in the reservoir sediment was in between 9.8 to 14.2 mg/kg. The organic matter in the sediment at inlet point A6 observed to be highest (14.2 mg/kg).

3.2.6 Moisture content:

Moisture content is the water held in spaces between sediment particles and is usually associated to the bulk density, porosity and organic matter. Low moisture content in sediments may be result of sand dominance and medium organic content (chandrakiran 2013). Moisture bulk density, porosity and organic content. Moisture content observed in reservoir sediment sample ranged from 8.2 mg/kg to 9.4 mg/kg.

3.3 Stream restoration:

The stream is contamination with different effluent and need to be restored by using various approaches. In the drainage basins the organic matter production has increased because of excessive nutrition in the water. Hence the effluence must be pre treated for equalization and pH adjustments. It is also essential to see that no industrial waste flows out of the factory in an open drain since this will be carried to the reservoirs along with rainwater.

Different methods have been employed to restore the reservoirs

- Precipitating the effluence components by using Alum before entering in to the reservoir.
- Reducing the algal biomass to increases the dissolve oxygen and water transparency which enhance light penetration in to the water helps to grow phytoplankton and these phytoplankton helps to reduce nutrients in the water.
- Removal of dead organic matter or sediment in the reservoir is essential to support aquatic life.

CONCLUSION

The BOD of the Palair Reservoir samples were in ranged between 95mg/l to 154mg/l in summer and 90mg/l to 146mg/l in rainy season. The COD of the palair reservoir samples were in ranged between 458mg/l to 690mg/l in summer and 410mg/l to 680mg/l in rainy season respectively and it needs to be treated before used as agriculture purposes. And there is no need to treated before used as agriculture purposes. All the physical and chemical properties of palair reservoir water are within the acceptable limits. The samples collected in summer and rainy season since these values are restricted to summer and rainy seasons. These values could be change in winter so further work should be carried out by collecting water samples in winter season.

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