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Water Parameters of Tanks in Melghat and Aquaculture

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Abstract— The proposed work has undertaken the study of Government policy of providing fish tanks without any exchange for the purpose of giving employment and nutritious food to the people in Melghat who are facing the problem of 'Malnutrition'. Suitability of five tanks for sound fish production has been tested. It also highlights the function and implementation of Government policy undertaken to solve the problem of Malnutrition. In the present study, some physico-chemical parameters such as Temperature, Turbidity, Electrical Conductance, pH, Dissolve Oxygen, Free CO_2, Chloride, Hardness, Calcium, Magnesium, Sulphate, Phosphate, Ammonia, Nitrate and Nitrite of 5 tanks in Melghat are investigated and tried to correlate with fish production of these tanks.

Index Terms— Physico-chemical parameters, water tanks, malnutrition, Melghat

1 INTRODUCTION

Melghat sanctuary is a beautiful piece of nature. Extended in Amravati forest division of Maharashtra State and covered about 1600 sq. Km. of area. It is gifted with dazzling greenery and different water sources like rivers, lakes, tanks etc. which is contained between latitudes 210 15′ North and 210 45′ North, longitudes 760 57′ East and 770 30′ East [1]. It is buffered by approximately equal extent of good forest cover. The forest system is mostly tree dominated. The climate of region is tropical. All the three seasons are well defined and reach extremity during the peak period. Summer is very scorching with maximum temperature of 40 - 45 ^{0}C. Winter is severe with minimum temperature of 10 - 15 ^{0}C and rainy season registers highest rainfall of the district. Annual rainfall is usually highest on the main ridge amounting to 2250 mm. and gradually decreases to about 1000 mm. towards North and West. Bulk of the rainfall is received from July to September. Precipitation is briskly received within 60 to 70 rainy days. The tract is hilly and rugged with altitudinal range from 1178 m. above MSL to 381 m. above MSL.

Most people lived in Melghat region are aborigine tribes. High percentage of them lived under poverty; the source of their livelihood generally is work on daily wages at any construction site, farm etc. that's why they cannot invest for education, this leads them to face illiteracy and blindly following tradition.

All these reason keep them unaware of different Government policies, due to this they cannot improve their living. They are unable to afford nourishing food for their children and not aware of when to vaccinate. This leads them to face the social as well as health related problems such as 'Malnutrition'.

Nowadays this becomes the most serious problem in the region. The Government has already picked up some steps in a way to tackle this problem, some policies and schemes has already implemented. One of the policies has provided 21 tanks for fish production without any exchange, the purpose is very cleared that to give an employment and provide fish as nutrition food.

Under this policy, for each region, Government appointed a society of members from the Grampanchayat of the same region. The basic objective of these societies is to increase fish production by taking care of the tanks and proper management of the policy. From last ten years Government provides requirements to the societies periodically such as fish seed, fish fertilizer, fish food etc, and maintenance equipment. It is the improved form of the previous policy, in which the total work used to give on the contract for a year and gain from each tank shared by contractor and Government.

Scientific study of these pisciculture tanks is necessary to get maximum fish production so as to solve the problem of wages and nutritious food of people in Melghat. For the present project 5/21 tanks in Melghat i.e. Biroti, Dabaka, Golayi, Karada and Hatida are selected because the study of these tanks would benefit the maximum (around 9000-10,000) population of this region.

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2 SITE DESCRIPTION

Five tanks in Melghat area were selected for investigation of water quality (Fig.–1). The mean value for the physico-chemical parameters for any tanks is a reasonable representation of the tank water under study. The sample collection and the analysis of the 15 physico-chemical parameters, was carried out in the rainy season, to study its suitability for fish production. At each location, a liter of water was taken, 50 cm below the surface, with a polyethylene bottle and brought to a laboratory for analysis of some parameters like Temperature, Turbidity, Electrical conductance, pH, Dissolved oxygen, Free CO_2, Chloride, Hardness, Calcium, Magnesium, Sulphate, Phosphate, Ammonia, Nitrate and Nitrite.

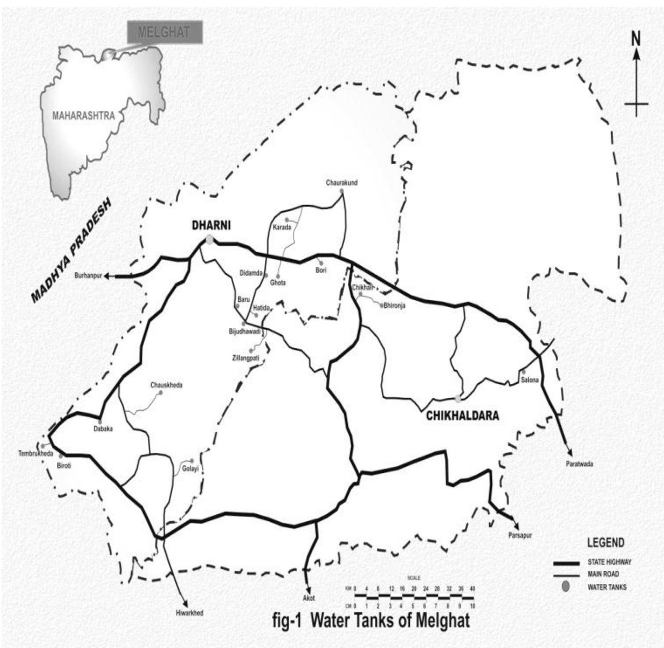

Figure 1 Water Tanks in Melghat.

3 MATERIALS AND METHODS

Water samples were collected from 5 tanks and brought to the laboratory for various physico-chemical analysis. Temperature, Turbidity, Free CO_2 and Dissolve Oxygen were measured on the sampling spot. Standard Methods for the Examination of Water and Waste-water was followed for analyses of different physico-chemical parameter [2].
Temperature was measured by Celsius thermometer, Turbidity measured by Nephelometric method; pH was measured by handy pH meter and Electrical Conductance was measured by an conductivity meter. Dissolved oxygen was measured by Winkler's Iodometric method. Free CO_2 was measured by Potentiometric Titration method. Chloride was estimated by Argentometric method. Hardness, Calcium and Magnesium were measured by EDTA method, Ammonia, Sulphate, Phosphate, Nitrate and Nitrite were estimated by Colorimetric method.

4 RESULT AND DISCUSSION

Table 1 below presents the chemical composition values obtained from the physico-chemical analysis of water samples from Biroti, Dabaka, Golayi, Karada and Hatida tanks.

Properties	Biroti	Dabaka	Golayi	Karada	Hatida
Temperature (⁰C)	25.1	27.3	26.7	28	26.5
Turbidity (NTU)	8.1	8.4	10.5	11.7	15.3
EC (µmhos)	159.22	132.70	80.54	49.13	67.73
pH	7.74	7.81	7.48	7.45	7.54
DO (mg/L)	9.45	8.24	8.57	7.96	8.66
Free CO_2 (mg/L)	3.920	1.307	3.920	2.614	1.307
Chloride (mg/L)	5.68	8.52	11.36	17.04	8.52
Hardness (mg/L)	136	108	72	48	60
Calcium (mg/L)	33.67	28.86	19.24	12.82	20.84
Magnesium (mg/L)	12.670	8.771	5.847	3.898	1.949
Sulphate (mg/L)	21.0	25.0	35.5	60.5	43.0
Phosphate (mg/L)	0.10	0.14	0.18	0.24	0.20
Ammonia (mg/L)	0.016	0.005	0.012	0.020	0.009
Nitrate-N (mg/L)	1.96	2.42	2.14	3.02	1.65
Nitrite-N (mg/L)	0.035	0.028	0.017	0.042	0.030

TABLE 1 PHYSICO-CHEMICAL PROPERTIES OF WATER.

4.1 TEMPERATURE

From the result above tabulated and figure 2 below, it is revealed that the temperature of water varied from 25.1 ^{0}C, 27.3 ^{0}C, 26.7 ^{0}C, 28 ^{0}C and 26.5 ^{0}C for Biroti, Dabaka, Golayi, Karada and Hatida water tanks respectively. No mark variation was observed. However, the observed variations in the temperature were closely related with the change in ambient temperature.
In fish, the process of multiplication time of reproduction respiration, metabolic rate and nutrition are directly influenced by temperature. Photosynthetic activity in the water body and decomposition of organic matter on the pond bottom are also regulated by temperature. The growth of the fish depends on temperature. Penaeus monodon normally become cramped and die at

temperature below 13 ^{0}C or above 33 ^{0}C [3] and show normal growth in the range of 28-33 ^{0}C [4]. For most of the cultural species 20-30 ^{0}C is considered favorable. Warm water fishes require relatively low dissolved oxygen and can live in temperature ranging from 10-35 ^{0}C [5].

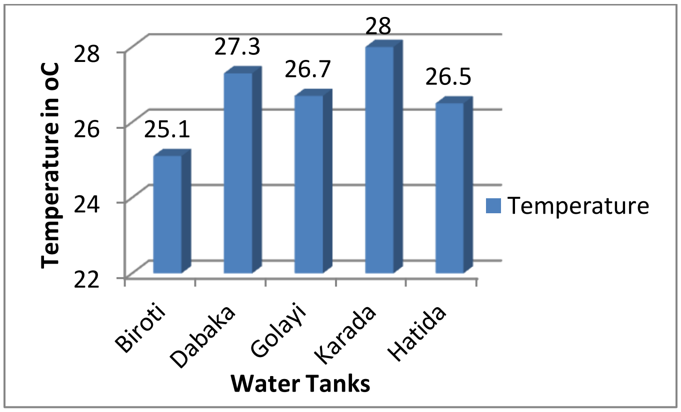

Figure 2 Temperature of water in Tanks.

4.2 TURBIDITY

From the figure 3 below, it can be seen that, the turbidity of water are 8.1 NTU, 8.4 NTU, 10.5 NTU, 11.7 NTU and 15.3 NTU for Biroti, Dabaka, Golayi, Karada and Hatida water tanks respectively. The majority of water tanks were higher value of turbidity.

Penetration of light to water phase is determine by turbidity which is measured optically and present the several factors such as, suspended clay particles, dispersion of plankton organisms, particulate organic matter and the pigments caused by decomposition of them. Excessive turbidity bespeaks of poor light budget and poor primary production. Plankton turbidity, on the other hand, while indicative or productive waters also limits heat and light penetration thus reducing the effective volume of productive zone. As plankton turbidity is a consequence of productive metabolism of water, this has sometime been used as a valuable index of fertility status of fish pond. Ponds with green water generally give better yields of fish than pond with clear water [6]. Various stages of coloration of a pond can be used as indicator for determining the fertility of a pond. It is generally found that the plankton turbidity and the turbidity due to suspensions of clay particles seldom exist together.

Ponds having high turbidity are generally poor in plankton due to lack of light penetration resulting in low productivity. While highly turbid water is undesirable for fish pond, productive ponds are generally found to have slightly turbid water. Probably an exchange process between the adsorbed nutrients on the surface of the clay particles and soluble nutrients in water helps to maintain higher nutrients concentration in water [7].

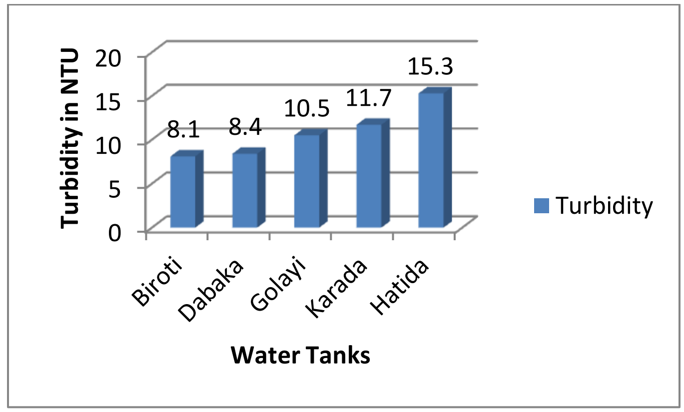

Figure 3 Turbidity of water in Tanks.

4.3 ELECTRICAL CONDUCTANCE

Electrical conductivity of ponds is commonly used for indicating total concentration of the cations or anions in the ponds and it is closely related to the total dissolved solids. As the dissolved solid in the highly mineralized waters are usually more than 65% of the conductivity, the value of dissolved solid, as a general rule, can be obtained by multiplying it by a factor of 0.65 [8].

In fresh water ponds, electrical conductivity is not usually considered, as an important parameter for regular observation. In such ponds, however, significant difference in the EC may some times indicate high concentration of tannins, lignins and other organic substances [9]. The conductivity of domestic wastewater may be near that of local water supply, although some industrial wastes have conductivities above 10000 µmhos /cm. Conductivity is highly depends on the presence of ions, their total concentration, mobility, relative concentrations and on the temperature.

Figure 4 shows a bar chart which presents the electrical conductance in the water samples. The respective values are 159.22 µmhos, 132.7 µmhos, 80.54 µmhos, 49.13 µmhos and 67.73 µmhos corresponding for Biroti, Dabaka, Golayi, Karada and Hatida water tanks.

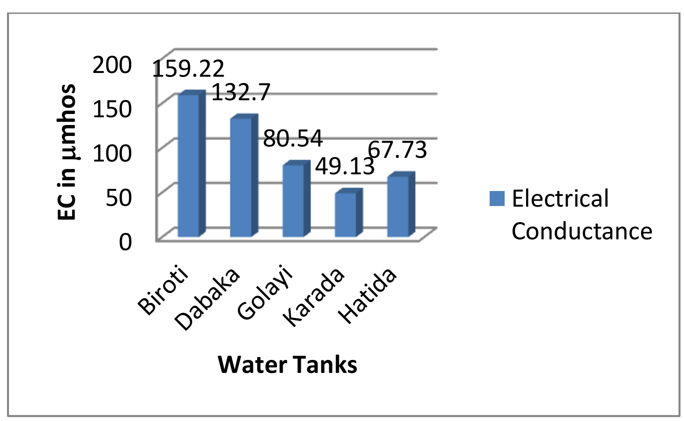

Figure 4 Electrical Conductance of water in Tanks.

4.4 pH (Potentia hydrogenii)

pH is an important environmental factor, which influences nutrient availability, microbial activity and toxic effect of some element. pH is the measure of the intensity of acidity or alkalinity and measures the concentration of hydrogen ions in water. From the experimental result above and figure 5 below, the respective values of pH in Biroti, Dabaka, Golayi, Karada and Hatida water tanks are 7.74, 7.81, 7.48, 7.47 and 7.54. It can be seen that, the pH of most of the water tanks was always in alkaline side.

A pH range from 7.0 to 9.0 is considered to be suitable for fish culture. This value is influenced by the concentration of bicarbonate, carbonate, carbon dioxide, soil and dissolved oxygen released during photosynthetic activity in aquatic environment. Diurnal variation of pH is associated with primary productivity and respiration by biotic community in fish ponds. Wide fluctuation of pH is considered detrimental for aquatic life. Reduction of high pH caused by intense photosynthetic activity is effected by alum and gypsum [10]. Most natural water is generally alkaline due to the presence of sufficient quantities of carbonates. pH of water get drastically changed with time due to the exposure to air, biological activity and temperature changes. Most chemical and biological reactions occur at a narrow range of pH.

However, a lower value below 4 will produce sour taste and higher value above 8.5, an alkaline taste. High pH induces the formation of trihalomethanes, which are toxic. The carbon dioxide produced by respiration of animals and plants in water have the effect of lowering pH. Carbon dioxide and bicarbonate removed from the water by the photosynthetic processes of aquatic plants raises pH. The same processes alter the dissolved oxygen content; oxygen drops during respiration and decomposition; it rises with photosynthetic activity. A pH that is too high is undesirable because free ammonia increases with rising pH [11]. The acceptable pH range for most finfish and shellfish species is 6.8 - 8.5.

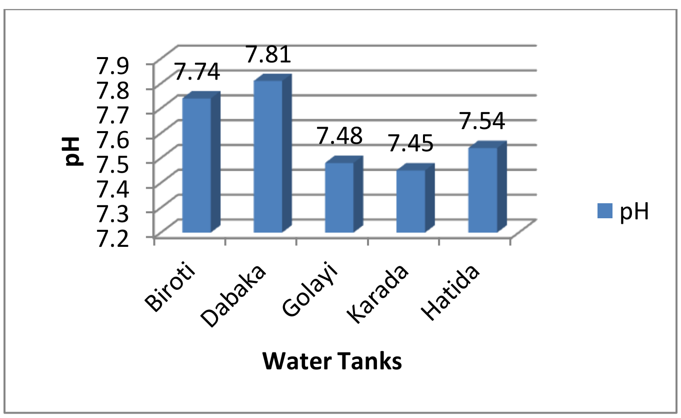

Figure 5 pH of water in Tanks.

4.5 Dissolved Oxygen

Among water variables oxygen is the most critical factor which influences survival, growth and reproduction of aquatic animals. Solubility of oxygen in water depends upon temperature, pressure and dissolved salts. Higher the temperature lowers the solubility of oxygen in water. Balance of oxygen in fish pond at a given time is the difference between production and demand for the oxygen by the aquatic environment. Its presence is essential to maintain the higher forms of biological life in the water; and the oxygen balance of the system largely determines the effects of a waste discharge in a water body.

From the figure 6 below, it is observed that, the dissolved oxygen of water are 9.45 mg/L, 8.24 mg/L, 8.57 mg/L, 7.96 mg/L and 8.66 mg/L for Biroti, Dabaka, Golayi, Karada and Hatida water tanks respectively. At all the water tanks in Melghat recorded the higher values of dissolved oxygen.

Early morning DO of about 5.0 mg/L is considered suitable for fish growth in ponds under intensive cultivation. High content of salt and organic matter induce negative balance of oxygen in most of the waste water and it becomes limiting factor in sewage fed aquaculture. Maintenance of adequate level of oxygen is, therefore, essential for survival and growth in sewage enriched ponds [12].

During day time increased photosynthetic activity due to phytoplankton and algal bloom produces considerable amount of oxygen. The DO thus produced is continuously consumed by fish and other aquatic organisms during night and decreases to minimum level in the early morning. Low oxygen in water can kill fish and other organisms present in water. Organisms have specific requirement of oxygen, for example, game fish requires at least 5 mg/L and coarse fish about 2 mg/L of minimum dissolved oxygen in water [13]. The dissolved oxygen level in water is constantly changing and represents a balance between respiration and decomposition that deplete oxygen and photosynthetic activity which increases it. Organic waste may overload a natural system causing a serious depletion of the oxygen supply in the water that in turn leads to kill fish.

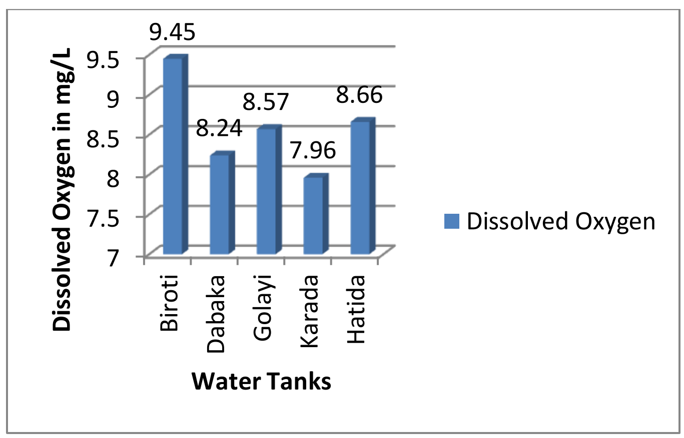

Figure 6 Dissolved Oxygen of water in Tanks.

4.6 Free CO2

From the result above tabulated and figure 7 below, the concentration of free CO_2 in water samples are 3.920 mg/L, 1.307 mg/L, 3.920 mg/L, 2.614 mg/L, and 1.307 mg/L for Biroti, Dabaka, Golayi, Karada and Hatida water tanks respectively. At all the water tanks in Melghat recorded lower values of free CO_2 concentration.

Most fish species survive several days in water containing upto 60 ppm carbon dioxide provided dissolved oxygen is plentiful. When DO concentration is low, the presence of appreciable carbon dioxide hinders uptake of oxygen. Unfortunately carbon dioxide concentration are high when DO concentration are low e.g. in night hours. When the conversion of carbon dioxide to organic matter by photosynthesis is greater than the available carbon dioxide from biotic respiration and organic matter decomposition, required carbon dioxide is drawn from bicarbonate reserve. At pH 4.5 to 8.3 only carbon dioxide and bicarbonate will be present which is generally observed during early hours. At pH 8.4 to 10.5 both carbonate and bicarbonate will be present with no carbon dioxide, which will occur during day time photosynthesis [14].

The importance of carbon dioxide lies essentially as a supplier of carbon in carbohydrate synthesis. Its importance has sometime been over estimated and poor production of fish in ponds manures with lime has been cribbed as to the removal of carbon dioxide. Carbon dioxide (CO_2) is present in water supplies in the form of a dissolved gas. Typically, surface water contain less than 10 ppm free carbon dioxide while ground water may have much higher concentrations. Dissolved in water, CO_2 forms carbonic acid that lowers pH. Of significance for fish is the fact that when the oxygen concentration falls (e.g. through the degradation of organic wastes), the carbon dioxide concentration rises. This increase in carbon dioxide makes it more difficult for fish to use the limited amount of present oxygen. To take in fresh oxygen, fish must first discharge the CO_2 in their blood stream, a process which is slowed down considerably when there are high concentrations of CO_2 in the water itself.

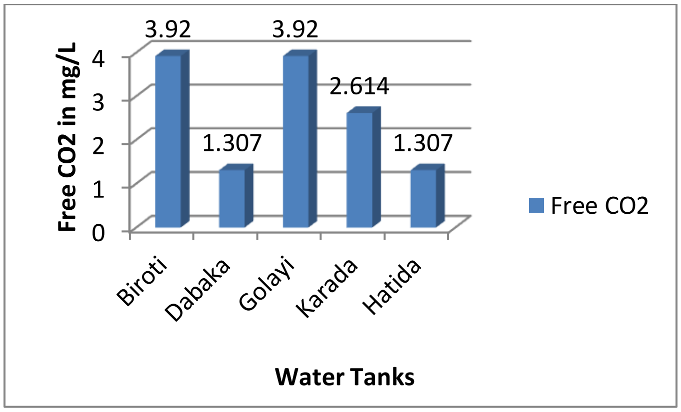

Figure 7 Free CO_2 of water in Tanks.

4.7 Chlorides

Chloride, in the form of chloride (Cl^-) ion, is one of the major inorganic anions in the water. In natural freshwaters, however, its concentration remains quite low and is generally less than that of sulphate and bicarbonate. The most important source of chlorides in the waters is the discharge of domestic sewage. Therefore, the chloride concentration serves as an indicator of pollution by sewage. Industries are also important sources of chlorides. Chlorides are highly soluble with most of the naturally occurring cations and do not precipitate, sediment and cannot be removed biologically in the treatment of the wastes. Chloride are present in large amounts may be due to natural processes such as the passage of water through natural salt formations in the earth or it may be an indication of pollution from sea water intrusion, industrial or domestic waste or deicing operations. Potable water should not exceed 250 mg/L of chloride.

Figure 8 shows a bar chart which presents the chloride contents in the water samples. The respective values are 5.68 mg/L, 8.52 mg/L, 11.36 mg/L, 17.04 mg/L and 8.52 mg/L correspondingly for Biroti, Dabaka, Golayi, Karada and Hatida water tanks. The entire water tanks were minimum value of chloride concentration.

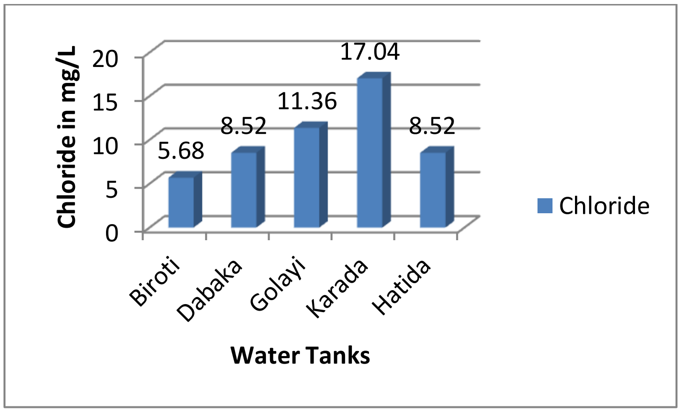

Figure 8 Chloride Concentrations.

4.8 Hardness

Hardness is the properties of water, which prevents the lather formation with soap and increases the boiling point of water principal cations imparting hardness, are calcium and magnesium. However, other cations such as strontium, iron and manganese also contribute to the hardness.

The anions responsible for hardness are mainly bicarbonate, carbonate, sulphate, chloride, nitrate, and silicates, etc. Fish also requires certain levels of calcium and magnesium ions in water and they do not grow normally in the water with less than 5 ppm of hardness.

From the figure 9 below, it can be seen that, the total hardness of water are 136 mg/L, 108 mg/L, 72 mg/L, 48 mg/L and 60 mg/L for Biroti, Dabaka, Golayi, Karada and Hatida water tanks respectively. Usually ponds having hardness less than 20 ppm respond positively to liming. Hardness is called temporary if bicarbonate and carbonate salts of the cations cause it. Mainly sulphates and chlorides of the metals caused permanent hardness.

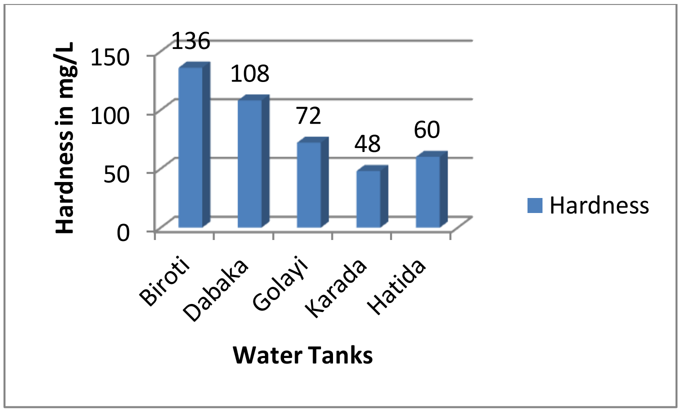

Figure 9 Hardness of water in Tanks.

4.9 Calcium

From the figure 10 below, it is observed that, the concentration of calcium varied from 33.67 mg/L, 28.86 mg/L, 19.24 mg/L, 12.82 mg/L and 20.84 mg/L for Biroti, Dabaka, Golayi, Karada and Hatida water tanks respectively. At all sampling stations, higher value of calcium was observed.
Mostly it is present in optimum concentration. In case of its non-availability, it can be added from external source for optimum yield of fish. An optimum concentration for calcium is 5 mg/L in water. Calcium is one of the most abundant substances of the natural waters. Being present in high quantities in the rocks, it is leached from there to contaminate the water. The quantities in natural waters generally vary from 10 to 100 mg/L depending upon the types of the rocks.
Disposal of sewage and industrial wastes are also important sources of calcium. It has got a high affinity to adsorb on the soil particles; therefore, the cation exchange equilibrium and presence of other cation greatly influence its concentration in the water. Natural softening of the water takes place when water percolates to aquifers due to the exchange by sodium ions. Concentration of the calcium is reduced at higher pH due to its precipitation as $CaCO_3$.

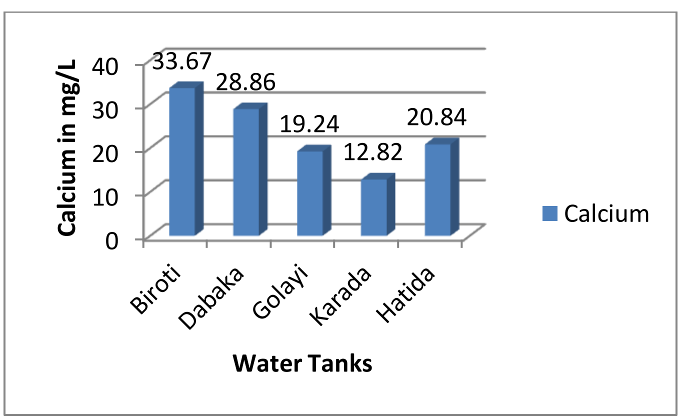

Figure 10 Calcium Concentrations.

4.10 Magnesium

Similarly, from the figure 11 below, the amount of magnesium varied from 12.67 mg/L, 8.771 mg/L, 5.847 mg/L, 3.898 mg/L and 1.949 mg/L for Biroti, Dabaka, Golayi, Karada and Hatida water tanks respectively. At all tanks sampling stations, higher value of magnesium was observed.
Pond water, for optimum production of fish the concentration of magnesium is 2 mg/L in water. Phytoplankton and algae require 2 ppm of magnesium for maximum growth [15]. Magnesium also occurs in all kinds of natural waters with calcium, but its concentration remains generally lower than the calcium. The principal sources in the natural waters are various kinds of rocks.
Sewage and industrial wastes are also important contributors of magnesium. Like calcium, the concentration of magnesium also depends upon exchange equilibrium and presence of the ions like sodium. Natural softening of water occurs during percolation through soil by exchange with sodium ions. Magnesium ions in water also precipitate colloidal organic matter and increase the transparency of water, which favour higher photosynthesis.

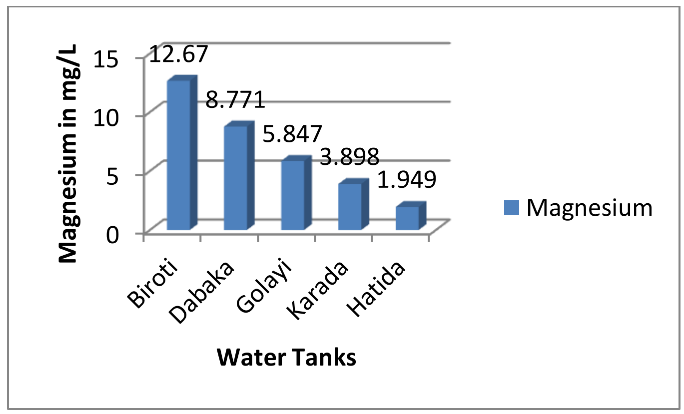

Figure 11 Magnesium Concentrations.

4.11 Sulphate

Sulphur as the secondary nutrients in water pond. Sulphur becomes available to fish food organisms through microbial conversion to sulphate or through decomposition of proteineceous materials. Sulphate is a naturally occurring anion in all kinds of natural waters. In arid and semiarid regions, it is found in particularly higher concentrations due to the accumulation of soluble salts in soils and shallow aquifers. Biological oxidation of reduced sulphur species to sulphate also increases its concentrations. Rainwater has quite high concentration of sulphate particularly in the areas with high atmospheric pollution. Discharge of industrial wastes and domestic sewage in the waters tends to increase its concentration.
Most of the salts of sulphate are soluble in water and as such it is not precipitated. However, it may undergo

transformations to sulphur and hydrogen sulphide depending upon the redox potential of the water. Sulphate is an important constituent of hardness with calcium and magnesium. Sulphate produces an objectionable taste at 300-400 mg/L concentrations. Above 500 mg/L, a bitter taste is produced in the water. At concentrations around 1000 mg/L, it is laxative [16].

From the figure 12 below, it can be seen that, the sulphate concentration varied from 21 mg/L, 25 mg/L, 35.5 mg/L, 60.5 mg/L and 43 mg/L for Biroti, Dabaka, Golayi, Karada and Hatida water tanks respectively. At all the water tanks in Melghat recorded lower value of sulphate concentration.

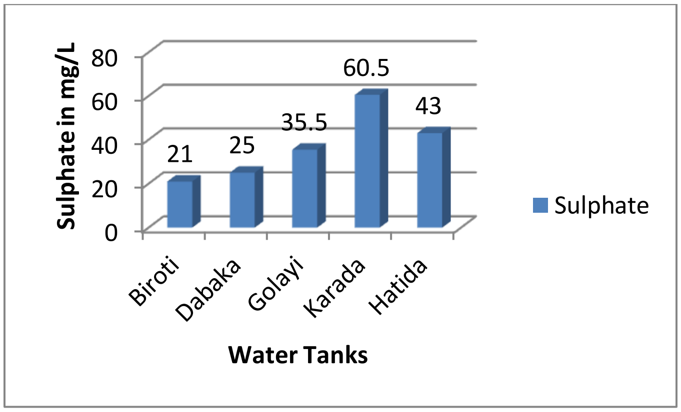

Figure 12 Sulphate Concentrations.

4.12 PHOSPHATE

From the experimental result above and figure 13 below, the respective concentration of phosphate in Biroti, Dabaka, Golayi, Karada and Hatida water tanks are 0.10 mg/L, 0.14 mg/L, 0.18 mg/L, 0.24 mg/L and 0.20 mg/L. It can be seen that at all the sampling station recorded high concentration of phosphate.

Low level of phosphorus generally uncounted in freshwater fishponds is considered as limiting factor for productivity. However, the productivity of wastewater ponds is not limited due to high concentration of phosphorus in wastewater. Considerable amount of phosphorus present in wastewater is absorbed on bottom sediments. Phosphorus in the natural freshwater is present mostly in inorganic forms such as $H_2PO_4^-$, HPO_4^{-2} and PO_4^{-3}. Phosphorus being an important constituent of biological systems may also be present in the organic forms. The rocks in which most of the phosphorus is bound, are generally insoluble in water, and hence the phosphorus content of natural freshwaters is low and biological growth is limited due to this fact.

The major sources of phosphorus are domestic sewage, detergents, agricultural effluents with fertilizers, and industrial wastewaters. The higher concentration of phosphorus, therefore, is indicative of pollution. The prime concern of phosphorus lies in the ability to increase the growth of nuisance algae, and eutrophication. Phosphorus as such is not harmful to the organisms. The quality criteria for phosphorus in water are only to check nuisance growth of algae and process of eutrophication.

According to U.S.EPA (1976), the concentration of it should not exceed 50 µg/L in any tributary to river or a lake and 25µg/L within these main resources. Srinivasan and Muthuswamy (1979) observed high value of phosphorus ranging from 0.8 to 10.4 mg/L in wastewater ponds of Madras. Olah et al (1986) reported the value of phosphate in wastewater ranging from 0.2 to 0.5 ppm in ponds of Calcutta.Banerjia (1967) studied available phosphate in fresh water ponds and correlated it with aquatic productivity. He observed less than 0.05 ppm phosphate concentration to be low for fish production, 0.05 to 0.2 ppm as moderate to high and above 0.2 ppm to be index of high productivity.

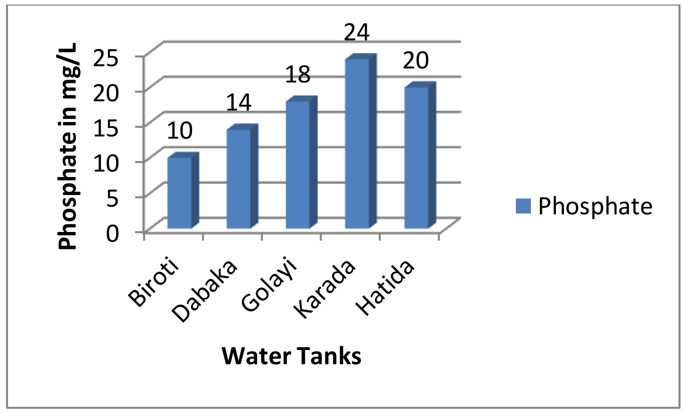

Figure 13 Phosphate Concentrations.

4.13 AMMONIA

Ammonia of mineral origin is rare in natural waters. The most important source of ammonia is the ammonification of organic matter. Sewage has large quantities of nitrogenous matter, thus its disposal tends to increase the ammonia content of the waters. Unionized ammonia is toxic to aquatic lives and reduces fish growth. Major source of ammonia in pond water is the direct excretion of ammonia by fish and crustacean. In addition, sewage effluents, depending upon its total ammonia nitrogen, pH and temperature, contribute 0.5 to 1.0 mg/L to wastewater fishponds. Increasing concentration of ammonia in water damage fish gills, adversely affects enzyme reaction, reduces the ability of blood to transport oxygen. Chronic exposure to ammonia increases susceptibility to fish diseases and reduces growth.

From the result above tabulated and figure 14 below, it can be seen that, the concentration of ammonia varied from 0.016 mg/L, 0.005 mg/L, 0.012 mg/L, 0.020 mg/L and 0.009 mg/L for Biroti, Dabaka, Golayi, Karada and Hatida water tanks respectively. At all the water tanks in Melghat recorded permitted values of ammonia concentration. Toxic concentration of ammonia for freshwater fishes for short exposure ranges between 0.7 and 2.4 mg/L as ammonia. Poor growth of fish in culture tanks had been attributed to accumulation of ammonia (Smith and Piper 1975). Robinette (1976) reported that 0.12 mg/L of ammonia caused reduced growth and gill damage in channel cat fish. In sewage fed fish ponds the concentration of ammonia is low due to high content of organic matter and neutral to slightly alkaline range of pH. The toxicity of ammonia increases with pH because at higher pH most of the ammonia remains in the gaseous form. The decrease in pH decreases its toxicity due to conversion of ammonia into ammonium ion, which is much less toxic than the gaseous form [17}. Ammonia is rapidly oxidized by certain bacteria, in natural water systems, to nitrite and nitrate-N process that requires the presence of dissolved oxygen.

In fish, ammonia represents the end-product of protein metabolism and what is important is whether it is present in the un-ionized form as free ammonia, NH_3, which is toxic to fish (both freshwater and marine) at >0.03 mg/L, or in the ionized form, NH_4^+, in which it is innocuous. The relative concentration of each is pH and temperature dependent. The higher the pH, the more of the NH_3 will be present. Ammonia can block oxygen transfer in the gills of fish; thereby causing immediate and long-term gill damage. Fish suffering from ammonia poisoning will appear sluggish and come to the surface, as if gasping for air. In marine environments, the safe level of NH_4^+ is between 0.02 and 0.4. The USEPA recommends a limit of 0.02 ppm as NH_3 in freshwater or marine environments. Total ammonia levels, at this limit, can range from 160 ppm at pH 6 and temperature of 5 ^{0}C to 0.06 ppm at pH 9 and temperature of 25 ^{0}C.

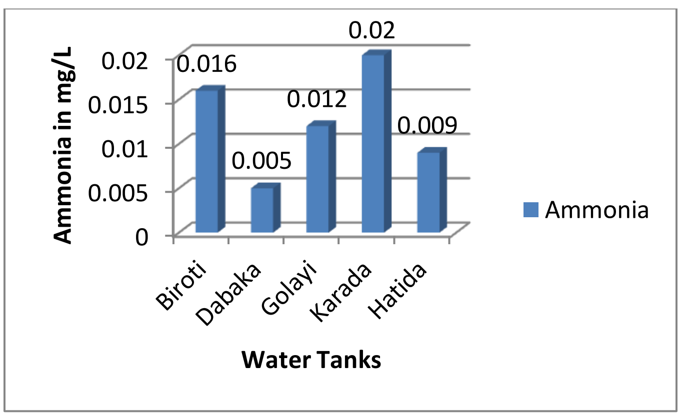

Figure 14 Ammonia Concentrations.

4.14 Nitrate-N

Considering same table above and From the figure 15 below, the respective values of nitrate-N concentration in Biroti, Dabaka, Golayi, Karada and Hatida water tanks are 1.96 mg/L, 2.42 mg/L, 2.14 mg/L, 3.02 mg/L and 1.65 mg/L. At all the water tanks favorable concentration of nitrate-N was recorded.

Nitrate is readily available form but all the inorganic forms of nitrogen can be used by green algae in their role as primary producer of energy containing mass in the aquatic food chain [18]. Nitrate represents the highest oxidized form of nitrogen. Only a few mineral sources of nitrate such as soda niter deposits in Chile exist in nature and most of the surface waters are, therefore, deficient in nitrate. The most important source of nitrate is biological oxidation of organic nitrogenous substances, which come in sewage, and industrial wastes or produced indigenously in the waters. Domestic sewage contains very high amount of nitrogenous compounds. Run-off from agricultural fields is also high in nitrate. Atmospheric nitrogen fixed into nitrates by the nitrogen-fixing organisms is also a significant contributor to nitrates in the waters. In the waste treatment systems, high amount of nitrates denote the aerobic conditions and high stability of the wastes. Although high concentrations are useful in irrigation but their entry into the water resources increase the growth of nuisance algae and trigger eutrophication. Nitrates occur in water as the end product in the biological breakdown of organic nitrogen, being produced through the oxidation of ammonia. Although not particularly toxic to fish, an excess nitrate in the water is often used as an indicator of poor water quality. Under anaerobic conditions, such as in the sludge or soil at the bottom of a pond, lake or aquarium, denitrification can be used to convert nitrate back to nitrite and from there to nitrogen gas, removing total nitrogen from the aquatic system.

In marine environments, levels of 0.1 mg/L to 0.2 mg/L are considered ideal. Levels exceeding 50 mg/L nitrate-nitrogen are considered unhealthy for lakes. Levels from 10 mg/L to 40 mg/L indicate poor water in aquariums, depending on the species being raised.

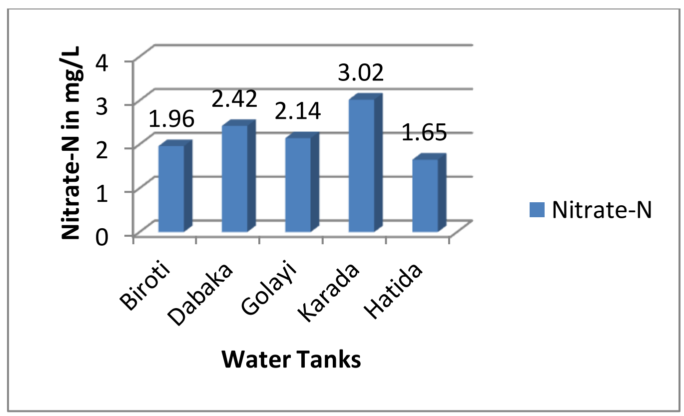

Figure 15 Nitrate-N Concentrations.

4.15 Nitrite-N

Similarly, from the table above and figure 16 below, the concentration of nitrite-N varied from 0.035 mg/L, 0.028 mg/L, 0.017 mg/L 0.042 mg/L and 0.030 mg/L for Biroti, Dabaka, Golayi, Karada and Hatida water tanks respectively. The entire water tanks were permitted value of nitrite-N concentration was observed.

Nitrite represents an intermediate form during denitrification and nitrification reaction in nitrogen cycle. There are no mineral sources of this ion in natural waters. Nitrite is a very unstable ion and gets converted into either ammonia or nitrate depending upon the condition prevailing in the water. Presence of even small quantity of nitrite will indicate the organic pollution and the availability of partially oxidized nitrogenous matter. Nitrites may also be produced in distribution systems through the activities of micro-organisms on ammonia [19]. Nitrites occur in water as an intermediate product in the biological breakdown of organic nitrogen, being produced either through the oxidation of ammonia or the reduction of nitrate. The presence of large quantities of nitrites is indicative of wastewater pollution. The level considered ideal for marine fish is between 0.01 and 0.04 ppm. Levels exceeding 0.55 mg/L nitrite-nitrogen can cause 'brown-blood' disease in finfish [20].

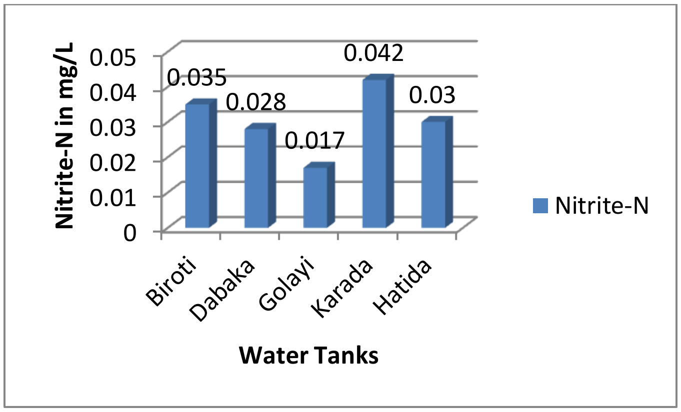

Figure 16 Nitrite-N Concentrations.

5 CONCLUSION

On the basis of data presented in table 1 above, it may be concluded that, the temperature of water varies from (25.1 – 28 ^{0}C). No mark variation in temperature was observed. However, the observed variations in the temperature were closely related with the change in ambient temperature. The majority of water tanks recorded high value of turbidity (8.1 - 15.3 NTU) in rainy season may be due to addition of suspended matter by surface washing. Electrical conductance ranged from (49.13 – 159.22 μmhos). Electrical conductance of water has recorded highest for Biroti tank (159.22 μmhos) was due to sewage contamination and this is correlated with higher values of hardness.

The pH of most of the water tanks was always in alkaline side and within permissible limit (7.45 - 7.81). This range is favorable for good fish production. High dissolved oxygen (7.96 - 9.45 mg/L) in Melghat water tanks may be due release of oxygen by algae. Biroti water tank was free from pollutants and recorded higher values of dissolved oxygen. The majority of water tanks recorded lower values of free CO_2 (1.307 – 3.920 mg/L), favorable for good production of fish.

The concentration of chloride (5.68 – 17.04 mg/L), significance of which lies in its potential to regulate the salinity of water recorded very lower values for all the water tanks and favorable for good fish production. Most of water tanks recorded permissible value of total hardness (48 - 108 mg/L), which is also favorable for good fish production. But Biroti water tank (136 mg/L) registered higher values of total hardness coincides with their high electrical conductance and hinder fish productivity. All the water tanks in Melghat recorded lower concentration of calcium (12.82 - 33.67 mg/L) and magnesium (1.949 - 12.670 mg/L) play an important role in antagonizing the toxic effect of various ions, was well below the permitted level (75 mg/L for calcium and 30 mg/L for magnesium).

The majority of water tanks recorded low concentration of sulphate (21.0 – 43.0 mg/L) favorable for good fish production. But Karada water tank showed higher sulphate concentration due to break down of organic substancesS in the soil and hinder fish productivity. Similarly, at all the sampling station recorded high concentration of phosphate (0.10 – 0.24 mg/L) and it is favorable for good fish production.

All the water tanks in Melghat have comparatively permitted values of ammonia (0.005 – 0.020 mg/L) nitrate-N (1.65 – 3.02 mg/L) and nitrite-N (0.017 – 0.042 mg/L) concentration and which is favorable for good fish production.

Thus, the above discussion vindicates that all the five water tanks (Biroti, Dabaka, Golayi, Karada and Hatida) in Melghat are favorable for good fish production and the Government policy of providing these tanks without any exchange for fish production to tackle the problem of Malnutrition and employment is going on in fruitful direction.

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