A STUDY ON SILT CHARACTERISTICS AND CAPACITY OF PERIURBAN TANKS OF CHENNAI BASIN

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ABSTRACT

The present study aims at understanding the wide range of stakeholders involved in a tank based system from the point of view of livelihoods. It also makes an attempt to quantify the benefits in economic terms that each stakeholder group is able to derive from the tanks. Tanks are a complex system constituting catchment, physical structure and canals as major components Tanks have a multiple uses and have varied range of stakeholders who are dependent on the tank directly or indirectly.

In southern India, water tanks are an integral part of village settlement. These tanks take care of villager's needs of water for domestic and agricultural purposes. Over the years, with sediment deposition the water storage capacity of these tanks has been considerably reduced. In recent times there is a general decline in the condition of tanks, this is due to several reasons such as decentralization of administration, lack of farmer's involvement, encroachments, siltation, urbanization, system failure, extinction of tanks, decline in tank fed cultivation etc. Among these siltation is the most dangerous process. So desilting of irrigation tanks are necessary, has primary benefits of increased rain water storage, ground water recharge, water availability and restoration of biological activity. It also serves as a collection point for runoff from the catchment area, pond for pisiculture, source of silt for fertilization and construction material, a location for cultivation on common lands and a source of drinking water to livestock.

The present study focuses on characterization of tank bed silt and its purposeful use in agricultural fields as manure. By removing huge amount of sediments from the tanks increases the water storage capacity. The economic analysis of this application of sediments to the agricultural field by calculating benefit cost ratio that is the benefit obtained from application of sediments to the field to the cost of delisting. And to study the encroachment of irrigation tanks by due to certain urbanization, also capacity measurement of tanks for the entire Chennai basin.

The management of large quantity of desilted sediments of tanks are very difficult. The purposeful use of these sediments on agricultural fields improves the soil fertility. It is useful to the farmers who is completely depends agriculture as their life source. Here tanks act as multipurpose source for the stake holders.

1. INTRODUCTION

Runoff water carries along nutrients and fine organic matter particulates from agricultural lands. Often the sources and pathways of nutrients moved by sediments in the runoff are difficult to identify. The deposition of sediments in the tanks reduces its capacity and also additional water storage in the rain fed areas. Hence, removal of sediments from tanks is a relavant approach for rain fed farming system. Runoff occurs in situations where the intensity of rainfall exceeds the infiltration rate which leads to surface flow and ponding of water. Runoff from the agricultural lands leaves the land unproductive and promotes land degradation.

Modern agricultural practises depend on commercial fertilisers to supply plant nutrients. Non-point source pollution of surface and ground water has been linked to agricultural practises. With an environmental dimension added to sustainable productivity in semi-arid ecco-reagions, assessing the quality of runoff water can cause chemical pollution. This is further burgeoned with sedimentation, which cause interference with drainage, land use, irrigation and decreases water storage capacity of tanks.

For rain fed farming system there is a need to capture significant amount of rain water, which is generally lossed as runoff and drainage. This stored water can be used as supplementary irrigation, increasing crop productivity and resource use efficiency. However deposition of sediments in tanks reduces its capacity and also hampers the additional water storage in the rain fed areas. Hence removal of sediments from tanks is a relevant approach to rain fed farming system.

There are nearly 39,202 tanks all over Tamil Nadu. Most of these tanks were created centuries ago. All these tanks were common property resources, created maintained and managed by users. These people who built these tanks were fully aware of their importance and hence made elaborate arrangements for their proper maintenance. An irrigation tank is a small reservoir constructed across the slope of valley to catch and store water during rainy season and use it for irrigation during dry season. The distribution of tanks was quite danse in some areas. However over years the performance of tanks has been declining.

In ancient days tanks were considered to be the property of rulers. Farmers paid a portion of the produce to the ruler. Farmers were also in charge of the maintenance of the tanks and supply channel. Zamindars ensured the proper maintenance of tanks and channels, since they repaid the benefits of farming in large areas.

The purpose of tanks is to store the water required for irrigating the land. It is evident that over a period of time the capacity of tank might get reduced due to sediment load from catchment as well as supply channel. To avoid the losses from tank to desilt the bed and to reduce the water spread area is necessary. Desiltation of bed makes the tank to function as a percolation tank. The removal of soil can be used for strengthing the tank bed and also can be used as manure in agricultural land.

2. LITERATURE REVIEW

Padmaja et al. (2003) conducted a study in Madak district of Andra Pradesh that the economics of disiltation and the effective use of these sediments as plant nutrients. The overall goal of the study was to assess the economic feasibility of desilting operation by quantifying the amount of plant nutrients returned to agricultural fields through sediment application. And to quantify the amounts of Nitrogen (N), Phosphorus (P) and Organic carbon (C) returned to agricultural fields and economic valuation of sediment in terms of cost of N and P nutrients, to assess the differences in quality and terms of physical, chemical and biological parameters of sediment from different water storage tanks in Medak district of Andhra Pradesh. Benefit-cost ratio is such that the valuation of nitrogen in the sediment is based on the cost of urea fertilizer and fertilizer equivalent value of phosphorus is based on the cost of diammonium phosphate (DAP) fertilizer at the existing rates. The benefit-cost ratio calculated is the apparent value and indicates only cost of desilting operation and value of silt as source of N and P nutrients. B/C ratio for the desilting operations from water tanks based on the economic plant nutrient value (N and P content) of the district was calculated to be 1.23, which reflects a positive benefit for the cost.

Osman et al. (2007) calculated benefit cost ratios of two treatments one with silt and other without silt for cotton and chillies. A simple formula is used to meet the crop nutrients. The study is based on the secondary data compiled from the reports of government of Andra Pradesh, Karnataka, Tamil Nadu, and Orissa states and also government publications such as statistical abstracts of respective states for different years. And the result obtained that benefit cost ratio is greater than 1.5 for both the treatments. And they also mentioned that the tank bed generate income and employment during drought periods by creating off farm opportunities and have a large implication on the sustainability of land use system.

Amaranth et al (2006) presented a study on the estimated cost and benefits of rehabilitation and financial feasibility of investment in tank rehabilitation in Madurai district. ‘DHAN’ (Development of Humane Actions) are also involved in motivating the people to participate in tank rehabilitation. Tank Farmers Association (TFA) was formed at the tank. 102 tank associations were formed in the block and rehabilitation works were carried out in 42 tanks. The benefit cost ratio obtained is greater than 1.5, which is prescribed for irrigation projects.

Binitha (2006) conducted an experimental study on characterisation tank silt of north K and its

effective use on growth and yield on ground nut. They compared the physical chemical and mineralogical properties of the tank silt of Kyasanakere and its catchment soil. A total of 144 tank silt samples were collected from the selected 33 tanks spread out in different taluks of 6 districts of North Karnataka. The samples were drawn at 4 depths of 0 to 15, 15 to 30, 30 to 60 and 60 to 90 cm by sampling procedure in the period of the year when the amount of water in the tank was less. The application of tank silt at the rate of 20t per ha significantly increased the nitrogen content of crop as compared to 10t per ha and no silt at 30, 60, 90 DAP (Di Ammonium Phosphate). With respect to the phosphorus content, 20 t per ha of silt recorded significantly higher values at 30, 60, 90 DAP over 10 t per ha and no silt. Similar trend was followed with respect to potassium and sulphur.

Yadahalli (2008) conducted three experiments to study the effect of set of row cultivation with tank silt. The experiments were conducted in VIth and E blocks of Regional Agricultural Research Station, Bijapur in the Northern Dry Zone of Karnataka. Result obtained is a considerable increase in crop yield by tank silt.

Canet et al (2003) Used sediments from Albufera lake for agricultural use. They mentioned that, agricultural use of silt probably one of the most promising alternatives, for the management of removal of sediments from the lake that would generate a very large amount of material. Since soil application makes good use of the sediment contents of clay and silt, nutrients and organic matter and somehow brings the material back to its original place. They conducted experiments and found that the application of high rates of sediment nearly doubled the clay contents in soil. Water-retention capacity of soil was clearly increasing. It is also a sound procedure to avoid the environmental issues.

Mojid (2009) investigated the growth, yield and water use efficiency of wheat in five soil textures obtained by amendment. The amendment which is used as loamy sand, sandy loam and silt loam. Wheat was cultivated with four irrigations and recommended dose of fertilizers. Increased porosity and pore size distribution in the finer-textured soils improved soil structure with a consequent improvement in soil physico-chemical properties. The saturated hydraulic conductivity decreased significantly, while field capacity and water retention increased considerably as the textured of the soil become finer.

Ramanagowda (2009) worked out a farm study of tank desilting on ground water recharge in southern Karnataka. Huge investments are needed for tank desiltation. Tank distillation has several benefits with wide range of usefulness that would further justify investment, drought mitigation, ground water recharge etc. the experiment involving farmers in the tank desiltation programme by motivating them to bear the cost of transportation of silt to the field as it is enriched soil being tried in some selected tanks of kolar district during 1997 and 1998 and its impact on ground water recharge has been assessed.

Shanmugham et al (2008) focussed on community based water shed development in Madurai Tamil Nadu, under DHAN foundation. They found that silt application to dry lands from these tanks has become a beneficial activity in all watersheds. From Punganur experience of silt application, there is significant improvement to soil texture as well as fertility.

3. STUDY AREA

The study area chosen is a mini water watershed within Chennai basin. The mini watershed is called Mambakkam mini watershed which is located in Kancheepuram district of Tamil Nadu.

Mambakkam mini watershed is located south of Chennai city, and lies between the east longitudes of $80^0$04'30''to $80^0$15'30'' and north latitudes of $12^0$47'00'' to $12^0$56'30''. The areal extend of study area is 224 Km^2. The study area stretches from east to west for a width of 18Km from sea cost towards the inland, and length of 16Km along the north south. It comprises three blocks namely Kattankulathur, St Thomas mount and Thiruporur of Kancheepuram district and covers 66 revenue villages. It lies on the east coast with plains, and slightly elevated areas on the west. Maximum and minimum elevations of the study area are between 2m and 10m in the coastal plain, 10m and 25m in the central region. The general slop is towards the east and northeastern directions. In the north western, central western and south western are the hills and reserve forests the trend of cost line is more or less, uniform with a plain topography. There are major rivers or system tanks other than some medium and small tanks. Some of the tanks are well connected and for a drainage

network. Most of the surplus during the heavy monsoon floods of these areas, and finally goes to to Pallikaranai swamp. Almost all drainages flow from west to east expect certain undulations due to topography, and finally end in the Bay of Bengal. Generally a subtropical maritime monsoon type climate prevails over the study area. The maximum temperature varies between 37^0c and 44^0c and minimum temperature varies from 18^0c to27^0c. The annual rain fall of Tamil Nadu is 945.7mm, but whereas the annual normal rainfall of the study area recorded in six rainfall station, the average varies from 883 in the year 2003 to a maximum of 2,133 mm in the year 2005 which is high when compared to the normal rainfall of Tamil Nadu as a whole.

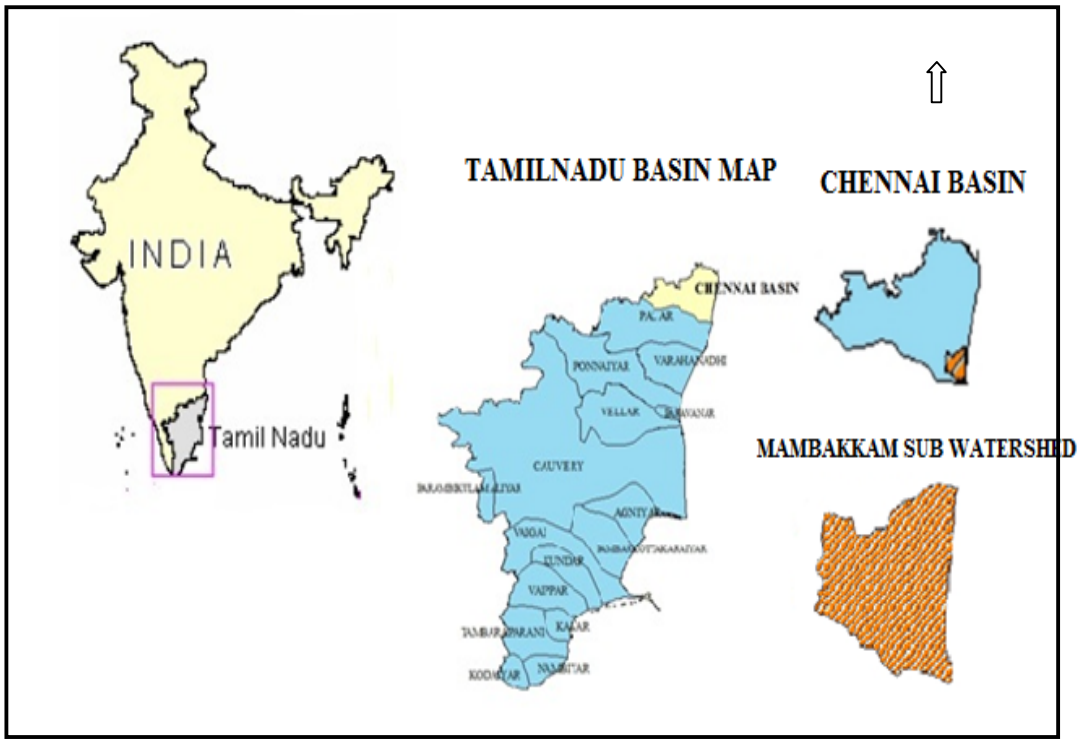

Figure 1. Index Map

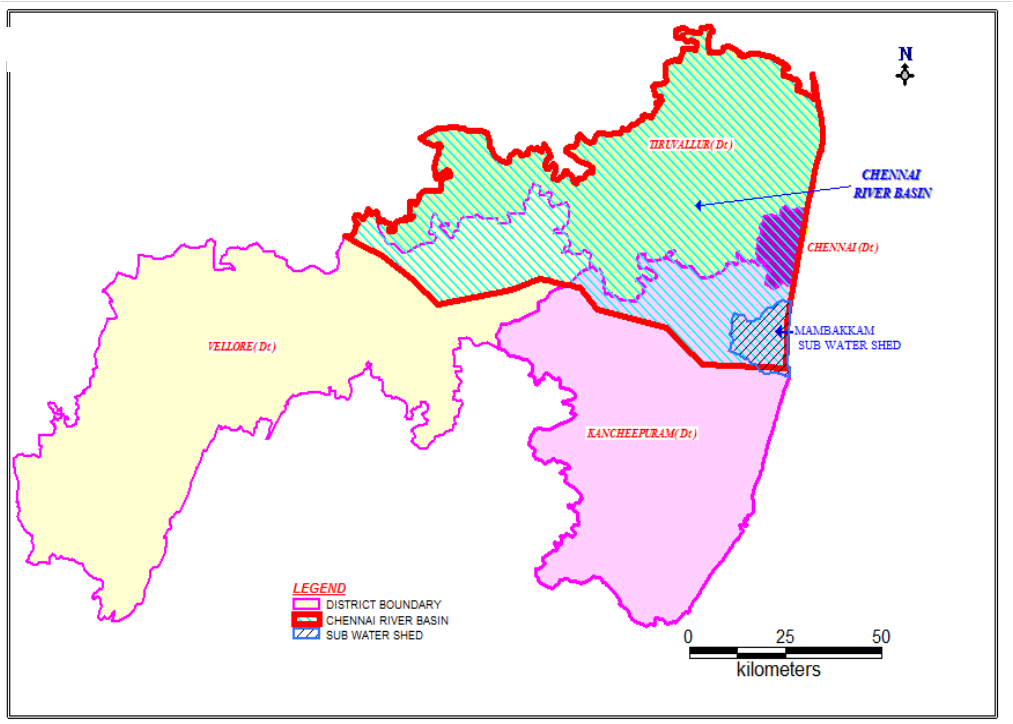

Fig.3 Chennai basin boundary

4. METHODOLOGY

The four topographic maps 57O, 57P, 66C, 66D of 1:50000 scales registered to Map info 6.5latitude and longitude values of each topographic map is given for georeferencing and the topographic maps are combined. The Chennai basin boundary and Mambakkam sub watershed overlayed on the topographic maps. Within the Mambakkam sub watershed boundary the number of tanks and their locations were identified. The latitude and longitude found out from the map.

SEDIMENT SAMPLE COLLECTION

The soil samples were collected from the identified tanks of Mambakkam sub watershed. Then the analysis conducted on these collected samples. Samples were air dried for 24 hours and passed through 2mm sieve and to conduct the following experiments.

a. PH
b. EC
c. Moisture content
d. Soil texture analysis
e. NPK (Nitrogen Potassium) tests.

4.1 Instruments for sample collection

To find out the location of tanks Gps and Google map were used by knowing the latitude and longitude of tanks from Google map and the latitude and longitude from Gps the identification of tanks were possible. For collecting the soil sample from different depths auger and shovel is used.

4.2 Sampling location and different depths

The depths of sediment sample collection selected in such a way that four different positions for sample collection will be selected from each tank and from one position two different depths areselected 15cm and 30cm from the top surface. Within the Mambakkam sub watershed 10 tanks are there sediment samples are collected from these tanks.

4.3 Characterisation of tank silt

By conducting the experiments on collected samples the silt characteristics are known. From the NPK analysis the nutrient value of the silt can assessed.

4.4 Economic value of nutrients

Economic value of nutrient was calculated from the commercial value of urea, Di ammonium phosphate and Muraite of potash. By knowing the sediment volume by tank capacity survey and characterisation of tank silt by sediment analysis nutrient value was calculate.

4.5 Tank capacity survey using Gps

Tank capacity survey will be conducted when tanks are in dry condition. One or two tanks of Mambakkam sub watershed will selected for tank capacity survey. Survey will conduct by using differential Gps. From this capacity survey the present tank capacity will be known. And from the tank memoir of 1915 the old capacity of those tanks can find out. By reducing the new capacity from the old capacity the sediment volume can calculate.

4.6 Benefit cost ratio

Benefit cost ratio was calculated as the ratio of benefit which is obtained from the economic value of nutrients to the cost of desilting. Then the economic feasibility of desilting will be known.

5. RESULTS AND DISCUSSIONS

The following tanks located within Mambakkam mini watershed were studied and experiments were conducted from the collected sediment samples as given in Tables below.

Table.1 Soil texture analysis test result

No	Tank names	soil texture
1	Mambakkam	Loam
2	Vengai vasal tank	Loam
3	Maduripakkam tank	Silt loam
4	Venkatamangalam tank	Loam
5	Melkoratiyur	Sandy clay loam
6	Nallambakkam tank	Clay loam
7	kolathur	Clay
8	Pudupakkam	Clay loam
9	sitalapakkam	Clay loam
10	Rathnamangalam	Loam

The texture analysis revealed that the composition of the sediment deposited in the tanks varied widely within the boundary reflecting on the soil type, topography, rainfall intensity, crop cover and organic matter content of the soils in the catchment area.

Table.2 Total Nitrogen in sediments for different tank

No	Tank names	N(mg/kg)
1	Mambakkam	5110
2	Vengai vasal tank	5413
3	Maduripakkam tank	5320
4	Venkatamangalam tank	4760
5	Melkoratiyur	5040
6	Nallambakkam tank	5226
7	kolathur	5040
8	Pudupakkam	5040
9	sitalapakkam	4666
10	Rathnamangalam	4480

Fertilizer usage details provided by the State District Officials reveal that mostly Nitrogen (N) and Phosphorus (P) are applied through Di ammonium phosphate (DAP) fertilizer and only Nitrogen was applied through urea fertilizer. Nitrogen and Phosphorous are the most important nutrients that contribute towards higher crop yields. The sediment samples were analysed for N and P contents. The total N content in the tank sediment samples varied from 4760 mg kg-1 to 5320 mg kg-1 sediment.

Table.3 Available phosphorous in sediments for different tanks

No	Tank	P(mg/kg)
1	Mambakkam	453
2	Vengai vasal tank	193
3	Maduripakkam tank	770
4	Venkatamangalam tank	0.91
5	Melkoratiyur	396
6	Nallambakkam tank	116
7	kolathur	323
8	Pudupakkam	50
9	sitalapakkam	56
10	Rathnamangalam	51

The total Phosphorous per cent in the sediment samples of different tanks ranged between 0.91 mg kg-1 and 770 mg kg-1 of sediment.

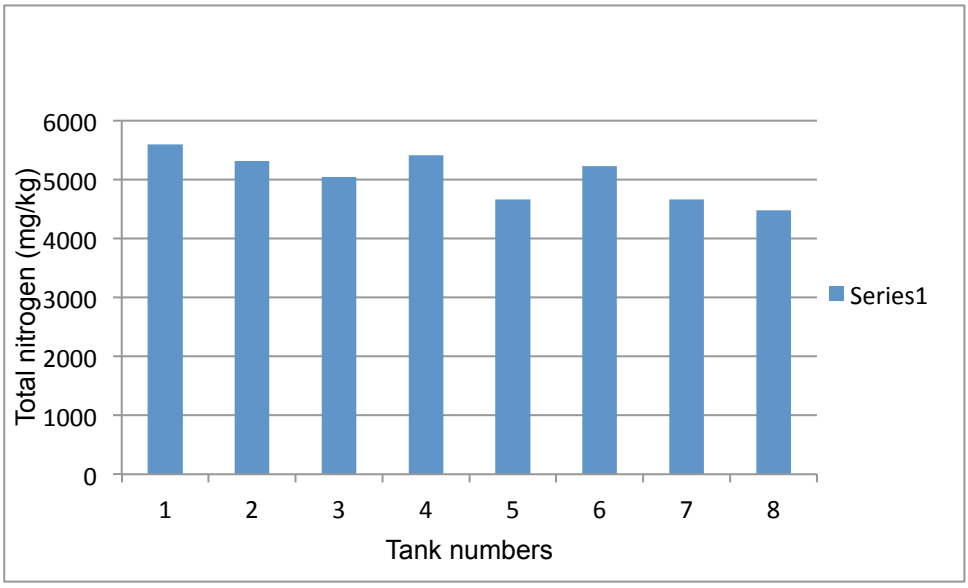

Figure 1. Total Nitrogen for different tanks

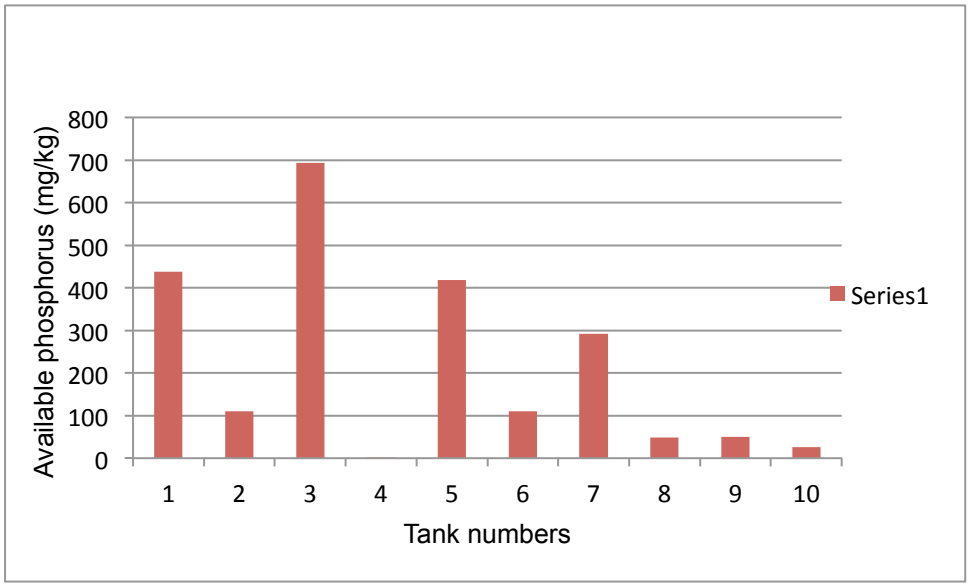

Figure 2. Available Phosphorous for different tanks

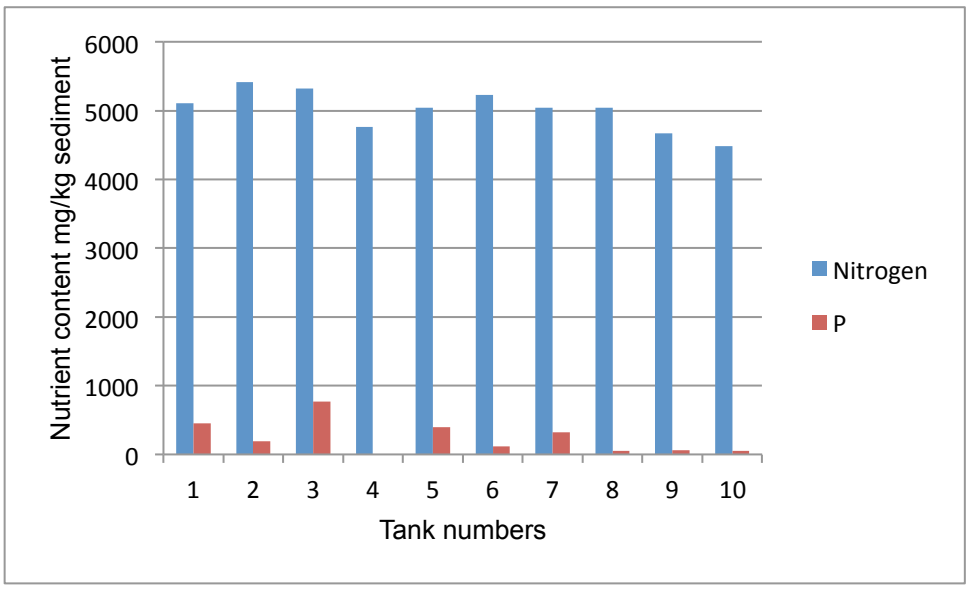

Figure 3. Nutrient content of sediment for different tanks

CONCLUSION

The economic valuation of sediment is calculated in terms of cost of nitrogen and phosphorus nutrients. The valuation of nitrogen in the sediment is based on the cost of urea fertilizer and fertilizer equivalent value of phosphorus is based on the cost of di ammonium phosphate (DAP) fertilizer at the existing rates. The fertilizer dose recommended for paddy field in (kg/ha) as per Tamil Nadu Agriculture Department, Nitrogen is100 kg/ha and Phosphorus 50kg/ha. The value of Nitrogen nutrient in urea is Rs.12.60/kg of urea. The value of Nitrogen nutrient in DAP is Rs.120/kg of DAP. The unit cost of Phosphorus in DAP Rs.52/kg of DAP. Based on these cost the value of Nitrogen per kg sediment is RS.0.063, and the value of Phosphorous per kg sediment is RS.0.012.Application of every 91.8 kg of silt from the tanks will reduced the use of urea by 1kg.

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