INTERNATIONAL JOURNAL OF PLANT, ANIMAL AND ENVIRONMENTAL SCIENCES
IJPAES
Volume-8, Issue-1 Jan-Mar-2018 Coden: IJPAJX-CAS-USA, Copyrights@2018 ISSN-2231-4490
Received: 5th Jan-2018 *Revised: 24th Jan-2018* *Accepted: 25th Jan-2018*
DOI: 10.21276/Ijpaes *http://dx.doi.org/10.21276/ijpaes* *Research Article*

INFLUENCE OF WATER QUALITY CHANGES ON THE DISTRIBUTION AND DIVERSITY OF AQUATIC MACROPHYTES IN CERTAIN WETLANDS OF CHIKKAMAGALUR DISTRICT.

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ABSTRACT: The present study was carried out to assess the water quality changes and the distribution of aquatic plants, also influenced on the nutrient condition of the water bodies. In this context, water samples were collected at different selected points in chikmagalur district during the year (October 2015- September 2016) at different seasons. Water samples were collected every season for physico-chemical analysis and analyzed by following standard procedures.(APHA,1995). Simultaneously aquatic plants were collected in each study sites and identified with the help of published manuals (C.D.K Cook, 1996). In the study sites, wide-range of aquatic macrophytes were recorded such as *Salvinia adnata* Desv, *Ludwigia adscendens* (L.) Hara, *Polygonum* sp, *Trapa natans* var. *bispinosa* (Roxb.) Makino, *Nelumbo nucifera* Gaertn., *Nymphoides indica* (L.) Kuntze, *Utricularia stellaris* L.f, *Ottelia alismoides* (L.) Pers, and *Hydrilla verticillata* (L.f.) Royle. The physico-chemical analysis values indicate the seasonal variations in each sampling points. Water quality values indicates slightly high BOD in S1 (10.43mg/l) compared to other sites, (0.42mg/l) in S9 respectively. Calcium values shows high (225.46 mg/l) in S1 compared to other stations. Among the study sites, Doddakere lake receives city runoff water and enriched with nutrients. Hence it is converted into eutrophic nature.
Key words: Water quality, aquatic plants, nutrient, physic-chemical parameters.

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INTRODUCTION

Wetlands are transition areas between land and water bodies, characterized by shallow water overlying waterlogged soil as well as interspersed submerged, emergent or floating vegetation. Water quality in wetlands is subjected to the natural degradation, processes of eutrophication and the impacts of human activities. These aquatic habitats exposed with multiple constraints due to their great abiotic variability, but this offers to species with particular adaptations many opportunities to succeed [1].

The larger aquatic plants growing in wetlands are usually called macrophytes. These include aquatic vascular plants, aquatic mosses and some larger algae. The presence or absence of aquatic macrophytes is one of the characteristics used to define wetlands [2]. Also macrophytes are common biological component of an aquatic ecosystem. The occurrence of aquatic plant species in lakes is closely related to water chemistry [3].

Accumulation of nutrients in an aquatic ecosystem leads to eutrophication resulting into massive growth of the macrophytes and weeds [4]. The quality of the water in wetlands is subjected to the natural degradation and also to the impact of manmade activities. Human disturbances cause a notable catastrophic change in structural and functional components of the water body. Point and non-point sources contribute variety of pollutants. Whichever be the pollutant sources, they will finally support macrophytes in the name of nutrients. Most of the macrophytes are naturally occurring and well adapted for their ecological surroundings. Apart from those naturally occurred macrophytes, some other exotic species may enter to that particular aquatic body whose nutrient load severely increased due manmade activities. Depending upon nutrient availability, newly entered species sustain, regenerate and can even distribute exponentially.

Aquatic macrophytes absorb nutrient mineral ions from water column and influence metal retention indirectly by acting as traps for particulate matter, by slowing the water current and favouring sedimentation of suspended particles [5].

Over a period of time the sediment will support rooted emergent macrophytes like species of *Nelumbo, Cyperus, Typha* etc., and rooted submergent macrophytes like species of *Myriophyllum, Ceratophyllum* etc., respectively. Macrophytes naturally perform many ecosystem functions and provide services to human society. One of the important ecological functions performed by macrophytes is uptake of dissolve nutrients [2]. Dissolved nutrients influence the diversity and distribution of macrophytes. Also due to the local climatic conditions, edaphic factors, percentage of human disturbances, distribution and diversity varies. Therefore present study focus on the relationship between water chemistry and distribution of macrophytes in selected wetlands in Chikmagalur district.

STUDY AREA

We conducted our study on eight selected water bodies located in western ghats area of Chikmagalur district, surrounded by Chandradrona hills. The district lies between 12° 54´ 42´´ and 13° 53´ 53´´ North latitude and between 75° 04´ 46´´ and 76° 21´ 50´´ east longitude. It enjoys a tropical climate with moderately heavy monsoon showers. On an averageit receives normal rainfall of 1925 mm annually. The dense forest and coffee plantations are the green contributors. Kemmangundi, Kuduremukha, Mullayanagiri, Datta peeta, Devirammana betta were the famous hill stations of the district. The whole district spread over in the seven taluks, namely Chikmagalur, Koppa, Mudigere, Sringeri, Tharikere, Kadur and Narasimharajapura. According to the recent Demographic records 81% of population in the district resides in the rural area. Chikmagalur taluk has highest population where as Sringeri Taluk being less populated. The details of selected water bodies is presented in Table-1.

Table 1: List of selected wet lands

Wetlands	Taluk	Geographical Location			Water Depth (m)
		Altitude (m)	Latitude	Longitude	
Doddakere (S1)	Tharikere	672	13°42'49.63"N	75°49'3.04"E	4
Mushitikere (S2)	Kadur	823	13°35'26.35"N	75°56'33.27"E	10
Lingadahallikere (S3)	Tharikere	800	13°35'59.39"N	75°50'37.71"E	8
Duglapurkere (S4)	Tharikere	644	13°43'2.30"N	75°45'11.17"E	5
Rangenallikere (S5)	Tharikere	629	13°42'15.79"N	75°41'24.47"E	4
Lakkavallikere (S6)	Tharikere	626	13°42'12.52"N	75°39'30.06"E	5
Itigekere (S7)	N.R.Pura	756	13°20'17.14"N	75°27'8.64"E	4
Nallurkere (S8)	Sringeri	640	13°28'36.94"N	75°12'39.92"E	6

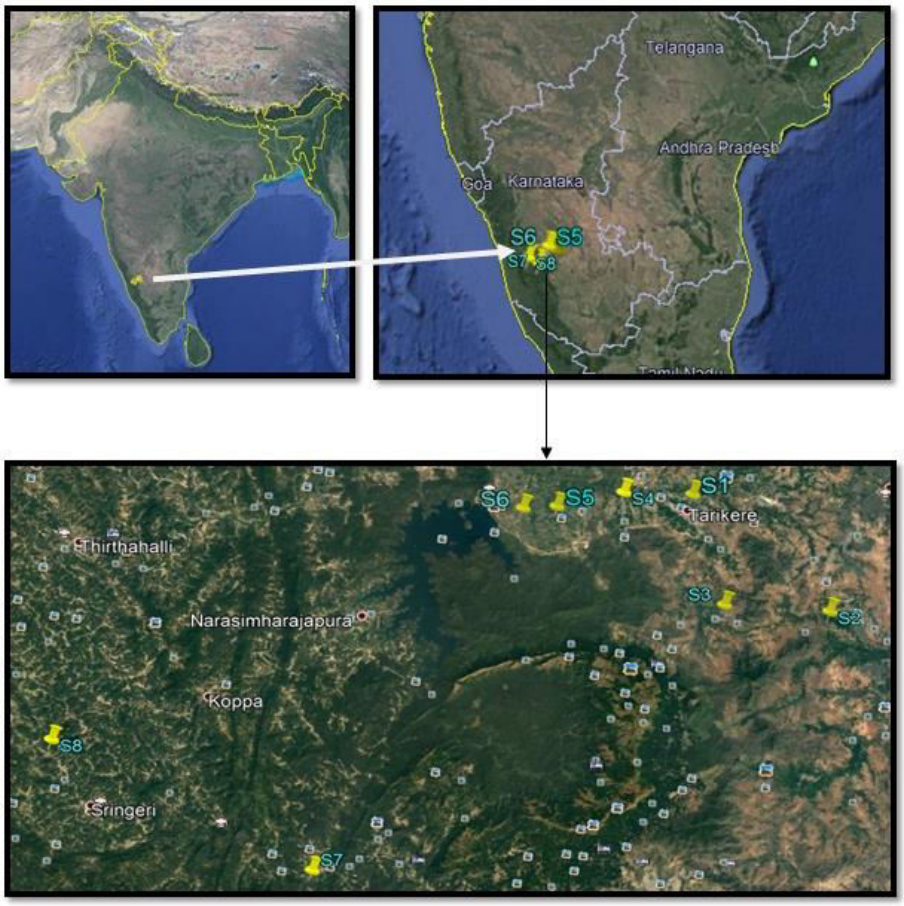

Figure-1: Map of Study stations

Figure-2: Overview of study stations

MATERIALS AND METHOD

Water samples were collected in Polyethylene cans at seasonal intervals during 2016-17) to study the Physico-chemical characteristics. Subsequently macrophytes were collected to know the distribution and diversity which influenced by water quality change.

Physico-chemical analysis of samples was analyzed according to the standard methods and the values were compared with World Health Organization and Indian Standard Specifications (IS: 1050-1983; IS: 2490 – 1982). Air and water temperature (°C) measured on the site using Mercury Thermometer. Total Dissolved Solids (mgl^{-1}), pH, Conductivity (mS) and Salinity (ppt) were analysed using electrometric method. Dissolved oxygen (mgl^{-1}), Biological oxygen demand (mgl^{-1}), Alkalinity (mgl-1), Chloride (mgl^{-1}), Hardness (mgl^{-1}), Calcium (mgl^{-1}), Magnesium (mgl^{-1}) were analysed using titrimetric method. Sulphates, Nitrates, phosphates were estimated using Spectrophotometer. Macrophytes were identified by referring Flora of Chikmagalur [6], Flora of Shimoga [7], and Aquatic and Wetland Plants of India by Christopher D. K. Cook [8].

RESULTS AND DISCUSSION

The study results reveals that Physico-chemical characterstics of the water bodies along with abundance of macrophytes in water bodies indicates oligotrophic to eutrophic condition. Fig.3-5 summarises that on the basis of water quality macrophytes inhabit is witnessed. physico-chemical analysis data and its variation was recorded at different sites. pH values shows slightly acidic in Nallur lake, due to anthropogenic activity (washing cloths and vehicles) and agricultural runoff. Similarly turbidity values shows slightly high in both Nallur and Ittige kere. Nitrates and Phosphates shows increasing trend in Doddakere (Tarikere) due to city runoff water and waste water discharge. Thus these water bodies are shows rich in siltation with excessive nutrients causes eutrophication. Whereas Mushti kere and Lingadahalli kere supported higher the depth and larger water spread area covered along with less submerged and floating plants indicates oligotrophic conditions .These two stations shows negligible anthropogenic activities and receiving water from hilly catchments zone. Thus no pollution source and siltation and accumulation of pollutants as sediment doesn't having a capacity to support larger macrophytes. Only littoral zone, marshy area of Mushtikere supports about 13 species of semi-aquatic plants belonging to 11 different families.

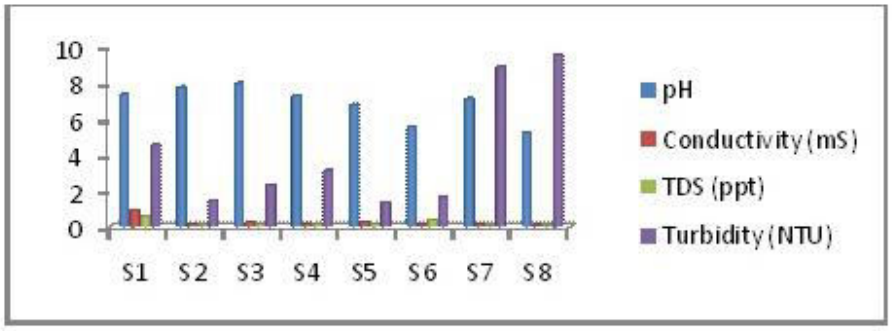

Figure-3: Shows variation of water Quality Parameters (pH, Conductivity, TDS and Turbidity)

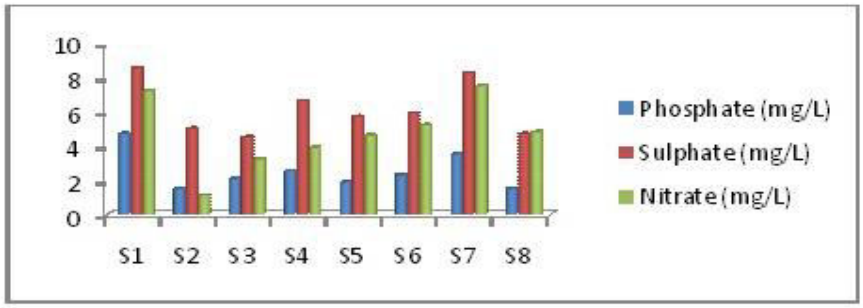

Figure-4: Shows variation of water Quality Parameters (Phosphate, Sulphate, Nitrates)

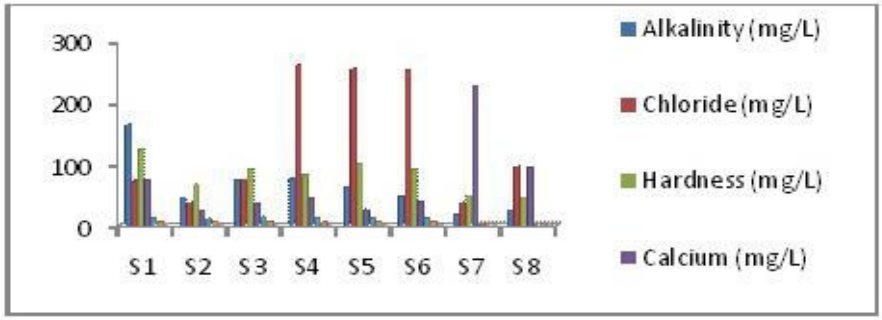

Figure-5: Shows variation of water Quality Parameters (Alkalinity, Chlorides, Hardness and Calcium)

About 33 taxa belonging to 26 different families were recorded from eight study stations. The distribution illustrated in Table1. Menyanthaceae, Nymphaeaceae, Cyperaceae, Hydrocharitaceae, Covolulaceae, Polygonaceae and Fabaceae families were dominated by two species each. Among the study sites, S-2 supported a rare semi-aquatic plant namely *Cleome chelidonii* L.f. belongs to family Cappariacea. The total of 13 species of semi aquatic plants were identified followed by floating taxa by 7 species. 4 species of rooted emergent, 5 species of rooted submergent and 3 species of sedges. (Fig 5). Among the individual taxa, *Nelumbo nucifera* Gaertn, *Salvinia adnata* Desv and *Nymphoides indica* (L.) Kuntze respectively dominated.

Table 2: Distribution of Taxa in different study stations

Macrophytes	S1	S2	S3	S4	S5	S6	S7	S8
***Aeschynomene aspera* L.**	-	+	-	-	-	-	-	-
***Centella asiatica* (L.) Urb.**	-	+	+	-	+	-	+	+
***Ceratophyllum demersum* L.**	+	-	-	-		+	+	-
***Cleome chelidonii* L.f.**	-	+	-	-	-	-	-	-
***Commelina diffusa* N. Burman**	-	+	-	-	-	-	+	-
***Cyperus rotundus* L.**	+	-	-	-	-	+	+	+
***Eichhornia crassipes* (Mart.) Solms**	-	-	-	-	+	+	-	+
***Eriocaulon cinereum* R. Br.**	+	+	+	-	-	+	+	+
***Hydrilla verticillata* (L.f.) Royle**	+	-	-	-	-	+	-	+
***Hygrophila auriculata* (Schumach.) Heine**	+	-	-	+	-	+	-	+
***Ipomoea carnea* (L.) Sweet**	+	-	+	+	+	+	+	+
***Ipomoea aquatica* Forsk.**	-	+	-	-	-	-	-	-
***Limnophila indica* (L.) Druce**	-	-	-	-	+	-	+	+
***Ludwigia adscendens* (L.) H. Hara**	+	-	-	+	-	-	+	-
***Myriophyllum oliganthum* (Wight & Arn.) F.Muell.**	-	-	-	-	-	-	+	+
***Nelumbo nucifera* Gaertn.**	+	-	-	+	+	+	+	+
***Nymphaea pubescens* Willd.**	+	-	-	+	+	+	-	+
***Nymphaea rubra* Roxb. ex Andrews**	+	-	-	-	+	-	+	-
***Nymphoides cristata* (Roxb.) Kuntze**	-	-	-	-	-	-	+	+
***Nymphoides indica* (L.) Kuntze**	+	-	+	+	+	+	+	+
***Ottelia alismoides* (L.) Pers.**	-	+	-	-	-	-	+	-
***Oxystelma esculentum* L.f.) R.Br.ex Schult.**	-	+	-	-	-	-	-	-
***Parkinsonia aculeata* L.**	-	+	-	-	-	-	-	-
Pavonia odorata Willd	-	+	-	-	-	-	+	-
***Pistia stratiotes* L.**	-	-	-	+	-	-	+	-
***Polygonum barbatum* L.**	+	+	+	+	+	+	+	+
***Polygonum glabrum* Willd.**	+	-	+	+	-	-	+	-
***Rotala rotundifolia* (Roxb.) Koehne**	-	-	-	-	+	-	+	+
***Salvinia adnata* Desv.**	+	-	-	-	+	+	+	-
***Scirpus articulatus* L.**	+			+	+	+	+	+
***Trapa natans* var. *bispinosa* (Roxb.) Makino**	+	-	-	+	-	+	+	+
***Typha angustata* Chaubard**	+	-	-	-	-	+	+	-
***Utricularia stellaris* L. f.**	+	-	-	-	-	-	+	-

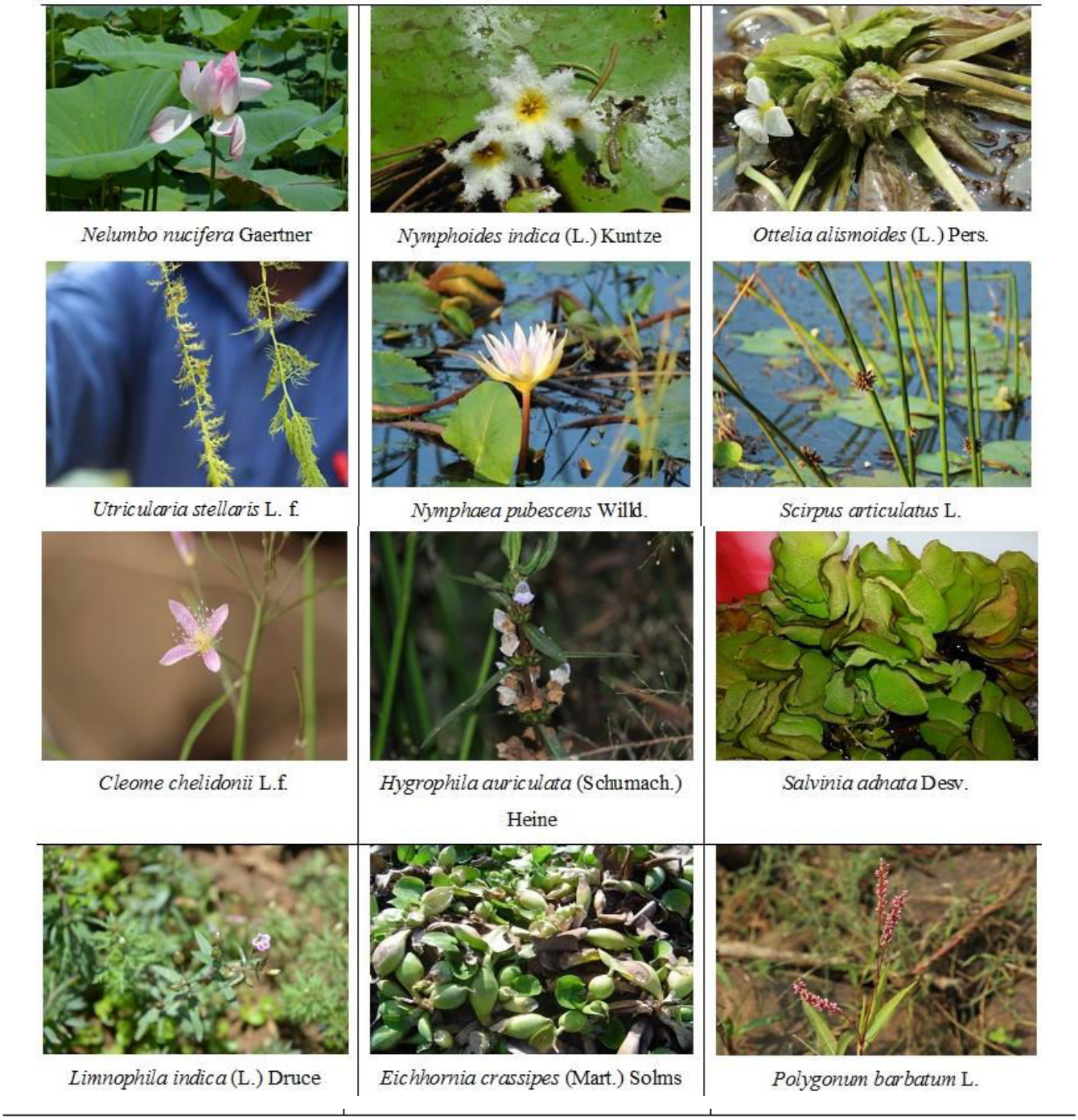

Figure-6: Some of the photographs of Macrophytes recorded in study stations

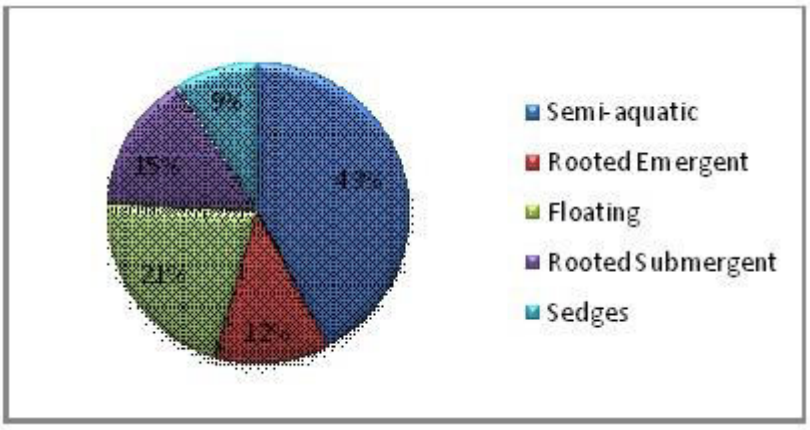

Figure-7: Macrophytes distribution Percentage

In addition to this, the nutrient level in water influenced with distribution of macrophytes were recorded. Once an aquatic plant community develops in a lake, its close contact with the lake water strongly affects the dominant ecosystem processes, such as nutrient cycling, primary productivity and trophic transfer of substances, and it responds to both abiotic and biotic factors in the environment [9]. The aquatic plants absorb the major plant nutrients like nitrogen and phosphorus that is also major pollutants of the domestic wastewater for luxuriant growth. Similar results witnessed in our study area. Higher amounts of nitrates, phosphates and sulphates supported 3 dominated species *Nelumbo nucifera* Gaertn, *Salvinia adnata* Desv and *Nymphoides indica* (L.) Kuntze in 4 stations (S1, S5, S6, S7) when compared to other stations (Table 3). These 3 species dominated the entire station exponentially.

Table 3: Macrophytes dominated with increasing level of Nutrients

Wetlands	Nutrient load measured			Dominated Macrophytes		
	Nitrates (mg/L)	Phosphates (mg/L)	Sulphates (mg/L)	*Nelumbo nucifera* Gaertn	*Salvinia adnata* Desv	*Nymphoides indica* (L.) Kuntze
S1	7.2	4.7	8.5	+	+	+
S2	1.1	1.5	5.0	-	-	-
S3	3.2	2.1	4.5	-	_	+
S4	3.9	2.5	6.6	+	-	+
S5	4.6	1.9	5.7	+	+	+
S6	5.2	2.3	5.9	+	+	+
S7	7.5	3.5	8.2	+	+	+
S8	4.8	1.5	4.7	+	-	+

(+ and - indicates the presence and absence of species respectively)

CONCLUSION

The present study indicates that Water chemistry influence on macrophyte distribution and abundance. The study concludes that anthropogenic activity and urban runoff with discharge of waste water was noticed in Tarikere lake and found to be under threat. Water quality shows eutrophic condition. Lakes located near human interference namely Tarikere Doddakere, Rangenahalli lake also enriched with siltation due to encroachment of the catchment area

ACKNOWLEDGEMENTS

We wish to thank DST (SERB) New Delhi for granting to conduct research on wetland biodiversity.

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INTERNATIONAL JOURNAL OF PLANT, ANIMAL AND ENVIRONMENTAL SCIENCES

ISSN 2231-4490

International Journal of Plant, Animal and Environmental Sciences