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Role of macrophytes for the upliftment of Socio - Economic weekened section of Upper Lake

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Abstract - Lakes are believed as one of the most prolific ecosystems satisfying the need of bio resources as well as acting as sources of livelihood for the people living in near regions. The present study was intended to assess the types of aquatic macrophytes that grow in and around lakes, and to assess the opportunities from these aquatic vegetation. The principal methods were ocular observation, photography and literature survey. In this study, we monitored the presence of macrophytes at 6 stations of Bhoj Wetland during the year 2016-2017. During the studied period, total 12 species of macrophytes were identified in the studied area and out of these the 3 more predominant species were *Eichhornia crassipes, Lemna minor, Ceratophyllum demersum*. These aquatic plants are ecologically beneficial as well as used for food, fodder, pharmaceutical products, fertilizers, etc., so their socio-economic importance should not be underestimated. Thus the harvesting of these macrophytes can be suggested in a systematic way on commercial basis in the areas of natural growth. With the socio-economic point of view, these practices can become opportunities to small communities, especially women who rely on fisheries and aquaculture based livelihood.

Key Words - Macrophytes; Upper Lake.

1. INTRODUCTION

Lakes are indispensable part of the fresh water ecosystem and plays significant role in the functioning and persistence of life. Many organisms depend on freshwater for their existence and humans often depend on lakes for many 'goods and services' such as portable water, aquaculture, agricultural and irrigation, recreation etc [6]. The Upper Lake of Bhoj Wetland is rich in biodiversity with the major components being phytoplankton, zooplankton, macrophytes, fishes, aquatic insects and birds [20]. Biological diversity with its ever since evolutionary evidences, always presented its effect on the social evolution of humans at global level [9]. The biodiversity of aquatic macrophytes is an essential component of the lake since they provide habitat for aquatic organisms and also help in maintaining water quality and nutrient cycling. The term aquatic macrophytes refer to the large plants able to be seen by the naked eyes [26]. They are regarded as photosynthetic organisms of freshwater habitats, consisting of vascular plants, aquatic bryophytes and macro algae growing permanently or temporally in aquatic environments [18]. They are also being used as food, fodder, pharmaceutical products, fertilizers, etc, [1]. However they are extremely susceptible to any type of nutritional changes and organic pollutants due to, urbanization, industrialization or anthropogenic activities. These conditions lead to increase in nutrient concentration, death & decay of macrophytes, giving rise to eutrophic conditions. Thus our water bodies are losing their natural components promoting the unnecessary growth of

obnoxious weeds which affect the ecosystem health, recreational activities and the aesthetic appeal of the aquatic bodies. But, with due regards to their beneficial properties, the harvesting of these macrophytes can be made in a systematic way on commercial basis in the areas of natural growth. With the socio-economic point of view, the present study was conducted with the aim of identifying various types of macrophytes and assessing the opportunity of these from the shallow water bodies of Bhopal's Upper Lake.

2. STUDY AREA

Bhoj Wetland is one of the oldest man-made aquatic body in the central India. It is separated into two parts Upper Lake and Lower Lake. The Upper Lake was build in the 11th century by king Bhoj by constructing an earthern dam across the Kolans River, branch of the Betwa River. The catchment area of this lake is 370 sq km, maximum water area is 3105 ha, storage capacity 100.8 million cubic meters with a water spread area 12.2 sq miles and maximum depth is 6 meters. The eastern end of upper lake catchment area is surrounded by urban component while the remaining part is rural area.

The Lower Lake was built in 1794. This lake is situated in the middle of the city and its almost entire catchment is occupied by human settlements .The Lower Lake has a surface area (water spread) of 1.29 km^2, and its watershed area is 9.6 km^2. The Lower Lake obtains its input through subsurface seepage from the Upper Lake. The maximum and minimum depths of both the lake were 10.7 m and 6.16 m respectively.

The 6 different stations of Upper and Lower Lake were Behata village in Bairagarh (Site I), Opposite to Christian graveyard between Lalghati (Site II), Kamla park (Site III), MVM College (Site IV), Hamidia College (Site V) and Lilly Talkies (Site VI).

***2.1. Direct Observation & Photography*:** The physiochemical parameters were determined on site and in the laboratory. The Macrophytes were photographed and collected in poly bags by an iron hook and identified by using "Workbook on Limnology" Adoni, 1985 [3].

***2.2. Literature Survey*:** The literature and research article were consulted about the significance, possible uses and functions of a particular variety of aquatic macrophytes so that its socio-economic importance can be resolved.

3. Results and Discussion At an instantaneous inspection on the visual basis following are the aquatic macrophytes present throughout the studied period.

3.1. *Spirodela polyrhiza*: Duckweeds belong to the family *Araceae,* Order Alismatales and are free-floating aquatic plant, rapidly growing on the surface of lakes and ponds. It consists of four genera: *Lemna*, *Spirodela*, *Wolffia* and *Wolffiella* and is the smallest known flowering plant species of the world. Duckweed produces great biomass highly rich in protein (containing up to 43% crude protein, 5% lipids and a highly digestible dry matter) content and it is a very good feed for feeding animals like fishes, cattle and poultry [21]. Duckweeds have received research interest because of their immense potential in the absorption of minerals (Na, K, Fe, Mg, Al) due to which they can tolerate high organic loading from sewages, animal industries or from agricultural fields [15]. In the present studies, two varieties of duckweed namely *Spirodela polyrhiza* and Wolfia were observed on the surface of Upper and Lower Lake water. But the presence of these macrophytes was scattered and does not show its presence throughout the year at all the sites under study. Development of a manageable fostering system for duckweeds may be utilized in new socioeconomic concept such as fish feeds, poultry industry and alternative diets that help to form small scale integrated farming operations.

Fig. 3.1 ***Spirodella polyrhiza***

3.2. Azolla It is a genus of heterosporous fresh water ferns in the family Salviniaceae, Order Salvinniales. It is a fern of great agronomic significance due to its ability to live symbiotically with *Anabaena azollae* and fix atmospheric nitrogen (N). It is used for the elimination of heavy metals (chromium, nickel, copper, zinc, and lead) from domestic or industrial wastewater. Azolla can be easily grown and due to its high crude protein contents (20 to 30%) and presence of essential amino acids especially lysine, vitamins like A & B_{12} and macronutrients like calcium, phosphorous, potassium and magnesium it is suggested to feed animals, poultry and fishes [4]. Azolla at the rate of 800 grams (fresh weight) on an average per day, enhanced the monthly milk yield by at least 10 liters per cow [12]. Azolla was observed in very less amount at Site S-1 Behta village but the presence of this macrophyte was scattered and does not show its presence throughout the year. The aquatic environment of this region is supporting the growth of *Azolla* species and these circumstances can be used as economic opportunities since this fern finds its applications in making biofertilizer and biofeeds.

Fig. 3.2 Azolla

3.3. Eichhornia crassipes is a free floating heliophyte of the family *Pontederiaceae*. It is listed as one of the most prolific plants on earth, so it causes major economic losses as well as it also acts as an ecological burden to many tropical and sub-tropical countries of the world [17]. So water hyacinths are harvested and have been put into valuable uses in several countries. Water hyacinth is used in the removal of pollutants from waste water from various industries, distilleries, etc. thus acting as a filtering agent for polluted water. Apart from its aesthetic and decorative value, the plant has been found useful as a source of animal feed [14], biomass energy, raw materials for building, handycraft making as well as fertilizers for use in agriculture [23]. Thus there are a various uses of the plant, some of which have been developed and others are still in their early stages of growth or may remain as ideas only. Water hyacinth is present in almost entire catchment area throughout the year except at site III Kamla Park. With regards to the beneficial properties of the plant, economic benefit could be taken as it is a potential source of livelihood improvement

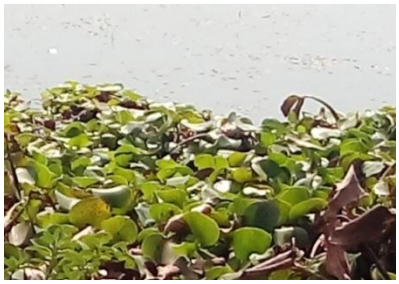

Fig. 3.3 ***Eichhornia crassipes***

3.4. Pistia stratiotes It is a free floating, feathery aquatic macrophyte belongs to family Araceae and widely distributed throughout the world. This plant is considered to be menace in stagnant waters since it blocks light and gas exchange, clogs waterways and irrigation canals, affects hydro-electricity production, rice paddies and ruins fishing ground [24]. The occurrence and distribution of *P. stratiotes* in Upper Lake is low-cut on a major basis, but were present at the margins of Behta village (S-I) and Hamidia College (S-IV). It is used for the phytoremediation of heavy metals (Hg, Cd, Cr) as well as a ammonium-nitrogen from polluted water [25]. The plant is also reported to have diuretic, antidiabetic, antifungal,

antimicrobial properties and known to be used in Ayurvedic medicine [25]. Leaves are used in the treatment of eczema, leprosy, ulcers, piles, syphilis [25]. It can be used as fodder for cattle and pigs as well as cover for fry and small fish in aquariums. Due to its high capability of decomposition, it is an appropriate substrate for biogas production [22]. Thus, a broad range of utilizations of pistia is an opportunity in diverse ways if managed properly.

Fig. 3.4 ***Pistia stratiotes***

***3.5. Ceratophyllum demersum*:** *Ceratophyllum demersum* is a fast growing submerged, perennial hydrophyte belongs to the order Nymphaeales and family Ceratophyllaceae [5]. This plant is globally distributed due to high vegetative reproduction capability, and produces huge biomass resulting in loss of biodiversity. But it is useful as oxygen generators and provides excellent cover for newly hatched fish [16]. The bifurcated leaves of the plant and thin cuticle on the plant outer surface help in the uptake of metals (Cu, Cr, Pb, Hg) from water thus playing an ecologically valuable role in phytoremediation process [5]. *C. demersum* has allelopathic traits as it excretes substances that restrain the growth of phytoplankton and cynobacteria [13]. The *C. demersum* was present in almost entire catchment area but its eminent presence was seen in the site I Behata village.

Fig. 3.5 ***Ceratophyllum demersum***

3.6. Trapa bispinosa is an annual, floating-leaved aquatic plant belongs to the family Trapaceae. Its upper leaves drift above water surface in a creative radial pattern and thus forms a thick mat in the water column [19]. Trapa bispinosa is locally well-known as singhara and it is cultivated commercially in different parts of India for its edible seasonal fruit which is a good source of nutrition having large amount of carbohydrate, protein, and vitamins. It is a potentially safe and effective plant that has immense medicinal and nutritious values. It is used in the treatment of conditions such as diarrhoea, dysentry, polyuria, ulcers, leprosy, and sore throat. The recent pharmacological studies reveal that this has important analgesic, antibiotic, antidiabetic and immunomodulatory activities [2]. High quantity of minerals, ions, namely, Ca, K, Na, Zn, and vitamins; saponins, phenols, alkaloids, flavonoids are reported in the plants [2]. Trapa bispinosa is already cultivated commercially in site I Behta village and at site II Christian cementry its presence is observed on a low cut basis. With regards to the beneficial properties of the plant as well as food for humans, Trapa can be cultivated cost-effectively by the small communities of people for their income.

3.7. ***Potamogeton crispus*** grows solely as a submersed perennial aquatic plant leaves belonging to the family Potamogetonacea. It usually prefers alkaline, calcareous and eutrophic water [7]. *Potamogeton crispus* competes with indigenous species for light and space early in the growing season; often reducing plant diversity and altering predator/prey relationship [10].

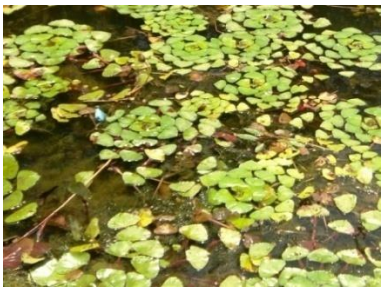

Fig. 3.6 *Trapa bispinosa*

Aqueous extracts of *P. crispus* confirmed antimicrobial activity against 17 different microorganisms including *Escherichia coli* and *Staphylococcus aureus* [11]. *P. crispus* has been proven to be a good resource for carotenoids, which are often used in medicine and cosmetics for their anti-oxidation, immunity-regulation and tumour proliferation-slowing properties. The plant also provides habitat for fish and invertebrate and is a valuable food source to aquatic herbivores [8]. In present study, the prominence of *P. crispus* was observed in shallow regions of site S-I Bairagarh followed by S-3 Kamla Park.

Fig. 3.7 Potamogeton Crispus

4. CONCLUSION

P. stratiotes, *E crassipes*, *C. demersum*, *Azolla* and, *Trapa bispinosa*, are the plant that are seen usually throughout the studied period and are flourishing in existing physico-chemical condition of Upper Lake water. These macrophytes are generally considered as sign of polluted aquatic conditions but at the same time they may be utilized for manufacture of food and feed, fuel as well as bioremedy for controlling pollution. These aquatic macrophyte are measured as hazard to water bodies if they spread in an uncontrolled way but, with due regards to their valuable properties, an additional economic advantage could be taken by the small group of people especially women, who rely on local fisheries and aquaculture based livelihood.

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