WELCOME

यावानर्थ उदपाने सर्वतः सम्प्लुतोदके ।

तावान् सर्वेषु वेदेषु ब्राह्मणस्य विजानतः ॥ ४६ ॥

A lake is the landscape's most beautiful and expressive feature. It is earth's eye; looking into which the beholder measures the depth of his own nature.

~Henry David Thoreau

Pure water is the world's first and foremost medicine.

~Slovakian Proverb

ASSESSING THE HEALTH OF 12 LAKES OF BENGALURU BY CONSIDERING THE MACROPHYTES AND SOME TERRESTRIAL ANGIOSPERMS IN AND AROUND THE LAKES

PRATEEK BHAT.T**   PRAMOD KASHYAP.C**

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INTRODUCTION

- What are lake ecosystems?
- What are aquatic plants/hydrophytes/macrophytes?
- What are their roles?
- Is there a link between the hydrophytes and the lake water quality?
- Are they indicators of water quality?

LAKE ECOSYSTEM

Printed by the Department of Natural Resources,
Wildlife Resources Division, Aquatic Education Program.

INTRODUCTION

- What are lake ecosystems?
- What are aquatic plants/hydrophytes/macrophytes?
- What are their roles?
- Is there a link between the hydrophytes and the lake water quality?
- Are they indicators of water quality?

MOTIVATION

- Dwindling of native **hydrophytes**

- Increase in the **non native /exotic/obnoxious weeds, eutrophication, pollution** and **encroachment** of lakes.

- Drastic change in the **quality of water** due to **eutrophication** and increased **Invasive plants.**

- There is no prominent **indexing system** and for the **indicator hydrophytes**

AGENDA

➤ To **provide a preview and awareness of twelve lakes of Bengaluru**, by considering and visualizing certain **indicator hydrophytes and semi-aquatic species.**

➤ **Providing a rough information about the status of these lakes** and also about considered macrophytes

➤ Making all common people **to understand the importance and the existence of lakes.**

MATERIALS AND METHODS

➥ **Study Area:** **Bengaluru** **the capital of**
Karnataka   State.

➥ Altitude - 920 metres **above mean sea**
level

➥ Area - 741sq.kms **between   latitudes**
12° 39'00" to 13° 13'00"N   **and longitude**
77° 22'00" to 77° 52'00"E.

➥ **Time of visit - June , July 2014**.

COLLECTIONS

❖ The **12 lakes** of Bengaluru viz.,

- **Agara lake**
- **Begur lake**
- **Bellandur lake**
- **Benniganahalli lake**
- **Garudacharpalya lake**
- **Varthur lake**
- **Iblur lake**
- **Devasandra lake**
- **Madiwala lake**
- **Lalbagh lake**
- **Mahadevapura lake**
- **Seegehalli lake**

RESULTS

◉ The profile of the surveyed lakes has changed due to **increased anthropogenic activities** due to the demands of rapid **urbanization** in and around these lakes.

◉ The changing profile in the lake is depicted by the **absence of many sensitive aquatic angiosperms** and the **sustenance of only the rigid species of angiosperms.**

◉ The occurrence of mostly **invasive obnoxious weeds** in most of the lakes surveyed indicates **eutrophication** and also majority of the plants recorded are **bio-indicators** of polluted lakes.

Table- I : Angiosperm plant diversity of 12 lakes of Bangalore

LAKES OF BANGALORE AND ITS ADJACENT AREAS	Agara lake	lake Begur	Bellandur tank	Benniganahalli (Bayapanahalli) lake	Garudacharplaya lake	Varthur lake	Iblur lake	Devasandra lake	Madiwala lake	Lalbagh lake	Mahadevapura lake	Seegehalli lake
Family and species of Angiosperm												
DICOTYLEDONS												
Acanthaceae												
Hygrophila schulli (Buch.-Ham.) M.R.Almeida & S.M. Almeida	+	+	+	+	+	+	+	+	+	+	+	+
Amaranthaceae												
Achyranthes aspera L.	+	+	+	+	+	+	+	+	+	+	+	+
Alternanthera paronychioides A. St.-Hil	+	+	+	+	+	+	+	+	+	+	+	+
Alternanthera philoxeroides (Mart.) Griseb.	+	+	+	+	+	+	+	+	+	+	+	+
Alternanthera sessilis (L.) R.Br. ex DC	+	+	+	+	+	+	+	+	+	+	+	+
Amaranthus spinosus L.	+	+	+	+	+	+	+	+	+	+	+	+
Gomphrena celosioides Mart.	+	+	+	+	+	+	+	+	+	+	+	+
Asclepiadaceae												
Calotropis gigantea (L.) Dryand.	+	+	+	+	+	+	+	+	+	+	+	+
Asteraceae												
Acmella paniculata (Wall. ex DC.) R.K.Jansen	+	+	+	+	+	+	+	+	+	+	+	+
Eclipta prostrata L.	+	+	+	+	+	+	+	+	+	+	+	+
Parthenium hysterophorus L.	+	+	+	+	+	+	+	+	+	+	+	+
Tridax procumbens L.	+	+	+	+	+	+	+	+	+	+	+	+
Convolvulaceae												
Ipomoea aquatica Forssk.	+	-	-	-	-	-	-	-	+	+	-	-
Ipomoea fistulosa Mart. ex Choisy	+	+	+	+	+	+	+	+	+	+	+	+
Euphorbiaceae												
Croton bonplandianus Baill.	+	+	+	+	+	+	+	+	+	+	+	+
Croton parvifolius Müll.Arg.	+	+	+	+	+	+	+	+	+	+	+	+
Jatropha gossypiifolia L.	+	+	+	+	+	+	+	+	+	+	+	+
Ricinus communis L.	+	+	+	+	+	+	+	+	+	+	+	+

Fabaceae												
Crotalaria pallida Aiton	+	+	+	+	+	+	+	+	+	+	+	+
Lamiaceae												
Hyptis suaveolens (L.) Poit.	+	+	+	+	+	+	+	+	+	+	+	+
Leucas aspera (Willd.) Link	+	+	+	+	+	+	+	+	+	+	+	+
Malvaceae												
Abutilon indicum (L.) Sweet	+	-	-	-	-	+	-	-	+	-	-	-
Mimosaceae												
Mimosa pudica L.	+	+	+	+	+	+	+	+	+	+	+	+
Nelumbonaceae												
Nelumbo nucifera Gaertn.	+	+	-	-	-	+	-	-	-	+	-	-
Nyctaginaceae												
Boerhavia diffusa L.	+	+	+	+	+	+	+	+	+	+	+	+
Mirabilis jalapa L.	+	+	+	+	+	+	+	+	+	+	+	+
Nymphaeaceae												
Nymphaea nouchali Burm.f.	+	+	-	-	-	+	-	-	+	+	-	-
Nymphaea pubescens Willd.	-	+	-	-	-	-	-	-	+	+	-	-
Nymphaea rubra Roxb. ex Andrews	+	-	-	-	-	+	-	-	+	+	-	-
Onagraceae												
Ludwigia adscendens (L.) H. Hara	+	-	+	+	-	+	-	+	+	+	+	+
Papavaraceae												
Argemone mexicana L.	+	+	+	+	+	+	+	+	+	+	+	+
Passifloraceae												
Passiflora foetida	+	+	+	+	+	+	+	+	+	+	+	+
Polygonaceae												
Persicaria glabra (Willd.) M. Gómez	+	+	+	+	+	+	+	+	+	+	+	+
Sapindaceae												
Sapindus trifoliatus L.	-	-	-	-	-	-	+	-	-	-	+	-
Solanaceae												
Solanum torvum Sw.	+	+	+	+	+	+	+	+	+	+	+	+
Datura stramonium L.	+	+	+	+	+	+	+	+	+	+	+	+
Verbenaceae												
Lantana camara L.	+	+	+	+	+	+	+	+	+	+	+	+
Phyla nodiflora (L.) Greene	-	-	+	+	-	+	-	-	+	-	-	+
Stachytarpheta indica (L.) Vahl	+	+	+	+	+	+	+	+	+	+	+	+

MONOCOTYLEDONS

Araceae												
Colocasia esculenta (L.) Schott	+	+	+	+	+	+	+	+	+	+	+	+
Pistia stratiotes L.	+	+	-	-	-	+	-	-	+	-	+	+
Cyperaceae												
Cyperus alopecuroides Rottb.	+	+	+	+	+	+	+	+	+	+	+	+
Cyperus corymbosus Rottb.	+	+	+	+	+	+	+	+	+	+	+	+
Hydrocharitaceae												
Hydrilla verticillata (L.f.) Royle	+	+	+	+	+	+	+	+	+	+	+	+
Lemnaceae												
Lemna gibba L.	+	+	+	-	-	+	-	-	+	-	+	+
Spirodela polyrrhiza (L.) Schleid.	+	+	+	-	-	+	-	-	+	+	+	+
Wolffia globosa (Roxb.) Hartog & Plas	+	+	+	-	-	+	-	-	-	-	-	+
Poaceae												
Arundo donax L.	+	-	+	+	-	+	-	-	-	-	+	+
Chloris barbata Sw.	+	+	+	+	+	+	+	+	+	+	+	+
Eleusine indica (L.) Gaertn.	+	+	+	+	+	+	+	+	+	+	+	+
Pontederiaceae												
Eichhornia crassipes (Mart.) Solms	+	-	+	+	-	+	+	-	+	+	+	+
Typhaceae												
Typha domingensis Pers.	+	+	+	+	+	+	+	+	+	+	+	+

CONSIDERED INDICATOR SPECIES

❖ AQUATIC SPECIES

1) *Alternanthera philoxeroides*
2) *Eichhornia crassipes*
3) *Lemna gibba*
4) *Pistia stratiotes*
5) *Nelumbo nucifera*

❖ SEMI-AQUATIC SPECIES

1) *Colocasia esculenta*
2) *Ludwigia ascendens*
3) *Cyperus alopecuroides*
4) *Ipomea aquatica*
5) *Typha domingensis*

1)<u>*Alternanthera philoxeroides*</u> *(Alligator weed)***:-**

➤ **Clogs** the waterways.

➤ **Increases the concentration of phosphorus.**

➤ **Increases concentration of nitrogen.**

➤ **Reduces oxygen level** in water.

➤ Blocks the **sunlight.**

➤ Reduces the biological diversity.

➤ **Indicates higher ph** of water body.

Alternanthera philoxeroides

Scientific classification

Kingdom:	Plantae
Phylum:	Angiosperms
(unranked):	Eudicots
(unranked):	Core eudicots
Order:	Caryophyllales
Family:	Amaranthaceae
Genus:	*Alternanthera*
Species:	***A. philoxeroides***

Binomial name

Alternanthera philoxeroides
Griseb.[1]

2) *<u>Eichhornia</u> <u>crassipes</u>* *(Water hyacinth)*:-

➤ **Most invasive** and obnoxious weed.

➤ **This clogs the waterway.**

➤ Has high growth rate in a short span of time.

➤ Indicators of **high** amount of **Organic matters.**

➤ Also proof of **more** amount of **Nitrogen** and **Phosphorous.**

➤ Blocks the air-water interface.

➤ **Reduces the oxygen level** in the water to a great extent.

➤ **Blocks sunlight and crushes the native submerged plants.**

➤ They also alter the animal communities by blocking access of the water.

Water hyacinth

Common water hyacinth (*Eichhornia crassipes*)

Scientific classification

Kingdom:	Plantae
Phylum:	Angiosperms
Class:	Monocotyledoneae
Order:	Commelinales
Family:	Pontederiaceae
Genus:	***Eichhornia*** Kunth

3) *Lemna gibba:-*

➢ **Nitrogen** loving species.

➢ They greatly **slows water flow and clogs** the **irrigation** and **flood control canals.**

➢ Interferes **boating** , **swimming** and **fishing.**

➢ **Invades** ecologically important **native submerged plants.**

➢ Indicators of traces of **Nitrogen** in the Lake ecosystem.

➢ Also indicates small amount of **Phosphorous** present.

Kingdom:	Plantae
(unranked):	Angiosperms
(unranked):	Monocots
Order:	Alismatales
Family:	Araceae
Subfamily:	Lemnoideae
Tribe:	Lemneae
Genus:	*Lemna*
Species:	*L. gibba*

Lemna gibba
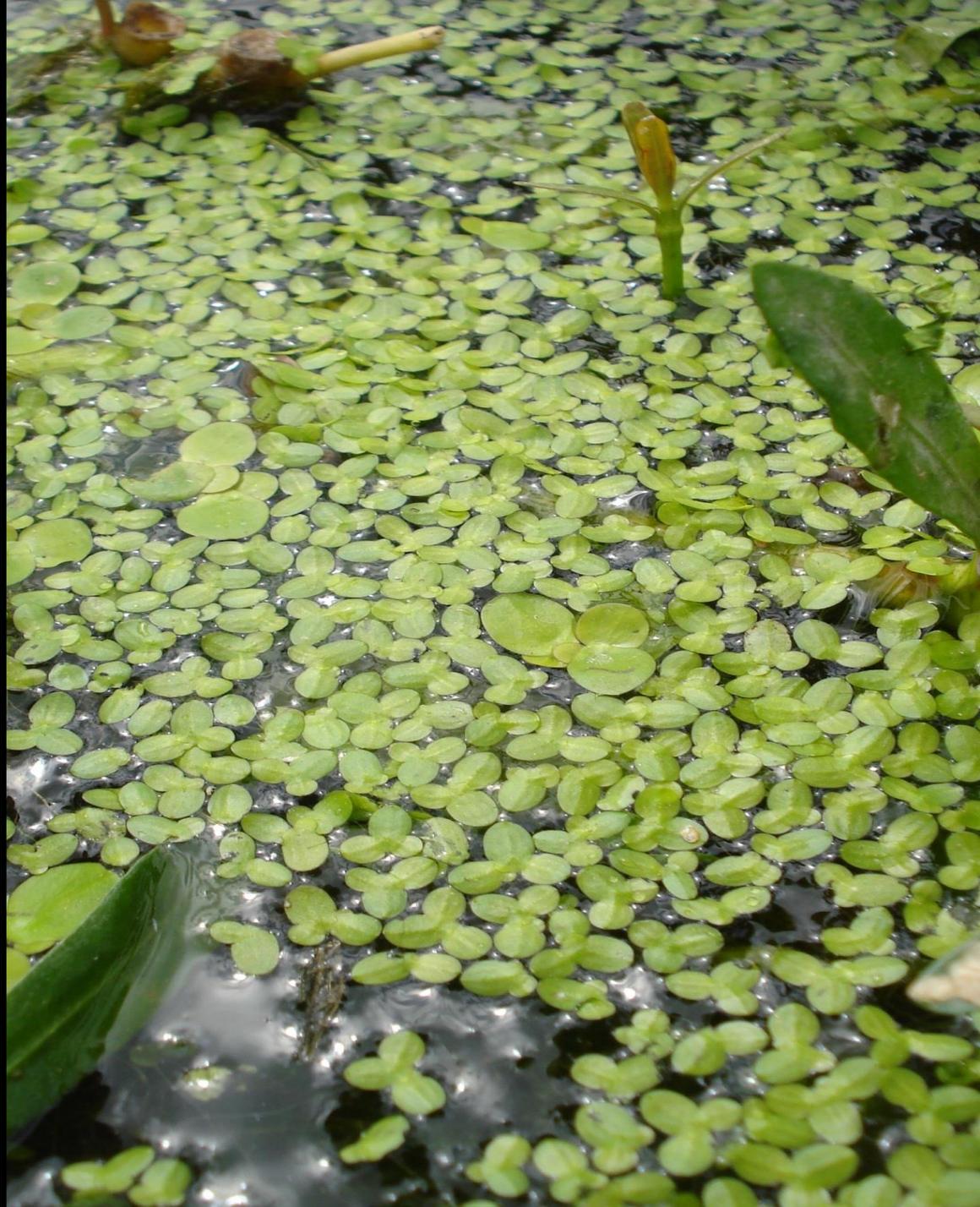
4)*Pistia stratiotes* (Water lettuce):-

➢ **Clogs the waterways.**

➢ **Blocks** the air-water interface.

➢ Indicates more amount of Organic matters.

➢ Greatly **reduces** the **dissolved oxygen** levels.

➢ Blocks sunlight.

➢ Alter the emersed plant communities by **pushing** away and **crushing** them.

➢ Makes boating impossible.

Pistia

Scientific classification

Kingdom:	Plantae
(unranked):	Angiosperms
(unranked):	Monocots
Order:	Alismatales
Family:	Araceae
Subfamily:	Aroideae
Tribe:	Pistieae
Genus:	*Pistia* L.[1]
Species:	*P. stratiotes*

5)<u>*Nelumbo nucifera*</u> *(Water lotus):-*

➢ **Not** found in lakes which are **highly polluted.**

➢ Clean water organism, **good condition** indicators.

➢ Indicates **high dissolved oxygen (DO)** in water.

➢ Indicates less amount/concentrations of **Nitrogen.**

➢ **Mercuric Eutrophication** is absent.

➢ Indicators of less concentration of phosphorus.

➢ Indicators of **less Organic/Sewage effluents** in the water.

Nelumbo nucifera

Scientific classification

Kingdom:	Plantae
(unranked):	Angiosperms
(unranked):	Eudicots
Order:	Proteales
Family:	Nelumbonaceae
Genus:	*Nelumbo*
Species:	*N. nucifera*

Binomial name

Nelumbo nucifera
Gaertn.

❖ *Semi aquatic species:-*

➢ These are **obligate wetland indicator** plant species.

➢ They are **aggressive** invaders.

➢ Have the capacity of **rapid nutrient uptake.**

➢ **Increase** the level of carbon in the lake systems.

➢ **Protect** the under ground plant tissues from **flooding** and **anoxic soil.**

➢ **Depletes** water supply through **excessive evapo-transpiration.**

➢ Retards water flow causing siltation.

➢ **Increases nitrogen and phosphorus** concentrations.

➢ Plants like Typha promotes gaseous **mercury production.**

➢ Typha **accumulates ethanol** which causes underwater **mortality.**

Colocasia esculenta

Binomial name

Colocasia esculenta
(L.) Schott

Ludwigia

Kingdom:	Plantae
(unranked):	Angiosperms
(unranked):	Eudicots
(unranked):	Rosids
Order:	Myrtales
Family:	Onagraceae
Genus:	*Ludwigia* L.

Species

Cyperus alopecuroides

Scientific classification

Kingdom:	Plantae
(unranked):	Angiosperms
(unranked):	Monocots
(unranked):	Commelinids
Order:	Poales
Family:	Cyperaceae
Genus:	*Cyperus*

Ipomoea aquatica

Scientific classification

Kingdom:	Plantae
(unranked):	Angiosperms
(unranked):	Eudicots
(unranked):	Asterids
Order:	Solanales
Family:	Convolvulaceae
Genus:	*Ipomoea*
Species:	*I. aquatica*

Binomial name

Ipomoea aquatica
Forssk.

©KASHYAP

Typha domingensis

Scientific classification

Kingdom:	Plantae
(unranked):	Angiosperms
(unranked):	Monocots
(unranked):	Commelinids
Order:	Poales
Family:	Typhaceae
Genus:	*Typha*
Species:	**T. domingensis**

Binomial name

Typha domingensis
Pers.

INDEX FOR THE SPECIES

❖ **AQUATIC SPECIES**

1) Alternanthera philoxeroides - **A**
2) Eichhornia crassipes - **A**
3) Lemna gibba - **B**
4) Pistia stratiotes - **B**
5) Nelumbo nucifera - **C**

*A- obnoxious/invasive weed
 B- moderately invasive
 C- good condition indicators.

*As per the survey related only to these 12 lakes

	AP	*EC*	*LG*	*PS*	*NN*	*CE*	*LA*	*CA*	*IA*	*TD*
AP-Alternanthera philoxeroides;EC-Eichhornia crassipes;LG-Lemna gibba;PS-Pistia stratiotes;NN-Nelumbo nucifera;CE-Colocasia esculenta;LA-Ludwigia adscendens;CA-Cyperus alopecuroides;IA-Ipomoea aquatica;TD-Typha domingensis										
Agara Lake	++	++	+	++	+	+	+	++	+	+
Begur lake	++	+	-	+	+	+	-	+	++	++
Bellandur Tank	+++	+++	-	++	-	++	+	+	-	+
Benniganahalli lake	+++	+++	-	-	-	+	+	+	-	+
Garudachar palya lake	++	+	++	+	-	++	-	++	++	++
Varthur lake	++	++	-	++	+	++	++	++	-	++
Iblur lake	+++	+++	-	+	-	+	-	+	-	++
Devasandra lake	++	+	+	+	-	+	+	+	+	+
Madiwala lake	++	+	+	++	-	+++	++	++	++	++
Lalbagh lake	+	+	++	+	++	+	+	+	+	+
Mahadevapura lake	++	+	+	+++	-	++	+	+	-	+
Seegehalli lake	++	++	++	+	-	++	++	++	+	++

+++ excess ; ++ moderate ; + less ; - absent

*quantity of the species if present

Lake Clustering based on Aquatic plant (Bio indicators) diversity

12 LAKES

LESS POLLUTED
- LALBAGH LAKE
- MADIWALA LAKE
- AGARA LAKE

MODERATELY POLLUTED
- DEVASANDRA LAKE
- GARUDACHAR PALYA LAKE
- BEGUR LAKE
- SEEGEHALLI LAKE
- MAHADEVAPURA LAKE

MORE POLLUTED
- BELLANDUR TANK
- BENNIGANAHALLI LAKE
- IBLUR LAKE
- VARTHUR LAKE

CONCLUSION

🗣 We can notice that there is an **increase in the anthropogenic activities** around the precious lake systems.

🗣 **Rapid Urbanizations** are causing Depletion of Lake and Lake Ecosystems.

🗣 Increase in **obnoxious weeds** which results in eutrophication .

🗣 **Bio-chemico properties** of the lake systems are getting disturbed and **imbalanced** .

🗣 Special care should be taken so that these lake systems get restored as they were in the previous years.

1973

1992

2000

2006

2009

Built up
Vegetation
Water Bodies
Others

ces.iisc.ernet.in
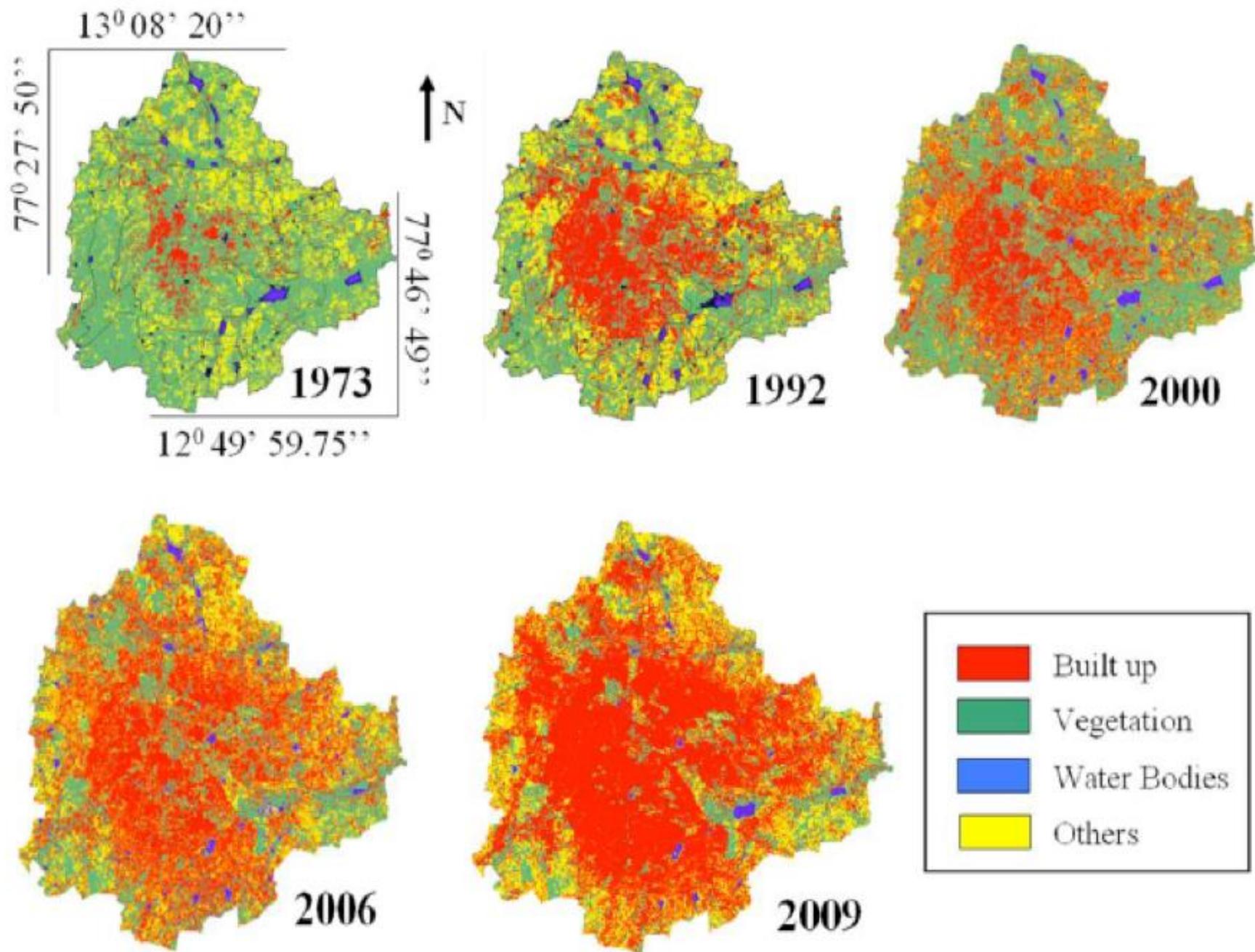
BIG BANG

BENNIGANAHALLI LAKE CRIES FOR HELP
OLD MADRAS ROAD

SHARADA PAI, RESIDENT

news 9

BIG news

10:15

STATE BJP PRESIDENT KS ESHWARAPPA PRESENT AT THE MEET

🔵AGARA LAKE🔵

◆ BEGUR LAKE ◆
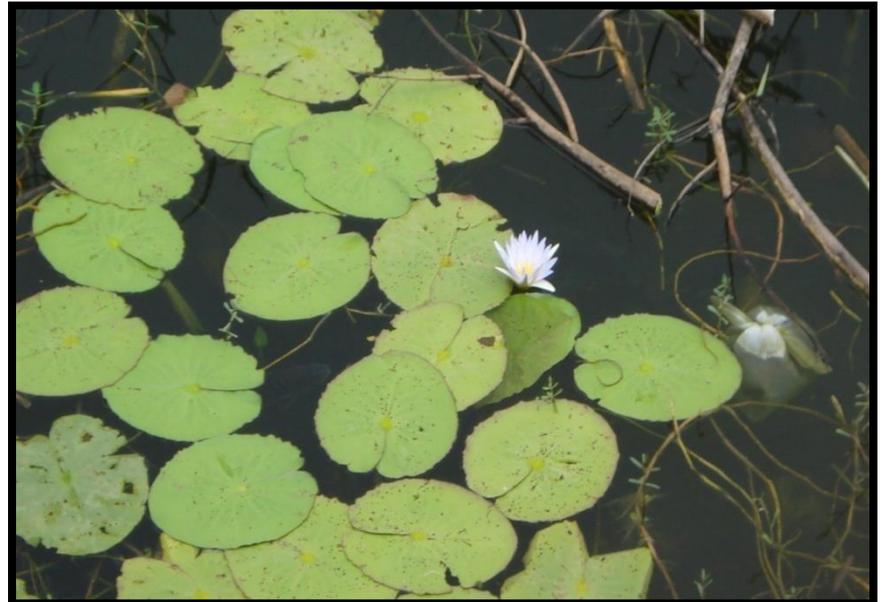
● BELLANDUR TANK ●

BENNIGANAHALLI LAKE

GARUDACHARPALYA LAKE

❖ VARTHUR LAKE ❖

IBLUR LAKE

DEVASANDRA LAKE
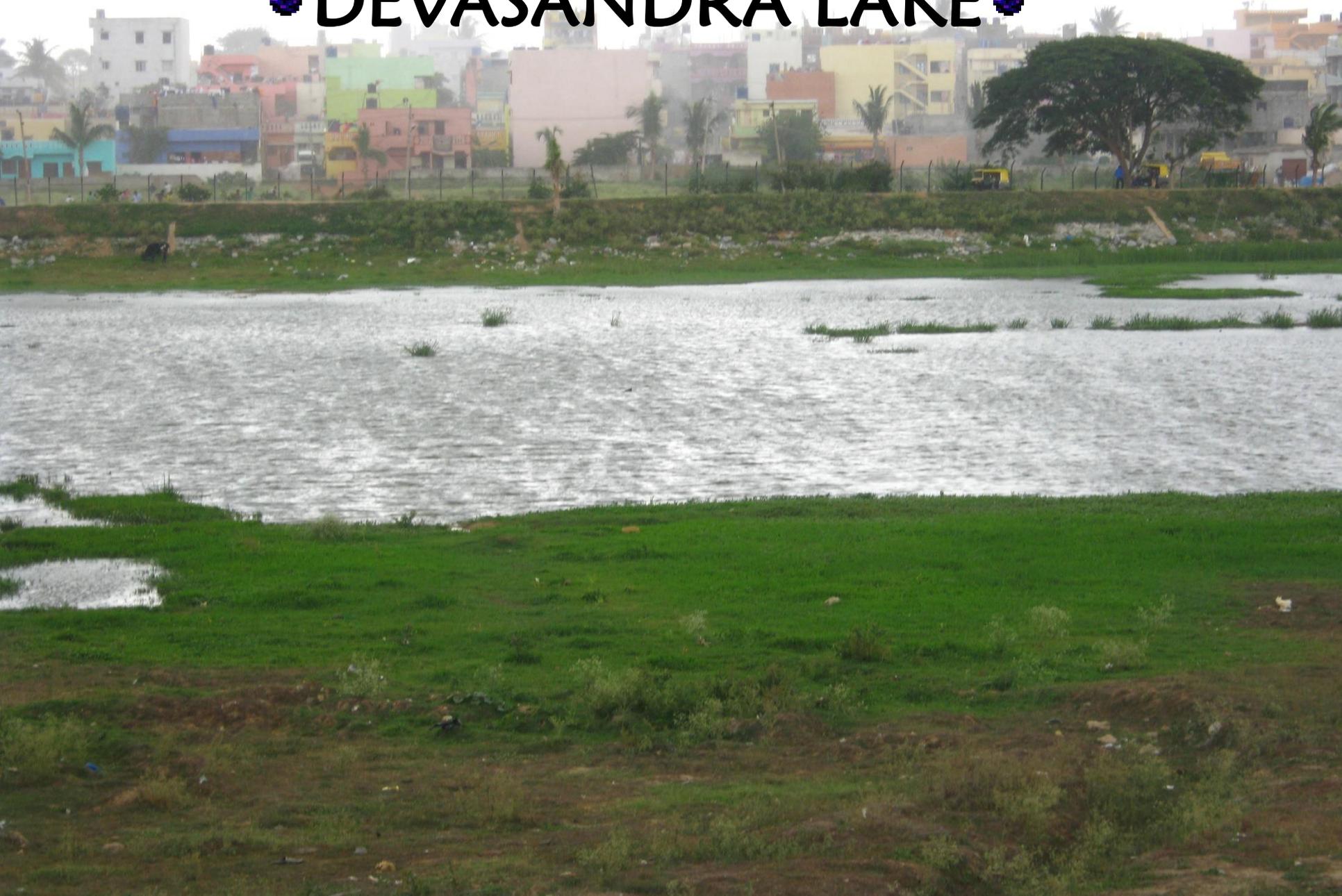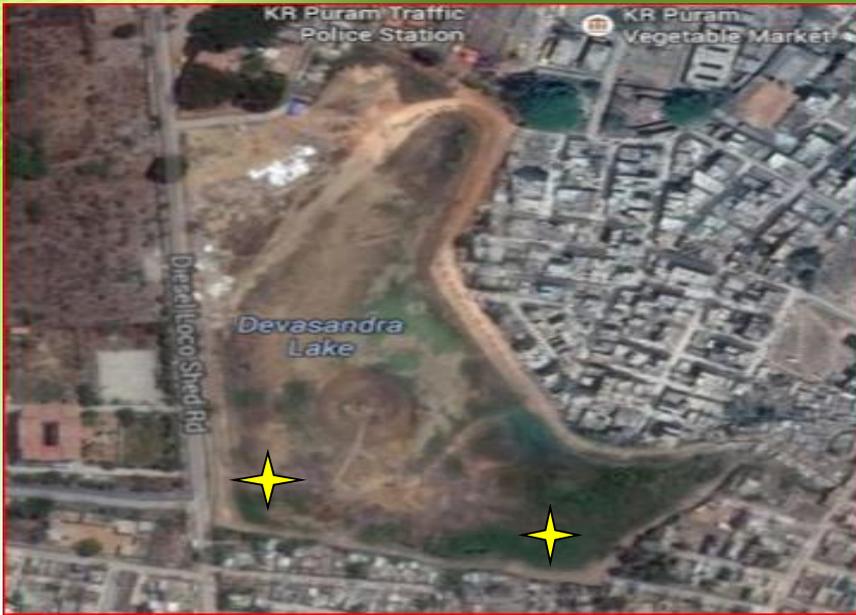
🔮 MADIWALA LAKE 🔮

LALBAGH LAKE
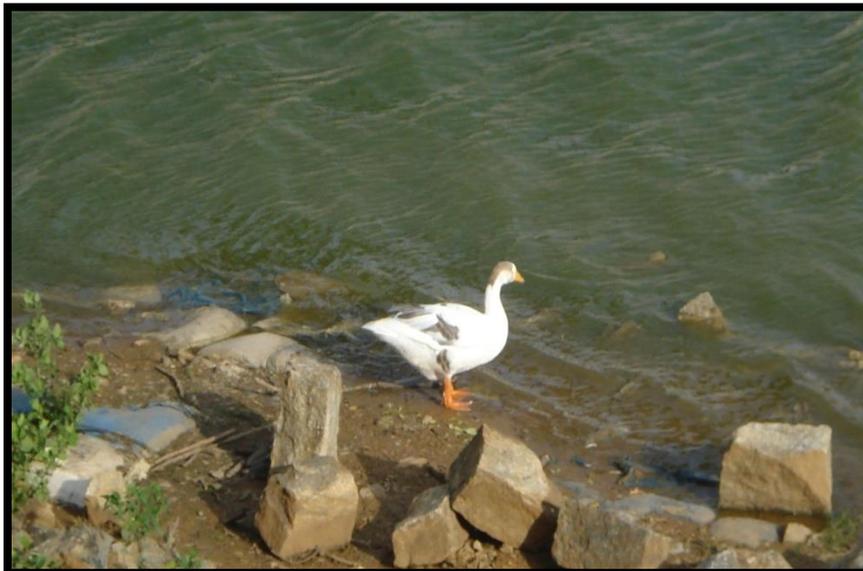
MAHADEVAPURA LAKE
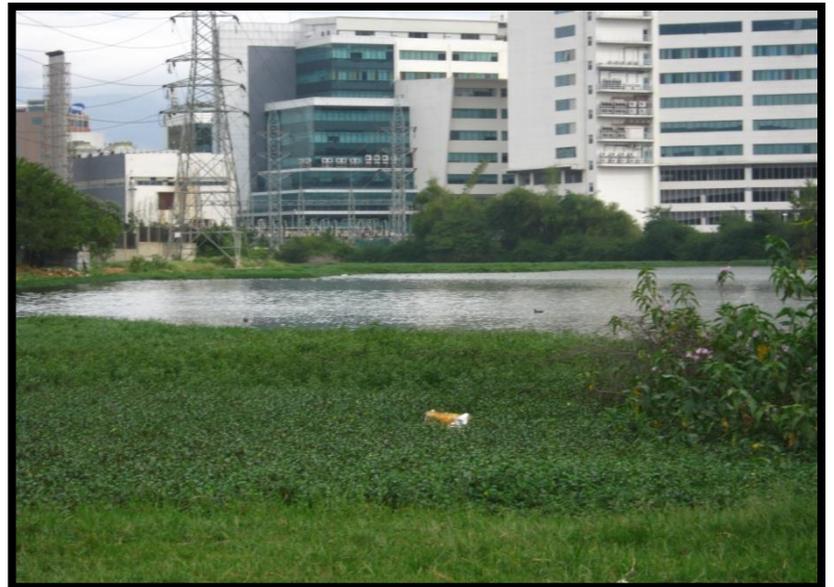
SEEGEHALLI LAKE

SUGGESTIONS

- Steps should be taken to **eliminate the obnoxious weeds**.
- Herbicides can reduce certain semi-aquatic species.
- **Dissolved oxygen** content in water body is increased if done so and hence healthy and attractive plants like *Nelumbo nucifera* etc will grow extensively.
- **Weed chopping machines** should be used to **eliminate the unwanted plants**.
- An **"Index system"** should be introduced in order to create awareness about the non native plants.

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