



AQUATIC MACROPHYTES OF THE WETLANDS OF HOJAI SUB DIVISION, NAGAON DISTRICT OF ASSAM, INDIA

Monjit Saikia

Associate Professor, Department of Botany,
Hojai College, Hojai, Nagaon-782435 (Assam)

Abstract

Hojai sub division is situated in the southern part of Nagaon district of Assam, India and global position in between the latitude 26°:01':05"N to 26°:03':00" N and 92°:45':40"E to 92°:47':05"E longitude. The study has been carried out for two years i.e from 2009 to 2010. Hojai contains 8 (oxbow type) beels covering total area of 345 hectare and Nabhangra beel was found to be with its highest depth (3.2 m). Altogether 62 macrophyte species of 51 genera under 30 families have been recorded, out of which 4 families are of Pteridophytes. 31 species were annual and 31 species were perennial. Cyperaceae with its 5 genera and 9 species, Poaceae with its 7 genera and 7 species and Hydrocharitaceae with 6 genera and 7 species were found to be the dominant families in the study sites. Cyperus was the dominant genera with its 4 species. There were 6 exotic aquatic plants species recorded. The aquatic macrophyte species, growing along the marshy edges of the wetlands formed the dominant ecological category (Emergent anchored 35.48%) and widely distributed throughout the wetlands. These aquatic plants are used as vegetable, herbal medicine, fodder by the rural inhabitants of Hojai.

Key words: Wetland, Beel, Hojai, Aquatic macrophyte.

Introduction

"Wetlands" is the collective term for marshes, swamps, bogs, and similar areas and are the source of many valuable aquatic flora and fauna including migratory birds and endangered species (Cowardin *et al* 1979). Ramsar Convention (1990) on Wetlands of International importance defined wetland as "the areas of marsh, fen, peat land or water, natural or artificial, perennial or temporary with water that is static or flowing fresh, brackish or salt including areas of marine water, the depth of which at low tide does not exceed 6 meters." Wetlands with their flora and fauna provide subsistence for millions of inhabitants in its vicinity. Nature has bestowed enormous wetlands and its repositories of biodiversity, the precious gifts to mankind. Globally, the wetlands have received a good deal of attention in recent years. Over exploitation of wetland resources, demand for human habitation and permanent change of landscape could be identified as the inherited problems during the past few decades (U.S.E.P.A., 1983).

The freshwater, perennial, large, lentic water bodies are popularly known as 'beel' in Assam (Sharma, 1993). The aquatic plants, better stated here as "aquatic macrophyte" are the important source of food, fodder, herbal medicine and domestic household materials. The present investigation deals with the identification, listing and ecological classification of the aquatic macrophytes of some oxbow lacks (beel) in Hojai sub division, Assam.

Various studies have been carried out on aquatic flora and ecology of wetlands in India and North-East India. But in Assam the wetlands have rarely been evaluated and understood from the floristic and ecological point of view and only a few works have been made so far. The works regarding floristic study were done by the workers like, Verma (1971), Malakar (1995) etc and ecological status of aquatic macrophyte were done by the workers like, Baruah *et al* (1997), Baruah (2003), Dutta (2005) etc. Unfortunately no significant such works have been performed in this part of India. Hojai sub division of Nagaon district, having a large number of wetlands has been selected for present investigation with the following aims and objectives.

- survey of wetlands, identification and listing of aquatic macrophyte to have a correct picture of the wetlands and their floral composition.
- Classification of aquatic macrophyte based on ecological adaptation, occurrence and role of exotic plant species in the wetland ecosystem to know the ecological status of the wetland flora of the study sites.

Study Area

Hojai sub division is situated in the southern part of Nagaon district of Assam with its mean altitude 82m above sea level and global position in between the latitude 26°:01':05"N to 26°:03':00" N and 92°:45':40"E to 92°:47':05"E longitude. It is situated at the southern part of Nagaon district. Hojai contains 8 beels (Table-1) in the south west corner. All these beels are oxbow type and formed by land locking of channels by gradual siltation and changing the course of river Kopili, a tributary of river Brahmaputra (Saikia, 2008). These are situated at a distance of 1-2 km from each other in the rural areas of Hojai sub division. Their mean average depth and areas are presented in the Table-1 which covers a total area of 345 hectares during rainy season.

Materials and Methods

The present investigations were conducted for two years i.e. from Jan, 2009 to Dec, 2010 and covers two aspects: survey of floral diversity and classification into different ecological grouping. To study floral composition, adequate field trips were undertaken during the study period to collect and record precisely the aquatic macrophyte species and prepared herbarium. They were identified by consulting the recognized Herbaria of the region, namely the Herbarium, Botany Department, Gauhati University and Regional Herbarium "ASSAM" of Botanical Survey of India, Eastern circle, Shillong. The whole year have been arbitrarily divided in to two seasons viz. summer (April to September) and winter (October to March). The flora of the wetlands were classified based on ecological adaptation in water. The macrophyte species were categorized according to the system of Weaver and Clement (1929) with some modification presented by Daubenmire (1947).

Results and Discussion

The total areas covered by the studied beels are 345 hectare and their individual depth and area are presented in the table- 1. The present study of the wetlands of Hojai sub-division reveals interesting findings about its floristic composition. It includes 62 aquatic macrophyte species of 51 genera under 30 families (Table-2), out of which 58 species are Angiosperms and 4 species are Pteridophytes (table-3). 31 species were found to be annual and 31 species were perennial. Among the species, angiospermic flora occupies the major portion. Cyperaceae is the largest family with its 5 genera and 9 species, followed by Poaceae with 7 genera and 7 species and so on. Similarly, Cyperus is the dominant genera with 4 species followed by Polygonum with 3 species and so on.

A special mention has also been made of exotic species, which have almost become naturalized in the study sites. Altogether 6 exotic species have been recorded from the study site (table-4). Among the six exotic species *Eichhornia crassipes* (Mart.) Solm. is the most dominant species followed by *Ipomoea fistulosa* Mart. Ex. Choisy. and so on. They restrict the growth and development of the flora of wetlands. Exotic Species are successful invader and become threat to the indigenous flora of the wetlands.

Ecological classification of the aquatic macrophytes based on adaptation in water of the study sites have been presented in the Table-5, where the macrophytes are categorized in to 7 different categories as follows:

(a) *Free floating*: The plant species that are found to remain in contact with water and air. In the study sites, out of 62 macrophytes, only 7 species (11.29%) have been recorded to be under this category e.g. *Eichhornia crassipes*, *Lemna perpusilla* etc.

(b) *Submerged suspended*: These species are rootless but submerged and remain in contact with water only. The flowers may or may not come above water surface. Only 2 species (3.23%) have found in the study sites under this category e.g. *Ceratophyllum demersum*, *Utricularia exoleta* etc

(c) *Submerged anchored macrophytes*: The entire plant or most parts of the plants are in contact with water and soil through its roots. The flowers usually borne on long peduncled inflorescences. 5 species (8.06%) under this category were recorded during the present investigation e.g. *Hydrilla verticillata*, *Ottelia alismoides* etc

(d) *Rooted with floating leaves*: The roots of such species are fixed in mud, but leaves have long petioles which keep them floating on water surface. The remaining parts of the species, except leaves, remain under water. 8 species (12.9%) under this category have been recorded from the study sites. e.g. *Nelumbo nucifera*, *Nymphaea lotus* etc.

(e) *Rooted with floating shoots*: These aquatics have contact with soil, water and air. They usually grow along the margins of wetlands, rooted in mud and spread its branches with their shoots just above water surface. They often produce respiratory roots at the nodes and the main stems remain submerged partially or completely. When water level recedes, these plants show terrestrial mode of life, their stems and leaves get reduced. At the advent of rains these plants again show profuse growth and development. This category has shown 5 species (8.06%) in the study sites. e.g. *Enhydra fluctans*, *Neptunia prostrata* etc.

(f) *Emergent anchored macrophytes*: Usually these plants grow along the edges of the wetlands. The roots, lower part of the stems and sometimes the lower leaves remain submerged. The apical parts of stems and inflorescences rise above the water surface. Under this category 21 species (33.87%) have been recorded from the study sites e.g. *Aeschynomene aspera*, *Cyperus bravifolius* etc.

(g) *Swamp and marshy macrophytes*: The plants under this category are found to grow well along the edges or bank of wetlands but except their roots which remain anchored in the marshy lands, all other parts of the plants remain well above the soil. Among these plants, sedges and grasses form the largest component. 14 species (22.58%) have been recorded under this category from the study sites. e.g. *Alpinia galanga*, *Paspalum distichum* etc.

The aquatic macrophyte species have often shown plasticity in their habit and the growth, vary according to their habitat. The free floating macrophytes can survive in mud during dry season while the emergent and marshy macrophytes survive fairly to some extent in deep water during rainy season. This may be due to their wide range of adaptability. The emergent anchored species are found to be most dominant in the study sites, followed by swamp and marshy wetland species. These plant species have been acquired amphibian characters and well adapted to drought and wet conditions and can withstand cold and extreme hot climate as well as shallow and deep water. These are the reasons for which they are so diverse. The rooted with floating leaves species shows reduced growth of stems and long petioles but possess rootstocks or rhizome for propagation. They might have been acquired these characters to survive in deep water and in adverse climatic conditions. The floating leaves are large and sometimes slightly lobed showing a tendency to increase the exposed surface. The submerged species are very weak and delicate and are well adapted to very low light intensity and show high rate of propagation.

Table-1. Depth and areas of the beels of Hojai, Nagaon, Assam.

| Sl. No. | Name | Depth(m) in summer season | Area (ha) |
|---------|----------------|---------------------------|-----------|
| 1 | Nabhangra beel | 3.2 | 72 |
| 2 | Kenduguri beel | 2.3 | 57 |
| 3 | Warigedeng | 2.5 | 48 |
| 4 | Taradubi | 3.1 | 37 |
| 5 | Erakopili-1 | 2.1 | 22 |
| 6 | Erakopili-11 | 2.2 | 26 |
| 7 | Theplaguri-1 | 3.3 | 46 |
| 8 | Theplaguri-11 | 2.7 | 37 |

Table-2. List of Aquatic Macrophytes species of wetlands of Hojai sub-Div, Nagaon district, Assam

| Sl. No. | Name of Sps. | Local name | Family | Life span |
|---------|---|--------------|------------------|-----------|
| 1 | <i>Acorus calamus</i> Linn | Boss | Araceae | Perennial |
| 2 | <i>Aeschynomene indica</i> L. | Kuhila | Liguminosae | Annual |
| 3 | <i>Alocasia fornicata</i> (Roxb) Schott. | Kola kochu | Araceae | Perennial |
| 4 | <i>Alpinia galanga</i> (L) Willd., | Tora | Zingiberaceae | Perennial |
| 5 | <i>Alternanthera philoxeroides</i> (Mart) Griseb. | Helesi sak | Amaranthaceae | Perennial |
| 6 | <i>Alternanthera sessilis</i> (L) DC. | Matikanduri | Amaranthaceae | Perennial |
| 7 | <i>Aponogeton natans</i> (L) Engl. | Not Known | Aponogetonaceae | Annual |
| 8 | <i>Azolla pinnata</i> R.Br | Puni | Azollaceae | Annual |
| 9 | <i>Brachiaria mutica</i> Forsk | Dhepa dol | Poaceae | Annual |
| 10 | <i>Blyxa aubertii</i> Rich | Not Known | Hydrocharitaceae | Annual |
| 11 | <i>Carex baccans</i> Nees | Not Known | Cyperaceae | Perennial |
| 12 | <i>Ceratopteris thalictroides</i> Brogn. | Pani dhekia | Perkariaceae | Annual |
| 13 | <i>Ceratophyllum demersum</i> Linn. | Sial bhobora | Ceratophyllaceae | Perennial |
| 14 | <i>Commelina benghalensis</i> Linn. | Konasimolu | Commelinaceae | Annual |
| 15 | <i>Cyperus bravifolius</i> (Rottb.) Hassk.. | Jota ghanh | Cyperaceae | Perennial |
| 16 | <i>Cyperus siliotensis</i> Nees., | Not Known | Cyperaceae | Annual |
| 17 | <i>C. compressus</i> Linn | Not Known | Cyperaceae | Annual |
| 18 | <i>C. corymbosus</i> Rottb. | Not Known | Cyperaceae | Perennial |
| 19 | <i>Echinochloa stagnina</i> Retz. | Not Known | Poaceae | Perennial |
| 20 | <i>Eichhornia crassipes</i> (Mart) Solm. | Bihmeteka | Pontedariaceae | Perennial |
| 21 | <i>Eleocharis acutangula</i> (Roxb.) Schult. | Not Known | Cyperaceae | |
| 22 | <i>Eleocharis dulcis</i> (Burm. F.) Henschel | Not Known | Cyperaceae | Annual |
| 23 | <i>Hydrilla verticillata</i> (L.f.) Royle | Not Known | Hydrocharitaceae | Perennial |
| 24 | <i>Hydrocharis dubia</i> (Bl.) Backer | Not Known | Hydrocharitaceae | Annual |
| 25 | <i>Hygroryza aristata</i> (Ritz.) Nees. | Petuli dol | Poaceae | Perennial |
| 26 | <i>Hymenachne assamica</i> Hitch | Dol ghah | Poaceae | Perennial |
| 27 | <i>Ipomoea aquatica</i> Forsk. | Kolmou | Convolvulaceae | Annual |
| 28 | <i>Ipomoea fistulosa</i> Mart. Ex. Choisy. | Amarlota | Convolvulaceae | Perennial |
| 29 | <i>Lemna perpusilla</i> Torrey | Sorupuni | Lamnaceae | Annual |
| 30 | <i>Leersia hexandra</i> Swartz | Erali bon | Poaceae | Perennial |
| 31 | <i>Ludwigia adscendens</i> (L) Hara | Panikhutura | Onagraceae | Perennial |
| 32 | <i>Marselia quadrifolia</i> L. | Panitengesi | Marseliaceae | Annual |
| 33 | <i>Monochoria hastata</i> (L) Solm. | Khar Meteka | Pontedariaceae | Perennial |
| 34 | <i>Monochoria vaginalis</i> (Barm. f.) Presl. | Bhatmeteka | Pontedariaceae | Annual |
| 35 | <i>Nelumbo nucifera</i> Geartn | Podum | Nymphaeaceae | Perennial |
| 36 | <i>Neptunia prostrata</i> (Lamk) Baillon | Pani lazuki | Mimosaceae | Perennial |
| 37 | <i>Nymphaea lotus</i> Linn. | Boga bhet | Nymphaeaceae | Perennial |
| 38 | <i>Nymphaea rubra</i> Roxb.Ex.Salibs | Rongabhet | Nymphaeaceae | Perennial |
| 39 | <i>Nymphoides cristatum</i> (Roxb) O.Kuntz. | Pan chuli | Hydrocharitaceae | Perennial |
| 40 | <i>N. indicum</i> (L.) O.Kuntz | Bora chuli | Hydrocharitaceae | Perennial |
| 41 | <i>Oenanthe javanica</i> (BL) DC. | Not Known | Apiaceae | Annual |

| | | | | |
|----|---|---------------------|------------------|-----------|
| 42 | <i>Ottelia alismoides</i> (L) Pers. | Panikol | Hydrocharitaceae | Annual |
| 43 | <i>Panicum paludosum</i> Roxb., | Pani Ghah | Poaceae | Perennial |
| 44 | <i>Paspalum distichum</i> L. | Ghanh | Poaceae | Perennial |
| 45 | <i>Pistia stratiotes</i> Linn. | Borpuni | Araceae | Annual |
| 46 | <i>Polygonum barbatum</i> Linn | Bihlongoni | Polygonaceae | Annual |
| 47 | <i>Polygonum hydropiper</i> Linn. | Pothorua bihlongoni | Polygonaceae | Annual |
| 48 | <i>Polygonum pulchrum</i> Bl | BorBihlongni | Polygonaceae | Annual |
| 49 | <i>Potamogeton nodosus</i> Poir | Not Known | Potamogetonaceae | Annual |
| 50 | <i>Ranunculus sceleratus</i> Linn. | Not Known | Ranunculaceae | Annual |
| 51 | <i>Rhynchospora rubra</i> (L) Makino. | Not Known | Cyperaceae | Annual |
| 52 | <i>Rotala rotundifolia</i> (Roxb.) Koechne | Not Known | Lythraceae | Annual |
| 53 | <i>Rumex nepalensis</i> Spreng. | Bonpaleng | Polygonaceae | Annual |
| 54 | <i>Salvinia natans</i> (L) All. | Not Known | Salvinaceae | Annual |
| 55 | <i>Sagittaria trifolia</i> L. | Kanr meteka | Alismataceae | Perennial |
| 56 | <i>Schumannianthus dichotomus</i> (Roxb.) Gagnep | Pati doi | Marantaceae | Perennial |
| 57 | <i>Scirpus grossus</i> L. | Ghugol | Cyperaceae | Perennial |
| 58 | <i>Spilanthes clava</i> DC. | Suhoni | Asteraceae | Annual |
| 59 | <i>Spirodela polyrrhiza</i> (L) Schleid | Maju puni | Lamnaceae | Annual |
| 60 | <i>Trapa natans</i> (L) var. <i>bispinosa</i> Roxb. | Singori | Trapaceae | Perennial |
| 61 | <i>Utricularia exoleta</i> R.Br. | Not Known | Lentibulariaceae | Annual |
| 62 | <i>Vallisneria natans</i> (Lour.) Hara. | Pata ghanh | Hydrocharitaceae | Perennial |

Table-3: Analysis of the Plant elements of the study sites

| Group | Families | | Genara | | Species | |
|--------------|----------|-------|--------|-------|---------|-------|
| | No. | % | No. | % | No. | % |
| Angiosperm | 26 | 86.67 | 47 | 92.16 | 58 | 93.55 |
| Pteridophyte | 4 | 13.33 | 4 | 7.84 | 4 | 6.45 |
| Total | 30 | 100 | 51 | 100 | 62 | 100 |

Table-4-List of Exotic Species in the wetlands of Hojai Sub division, Assam.

| Sl. No | Name of Species | Family | Place of origin |
|--------|---|----------------|------------------------|
| 1 | <i>Aeschynomene indica</i> L. | Liguminosae | Africa |
| 2 | <i>Alternanthera philoxeroides</i> (Mart) Griseb. | Amaranthaceae | Brazil |
| 3 | <i>Brachiaria mutica</i> Forsk | Poaceae | Africa |
| 4 | <i>Cyperus. compressus</i> Linn | Cyperaceae | Tropical America |
| 5 | <i>Eichhornia crassipes</i> (Mart) Solm. | Pontedariaceae | Tropical South America |
| 6 | <i>Ipomoea fistulosa</i> Mart. Ex. Choisy. | Convolvulaceae | Brazil |

Table -5: Ecological Classification of macrophyte species of the wetlands of Hojai sub division, Nagaon district. (FF= Free floating, SS= Submerged suspended, SA= Submerged anchored, RFL= Rooted with floating leaved, RFS= Rooted with floating shoot, EA= Emergent anchored, SM= Swamp and marshy.)

| Sl.No | Catego-ries | Name of species | No. of species | % of species |
|-------|-------------|---|----------------|--------------|
| 1 | FF | <i>Azolla pinnata</i> R.Br., <i>Cyperus siliotensis</i> Nees., <i>Eichhornia crassipes</i> (Mart.) Solms., <i>Lemna perpusilla</i> Torr., <i>Pistia stratiotes</i> L., <i>Spirodela polyrrhiza</i> (L) Schleid., <i>Salvinia natans</i> (L) All. | 7 | 11.29 |
| 2 | SS | <i>Ceratophyllum demersum</i> L., <i>Utricularia exoleta</i> R.Br. | 2 | 3.23 |
| 3 | SA | <i>Blyxa aubertii</i> Rich., <i>Hydrilla verticillata</i> (L.f.) Royle., <i>Ottelia alismoides</i> (L) Pers., <i>Potamogeton nodosus</i> Poir., <i>Vallisneria natans</i> (Lour) Hara. | 5 | 8.06 |
| 4 | RFL | <i>Apongeton natans</i> (L.) Engl., <i>Hydrocharis dubia</i> (Bl.) Backer., <i>Nelumbo nucifera</i> Geartn., <i>Nymphaea lotus</i> Linn., <i>N. rubra</i> Roxb. Ex. Salibs., <i>Nymphoides cristatum</i> (Roxb.) O.kuntz., <i>N. indicum</i> (L.) O.Kuntz., <i>Trapa natans</i> (L) var. <i>bispinosa</i> Roxb. | 8 | 12.9 |
| 5 | RFS | <i>Hygroryza aristata</i> (Ritz.) Nees., <i>Ipomoea aquatica</i> Forsk., <i>Ludwigia adscendens</i> (L) Hara., <i>Myriophyllum tuberculatum</i> Roxb., <i>Neptunia prostrata</i> (Lamk) Baillon. | 5 | 8.06 |

| | | | | |
|---|----|--|----|-------|
| 6 | EA | <i>Aeschynomene indica</i> L., <i>Alternanthera philoxeroides</i> (Mart) Griseb., <i>Cyperus bravifolius</i> (Rottb.) Hassk., ., <i>C. compressus</i> Linn., <i>C. corymbosus</i> Rottb., <i>Echinochloa stagnina</i> Retz., <i>Eleocharis dulcis</i> (Burm. F.) Henschel., <i>Hymenachne assamica</i> Hitch., <i>Ipomoea fistulosa</i> Mart.ex. Choisy., <i>Leersia hexandra</i> Swartz., <i>Marselia quadrifolia</i> L., <i>Monochoria hastata</i> (L) Solm., <i>M. vaginalis</i> (Barm. f.) Presl., <i>Oenanthe javanica</i> (BL) DC., <i>Polygonum barbatum</i> Linn., <i>P. hydropiper</i> Linn., <i>Ranunculus sceleratus</i> Linn., <i>Rhynchospora rubra</i> (Lour) Makino., <i>Sagittaria trifolia</i> L., <i>Scirpus grossus</i> L., <i>Spilanthes clava</i> DC. | 21 | 33.87 |
| 7 | SM | <i>Acorus calamus</i> Linn., <i>Alocasia formicata</i> (Roxb) Schott., <i>Alpinia galanga</i> (L) Willd., <i>Alternanthera sessilis</i> (L) DC., <i>Brachiaria mutica</i> Forsk., <i>Ceratopteris thalictroides</i> Brogn., <i>Commelina benghalensis</i> Linn., <i>Carex baccans</i> Nees., <i>Paspalum distichum</i> L., <i>Rumex nepalensis</i> Spreng., <i>Polygonum pulchrum</i> Bl., <i>Panicum paludosum</i> Roxb., <i>Rotala rotundifolia</i> (Roxb.) Koechne., <i>Schumannianthus dichotomus</i> (Roxb.) Gagnep. | 14 | 22.58 |

Conclusion

The Hojai sub-division is mainly consist of Dimasa, Manipuri, Assamese, Muslim, Karbi, Bengali, Nepali and Garo community. Most of the rural people are dependent on these beels for their day to day necessities. The natural topography of Hojai and its adjoining villages of the study sites lead to flow excess rain water into these beels during rainy season and get stored there. Thus the beels help to mitigate flood hazards or reduce the intensity of flood in the suburban and rural areas of Hojai sub-division. The aquatic plants of the beel are used as vegetable, herbal medicine, fodder by the rural inhabitants of Hojai. They sold these plants in the markets at good price e.g. grasses, flowers and seeds of *Nymphaea lotus*, *Nelumbo nucifera*, *Trapa natans*, *Euryale ferox* etc, tender shoots of *Ipomoea aquatica*, *Neptunia prostrata*, *Enhydra fluctans* etc. The domestic animals graze in and around the beels.

Deforestation, agricultural practices in the catchments areas and complete conversion of these natural wetlands into commercial fisheries lead to the degradation of these fresh water ecosystems. As a result of such activities of the local inhabitants in the catchments areas the wetlands areas are shrinking alarmingly which resulted in a series of ecological problems including extinction of most of our indigenous flora including migratory birds. The exotic species in the plant communities almost invaded the wetlands and restricted the growth of other native aquatic flora by their luxuriant growths. It may be another cause of less species diversity of the wetland flora of Hojai sub-division.

Therefore there is very important to make comprehensive study of plants including its present status, causes of threats towards existence, management and conservation policies etc to be followed. Thus there is need of biodiversity documentation for its preservation for future.

There is an urgent need to undertake constructive measures towards protection and management of these wetlands and also to conserve its rich native flora and fauna, not only for human being but for the environmental harmony also. The rural inhabitants should given training and make them aware about the importance of the wetland ecosystem and its components by conducting awareness programs, camps, workshops etc.

Acknowledgment

My sincere thanks are due to Gauhati University Herbarium, Department of Botany, G.U. and also BSI, Shillong, India for providing facilities to work in the herbarium that helped in identifying the collected specimens. I am sincerely grateful to the Principal and my colleagues and non teaching staff of Hojai College, Assam and my family for their inspiration rendered by them during the investigation.

References

- Baruah, P.P. (2003). Phytosociological account of macrophytes of a disturbed lentic habitat in middle Assam: Annals of Forestry. 11(1):27-36.
- Baruah, P., Gogoi, R., Bordoloi, S., Ahmed, S., Sharma, K., Goswami, D.C., Murthy, T.V.R., Shing, T.S., and Garg, J.K. (1997, March). Wetland of Assam: A project report: Assam Remote Sensing Application Centre, Guwahati and Space Application Centre (ISRO), Ahmedabad.
- Cowardin, et al. (1979). U.S. Fish and wildlife Service: Wetland classification, University of Florida, USA.
- Daubenmire, R.F. (1947). Plants and Environment. New York.
- Dutta, U. (2005). Ecological status of wetlands of Rudrasagar area in Sivasagar district, Assam: Ph.D. thesis. Gauhati University, Assam.
- Malakar, N.C. (1995). The Systematic studies on the Aquatic Angiosperms of Cachar District of Assam: G.C. College. Ph.D. thesis. Gauhati University, Assam.
- Ramsar convention Bureau. (1990). Proceedings of the fifth Meeting of the conference of contracting parties. Glands, Switzerland.
- Saikia, M. (2007). Ecological Studies of The Wetlands of Nagaon District of Assam: Ph.D. thesis, Gauhati University. Guwahati, Assam.
- Sharma P. (1993). Geo Ecological Study of Beels and Swamps in Nagaon and Morigaon Districts, Assam: Ph.D. thesis. Gauhati University, Assam.
- U.S. Environmental Protection Agency, (1983). Freshwater Wetlands for Wastewater Management :Environmental Impact Statement- Phase I report, (EPA 904, 19-83-107, U.S. EPA Regioniv. Atlanta), GA.-380 pp.
- Verma, D.M. (1971). Cyperaceae of Assam and Neighbouring areas: Ph.D. Thesis. Gauhati University, Assam.