

## Original Research Article

# Species Diversity amongst Aquatic/Wetland Bodies of Lucknow District, U.P., India

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## ABSTRACT

The biodiversity found on earth today is the product of over 3 billion years of evolution. The life supporting environment of earth- the biosphere is composed of three chief component- atmosphere, hydrosphere and lithosphere respectively. The hydrosphere is composed of all of the water on or near the earth. This includes the oceans, rivers, ponds, ditches, streams, lakes, etc. and even the moisture in the air. The aquatic environments include permanent and seasonal, flowing and standing, natural as well as man-made water bodies. Each type of water body has its own annual hydrological cycle, that is characterised by its own community of aquatic organisms. These aquatic and wet land organisms/plants have immense importance for sustainable life support systems including economic and aesthetic values and as such have played a central role in the evolution. It is very difficult to draw a line between the hydrophytes and the terrestrial plant communities because aquatic habitat cannot be sharply distinguished from the terrestrial ones. The aquatic and marsh vegetation of India is quite rich and diverse. Almost all the types of growth forms and life forms of aquatic plants are recognized in Indian wetlands. Approximately world's half of the aquatic flowering plants are present in the region.

### Keywords

Species diversity,  
Aquatic/Wetland  
bodies

## Introduction

According to Weaver and Clement (1938) the hydrophytes are plants that grow in water in soil covered with water or in soil that is usually saturated with water. Muenschar (1944) stated as 'those species which normally stand in water and must grow for at least a part of their life cycle in water, either completely submerged or immersed'. Recently Cook (1996) provide a broader definition of hydrophytes as- All pteridophytes and spermatophytes whose photosynthetically active parts are

permanently or at least for several months of each year part or whole submerged with water or which float in the surface of water," and regarding the wetlands plants idea of Cook is very definite which stated wetland plants are those which grows in places where inundation must occurred for at least fourteen days and saturation for at least sixty consecutive days. In Indian perspective Agarkar (1923), Biswas and Calder (1936), Bhandari *et al.*, (1962), Subramanyam (1962), Trivedi and Sharma (1965), Deb (1976), Cook (1996), Saini *et al.*, (2010), etc. are the prominent workers who studied

the aquatic and wetlands flora of different state as well as India as a whole. Of the 10 dicotyledonous and 11 monocotyledonous purely aquatic families, Podostemaceae with 24 species tops the list followed by Hydrocharitaceae (14 spp.) and Lemnaceae (14 spp.). A number of aquatic plants are endemic to India. (Rao, RR. (1994). Biodiversity in India (Floristic aspect). BSMPS, Dehra Dun.

### **Materials and Methods**

Lucknow district lies almost in the centre of the area between the Ganga on one side and the Ghaghra on the other. It is almost a level plain with few distinguishing features. Broadly speaking, it can be divided into three natural or physical divisions:

- (a) The Gomti basin
- (b) The Sai and its catchment area
- (c) The Central upland on the higher watershed, running from the north-west to the south-east and separating the two.

To the north and east of the Gomti, the land is an undulating plain and the number of rivulets, which traverse it, finally join the Gomti on its left bank. The Gomti basin comprises parts of the pargana of Malihabad on its right, those of Mahona on its left, the central part of the Lucknow tehsil and the north-eastern portion of tehsil Mohanlalganj. The river itself ordinarily runs in a deep and tortuous bed with high banks, cut up at places by ravines or the rivulets that join it on either of its banks. The soils on the alluvial plain along the high banks are strong contrast to those in sandy and sometimes water-logged narrow flood-plain of the river, called tarai. This tarai, is free from the floods of river is very fertile and yields good crops. The light sandy soil in tehsil Malihabad and Bakshi Ka Talab is also remarkable for excellent crops of

melons and mangoes for which Lucknow is so justly famous.

The area to the north and north-east of tehsil Bakshi Ka Talab near Mahona also contains a watershed between the Gomti and the Ghaghra and resembles generally the central upland in tehsil Lucknow, though the predominant soil is slightly clayey in texture- on account of its indifferent drainage it is dotted with numerous lakes (Jhils). The Reth takes its rise in this area and after flowing in an easterly direction through the district Barabanki eventually joins the Gomti on its left bank.

As mentioned above the district is crossed by a number of rivers and nallas, among which the Gomti is the principal one. As is obvious from the configuration of the district, they follow a south-easterly course. The main tributaries of the Gomti are Akraddi, Jhilingi, Reth, rivulet Kukrail and some minor nallas on the left. The other river of any importance is the Sai, which flows across the South-western corner and forms the boundary for a distance in southern part. The tributaries of this river are Nagwa and Bankh and join the main river from the north. In addition to these, a large number of small rivulets originating in the Central watershed area join one or the other of the streams described above. During the rainy season all those small rivers flows with a sufficient volume of water and during the hot season shrink to a narrow channel. Formation of bunds along sides of the rivers, tributaries, rivulets and many developmental works have also damaged many habitats leading to the closure of many natural streams/nallas of the district.

The central upland marks the watershed and forms the most fertile part of the district. The course of the Sharda canal marks the highest level of watershed. The general

slope of the district is from the north and north-west to the south and south-east with an almost imperceptible fall of one foot per mile with the exception of the immediate neighbourhood of the rivers which are entirely cut up by ravines, the slope of the land is very gradual and almost unnoticeable.

At its extreme north near Mahona the level is 450 feet above mean sea level, at Alambagh about the centre of the district near Lucknow it is 394 feet and at Nagram on the south-east the level of 373 feet, showing a slope of not more than 43 feet in length of 45 miles, or less than 1 foot per mile.

The district is completely devoid of any relief of appreciable size, and the monotony of the level plain is broken only in the vicinity of the rivers where the land is cut up by deep ravines. The Nallas originating to the north-west and south-east of the watershed join the river Sai while the Gomti forms the main channel of drainage for the area lying to the east of Lucknow. The rivulets arising in tehsil Bakshi Ka Talab flow eastward and ultimately join the Gomti. The fall in the level of the district is 26 cm per Km. It is not surprising that few decades back, in Malihabad and Mohanlalganj one should have met with lakes.

A triangle between Mohanlalganj and Gosainganj with Nagram as the apex is an area of inland drainage previously having a chain of lakes. The most important perennial lake is Karaula which spreads through many villages near Nagram. Due to urbanization, industrialization and many developmental works, most of the land of Lucknow district have been taken up by Lucknow Development Authority, Awas Evam Vikas Parishad and private housing societies during past few decades.

## **Results and Discussion**

As mentioned above the district is crossed by a number of rivers and nalas, among which the Gomti is the principal one. As is obvious from the configuration of the district, they follow a south-easterly course. The main tributaries of the Gomti are Akraddi, Jhilingi, Reth and some minor nallas on the left. The other river of any importance is the Sai, which flows across the South-western corner and forms the boundary for a distance in southern part. The tributaries of this river are Nagwa and Bankh and join the main river from the north. In addition to these, a large number of small rivulets originating in the Central watershed area join one or the other of the streams described above. During the rainy season all those small rivers flows with a sufficient volume of water and during the hot season shrink to a narrow channel.

Gomti takes its rise in the district Pilibhit. After a sinuous course of 42 miles in a south-easterly direction, it enters Kheri, and then cutting of the two tehsil of Muhamdi and Pasgawan from the rest of the district, flows almost due south to form the boundary between the district of Hardoi and Sitapur until its entrance into Lucknow district. Thence it flows south in a meandering course and forms the boundary between the tehsil Bakshi Ka Talab and Malihabad. As it moves towards the south, the loops of the meandering course river get more pronounced and the river penetrates into the country upto 2 or three miles before returning to its original direction. One such loop may be seen in the west of the village Kathwarha in the south-western part of the tehsil Bakshi Ka Talab. It enters the tehsil Lucknow between Ranimau and Raitha, and cross it diagonally after forming the boundary of tehsil Malihabad for about seven miles. Here it flows in a deep bed

between ill- defined banks, and is seldom violent. During heavy rains, sometimes, the river overflows its banks, but soon subsides. Near the entrance into the tehsil, the banks of the river are steep and dissected by a number of ravines, but at Duggaur and Kankarabad the banks begin to recede and the valley to widen out. In the tehsil Lucknow, the river valley is narrow, but it again widens out after leaving it. At the point where the river forms the boundary between Lucknow and Mohanlalganj, the river bed shrinks again. After leaving the tehsil Mohanlalganj at Sikandarpur Khurd, it continues to form the northern and the eastern boundary of Mohanlalganj. The river finally leaves the district at Salempur, where it is joined by the Loni and enters Barabanki.

At places there are narrow belts of tarai land between the two banks formed from silt deposited by floods. These tarai lands on account of their water- content have good crops of Kharif in years of drought, all tarai land however is apt to be inundated in years of heavy rain fall and is consequently somewhat of a precarious nature. The high bank, on the other hand, has lower water table and generally suffers from deficiency of water. The subsoil is almost always of a sandy porous nature and in many places, especially in the Mohanlalganj tehsil, is greatly broken by ravines.

The Akraddi nalla rises in the Gundwa tehsil of Hardoi district near the boundary of Lucknow district. It is the north- most/west tributary of the Gomti and flows for the most part in Malihabad. It is joined by some minor nallas in its lower parts and finally falls into the river Gomti near Manjhowa village, two miles to the west of Kathwarha. Jhilingi tributary originates in the tehsil Malihabad near village Masira Ratan. Running in a direction almost parallel to the

Akraddi nalla it joins the Gomti river near Gopramau. Behta tributary is the most important tributary of Gomti. It is a small perennial stream which has its origin in the Hardoi district and flows to the south of the tributaries mentioned above. It enters this district near railway lines on the north- western boundary. At first, after traversing only a short distance in the district it goes out and joins the tributary of Unnao, but soon returns and joins the district boundary near Jindaur. Thence flowing south- eastward in a most tortuous course through the southern and south- western part of the Malihabad tehsil, it reaches the boundary of Kakori and then, after forming for a short distance, it joins the Gomti on the right bank near village of Kankarabad. Loni tributary is the fourth and the last tributary of the Gomti joining it on the right. It is a small stream which has its origin in the Mohanlalganj tehsil. The north central portion of tehsil Mohanlalganj is drained by this river and its tributary nalas, which join it both from the north and the south. After covering a distance of about nine miles the river reaches its lower course and finally joins the Gomti at Salempur close to the north-eastern boundary of the district.

Most of the tributaries joining on the left bank are non-perennials. The only perennial streams are the Kukrail and the Reth. Kukrail river originates near village Asthi of tehsil Mohanlalganj. For the most part, after its entrance into the tehsil Lucknow the river runs in a narrow bed enclosed by steep banks. As compared with Loni its tributary nalas are a few in number. When it approaches the Gomti, its banks recede to a narrow strip on either side of the Faizabad road and it joins the Gomti near Papermill colony.

Reth River flows through the adjoining district of Barabanki, but a small portion lies

in Lucknow district in the north eastern part of the tehsil Bakshi Ka Talab. It joins the river Gomti on the border of the two districts near the village Guskar in the north- eastern part of the Mohanlalganj tehsil.

The river Sai enters the district on the south-west from the tehsil Bakshi Ka Talab in the Unnao district. For about six miles, it forms the boundary between Mohan and Bijnor (Lucknow) and then it enters the latter near Darabnagar. After separating out few villages from the rest of the pargana, it again forms the boundary separating Bijnaur from Govinda Parsandon and then enters Unnao at Bani. It reappears in pargana Nigohan and forms the boundary between it and pargana Maurawan of Unnao district at Birsinghpur. Though an important river, it serves only the southern and south western parts of the district. It is perennial stream, flowing in a narrow well-defined channel. Its bed is shallower than that of the Gomti, and the land on its banks is less dissected by ravines. Like the Gomti it also has sandy tracts on its left side. The tarai of the Sai is very small and extends over only three villages, Bhandnamau in Bijnor, and Miranpur and Mungtiya in Nigohan. All of these are occasionally visited by floods of the river.

The Nagwa nalla originates a few miles to the north of Mohan in the Unnao district. It soon reaches the boudary and separates the tehsil Mohan and Auras from Kakori. When it reaches the boundary near Bijnor, it turns abruptly to the east and forms a big loop till it reaches near Amawan. From there it flows in a south- easterly course up to the west of Banthra, where it again takes a 90° bend and finally falls into the Sai near village Bani. The stream has a small tributary named Samdia which originates locally and falls near Aridpur, Siktiya, village in Bijnor. Bankh- the chain of jhils to the south of the jail and the Charbagh railway station that

runs through the villages of Mohammadinagar; Saleh Aurangabad and to the east of Bijnor, gives rise to the Bankh. It enters the tehsil Mohanlalganj from the north-west and after traversing only two villages enters Nigohan from the north as a perennial stream. It turns towards the south-east through the central part and continues upto Nigohan town after which it again bends to the south-west and finally joins the Sai near Birsinghpur on the Raebareli border. The soil in its neighbourhood is mostly loam of a fair quality, but it becomes sandy as we go nearer the Sai.

There are a number of lakes viz. Kathauta, Kusaila, Khartola, Karaula, Hardoia, Jabreli, Chnauti, etc. in the district. The most important of these is the Karaula which is the only perennial lake near Nagram. The land near the banks is cultivated by people and sown with paddy and wheat. These lakes are also utilized for irrigation by cultivators either to supplement the canal irrigation where the land is within command area of canal or as an independent source of irrigation. There are no natural springs in the district and the small rivers and rivulets/nallas that take their rise from low lying lands or swamps do not serve any purpose other than that of drainage-channels during the monsoon. Due to urbanization, industrialization and many developmental works, most of the land of the district has been taken up by Lucknow Development Authority, Awas Evam Vikas Parishad and private housing societies during past few decades. Formation of bunds along sides of the rivers, tributaries, rivulets and many developmental works have also damaged many habitats leading to the closure of many natural streams/nallas of the district. Shrinking of these habitats has put many aquatic species under severe threat.

Anderson (1859) first explored the district and published his paper "Notes on the Flora of Lucknow with Catalogues of the Cultivated and Indigenous Plants" but he could not publish a complete list. As he stated "my list is not so complete as it might be, for, as my original collections were lost during mutinies. It has been compiled from a set of duplicates I sent to Dr. Thomson and from a small collection I made, while on service at Lucknow last year".

After a long gap of about one century Kapoor (1962) gave a comprehensive list of plant species indicating those species of Anderson's catalogue which could not be confirmed to be occurring in Lucknow as well as many additions to the catalogue. Patil (1963) published his flora of Lucknow and included only 330 species as he himself stated "the present list of plant is by no means exhaustive within the limits set above, but on the whole the wild herbs and almost all roadsides trees have been included".

Balasure and Srivastava (1964) published the Vegetation of Lucknow and covered Ca 200 species including some medicinal plants. Sharma (1964) added 13 species in addition to the Kapoor's list. Trivedi and Sharma (1965) gave an account of hydrophytes of the area. Husain and Kapoor (1970) added 12 species to the region. Subsequently, Saini (1990, 2002) has also published papers on additions to the flora of the district. Singh (1990, 1991, 1993, 1995, 1996, 2009, 2010) has surveyed the area for more than twenty years in different seasons for his thesis work and published more than 15 papers as single author or as a senior author and one book entitled 'Lucknow Flora- the plant wealth of the region (2006)'.

In the present communication the species diversity along each habitat of aquatic, semi-

aquatic, marshland habitats have been discussed.

### **Species diversity of aquatic and marshland**

The aquatic and marshy plant species normally grow and develop in water and complete at least a part of their life cycle in water. The common habitat of aquatic and marshland vegetation are rivers, lakes, ponds, puddles, ditches and low lying areas which remain submerged during major parts of the year.

The aquatic plants are classified into different categories on the basis of nature and depth of water and degree of soil wetness in which they can live. Plants living in flowing and standing water with excessive supply of water do not face the problems of water loss due to transpiration, wilting and drought, they are termed as hydrophytes. The hydrophytes of Lucknow district can be classified into following six categories on the basis of their contact with air, water and soil.

**(a) Free-floating:** In this category the species are only in contact with air and water like *Azolla pinnata* R. Br., *Eichhornia crassipes* Solms., *Hygroryza aristata* Nees, *Pistia stratiotes* L., *Spirodela polyrrhiza* Schleid, *Trapa bispinosa* Roxb., *Wolffia arrhiza* Wimm., etc.

**(b) Suspended:** In this group the species are only in contact with water and are rootless, e.g. *Ceratophyllum demersum* L., *Utricularia stellaris* var. *inflexa* Cl., *U. flexuosa* Vahl, etc.

**(c) Submerged attached:** These are only in contact with soil and water but in some cases flowers are slightly raised above water, e.g. *Hydrilla verticillata* Royle,

*Ottelia alismoides* Pers., *Potamogeton crispus* L., *P. nodosus* Poir., *P. pectinatus* L., *Vallisneria spiralis* L. etc.

**(d) Attached with floating leaves:** These are in contact with water, soil as well as air, e.g. *Aponogeton crispus* Thunb., *Ipomoea aquatica* Forsk., *Ludwigia adscendens* Hara, *Nelumbo nucifera* Gaertn., *Nymphaea nouchali* Burm. f., *N. stellata* Willd., *Nymphoides indicum* Ktze., *N. hydrophyllum* Ktze. etc.

**(e) Amphibious:** In this case the root, lower part of the stem and in some cases lower leaves are usually submerged in water, e.g. *Aeschynomene aspera* L., *A. indica* L., *Amisophacelus axillaris* R. Rao et Kam., *Eleocharis dulcis* Hen., *Eriocaulon cinereum* R. Br., *Hemarthria compressa* R. Br., *Ischaemum rugosum* Salisb., *Polygonum barbatum* L. ssp. *gracile* Danser, *P. glabrum* Willd., *P. hydropiper* L., *P. lapathifolium* L. var. *lanatum* (Roxb.) Steward, *P. limbatum* Meissn., *Limnophyton obtusifolium* (L.) Miq., *Ludwigia octovalvis* ssp. *sessiliflora* (Micheli) Raven, *L. perennis* L., *Monochoria vaginalis* Presl., *Oenanthe javanica* (Bl.) DC., *Paspalum paspalodes* (Michx.) Schibner, *Polypogon monspeliensis* (L.) Desf., *Rottboelia cochinchinensis* (Lour.) Clayton, *Sagittaria guayanensis* H.B.K., *S. sagittifolia* L., *Shoenoplectus grossus* (L. f.) Palla, *Typha angustata* Chaub. & Bory, *Vetiveria zizanioides* (L.) Nash, *Zannichelia palustris* L., etc.

**(f) Wetland:** A large number of species represent this group e.g. *Alternanthera paronychioides* St' Hill., *A. sessilis* DC., *A. pungens* Kunth, *Ammannia auriculata* Willd., *Ammannia baccifera* L., *Ammannia multiflora* Roxb., *Bacopa monnieri* (L.) Pennell, *Caesulia axillaris* Roxb., *Cardamine scutata* Thunb., *Centella*

*asiatica* L., *Centipeda minima* (L.) A.Br. et Aschers., *Coix lachryma-jobi* L., *Coldenia procumbens* L., *Cotula anthemoides* L., *Cyperus alulatus* Kern., *C. exaltatus* Retz., *C. imbricatus* Retz., *C. iria* L., *C. michelianus* Link ssp. *pygmaeus* (Rottb.) Aschers. et Graebn., *C. pangorei* Rottb., *C. rotundus* L., *Dentella repens* Forsk., *Echinochloa colona* (L.) Link, *E. crus-galli* (L.) Beauv., *Enhydra fluctuans* Lour., *Eragrostis* spp., *Eclipta prostrata* (L.) L., *Fimbristylis aestivalis* (Retz.) Vahl, *F. falcata* (Vahl) Kunth, *F. miliacea* (L.) Vahl, *F. ovata* (Burm. f.) Kern, *F. quinqueangularis* (Vahl) Kunth, *F. schoenoides* (Retz.) Vahl, *Hygrophila auriculata* Heyne, *Limnophila indica* Druce, *Mariscus compactus* (Retz.) Boldingh, *M. sumatrensis* (Retz.) Raynal, *Marsilea quadrifolia* L., *Pycreus flavidus* (Retz.) T. Koyama, *Polygonum plebeium* R.Br., *Pouzolzia zeylanica* (L.) Benn., *Rorippa indica* (L.) Hiern., *Rotala indica* (Willd.) Koehne, *Shoenoplectus articulatus* (L.) Palla, *S. juncooides* (Roxb.) Palla, *S. lateriflorus* (Gmel.) Lye, *S. maritimus* (L.) Lye, *S. mucronatus* (L.) Palla, *S. roylei* (Nees) Ovczinn. Czukav., *Sphaeranthus indicus* L., *Sphenoclea zeylanica* Gaertn., *Typha angustata* Bory et Chaub., *Veronica anagallis-aquatica* L. etc.

### Species diversity along banks of rivers, lakes, etc.

The species frequently met along the banks of rivers, ditches, ponds, lakes and nalas are *Ageratum conyzoides* L., *Alternanthera paronychioides* St., Hill, *Argemone mexicana* L., *A. ochroleuca* Sweet, *Arundo donax* L., *Canscora decussata* Schultes, *Chenopodium ambrosioides* L., *Chrozophora rottleri* Juss., *Coronopus didymus* Sm., *Corchorus capsularis* L., *Chrysanthellum americanum* (L.) Vatke, *Croton bonplandianum* Baill., *Cyperus*

*alulatus* Kern., *C. exaltatus* Retz., *C. imbricatus* Retz., *C. iria* L., *C. michelianus* Link ssp. *pygmaeus* (Rottb.) Aschers. et Graebn., *C. pangorei* Rottb., *C. rotundus* L., *Fimbristylis bisumbellata* Bub., *Gnaphalium luteo-album* L., *G. pulvinatum* Del., *Grangea maderaspatana* (L.) Poir., *Lindenbergia macrostachya* Benth., *Lippia javanica* Spreng., *Nicotiana plumbaginifolia* Viv., *Phragmites karka* (Retz.) Trin. ex Steud., *Phyla nodiflora* Greene, *Polycarpon prostratum* (Forsk.) Aschers. et Schweinf., *Polygonum plebeium* R.Br., *Pulicaria crispa* Sch.-Bip., *Ranunculus sceleratus* L., *Rumex dentatus* L., *Sesbania sesban* Merr., *Tamarix dioica* Roxb., *Typha angustata* Bory et Chaub., *Verbascum chinense* (L.) Sant., *Veronica anagallis-aquatica* L., *Vitex negundo* L., *Xanthium indicum* L. etc.

In Lucknow district about more than hundred species are found in water bodies and moist, marshy/wetland situation. Due to various threats to the habitat, species diversity of the water bodies is depleting day by day and time is not far when these species will come under various categories of endangerment. Government authorities should play an important role in conserving the natural resources to help save the threat to biodiversity of these aquatic, semi-aquatic and marshlands of the country.

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