Biodiversity and Prospective of Pteridophyte in North India

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Abstract

Biodiversity is fundamental to the fulfillment of human needs; a biodiversity rich region offers wide options and opportunities for sustaining human welfare including adoption to changes. The climatic condition and wide variety in physical features witnessed in India have resulted in a diversity of ecological habitats such as forests, grasslands, wetlands, which harbor and sustain wide ranging floral and faunal species placing. In order to prevent diversity loss of such pteridophytes during construction of hill road, their current diversity and ecology have been studied here. The aquatic plants species belongs to diverse habits and have distinctive characteristics. More than 9 aquatic species have been identified and they can be described. In ancient period these plants were prescribed as herbal extract for the cure of several diseases. The bio-resource based industrial setup has been proving itself as an emerging field of economy development. The pteridophytes (*Nephrolepis cordifolia, Nephrolepis exaltata, Nephrolepis tuberosa, Adiantum incisum, Cyrtomium falcatum*) with their attractive foliar are enormously used during the ceremonial events as beautifying and decorative assets for their aesthetic appeal.

Key words : Biodiversity, Indicator, Nutrition, Pteridophyte.

Introduction

In plant kingdom pteridophytes i.e. feather plants are most primitive vascular plants and are known as vascular cryptogams. They were the first vascular plants to grown on the surface of earth and began their life period from leafless, rootless individuals in the Silurian and Devonian periods. The pteridophytes are consisting of four groups: Licopods, Equisetum, Psilotaceas and Ferms[1].

Biodiversity refers to the variety of life forms at all levels of organization, from gene through species to higher taxonomic forms and also includes the variety of ecosystems and habitats as well the processes occurring therein. Biodiversity is fundamental to the fulfillment of human needs; a biodiversity rich region offers wide options and opportunities for sustaining human welfare including adoption to changes. India is one of the 17 Mega bio-diverse countries in the world and accounts for 7-8% of the recorded species[2]. The climatic condition and wide variety in physical features witnessed in India have resulted in a diversity of ecological habitats such as forests, grasslands, wetlands, which harbor and sustain wide ranging floral and faunal species placing. The climatic conditions cause prevalence of not and highly humid weather in this part of country and coupled with heterogenic physiography make possible luxuriant growth of a number of plant communities phyto-geographically, many a species are endemic to this region and it is also the center of origin for commercially important plants. The species diversity is so spectacular that it becomes often difficult to clearly identify separate riche to existing plant formations[3].

There are nearly more than two hundred numerous marshy land exist here which should be used for development of the area. The soil is mainly clayey loam mixed with silt. The soil is acidic and pH varies from 4.36-6.86. The average annual rainfall remains around 2000 mm and about 70% occurs during June-September. The relative humidity varies between 65-95% and is lowest during the month of March. The present paper deals with the floristic diversity of the study site and their prospective[4].

Ferns and their allies also known as the vascular cryptogamic plants have enormous aesthetic value and multifarious scope for exploring the bioactive molecules against various pathogenic causal organisms of bacterial, fungal and microbial origins. In view of the evolutionary trends of plants the Pteridophytes have valuable importance to unearth the number of uncertain hypothesis of evolution. In addition, more species of the Pteridophytes have been known and validated as potential genetic resource against many diseases and source of miscellaneous articles. However, the Pteridophytes have long history of their evolution and were known as dominant group of the plants during the carboniferous periods. Since, their dominating era few of the species have survived long and known as relic species (*Psilotum nudum*) playing major role to resolve the phylogenetic relationships and evolutionary trends.

Biodiversity in pteridophytes

The pteridophytes which dominated the earth during carboniferous are survived today by about12,000 species comprising 305 genera. Amongst of which most numerous are the homosporous ferns comprised of approximately 11,500 species, where as rest 500 as fern-allies known globally[6]. In India the Pteridophytes have been found to grow in almost all climatic zones under different habitats and represented by approximately 1200 species falling under 191genera. In addition to species composition the Pteridophytes are very diverse in their habitat as well as occupancy. Accordingly, they have been categorized aquatic (*Azolla* sp., *Marsilea* sp., and *Salvinia* sp.), terrestrial (*Cyathea* sp., *Angiopteris* sp., *Pteris* sp., *Polystichum* sp., *Athyrium* sp., *Lycopodium* sp., *Diplazium* sp.), epiphytic (*Oleandra* sp., *Vittaria* sp.,*Drynaria* sp., *Microsorium* sp.). However, most of the species of *Adianum*, *Psilotum*, *Cheilanthes* preferentially grow on rocks, where as few others like Actiniopteris, Woodsia and Onychium survive underextreme dry conditions. Very few are also known togrow in mangrove forests viz. *Acrostichum speciosum*. Amongst these Pteridophytes, the species of *Cyathea* commonly known as “tree fern” standing at a status of threatened category grow in tropical humid forests of the country. Being one of the twelve mega biodiversity countries of the world, India portraits three hotspots across its territory. The north east regions of the country comprised of seven provinces are a major component of the Eastern Himalayas which is richest in the Pteridophytic wealth. About 845 taxa belonging to 179 genera are known from these regions followed by the species composition of south India (Eastern and Western Ghats) from where approximately 345 taxa under 110 genera are known so far. In addition to above phytogeographical regions, the Western Himalayas of the North India stand at the third position exhibiting 340 taxa belonging to 100genera. This trend of diversity and

species composition has enforced the Indian subcontinent to be very distinct in respect of Pteridophytes[7]. Therefore, about 17% of the total species known from the country are at endemic status which needs urgent attention for their conservation.

Further construction and widening of the road is in offing as the area is in path of rapid modernization. This will impact diversity of these plants. In order to prevent diversity loss of such pteridophytes during construction of hill road, their current diversity and ecology have been studied here. Status of enlisted pteridophytes growing along hill roads is also ascertained from IUCN red list and list of catalogue of life (COL).The study is likely to help in further capacity augmentation/widening of these roads without harming the current diversity of the pteridophytes growing there .The study also provides a protocol to be followed for monitoring and management of biodiversity along other roads of this hotspot. Pteridophytes growing along hill roads of north India have not yet reported[8].

MATERIALS AND METHODS

All the selected area were surveyed with team of experts for two consecutive years during the months of October to January (2019). Data were collected within 200m (considering corridor of impact) of the roads by traversing on foot along all the pteridophytic habitats on both side of the roads (valley side and hill side). Vegetation, water channels, ridges and various habitats within the corridor of impact (200m of the road) were also considered for the listing of the pteridophytes.

The taxonomy of recorded species was done as per Fraser-Jenkins (2009). However, the genera and species within the families are listed alphabetically. The authorities of names follow Brummitt and Powell (1992) while the taxonomic citation is based on published literature and IPNI, Tropicos and The Plant List.

COLLECTION OF SPECIMEN

All the specimens were collected in fertile stage and were processed through conventional herbarium. They were identified by matching them with herbarium specimens of local universities and research institutions and also by using different floras of nearby areas[9]. Identifications of specimens were based on field characters with the aid of existing literature[10].

RESULTS AND DISCUSSION

The results here are the first report of Pteridophytes growing along hill roads of North India, so far their diversity, ecology and status in IUCN Red List and List of Catalogue of Life is concerned.

The study area, of North India has huge amount of agricultural land. The few villages in the study area are engaged in Paddy and Tea cultivation. Villages are scattered in between the large patches of agriculture lands especially for paddy due to heavy rainfall for six month. The tree cover in the study area is scanty restricted only in the habituated areas of the village and few along the boundary of the agricultural fields and road sides. It was observed that most of the villages in the study area was with large village beel (water bodies) used in rain water harvesting. One village was distributed in parts of two or three (tripartite) due to development of Tea Estate[11]. The study area is also characterized by many water

logged regions occupied by hydrophytes. Majority of the area covered in the present investigation was suitable of paddy crop. Almost entire south-east are occupied by forest, while north-west occupied by the large patch of scrub land with sparse population of *Areca catechu, Cocus nucifera, Bombax ceiba* and *Ficus religiosa*. The fern species were found near the water bodies[12].

Flora

Shrubs are the dominant perennials of this area, represented mainly:

i.	*Prosopis juliflora*	viii.	*Lantana camara*
ii.	*Lowsonia intermis*	ix.	*Zizyphus nummularia*
iii.	*Dichorostachys cinera*	x.	*Cassia auriculata*
iv.	*Mimosa hamata*	xi.	*Ipomoea fistulosa*
v.	*Calotropis procera*	xii.	*Euphorbia nivulia*
vi.	*Calotropis gigantea*	xiii.	*Capparis decidua*
vii.	*Maytenus emarginata*		

The low lying area along the fringes of agriculture lands were dominated by thick ground cover of herbaceous species:

i.	*Hygrophila auriculata*	viii.	*Cortalaria meicaginea*
ii.	*Echinops echinatus*	ix.	*Indigofera oblongifolia*
iii.	*Tridex procumbens*	x.	*Tephrosia purpurea*
iv.	*Xanthium strumarium*	xi.	*Tephrosia tinctoria*
v.	*Cressa cretica*	xii.	*Phragmites karaka*
vi.	*Cyperus sps*	xiii.	*Triumfetta pentandra*
vii.	*Abutilon indicum*	xiv.	*Typha angustata*

Aquatic Plant Diversity

The aquatic plants species belongs to diverse habits and have distinctive characteristics[13]. More than 9 aquatic species have been identified and they can be described into following broad categories.

- Suspended submersed hydrophytes: *Ceratophyllum demersum, Utricularia gibba*.
- Anchored submerged hydrophytes: *Hydrilla verticillata, Potamogeton crispus, P. pectinatus*.
- Anchored hydrophytes with floating shoots: *Ludwigia aquarium, Ipomea aquatica*.
- Emergent amphibious hydrophytes: *Sagittaria latifolia*.

Medicine and Pteridophytes

The Pteridophytes are long known for their medicinal and therapeutical utility. In ancient period these plants were prescribed as herbal extract for the cure of several diseases. Theophrastus (327-287 BC) and Dioscorides (50 AD) listed many Pteridophytes as a potential herbal formulation to cure more deadly disorders. However, Shushruta and Charak in their monumental contribution on the medicinal attributes of ferns have enormously mentioned the utility of *Marsilea minuta, Adiantum capillus-veneris* etc. First historical effort was made by

Caius in 1935to describe the medicinal uses of ferns in India, therefore get recognized as the first man to take this very initiative kind of investigations. Recently, enormous efforts have been made to determine the potentiality of Pterido-phytes in relation to their chemical composition and other aspects[14]. These plants are distinct in having glycosides, flavonoids, terpenoids, alkaloids and many primary as well as secondary metabolites which are used for preparation of expectorant. Formulations of these plants are also advised as supplement of aphrodisiac, appetizer, stimulants; however, certain species are used for the ailment of diuretic, ulcer as well as stomachic. Few of the Pteridophytic species are historically in practice in the homeopathy as well as ayurvedic system of medicines. The *Selaginella bryopteris*, *Lycopodium clavatum* are well known Pteridophytes for the homeopathic system of medicine, wherein the *Selaginella* is prescribed for the cure of neurological disorder and heat stroke effects. Similarly, the *Lycopodium clavatum* is also recommended to the patients of splinted bones. The *Helminthostachys zeylinica* commonly known as 'Kamraj' is well known herbal ayurvedic formulation to enhance the sexual efficiency and as a source of stimulant and aphrodisiac. Few of the Pteridophyte species have been screened out chemically and numbers of active novel chemical compounds are validated. The marsiline isolated from *Marsilea minuta* has immense utility and is used in psychopathy, diarrhea, cough, skin diseases, dyspepsia fever and insomnia. Many other fern species have been extensively explored and determined to exhibit great economic value. The *Pteris vittata* commonly called "Braken fern" has also shown antimicrobial activities against number of gastro-intestinal bacterial strains. Thus, pteridophytes having tremendous importance and vast medicinal scope would prove itself as the biological resource for the upliftment of human society[13].

Pteridophytes in industrial implications

The poverty alleviation in the developing countries like India is coherent to the multifarious industrial setup. The bio-resource based industrial setup has been proving itself as an emerging field of economy development. The pteridophytes (*Nephrolepis cordifolia*, *Nephrolepis exaltata*, *Nephrolepis tuberosa*, *Adiantum incisum*, *Cyrtomium falcatum*) with their attractive foliar are enormously used during the ceremonial events as beautifying and decorative assets for their aesthetic appeal[15]. Few of these species are used in the bouquet to extend the love in broad sense. The pteridophytes comprised of many relic species of the carboniferous periods are of immense importance in tracing the evolutionary trends in plants. However, many relic and recently evolved species are becoming rare and confined to fernery and nurseries with their high importance and increasing costs. In this way the industrial approaches of developing the fernery and nurseries can be an asset to meet out the requirement of fern lovers and enriching the economic inequities.

Environmental Management and Pteridophytes

The alarming rate of industrialization and urbanization has led the over emission of suspended particulate matter, metals and metalloids in the ecosystem of air, water and soil. These pollutants have toxic effect in living organisms at different biomagnifications level in water, soil and air. The bioaccumulation is a wonderful and cost effective technique to mitigate the impact of these toxicants. The plants particularly Pteridophytes are best known

bio-accumulator of many metals and metalloids. *Pteris vittata, Marsilea minuta, Equisetum debile, Salvinia molesta, Azolla pinnata* has been experimentally determined as a hyper-accumulator of carcinogenic heavy metals viz. arsenic, cadmium, mercury, copper and chromium respectively[16]. The arsenic has been major problem in the area of high water fed and paddy field practices mainly in West Bengal in India. Thus, these peculiar physiological properties of *Pteris vittata* can be utilized for the management of environmental related problems.

Genetic Resources and Pteridophytes

Adaptation to diverse habitats has indulged the pteridophytes to exhibit wondering genetic traits. Many of the taxa adapted to cold, desiccation and rains have been very peculiar to synthesize the proteins of specific composition. These specific protein have enabled many pteridophytes viz. *Selaginella bryopteris, Cheilanthes farinosa* to tolerate the extreme desiccation, whereas, *Azolla* sp., *Salvinia* sp., are known to tolerate rain fed. These plants having such potentiality can be utilized as the genetic resource for executing various research related activities and development of transgenic plants of high economic value.

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