FLORISTIC AND ETHNOBOTANICAL STUDIES OF KULDIHA WILDLIFE SANCTUARY, BALASORE DISTRICT, ODISHA

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Floristic inventories and diversity assessments are necessary to understand forest biodiversity. Inventory and diversity studies at different levels all over the world would fill the gaps in the biodiversity knowledge. The availability of comparable floristic inventory could help us to locate areas for conservation with scarce resources, as uncontrolled anthropogenic activities on forest have a significant impact on local, regional and global diversity, and the health and functioning of natural ecosystems.

Ethnobotany is a multidisciplinary science which involves various aspects of plant science, history, anthropology and culture. It has the potential to unearth the numerous uses of plants and various aspects of tribal life. The study of ethnobiology has the capability to usher profuse economic possibilities that may lead to new information unexploited natural resources and new uses of existing resources as source of food, medicine, fibre and fodder. Many plants used in the traditional medicines of tribals and other such communities are important sources of pharmacological active compounds. All these valuable informations can be gathered, documented and formed into a database through ethnobotanical explorations.

Kuldiha Wildlife Sanctuary (KWLS) was declared on January 4th, 1984. This sanctuary is situated in the southern part of the district of Balasore of Odisha State, lies between 21º 20' 31" to 21º 29' 08" N latitude and 86º 25' 23" to 86º 44' 50"E longitude. The sanctuary spreads over an area of 272.75 square kilometers. The forests of the region cover the Nato hills and the Sukhupata hills merging with the Similipal National Park. It lies close to Nilgiri forest Odisha towards north and Mayurbhanj forest Odisha state, in northwest direction. Through Gadasahi forests on the south west, Kuldiha have a disjointed link with Baula RF.

A detailed survey on floristic composition and ethnobotinical knowledge on the utilization of minor products of the KWLS is found less reported.Vivid floristic and ethnobotanical studies have been done for various districts of Odisha. However the plant wealth available in the remote area has not been explored thoroughly and no previous records are available on ethnobotanical knowledge from the proposed study area. Hence, this study was planned to document the floristic composition and ethnobotanical data available within the KWLS. To ensure the conservation of indigenous knowledge the present work was designed to study the floristic composition and ethnobotanical uses of the plant recourses of this region, by the native population and by other people.

The work included the following research investigation, done in the KWLS, summarized into two chapters:

- Taxonomic evaluation and systematic treatment of existing plant diversity and analysis
- Ethnobotanical documentation of folklore and traditions

Taxonomic evaluation and systematic treatment of existing plant diversity and analysis

The vegetation in the district ranges from tropical semi-evergreen to dry-deciduous to grasslands with varying species composition. According to Champion and Seth (1968) the forest harbours vegetations characteristic of tropical deciduous forest dominated mostly by *Shorea robusta*, but in particular it is intermediate between dry deciduous and moist peninsular type. Depending on the local micro-climate diversity, species composition and effect of different biotic and edaphic factors, the vegetation of the region can be divided below given subtypes.

(a) Tropical Semi evergreen forests

The semi-evergreen forests are predominant along the stream courses, moist valleys, gorges and waterfalls. A number of such places in the different forest localities are recorded. The semi-evergreen forest is the climatic climax of the hill complex and is found in undisturbed state. The main tree components are *Careya arborea. Bridelia retusa, Dillenia pentagyna, Diospyros ebenum, Mangifera indica, Mitragyna parviflora, Syzygium cumini, Terminalia arjuna* form the top canopy.

(b) Tropical Dry deciduous forest

The hill slopes, foothill and greater part of the region are covered with dry deciduous type of vegetation. The lower elevation is predominant with *Shorea robusta*. But it does not occur in pure formation. It occurs in association with other plant species such as *Anogeissus latifolia, Bombax ceiba, Bridelia retusa, Buchanania cochinchiensis, Chloroxylon swietenia, Dalbergia latifolia, Diospyros melanoxylon, Gardenia latifolia, Haldinia cordifolia and Xylia xylocarpa* complied as over storey tree stands.

(c) Scrub woodlands

The foot hills, steep slopes and other exposed dry areas are under this type of vegetation. This forest type is derived due to over-exploitation of deciduous forests. Due to severe destruction factors such as cutting and looping, the tree cover has been reduced much and become less dense. The tree species found here are *Cassia fistula, Diospyros melanoxylon, Phyllanthus emblica, Shorea robusta* and *Terminalia alata*.

(d) Scrub forests

Scrub forest is generally found at the lower elevations especially on pediments and plains adjoining the hill range. This type of vegetation has originated due to human intervention such as forest-fire, practice of shifting cultivation, cattle ranching and over exploitation of wildlife, especially plants diversity. In this forest type, the tree species either have disappeared or of reduced and shrubby stature. Few stunted trees such as *Melia azedarach, Alangium salvifolium, Cassia fistula, Cleistanthus collinus, Diospyros melanoxylon, Phyllanthu semblica, Shorea robusta, Strychnos potatorum* and shrubs like *Capparis zeylanica, Clerodendrum infortunatum, Flacourtia indica, Holarrhena pubescens, Lantana camara* are notable in respect of their abundance.

(e) Grasslands

Several areas in the hill range are covered with grasses and also interspersed with several stunted trees and shrubs. The dominant plant species in these grasslands are *Eragrostis viscosa, Eulalia quadrinervis, Oplismenus compositus, Panicum curviflorum, Heteropogon contortus* and few others.

(f) Riverine vegetation

The vegetation along the course of rivers, rivulets streams and in the sandy river beds and banks is quite characteristic and the floras available are *Terminalia arjuna, Bombax ceiba, Aegle marmelos, Dalbergia sissoo, Ficus hispida, F. racemosa, Sapindus emarginatus, Strychnos potatorum* are some of the common trees.

An analysis of the flora revealed about 534 species belonging to 345 genera under 84 families. All the species are enumerated in alphabetical order of families (Table 1). It is evident that flowering plants constitute the principal component of vegetation.

Dicotyledonous species out-number the monocotyledons ones. The former with 436 species belongs to 69 families and the latter with 98 species belongs to 15 families.

Habit wise analysis shows that the tree diversity is 38% (202 species), even though higher it is comparable to the herbaceous species diversity of 34% (184). The shrubby species, climbers, and epiphytes constitute only 15%, 11% and 2% respectively (Fig. 4). Among all families, Leguminosae has the highest number of species (56) followed by Rubiaceae (31), Lamiaceae (27) and Poaceae (26) (Fig. 2). Other dominant families are Malvaceae (24) followed by Phyllanthaceae (23). The dominant genera include Diospyros (9), Fimbristylis (8), Ficus (8), Phyllanthus (8), Lindernia (7), Dioscorea (6).

KWLS is represented by tropical deciduous forest with large no. of tree species. Therefore a community structure study has been initiated for the tree species of this region. The community structure recorded and analyzed at three different levels based on human interference viz. core zone, buffer zone and peripheral zone. Density, Frequency and abundance are the three important quantitative parameters used to describe the general nature of vegetation. In the peripheral zone a total of 35 tree species were identified. The density of *Croton persimilis* (4.800/ 100 sq m) was the highest. In the buffer zone a total of 63 tree species were identified. The density of *Macaranga peltata* (6.400/ 100 sq m) and *Shorea robusta* (6.400/ 100 sq m) were the highest. In the core zone a total of 105 tree species were identified. The density of *Shorea robusta* (22.545/ 100 sq m) was the highest.

Tree density were found higher in the core area (undisturbed sites) compared to buffer or periphery area (disturbed sites). Species exhibiting a low frequency indicates its irregular distribution or rarity in the forest. Frequency of the tree species like *Croton permilis*, *Shorea robusta* and *Glochidion lanceolarium* were found to be 100% in the peripheral area. However, the most abundant tree species was *Croton persimilis* (4.800) followed by *Caesalpinia digyna* (4.000), *Ziziphus oenoplia* (4.000), *Syzygium cumini* (3.667) and *Sterospermum colais* (3.200). Frequency of the tree species like *Croton persimilis*, *Holarrhena pubescens and Macaranga peltata* were found to be 100% in the buffer zone. However, the most abundant tree species was *Shorea robusta* (8.000) followed by *Terminalia alata* (7.000), *Macaranga peltata* (6.400) and *Pongamia pinnata* (5.000). Frequency of the tree species like *Syzygium cumini* (81.818), *Casearia graveolens* (72.727%) and *Canthium coramandelicum* (72.727%) were found to be high in the core zone. However, the most abundant tree species was *Shorea robusta* (35.428) followed by *Memecylon edule* (17.000).

The importance value index depicts the importance of the species in terms of its dominance and ecological success. IVI of *Shorea robusta* (55.647), *Croton persimilis* (29.870), *Diospyros melanoxylon* (26.102), *Syzygium cumini* (17.157) and *Glochidion lanceolarium* (14.930) were noted to be highest in the periphery area. IVI of *Diospyrosebenum* (21.161), *Macaranga peltata* (16.645), *Holarrhena pubescens* (12.128) and *Melia azedarach* (10.306) were noted to be highest in the buffer area. IVI of *Shorea robusta* (9.802) and *Sterculia guttata* (12.199) were noted to be highest in the core area.

From the distribution index it was seen that nearly 80% of the species showed contiguous distribution in the core area. The buffer zone exhibited maximum proportion of the species (25%) with random distribution. Odum (1971) opined that under natural conditions, a contiguous distribution of plants is normal. High degree of contiguous distribution in the core area is an indication of stability of the ecosystem. A higher degree of random distribution of species is an evidence of uniformity of the environment in the buffer and periphery zone which may be due to disturbances like as grazing and felling in natural forest.

In the present study, Sorensen's index of similarity (IS) among the three study sites varied between 5.254 % and 11.018%. The value of similarity (IS) of the tree species between periphery and buffer region was found to be highest (11.018%) followed by the value (7.211%) between buffer and core region. This low value of similarity can be attributed to the varying degree of disturbances between the core and the periphery area.

In tree species, the value of species richness (Dmg) was highest in core area (14.852) and lowest in periphery area (7.114).The higher value of the diversity indices is an obvious indication of high tree species diversity and abundance. Shannon's diversity index was calculated on the basis of important values. The value of species diversity (H') in tree species was highest in core area (4.332) and lowest in periphery area (3.115). The diversity values of tree species obtained in the present study is comparable to the reported range of Indian tropical forests. Simpson index of dominance was calculated by using the important value of the plant species which showed minor variation within the study site. The value of dominance (D) in tree species was found to be highest in core area 0.982) and lowest in periphery area (0.931). The altitude, environmental factors, habitat and soil characteristics may be the main factors which eventually lead to the variations in species diversity and density in the three study sites.

Ethnobotanical documentation of folklore and traditions

The data revealed that the Santhal tribes and the natives of this area who mostly dwell around this sanctuary a total of 236 species of 184 genera 64 families for various purposes. This includes 46 herbs, 48 shrubs, 104 trees and 38 climbers. The preference of using trees over other life forms may be attributed to the relative abundance of trees naturally occurring in the area. Among them 2 species (*Mucuna pruriens* and *Flacourtia indica*) are endemic, 4 species (*Uvaria hamiltonii, Rauvolfia serpentina, Garcinia cowa* and *Homalium nepalense*) are rare, 1 species (*Smilax lanceifolia*) endangered and 2 species (*Dysoxylum gotadhora* and *Gouania microcarpa*) are new record to the state.

The variety of uses has been categorized broadly as medicinal, wild edibles, fodder, timber, fibre, fuel and other miscellaneous uses which include fish poison, fencing material, leaf plate, broom etc. A total of 46.61% plants were used as medicine, 35.86% plants as wild edibles, 20.25% as fodder for domestic animals or consumed by the wild animals of the sanctuary, 11.81% as source of timber, 8.86% as source of fibre, 4.64% as fuel wood and 18.14% plants were identified having various miscellaneous uses.

The use of timber included making agricultural implements, furnitures, match sticks and construction. The 28 plants identified belonged to 15 families. Maximum exploitation was observed from the members of Rubiaceae, Combretaceae and Leguminosae as source of timber. 6 species (*Vitex leucoxylon, Dalbergia latifolia, Dalbergia sissoo, Diospyros montana, Discospermum abnorme* and *Dysoxylum gotadhora*) were identified that were used only for their timber value. *Dysoxylum gotadhora* is a new record for the state. *Extraction of timber results in large scale felling of trees which is one of the cause of deforestation of various parts of this sanctuary.*

Dry twigs and stems of *Cassia fistula, Cleistanthus patulus, Suregada angustifolia Acanthus ilicifolius* are preferred source of fire wood. Stems or barks of 22 plants are used as source of fibre for making ropes, threads, carpets and as floss. Members of Leguminosae and Malvaceae are the most exploited plants for this purpose; followed by members of Convolvulaceae, Combretaceae, Vitaceae and Apocynaceae. Barks of 10 plants are used for making ropes which makes it favourable from conservation point of view. *Extraction of fibre can serve as a source of economy for the tribals of this region. Further study of these plants*

and awareness could lead to making an alternative to the commercial natural fibres and plastics.

The arboreal species provide foliage and young pod to cattle during the odd periods. The plants identified as fodder not only includes the cattle feed but also the plants that provide food to the wild animals. Out of 48 plants identified 24 are used as fodder plants and 24 are consumed by the wildlife of the sanctuary which includes the elephants, monkeys, *chital* deer, birds and giant squirrel. Among the all reported species, trees were the most commonly used (75%) followed by shrubs (16.66%), herbs (6.25%) and climbers (2.08 %). The present finding indicates that this region holds rich reserve of fodder plants and the wisdom of forage utilization should be included in modern management practices.

A total of 85 plant species have been documented with edible values of which 13.09% constitutes herbs and climbers each, 21.42% shrubs and 52.38% trees. The plant parts used were fruits, leaves and shoots, tuber, flowers, seeds gums and calyx. *Keeping the idea of food security in mind these plants should be furthered be studied as low cost nutrients alternatives. Proper awareness and promotion is required for introduction of these vegetables in markets which would improve the livelihood of the locals.*

The study provides information about ethnomedicinal use of 110 different plant species by native of KWLS. Analysis of the habit wise distribution of these species indicates that trees are mostly used as medicine, followed by herbs. Maximum plants are to treat gastrointestinal disease, rheumatism, skin disease, cuts, cold and cough, fever, head ache and others. The parts utilized show that most of the herbal medicines (56%) are obtained from seeds, roots, stems and the bark. This calls for conservation measures to facilitate sustainable utilization of these plant resources.

15 plants species have been reported in this study to be used for treatment of joint pain, a comparison of ethnobotanical data gathered in the present study with Indian medicinal plant literature indicated that the information regarding the use of some plants (*Cryptolepis dubia* (Burm.f.) M.R. Almeida and *Xantolisto mentosa* (Roxb.) Raf.), or this particular disease are relatively new reports. 5 plants are reported in the treatment of piles, of which *Catunare gamspinosa, Cyanthillium cinereum* are specifically applied as topical application. The use of *Catunaregam spinosa* and *Tridax procumbens* in piles are new reports. The use of tender twigs as tooth brush is a well practised method.

A total of 47 species of 45 genera 28 families were identified to be useful in treating gastrointestinal disorders. Among the families mentioned in this study the Leguminosae had the highest number of species used for treatment. A comparative study with available medicinal plants literatures indicated that the information regarding the use of some plants (*Bridelia retusa, Homalium nepalense, Micromelum minutum, Persicaria hydropiper, Xylia xylocarpa*) for a particular disease is relatively less known. This study reports the use of 5 plants in the treatment of tooth ache. The use of *Kaempferia angustifolia* in tooth ache is a new report. The herbal healers of Kuldiha also identify 9 plants that are used as anthelmintic.

The use of *Jatropha curcas, Micromelum minutum* and *Triumfetta rhomboidea* are relatively less known. Skin diseases like eczema, scabies, ring worm infection and other rashes and boils can be treated using herbal medicines, herbalists of KWLS reported 16 plants used in various skin related diseases. 5 plants are used as topical application on scabies of which the use of *Cayratia pedata* and *Tiliacora racemosa* are new reports. 6 plants have been recorded to be used in treating poisonous bites. *Millettia racemosa* and *Pseudaidia speciosa* for the treatment of tick bites and snake bites respectively is a new report. 11 plants are recorded that are used to treat cuts and wounds.

Most of the uses are as topical application on wounds. *Mucuna pruriens,* endemic to Odisha has been reported to be used in constipation, and cough and cold but it's used in wound healing is relatively new. The use of *Cyanthillium cinereum* in wound healing is also a new report. The use of *Andrographis paniculata* (Pani et al., 2015) and *Nyctanthes arbor-tristis* has been variously reported in the use of malaria. The use of fruits of *Terminalia chebula* for treating malarial fever is a new report. Uses of *Evolvulus alsinoides*, *Cryptolepis dubia* and *Caesalpinia bonduc* in the treatment of jaundice have been reported in previous literatures.

The use of *Abrus precatorius* in mumps, *Jatropha gossypiifolia* in leprosy and *Holarrhena pubescens* are few of the interesting findings. *Gouania microcarpa* is a new record to the state and is used to cure chicken pox. Use value helps to identify the relative importance of the species to the local community. In the present study, the UV ranged between 0.33 and 1.33. Based on UV data, 71 plants were identified that had UV ranging between 1 and 1.33. These species were used for diverse purposes, as medicine, food, fodder or as fuel and timber.

This research summarized the floristic diversity and ethnobotanical uses of plants distributed in KWLS. The ecological studies on the tree species are indicative of the fact that the KWLS is a stable ecosystem with great species diversity. The present study further emphasize along with the existing literature on the sustainable utilization of native plants for sustaining the traditional healthcare system based on ethnobotanical knowledge and needs scientific validation of available knowledge, for the benefit of human population.