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Plant Diversity and Sustainable Development in a Tribal Village Eco-Complex on the Eastern Ghats of Orissa

Sudhansu S. Dash[1] and Malaya K. Misra[2]

Ecology & Floristic Laboratory, Department of Botany, Berhampur University, Berhampur 760 007 Orissa, India

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ABSTRACT The paper reports the plant diversity available in and around three tribal village ecosystems of Phulbani district of Orissa and shows how the biodiversity resources essentially met the basic demand of the tribals for their sustenance. Of the total 249 plant species recorded in and around the villages, the tribals used 43 species for food, 16 for fuel, 61 for medicine, 18 for timber, 18 for other economic purpose, 3 as stimulants and 17 as sacred plants. Besides, 13 species served as fodder plants. It was felt that biodiversity is essential for the functioning of village ecosystems.

INTRODUCTION

Orissa state is represented by 62 tribes (*ca* 7 million). These tribes settled mainly in the vicinity of the forests in small groups. A tribal village may be considered as an ecosystem taking into consideration the biomass production and consumption, and energy flow in the village (Nisanka and Misra, 1992; Nayak et al., 1993). Until recently the villages in Asia were closed ecosystems extracting all their requirement from the surrounding environment except salt and a few other commodities. Despite the destruction of many of the forests the tribal villages still depend on the surrounding forest resources for their sustenance. The physical resource base along with plants and animals (biodiveristy) are very important natural resources which control the functioning of the village ecosystem. Any imbalance or change due to overexploitation or due to some other reason in the natural environment affects the carrying capacity of the ecosystem. Any unplanned developmental (economic) activity in the villages will have great deleterious impact on the natural environment. Since the 1980s the concept of sustainable development has been proposed as a requirement for establishing compatibility between ecosystem development and environment quality.

Sustainable development involves devising a socio-economic-ecologic system that ensures non-declining condition of achieving the desirable objective far in future (Pearce et al., 1989). This implies quantitative improvement of human condition without quantitative increase of the environmental impact beyond the carrying capacity of a system (Daly, 1991). The fundamental condition for sustainable development is that the natural capital base is maintained at a constant level. Natural capital is the stock of all types of natural resources and the environment that yield a flow of useful goods and services over time (Daly, 1991) Natural resources are the forests, grasslands, aquatic systems, wastelands, etc. which help in the functioning of a village ecosystem. Unfortunately these resources are rapidly deteriorating which need restoration. Evaluation of these natural resources from diversity point of view is highly essential before any restoration measure is undertaken. Restoration is only possible through sustainability.

The main objective of this paper is to evaluate and justify how the plant diversity of a tribal village eco-complex helps in sustaining the ecosystem in a balanced manner.

STUDY AREA AND ENVIRONMENT

The study covers a cluster of 3 tribal villages - Rajikakhola, Nediguda and Badruguda (84° 21'E and 20° 15'N) of Phulbani district, situated on the Eastern Ghats of Orissa at an elevation of 730 m. Phulbani district is popularly known as Kondhamal, pre-dominated by

1. *Present Address:* Botanical Survey of India, Sikkim Himalayan Circle, Gangtok, Sikkim India
2. Address for all correspondence

Kondha tribe. Rajikakhola is situated about 3 km interior from the Phulbani-Berhampur state highway and on the forested foothills while the other two villages situated about one-half kilometre away from the highway in the opposite side of Rajikakhola. All the villages are inhabited by kondhas.

The area experiences a typical monsoonic climate with an average annual rainfall of 1500 mm. Depending upon rainfall and temperature the year can broadly be divided into three distinct well marked seasons *viz.*, rainy (June-September), winter (October to February) and summer (March to May). Seasonal variations of temperature showed great variation. The lowest temperature in winter goes down to 0.5°C and in summer highest temperature reaches as high as 42°C.

The soil of Rajikakhola is loamy-sand, of Nediguda loamy and Badruguda is clay-loamy. The water holding capacity of soil varies from 30-44 % and with average pH ranging from 5.2 to 6.7. Organic carbon was very less which ranges from 0.1 to 0.8 % (Dash, 1997).

METHODS

Floristic survey of the area was done along with the ecological studies of the village ecosystems covering all seasons (Dash, 1997). Informations on minor forest products, ethnobotany, and the conservation measure taken by the people to protect the forest were collected with the help of questionnaire, participatory rural appraisal (PRA) method and sample survey. While applying the PRA method people were asked in groups and everybody was given equal opportunity to speak about his own view. Public perception towards the role of plants in subsistence of the village ecosystems was also collected through individual survey. Plants used for different purposes are categorised into different groups. Plant specimens collected were dried,. labelled, identified and preserved in the herbarium of the Botany department, Berhampur University (BOTB).

OBSERVATION

The plant resources (wild and cultivated) available in and around the villages almost met the day to day requirement of the people for their subsistence. Except for a few commodities these tribals depend on the biodiversity resources of the area. These resources are utilised in a variety of purposes which are categorised as follows.

Food

Wild fruits, leaves and flowers were used as food. Besides, the wild germplasm (varieties) under shifting as well as settled cultivation met the staple food requirement of the tribals. The wild fruits and leafy vegetables not only support the human beings but also a substantial amount of the material goes to the animal husbandry system as fodder. About 8.6 tonnes of jack fruit in average was collected per village, during the year, of which only 20 % was for human consumption and a major portion of the rest part being utilized as fodder.

The plant diversity of the village eco-complex and its immediate vicinity provides 21 plants with edible fruits, 19 plants with edible leaves and 3 plants with edible flowers. Children and women used to collect the wild raw food materials along with other minor forest products. In the village complex edible fruits and leafy vegetables were found to be collected 16.6 kg and 109 kg in average per household per year respectively.

The plants yielding edible fruits in the villages are: *Aegle marmelos, Alangium salviifolium, Anacardium occidentale, Annona reticulata, A. squamosa, Artocarpus heterophyllus, Carissa carandas, Diospyros melanoxylon, Feronia limonia, Ficus recemosa, Flacourtia indica. Lantana camara* var. *aculeata. Mangifera indica, Moringa oleifera, Phoenix sylvestris, Phyllanthus emblica, Semecarpus anacardium, Syzygium cuminii, Tamarindus indica, Ziziphus mauritiana* and *Z. oenoplia.*

Plants used as leafy vegetables are: *Amaranthus spinosus, A. viridis, Bauhinia purpurea, B. variegata, Borreria articularis, Canthium parviflorum, Cassia tora, Celosia argentea, Commelina benghalensis, Glinus oppositifolius, Hibiscus subdariffa* ssp. *cannabinus, Indigofera cassioides, Marsilea minuta, Moringa oleifera, Murraya koenigii, Oxalis corniculata, Polygala arvensis, Portulaca oleracea* and *Sphaeranthus indicus.*

The flowers of *Bauhinia purpurea, B. variegata* and *Moringa oleifera* were used as food.

Timber

The timbers were collected from forest for the construction and/or repair of thatched house and for making agricultural implements. The villagers used 18 timber yielding trees which are: *Anogeissus acuminata, Careya arborea, Dalbergia lanceolaria, D. latifolia, D. paniculata, D. sissoo, Gmelina arborea, Haldina cordifolia, Lagerstroemia parviflora, Lannea coromandelica, Mangifera indica, Mitragyna parvifolia, Phoenix sylvestris, Pterocarpus marsupium, Shorea robusta, Tectona grandis, Terminalia alata* and *Toona ciliata*.

Economic Product

The minor forest products collceted in different seasons were either used or sold in the weekly market at Tikabali and Shankarkhola. Table 1 depicts the details of plants and plant products and their uses.

Stimulant

Three plants were sued as stimulant. Sap of *Caryota urens* was extracted from the plant and consumed as such or after fermentation as liquor. During the study period the tribals of Rajikakhola were found to be collected 12650 litre of sap and consumed that. It was observed that some of the villagers live on the sap for days together without food. Rolled dried leaves of *Diospyros melanoxylon* were smoked as bidi. Of course true bidi is prepared with tobacco leaves. Flowers of *Madhuca longifolia* var. *latifolia* were used for preparation of country liquor through traditional distillation method.

Sacred plants

Seventeen plants were worshipped by the people particularly during different socio-religious functions. The sacred plants, by and large,

Table 1: Plants used as economic resources

Name of plant	*Plant parts used*	*Material prepared*
Aristida setacea Retz.	Inflorescence stalk.	Broom
Bauhinia vahlii Wt. & Arn.	Bark, leaves	Making of rope, cups and plates locally known as *Khali* and *Dana*
Bombax ceiba L.	Fruit (cotton)	Mattress
Dendrocalamus strictus (Roxb.) Nees	Young shoot tip	Vegetable
Helicteris isora L.	Bark fibre	Making of rope
Imperata cylindrica (L.) Raeschel	Leaves	Thatching
Madhuca longifolia (Koenig) Macbr. var. *latifolia* (Roxb.) Cher.	Flowers Seed	Preparation of liquor Oil,. lubricator
Phyllanthus emblica L.	Fruit	Edible, prickle
Pongamia pinnata (L.)	Pierre	Seed Oil, used for manufacture of soap and an lubricator
Sapindus emarginatus Vahl	Seed	Cloth washing, Head washing (cleaning)
Sida acuta Brum. f. *S. cordata* (Burm.f.) Borss. *S. rhombifolia* L.	Whole plant	Traditional broom
Shorea robusta Gaertn.	Leaves	Making of cups and plates
Smilax zeylanica L.	Stem	Tooth-brush
Strychnos nux-vomica L.	Fruits	Medicine, collected by vendors
Tamarindus indica L.	Fruits	Food soaring agent
Thysanolaema maxima (Roxb.) Kuntze	Inflorescence	Broom
Albizia procera *Anogeissus* spp. *Bridella retusa* *Buchanania lanzans* *Cassia* spp. etc.	Whole plant	Fuelwood

are protected by the villagers. This mode of preservation of natural vegetation over a long period of time reflects the social and ecological stability of the region, help to conserve the germplasm. The plants are: *Aegle marmelos, Anisomeles indica. Azadirachta indica, Butea superba. Dendrocalamus strictus, Emblica officinalis, Ficus racemosa, F. religiosa, Madhuca longifolia* var. *latifolia, Mangifera indica, Martynia annua, Mamosa pudica, Ocimum basilicum, Saraca asoca, Sesbania grandiflora, Tamarindus indica* and *Terminalia bellirica.*

Fooder

Apart from grasses, 13 plants were useful as fodder. In these villages stall feeding is not a common practice. Thus cattle are left free to the nearby forests for grazing. In absence of sufficient or no rangeland/grazing land the adjacent forest plays a vital role in solving the fodder problem of the villages. The principal fodder plants are: *Ailanthis excelsa, Artocarpous heterophyllus, Cipadessa baccifera, Desmodium gangeticum, D. triflorum, Flacourtia indica, Garuga pinnata, Indigofera cessoides, Mitragyna parvifolia, Symplocos racemosa, Tamarindus indica, Ziziphus mauritiana* and *Z. oenoplia.*

Fuelwood

For fuel, the villagers mainly depend on wood biomass which were collected from the nearby forest. Firewood was the main source of fuel for cooking, heating and other domestic activities, mostly comprises stem wood. The average annual per capita consumption of wood was 1.06 tonne. In addition a substantial amount of commercial fuelwood was also exported from the village ecosystem. Sixteen plants were used in the villages as fuelwood. They are: *Ailanthus excelsa, Alangium salviifolium, Albizia procera, Anogeissus acuminata, A. latifolia, Bridelia retusa, Buchanania lanzan, Careya arborea, Carissa carandas, Cassia fistula, C. occidentalis, C. sophera, Cassine glauca, Cipadessa basifera, Clerodendrum viscosum* and *Garuga pinnata.*

Medicine

The tribals mostly depend upon the indigenous drugs of local plants. The whole plant or a part of the plant used as medicines (the diseases are mentioned in parentheses) are: *Achyranthus aspera* (tooth-ache), *Andrographis echioides* (cattle wound), *A. paniculata* (skin diseases), *Asperagus racemosus* (urinary discharge), *Azadirachta indica* (skin diseases and worm), *Breynia vitis-ideal* (eye diseases), *Centella asiatica* (madness), *Cissus guadrangularis* (rheumatism and bone fracture), *Grangea maderaspatana* (stomach diseases), *Madhuca longifolia* var *latifolia* (dysentery), *Mucuna prurita* (worms), *Phyllanthus fraternus* (jaundice and liver diseases), *Pergularia daemia* (toothache), *Pongamia pinnata* (toothache), *Side cordifolia* (fracture and swelling), *Tamarindus indica* (injuries), *Tridax procumbens* (antiseptic), *Vanda tessellata* (otitis), and *Woodfordia fructicosa* (unconciousness).

The leaves of the following plants were used as medicine. *Acalypha indica* (mouth infection), *Adhatoda zeylanica* (cold and cough), *Ammannia baccifera* (stomach diseases), *Barleria prionitis* (ringworm and rheumatism), *Eclipta prostrata* (jaundice and liver diseases), *Holarrhean pubescens* (rheumatism), *Jatropha gossypifolia* (purgative), *Leucas aspera* (sinusitis), *Pavetta indica* (skin diseases), Plumbago zeylanica (snake bite), Polycarpea corymbosa (boils and inflamatory swelling), Solanum nigrum (constipation), Tribulus terrestris (bodyache) and Vitex \negundo (fever and toothache).

The roots/underground parts of the following plants were used a medicine. *Caesalpinia bondue* (dysentery), *Curculigo orchioides* (gonorrhoea), *Datura metel* (pimples), *Elephantopus scaber* (pimples in infants), *Gloriosa superba* (abortion), *Hemidesmus indicus* (dysentery and diarrhoea), *Mimosa pudica* (urinary diseases). *Oldenlandia corymbosa* (liver diseases), *Polygala arvensis* (fever), *Sida rhombifolia* (bile complaint in children) and *Tephorsia purpurea* (toothache).

The barks of the plants which were used a medicine are: *Alstonia scholaris* (fever), *Diospyros melanosylon* (diarrhoea and dyspepsia), *Erythrina variegata* (dysentery and indigenstion), *Lagerstroemia parviflora* (wounds), *Lannea coromandelica* (dysentery), and indigestion), *Mangifera indica* (rheumatism) and

Syzygium cumuni (food poisoning and snake bite).

The seeds/fruits of the following plants were used as medicine. *Abrus precatorius* (opthalmic diseases), *Cassia fistula* (constipation), *Pongamia pinnata* (oil against rheumatism), *Sapindus emergenatus* (pain), *Semecarpus anacardium* (cattle foot and mouth disease), *Solanum surattense* (toothache), *Strychnos nux-vomica* (pile), *Terminalia bellirica* (cold, constipation and acidity), and *T. chebula* (cooling agent and skin diseases).

Analysis of Plant Diversity

The detail analysis of the plant diversity with in the revenue boundary and adjacent forest area (Dash, 1997) revealed altogether 249 species under 206 genera belonging to 67 families. The monocot : dicot ratio of the species was 1: 4.8, monocots being represented 13% of the total families and 16% of the total genera recorded from the area. Fabaceae being the most dominant family represents 23 species followed by Poaceae by 21. Ten dominant families such as leguminosae (Fabaceae), Gramineae (Poaceae), Euphorbiaceae, Composite (Asteraceae), Caesalpiniaceae, Acanthaceae, Rubiaceae, Amaranthaceae, Cyperaceae and Verbenaceae represent 50% of the total species comprise 71 trees, 37 shrubs, 91 herbs, 3 parasites, 18 climbers, 3 legumes and 26 grasses.

DISCUSSION

The three villag ecosystems were open and partially independent (Dash, 1997). The subsystems such as domestic, agricultural and animal husbandry of the village ecosystems are directly linked to forest ecosystem. The biodiversity of the surrounding area. controls the economy of the villages and it partially or fully met with the basic requirements such as food (43 plants), fuel (16 plants), medicine (61 plants) and materials for house construction (18 plants) of the villagers. apart from this they use 3 plants as stimulant and 17 as sacred and 13 as fodder species. In traditional societies people of an area generally adjust with the available natural resources within their reach for their sustenance. Thus the role of biodiversity in maintaining the self-sufficiency of the village ecosystem cannot be ignored. Gadgil (1993) while working on 82 villages in semi-arid districts of India sugested that biomass harvests from common lands furnish 14-23 % household income from all sources. The degree of influence of plant diversity on the functioning of the village ecosystem is highly site specific. The floristic analysis of the area shows that shrub species outnumbered the tree species. This indicates that the biodiversity was under tremendous pressure and has been destroyed to a great extent. The forest ecosystem in the vicinity of the villages studied is 'fragile' (less stable). Moreover, from the present study it can be concluded that there exists a integral relationship between the sustainable development of the tribals and the biodiversity, are complementary to each other. The quality of human life of these 'ecosystem people' is intimately linked to the productivity and diversity of other living organisms in their own restricted resource catchments (Gadgil, 1993). Therefore, conservation of biodiversity in and around the villages, help for the development and maintenance of its ecosystems, with special emphasis to the indigenous knowledge available within the people (Gadgil et al., 1993).

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