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PLANT DIVERSITY OF ANDAMAN AND NICOBAR GROUP OF ISLANDS AND THEIR ROLE IN ECO-DEVELOPMENT OF THE REGION

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Prosperity of a nation is chiefly determined by its capacity to utilize and conserve its resources. Suitable strategies based on an understanding of the nature and extent of physical and biological resources of a region, thus need to be formulated for bringing out rapid development and economic progress. In this paper, the role of agro-biodiversity of Andaman and Nicobar Group of Islands, their geographic distribution, regional diversity and present state of exploitation and utilization are critically examined to explore some avenues and action plan for their conservation and use.

Key words: Agro-biodiversity, A&N Group of islands, status, conservation

The Andaman and Nicobar Group of Islands consist of about 300 islands covering an area of 8293 sq. km., spread over a length of 700 km and breath of 250 km. The Islands are situated between 6 - 14° N and 92 - 94° E, in the Bay of Bengal. The general terrain, land formation and topography of Andaman group of islands are hilly and undulating, enclosing narrow valleys. The highest peak is the Saddle peak (732 m) whereas the Nicobar group of islands are invariably encircled by coral reefs and shallow sea. Some of the islands are naturally endowed with long narrow stretches of sandy coasts. Principal islands of the Andaman group, viz., North Andaman and Rutland islands are separated by narrow straits. Little Andaman is an important island. Northern-most point is approximately 901 km from mouth of Hooghly river basin and 190 km from Myanmar coast. The Great Nicobar island is the southernmost island of Andaman and Nicobar Group of Islands situated between 8 45° - 7 15° N latitudes and 93 37° - 93 56° E longitudes with an estimated area of nearly 1,045 sq. kms. It has aproximately a width of about 30 kms in north and very narrows (about 3 m) at southern tip, known as Indira Point (Pygmalion Point) which is only 144 kms away from Indonesian island Sumatra. In these isrands, Car Nicobar and Katchal are almost flat while other islands have a hilly terrain. The land surface of Little Nicobar and Great Nicobar is very irregular, undulating and often cut up by steep hills and valleys. The hot humid tropical climate prevalent in the close proximity of equator has enriched the landmass with evergreen forests. The region is characterized by an average rainfall of about 3000 mm, distributed over the greater part of the year. The relative humidity is as high as 80 - 90 per cent and temperature ranges from 23.2 - 30.7° C during the year. The islands are subjected to both south-west and north-east monsoons, the former from May to October and the latter from November to December. The aboriginals of the Andaman islands may be described as a race by themselves. One of them, the Negrito stock, includes Andamanese, Jarawas, Onges and Sentinels tribes generally found in Andaman group of islands. The second group,

Mongoloid in origin, includes the inhabitants of Nicobar group of islands, i.e., Nicobarese and the Shompens. Some of these aboriginals are in fact seriously threatened with extinction. Agriculture is not generally practiced by these Stone Age people. They are natural hunters and gatherers of food and move in groups for game, fishing, collecting wild yams, banana and *Pandanus* fruits. 'Onge' tribe too collects wild roots tubers and fruits which they use as food.

I. How the agro-biodiversity developed ?

Wide climatic and physiographic diversity has offered immense opportunities for the cultivation of large array of food, fodder, fruits, other horticultural/plantation crops and medicinal plants in fertile valleys, on the hilly terraces and in the exposed flat hill tops under irrigated and rainfed conditions of Andaman and Nicobar group of islands and thereby enormous variability developed in these crops. Primitive agricultural system followed by aboriginals of raising crops under stress conditions have generated much variability. Further, in the isolated islands which are different from each other, the tribal people belonging to various ethnic groups and settlers grow their own preferred cultivars of different crops. In the course of time, the process was accelerated and genetic diversity has been augmented enormously through conscious and unconscious selections by the people. Diverse plant types brought into the region from mainland India and through trade routes through sea from Myanmar (maize, *Coix*, sword bean and other beans, oil palm) and through Indonesian islands (rice, medicinal plants etc.)

II. Present status of agro-biodiversity wealth

The greater portion of the islands are under dense forest vegetation. Only in the areas of settlements, rice and plantation crops are cultivated. Area reserved for aboriginals (4671 sq. km), under forest (7,144 sq. km) and crops/plantations are given below :

Rice	:	11,963 ha
Coconut	:	4,898 ha
Areea nut	:	2,000 ha (approx.)
Rubber	:	6,000 ha
Oil palm	:	6,305 ha (approx.)
Cashewnut	:	600 ha
Other crops	:	-

Rice is the staple food and is grown on about 12000 ha yielding 21,000 t; planted in June/July/August and harvested between October/November, depending upon region, varieties and farming systems. Most of rice cultivars are not the landraces of this region but are old varieties brought by settlers from mainland India or improved varieties introduced by various agencies. Tapioca grows well on hilly slopes. In due course of time, wide variability has been generated in different agri-horticultural crops introduced by Britishers, and Indian settlers from Tamil Nadu, Kerala, Bihar, Tamilian refugees from Sri Lanka, and Bangala Desh refugees. The crops/species, which have now become naturalized and well established are listed in Table 1.

IIa. Forest flora of Andaman and Nicobar Group of Islands

(i) Andaman group of islands resemble each other in land formation, topography and other climatic factors. Little variation exists due to elevation and edaphic factors. Giant evergreen forests occur along larger streams endowed with dèep alluvial soil. Prominent tree species included *Dipterocarpus alatus, Artocarpus chaplasha, Sterculia campunulata.* Under tropical evergreen forest, vegetation was not luxuriant. *Dipterocarpus grandiflorus* has been a conspicuous species occurring on moist clayey hill slopes. Valley forests include *Musa* spp. and tree ferns. Cane brakes are distributed throughout evergreen and semi-evergreen climaxes. Creeping bamboo (*Dinochloa*) and wet bamboo brakes occur along streams. *Bambusa schizostachyoides* and

Oxytenanthera spp. are very common. Some of the important species which constitute deciduous forests include *Pterocarpus dalbergioides, Canarium euphyllum, Chukrassia tabularis, Dillenia pentagyna, Lannea coromandelica* and *Sagaraea elliptica Artocarpus lakoocha, Lagerstromoea hypoleuca.* Important plant species forming littoral forest vegetation include : *Manilkara littoralis, Calophyllum inophyllum, Thespesia populnea, Crinum asiaticum* and *Pongamia pinnata.*

(ii) Mangrove forests are adapted to survive tidal mud permanently wet with salt water. *Rhizophora mucronata, Bruguiera conjugata,* and *Avicennia officinalis* are major species of significance.

(iii) Major forest types identified in Nicobar group of islands have some Malaysian and Indonesian species component. These include *Dendrolobium umbalatum, Casuarina equisetifolia, Pandanus tectorius, Mangifera comptosperma, Rhizophora epicula, Sonneratia caseolaris, Areca catachu* and *Elaeocarpus serratus.* Plants cultivated by the aboriginals and those introduced by the settlers include coconut (*Cocos nucifera*), *Pandanus* and banana. Tree species such as *Pterocarpus dalbergioides, Tectona grandis* and several others are also grown.

(iv) The flora of Andaman and Nicobar group of islands is unique in the sense that it exhibit multidimensional affinities to north - eastern region of India and Myanmar in north, Thailand and Malaysia in the east and Sumatra and Java towards South. The vegetation and environmental factors have not allowed large scale introduction of either plant or animal species. About 1,425 species of angiosperms comprising 1078 dicotyledons and 347 monocotyledons occur in this region. Of these, only 14 per cent species are endemic to these islands; 54 per cent occur in mainland India and remaining 32 per cent extend their distribution to adjacent areas of SE Asia, Malaysia and Indonesia. There is phytogeographic distinctness between Andaman and Nicobar group of islands. Only 28 per cent of species have common distribution.

Table 1. Crops/species grown in Andaman and Nicobar Group of Islands

Crop group and Crop species
I. AGRICULTURAL CROPS
Brassica campestris, B napus, Raphanus sativus, Abelmoschus esculentus, Gossypium barbadense, Hibiscus mutabilis, Cajanus cajan, Canavalia ensiformis, Cyamopsis tetragonoloba, Lablab purpureus, Vigna trilobala, V. unguiculata, Benincasa hispida, Citrullus lanatus, Cucumis melo, C. sativus, Cucurbita maxima, C. moschata, Coccinea grandis, Lagenaria siceraria, Momordica charantia, Luffa cylindrica, Trachyspermum involucratum, Trichosanthes anguina, T. cucumerina, Coriandrum sativum, Ipomoea batatas, Lycopersicon esculentum, Solanum melongena, Sesamum indicum, Manihot esculanta, M. glaziovii, Discorea alata, D. esculenta (yams), *Colocasia esculenta, Capsicum frutescens, Echinichloa colona, Eleusine coracana, Saccharum officinarum, Zea mays, Portulaca oleracea, Pachyrrhizus erosus, Phaseolus lunatus, P. vulgaris, Pisum sativum* and *Sesbania grandiflora.*
II. HORTICULTURAL CROPS
Anona reticulaae, A. muricata, A. squamosa, Garcinia mangostana (mangosteen), *Durio zibithinus* (durian), *Aegle marmalos* (bel), *Citrus grandis, Ananas comora* (pine apple), *Belamcanda chinensis, Anacardium occidentale, Mangifera indica, Moringa oleifera, Carica papaya, Achras sapata* (sapota), *Diospyros discolor* (raspberry), *Musa paradisiaca* (banana), *M. textilis and Punica granatum* (pomegranate).
III. MEDICINAL PLANTS
Centella asiatica, Catharanthus roseus, Ocimum tenuifolia, Plantago major, Cannabis sativa, Zephyranthus carinata and *Z. rosea.*
IV. WILD GRASSES AND LEGUMES
Bothriochloa pseudo-ischaemum, Brachiaria distachya, B. mutica, B. paspaloides, Cymbopogon nardus, Dactyloctonium aegyptium, Heteropogon contortus, Imperata cylindrica, Paspalum scrobiculatum, Panium miliaceum, Rothboellia exaltata, Alysicarpus vaginalis, Clitoria ternatea, Crotalaria retusa, Atylosia scarabaeoides and *Mucuna* species.
V. PLANTATION CROPS
Elaesis guineansis (oil palm), *Cocos nucifera* (coconut), *Myristica fragrans* (jaiphal), *Piper betle* (betel), *Theobroma cacao* and *Areca catachu* (Arecanut).
VI. MISCELLANEOUS PLANTS
Bombax ceiba, Bixa orellana, Ceiba pentendra var. *indica, Glyciridia sepium, Cassia fistula, Lagerstromoea indica* and *Eucalypus botryoides.*

(v) Rare endemic plant species (187) included *Bauhinia nicobarica, Cyrtandiomoea nicobarica, Mangifera comptosperma,* which were previously known to occur in Vietnam, Thailand and Myanmar, and now occur in Car Nicobar. *Phalaenopsis speciosa* is a rare endemic orchid occuring in these islands, besides *Amomum acullatum, Mangifera andamanica, Amorphophallus camosus, Tinospora andamanica* and *Syzygium andamanicum.*

(vi) Some of the indigenous medicinal plants used by the aboriginal tribes as cure of sickness and injuries, are *Aristolochia tagala, Calophyllum filiformis, Ficus rumphii, Vitex negundo, Myristica elliptica, Merremia peltata* and *Corymborkis veratrifolea.*

(vii) The main food, of the aboriginals are *Artocarpus chaplasha, Mangifera andamanica, Pandanus lerum* (it is a large orange coloured fruit and constitute staple food of the Nicobarese and Shompen tribe). Banana and coconut provide food for survival of these tribals (Bhargava, 1981).

IIb. Faunal diversity of Andaman and Nicobar Group of Islands

In comparison to plant wealth, Andaman and Nicobar group of islands are poor in faunal wealth. Wild pigs (*Susanda mononsis*) and civet cat (*Paguma larvata tytleri*), spotted dear (*Axis axis*), barking deer (*Mutinus muntjak*) are found. The islands are rich in avifauna. Out of 145 species reported to be occuring in this region, the important species are : Lesser whilstling Teak (*Dendroegyna javanica*), grey partridge (*Francolinus pondicerianus*), Moor Hen (*Gallinula chloropus orientalis*), Andaman Wood Pigeon (*Columba palumboides*), Nicobar pigeon (*Calaenas nicobarica*), Crow pheasant (*Centropus andamensis*), Hill Myna (*Gracula religiosa andamensis*) etc.

III. Ecological status of the islands

In order to meet the growing demands and high population pressure, man has to exploit natural resources for his existence. The Andaman and Nicobar group of islands constitute a generalized ecosystem and is characterized by high species diversity index. In such terrestrial ecosystems, therefore, net primary productivity tends to be high and many ecological riches are available to naturally occurring plant species at each tropical level. The ecosystem possesses greater stability, homeostasis, better every flow and high diversity index. The agricultural utilization of a natural ecosystem may be accomplished by manipulation rather than by transformation through drastic changes. It would be advantageous that an artificial ecosystem perhaps could be created to replace the natural one on a limited scale. Cultivation/plantation may possibly proceed in this ecosystem by substituting certain preferred domesticated species such as coconut, oil palm, cashew, areca nut, pepper and rubber for wild species that occupy equivalent riches. Thus, an assemblage of cultivated trees and shrubs, climbers, herbs and perhaps root crops may take over spatial and functional roles essentially similar to those fulfilled by wild species of natural ecosystem. In fact, probably cultivation began by the manipulation of generalized ecosystem where the high diversity wild species would encourage the use of wide variety of plants and animals for subsistence. Among various tree species of economic importance to man, the red oil palm is one which gives high return with least disturbance to the ecosystem. A large area (6300 ha) now is under oil palm (*Elaeis guineansis*) cultivation across these islands.

IV. NBPGR's role in conservation of genetic resources

The agro-biodiversity noticed in the Andaman and Nicobar group of islands is enormous. The resources vary widely and will remain so if the plant cover is carefully managed and exploited. There is an urgent need to tap these resources. Andaman and Nicobar groups of islands have

shown a vast scope for agriculture, horticulture, animal breading, poultry farming, fishery, forestry and allied avenues of economic upliftment of the society. Extension workers are fast approaching distant tracts. It is of utmost importance that the native diversity occurring across the whole islands should be speedily collected and conserved in the National Gene Bank for present and future use. The NBPGR has developed state-of-the-art in the field of plant germplasm collection, evaluation and maintenance.

The NBPGR, under National Agricultural Technology Project on Plant Biodiversity (NATP PB), is in the process of formulating a programme of germplasm collection and characterization/ evaluation for direct utilization and as useful donors for adaptive traits such as resistance to drought, cold and for quality characteristics in collaboration with Central Agricultural Research Institute (CARI) and Botanical Survey of India, located at Port Blair and other Government/ Non-Government Organizations. The available landraces will be collected from the region, evaluated and conserved in the National Gene Bank for posterity. Public sector and nongovernment and private organizations may come together to establish a consortium to share genetic resources on committed contribution basis. *Ex-situ* conservation, on-farm conservation of landrace diversity and *in-situ* conservation will be judiciously integrated. *In-vitro* and cryopreservation techniques will be refined and these will find increasing use in germplasm conservation of vegetatively propagated and difficult recalcitrant group of species. Work on unique identity of genetic diversity available in germplasm collections determined through critical screening for biotic and abiotic stresses, quality attributes and characterization of germplasm holdings is expected to progress rapidly on prioritized species and group of crops. Isozyme profiles and DNA Fingerprinting will be used for establishing unique identity of genotypes and this information alongwith video images of plant samples will be available in the computer database. Core subsets of primary germplasm collections having diverse genes for resistance/adaptation/preferred specific traits will become available in priority selected crops. Quarantine services will be more efficient because of increasing use of ELISA and DNA probes for early detection of viruses and viroids in high risk seed material/plant propaguies. A new activity during the coming decade is likely to be the rejuvenation and evaluation of seed samples kept under long term storage. Thus plant genetic resources activities are going to enhance manifold. The access to PGR needs to be regulated keeping in view the Sovereign Rights of states and with the enforcement of new legislations relating to Plant Variety Protection (PVP) and TRIPS. Role has also to be played to regulate/oversee/monitor the influx of new patented material and extend help in resolving disputes. Thus the component of Indian National Plant Genetic Resources System will go a long way in the conservation of immensely valuable genetic diversity required for sustained production and food security and thus alleviation of hunger and poverty. The NBPGR's Gene Bank can conserve over 10.5 lakh accessions. The Gene Bank facilities include 12 long-term module (-20C), and medium term storage (+10C) at Headquarters and medium term storage facilities at its regional stations and National Active Germplasm Sites (NAGS). In addition, cryo-bank has the facility to conserve 2 - 5 lakh samples in liquid nitrogen.

V. Future strategies for Eco-development of the region

Because of the geographical location and difficult access, much of the biodiversity in these islands, from micro to the macro has been preserved. Across the whole group of these islands, large areas are under-developed and financial

resources of the farmers are extremely poor. Therefore, special programmes are to be tackled by an integrated programme of development. Fortunately, we are more conscious of the natural wealth that lies embedded in the Andaman and Nicobar group of Islands. The resources, with which nature has endowed these islands and those introduced and naturalized in the region, are so rich now that their proper utilization/exploitation cannot only sustain life well but also give a standard of living to the people inhabiting them.

Whereas, the detailed programme for eco-development of the Andaman and Nicobar group of islands would vary from place to place, island to island according to prevailing conditions, some broad suggestions can be made for the eco-development of the region in context of agro-biodiversity and their proper exploitation. Although with the establishment of Central Agricultural Research Institute (CARI), research in the field of agriculture attained momentum and much have been accomplished, yet necessity for conducting more extensive research work through a chain of experimental centres in the important islands, is all the more important, because wide range of conditions exist in different islands even within a short distance. In the scientific transformation of the rural economy of the Andaman and Nicobar group of islands, more emphasis is to laid on the introduction of superior high yielding cultivars, so as to boost the agricultural production/potential of the region.

The ecological diversity in habitats ideally provides a venue for the introduction of newer germplasm of wide variety of agri-horticultural economic types. Particularly, the change in the growing of agricultural crops, forest species with that of crops most suited to the zone is desired. Introduction of oil palm plantation by Forest -and Plantation Development Corporation (FPDC) at Hut Bay (Little Andaman), is a right step. The FPDC has plans to enlarge oil palm plantation more extensively. It seems that the region is ideally suited for oil palm plantation. Rubber was also introduced in a large scale in Katchall island. Spices and condiments also add good returns. In Camorta islands, cashew plantations have been established. Areca nut and *Cocos nucifera* (coconut) have proved boon to the Nicobar group of islands. It showed variation in the size and colour of nut, kernal weight, and yield. Coconut grows as wild population unattended in several Nicobar islands. Coconut of these islands, despite the association with many insect and termites etc., are not infested with any of the major diseases and pests, which affect the plantations elsewhere in the world. It is probably due to presence of some gene complexes, that wild population with a magnitude of variations survived so long. More areas at present under forests needs replacement by plantation crops, medicinal plants, cash crops such as cardamom, cinnamon, ginger and turmeric, and pepper. Areas under coconut and oil palm plantations also need to be enlarged to a great extent.

Finally, the maximization of efforts towards efficient and economic land use would be required. Silvi-agricultural needs of the terrain/region would demand raising of quick growing food (*Echinochloa frumentacea, Eleusine coracana, Panicum miliaceum, Brassica campestris, Vigna unguiculata, Lablab purpureus, Lagenaria siceraria, Cyamopsis tetragonoloba, Luffa cylindrica, Manihot esculenta, Pisum sativum, Colocasia esculenta*) fuel, M & AP (*Calophyllum filiformis, Myristica elliptica, Vitex negundo* etc.) and plantation crops (*Elaeis guineansis, Cocos nucifera, Piper betle* etc.), fodder trees (*Brachiaria distachya, Crotolaria retusa, Paspalum scrobiculatum, Panicum miliaceum, Heteropogon contortus*). Lot of hue and cry has been raised about manifold problems in these islands, exploitation of setllers and aboriginals and backwardness of these tribes. Eco-conservation and integrated rural enhancement may be launched by way of involving government officials and

active manpower of the region. It is high time now that scientists/technocrats and administrators specializing in microdimensional features of eco-development, social workers and grass-root activists, educationists and visionaries, all sit together to arrive at solution to eco-developmental problems in the Andaman and Nicrobar group of Islands and act accordingly.

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