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PLANT GENETIC RESOURCES OF SIKKIM

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ABSTRACT

Sikkim Himalaya is an unique ecosystem encompassing tropical, temperate and alpine vegetation types. Lepchas and Bhutias consume many native species as subsistence foods at high altitudes. Wild relatives of crop plants like *Musa balbisiana, Phoenix rupicola, Mangifera sylvatica, Coffea bengalensis, Camellia kissi, Malus sikkimensis, Fragaria daltoniana, Myristica longifolia, Allium wallichii,* and *Avena aspera* constitute some of the genetic resources for assessment and development.

INTRODUCTION

The Sikkim Himalayas represent Tethys sea of geological past and display a highly varied topography encompassing Kanchenjunga range (8540 m). The Western Singalila and Eastern Chola ridges sloping down to Indian plains receive heavy rainfall (120 - 600 cm) whereas the upper Tista valley is drier and Tibetan in character. All the major climatic features could be seen in a short distance reflecting unique vegetation. The natural history of Sikkim was studied by Hooker (1854) and Flora of alpine zone was analysed by Smith & Cave (1911). Endemic elements were enumerated by Raju *et al.*, (87-88) to conserve the threatened species but no attempt has been made to evaluate the edible plants and their wild relatives. The present work deals with an account of genetic resources for future.

OBSERVATIONS

Floristic wealth :

An estimated 5000 species of vascular plants are reported from Sikkim of which 10% are ferns. The seed plants constitute the bulk of vegetation which is a renewable resources. Though called as 'Denzong', Sikkim is densely forested. Three major climatic types are distinguished with distinct floristic composition, structure and function etc.

The tropical zone is characterised by Sal (*Shorea robusta*) mixed with *Magnolia pterocarpa, Lagerstroemia parviflora, Careya arborea* in Terai region at Sukna. As we ascend from Sevoke an association of *Duabanga grandiflora, Alstonia scholaris, Tetrameles nudiflora* association predominate the humid valleys. *Musa balbisiana, Mangifera sylvatica* and *Coffea benghalensis* frequent the slopes of lower Tista in this zone. Many canes (*Calamus* spp.), wild date (*Phoenix rupicola*) and *Wallichia densiflora* are found in rocky crevices. The landslip zone at Lukbir. *Schima wallichii* and *Dendrocalamus hamiltonii* are common in subtropical zone up to Singtam. Terraced rice fields can be seen up to Gangtok (1800 m).

The temperate zone extends from 1800 m to 3300 m is characterised by Oak forest. *Alnus nepalensis-Michelia doltsopa-Quercus spicata* association is predominant up to 2300 m. The large cardomom is cultivated in this zone. Rhododendron forest cover the peaks at Tendong, Mt. Mainom and Phodong above 2300 m. A community of *Alcimandra cathcartii, Cinnamomum inpressinervium, Daphniphyllum himalayense* is seen in Rangit valley near Damthang whereas *Camellia kissi* is found at Kechipheri lake. *Gynocordia odorata, Terminalia myriocarpa, Juglans regia* are some useful trees in this zone. The valleys of Lachen and Lachung have broad

leaved forest with *Magnolia campbellii* at Lachen and *Magnolia globosa* near Lachung. A Rhododendron froest with high species concentration is characteristic of Yumthang valley at 3300 m. *Larix griffithii* is dominant in subalpine zone above Lachung whereas Hemlock (*Tsuga dumosa*) covers steep slopes above Zema along upper Tista. The Silver fir (*Abies densa*) covers large tracts in subalpine zone up to 4300 m. Tree rhododendrons, *Juniperus recurva* and *Picea smithiana, Betula alnoides* and *Salix sikkimensis* predominate the subalpine scrub zone. The World's highest living tree *Diplarche pauciflora* and *Rhododendron nivale* do grow in Donkia La (6100 m). Cushion plants are characteristic of plains above Momay and Giagong (5000 m) whereas alpine meadows are extensive in Llonak valley and Cholamo lake region above 5500 m. Kiang and Yak graze in this area full of wild-life. Some two hundred species of flowering plants are found above 5600 m where native onion and oats grow.

Edible plants :

The Lepchas and Bhutias of Sikkim living at high altitudes mostly depend upon wild plants as subsistence foods. Buckwheat, Millet, Potato and Maize are grown near habitations whereas Large Cardomomum is extensively cultivated. Commercial tea plantations are confined to Temi in Rangit valley. Many native species and apple to upper Tista, are consumed in different climatic zones. A cursory examination of these reveal that they can provide as traditional crops if introduced into agriculture. Secondly the wild relatives of known crop plants and less-known useful species can provide as genetic resources for further improvement.

(a) *Leafy vegetables* : Whole plants or young shoots and flower buds of the following *viz. Bauhinia variegata, Masseanda roxburghii, Phlogacanthus thyrsiflorus, Musa balbisiana, Cycas pectinata, Dillenia pentagyna, Casearia glomerata, Begonia rubrovenia, Smilacina oleracea, Procrius crenata* and *Dendrocalamus hamiltonii* are commonly used in tropical zone. *Hottuynia cordata, Tupistra nutans, Paeonia emodi, Fagara oxyphylla, Cissus repanda, Indigofera cassioides, Vaccinium serratum, Chasalia curviflora* are some common plants used by Lepchas of Sakyong valley whereas species of *Impatiens, Polygonum, Bistorta* and *Rheum nobile* are much relished by Bhutias of subalpine zone.

(b) *Fruits* eaten raw or cooked include *Clausena dentata, Actinidia strigosa, Sarauia nepalensis, Kadsura heteroclita, Schisandra grandiflora, Holboellia latifolia, Decaisnea insignis, Rosa macrophylla, Evodia fraxinifolia, Hovenia dulcis, Rhus javanica, Syzygium kurzii, Pyrularia edulis, Vitis repanda* and *Podophyllum hexandrum* to name few.

(c) *Seeds* are eaten roasted or as source of edible oil. *Shorea robusta, Salmalia malabarica, Diploknema butyracea, Sterculia pallens, Abroma augusta, Bauhinia vahlii, Prinsepia utilis, Corylus ferox* are common forest species whereas *Hodgsonia* offers as a potential crop as source of edible oil. Kernels of *Juglans regia, Calamus flagellus, Dendrocalamus hamiltonii, Aglaia edulis,* aril of *Baccaurea sapida* and *Taxus baccata* and pulp of *Benthamidia capitata, Poupartia axillaris* are relished by natives.

(d) *Beverages* are obtained from *Coffea benghalensis, Camellia kissi, Eurya acuminata* and *Rhododendron arboreum* whereas sweet sap is obtained from *Acer papilio. Arundinaria* or *Bambusa* are also exploited in making wine whereas cultivated millet (*Eleusine corocana*) is the source of traditional drink 'Murwa'

(e) *Spices & condiments : Allium caesium* and *Thoropogon palliaus,* are native onions abundant at high altitudes. *Cinnamomum impressionervium, Myristica longifolia* and *Piper nepalense* are common spices of temperate zone. The endemic palm *Wallichia disticha* is endangered by Lepchas using the pith as source of Sago.

Wild relatives of cultivated plants :

Genetic resources of Sikkim encompass primitive tribes, game animals, folklore medicine and wild relatives of crop plants. They include food plants, native legumes, fodder species, fuel and timber trees etc. Germplasm collections can be broadly classified under (a) crop plants, (b) medicinal herbs, (c) economic trees and (d) ornamentals.

Wild relatives of crop plants include oats, sugarcane, banana, pulses, yams, figs, mustard, nutmeg, pepper, cinnamon, cardamom, turmeric, onion, tea and coffee. Fruit trees include avocado, apple, mango, mulberry, olive, strawberry etc. Medicinal plants like *Rauvolfia serpentina, Ephedra gerardiana* var. *sikkimensis, Dichroa febrifuga, Aconitum ferox, Heracleum nepalense, Picrorrhiza scophularifolia, Panex pseudoginses* and *Nardostachys jatamansi* are well known. The native trees *Schima wallichii, Michelia doltsopa, Machilus edulis, Toona ciliata, Castonopsis hystrix, Gmelina arborea, Bischofia javanica* and *Tetramales nudiflora* are employed in furniture or box wood industry. Most of the plants of temperate zone are of ornamental value. Rhododendrons, Primroses, and Orchids of Sikkim were introduced to horticulture but many need further study.

CONCLUSION

Emphasizing the need for studies on genetic plant resources Mehra & Arora (1982) observed that proposed biosphere reserves need not necessarily include endemic or threatened taxa. As many wild relatives of crop plants do not possess striking flowers or morphological features but constitute most important resources, the botanical exploration and evaluation of floristic wealth is a priority. Zeven & Zhukorsky (1975) considered Indian subcontinent as their Hindusthan Centre of diversity of cultivated plants. Important crops of this region are bamboos, fruit trees, cucurbits, pulses and rice. A cursory examination of the plants enumerated below indicates that all categories are represented in Sikkim. Further it is also clear that besides tropical and temperate crops there are alpine species growing at highest altitudes in the World. It is obvious that distribution pattern of wild relatives will enable experimented cultivation of crops. The native uses of edible plants will also lead to collection of germplasm, selection and multiplication. New hybrids and new crops can be developed from the flora of Sikkim Himalaya.

ENUMERATION OF POTENTIAL GENETIC RESOURCES FOOD/FORAGE ETC.

Amomum aromaticum Roxb.
A. dealbatum Roxb.
Allium sikkimensis Baker
A. wallichii Kunth
Asparagus filianus Buch.-Ham.
Actinidia callosa Lindl.
Acer pectinatum Wall.
Atylosia mollis Baker
A. volubilis Gamble
Arisaema utile Hook. f.
Avena fatua L. var. *glabrata* Peterm.
Arundinaria hookeri Lour.
A. suberecta Munro
Bambusa nutans Wall.
Bauhinia scandens L.
Capparis olacifolia Hook. f. & Thoms.
Camellia kissi Wall.
Coffea benghalensis Heyne
Cinnamomum inpressinervium Meissn.
C. parthenoxylon (Jaks) Meissn.
C. glaucescens (Nees) Hand.-Mazz.
Calamus acanthospathus Griff.
C. latifolius Roxb.
Colocasia fallax Schott.
Cymbopogon microtheca (Hook.) A. Camus
Cardamine griffithii Hook. f. & Thoms.
Cucumis sativas var. *sikkimense* Hook. f.
Dendrocalamus hamiltonii Nees
Dioscorea deltoidea Wall.
D. prazeri Prain & Burkill.
Decaisnea insignis (Griff.) Hook.

Dicentra scandens (D. Don) Walp.
Dolichos tenuicaulis (Baker) Craib.
Ensete glaucum (Roxb.) Cheesm.
Erianthus sikkimensis Hook. f.
Eugenia ramosissima (Bl.) Wall.
Eriobotrya dubia (Lindl.) Decaisne
Fragaria daltoniana J. Gay.
F. nubigiosa Lacaita
F. nubicola Lindl.
Fritillaria cirrhosa D. Don
Fagopyrum dibotrys D. Don
Gnetum montanum Markgr.
Holboellia latifolia Wall.
Horsfieldia kingii (Hook.) Warb.
Knema tenuinervia (DC.) Wilde
Kadsura heteroclita (Roxb.) Craib.
Lactuca gracilliflora DC.
Mangifera sylvatica Roxb.
Mulus sikkimensis (Wenz) Koehne
Morus serrata Roxb.
Musa balbisiana Colla.
M. hookeri King ex A.M. & J. M. Cowan.
M. thomsonii King ex A.M. & J. M. Cowan.
Neocinnamomum caudatum (Nees) Merr.
Piper peepuloides K. & P.
P. wallichii Hard-Mazi
Persea clarkeana (King ex Hook. f.) Kost
P. duthei King
P. gammieana King ex Hook. f.
P. bombycina (King) Kosler
Procius crenate C. B. Robs
Olea dioica Roxb.
Oryza minuta J. S. Presl.
Podophyllum sikkimense R. Chatterjee & Mukerjee
Passiflora nepalensis Wall.
Phytolacca acinosa Roxb
Pueraria phaseoloides (Roxb.) Bth.
P. wallichii DC.
Pennisetum flaccidum Griseb.
Phoenix humilis Royle
P. rupicola T. Anders.
Prunus rufa Hook. f.
Polygala arillata Buch.-Ham.
Ribes luridum Hook. f.
R. glaciale Wall.
Rheum acuminatum Hook. f.
R. nobile Hook. f.
R. spiciforme Royle
Sorbus wallichii (Hook.) Yu
Syzygium venosum (Lam.) J. Gueho & A. J. Scott.
Saccharum procerum Roxb.
Tupistra nutans Wall.
Theropogon pallidus (Kth.) Maxim.
Spondias pinnata (L.f.) Kurz.
Theropogon pallidus (Kth.)
Wallichia densiflora Mart.
Zingiber capitatum Roxb.

MEDICINAL

Aconitum luridum Hook. f. & Thoms.
Acorus calamus L.
Astilbe rivularis Ham.
Artemisia campbelli Hook. f. & Thoms.
Berberis concinna Hook. f.
Curcuma angustifolia Roxb.
Costus speciosus Sm.
Ephedra gerardiana L. var. *sikkimense*
Dioscaea prazeri Prain
Diplomeris hirsuta (Lindl.) Lindl.
Mucuna macrocarpa Wall.
Dichroa febrifuga Lour.
Hymenodictyar flaccidum Wall.
Uncaria scandens (Sm.) Hutch.
Nardostachys grandiflora DC.
Veleriana jatamansii Jones
Swertia hookeri Clarke
Stephonia elegans Hook. f.
Picrorrhiza scrophularifolia Pennell
Plantago erosa Wall.
Gentiana robusta King.
Heracleum nepalense Wall.
Zanthoxylum acanthopodium DC.
Panax pseudoginseng Wall.
Psychotria erratica Hook. f.

ORNAMENTALS

Iris clarkei Baker
Cardiocrenum giganteum (Wall.) Makino
Lilium wallichianum J. A. & J. H. Schott
Notholirion macrophyllum (D. Don) Boiss.
Thalictrum chelidonii DC.

Clemais montana Buch.-Ham.
Curcuma aromatica Roxb.
Meconopsis paniculata (D. Don) Prain
M. villosa Taylor
Magnolia campbellii Hook f.
Erythrina suberosa Roxb.
Geranium polyanthes (Edgw.) Hook. f.
Rosa macrophylla Lindl.
Argyreia hookeri (Bel.)
A. sikkimensis Hook. f. & Thoms.
Phlogacanthus thyrsofloris
Jasminum humile Linn.
Impatiens sulcata Wall.
Primula sikkimensis Hook. f.
P. calderana Bolf. f. & Cooper
Hedychium aurantiacum Rose
Roscoea purpurea Sm.
Morina longifolia Wall.
Rhododendron hodgsonii Hook. f.
Paphiopedilum tibeticum King
Hydrangea vestita Wall.
Mussaenda roxburghii Hook. f.
Cycas pectinata Griff.
Wallichia densiflora Mart.

ECONOMIC TREES

Acrocarpus fraxinifolius Arn. ex Wight
Abies densa Griff.
Alnus nepalensis D. Don
Albizia julibrissin Durazz.
Bischoefia javanica Blume
Betula alnoides Buch.-Ham.
Brassaiopsis hispida Seem.
Castanopsis tribuloides (Sm.) A. DC.
Duabanga grandiflora (Roxb. ex DC.) Walp.
Daphne bholua Buch.-Ham. ex D. Don
Erythrina arborescens Roxb.
Edgeworthia gardneri (Wall.) Meissn.
Gynocordia odorata R. Br.
Englehardtia spicata Leschen.
Larix griffithiana Carriere
Michelia velutina DC.
Populus ciliata Wall.
Rhododendron arboreum Sm.
Schima wallichii (DC.) Korth.
Saraуja nepaulensis DC.
Terminalia myriocarpa Heurck. & Muel.-Arg.
Tsuga dumosa (D. Don) Eichler
Quercus spicata Sm.

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