

Indigenous palms of India

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Palms stand next to grasses in the socio-economy of the human race, apart from their significant contribution to beautify the urban landscapes as horticultural ornamentals. This group in India is represented by 20 genera and about 96 species among which 24 species belonging to nine genera are endemic to India. Most of our forest palms are experiencing severe threat to their existence, mainly due to anthropogenic factors. Measures for their conservation, worthy of mention, are almost nil. The present article is a review of Indian palms with reference to their diversity, distribution, ecology, status and relevance in native economy along with a brief account of some endemic/endangered taxa. A note on the strategies for their conservation and possible commercial exploitation has been appended.

WE, the urbanites, are well acquainted with coconut (*Cocos nucifera*), arecanut (*Areca catechu*), date (*Phoenix dactylifera*) and oil palms (*Elaeis guineensis*), extensively cultivated for commercial exploitation of their fruits and seeds along with royal (*Oreodoxa* sp.) and table palms (*Livistona chinensis*) and a host of ornamental palms enriching the beauty of our parks, gardens and avenues. Our rural population is equally conversant with Tad (*Borassus flabellifer*), Bhirly-mad (*Caryota urens*) and Shindhi (*Phoenix sylvestris*) palms, which grow naturally in major parts of our country with a variety of uses, including extraction of sugary sap that exudes from their injured stem or flowering axis yielding jaggery or a favourite alcoholic beverage on fermentation. In parts of Gujarat, Rajasthan and Tamil Nadu, jaggery production from saps of Tad and Shindhi still continues to be a vanishing cottage industry.

The tropical group palms are monocots and have 200 described genera with about 2779 species¹. Their members are typically characterized by woody, unbranched, tall stem, a crown of palmately or pinnately divided large leaves, huge, branched, flowering axis protected by several large and often thick bracts, small unattractive unisexual flowers and fibrous drupaceous fruits. Majority of them inhabit tropical rainforests; some are coastal in distribution and others extend to arid regions. A few are mangrove components of salt marshes. They are a source of food, fodder, shelter and medicine to local inhabitants.

Geologically, the palms extend to the Cretaceous Period of Upper Mesozoic Era² when flowering plants were believed to have originated on the earth's surface. Botanically, the palm family is called Arecaceae after the generic name *Areca* of Linnaeus³, a latinized version of

'Adike' or 'Adika' by which name the famous masticatory nuts of areca palm are known in South Indian languages.

Palm explorers of India

Much of our knowledge about Indian palms is due to pioneering contributions of Griffith⁴, Beccari⁵, Blatter⁶, Mahabale² and Basu⁷. As a team leader of projects on phytosociology, ecology and reproductive biology of Indian palms, the senior contributor had an opportunity to study the state-of-the-art of our forest palms for a period of nine years, from 1989 to 1997, with special reference to those that are endemic or endangered in our flora^{8,9}.

Diversity of Indian palms

The family is represented by 20 genera and 96 species distributed in five out of six sub-families of Uhl and Dransfield¹. The largest genus, *Calamus* with 44 species is followed by *Phoenix* seven, *Pinanga* five and the rest with less than five species each. The genera *Borassus*, *Salaca*, *Livistona*, *Nypa*, *Hyphaene* and *Ptychoraphis* are represented by a single species each. In addition, *C. nucifera* and *A. catechu* are extensively cultivated as plantation crops. They have almost naturalized in parts of Kerala and Andaman-Nicobar islands.

Except *P. sylvestris*, *C. urens* and *B. flabellifer* which are widespread in peninsular India, the rest are of restricted distribution in specialized eco-geographical regions of the country. The forests of Andaman-Nicobar islands (13 genera, 24 species), northeastern and eastern Himalayan region (12 genera, 36 species) and the Western Ghats (7 genera, 30 species) are major centres of palm concentration. *Nypa fruticans* and *Phoenix paludosa* are fringe mangrove species occurring in salt marshes of Sundar-

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bans and Andaman–Nicobar islands. *P. paludosa* is also found in Orissa. *Hyphaene dichotoma* is restricted to the sandy coastal belt from Goa to Saurashtra shores.

Majority of the forest palms grow under the shade of dominating forests trees along fragile hill slopes and stream courses in warm humid conditions. A few like *B. flabellifer*, *P. sylvestris*, *P. robusta*, *Trachycarpus martianus*, *Bentinckia condapanna* and *Caryota obtusa* grow fully exposed to sunlight. Others like *Phoenix humilis* and *P. acaulis* often extend to degraded forest margins in grasslands. Most of them are found below 1250 m altitude. Certain species of *Calamus* (1400–1800 m), *B. condapanna* of the southernmost tip of the Western Ghats (1300–1750 m) and *Trachycarpus takil* of Kumaon Himalaya (1800–2400 m) are distributed at higher altitudinal ranges. *T. takil* is the only Indian species growing in temperate conditions.

Tall or dwarf woody trunk is a typical feature of majority of palms. However, stems of rattan palms are comparatively weak. Some like *Daemonorops jenkinsiana* and four species of *Plectocomia* of the northeastern region take up the climbing habit, while those of *Calamus* are scramblers clasping adjacent trees through spines of leaf axis and leaflets. *Salaca secunda*, *Wallichia densiflora* and *P. acaulis* have small tuberous stems. *P. humilis* of the northeastern region and the Western Ghats has populations having tuberous stems and there are also those with 1.2 m tall stems.

Branching of aerial trunk is rare and is mainly induced by injury to the terminal growing bud. This has been reported in date palm, areca nut, coconut and palmyra palm^{2,10,11}. Regular branched habit is found only in the genus *Hyphaene*, among which *H. dichotoma* is indigenous.

Regular annual flowering and fruiting is a rule. However, *Corypha*, of which three species occur in our country, flowers and fruits only once in its lifespan after attaining a full vegetative growth of about 40 years and dies away leaving enormous seed population to continue the progeny. Such palms are called hepazanthic or monocarpic. In fishtail palms (*Caryota* sp.), after vegetative growth, the uppermost bud of the trunk turns out into a huge drooping flowering axis followed by buds on the successive basal older nodes of the trunk¹. This is called basipetal flowering. Of the three species of the genus found in India, *C. urens* is widespread; *C. obtusa* is restricted to the northeastern region and tufted stemmed *C. mitis* to the Andaman–Nicobar islands.

Though reproduction by seeds is universal, some palms have also resorted to vegetative multiplication. Many species of *Phoenix*, *Arenga* and *Wallichia* produce vegetative offshoots called bulbils from basal portions of their stems which, on rooting, develop new saplings. The estuarine palm, *N. fruticans* has creeping underground stem (rhizome) that produces aerial shoots at close intervals, forming dense strands which effectively conserve the

silty soil of the salt marshes. Species of *Pinanga* have a network of extensively traversing underground stems (suckers) that produce aerial stems at intervals, resulting in islands of plants in fragile forest slopes thus ensuring control over soil erosion. Of these, *Pinanga dicksonii* with woody stem is found in warm humid forests of the Western ghats from North Canara to Kerala; *P. kuhlii* and *P. manii* in the Andaman–Nicobar islands and *P. gracilis*, *P. hookeriana* and *P. griffithii* in the Northeast. These have almost herbaceous aerial stems.

Role of Indian palms in native economy

Stems of rattans, *P. dicksonii* and leaves of a variety of palms are extensively utilized as construction materials of hutments by forest dwellers. Leaf shingles and mats are typical of tribal homes. Leaf axis, leaf sheath fibres and stem fibres are used as cordage and for preparation of brooms, baskets, brushes, hats, etc. Fishtail palm fibres were once famous as ‘Kitul’ fibres. Foliage of *W. densiflora* and several other palms of the northeastern region are commonly employed as staple fodder for ponies. The central soft part of the stem of *Corypha umbraculifera*, *C. urens*, *C. obtusa*, *Phoenix rupicola*, *P. acaulis*, and *P. humilis* is a rich source of starch. Palms are felled to extract this central ‘pith’ which is dried, powdered, stored and used for preparation of bread by natives. Tribals of Khasia hills cultivate *P. acaulis* and *P. humilis* for this purpose (Figure 1). Stem apices of *C. urens*, *C. obtusa*, *Wallichia disticha* and *B. condapanna* are chewed raw or cooked as a delicacy by the natives. Such uses have endangered the populations of these palms in their native habitat. Also, shoot apices of *B. condapanna* are a favourite of the elephants, forcing the palm to take refuge on inaccessible mountain cliffs. *B. flabellifer*, *C. urens*, *Arenga saccharifera*, *A. wightii* (Dudsal) and *N. fruticans* exude a sugary sap from their cut flowering axis that yields country liquor on fermentation. These palms are extensively tapped for this purpose in the forest areas. Tender seeds of tad palm, rattans and nipa are delicacies. Tad golis find a regular place along the road-side markets of Mumbai. The mature nuts of *Areca triandra*, *A. nagen-sis* and *Pinanga* species are employed as substitutes for betel nuts, specially in the northeastern region where they are called ‘Tambols’ or ‘Ram tambols’. The hard kernels of *Corypha umbraculifera* are called vegetable ivories. A variety of miniature articles are carved from them.

Status of Indian palms

Past history

Deccan intertrappean exposures assigned to Upper Cretaceous or Lower Tertiary (Palaeocene, Eocene) periods, found in abundance in Nagpur and Wardha districts of

Maharashtra and Chindwada district of Madhya Pradesh are rich in palm remains consisting of their fossilized stems, roots, leaves, flowering axes and fruits. They also occur in Mio-Pliocene exposures of our country, though affinities of these with extant palms are still awaited. In lignite deposits of Sindhudurg Formation of Ratnagiri and Sindhudurg districts of Maharashtra assigned to Miocene (approx. 20 million years back), characteristic echinate fruits and pollen grains of *Eugeissona triste* (a Malayan palm) are found, though this species is found to be entirely lacking from the present flora of the country^{12,13}. Similarly, pollen grains and cuticles of estuarine *N. fruticans*^{14,15} dominate these exposures, though presently this palm is found in the Andaman–Nicobar islands and Sunderbans. These and other evidences afford sufficient indicators to conclude that the palms were more numerous and widespread in the past than what they are at present.

Present status

Most of our forest palms, except *Calamus*, exhibit highly restricted distribution to ecological niches within biogeographic regions where they exist. About 24 species belonging to nine genera are endemic, including 14 species of *Calamus*. Besides, the genera *Livistona*, *Hyphaene*, *Borassus*, *Nypa*, *Salaca* and *Ptychoraphis* are represented by a single species each in our flora. The past history of the family of palms in India indicates that most of our present palm species, with the possible exception of *Calamus*, represent relic elements of the past flora on their way to extinction. Save Andaman–Nicobar islands, the rest of the bio-geographical regions of distribution of the palms are subjected to extensive habitat loss due to anthropogenic factors like continued deforestation, change in land use, unscrupulous extraction of wild source, etc. that poses serious threat to our natural palm populations.



Figure 1. *Phoenix acualis* Roxb. at Barapani near Shillong amongst degraded grassland. Note pine trees in the background.

Important endemic and endangered palms of India

T. takil Becc. (Figure 2), locally called 'Jamar', is an endemic fan palm found at 2300–2400 m altitude in Kumaon Himalayas as undergrowth in Banj Oak (*Quercus dialata*) forest, where the soil is covered with snow from November to March. It is the only frost-tolerant palm of our country. Abundant plants of this palm were noticed in Mount Takil, Kumaon by Duthie in 1886. Beccari later named it as *T. takil* and introduced it in Europe in 1887 from the seed collection received from plants of Choubattia Botanical Garden near Ranikhet, Almora district, where the plants of this palm were raised through seed collection from wild population found in Badkot forests, Almora district⁶. The palm is distinguished by a network of leaf sheath fibres that practically cover the trunk up to its base and by a whorl of old, persistent, reflexed leaves below the crown of fresh ones. Presently, the Takil mountain, a type locality of this palm, is untraceable¹⁶. Most of the Badkot forest population has succumbed to forest fire leaving a few palms in Bunj Oak forest. The palm, however, has thrived well and has almost naturalized in Choubattia Botanical Garden, Ranikhet. Seedlings raised in Mumbai have survived well.

T. martianus H. Wendl (peacock feather palm), an elegant fan palm (Figure 3) called Deing-Kleu or U Kleu in the Khasi hills, grows at lower altitudes of 1600 m throughout NE Himalayas extending to Nepal and Myanmar in forest margins along hillocks, fully exposed to sunlight. The Khasi tribes raise seedlings of this ornamental palm



Figure 2. *Trachycarpus takil* Becc. undergrowth in the forest of *Quercus dialata* at Badkot, Almora district.

to sell them in Shillong market. The plants of this palm have survived well in the palm garden of Kalina campus, Mumbai University.

C. umbraculifera L., the famous 'tale palm' or 'tad-patri' on the compressed dried leaves of which are found our ancient scriptures, grows in the hills and valleys of the Western Ghats forests from Uttara Kannada district of Karnataka to Kerala and extending further to Sri Lanka. Monocarpic habit, extensive use of their foliage and pith of stems have endangered these palms in their natural habitat. They are often found planted in botanical gardens. Seeds germinate readily and seedling survival is excellent under Mumbai conditions. Two more species of *Corypha*, *C. elata* and *C. talliera* are found in Bengal. *Livistona jenkinsiana* Griff., a sister of our common garden table palm (*L. chinensis*), is the only wild species of this genus in India. It occurs in forests of Assam and Arunachal Pradesh. Natives often cultivate these palms in their backyards as their leaves are extensively used for preparation of hats and as roofs for their boats¹⁷.

Hypaene dichotoma Furtado, locally called as 'Doum palm' or 'Ravan Tad', is distributed in the sand dunes of the west coast from Goa to Saurashtra. The palm is seen mostly in habitations of former Portuguese colonies. Plantations of this palm along the Diu coast have been taken up by the Forest Department to create an effective coastal shelter-belt. It is said that the palm was introduced in India by Portuguese sailors from Africa, as they employed the oil-rich seeds of this palm to light up their ships during night time. However, fossil petioles resem-

bling closely with those of this palm and fruits assignable to species of genus *Hyphaene* have been described from Deccan intertrappean exposures of our country¹⁸. The fruits remain buried in the sand and germinate readily at the onset of monsoon.

Two species of *Phoenix*, viz. *P. rupicola*; T. Anders and *P. robusta* Hook are endemic to our country. The former is an extremely graceful ornamental palm restricted to forests of Sikkim Himalayas. The latter called 'Schelu' in



Figure 4. *Wallichia disticha* T. Anders, a progeny of Dawki forests, Meghalaya growing in the Palm Garden, Kalina campus, Mumbai University for the last seven years.



Figure 3. *Trachycarpus martianus* Wendi. Khasia hills, Meghalaya.



Figure 5. *Bentinckia condapanna* Berry, along the mountain slopes of Upper Kodhyar, Kanyakumari district.

Marathi, occurs as restricted populations along hillocks of the Deccan Plateau (Pune district) and in Parashnath Hills, Bihar. It is distinguished from common Shindhi plants (*P. sylvestris*) by broader trunks with spirally arranged leaf bases. The fruits are edible and a favourite of wild pigs. *P. rupicola* is rarely found planted in Indian gardens.

The mature seeds of all Indian *Phoenix* species germinate readily and seedling survival is extremely satisfactory under Mumbai conditions. *W. disticha* T. Anders, (Kotang of Lepchas, Sikkim) found along hill slopes in the shades of forest trees in Uttaranchal, Sikkim, Meghalaya and Assam, extending to Myanmar, is the only palm with distichous feathery leaves forming a two-sided crown. Extensive use of shoot tips of this palm as 'cabbage' by natives is threatening the existence of this palm in its native habitat. The palm reproduces both by seeds and suckers. Seedlings and saplings have survived well in Kalina campus, Mumbai University (Figure 4).

Caryota obtusa Griff., a close relative of *C. urens* and called 'Suwar' by Khasi tribes, is restricted to Meghalaya and Assam along forest margins in full sunlit conditions. Its dried stem pith is a source of bread for locals. Seed germination and seedling survival is satisfactory under Mumbai conditions. Indiscriminate felling of trees for extraction of pith has threatened the existence of this palm in its native habitat.

Areca triandra Roxb. and *A. nagensis* Griff. are two wild relatives of areca nut; the former is found in the Andaman-Nicobar islands and the latter in Assam. *A. nagensis*, an endemic species rarely found in forest shades along streams in Naga and Mikir hills of Assam, is of high ornamental value and worthy of domestication. *A. triandra* on the contrary, is a well-represented species specially in the forests of Nicobar islands. This species is often found in areca nut plantations in Meghalaya.

Genus *Bentinckia* of feather palms named after Lord Bentinck, the former Governor General of British India, is endemic to our country with two species. *B. condapanna* Berry (Komuga, Coddapanna, Tamil), (Varukamavi, Kerala) is restricted to the southernmost Western Ghats mountain cliffs (Figure 5) at inaccessible heights of 1300–1800 m in the evergreen forests of Tamil Nadu and Kerala. The palm is highly ornamental with brilliantly coloured flowering axis and fruits. Though it reproduces vigorously by seeds, hardly any palms are found in accessible forests as these are felled for terminal tender shoots which are eaten by natives as well as wild elephants. Habitat destruction for tea plantation is also responsible for its localized distribution on mountain cliffs. Hints towards cultivation of this palm have been provided by Rao and Banerjee¹⁹. However, the palm is still to be domesticated. Its relative, *B. nicobarica* Becc., grows at lower elevations in moist forests of Katchal islands, Nicobar along with other palms like *A. catechu*, *A. triandra*, *Pinnanga manii* and *Ptychoraphis augusta*.

Conservation and commercial exploitation of Indian palms

Most of our palms are potential horticultural ornamentals. Though *C. urens* and a few other Indian palms like *Licuala peltata*, *L. spinosa*, *C. umbraculifera*, *C. elata* and *Caryota mitis* do find place in some Indian gardens, no systematic attempts have been made to popularize the species. Majority of them can thrive well outside their natural habitat and could serve to beautify the environment. This is one way of *ex situ* conservation of our germplasm along with some economic benefit. Setting up of a few germplasm centres for Indian palms in suitable bio-geographic regions would ensure regular supply of their seedlings and saplings along with necessary know-how for their up-keep. The Government of India has recently established two such centers: one at the Regional Plant Resource Centre, Bhubaneswar and the other at TBGRI, Thiruvananthapuram. A better approach would be to establish de-centralized nurseries in their native habitats and motivate forest dwellers to raise seedling stocks of wild palms found in their environment. These could then be purchased from them by palm lovers for *ex situ* introduction. Such ventures would provide economic benefits to forest dwellers and thereby help in the *in situ* conservation of these species.

Among the 44 species of scrambling rattans (*Calamus* sp.), 14 are endemic and only seven are at present commercially exploited, providing employment opportunity to over 3 lakh people²⁰. Commercial exploitation and conservation measures for the vast majority are still awaited. Though FRI Peechi, and Dehradun are contributing some information, establishment of a separate National Institute for Rattans is warranted. There is ample scope to involve natives in the process of conservation and sustainable utilization of rattan resources through organization of Joint Forest Management Committees in rattan-rich forest areas.

Amongst wild palms that exude sugary sap from injured stem tops or flowering axis bases, the estuarine palm *N. fruticans* merits special attention. Successful attempts have been made to establish this palm in nonsaline wetlands of Kerala and Chennai²¹. Information on its commercial plantation through seeds and suckers in saline marshes, and standardization of its tapping and sugar and alcohol production technology have been generated in Malaysia and Philippines²². Sugar and alcohol-producing factories based on this palm are successfully operating in Sarawak. One should therefore justifiably think of raising commercial plantations of this endangered palm in saline marshes practically all along our coast for commercial exploitation of sugar and alco-fuel. This would be of relevance as the Government of India is actively promoting alcohol production in sugarcane factories to be utilized as environmentally safe bio-fuel. Such strands of *Nypa* would also protect precious marshland soil from erosion and serve to be effective coastal shelter belts.

Such ventures would also provide enhanced employment opportunities to the coastal inhabitants. Similarly, dense plantations of *H. dichotoma* could be raised along the sandy shores of the west coast as a shelter belt component. It would add to the aesthetic value of our coasts. Its oil-rich seeds could be an additional source of bio-diesel.

Any sustainable efforts towards conservation and commercialization of native palm resources would have to involve primary stakeholders (natives) as partners to ensure *in situ* conservation of these resources in their native habitat. NGOs like National Society of Friends of Trees, Mumbai can play a crucial role in awareness raising and in popularizing *ex situ* conservation of Indian palm germplasm. Industrial houses like Reliance and Godrej are already playing an active role in conservation of mangroves and other biodiversity elements. They can be called upon to take up the cause of Indian palms also.

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