

Orchid Diversity of India

Its Conservation and Sustainable Utilization



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Cover page

Front: *Paphiopedilum hirsutissimum*, *Dendrobium nobile*,
Vanda coerulea

Back : *Cymbidium lowianum*

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Orchid Diversity of India

Its Conservation and Sustainable Utilization

Orchids have gripped human imagination since time immemorial because of their bizarre of shapes, sizes, colors, architecture of flowers. Orchids have become an object of central attraction among common man, horticulturist, herbalist, naturalist, and scientists as they possesses long vase life of flowers, inherent therapeutic value to cure many simple and complex diseases, complex life cycle and mode of living, reservoirs of phyto-chemical, etc. Orchidaceae, the family of orchids comprises of 25,000 to 35,000 species in 800 genera constituting second largest family of flowering plants in the world. India accounts for nearly 7 per cent of world's orchid genetic diversity contributed 1300 species in 184 genera and many more are discovered year after year. The distribution pattern reveals five major phyto-geographical regions viz., North Eastern Himalayas, Peninsular region, Western Himalayas, Western Ghats and Andaman and Nicobar group of Islands. The share of each State of India in orchid diversity is presented in Table 1. Approximately 60 per cent of species of Indian origin are epiphytic, while the rest are terrestrial. However, certain genera like *Cymbidium* and *Liparis* have both epiphytic as well as terrestrial species. Amongst the terrestrial orchids, while all species in genera *Aphyllorchis*, *Corallorhiza*, *Cyrtosia*, *Didymoplexis*, *Epipogium*, *Erythroorchis*, *Evarandiathi*, *Galeola* are saprophyte, but few species like *Cymbidium micorhizon* and *Eulophia zollingeri* are also adapted to saprophytic mode of life. The twelve genera of Indian orchids are represented by more than 20 species whereas 18 genera are monotypic. The genus *Dendrobium* with 104 known species constitute largest genus of orchids in India. The endemicity in Indian orchids is very high and nearly 29 per cent of recorded taxa are endemic. The three genera *Jejosophia*, *Smithsonia* and *Xanicophyton* and 352 species are endemic to this country. In addition, a large number of species are near endemic which extended their distribution to adjacent countries only.

Table 1: State wise distribution of orchids in India

Name of the State	Orchids (Number)	
	Genus	Species
Andaman & Nicobar Group of Islands	59	117
Andhra Pradesh	33	67
Arunachal Pradesh	130	600
Assam	81	191
Bihar (including Jharkhand)	36	100
Chhatisgarh	27	68
Goa, Daman & Diu	18	29
Gujrat	10	25
Haryana	3	3
Himachal Pradesh	24	62
Jammu & Kashmir	27	51
Karnataka	52	177
Kerala	77	230
Madhya Pradesh(including Chhattisgarh)	34	89
Maharashtra	34	110
Manipur	66	251
Meghalaya	98	352
Mizoram	74	246
Nagaland	63	241
Orissa	48	129
Punjab	12	21
Rajasthan	6	10
Sikkim	115	496
Tamil Nadu	67	199
Tripura	33	48
Uttaranchal	72	237
Uttar Pradesh	19	30

Source: Singh, D.K. 2001. Orchid diversity in India. *In: Orchid science & commerce* (Ed. Pathak *et al.*)

Table 2. Present Status of orchids in India

Habitat	Species	Endemic	Extinct / Nearly extinct	Endangered
North Eastern India	675	76	18	34
Eastern Himalayas	730	88	18	105
Western Himalayas	255	10	-	44
Peninsular India	267	13	5	25
Eastern India	130	6	-	5
Andaman and Nicobar group of Islands	117	15	2	2
Central India & Gangetic Plains	60	-	-	-

Economic Importance

Orchids represent royalty and aristocracy in medicine and floriculture. The flowers of orchids are well known for their uniqueness in shape, size, color and scent, are exquisitely attractive, normally remain fresh for longer period of time in comparison to other flowers. These qualities have made orchid growing a highly profitable industry all-over the world and today more than 1.2 lakh hybrids are known and cultivated for cut-flowers and potted plants and more and more new ones are being registered every month. The most significant use of orchids is ornamental because of their increasingly beautiful flowers of variant colors and shapes with long shelf life. A large number of species bear attractive flowers and their capacity for interspecific as well as intergeneric breeding has generated tremendous possibilities producing hybrids of diverse floral characteristics. There are about 70 species of Indian orchids that have been used in breeding programmes for producing several primary and other generation hybrids in and outside country. For example, *Dendrobium nobile*, an Indian orchid species has once extensively used in hybridizing over 77 hybrids registered in which it was parent. The wild native orchids are likely to play a unique role in the development of new cultivars/

hybrids and also restructuring of existing ones with one or other attributes. India constitutes invaluable reservoir of these genes that are needed for development of new varieties. Many Indian orchid species itself are suitable as potted plants if grown in perfection.

The Indian orchids have also been used in various indigenous systems of medicines since time immemorial. In the Ayurvedic system of medicine a group of eight drugs known as 'Ashtavergha' is used in the preparation of various rejuvenating formulations and the tonics such as 'Chyavanprash'. Among eight drugs of ashtawarga group Jeevak (*Malaxis mucifera*), Rishbhak (*Malaxis acumita*), Ridhi (*Habenaria intermedia*) and Vridhi (*Habenaria edgeworthii*) comes from orchids. The ethanobotanical studies carried out in the country showed that many orchids were used in medicine. The most important commercial product isolated from orchids is Vanillin from cured beans of *Vanilla planifolia*, which is used for flouring, chocolates, pudding and ice cream and also used as deodorants in soaps, perfumes and powders.

The therapeutic value of orchids is related to variety of phytochemical constituents including alkaloids, flavonoids, terpenes, carbohydrates and glycosides present in them but till recent past little attention was paid for isolation and identification of these compounds. Recently the utility of *Cymbidium* hybrids, *Epipactis hellebonie* and *Liparis ovata* in anti-AIDS medicine has been identified. Orchids have now come under ambitious chemical study for extraction of alkaloids, polyphenols, terpenoids, and steroids molecules of biological interest. The future application of such studies may eventually turn commercial to create new forms of drugs.

Depletion of orchid wealth

Although orchids belong to one of the largest families, they are also perhaps most seriously threatened plants on this globe. Their vulnerability stems from two sources: the first being their highly specialized lifecycle, dependency on pollinators for pollination, lack of reserved food material in the seeds, reliance on micorrhizal fungi

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for seed germination and second ornamental and therapeutic value which they possess has made them so sought after the man. Each species is adapted to live in a specialized environment because of their specialized requirements and many species are very restricted in distribution and endemism is very high. Any destruction or degradation of natural habitat beyond a tolerable limit causes threat for their survival. Owing to human pressure on land and developmental activities large tracts of forests in orchid rich belts were converted in to agricultural land, tea plantations, commercial forestry plantations and industrial complexes and trees festooned with orchids were mowed down for building roads, bridges and river valley projects.

The epiphytes are faced with maximum danger due to cutting of the host trees serving as substrate and also due to increasing aridity of climate as a result of deforestation. The indigenous forests are dwindling rapidly and many epiphytic species are in danger of losing their natural homes. Habitat destruction is widely viewed by the experts as the primary threat to rare orchid species worldwide. In India about 2 million people cultivate nearly 11 million hectares of land following shifting cultivation, majority of these people live in northeastern hill region. The use of steep land after cleaning natural vegetation and production of food crops not only affects the flora and fauna but also results into excessive soil erosion and ecological imbalance. The main loss of forest has been conversion of forestland into agricultural land, river valley projects, industries, roads, tourism, and communication. The mechanization of agriculture, the increase in yields from the use of enormous quantities of fertilizer and the development of productive forestry plantations, have made habitats more uniform and reduced their diversity.

With the advancement of human civilization and exploration of orchids world over for medicinal, ornamental and scientific purpose, the actual depletion of orchids began from there. During the British colonial period when commercial orchid growing was in its infancy, orchid from Indian forests were much exploited and exported to European destinations. The seizure of 636 plants of *Paphiopedilum*

druryi an endangered and endemic species from local nurseryman by State Forest Department of Kerala is an eye opener about the fate of other such species. It seems that the clandestine trade of native orchids from their natural habitat is unabatedly continuing.

Why to conserve orchids?

The biological wealth of a country is its valuable heritage, which is the product of millions of years of evolution. The Orchid flora, which is still largely unknown and has immense potential in the form of horticultural, medicinal value, they may have many more uses and economic potential not known today. But this biological wealth of the country is continuous on decline. All attempts to locate certain species like *Aphyllorchis gollaoii*, *Coelogyne truetleri*, *Anoetochilus rotandifolius*, *Paphiopedilum charlsworthii*, *Paphiopedilum wardii*, *Vanda wightiana*, *Pleione lagenaria*, *Zeuxine pulchra* since several decades have been in the vain and these species probably have vanished from Indian lands. It is estimated that nearly 250 species of native orchids are under the threats of various categories. The endemic species are exclusive biological capital of a nation ones lost or became extinct it is irrecoverable loss for that country as biodiversity is sovereign right of each country as per Convention of Biodiversity. Out of known 1300 species of Indian orchids, 352 are endemic to this country of which 40 are “endangered” and 72 are “vulnerable”. Some of them are enlisted in Table 2.

Table2: Various categories of threats to some endemic orchids of India

Name of Orchid Species	Distribution	Habit	Categories of threats
<i>Acampe congesta</i>	Aghasthymalai hills	Epiphyte	Endangered
<i>Achrochaene punctata</i>	Sikkim Himalayas	Epiphyte	Endangered
<i>Anoetochilus clarkei</i>	Sikkim Himalayas	Terrestrial	Endangered
<i>Anoetochilus pantlingii</i>	Manipur	Terrestrial	Endangered

Name of Orchid Species	Distribution	Habit	Categories of threats
<i>Anoectochilus tetrapterus</i>	Himalayan region	Terrestrial	Endangered
<i>Bulbophyllum arueum</i>	Silent Valley	Epiphyte	Endangered
<i>Bulbophyllum fuscopurpureum</i>	Nilgiris	Epiphyte	Endangered
<i>Bulbophyllum mysorensis</i>	Southern deccan	Epiphyte	Endangered
<i>Bulbophyllum nodosum</i>	South Western Ghats/ Nilgiris	Epiphyte	Endangered
<i>Bulbophyllum piluliferum</i>	Sikkim Himalayas	Epiphyte	Endangered
<i>Bulbophyllum protractum</i>	Andaman Islands	Epiphyte	Rare
<i>Bulbophyllum thomsonii</i>	Sikkim Himalayas	Epiphyte	Critical
<i>Coelogyne glandulosa</i> var. <i>Satyanarayanae</i>	Nilgiris	Epiphyte	Vulnerable
<i>Cymbidium gammieanum</i>	Sikkim Himalayas	Epiphyte	Endangered
<i>Dendrobium tenuicaule</i>	Andaman Islands	Epiphyte	Endangered
<i>Eulophia cullenii</i>	Aghasthymalai hills	Terrestrial	Endangered
<i>Goodyera secundiflora</i>	Himalayan region	Terrestrial	Endangered
<i>Habenaria andamanica</i>	South Andaman	Terrestrial	Rare
<i>Habenaria caranjensis</i>	Konkan	Terrestrial	Critical
<i>Habenaria cumminsiana</i>	Sikkim Himalayas	Terrestrial	Endangered
<i>Habenaria flabelliformis</i>	Anamadi slopes	Terrestrial	Endangered
<i>Habenaria richardiana</i>	Annamalai/ Palani Hills	Terrestrial	Vulnerable
<i>Hetaeria ovalifolia</i>	Peninsula	Terrestrial	Extremely rare
<i>Malaxis andamanica</i>	Andaman Islands	Terrestrial	Endangered
<i>Malaxis crenulata</i>	Nilgiris	Terrestrial	Endangered
<i>Malleola andamanica</i>	Andaman Islands	Epiphyte	Rare
<i>Phalaenopsis speciosa</i>	Andaman Islands	Epiphyte	Rare
<i>Paphiopedilum druryi</i>	Travancore Hills	Terrestrial	Endangered
<i>Phaius lurius</i>	Aghasthymalai Hills	Terrestrial	Vulnerable
<i>Taeniophyllum andamanicum</i>	Middle Andaman	Epiphyte	Rare
<i>Taeniophyllum scaberulum</i>	Travancore	Epiphyte	Vulnerable
<i>Vanilla wightiana</i>	Travancore; South West Ghats	Climbing epiphyte	Vulnerable
<i>Zeuxine andamanica</i>	South Andaman	Terrestrial	Rare

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Owing to inherent capacity of orchids for draught resistance, nutrient conservation, long shelf-life of flowers etc. it is believed that orchids can contribute many genes to other crops just as went on creation of "Golden Rice". Other than economic consideration we also have responsibility to protect them for the generations yet to land on this earth. The better minds of tomorrow may have much more diverse uses that are unknown to us. Although evolution is a natural process and the unfit species becomes extinct due to natural selection but this slow natural process of extinction is being continuously accelerated by the human beings by changing (degrading) the environment through population explosion, habitat destruction and environment pollution.

***In situ* conservation**

Orchids are highly evolved and still evolving very rapidly. The *in situ* conservation of species ensures their natural growth, proliferation and perpetuation without hindering the process of evolution as part of natural ecosystem. India has an elaborate Protective Area Network (PAN) comprising 86 National Parks, 480 Wildlife sanctuaries covering about 4.66 per cent of total geographical area of the country. There is further plan to expand this network to 160 national parks and 698 Wildlife sanctuaries to cover 5.69 per cent of total geographical area of the country. This network automatically provides the protection to the species lie in them. Unfortunately, many important and endangered orchids viz., *Paphiopedilum druryi* in Aghasthymalai hills of Kerala, *Vanda coerulea* in Meghalaya, *Paphiopedilum wardii* and *P. specerianum* in Assam, *Renanthera imscootiana* in Arunachal Pradesh and many more lie outside PAN. Few conscious State Governments like Arunachal Pradesh, Sikkim, Karnataka, and West Bengal has designated the orchid rich habitats as "Orchid Sanctuaries". These sanctuaries attract Wildlife Protection Act, 1972 as amended in 1992. Ministry of Environment & Forest; Govt. of India is implementing *in situ* conservation of wild flora through protection of habitats and ecosystem and also by formulating laws to discourage the unscrupulous trade of protected species.

The people living in the natural habitats are needed to be involved in the programme of conservation. Although the Joint Forest Management policies of the government involved them in natural resource management but lack of knowledge about these plants and their importance provides a loophole to which unscrupulous collectors utilize without hindrance. Educating the people about natural resource of orchids in their vicinity and its importance would discourage such unscrupulous collection. Further, the researches on population biology, conservation genetics and ecology of endangered/ rare orchids need to be accelerated for effective conservation

***Ex situ* conservation**

Ex situ conservation can be achieved by perpetuating sample populations in genetic resource centers, botanical gardens, tissue culture repositories, seed gene banks. As *ex situ* conservation measures Botanical Survey of India, the apex organization under the Ministry of Environment and Forest, Government of India has established 3 National Orchidaria at Shillong, Yercaud, and Howrah for conservation and multiplication. Similarly States like Arunachal Pradesh, Assam, Mizoram, Karnataka, Nagaland, West Bengal, Sikkim, Himachal Pradesh, and Orissa have also established orchidaria for *ex situ* conservation. The National Research Centre for Orchids, Sikkim, Tropical Botanical Garden and Research Institute, Trivandrum, Kerala and several other organizations are engaged in the conserving orchids. *Ex situ* conservation of orchid species at various orchidaria of the country is given in Table 3.

The distribution of orchids and mode of living throw light on the problems that would come along in the maintenance of live collections in orchidaria. For maintenance of live collections requires provenance field data to establish and maintain the plants in the most suitable way. These notes are also vital to scientists who study the orchids and need to know the origin of a particular plant. Many plants are often lost by poor cultural conditions, indifferent housing, changing and often inexperienced staff, and a shortage of funds for the care

Table 3. *Ex situ* conservation status of orchids at various orchidaria in India

Sl. No.	Name of Orchidaria	Orchids (Number)
1.	Tropical Botanical Garden & Research Institute, Trivandrum, Kerala	450 species and 80 Exotic hybrids
2.	State Forest Research Institute, Itanagar, Arunachal Pradesh	400 species and hybrids
3.	National Research Centre for Orchids, Pakyong, Sikkim	265 species and 60 hybrids
4.	National Orchidarium, Shillong, Meghalaya	330 species
5.	Regional Research Station, Uttar Bang Krishi Vishva Vidhyalaya, Pedong, W. B	165 species
6.	Khonghampat Orchidarium, Imphal, Manipur,	110 species
7.	National Orchidarium (BSI), Yercaud, Tamil Nadu	100 species
8.	Kerala Forest Research Institute, Peechi, Kerala	100 species
9.	Deptt. of Botany, Vivekananda College, Kolhapur, Maharashtra	90 species
10.	Loyed Botanical Garden, Darjeeling, W. Bengal	75 species
11.	Tamil Nadu Agricultural University, Yercud, Tamil Nadu	73 species
12.	State Orchidarium, Saramsa Garden, Sikkim	70 species
13.	Kerala Agricultural University, Vellanikara, Kerala	60 species and 22 hybrids
14.	Bidhan Chandra Krishi Vishva Vidhyalaya, Kalyani, W. B	35 species and 7 hybrids
15.	Regional Plant Resources Centre, Bhubneswar	19 species
16.	Indian Institute of Horticultural Research, Hessarghatta, Karnataka	13 species

and maintenance of plants. When orchidaria are constructed without keeping in mind the degree of manipulation is required in a particular climatic condition and the agro-climatic requirements of orchids to be conserved in them, these conservation structures may act as "death

chambers”. The other method for conservation of live collection is “Artificial Natural Habitat” in which the epiphytic orchids are placed on the suitable host tree and it cling the host during the season of active growth. It involves least expenditure on maintenance but its application is constrained by availability of suitable host and limits the conservation of species to which have either wider climatic range or specific to that locality.

Orchid trade regulations

Orchids are an endangered group of plants; hence trade is regulated under the Convention of International Trade for Endangered Species (CITES). India being a signatory to this convention, therefore orchid trade attracts the Wildlife Protection Act (1972) of Govt. of India amended in 1992. Accordingly, Orchids have been brought under Schedule VI of the act and the trade is regulated. All orchids grown in wild are not allowed for trade. The orchids meant for trade must be nursery grown and a declaration to that effect must be made by the individual nurseryman or grower and submit the list to the Regional Deputy Director, Wildlife Preservation, through the Chief Wildlife Warden of the State. Hereafter, the Regional Deputy Director and the Chief Wildlife Warden of the state will jointly inspect the nursery and the list of plants will be verified in the nursery. After full satisfaction, the Chief Wildlife Warden is authorized to issue legal procurement certificate for any orchid to be sold and exported. Under the law nurseryman is bound to submit a quarterly return of receipts and disposal of plants to the plant inspection office regularly. On the basis of joint inspection report his nursery will be registered for domestic or foreign trade.

The orchids listed in Appendix I of CITES include *Cattleya sinneri*, *Cattleya trianae*, *Didicicia cunninghamii*, *Laelia jongheana*, *Laelia lobata*, *Lycaste virginalis*, *Paphiopedilum*- all species, *Renanthera imschootiana* and *Vanda coerulea* and remaining species are included in Appendix II. In the recent CITES conference flaked seedlings of orchids listed in Appendix I have been excluded out of control. Hence flaked seedling of orchids can

now be exported without CITES certificate and inspection. The ratification of which is awaited from Govt. of India.

Orchid Research and Development

From eighteen and half century to nineteen and half century orchids in India were concern of European explorers and local collectors. During this period a large genetic wealth of orchids was documented and identified. This was further augmented by Botanical Survey of India which has been entrusted with documentation, inventorisation and conservation of plant genetic resource of the country. The orchid flora has been inventorised at the state level. With these results the State Governments have become more cautious in protecting the genetic wealth lies in their states. The orchid resource present in the different PANs also being inventorised. Many new species and new records have been added to orchid flora of the country and few species, which have been thought to vanish, have been rediscovered.

The early studies were confined to taxonomy, cytogenetics, testing the suitability of substrate for growing of orchids, nutritional requirements for different species, mycorrhizal association, identifying range of host trees etc. After the development of technique for asymbiotic germination, orchids got an impetus world over. Many Indian universities and research institutions started working on asymbiotic germination. Further, keeping pace with world research, scientists in India generated plants by using shoot, leaves, roots, and other parts of the plant. Today, we are known the techniques not only to propagate many our native species by means of asymbiotic germination and meristem culture but also exotic hybrids. The country also have developed the expertise on flowering orchids *in vitro* so that developed hybrids can be screened without wasting much resource, time, energy on rearing unfruitful progenies. Interestingly, *in vitro* flowered plants can also be sold as souvenirs, thus have direct commercial utilities. The encapsulated propagules known as artificial somatic seeds /beads have been produced, ensures economy of space and nutrient during storage, lab to land transfer and transport

of tissue culture raised genotypes. These can be stored and used whenever the necessity arises. This tool is fit for conserving the genetic resource and also a boon to commercial tissue culture laboratory, which can adjust the production cycle of planting material as per requirement of growers.

The depleting orchid wealth in their natural habitats and apprehension of bio-piracy are cause of a concern. The studies on conservation genetics, population biology, ecology, conservation techniques are need to be taken up for efficient management of orchids in their habitat. In this task priority have to be accorded to endangered, rare, threatened/ endemic species. A program on molecular characterization of endemic species needs to be taken up to prevent them from Biopiracy. One more conspicuous area of concern is ever expanding world orchid industry. India with large genetic resource and suitable agro climate for growing of both tropical and temperate orchids is lagging behind with many of its South East Asian neighbors. For sustainable commercialization the areas like orchid breeding, production technology, plant protection, post harvest technology, green house management requires immediate attention.

The breeding of orchids is challenging and rewarding area has rather been slow in spite of a large genetic wealth in hand. Some institutions and private orchid laboratories have engaged themselves in this direction and we have registered a few hybrids with international registration authority. Developing new hybrid requires considerable patience, deep understanding of the subject, and ability to predict possible trends in the market. A large number of hybrids of *Cymbidium*, *Vanda*, *Dendrobium*, *Oncidium*, etc. are already been produced in South East Asian countries and have lead over 50 years in experience. In those countries growers augmented themselves with the latest technologies of breeding and possess new and interesting lines with which they infuse their industry every 3-5 years. Owing to mating behavior of orchids and ever-changing preference of consumer makes them obsolete very quickly in the eyes of consumer. The sustainable commercialization of orchids depends on indigenous, time

bound, well-considered breeding programme. Besides this, specific technical know-how on cultural practices and post harvest management needs to be addressed keenly.

Orchid Commerce

Indian orchids are in demand both domestic and international markets as parents for developing new cultivars, re-structuring the existing ones, cut flower and potted plants (Table 4). Some of Indian orchids have already proved their worth as parents and many are unknown to the world because indigenous orchid breeding programme could not evolved successfully. Further induction of polyploidy in the existing stock and careful evaluation of present and developed stock would enhance their market as parents for developing new cultivars. In the recent past a few orchid laboratories and institution have started working on the breeding of orchids. As elsewhere in the world, entrepreneurs in India would also try their hand on orchid breeding and thus the demand for these plants would go up further. A number of orchids having therapeutic value but the knowledge of this are confined to either user or ethanobotanist. Once this knowledge spreads to the upcoming herbal industry the demand would further increase. Screening for phytochemical constituents in therapeutically known orchids may make them a part of pharmaceutical industry.

A large numbers of species having bizarre shape, exquisite colors, size and long lasting flowers for which some people even might have not thought in their dreams could be utilize for harnessing the market as potted plant. The incorporation of orchids in government and private gardens for landscaping may further boost their demand. Currently, whatever the demand exists, majority of it met by clandestine trade from the wild habitats. A strict compliance with law would deter the people from collecting orchids from the wild and also propel them to grow them in nurseries for trade. This can be exploited to provide employment to the people. The Fig. 1 illustrates sustainable utilization of orchid wealth.

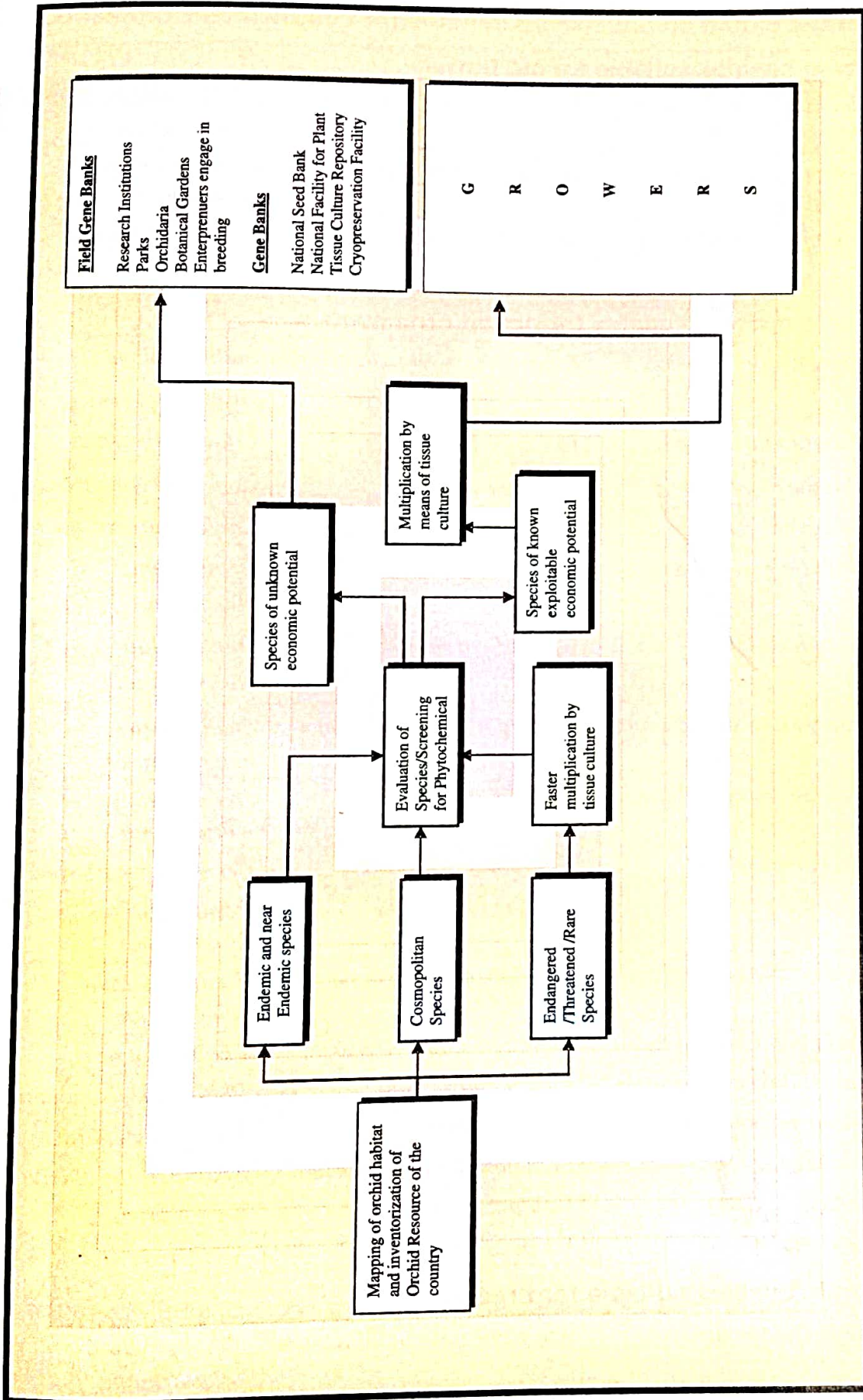


Fig-1. Conservation and Sustainable Utilization of Orchid Wealth

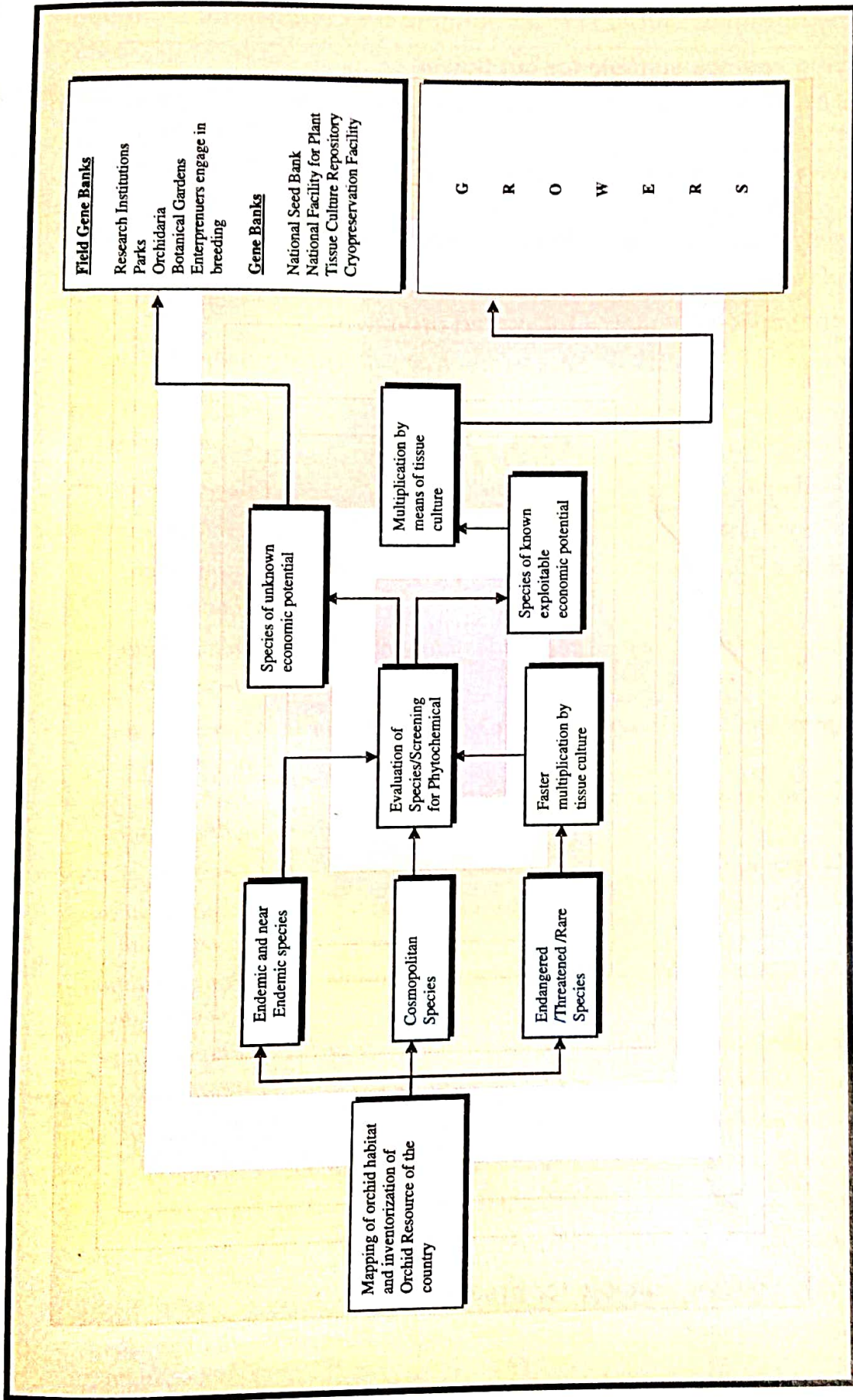


Fig-1. Conservation and Sustainable Utilization of Orchid Wealth

Table 4. Indian orchid species suitable for commercial exploitation

Orchid species suitable for cut flower		
<i>Cymbidium eburneum</i>	<i>Paphiopedilum fairrieianum</i>	<i>Paphiopedilum hirsutissimum</i>
<i>Paphiopedilum insigne</i>	<i>Paphiopedilum spicerianum</i>	<i>Paphiopedilum venustum</i>
<i>Paphiopedilum villosum</i> <i>Vanda tessellata</i>	<i>Renanthera imschootiana</i>	<i>Vanda coerulea</i>
Orchid species suitable for potted ornamentals		
<i>Anoectochilus brevilabris</i>	<i>Ascocentrum ampullaceum</i>	<i>Bulbophyllum putidum</i>
<i>Calanthe chloroleuca</i>	<i>Calanthe herbacea</i>	<i>Calanthe masuca</i>
<i>Calanthe plantaginea</i>	<i>Calanthe triplicata</i>	<i>Coelogyne corymbosa</i>
<i>Coelogyne cristata</i>	<i>Coelogyne nitida</i>	<i>Coelogyne ochracea</i>
<i>Cymbidium aloifolium</i>	<i>Cymbidium devonianum</i>	<i>Cymbidium eburneum</i>
<i>Cymbidium lancifolium</i>	<i>Cymbidium mastersii</i>	<i>Dendrobium chrysotoxum</i>
<i>Dendrobium densiflorum</i>	<i>Dendrobium fimbriatum</i>	<i>Dendrobium heterocarpum</i>
<i>Dendrobium moschatum</i>	<i>Dendrobium nobile</i>	<i>Dendrobium williamsonii</i>
<i>Eria bambusifolia</i>	<i>Eria coronaria</i>	<i>Goodyera hemsleyana</i>
<i>Goodyera hispida</i>	<i>Malaxis calophylla</i>	<i>Paphiopedilum fairrieianum</i>
<i>Paphiopedilum hirsutissimum</i>	<i>Paphiopedilum insigne</i>	<i>Paphiopedilum spicerianum</i>
<i>Paphiopedilum venustum</i>	<i>Paphiopedilum villosum</i>	<i>Phaius flavus</i>
<i>Phaius tankervilleae</i>	<i>Phalaenopsis lobbii</i>	<i>Phalaenopsis mannii</i>
<i>Pleione hookeriana</i>	<i>Pleione humilis</i>	<i>Pleione maculata</i>
<i>Pleione praecox</i>	<i>Renanthera imschootiana</i>	<i>Spathoglottis plicata</i>
<i>Vanda coerulea</i>	<i>Vanda coerulescens</i>	<i>Vanda cristata</i>
<i>Vanda stangeana</i>	<i>Vanda tessellata</i>	<i>Vandopsis undulata</i>
Orchid species suitable for breeding		
<i>Arachnis cathcartii</i>	<i>Ascocentrum ampullaceum</i>	<i>Bulbophyllum leopardinum</i>

<i>Bulbophyllum putidum</i>	<i>Calanthe chloroleuca</i>	<i>Calanthe herbacea</i>
<i>Calanthe masuca</i>	<i>Calanthe plantaginea</i>	<i>Calanthe triplicata</i>
<i>Coelogyne barbata</i>	<i>Coelogyne corymbosa</i>	<i>Coelogyne cristata</i>
<i>Coelogyne fuscescens</i>	<i>Coelogyne nitida</i>	<i>Coelogyne ochracea</i>
<i>Cymbidium devonianum</i>	<i>Cymbidium eburneum</i>	<i>Cymbidium hookerianum</i>
<i>Cymbidium iridiodes</i>	<i>Cymbidium lancifolium</i>	<i>Cymbidium longifolium</i>
<i>Cymbidium lowianum</i>	<i>Cymbidium munronianum</i>	<i>Cymbidium tigrinum</i>
<i>Cymbidium tracyanum</i>	<i>Cymbidium whiteae</i>	<i>Dendrobium bensonae</i>
<i>Dendrobium candidum</i>	<i>Dendrobium densiflorum</i>	<i>Dendrobium farmeri</i>
<i>Dendrobium formosum</i>	<i>Dendrobium gibsonii</i>	<i>Dendrobium infundibulum</i>
<i>Dendrobium nobile</i>	<i>Dendrobium parishi</i>	<i>Dendrobium pendulum</i>
<i>Dendrobium primulinum</i>	<i>Dendrobium wardianum</i>	<i>Dendrobium williamsonii</i>
<i>Paphiopedilum fairrieanum</i>	<i>Paphiopedilum hirsutissimum</i>	<i>Paphiopedilum insigne</i>
<i>Paphiopedilum spicerianum</i>	<i>Paphiopedilum venustum</i>	<i>Paphiopedilum villosum</i>
<i>Papilionanthe teres</i>	<i>Pecteilis gigantea</i>	<i>Phaius flavus</i>
<i>Phaius tankervillae</i>	<i>Phalaenopsis decumbens</i>	<i>Phalaenopsis lobii</i>
<i>Phalaenopsis mannii</i>	<i>Pleione hookeriana</i>	<i>Pleione humilis</i>
<i>Pleione maculata</i>	<i>Pleione praecox</i>	<i>Renanthera imschootiana</i>
<i>Spathoglottis plicata</i>	<i>Thunia alba</i>	<i>Thunia marshalliana</i>
<i>Thunia venosa</i>	<i>Vanda coerulea</i>	<i>Vanda coerulescens</i>
<i>Vanda cristata</i>	<i>Vanda pumila</i>	<i>Vanda stangeana</i>
<i>Vanda tessellata</i>	<i>Vanda undulata</i>	<i>Vandopsis undulata</i>
Orchid species suitable for species trade		
<i>Anoectochilus brevilabris</i>	<i>Arachnis cathcartii</i>	<i>Ascocentrum ampullaceum</i>
<i>Bulbophyllum putidum</i>	<i>Calanthe chloroleuca</i>	<i>Calanthe herbacea</i>
<i>Calanthe masuca</i>	<i>Calanthe plantaginea</i>	<i>Calanthe triplicata</i>
<i>Coelogyne cristata</i>	<i>Coelogyne nitida</i>	<i>Coelogyne ochracea</i>

<i>Cymbidium devonianum</i>	<i>Cymbidium eburneum</i>	<i>Cymbidium lancifolium</i>
<i>Cymbidium mastersii</i>	<i>Cymbidium tigrinum</i>	<i>Cymbidium whiteae</i>
<i>Dendrobium chrysotoxum</i>	<i>Dendrobium densiflorum</i>	<i>Dendrobium devonianum</i>
<i>Dendrobium falconeri</i>	<i>Dendrobium farmeri</i>	<i>Dendrobium heterocarpum</i>
<i>Dendrobium nobile</i>	<i>Dendrobium pendulum</i>	<i>Dendrobium primulinum</i>
<i>Dendrobium wardianum</i>	<i>Paphiopedilum fairrieianum</i>	<i>Paphiopedilum hirsutissimum</i>
<i>Paphiopedilum insigne</i>	<i>Paphiopedilum spicerianum</i>	<i>Paphiopedilum venustum</i>
<i>Paphiopedilum villosum</i>	<i>Phaius flavus</i>	<i>Phaius tankervillae</i>
<i>Phalaenopsis decumbens</i>	<i>Phalaenopsis lobii</i>	<i>Phalaenopsis mannii</i>
<i>Pleione hookeriana</i>	<i>Pleione humilis</i>	<i>Pleione maculata</i>
<i>Pleione praecox</i>	<i>Renanthera imschootiana</i>	<i>Spathoglottis plicata</i>
<i>Vanda coerulea</i>	<i>Vanda coerulescens</i>	<i>Vanda cristata</i>
<i>Vanda stangeana</i>	<i>Vanda tessellata</i>	
Orchid species suitable for hobby collectors		
<i>Anoectochilus brevilabris</i>	<i>Arachnis cathcartii</i>	<i>Ascocentrum ampullaceum</i>
<i>Bulbophyllum hirtum</i>	<i>Bulbophyllum putidum</i>	<i>Calanthe chloroleuca</i>
<i>Calanthe herbacea</i>	<i>Calanthe masuca</i>	<i>Calanthe plantaginea</i>
<i>Coelogyne cristata</i>	<i>Coelogyne nitida</i>	<i>Coelogyne ochracea</i>
<i>Cymbidium devonianum</i>	<i>Cymbidium eburneum</i>	<i>Cymbidium lancifolium</i>
<i>Cymbidium mastersii</i>	<i>Cymbidium tigrinum</i>	<i>Cymbidium whiteae</i>
<i>Dendrobium chrysotoxum</i>	<i>Dendrobium densiflorum</i>	<i>Dendrobium devonianum</i>
<i>Dendrobium falconeri</i>	<i>Dendrobium farmeri</i>	<i>Dendrobium heterocarpum</i>
<i>Dendrobium nobile</i>	<i>Dendrobium pendulum</i>	<i>Dendrobium primulinum</i>
<i>Dendrobium wardianum</i>	<i>Paphiopedilum fairrieianum</i>	<i>Paphiopedilum hirsutissimum</i>
<i>Paphiopedilum insigne</i>	<i>Paphiopedilum spicerianum</i>	<i>Paphiopedilum venustum</i>

<i>Paphiopedilum villosum</i>	<i>Phaius flavus</i>	<i>Phaius tankervilleae</i>
<i>Phalaenopsis decumbens</i>	<i>Phalaenopsis lobii</i>	<i>Phalaenopsis mannii</i>
<i>Pleione hookeriana</i>	<i>Pleione humilis</i>	<i>Pleione maculata</i>
<i>Pleione praecox</i>	<i>Renanthera imschootiana</i>	<i>Spathoglottis plicata</i>
<i>Vanda coerulea</i>	<i>Vanda coerulescens</i>	<i>Vanda cristata</i>
<i>Vanda stangeana</i>	<i>Vanda tessellata</i>	
Orchid species suitable for hanging basket		
<i>Aerides multiflora</i>	<i>Aerides odorata</i>	<i>Aerides rosea</i>
<i>Cymbidium devonianum</i>	<i>Dendrobium aphyllum</i>	<i>Dendrobium chrysanthum</i>
<i>Dendrobium crepidatum</i>	<i>Dendrobium densiflorum</i>	<i>Dendrobium devonianum</i>
<i>Dendrobium falconeri</i>	<i>Dendrobium farmeri</i>	<i>Dendrobium ochreatum</i>
<i>Dendrobium pendulum</i>	<i>Dendrobium primulinum</i>	<i>Dendrobium wardianum</i>
<i>Gastrochilus acutifolius</i>	<i>Gastrochilus dasypogon</i>	<i>Rhynchostylis retusa</i>

The exotic orchid cut flower industry is growing at the rate of 10-20 % annually and is presently US\$ 55 billion and India could do wonders with orchid cut flowers exports if this area could be promoted well. A group of knowledgeable experts could guide and advice the government so that the recommendations made are implemented for the benefit of the growers and exporters. The efforts of last two decades have made orchid popular and now the flowers are used in festivities to make an event colorful. This trend will continue to do better as cultivation proliferate further. In the recent past the government and private agencies have established commercial orchid farms in and around Bangalore, Chennai, Guwahati, Kochi, Mumbai, Pune, Thiruvananthpuram, Sikkim and Darjeeling district of West Bengal. They came up with cultivated orchid hybrids and species of *Dendrobium*, *Cymbidium*, *Cattleya*, *Paphiopedilum*, *Phalaenopsis*, *Calanthe*, *Laelia*, *Mokara*, *Oncidium*, *Vanda*, *Vanilla*, etc. on mass scale in the various agro climates for both domestic consumption and exports.

Steps to be taken for strengthening orchid industry

Science driven modern farms to go orchid cultivation in India, it requires not only entrepreneurial skills coupled with knowledge to manage and operate a disease and pest free farms, and production of quality flowers acceptable in international markets, but it is also vitally important to achieve global production standards in order to become price competitive. Therefore, growers in India should be facilitated with

1. Quality planting materials of internationally accepted varieties/ hybrids.
2. Advanced farm management and growing skill.
3. Latest scientific inputs from research institution to produce and cultivate new and disease free varieties round the year.
4. Cost effective greenhouse technology suitable to Indian conditions for growing international standard orchids.
5. Upto date market information and database on trade.
6. Soft loan with low bank interest rate.
7. Lower freight charges and availability of sufficient cargo space.
8. Better infrastructure by way of good road network with refrigerated transport and cold storage facility at airports.
9. Simplified procedures to export and billing.
10. Insurance coverage to delayed delivery on export.
11. Upgraded information on post harvest handling and packaging.
12. Availability of land on lease to encourage large projects.
13. Easy import of certain pesticides, chemicals, etc on demand.

Conclusion and recommendations

The depleting resource of orchid wealth could only be protected by the concerted efforts of people living with orchids in their natural habitats, scientists, planners, managers of protective area network and law enforcing authorities. Since the technical know-how on propagation of many Indian species is available, the orchids propagated

by conventional propagation methods need to be prohibited for export barring domestic markets, which would provide free movement of germplasm within the country. If not all, at least the species threatened, vulnerable, rare may be considered for banning first and the rest may be considered later after the review of the previously banned species. The orchids with their bewildering shapes, exquisite colours, flabergasting mimicry and variety of fragrance will go on structuring and re-structuring long lasting cut flowers and potted plants as per whims and fancies of the consumers around the world. Here is a question that needs to be addressed with great foresight and pragmatic research, in the age of e-commerce How (?) and What (?) can India contribute towards this million dollar orchid industry by crossing all hurdles and thereby gaining a share in the world trade?