

# VISION - 2030



राष्ट्रीय आर्किड् अनुसंधान केन्द्र

(भारतीय कृषि अनुसंधान परिषद्)

पाक्योङ - ७३७ १०६, सिक्किम

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(Indian Council of Agricultural Research)

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## FOREWORD

The diverse challenges and constraints as growing population, increasing food, feed and fodder needs, natural resource degradation, climate change, new parasites, slow growth in farm income and new global trade regulations demand a paradigm shift in formulating and implementing the agricultural research programmes. The emerging scenario necessitates the institutions of ICAR to have perspective vision which could be translated through proactive, novel and innovative research approach based on cutting edge science. In this endeavour, all of the institutions of ICAR, have revised and prepared respective Vision-2030 documents highlighting the issues and strategies relevant for the next twenty years.

The orchids are highly priced in the international flower trade due to their incredible range of diversity in size, colour, shape, forms, appearance and long lasting qualities of flowers. Orchids account for a large share of global floriculture trade and are estimated at around 10% of international fresh cut flower trade. India harbours 160 genera and more than 1300 species of orchids including commercially important species like *Arachnis*, *Cattleya*, *Cymbidium*, *Dendrobium*, *Paphiopedilum*, *Phalaenopsis* and *Vanda*. Indian terrestrials are located in North East and North Western parts of India. Despite, their genetic diversity, adequate research on orchids is still in developing stage. In 1996, National Research Centre for Orchids came into existence for filling up this vacuum at Pakyong, Sikkim.





It is expected that the analytical approach and forward looking concepts presented in the 'Vision-2030' document will prove useful for the researchers, policymakers, and stakeholders to address the future challenges for growth and development of the agricultural sector and ensure food and income security with a human touch.

Dated the 29<sup>th</sup> June, 2011  
New Delhi

(S. Ayyappan)



## PREFACE

With advancement in technology, the orchids have become most important segment in floriculture trade. Horticulturists worldwide today grow orchids not only because they are mysterious and fascinating but mainly due to the fact that they are highly prized. Orchid being highly amenable to intergeneric and interspecific hybridization, a number of novel hybrids with various hues, shapes; sizes are being added constantly to meet the increasing demand of changing market.

NRCO primarily involved in improvement and production by undertaking activities of germplasm collection, characterization, evaluation, conservation and utilization of germplasm for crop improvement. Besides, it is also a nodal centre, National Active Germplasm Site for Orchids in the country for conservation of indigenous and exotic orchid germplasm. The centre is also involved in standardization of production technology for commercially important orchids and diseases and pests management.

The Vision 2030 document of NRCO outlines the strategies for conservation and utilization of genetic wealth of the country in development of commercial cultivars of national and international standards to meet the ever-changing demand of floriculture products. The orchid breeding is nearly 100 year old and the breeders world over infuse the market in every 3-5 years. Therefore, there is an urgent need to introduce modern stud varieties for development of internationally competitive varieties without losing much time. The introduced and available varieties and also breeding population may be used to develop mapping population to tag the useful genes. These can be used in the Genomic Aided Breeding programmes to develop commercial hybrids.

The quality planting material of elite clones is either not available or available in very limited quantity. If available, it is very costly. Most of our research efforts were directed to development of protocols for mass propagation of indigenous species and very few efforts have been made to develop the propagation protocols for commercially cultivated orchids. There is immediate need to develop the reliable protocols for mass propagation of selected commercial orchids with an emphasis to reduce the cost of planting material. The orchids are infected by a number of viral diseases but most serious are Cymbidium Mosaic Virus (CymMV) and Odontoglossum ring spot virus (ORSV). There is need to develop laboratories producing disease free planting material to address the demand.



I am deeply indebted to Dr. S. Ayyappan, Director General (ICAR) and Secretary (DARE) Govt. of India, for his thought provoking ideas and guidance to develop this document in its present form. I am equally indebted to Dr. H. P. Singh, Deputy Director General (Hort.) for his keen interest, valuable advice and guidance in preparing this document and to Dr. U. Srivastava, Assistant Director General (Hort. II) for encouragement and continuous support.

I record my sincere appreciation to all the scientists for their significant contribution for the development of this document.

Place: Pakyong, East Sikkim.

Dated: 30<sup>th</sup> June, 2011

(R. P. Medhi)

Director





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## PREAMBLE

In the western world, the first reference to orchids was by Theophrastus considered by many as the Father of Botany. In his study 'Inquiry into Plants' around 300 B.C. he coined the term 'Orchis' to describe some of terrestrial species of orchids. 'Orchis' is a Greek word meaning testicles.

The orchids are one of the distinctive plants of nature and highly priced in the international flower trade due to their incredible range of diversity in size, colour, shape, forms, appearance and long lasting qualities of flowers. They are considered as high value flowering plants as cut flowers well as potted plants. Out of 1300 species of orchids of India, 800 species are found in North Eastern Hill Region due to their congenial climatic conditions, diversified topography and altitudinal variation. Among flower crops, orchids contribute 10% share in international trade. In addition, the Sikkim Himalayan region is the centre of origin of an important species like *Cymbidium*. Other valuable genera of commercial importance available in the region are *Coelogyne*, *Dendrobium*, *Paphiopedilum*, *Pleione*, *Rhyncostylis*, and *Vanda* etc. Varied agroclimatic conditions of our country is highly favourable for cultivation of commercial orchids like *Cattleya*, *Vanda*, *Dendrobium*, *Arachnis* and *Aerides* in tropical areas, *Cymbidium* hybrids, *Paphiopedilum*, *Dendrobium* hybrids and *Phalaenopsis* in subtropical areas and *Cypripediums*, *Cymbidiums* etc in temperate areas. Among orchids, *Cymbidiums*, *Dendrobiums*, *Phalaenopsis*, *Cattleyas*, *Vandas*, *Arandas*, *Arachnis* etc used as cut flowers whereas *Aerides*, *Arachnanthe*, *Bulbophyllum*, *Calanthe*, *Coelogyne*, *Eria*, *Phaius*, *Phalaenopsis*, *Pleione*, *Rhyncostylis* are used as potted orchids.

Though India possesses climatic advantage in comparison to the European countries, it failed to exploit this potential due to lack of required research support to this area. Orchid is very climate specific and requires constant monitoring for the management of temperature, light, humidity, water and nutritional requirements. Every item should be always perfect to make it a success story. So it is necessary to standardize the production technologies to the perfection. Another major input constraint is the non-availability of quality hybrids and planting material in large scale. This necessitates an urgent initiation of a strong breeding programme based on sound methodologies to develop varieties/ hybrids of internationally accepted quality. Molecular breeding should also be made an integral part of the crop improvement programme to incorporate noble characters in an accurate and rapid fashion. Mass multiplication of quality hybrids or lines through tissue culture is another priority. Standardization of post-harvest management in another major concern and is to be addressed on urgent basis. Research on integrated pest and disease management is also a need of hour. Proper research support is also necessary to save the valuable genetic resources in a scientific manner. Establishment of National Research Centre for Orchids at Pakyong, Sikkim, is in fact a due and timely recognition of the scope and





commercial potential of orchid culture in India and in this region, in particular.

The Vision Document 2030 contemplates realization of the above objectives envisaged by the Planning Commission of India. Thrusts have also been given on conservation of genetic resources, systemic breeding and production of commercial varieties and hybrids of superior quality of orchids for national and international trade, standardization of agro-techniques for commercial cultivation and package of practices for post-harvest management for domestic and export markets for orchids and other temperate flowers of commercial value, production of quality planting materials of orchids and other selected bulbous flowering plant and to act as a repository of information and as a centre for providing training on orchids and other floricultural crops.



## ORCHID SCENARIO

Orchids comprise the largest family of flowering plants with 25,000 species belonging to 600-800 genera. They are prized for their incredible diversity in the size, shape and colour and attractiveness of their flowers and high keeping qualities even upto 10 weeks. Most of the orchids have originated from tropical humid forests of Central and South America, India, Sri Lanka, Burma, South China, Thailand, Malayasia, Philippines, New Guinea and Australia. Brazilian *Cattleya*, Mexican *Laelia* and Indian *Cymbidium*, *Vanda* and *Dendrobium* have played a major role in developing present day beautiful hybrid orchids which numbers more than 200000. In the international trade, among top ten cut flowers, orchids rank the sixth position and among orchids *Cymbidium* ranks the first position and in floricultural crops it accounts for 3% of the total cut flower production.

Orchids have emerged as an important item in the global cut flower trade. In the international trade, orchid genera mainly *Cymbidium*, *Dendrobium*, *Paphiopedilum*, *Phalaenopsis*, *Vanda*, *Cattleya* and *Oncidium* are used for cut flower production. India accounts for nearly 7% of worlds orchid biodiversity contributing 1300 species which are distributed in five major phyto-geographical regions viz. North eastern Himalayas, Peninsular region, Western Himalayas , Western Ghat and Andaman and Nicobar Islands (Table 1).

**Table 1: State wise distribution of orchids in India**

State	Orchids (Number)		State	Orchids (Number)	
	Genera	Species		Genera	Species
A & N islands	59	117	Maharashtra	34	110
A.P.	33	67	Manipur	66	251
Arunachal Pradesh	130	600	Meghalaya	98	352
Assam	81	191	Mizoram	74	246
Bihar	36	100	Nagaland	63	241
Goa, Daman & Diu	18	29	Orissa	48	129
Gujrat	10	25	Punjab	12	21
Haryana	3	3	Rajasthan	6	10
H.P.	24	62	Sikkim	115	496
J & K	27	51	T.N.	67	199
Karnataka	52	177	Uttarakhand	77	237
Kerala	77	230	U.P	19	30

Source: NRC for Orchids, Pakyong, Sikkim



India's exports of floriculture products comprising cut flowers, loose flowers, saplings, potted plants, seeds and bulbs, micropropagated plants, floral oil and concretes, natural dyes from flowers and plants, dry flowers and plant parts, ornamental plants for interior decoration and landscaping increased from US \$ 22.0 mn in 2005 to US\$ 29.6 mn in 2008 recording a CAGR of 10.4% (Table 2). The main markets for India's exports of cut flowers were largely the developed countries like Japan, USA, Netherlands, UK and Germany.

**Table 2: India's export markets of cut flowers (US \$ mn)**

Country	2005	2006	2007	2008	CAGR (%)
Japan	3.21	12.15	63.84	7.79	34.4
USA	4.22	4.56	3.23	4.55	2.5
Netherlands	3.23	2.38	3.17	3.71	4.7
UK	2.32	2.62	2.26	2.77	6.1
Germany	1.76	1.84	2.74	1.99	4.2
UAE	0.71	0.78	1.18	1.05	13.9
Italy	1.16	1.08	0.92	0.85	-9.8
Spain	0.2	0.46	0.58	0.64	47.4
Polland	0.17	0.03	0.33	0.57	49.7
Malayasia	0.14	0.19	0.22	0.54	56.8
Australia	0.53	0.43	0.55	0.52	- 0.6
World Total	22.01	31.46	90.45	29.59	10.4

The orchids have taken a significant position in cut flower industry due to its attractiveness, long shelf life, high productivity, right season of bloom, easy in packing and transportation. Orchid accounts for a large share of global floriculture trade both as cut flowers and as potted plants and is estimated around 10% of international fresh cut flower trade which stood at US \$ 6.0 bn in 2006. Imports of fresh cut orchids into the EU increased by 3% annually on an average between 2002 and 2006, amounting to US \$ 112 mn in 2006. Italy was the largest EU importer of fresh cut orchids accounting for 29% of total imports followed by France (19%), Germany (12%) and the UK (9%). The supply of orchids to EU was dominated by Netherlands and Thailand. Considering world export value of orchid flower, the Netherlands ranked the first with the export value of 111.7 million US\$ (48.2%) while Thailand ranked second with export value of 73.3 million US\$ (31.6%)

Major markets in Asia are occupied by Japan and Singapore. Total imports of orchids by Japan accounted for US\$ 57.4mn in 2008 making it the largest importer of the orchids in the world. The main sources of imports include Thailand, Taiwan, New Zealand and Malayasia together accounting for as



much as 96.5% of the total imports of the orchids by Japan in 2008. Imports by Singapore of fresh orchids amounted at US \$ 6.5mn in 2007 with Malayasia, Thailand and Taiwan being the main sources of imports for the country. Imports of fresh orchids by Singapore from India was only US\$ 1379.3 representing a share of 0.02% of the country's total imports of the product in 2007 (Table 3). This clearly indicates that there is vast scope of increasing India's exports to Singapore particularly considering the proximity of the country and Indias East Policy.

**Table 3: Imports of orchids by Singapore (2007)**

Country	Value (US\$)	Share (%)
Malayasia	5422069.0	83.03
Thailand	520699.7	7.97
Taiwan	307596.2	4.71
Mauritius	149655.2	2.29
Indonesia	117241.4	1.90
Netherlands	8275.9	0.13
New Zealand	2758.6	0.04
India	1379.3	0.02
China	699.7	0.01
Total imports	6530344.8	100.00

Source: International Enterprise Singapore

### Area, Production and Productivity

Orchids are cosmopolitan occurring in diversified habitat starting from tropical Asia, South America, Central America to Southern Patagonia and Macquarie Island.

The Royal Botanical Gardens of Kew listed 880 genera and 25,000 species of orchids of which 300 to 350 genera from tropical America, 250 to 300 genera from tropical Asia, 125 to 250 genera from tropical Africa, 50 to 70 genera from Oceania , 40 to 60 genera from Europe and temperate Asia and 20 to 30 genera from North America. The largest genera are *Bulbophyllum* (2000 species), *Epidendrum* (1500 species), *Dendrobium* (1400 species) and *Pleurothallis* (1000 species). The Netherlands grows orchids in 208 hectares. Countries like Singapore, Thailand, Malayasia, Indonesia, Japan and Australia are growing orchids in 100, 3500, 280, 128, 428 and 1000 hectares, respectively.

India is enriched with biodiversity of orchids comprising 1300 species and made up of large flowered, terrestrial, epiphytic and also saprophytic orchids. Terrestrial orchids are distributed in north western India, epiphytic in north eastern India and small flowered orchids in western ghats. Habenaria with 100 species is the largest terrestrial genus of the orchids, *Dendrobiums* covers as the largest epiphytic genus with 70 species and *Paphipedilums* are restricted to north east Himalayan regions. The north western



Himalayas have a total of 200 species, western ghats about 300 species and north eastern region harbours about 800 species. The varied altitudinal variations starting from foot hills to high Himalayas mountain range and deep river valleys with high monsoonal rain and humidity, distinguished soil characteristics have played a vital role to develop a rich biodiversity of orchids in the north eastern hill region.

### Trend in growth

#### *Cymbidium*:

*Cymbidiums* are among the most popular winter and spring blooming semi-terrestrial orchids originated from tropical and subtropical Asia covering North Eastern India, China, Japan, Malayasia, the Philippines, Borneo islands and North Australia, usually grown in cooler climates at high elevations. *Cymbidiums* are highly valued for genetic resources, cut flowers, hanging baskets, potted plants and herbal medicines. *Cymbidium* has been considered as top commercial orchids in Europe since many years. They fetch the highest price in the international markets of which major Asian markets of Singapore and Japan or the Dutch market. *Cymbidiums* imported from the Netherlands fetched as much as 11.18 US\$ per stem in Singapore those imported by Japan from New Zealand fetched US \$ 3.33 per stem. As per Dutch Auction market is concerned, the *Cymbidiums* fetched highest value averaging Euro cents 331 par stem during 2003-2007 period (Table 4).

**Table 4: Average Annual Prices at Netherlands Auction (2003-2007) (Euro cents /stem)**

<b>Orchids</b>	<b>2003</b>	<b>2005</b>	<b>2007</b>	<b>Average price</b>
<i>Phalaenopsis</i>	38	46	37	40
<i>Cymbidium</i> (Big bud)	330	334	329	331
<i>Cymbidium</i> (Small bud)	138	148	140	142
<i>Paphiopedilum</i>	58	52	63	58

Source: CBI Market Survey, The Cut Flowers and Foliage Market in the EU

In India, Arunachal hills, Sikkim and Darjeeling hills with cool summer night and monsoonal summer rain are ideal for *Cymbidium* cultivation. The growth of orchid exports from north eastern hill region especially Sikkim would provide opportunities for employment and also for development of supporting industries like packaging, cold storage and transportation. East Sikkim has been declared as Agri Export Zone exclusively for production of *Cymbidium* orchids. In Sikkim, more than 250 hybrids of *Cymbidium* orchids are commercially cultivated in an around 25 ha of land and about 5 lakhs spikes are produced annually.



### ***Dendrobium:***

*Dendrobiums* are popular flowering potted plants and cut flowers around the world due to their floriferousness, wide range in flower color, size and shape, year round availability and lengthy vase life. Hawaii, California and Florida are major potted *Dendrobium* growing regions in the United States. The wholesale value of sales for this commodity in Hawaii has been found for several decades and sales increased from US \$ 2.4 million in 1991 to US\$ 5.6 million in 2000 (Table 5).

**Table 5: Quantity of consumption and wholesale value of sales of potted *Dendrobium* in Hawaii (Johnson, 1999).**

<b>Year</b>	<b>Number of pots sold</b>	<b>Value (US \$)</b>	<b>Number of growers</b>
1985	0.2 millions	1.1 million	88
1991	0.4 millions	2.4 million	47
2000	1.0 million	5.6 million	69

In the Netherlands, production of potted orchids is now 40 to 50 million units with *Dendrobium* increasing in popularity. Imports from Thailand, the world's largest exporter of tropical cut orchids and second largest supplier to the EU, accounted for 22% of supplies to the EU. Thailand holds a particularly strong position in *Dendrobium* orchids.

**Table 6: Orchid price in Singapore (US\$)**

<b>Product details</b>	<b>Origin</b>	<b>Price /stem</b>
Orchid <i>Cymbidium</i>	Malaysia	1.97
Orchid <i>Cymbidium</i>	Netherlands	11.18
Orchid <i>Cymbidium</i>	Taiwan	5.26
Orchid <i>Dendrobium</i> XL	Thailand	0.46
Orchid <i>Dendrobium</i> L	Thailand	0.39
Orchid <i>Dendrobium</i> M	Thailand	0.33
Orchid <i>Dendrobium</i> S	Thailand	0.26
Orchid <i>Oncidium</i> XL	Malaysia	0.72
Orchid <i>Oncidium</i> L	Malaysia	0.59
Orchid <i>Oncidium</i> M	Malaysia	0.39

Source: Market News Service-Week 14, 2009, ITC

### **Other Tropical Orchids**

Vanda is widely distributed throughout Australasia from China through the Philippines, Indonesia, Malaysia, New Guinea and Australia, Myanmar, Thailand, India and Sri Lanka. In the world tropical



orchid trade, *Dendrobium* is the most dominant crop in addition to *Mokara*, *Oncidium*, *Aranthera*, *Aranda*, *Vanda*, *Arachnis*, *Renanthera*, *Ascocenda*, *Phalaenopsis*, *Cattleya* and *Paphiopedilum* which are being grown as cut flowers and potted plants. Thailand is the largest world exporters of tropical orchids. China is the largest consumer of orchid cut flowers from Thailand 7,493 tons followed by Japan, USA, Italy, India, Taiwan, Vietnam and the Netherlands at 4,407, 2892, 2395, 1830, 983, 793 and 689 tons, respectively. *Dendrobium* flower is the most important orchid genera with market value share of 94.7%. Other significant orchid genera being exported from Thailand were *Mokara*, *Aranthes*, *Aranda*, *Oncidium*, *Vanda*, *Arachnis* and *Ascocenda* with the market share of 3.69, 0.52, 0.48, 0.44, 0.13, 0.01 and 0.01% of total export value respectively (Table 7).

Considering import value of orchid plants, Japan was also the largest importers of Thai orchid plants at 2.4 million US \$ worth followed by the Netherlands, USA, Germany, Rep. of Korea and Vietnam with the value of 1.6, 1.4, 1.0, 0.9 and 0.9 million US \$ respectively. In 2009, Thailand exported 211 genera of orchid plants. *Dendrobium* and *Phalaenopsis* plants were the most important orchid genera for exports with the market share of 51.4 and 25.5%. Other important orchid genera being exported from Thailand were *Vanda*, *Mokara*, *Oncidium*, *Cattleya* and *Ascocenda* with the market share of 8.9, 3.7, 3.1, 2.7 and 1.2% of total export value, respectively.

**Table 7: Orchid export from Thailand in 2009 (% share of total export value)**

Cut orchid		Orchid plant	
Orchid genera (20)	Value shared (%)	Orchid genera (211)	Value shared (%)
<i>Dendrobium</i>	94.73	<i>Dendrobium</i>	51.4
<i>Mokara</i>	3.69	<i>Phalaenopsis</i>	25.5
<i>Aranthera</i>	0.52	<i>Vanda</i>	8.9
<i>Aranda</i>	0.48	<i>Mokara</i>	3.7
<i>Oncidium</i>	0.44	<i>Oncidium</i>	3.1
<i>Vanda</i>	0.13	<i>Cattleya</i>	2.7
<i>Arachnis</i>	0.01	<i>Ascocenda</i>	1.2
<i>Ascocenda</i>	0.01	<i>Epidendrum</i>	0.6
		<i>Cymbidium</i>	0.3
		<i>Rhyncostylis</i>	0.3
		<i>Spathoglottis</i>	0.3
		<i>Paphiopedilum</i>	0.2
		Others	1.8



At present half of *Phalaenopsis* orchids in the world are produced in Taiwan. *Phalaenopsis* orchids were the leading flower export, valued at US\$ 23.39 million and accounting for 35 percent of total flower exports in 2004. According to information being collected in recent years, Netherlands is still Taiwan's strongest competitor in the race of exporting *Phalaenopsis* orchids, while several Asian countries including Vietnam, Malaysia and China face a serious threat to Taiwan in exporting other flowers because they ask for lower prices and have cheap labor and land. But the Asian countries' technology is still far inferior to Taiwan for this moment.

### Diversification of uses

Orchids are adapted in nearly every environment in the world. Epiphytic orchids like *Thunia*, *Coelogyne*, *Cattleya*, *Laelia*, *Dendrobium*, *Calanthe*, *Bulbophyllum*, *Aerides*, *Phalaenopsis*, *Aranda* and *Aranthera* with thick leaves and succulent stems have CAM and are drought tolerant with higher water use efficiency. Rhizomatous orchids like *Habenaria*, *Eulophia* etc requires terrestrial climate. Several local species of *Vanda*, *Cymbidium*, *Ascocentrum*, *Paphiopedilum*, *Calanthe*, *Dendrobium* etc. are in great demand in international market for breeding materials (Table 8). Species and hybrids of orchid genera including *Cymbidium*, *Dendrobium*, *Phalaenopsis*, *Odontoglossum*, *Oncidium*, *Cattleya*, *Paphiopedilum*, *Vanda*, *Aeridovanda*, *Aranda*, *Mokara*, *Arachnis*, *Vascostylis*, *Renanthera*, *Rhyncicentrum*, *Rhyncovanda* etc. are important as cut flowers.

**Table 8:** 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 parishii</i>	<i>Dendrobium pendulum</i>
<i>Dendrobium primulinum</i>	<i>Dendrobium wardianum</i>	<i>Dendrobium williamsonii</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>Papilionanthe teres</i>	<i>Pecteilis gigantea</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>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>			

Tribal people of North eastern hill region use wild orchids for a variety of folk medicine as orchids are rich in alkaloids, flavonoids, glycosides, carbohydrates and other phytochemicals. Experimental evidences have reported on the isolation of a number of alkaloids like anthocyanins, stilbenoids and triterpenoids from orchids. Orchinol, hircinol, cypripedin, jibantine, nidemin and loroglossin have been reported from orchids.

Aromatic orchids like *Aerides multiflorum*, *Aerides odoratum*, *Aeranthes Bulbophyllum odoratissimum*, *Cattleya maxima*, *Coelogyne cristata*, *Coelogyne ochracea*, *Cymbidium ensifolium*, *Dendrobium nobile*, *Epidendrum cristatum*, *Epidendrum floribundum*, *Epidendrum nocturnum*, *Lycaste*, *Oncidium spaceolatum*, *Phaius tankervilleae*, *Rhyncostylis retusa*, *Vanda cristata*, *Vanda tessellata*, *Zygopetalum intermedium* can be exploited for extraction of essential oils. Leaves, tubers and pseudobulbs of different species are used for edible purposes. Vanilla- a major spice crop and source of vanillin comes from *Vanilla planifolia*. *Anoectochilus* leaves are used as vegetables in Indonesia and Malaysia. Pseudobulbs of *Cymbidium maladimum*, *Dendrobium speciosum*, tubers of *Microtis uniflora* and *Caladenia carnea* are eaten.

Orchids are highly attractive, delicate and available in variety of colours and they can be preserved by drying for use in flower arrangement and dried flower craft. Bright flowers of orchid genera like *Dendrobium*, *Cymbidium*, *Paphiopedilum*, *Cattleya*, *Pholidota* etc. can be used for drying and wedding centerpieces.

### **Impact of climate change on productivity of orchids**

Orchids are the most complex, advanced and successful family of flowers on the planet. Epiphytic orchids usually grow on tree trunks or branches and survive through nutrients from decaying organic matter that accumulates around the root zone and on their leaves and are usually distributed in tropical areas. Terrestrial orchids are originated from temperate regions and can tolerate adverse climatic conditions. Climate change due to global warming interacts with habitat loss and fragmentation, introduced and invasive species and population growths and many ecosystems are likely to undergo severe modification. In Asia, climate change is projected to compound the pressures on natural resources and the environment associated with rapid urbanization, industrialization and economic



development. In Latin America, there is a risk of significant biodiversity loss through species extinction in many areas. Semi-arid vegetation will tend to be replaced by arid vegetation. Levels of precipitation are likely to change radically in many areas of the world. Increasing temperature may result in vegetational zones gradually moving vertically up mountain sides, both permitting tropical species to subtropical areas, subtropical species to temperate areas and eliminating the species in the highest zones. Epiphytic orchids may be affected in various ways by changes in the availability of light, nutrients and moisture. Climate change is major threat to pollination services and there is a need to conserve plant communities in which orchids live. The combination of higher temperatures and lower rainfall may make forests more susceptible to fire and it may lead to extinction of local species. During 1984, World Orchid Conference held in Miami, it was proposed that the orchid community should start banking orchid seed as an insurance against possible losses of species from their habitats in the wild. Majority of orchid species are capable of tolerating dry storage for many decades when stored at  $-20^{\circ}\text{C}$ . Liquid nitrogen storage may produce further extensions of life spans of orchid seeds. Living collections are recently underutilized as a conservation tool and there is a need to do more to induce members of the wider orchid community.

### **Potential areas for increased production of orchids**

Countries like Thailand, Malaysia, Singapore, Philippines, Sri Lanka, and Indonesia have established their own orchid Industries. A large export market can be made available if the products are right and marketed in proper way. Despite the fact that India has diversified climate, low cost of labor, and progressive farming technology, the orchid industry is still in an infant stage both in terms of micro propagation and commercial cultivation. This has been mainly due to non-availability of suitable planting material for large scale cultivation, lack of technology for commercial multiplication, lack of post-harvest handling technology for cut-flower export, and lack of incentives, appropriate Government policies for exporters, and commercial approach in cultivation.

Fortunately, the country has all the potentials for development of a successful orchid industry on scientific basis; it has varied and suitable climate and almost all the important commercial varieties of orchids including those of *Cattleya*, *Cymbidium*, *Dendrobium*, *Phalaenopsis*, *Paphiopedilum* and *Vanda* can be grown for cut-flower production. Sikkim, Arunachal Pradesh, and Himachal Pradesh are orchid rich areas in the country. In South India, Kerala with high humidity and low temperature accompanied by good rainfall, has the congenial climate for commercial orchid cultivation. There is also a tremendous potential for growing these plants, on commercial scale, along the coastal region in Maharashtra, Andhra Pradesh, Tamil Nadu, and Karnataka, besides in the Western Ghats.



## ABOUT NRCO

### History

Keeping in view of the export potential of orchids, based on recommendations of the Planning Commission, the Indian Council of Agricultural Research (ICAR) established a National Research Centre for Orchids during VIII th Five Year Plan at Pakyong (Sikkim) in October 1996 at Tadong. The centre later shifted to Pakyong, Sikkim after the acquisition of 22.19 acres of land from the state of Sikkim on lease basis for 99 years. In October, 1997, the centre also took over the Darjeeling centre of CPRI, Shimla.

### Location

National Research Centre for Orchids (NRCO), as unit of ICAR is located at Pakyong, East Sikkim , 32Km away from Gangtok. The Center is situated at 1,300 meters above MSL on hilly terrain. The average rainfall at Pakyong ranges from 2,000 -2,500 mm per annum, mainly distributed from April to October, humidity varies from 70-80%, and temperature ranges from 7-27<sup>0</sup>C. The nearest railway station is at New Jalpaiguri (NJP) and airport is at Bagdogra which is about 130 km away from the centre. The centre is in process of developing phase and modernising its infrastructure including construction of office building and residential quarters.

### Infrastructure

#### Laboratory

The centre possesses 22.19 acres of sloppy land. The laboratory cum administrative building, two fibre houses, 15 medium cost polyhouses with micro-irrigation system, four net houses and four low cost polyhouses have been constructed on sloppy land for different experimental and conservation purpose. The centre is also equipped with automatic weather station to assist in carrying out research in different disciplines. Orchid sanctuary has been created on 4 acres of farmland covered with different species of trees for *ex-situ* conservation. The centre is also equipped with automatic weather station to assist the carrying out research in different disciplines. The centre has developed a well equipped molecular biology laboratory to carry out advance research on DNA Fingerprinting of orchids. Instruments like PCR, Real time PCR, Gel doc. systems, UV spectrophotometer, Nanodrop spectrophotometer, lypholyzer etc are available in this Centre under crop improvement division. A good tissue culture laboratory was also developed with inverted microscope, shakers, laminar flows, etc for production of quality planting materials of orchids .For virus indexing and other disease diagnosis, facilities developed in crop protection division also and instruments like ELISA reader, Gradient PCR, stereo



zoom microscope are available in the centre.

## Library

The centre has developed good library facilities for reference studies. Near about 1100 books on orchids and other scientific subjects are available in the library. At present the centre is subscribing 39 National journals and scientific magazines like - Current Science, Indian Journal of Horticulture, Intellectual Property Right, Journal of Experimental Biology, Ornamental Horticulture, Indian Journal of Plant Physiology, Indian Phytopathology, Indian Journal of Genetics and Plant Breeding, Indian Journal of Plant Genetic resources, Indian Journal of Agricultural Sciences, Journal of Indian Society of Soil Science, Current literature of Science, Indian Horticulture, Biotech news, Terra Green, Floriculture Today, Indian Farmer Digest, Indian Farming, Gene News, Agro India etc. The centre is also subscribing 15 International Journals like Hort Science, Hort Technology, Plant Science, Genetics, The Journal of World Intellectual Property, Nature, Euphytica, Orchid Review, Horticulture Science and Biotechnology, Crop Protection, Plant Disease, Trends in Genetics etc. Hort.CD and Agric CD are also available in the library. The centre has also taken initiative for library automation to strengthen library facilities.

## Budget

(Rs. in lakhs)

Sl.No.	Plan	Plan Period	Plan	Non-Plan	Total
1.	IX	1997-2002	581.00	208.50	789.50
2.	X	2002-2007	678.00	286.66	964.66
3.	XI	2007-2012	1350.00	535.00	1885.00
4.	XII	2012-2017	2000.00	1000.00	3000.00

## Manpower

Sl. No.	Category	X I Plan		Additional proposed in XI Plan onwards
		Sanctioned	Filled	
1.	Scientific	16	07	09
2.	Technical	07	06	06
3.	Administrative	10	06	06
4.	Supporting	07	06	04



## VISION 2030

### Vision

- To enhance productivity of orchids for meeting domestic demand and global export.

### Mission

- Utilize the scientific, technological and traditional knowledge for sustainable orchid production

### Objectives

- To conserve genetic resources and develop superior quality varieties of orchids using modern biotechnological tools.
- To develop integrated production and protection systems using traditional and non-traditional techniques and novel biotechnological approaches.
- To develop post harvest technologies of orchids focusing on product development and product diversification for domestic and export purposes.
- To act as a centre for training in research methodology, technology up gradation and monitor the adoption of new and existing technologies on spices.

### Researchable areas to accomplish the vision are:

1. Conservation of genetic resources, bar-coding and crop improvement
2. Increasing productivity of orchids
  - Production of quality planting materials
  - Productivity enhancement technologies and systems through better input management
  - Bio risk management
3. Pollination and role of pollinators in orchids
4. New market oriented technologies for secondary agriculture and value addition
5. Effective transfer of technologies to the target groups



## HARNESSING SCIENCE

The National Research Centre for Orchids has accepted the challenges to harness the power of intellectual minds and conventional thinking to the zenith level of science to increase orchids productivity, enhance input use efficiency, and reduce post harvest losses keeping in view on reducing the cost of production and post-production. We also proceed to develop effective solutions to emerging problems through conventional techniques and modern sciences thereby producing spices that will improve the quality of life.

The major thrust area is on conservation of orchid genetic resources, bar-coding and crop improvement. The NRCO possesses a huge collection of orchid germplasm. To address future needs, research will facilitate sustainable use of available genetic resources through characterization, genetic enhancement, functional genomics and molecular breeding tools like marker-aided selection and gene stacking and customized genetic engineering.

Climatic management is another area of our concern and successful cultivation of orchids is totally dependent upon microclimatic factors. Protected orchid cultivation offers immense potential if climatic factors especially light, temperature, humidity and aeration are scientifically and efficiently managed. Modern techniques for sustainable floriculture on integrated crop management, integrated nutrient management, integrated pest management, diversified farming system and orchid based farming systems would be perfected further for wider adaptability.

Importantly, precision agriculture would enhance production efficiency. For this purpose improved long range weather prediction technology would be required to take advantage of precision operations for crops and resource applications. This may also aid to the better understanding of global warming and climate change. Frontier sciences like nano-technology, information and communication technology and remote sensing and also techniques like Geographic Information System would be integrated in the ongoing and future research programs for improving research efficiency, better targeting of technologies and also identifying orchid production and marketing environments.

Another important focus would be to develop improved genotypes and management practices for raising productivity of these commodities in different agro –eco-regions, consumer preferred quality traits and economically viable would be high priority. Enhancing vase life and improving demand driven commodity traits (flower colour, size, number and forms) of orchids through different post-harvest approaches would be prioritized. Since markets for value added products and packed orchids are consistently increasing, low cost improved technologies would be developed to improve market efficiency and to remain competitive. Also, issues related to sanitary and phyto-sanitary measures



would be appropriately addressed.

Bio-risk is another assuming menace in orchid cultivation due to climate change and emerging insect-pests and diseases. To overcome this problem, efforts would be made to develop effective and integrated risk and disaster management production systems. Early warning systems and prediction of movement of bio-risk agents etc. would be developed for taking decisions at the local, regional and national levels.

Under IPR regulations, the thrust would be to develop effective and need based programmes to accelerate innovations and link farmers with different stake holders to harness growing opportunities. Hence, participatory information and communication technology would be evolved by showcasing research products and technologies for effectively linking research accomplishments with the stakeholders.

We are also committed to appreciate individuals who can contribute to our mission. Through our HRD programme, we share knowledge, experiences and build relationships with qualified students from biotechnology, microbiology, biochemistry and other agricultural sciences.



## STRATEGY AND FRAMEWORK

### Genetic Improvement

- Genera and species wise cataloguing of all germplasm collection using IPGRI descriptors. Ex-situ conservatories as well as *in situ* repositories of the collected germplasm of valuable rare, threatened and endemic orchids will be strengthened.
- The rich diversity of orchids in the country requires a strong conceived Network Approach. The NRC for Orchids have to work on a network mode and also to work as an National Active Germplasms site with the various active centres working on specific group of orchids. In view of the IPR regulations, it is the paramount importance to protect our germplasms using modern tools of bar coding. A network project involving groups with identical interest between universities /ICAR. These germplasm should be conserved with the duplicate sets grown in at least two locations, properly catalogued and characterized with national number obtained from NBPGR avoiding duplication. Cryopreservation to conserve germplasm can be taken up with NBPGR.
- At present, orchid trade is solely based on the hybrids derived from varietal, interspecies and inter-generic crosses. Building up a strong crop improvement programme based on sound breeding methodologies that will yield into development of hybrids/varieties of internationally acceptable quality. It is essential to develop own hybrids suitable for varied agroclimate for our country fulfilling the basic requirements of market demands.
- Evaluation of newly evolved genotypes to suit specific agro-ecological conditions
- Locating sources of resistance for biotic and abiotic stresses using conventional and biotechnological tools and developing varieties with high yield, quality and specific traits.

### Frontier Science Technologies

- It is essential to use the available hybrids and segregating populations to develop Association mapping. Hence the facilities available at IIHR and NRCO may be used to develop genome assistant or marker assistant selections.
- The lead obtained GIS with the help of facilities of ISSR for *Cymbidium* to cover other species which aid in location specific as well as species specific survey effective.
- Characterization of rhizosphere microbial community structure and effect of engineered nanoparticles on microorganisms in the rhizosphere and non-rhizosphere.



- ❑ Commercialization of orchids through bioreactors covering micro propagation technology to industry in network mode.

### **Management of natural resources**

- ❑ Cost effective agro-climatic management through optimization of a number of factors like light, temperature, humidity, water, air, growing media and nutrition for quality flower production. The standardization of growing media using cheap and indigenous materials such as cocochips, cocopeats may be explored and this must be used in consonance with cropping system to develop an orchid based farming systems
- ❑ Development and popularization of cost effective agricultural practices (INM/IPM) for increasing productivity
- ❑ Quantification of water use efficiency and water requirements in orchids
- ❑ Carbon sequestration potential in orchid based cropping systems

### **Post harvest and value addition**

- ❑ Development of location specific complete protocols starting from harvesting, post-harvest techniques upto domestic and international markets for each genera of commercial orchids.
- ❑ Developing a comprehensive approach on value added products from wild orchids including species trade, drying, flower arrangements, herbal medicines, edible products and other aesthetic products.
- ❑ Bioprospecting using bioinformatics tools

### **Bio-risk management**

- ❑ Surveillance, identification and characterization of new invasive pests and pathogens
- ❑ Pest-risk analysis
- ❑ Development of rapid and reliable diagnostics against pests and pathogens including invasive species
- ❑ Management of new invasive pests and pathogens

### **Policies**

- ❑ Commercialization of the technologies



- Genetic finger printing of germplasm and its registration
- Registration of released varieties or hybrids
- Patenting technologies related to orchids
- Documentation of ITK's

### **Transfer of Technology**

- Constraint analysis and impact assessment of new technologies
- Production of quality planting materials and distribution
- Large scale demonstration of proven technologies through training and FLD's
- Establishing technology information centre
- Participatory planting material production of commercial orchids

## **EPILOGUE**

As a pioneer in orchid flower research and development, the NRCO is committed to enhancing productivity of quality orchids for improving livelihood opportunities of farmers, and for ensuring sustainable farming and agricultural growth. A revolution in orchid production technologies is imminent. While there is a great deal of path breaking efforts to be made, stale or technologies that may not hold as much promise of profit making need to be slashed. This would transform the existing fatigue in orchid production into a vibrant and competitive profit making sector. Apparently, there is a need for bold initiatives that would need to overcome the ways the current system drives farmers into abandoning orchid cultivation. Our research efforts will be able to unleash such crucial initiatives.



## ANNEXURE

### Strategic Framework

Goal	Approach	Performance Measure
Evaluation, valuation and improvement of genetic resources effectively to meet the challenges of biotic and biotic stresses to sustain the impact of climate change in addition to quality	Character specific collection of exotic and indigenous germplasm, locating resistance source and evolving high yielding and disease resistant lines through selection, mutation, inter-generic and inter-specific crosses, polyploidy breeding and biotechnological tools for orchid improvement	Specific collection of indigenous germplasm from NEH region, western India, Western Ghats and Orissa and exotic germplasm from Thailand, Britain, Singapore, Australia, Hawaii, New Zealand will be attempted to enrich basic genetic materials Genera and species wise cataloguing of all germplasm collections using IPGRI descriptors Identification of genes contributing resistance to biotic and abiotic stress factors and quality characteristics Improvement of <i>Cymbidium</i> to develop hybrids or varieties with less pre-blooming period and resistance to viruses. Varietal evaluation of newly developed genotypes to suit specific agro-ecological conditions Development of highly adaptive and tolerant genotypes to mitigate climate change and water stress Genetic engineering and transformation for early flowering and extending shelf-life in commercial orchids Development of Bar codes for germplasm
Increasing productivity of orchids through quality planting materials production and protected cultivation	Targeting the production levels by propagating and distributing quality planting materials of improved hybrids for effective spread	Production of nucleus planting materials through mass multiplication using standardized protocols of commercial orchids Standardization of protocols for mass multiplication of endangered, rare and threatened orchid species Participatory quality planting material production of commercial orchids Developing technologies suitable for protected cultivation of disease free planting materials
Developing efficient system for management of climatic factors and nutrients to get maximum production and developing an effective model	Generation of eco-region specific technologies based on maximum productivity of available natural resources	Cost effective nutrient and agro-climatic management through optimization for quality flower production Development and popularization of cost effective agricultural practices (INM/IPM) for increasing productivity Quantification of water use efficiency and water requirements in orchids Carbon sequestration potential in orchid based cropping systems Development of profitable orchid based cropping systems with other high value flower crops. Reducing pre-blooming period of <i>Cymbidium</i> orchids using effective management practices for higher income



<p>Management of biotic stress to reduce production losses by developing diagnostics, forecasting models, biocontrol systems and effective management strategies</p>	<p>Identification of new and effective bio-molecules for management of biotic stresses coupled with development of innovative diagnostic techniques for rapid, accurate and cost effective detection of high impact pests and diseases.</p>	<p>Surveillance, identification and characterization of new invasive pests and pathogens, pest risk analysis            Characterization of rhizosphere microbial community structure and effect of engineered nanoparticles on microorganisms in the rhizosphere and non-rhizosphere            Development of rapid and reliable diagnostics against pests and pathogens including invasive species            Management of new invasive pests and pathogens</p>
<p>Post-harvest and value addition</p>	<p>Development of post-harvest technologies to improve product quality and value addition, chemo profiling and identification of new flavour / bioactive principles</p>	<p>Development of pre-harvest, harvest and post-harvest technologies for specific target groups like domestic and export market and hybrid/variety specific technologies.            Development of packaging for marketing of commercially important fresh and dried produce.            Development of orchid based technologies for dry flowers and floral arrangement.            Use of orchid waste for production of phytochemicals including pigments, food, feed, herbal medicines and essential oils.            Patenting technologies related to spices</p>
<p>Effective TOT to the target groups</p>	<p>Participatory approach for effective transfer of technologies to empower stakeholders, analyzing feedback for further refinement</p>	<p>Identification of various clusters of production, selection of beneficiaries and impart training and technical inputs in order to produce orchids of international standards            Large scale demonstration of proven technologies through FLD's and technology dissemination using advanced tools            Upgradation of Knowledge, Know How techniques, Managerial Skills and Self employment among extension functionaries, farmers, school drop outs, young man and women generations by organizing Kisan Mela, exhibition, Brainstorming session, need based and focused Training Programme, Demonstration, Model training Courses etc.            Inter-institutional collaboration to facilitate popularization of effective technologies            Commercialization of technologies and patenting            Documentation of ITK's</p>

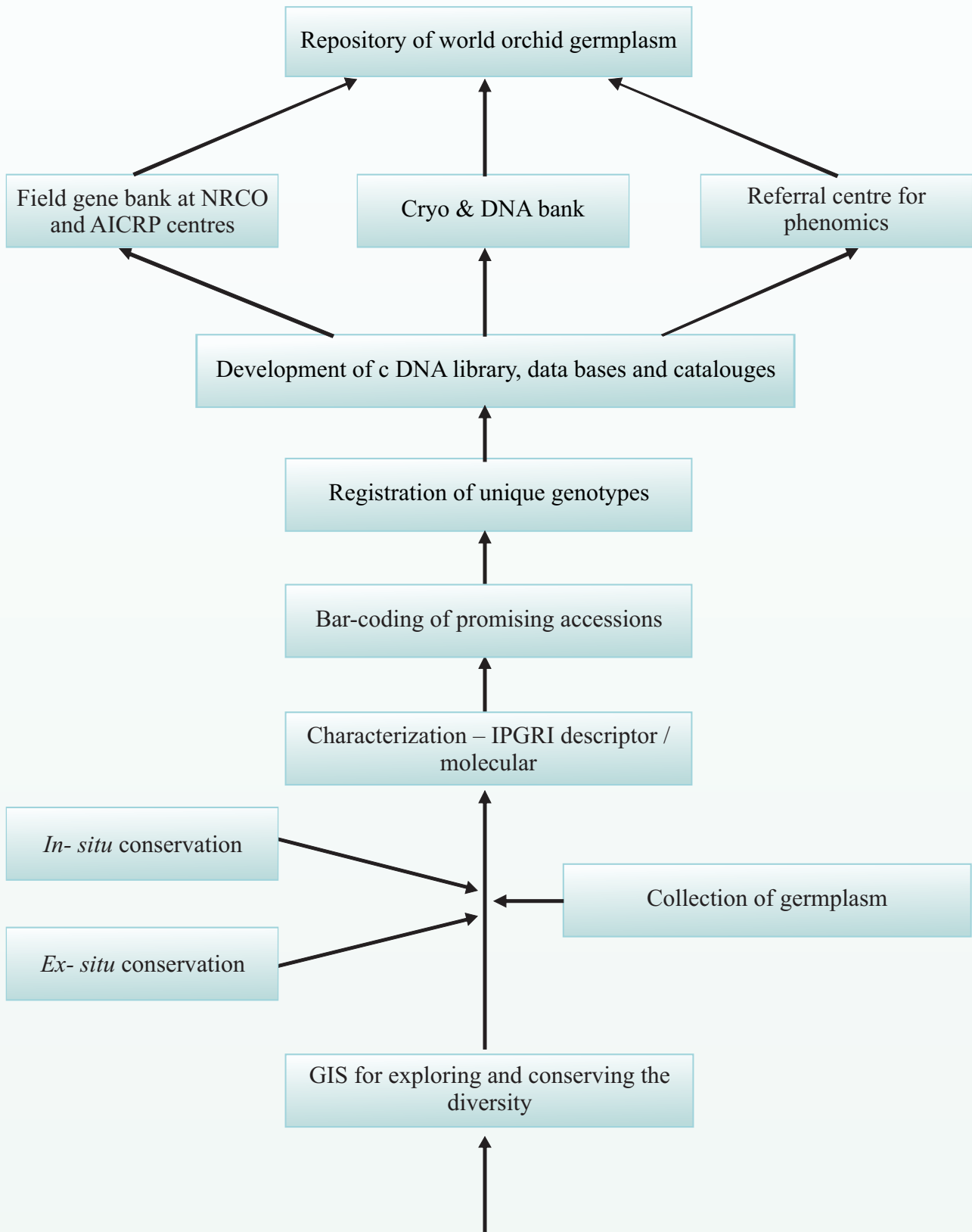
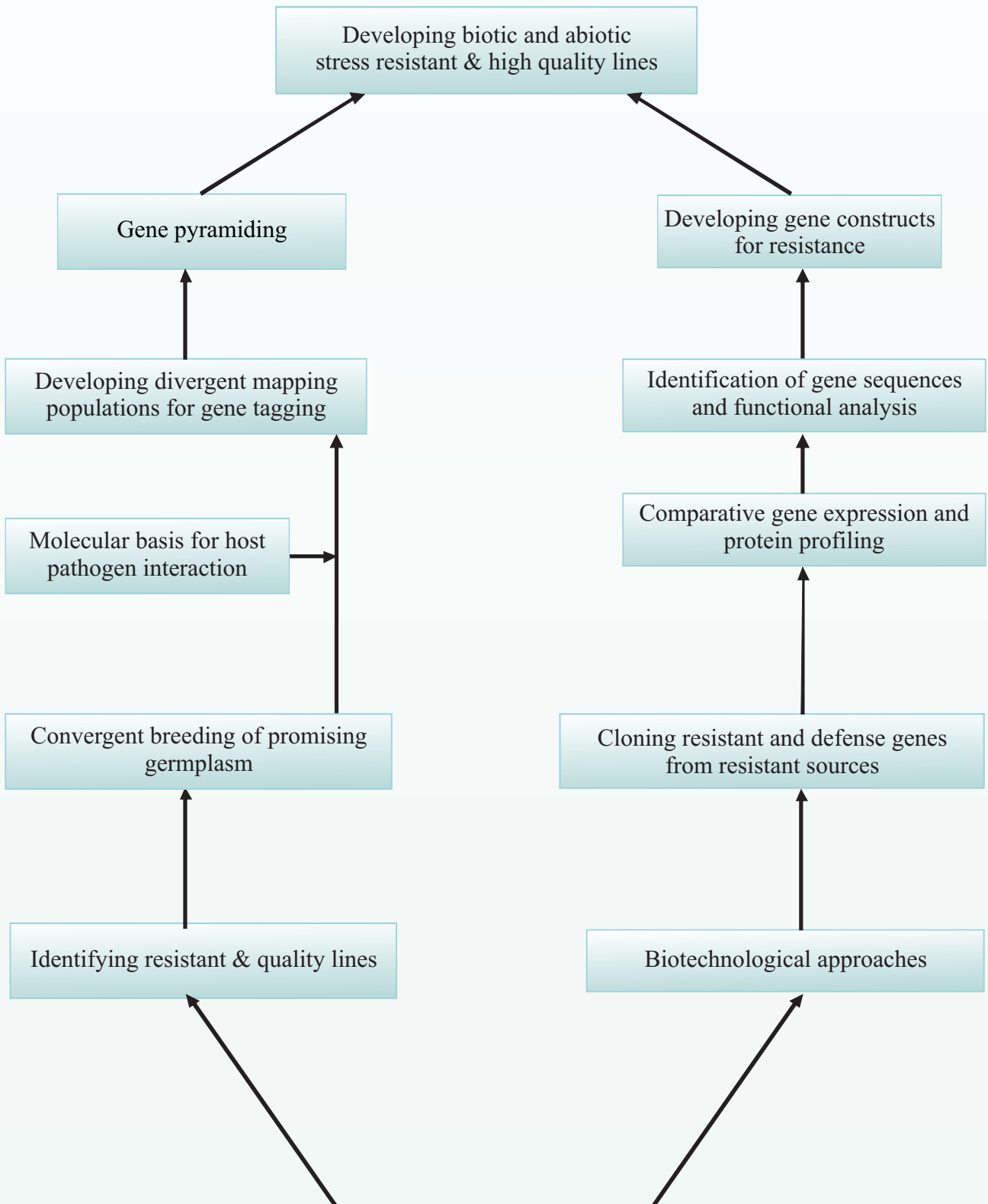


Fig 1: Conservation of genetic resources





**Fig 2:** Varietal development with resistance to biotic/ abiotic stress

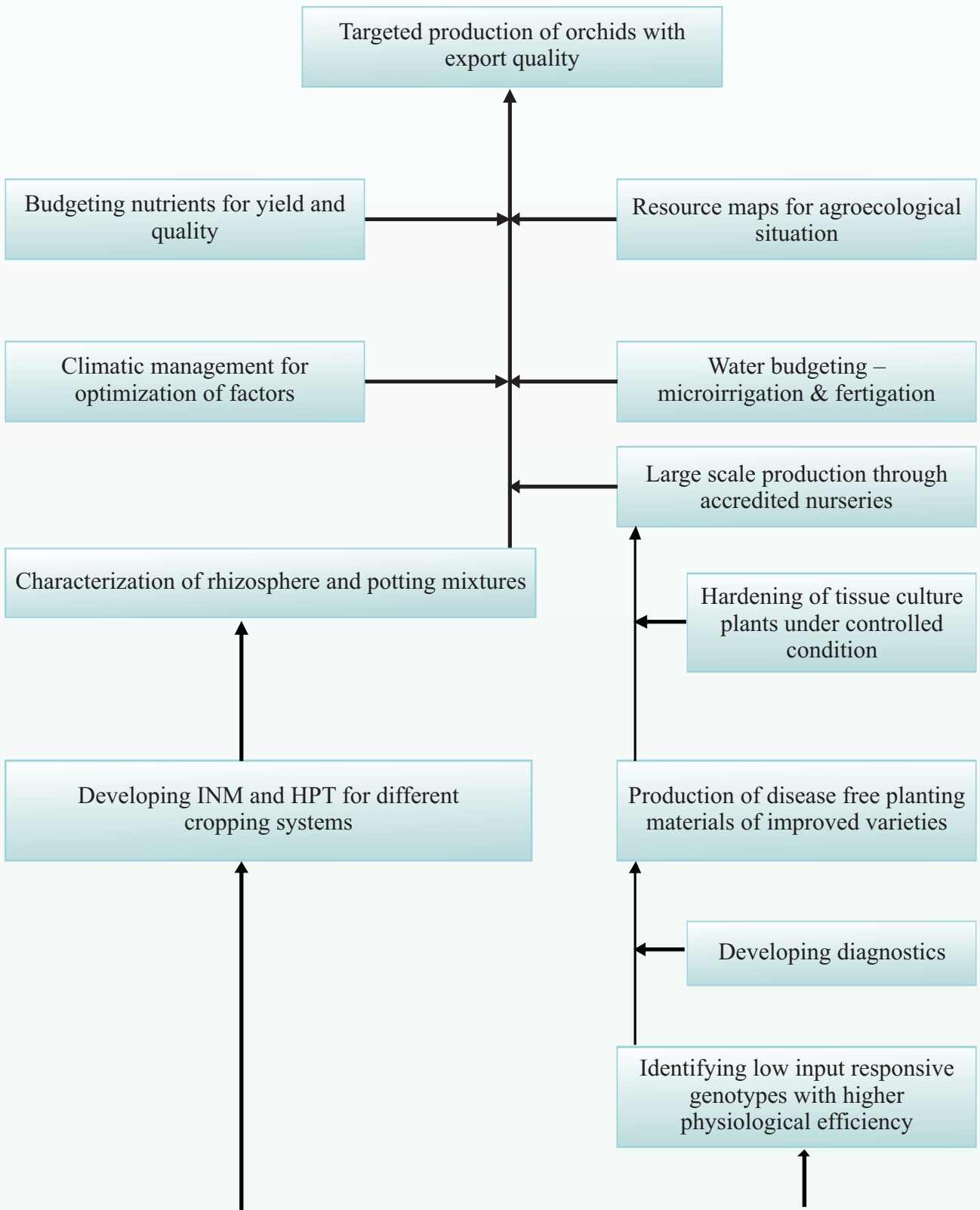


Fig 3: Resource budgeting and cropping system management



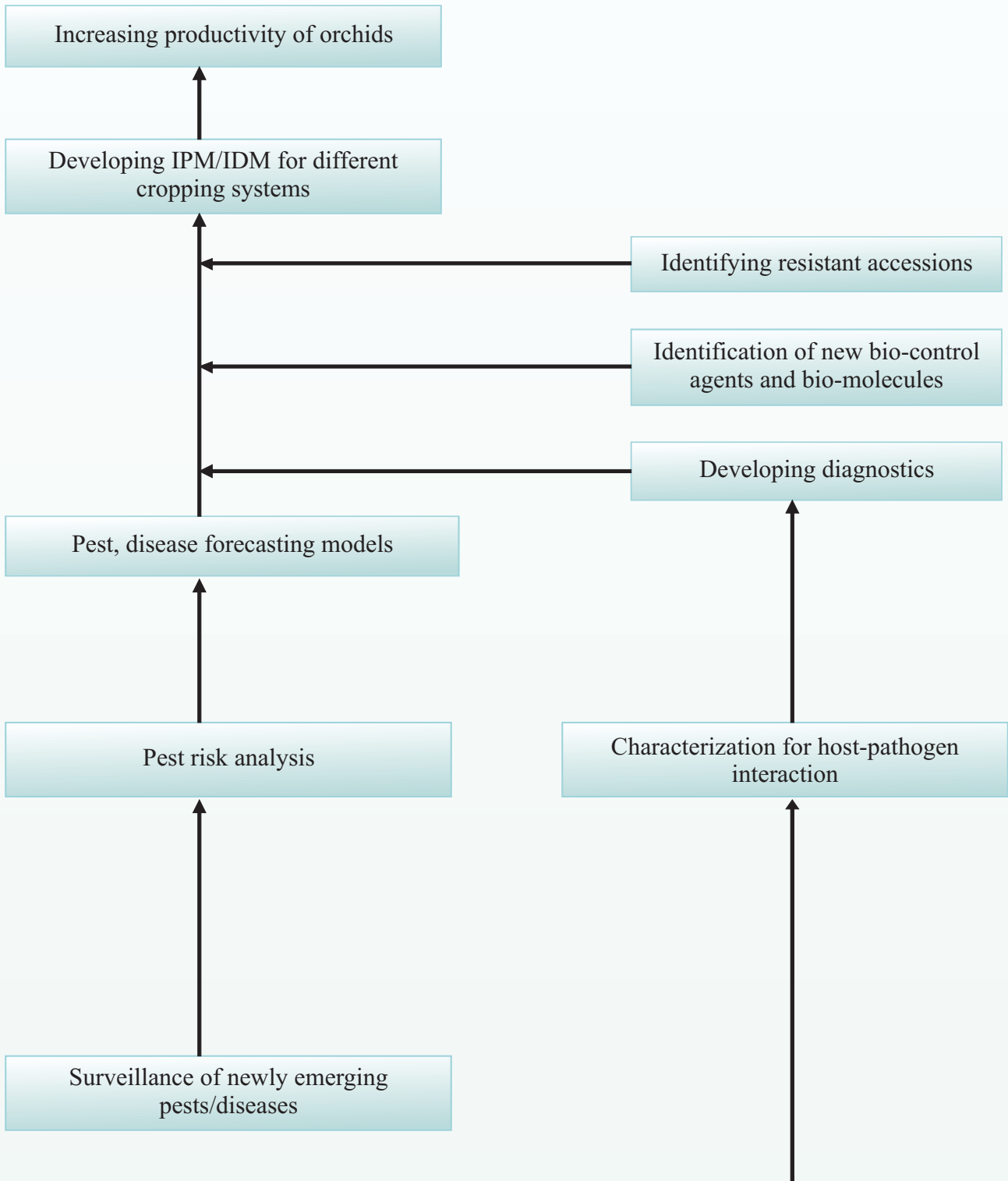
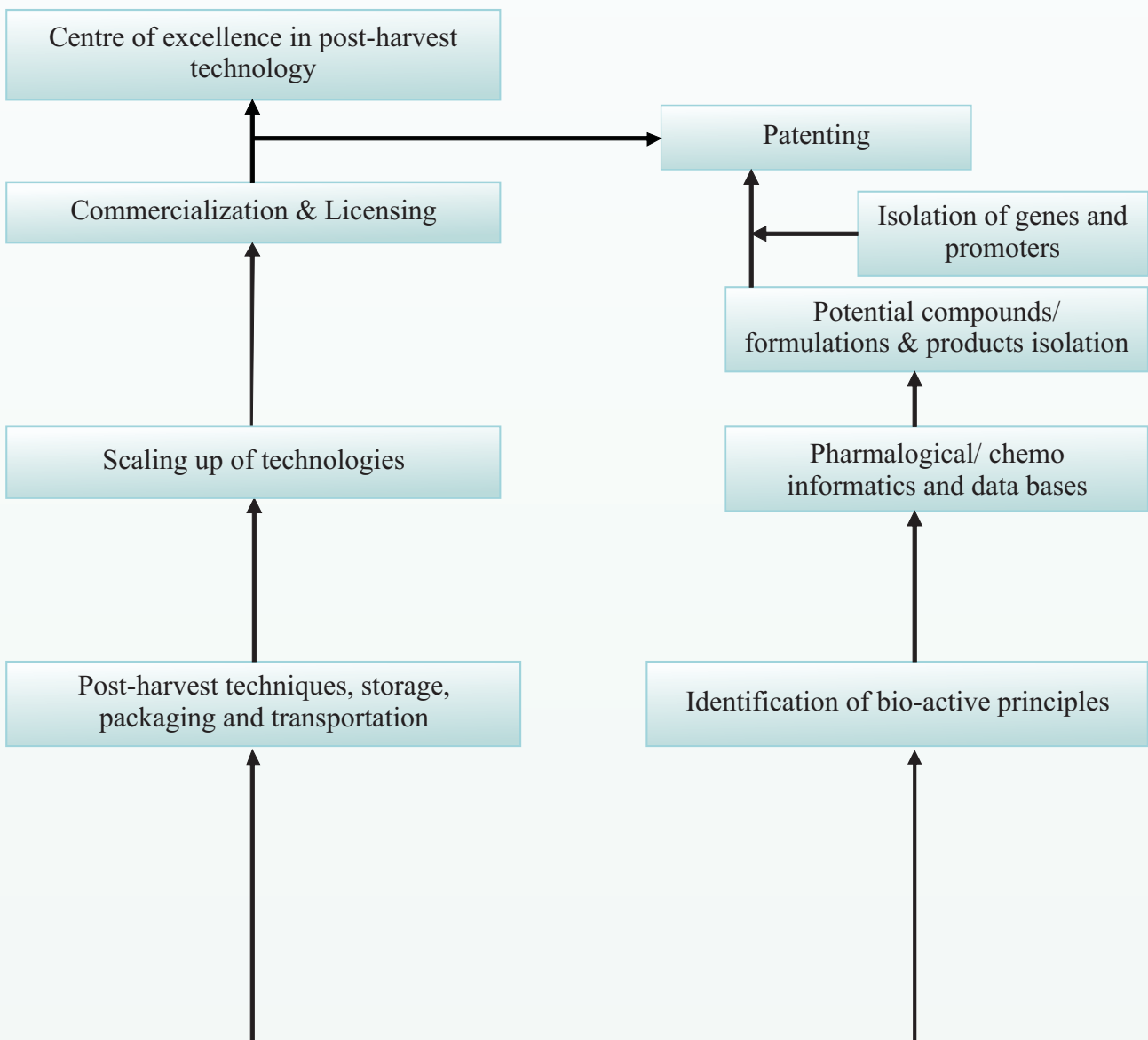
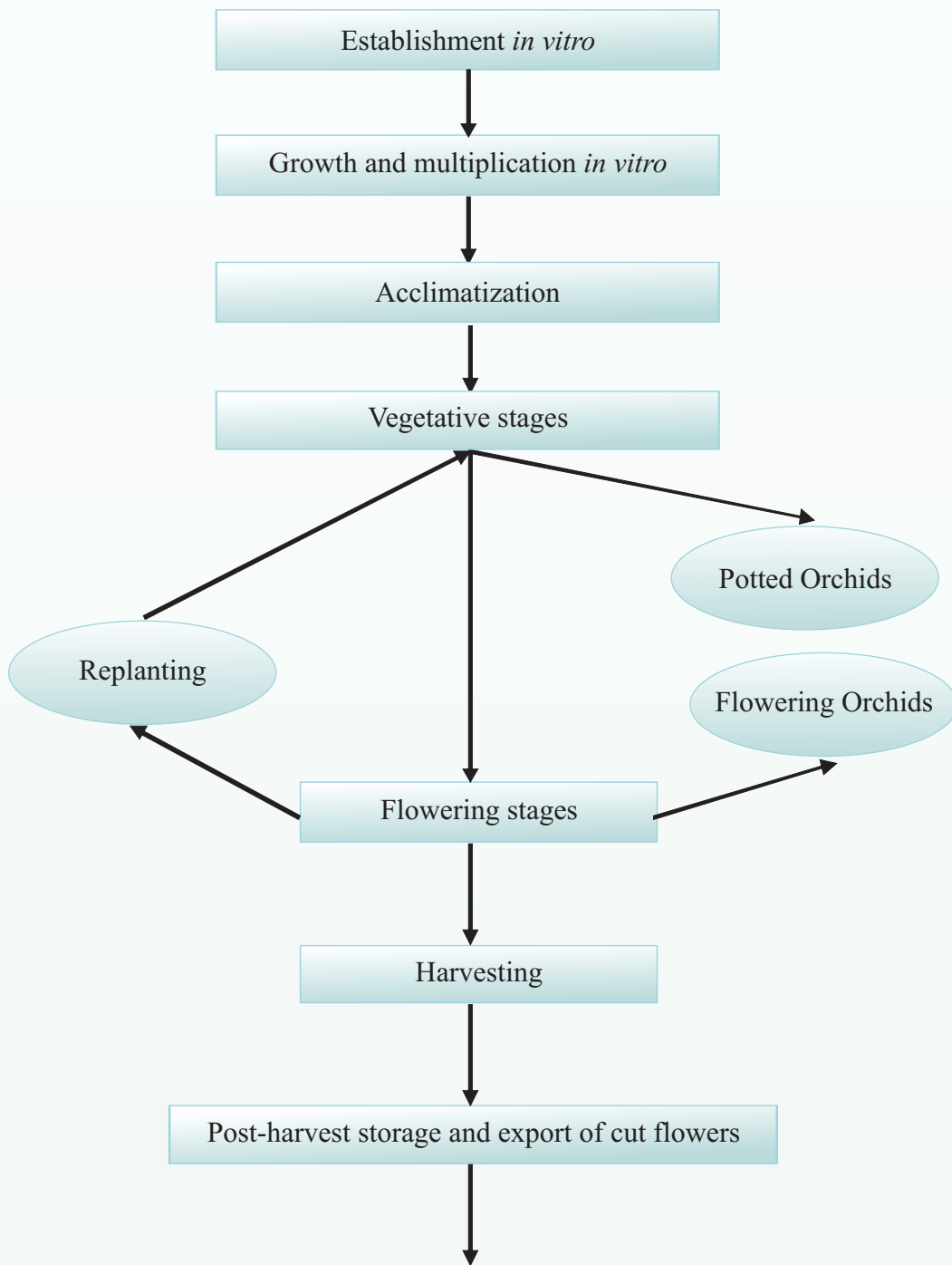


Fig 4: Bio-risk Management



**Fig 5: Post-harvest management & value addition**





**Fig 6:** Production processes in orchid industry

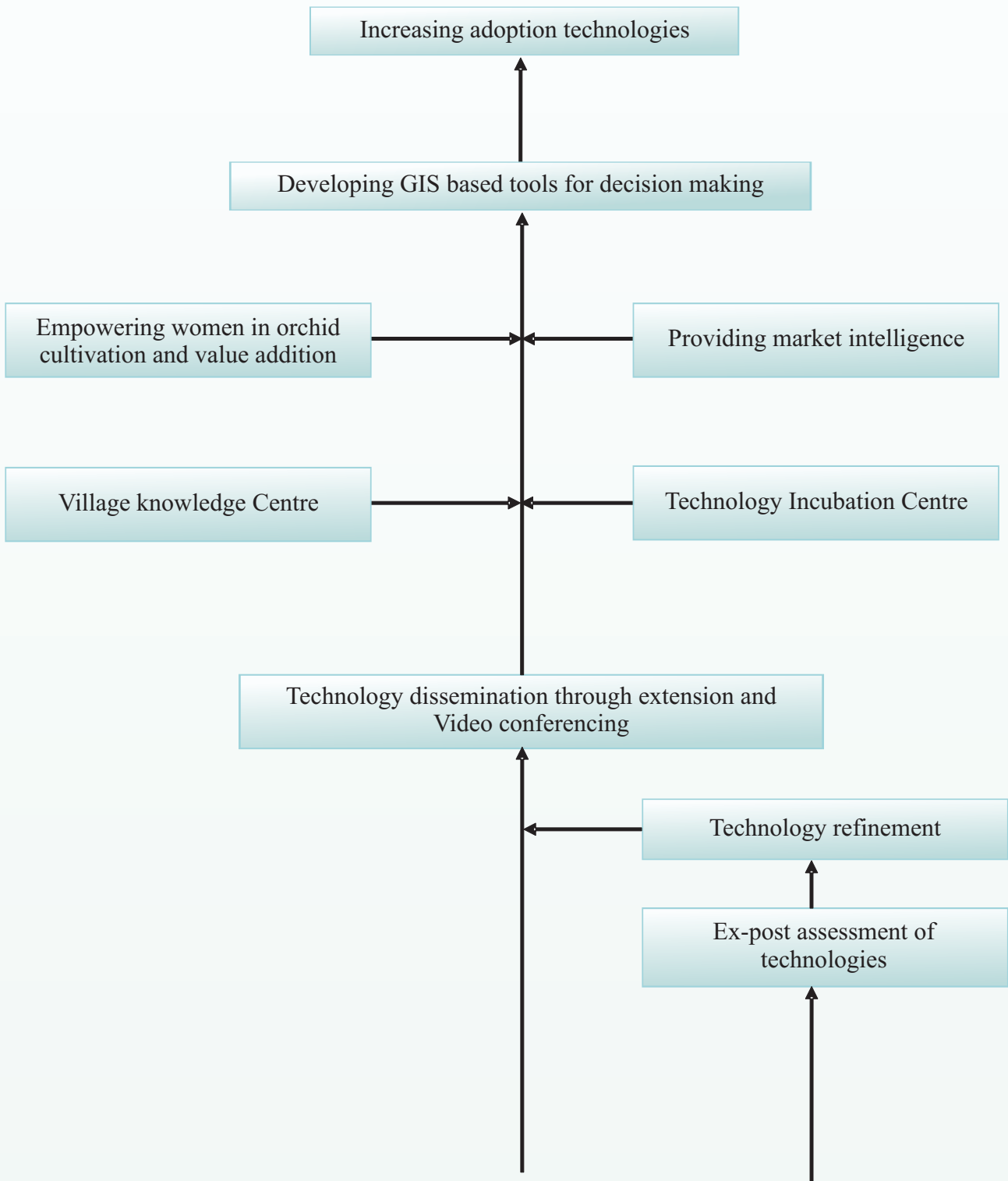


Fig 7: Technology transfer and impact assessment

