

Lantican, Flordeliza

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Ornamental Program Area Research Planning and Prioritization

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Ornamental Program Area Research Planning and Prioritization

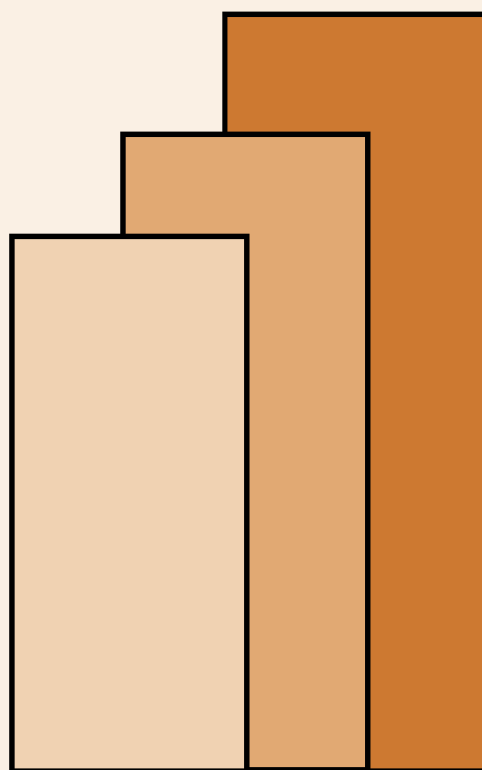
Flordeliza A. Lantican

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Abstract

The Philippine cutflower industry has evolved from a garden hobby to commercial enterprise only in the early 1980s. The production of fresh cutflowers is intended primarily to cater to the domestic market. As the preference and buying capacity of high and middle class consumers have changed and improved, domestic requirement has grown so fast in tandem with institutional demand brought about by the growing tourism industry. At present, only a limited quantity of locally produced cutflowers is traded in the international market.

The country's proximity to major international markets coupled with a favorable agro-climatic conditions and low-labor costs serve as potential basis for an export-oriented development of the industry.

Under the DA's Key Commercial Crops Development Program (KCCDP), cutflowers are among the commodities that require more government investments on marketing strategy or promotion, product development/awareness and extensive research to boost their competitiveness in the medium-term. As an emerging export winner, DOST has included ornamental horticulture as one of the priority commodities for science and technology agenda (STAND). Both government initiatives were conceived to address the industry's limitations in terms of production/propagation, pest management, and postharvest handling.

This study aims to present an industry profile with focus on domestic production, consumption, external trade, problems/constraints, and market prospects; review past researches on ornamentals, technologies generated/adopted, and the extent of participation of the private and public sectors; identify research and technology gaps for the ornamental industry; identify strengths and weaknesses in the institutional structure of research and extension interface, including physical and manpower investments and research complementation efforts; and suggest recommendations and R&D agenda for the ornamental industry to be used by DA-BAR in research planning and prioritization.

Final Report

Ornamental Program Area Research Planning and Prioritization¹ Flordeliza A. Lantican²

1. Introduction

1.1 Background

Ornamentals are categorically classified into cutflowers, foliage, plant parts, live plants, and dried flowers and plants. The most popular cutflower cultivars produced in the Philippines are orchids, anthuriums, roses, gladioli, heliconias, and chrysanthemums. These usually come in various arrangements such as corsages, wreaths and other creative forms. Some important foliage plants grown include ferns, palms, podocarpus, crotons, dracaenas and murrayas.

The Philippine cutflower industry has evolved from a garden hobby to commercial enterprise only in the early 1980s. The production of fresh cutflowers is intended primarily to cater the domestic market. As the preference and buying capacity of high and middle class consumers have changed and improved, domestic requirement has grown so fast in tandem with institutional demand brought about by the growing tourism industry. At present, only a limited quantity of locally produced cutflowers is traded in the international market.

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Under the DA's Key Commercial Crops Development Program (KCCDP), cutflowers are among commodities that require more government investments on marketing strategy or promotion, product development/awareness and extensive research to boost their competitiveness in the medium term. Along the same vein, DOST has included ornamental horticulture, as an emerging export winner, one of the priority commodities for science and technology agenda (STAND). Both government initiatives were conceived to address the industry's limitations in terms of production/propagation, pest management, and postharvest handling.

¹ Final report of research project commissioned by the Philippine Institute for Development Studies and the Department of Agriculture-Bureau of Agricultural Research.

² Associate Professor, Department of Agricultural Economics, College of Economics and Management, University of the Philippines Los Baños. The author acknowledges the excellent assistance provided by Mrs. Cecilia M. Lantican and Mr. Alexis Garcia in the data processing and preliminary analysis.

This study is an offshoot of the DA-BAR and PIDS collaboration in an attempt to harness the industry's potential through strengthening R&D planning and prioritization.

1.2 Objectives

1. Present an industry profile with focus on domestic production, consumption, external trade, problems/constraints, and market prospects;
2. Review past researches on ornamentals, technologies generated/adopted, and the extent of participation of the private and public sectors;
3. Identify research and technology gaps for the ornamental industry;
4. Identify strengths and weaknesses in the institutional structure of research and extension interface, including physical and manpower investments and research complementation efforts; and
5. Suggest recommendations and R&D agenda for the ornamental industry to be used by DA-BAR in research planning and prioritization.

2. Industry Profile

2.1 Domestic Production

Due to data constraints, analysis on domestic production of ornamental horticulture focuses only on the major cutflowers grown in the country such as anthuriums, chrysanthemums, roses, orchids and gladioli. The discussion on external trade of ornamentals covers only fresh and dried cutflowers, live plants, fresh foliage and other plant parts. In 1997, the aggregate production of the five cutflower types reached 9.01 million dozens covering a total area of 937 hectares (Table 1). On the average, from 1990-1997, the country's production of the five cutflower types was 13.60 million dozens from 1,100 hectares. Such figures marked an average growth rate of 33.45% in production and 5.44 % in area harvested.

2.1.1 Anthuriums

The commonly grown varieties in the Philippines include Kaumana (red), Nitta (orange), Chandler (dark pink), Kaonaiwan (white), Gloria Angara (light red), and Baguio white (Rosario, 1997). Large-scale farms also grow Holland varieties particularly Midori (light green), Mauricia (dark pink), Alexis (red), Tropical (red), Margaretha (white with red spadix), Fantasia (white with faint pink veins), and Obakes (characterized by the greenish color on the spathes). Paradiso, Sultan, President, and Aphrodite are examples of Obakes. Atlanta, Texas, Montana and Arizona are the most popular varieties for potted plants.

Table 1. Area harvested, production and yield of selected Philippine cutflowers, 1990-1997.

Cutflower Type	1990	1991	1992	1993	1994	1995	1996	1997	Average 1990-1997	Average Annual Growth Rate
Anthurium										
Area (Ha)	55	60	65	87	101	106	112	104	86	10.12
Production ('000 Doz)	97	108	137	171	260	275	287	290	203	18.03
Yield ('000 Doz/Ha)	1.76	1.80	2.11	1.97	2.57	2.59	2.56	2.79	2.27	7.42
Chrysanthemum										
Area (Ha)	61	218	248	86	90	96	94	103	125	32.09
Production ('000 Doz)	297	8,178	8,867	1,750	1,965	942	987	1,228	3,027	367.30
Yield ('000 Doz/Ha)	4.87	37.51	35.75	20.35	21.83	9.81	10.50	11.92	19.07	85.03
Rose										
Area (Ha)	225	249	257	300	269	284	271	277	267	3.36
Production ('000 Doz)	1,879	2,560	2,285	3,274	3,279	3,478	3,783	3,978	3,065	12.70
Yield ('000 Doz/Ha)	8.35	10.28	8.89	10.91	12.19	12.25	13.96	14.36	11.40	8.77
Orchids										
Area (Ha)	52	55	64	76	79	92	89	94	75	9.09
Production ('000 Doz)	565	683	731	941	1,106	1,199	1,286	1,615	1,016	16.49
Yield ('000 Doz/Ha)	10.87	12.42	11.42	12.38	14.00	13.03	14.45	17.18	13.22	7.22
Gladioli										
Area (Ha)	389	682	749	527	628	641	397	359	547	4.16
Production ('000 Doz)	2,540	8,972	10,049	6,087	9,097	9,670	1,891	1,896	6,275	28.77
Yield ('000 Doz/Ha)	6.53	13.16	13.42	11.55	14.48	15.08	4.76	5.28	11.47	12.78
TOTAL										
Area (Ha)	782	1,264	1,383	1,076	1,167	1,219	963	937	1,100	5.44
Production ('000 Doz)	5,378	20,501	22,069	12,223	15,707	15,564	8,234	9,007	13,586	33.45
Yield ('000 Doz/Ha)	32.38	75.17	71.59	57.16	65.08	52.77	46.23	51.53	56.00	14.46

Source: Bureau of Agricultural Statistics

The area harvested to anthuriums increased annually by 10.12% on the average from 1990 to 1997. The positive growth could be attributed to the cultivation of new areas and increase in number of new entrants in the cutflower industry. Anthurium production for the same period increased by 18.03% annually from 97,000 dozens in 1990 to 290,000 dozens in 1997.

2.1.2 Chrysanthemums

Chrysanthemums are herbaceous bushes that produce flowers in clusters or in a single, large or medium-sized flower per stalk with varying colors, sizes, shapes, hardness and long-lasting characteristics.

The area cultivated to chrysanthemums doubled from 61 hectares in 1990 to 103 hectares in 1997. As a result, production increased significantly by more than 300% annually, from 297,000 dozens in 1990 to 1.2 million dozens seven years later. The remarkable improvement in production could be attributed to the expansion in hectarage of growers cultivating Holland and Malaysian varieties in Cavite, Benguet, Cebu, Misamis Oriental and Davao.

2.1.3 Roses

Roses can be cultivated in pots, greenhouses and/or substrates. Rose propagators in the Philippines use different varieties for local consumption and exports. The widely cultivated American varieties which include the Bravo red variety are highly demanded especially during Valentines Day. The other well-sought varieties are Queen Elizabeth which is characterized by its striking color, the Perfume Delight which exudes a very appealing scent, and the Mercedes which has a long vase life of seven days.

Between 1990 and 1997, there was a slight change in area planted to roses as indicated by a minimal growth of only 3.36% annually. However, production more than doubled, rising annually at 12.70% as yield improved by 8.77% per year in key supply centers in Benguet, Davao and Cebu. From approximately 1.9 million dozens in 1990, production increased nearly to 4.0 million dozens in 1997.

2.1.4 Orchids

Orchids are herbaceous perennials consisting of over 10,000 species. Dendrobium and Vanda are the most popular cutflower types in the country. Other preferred orchid genera are cattleyas, oncidiums and phalaenopsis.

The total area devoted to orchids grew by 9.09% from 1990 to 1997. The average area of 75 hectares produced an average of 1.02 million dozens of flowers for the past eight years, growing at 16.49% per annum. The increasing number of

blooming plants in Negros Occidental, Davao and South Cotabato resulted in better harvests.

2.1.5 Gladioli

Gladioli are tuberous horticulture plants and have wide, sword-shaped leaves that produce large flowers in thick clusters along the stalk. The major varieties grown in the country are the Red Japanese and Friendship Pink.

Despite the damages caused by a strong typhoon in the mid 1990s, gladioli still posted a positive growth in production of 28.77% annually as the expansion in hectareage and improvement in yield in the early 1990s more than offset the contraction in the latter period. Gladioli production reached 1.9 million dozens in 1997.

2.2 Domestic Demand

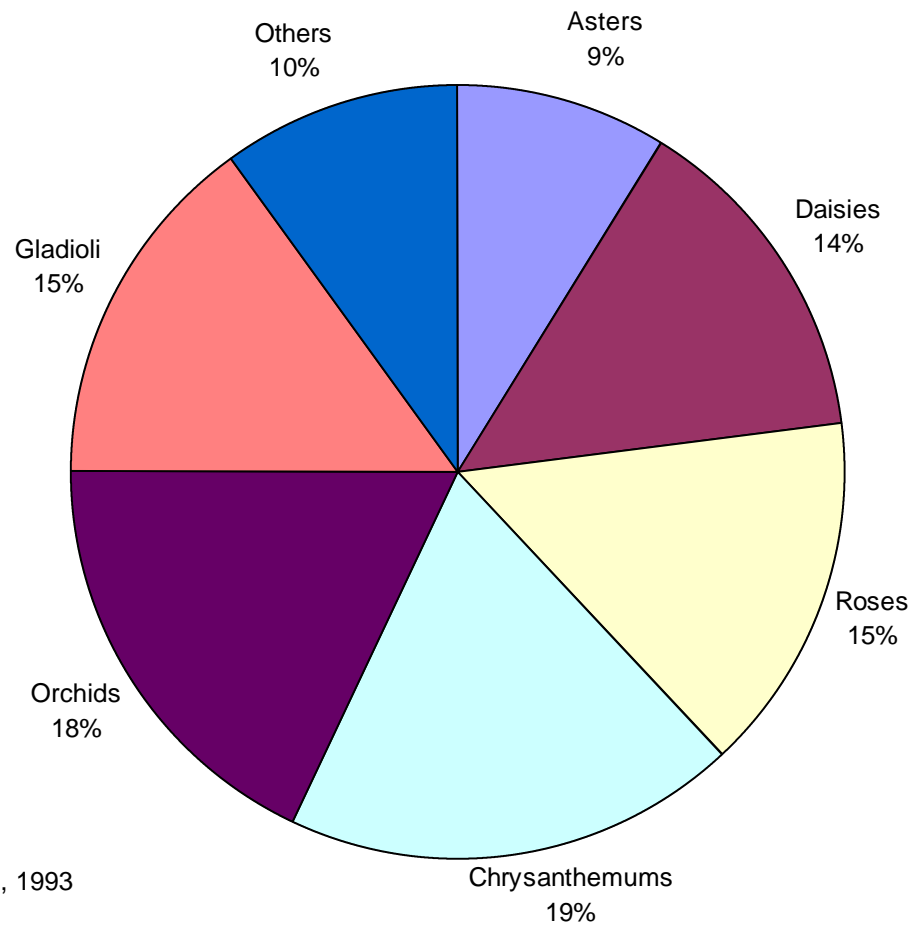
The ornamental horticulture industry has shown steady growth in the local market. The cutflower industry has demonstrated high consumption in the local market due to the increasing number of middle and high-income classes and changing consumer preferences, along with expanding institutional demand driven by the growth of tourism.

Local growers sell their cutflowers to traders and retailers or directly to flowershop operators in major demand centers particularly Metro Manila and Cebu where bulk of cutflower supply is absorbed. In terms of volume, approximately 85% of the total demand takes place in Manila and Cebu.

There are no available official statistics yet on consumption of cutflowers in the Philippines. Neele (1993) estimated that the total demand for cutflowers in 1993 reached 9.4 million dozen stems. Chrysanthemums were the most preferred cutflower type, accounting for 19% of the total demand (Figure 1). Orchids (18%), roses (15%), gladioli (15%) and daisies (14%) were also popular among Filipinos.

The rising number of nursery operators, real estate developers and landscapers implies an increasing demand for foliage plants. Some foliage plants serve as accents in floral decorations displayed in hotels, restaurants, offices and malls. Others like palms, “Song of India” and “Song of Jamaica” are the favorite centerpieces in landscaping.

Figure 1. Estimated Consumption of Cutflowers by Type of Flower, 1993.



Source: Neele, 1993

2.3 External Trade

2.3.1 Exports

The overall export performance of ornamentals in terms of value appears favorable particularly for live plants (41%) and fresh foliage and other parts (27%). These ornamentals accounted for two-thirds of the total export earnings while the balance was contributed by dried flowers and plants (20%) and fresh cutflowers (12%) in 1997 (Figure 2). The Philippine ornamental exports grew by 6.22% annually, from U.S. \$1.50 million in 1991 to U.S. \$1.98 million in 1997.

Exports of live plants, fresh foliage and other plant parts earned for the country a total of US\$ 1.98 million in 1997 (Table 2). The value of exports rose by 16.05% for live plants and 16.62% for fresh foliage and other plant parts annually from 1991 to 1997. The major importers of live plants included Japan (47%), Korea (25%), and Malaysia (20%). For fresh foliage and other plant parts, the important markets were United States (84%) and Canada (12%) as shown in Figure 3.

The Philippine cutflower exports exhibited a positive growth for both fresh and dried form. The value of fresh cutflower exports grew by 23.3% annually despite of a downward trend in exports from 1995 to 1997. The rise in export earnings due to improvement in production of several cutflower types brought about by expansion in area planted and increase in the number of blooming plants in key production areas during the early 1990s offset the decline in the value of exports in the later part of the 1990s. For dried flowers and plants, export earnings improved from US\$ 291,000 in 1991 to US\$ 392,000 in 1997 or at a growth rate of 16.05% annually.

A study made by FRLD (1993) indicated that peak selling months for cutflowers in the export market are January, April, September and December, when demand for specific cutflower types like anthuriums and heliconias in some importing countries like Japan is high. The main market for fresh cutflowers was Japan, absorbing almost all (99%) of the country's exports (Figure 3). Other foreign buyers of fresh cutflowers included Hongkong (0.43%) and Singapore (.07%). For dried flowers, the leading buyers were the Netherlands (49%) followed far behind by Lebanon (11%), Portugal (8%), Kuwait and Korea (both 6%), Taiwan (5%), and Japan (4%).

2.3.2 Imports

The total value of imported ornamentals reached US\$ 1.63 million in 1997. Live plants accounted for the bulk (89%) of the country's ornamental imports, followed by dried flowers and plants (6%), and fresh cutflowers (5%) in 1997 (Figure 4).

Figure 2. Value of Philippine Ornamental Horticulture Exports by Product Group, Philippines, 1997.

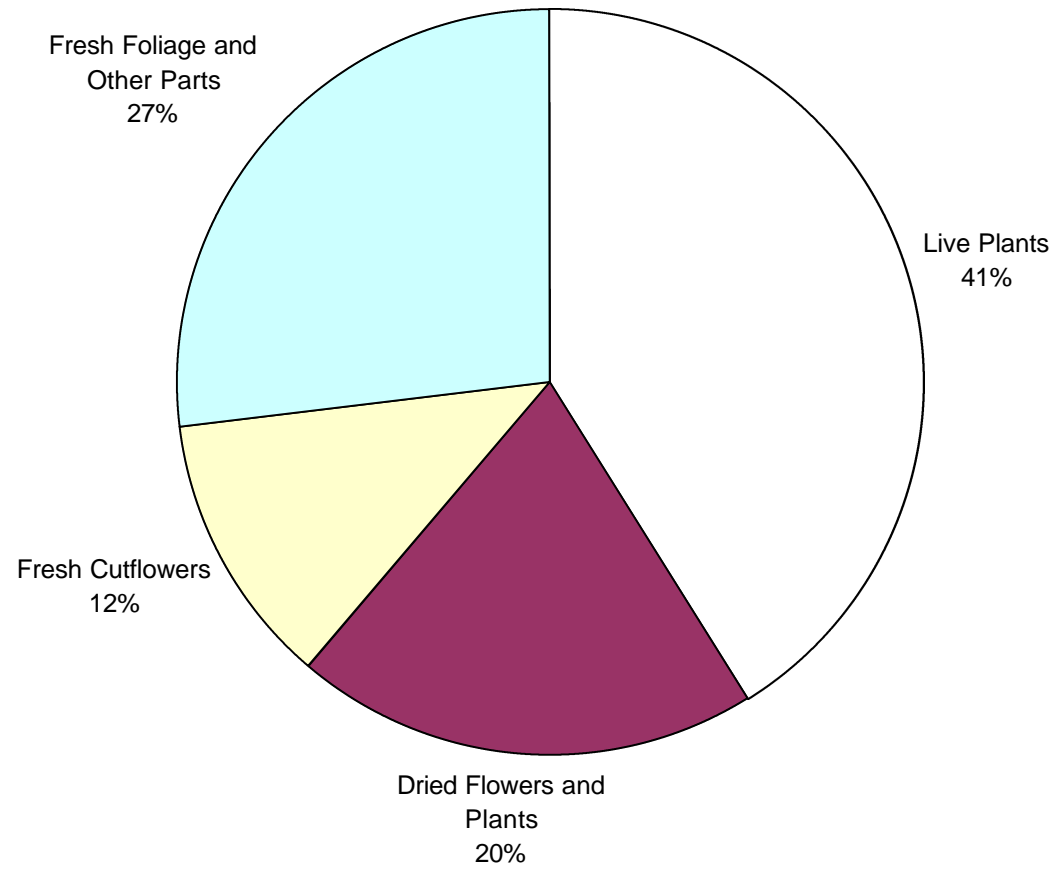


Table 2. Philippine exports of cutflowers and other ornamentals, Philippines, 1991-1997 (FOB US\$'000)

TYPE OF ORNAMENTALS	1991	1992	1993	1994	1995	1996	1997	AVERAGE (1991-1997)
Fresh Cutflowers	142	341	611	625	500	410	234	409
Fresh Foliage and Other Parts of Plants	431	399	442	663	595	748	544	546
Live Plants	635	645	360	318	281	703	812	536
Dried Flowers and Plants	291	348	156	123	217	371	392	271
TOTAL	1,499	1,733	1,569	1,729	1,593	2,232	1,982	1,762

Source: National Statistics Office

Figure 3. Market Shares of Different Countries Importing Ornamental Plants from the Philippines, 1997.

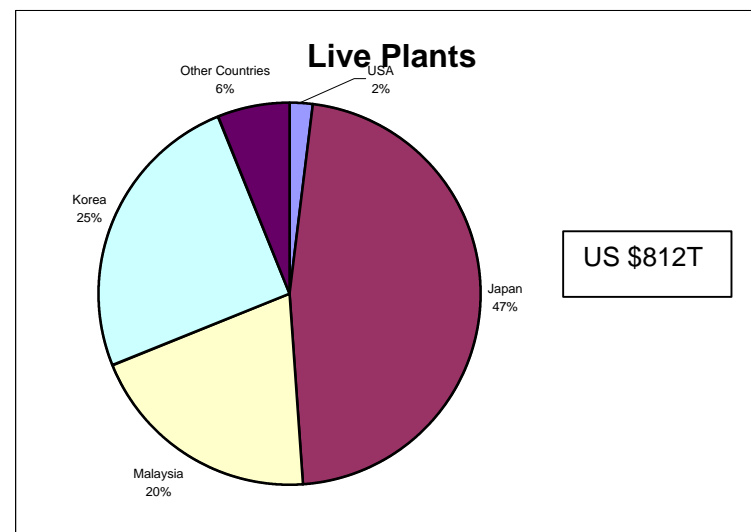
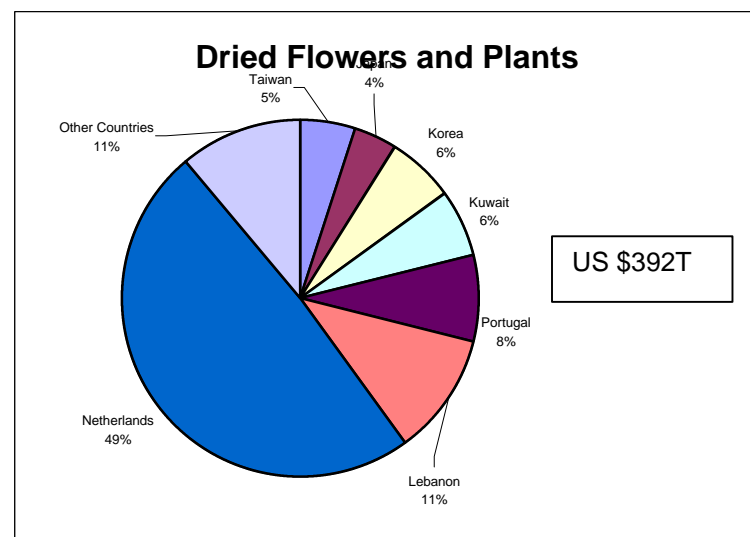
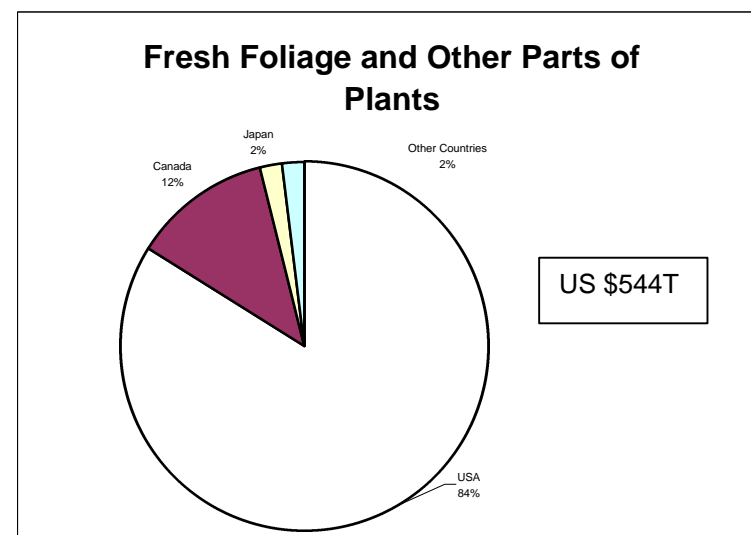
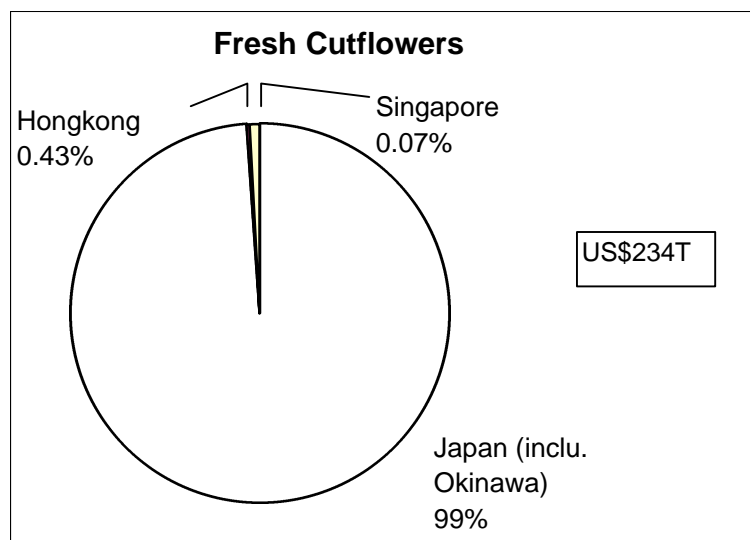
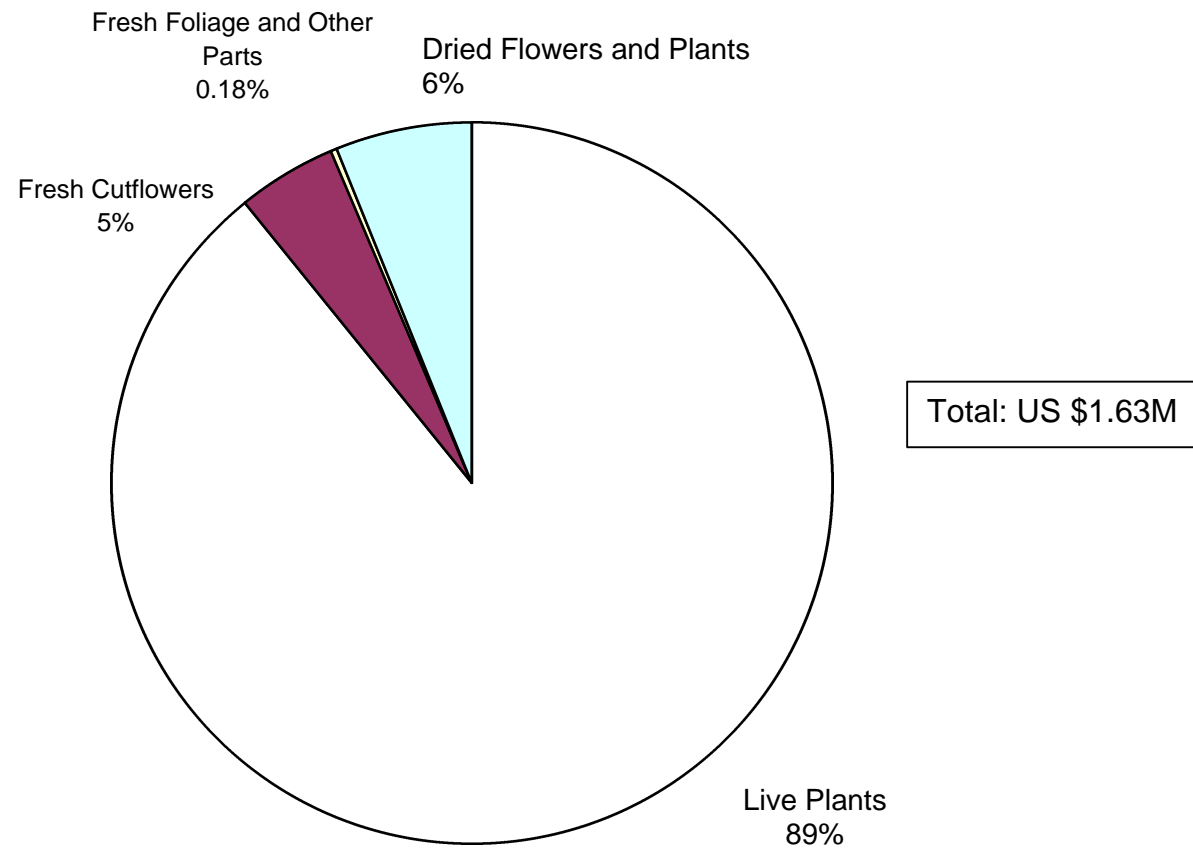


Figure 4. Value of Ornamental Horticulture Imports by Product Group, Philippines, 1997.



For eight years, imports of live plants rose significantly, from a minimal value of US\$ 154,000 in 1991 to as high as US\$ 1.46 million in 1997 (Table 3). Israel (69%), Thailand (8%) and Netherlands (8%) were the dominant suppliers of live plants, providing 85% of the total imports in 1997 (Figure 5).

Dried flowers and plants imported abroad also posted a remarkable increase in value from a low US\$ 3,000 in 1991 to as high as US\$ 102,000 (Table 3). United States (51%) and Australia (43%) were the main suppliers of these ornamentals (Figure 5).

The Philippines also imports cutflowers to augment domestic supply particularly during Holidays and for other special occasions. From 1991-1997, the country's value of fresh cutflower imports showed a positive growth of 40.18% annually. However, imports of fresh cutflowers between 1995 and 1997 declined from US\$ 196,000 to only US\$ 74,000 partly due to an increase in the domestic production (Table 3). Cutflower imports generally peak during the last two weeks in October, the period heading toward All Saint's Day celebration in November, March for Graduation Day, May for the Flores de Mayo and other festivities for Yuletide season. Among ornamental exporting countries to the Philippines in 1997, the Netherlands supplied 34% of the volume of fresh cutflowers, followed by Malaysia (33%) and Thailand (15%). For fresh foliage and other plant parts, the Netherlands still provided the biggest bulk (49%), then Hongkong (26%) and Malaysia (12%). The United States and Australia were the leading suppliers of dried flowers and plants, with 51% and 43% market shares, respectively. Israel was the main provider of live plants (69%) (Figure 5).

2.4 Problems and Constraints Affecting the Ornamental Industry

2.4.1 Production - related

The major problems and constraints adversely affecting the operations of ornamental growers are as follows: (1) lack of proper diagnosis and control of plant pests and diseases; (2) limited access to new production technology and planting materials; (3) limited access to financial resources; and (4) high production costs.

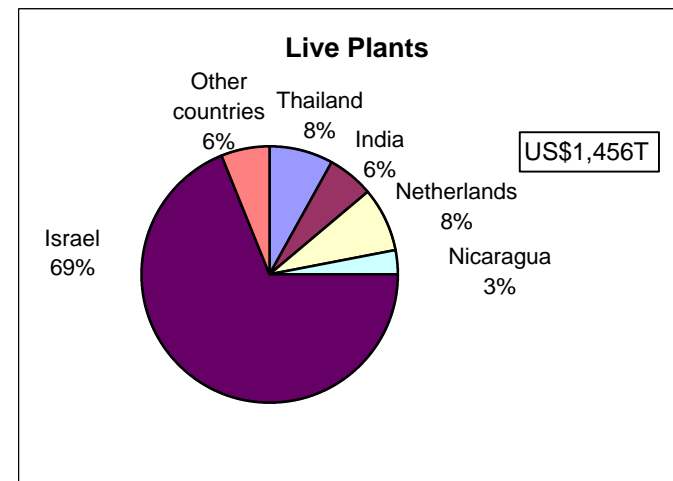
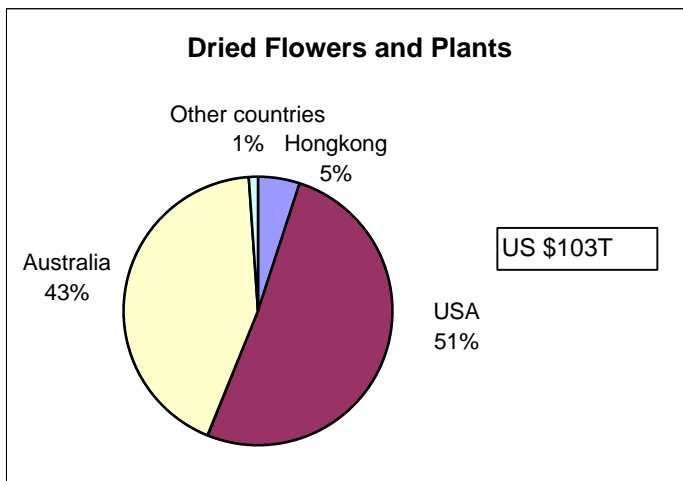
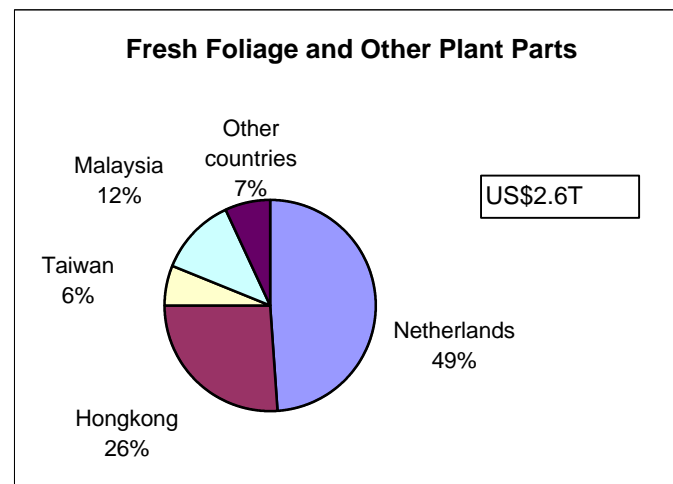
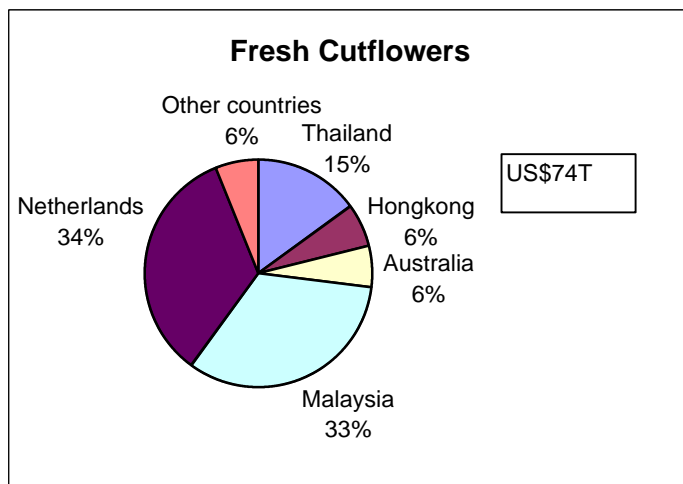
There are several ornamental growers in major production centers who are still unaware of the pests and diseases that hamper their productivity largely because of a lack of technical knowledge on pest and disease management. Orchid growers in Laguna and Davao for instance, have the barest knowledge on the control of root and stem rot, bud drop and mite infestations. Gladioli growers in Benguet and Laguna complain of corm-rotting as an uncontrollable disease. Anthurium growers of Laguna, Batangas, Negros Occidental and Davao have to deal with bacterial blight, a disease which has taken a heavy toll on the anthurium population nationwide. The chrysanthemum producers in Benguet and Cebu have

Table 3. Philippine Imports of Cutflowers and Other Ornamentals, 1991-1997 (FOB US\$'000).

TYPE OF ORNAMENTAL	1991	1992	1993	1994	1995	1996	1997	AVERAGE (1991-1997)
Fresh Cutflowers	44	178	179	216	196	142	74	147
Fresh Foliage and Other Parts of Plants	-	-	-	1.4	60	58	3	31
Live Plants	154	785	555	842	672	529	1455	713
Dried Flowers and Plants	3	0.39	-	16	8	38	102	28
TOTAL	201	963	734	1,075	936	767	1,634	919

Source: National Statistics Office

Figure 5. Market Shares of Different Countries Exporting Ornamental Plants to the Philippines, by Type and Form, 1997



to contend with bacterial wilting, a common disease during the initial stages of production.

The second critical problem affecting the growers is limited access to new production technology and quality planting materials. Most of the small-scale growers still practice traditional cultural management techniques, resulting in inefficient and costly production thus rendering their products less competitive with imported ones in the domestic market. Due to limited access to new planting materials, growers still utilize traditional planting stocks that are less productive and of inferior quality. Only a few large-scale growers can source new planting materials directly from notable breeding centers abroad. Technology adoption likewise is evident to few large-scale growers who have the capability, resources and access to it.

The major constraints which hamper access to financial support primarily come in the form of restrictive requirements imposed by many financial institutions. Growers identify the need for collateral to secure credit, short grace periods for loans, and prohibitive interest rates as the inhibiting factors to capital sourcing from the banking institutions..

The last critical problem affecting growers is the high production costs caused mainly by an increase in the price of chemicals and fertilizers.

2.4.2 Marketing

The common marketing problems encountered by key players in the ornamental industry are: (1) limited access to reliable market information; (2) lack of quality standards; (3) inadequate market infrastructure; and (4) limited access to credit support.

Key participants in the ornamental industry experience limited access to reliable and accurate market information pertaining to production statistics, quality requirements, preferred varieties, seasonality of production, prices at various market levels, and supply and demand situation in the domestic and export markets.

Ornamental growers express the need to be informed on variety and quality standards required by traders and end-users such as households and institutional buyers (hotels, flowershops and funeral parlors). Unavailability of such information keeps them to cling on the traditional ornamental varieties/cultivars thus limiting also the market possibilities for them.

Cutflower producers in Benguet, Cebu and Davao, on the other hand, are highly dependent on traders as their main source of information. Benguet rose growers have no means of checking the accuracy and reliability of information

furnished. There are cases when they receive information from traders about the buying price two weeks after the deal is made.

The present sorting system widely adopted by ornamental growers is based on subjective personal judgement of stem length, size of flowers, quality and variety rather than on well-defined and objective standards.

The lack of packing houses for packaging and conditioning before transport and poor road network from the major production sites to the demand centers is a major industry concern as these adversely affect the quality of ornamentals. Access to the cutflower producing barangays in Ambiong (Benguet) and Pung-ol and Sirao (Cebu) is hampered by unpaved roads especially during the wet season, the main cropping of cutflowers. Traders in Baguio find difficulty in marketing cutflowers when major landslides occur along the major road networks leading to the lowlands. Inadequate transport facilities is a common complaint among Visayas and Mindanao-based traders.

Limited access to credit sources is also a major problem of traders. Considering that postproduction practices and transportation of ornamentals constitute the bulk of marketing costs, the traders need capital to maintain the quality of ornamentals and at the same time facilitate their movements from the major production sites to the key demand centers. Formal lending institutions offer loans to business enterprises with interest rates ranging from 18% to 26%, which florists and retailers find beyond their capacity to pay. Some traders could not meet the collateral requirements demanded by financial institutions. The shortness of the grade period (6-8 months) is another common complaint, since the productivity of ornamentals like cutflowers starts only by the second and third years of operation.

2.5 Market Prospects

In general, the Philippine ornamental horticulture industry looks promising. Despite the onset of the Asian currency crisis in 1997, producers of high quality flowers have experienced an increase in demand. This implies that the domestic market has become increasingly discriminating which explains why certain imported cutflowers are more saleable than local ones.

According to industry sources, those producing low quality cutflowers were adversely affected by the regional financial crisis. Cutflower growers need to produce new varieties and hybrids of flowers characterized by longer vase life, vivid colors, larger buds and longer stems; and adopt proper cultural management and postharvest handling technologies/practices in order to be competitive in the domestic and export markets.

In the short-run, Metro Manila and Cebu will remain as the key domestic centers for cutflowers to be grown by major producing provinces such as Davao, Negros Occidental, Benguet, Cebu, Laguna and Batangas. Aside from these two

cities, growers should also tap alternative outlets such as neighboring provinces with potential markets for particular cutflower types locally available or provinces having deficits in supply. For instance, growers in Luzon, particularly in Benguet, could supply the needs of the other provinces in the northern and southern parts of Luzon.

Cutflower types like dendrobiums, roses, chrysanthemums and anthuriums can compete with imported blooms since the import parity prices (c.i.f. values, adjusted for tariffs and internal costs) of foreign sourced cutflowers are relatively higher than their domestic prices. Findings of Dy (1995) reveal that the import parity price coming from Thailand is P110/dozen, 9% higher than the domestic wholesale price of P100/dozen. Local roses can also compete with imported varieties considering that the import parity price of the latter is about P151/dozen as against the former's wholesale price of P71/dozen. In the case of chrysanthemums, the landed price of Malaysian mum imports including internal costs is P167/dozen compared with domestic wholesale price of P120/dozen. The import parity price of anthuriums obtained from the Netherlands is P600/dozen, which is double the wholesale price of locally grown anthuriums in the domestic market.

In the export market, with the exception of anthuriums, the other three cutflower types at present, seem not to be competitive because the export parity price is much lower than the domestic wholesale price. Estimates made by Dy (1995) show that dendrobium's export parity price of P52/dozen is about 50% lower than the prevailing domestic price of P100/dozen. The export parity price of rose, on the other hand, is about 30% lower than prevailing domestic wholesale price of P71/dozen. In the case of chrysanthemum, the Taiwan variety which is commonly produced by growers is not tradable in the export market. The export price of Malaysian mum, a tradable variety, is about P39/dozen, much lower than the wholesale price of P220/dozen.

Other ornamentals like live plants and fresh foliage used in landscaping exhibits and floral arrangement are favorably gaining foothold in the international market according to industry sources. There are some Filipino producers, who either shift to foliage plants or diversify its operations, growing both fresh cutflowers and live plants and fresh foliage.

Prospects for an increased Philippine export of ornamentals depend on worldwide demand trends and the country's capability to meet export market's requirements in terms of quality, variety and quantity to maintain and expand contracts with importing countries. Japan, Hongkong and Korea have been identified and single out by the private sector as among the fastest growing import markets for cutflowers and live plants. The increasing demand for ornamentals in these countries could pave the way for the Philippines' entry into the export market. One major advantage that the Philippines has is its proximity compared to ornamental horticulture exporting countries in Europe to these Asian countries.

3. Status of Ornamental R&D

3.1 Profile of the National Research System for Ornamentals

The Philippine National Agriculture and Research System (NARS) is composed of two basic structures: (1) PCARRD as the planning and coordinating body, and (2) the national agriculture and resources R&D network (NARRDN)³, a constellation of research centers and stations. The NARRDN members are line agencies (DA, DENR, and LGUs) and R&D institutions (state colleges and universities), and the private sector.

PCARRD today provides central leadership in the national agriculture research system which includes environment and natural resources. Its mandate covers formulation of plans and policies; establishing a system of priorities; developing a national R&D program; establishing and managing a network of centers of excellence for agriculture and natural resources (ANR); providing mechanism for coordination and assessment; and maintaining a repository of research information.

The basic units of this network are the 221 institutions comprising the 14 regional R&D consortia, which were established to build up regional capability for research management (Table 4). Once admitted as a member of the national research system, the agency is expected to align its current research thrusts with national research priorities. Private research institutions become members of the NARS and avail of grants-in-aid provided their research projects are attuned to priority research areas and results are made available to the public.

Table 4. The Regional Consortia, their Base Agencies and Membership, 1999.

REGION	CONSORTIUM	BASE AGENCY	MEMBERS
CAR	HARRDEC	BSU	16
1	ILARRDEC	MMSU	13
2	CVARRD	ISU	13
3	CLARRDEC	CLSU	17
4	STARRDEC	UPLB	14
5	BICARRD	CSSAC	15
6	WESVARRDEC	DA Reg. VI	26
7	CV-CIRRD	DA Reg. VII	11
8	VICARP	VISCA	20
9	WESMARRDEC	PCA Reg. IX	15
10	NOMCARD	CMU	14
11	SMARRDEC	DA Reg. XI	19
12	CEMARRDEC	USM	18
13	C-CARRD	DOST Reg. XIII	10

³ Composed of 4 national multi-commodity R&D centers; 7 national single-commodity R&D centers; 20 regional R&D centers; 88 cooperating stations; and 9 specialized agencies.

The national research centers have been selected not only on the basis of the strength of their existing facilities, strategic location and availability of research expertise, but also on the basis of their potential capabilities.

A national research center, whether multi-commodity or single commodity in scope, conducts basic and applied research across a broad range of disciplines. It packages generated technology appropriate for specific commodities and dominant farming or production systems after successful technology verification trials in regional and cooperating field stations.

A regional center concentrates on applied research on commodities of major importance to the region. The purpose is to provide more location-specific information needed within the various agro-ecological zones of the country. The regional research center verifies the output of national research centers and fine-tunes the packages of mature technologies to suit regional conditions.

Cooperating field stations are selected as experimental sites of state colleges and universities, the DA, and private organizations that provide facilities for on-farm/field trials.

Identified research centers and stations have specific responsibilities in conducting research at different levels for each commodity group. For ornamentals, the research centers and experiment stations pursuing R&D activities at the national and regional levels are listed in Tables 5 and 6.

Table 5. R&D Networks for Ornamentals, Philippines, 1999.

NATIONAL RESPONSIBILITY	REGIONAL RESPONSIBILITY	COOPERATING AGENCIES
Luzon <ul style="list-style-type: none"> University of the Philippines Los Baños 	Luzon <ul style="list-style-type: none"> Benguet State University Central University Mindanao <ul style="list-style-type: none"> University of Southern Mindanao 	Visayas <ul style="list-style-type: none"> Visayas State College of Agriculture State Polytechnic College of Palawan West Visayas State University

Source: DA-BAR, 1998

Table 6. DA-Based Ornamental R&D Centers and Stations, Philippines, 1998.

R & D CENTERS/STATIONS
Cooperating Stations <ul style="list-style-type: none"> BPI Baguio National Crop Research and Development Center
RIARCS/ROSeS <ul style="list-style-type: none"> DA-CENVIARC Research Outreach Station for Lowland Rainfed

At the national level, the University of the Philippines Los Baños (UPLB) is the major institution working on ornamental R&D. As a national commodity research center, it is expected to provide national leadership in the planning and orchestration of ornamental research, development and extension programs. Within UPLB, major concerns in ornamental research are handled by specialized departments. For example, crop improvement is a responsibility of the Institute of Plant Breeding (IPB). Crop protection is tasked to the National Crop Protection Center (NCPC). Development of postharvest technologies is a concern of the Postharvest Training and Research Center (PHTRC). Academic departments such as the Department of Horticulture at the College of Agriculture are preoccupied with landscape planning, breeding and generation of cutflowers and ornamental plants production technologies. Crop physiology is handled both by the Department of Horticulture and IPB.

In the regions, the Benguet State University (BSU), Central Luzon State University (CLSU), and University of Southern Mindanao (USM) assume the regional responsibility for ornamental R&D. Cooperating agencies such as the State Polytechnic College of Palawan (SPCP), Visayas State College of Agriculture (VISCA), and West Visayas State University (WVSU) share the same responsibility.

Under the DA, the Bureau of Agricultural Research (BAR) integrates the department's research programs and activities. It likewise coordinates a hierarchy of research institutes, centers and stations classified either as national or regional. These constitute DA's R&D system (DARDS) which is composed of attached bureaus, agencies and corporations that operate 46 national research centers/stations in various locations in the country.

In the regions, the department coordinates 3 Regional Integrated Agricultural Research Centers (RIARCs). Under them, are 67 Research Outreach Stations (ROSEs) or an average of four per region. The ROSEs serve as satellite of the RIARCs and link between the regional and provincial research, development and extension programs. They are tasked to undertake mid-stream and down-stream applied research, demonstrate technologies, serve as training facilities, and propagate generic materials.

Among DA-based cooperating stations, only the Bureau of Plant Industry-Baguio National Crop Research and Development Center undertakes basic and applied research for ornamentals. Among research outreach stations, only the DA-CENVIARC Research Outreach Station for Lowland Rainfed maintains and conducts ornamental studies (Table 6).

3.2 Funding, Manpower and Research Facilities

3.2.1 Funding

Resource allocations of research-oriented institutions come from direct budgetary allotment and project funds provided by other government agencies, foreign donors, and in minimal amount, from the private sector. In 1992 to 1997, budgetary allocations for R&D in agriculture and natural resources comprised 75% direct financial support from the national government and 25% from project funds (David et al. 1998). From project funds, 15% share was from local (government) sources, while 10% from foreign assistance.

On top of the Philippine National Agriculture Research System (NARS), PCARRD for instance, generated direct local and external financial support of 70.8% and 29.2% respectively. (Figure 6). In total, these were the figures administered by PCARRD, wherein nearly 60.0% of which was distributed among member agencies in the network.

The SCUs as a group enjoyed an average of P154 million budgetary

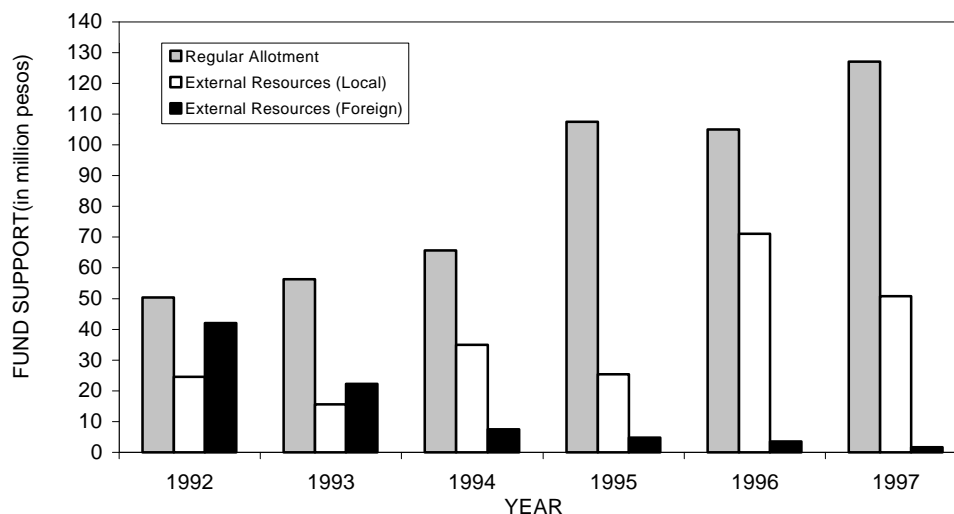


Figure 6. PCARRD's Regular Allotment vis-a-vis External Resources Generated, 1992-1997 (in million pesos).

support from 1992-1997, excluding external grants. Among SCUs, UPLB received a significant proportion of allocations through the years. The amount could even equal or surpass that of other SCUs combined (Table 7).

Meanwhile, the DA received 52% or the amount of P900 million from the national direct budgetary support for agriculture in 1996 (Figure 7). Of this amount, P300 million was used to support the research expenditures of the various RIARCs and ROSEs (Table 8). The rest of the amount was shared among

Table 7. Public Expenditures* of Major State Colleges/Universities in Agriculture, 1992-1997 (in million pesos)

AGENCY	1992		1993		1994		1995		1996		1997	
	Reg. Allot.	Ext. Res.	Reg. Allot.	Ext. Res.	Reg. Allot.	Ext. Res.	Reg. Allot.	Ext. Res.	Reg. Allot.	Ext. Res.	Reg. Allot.	Ext. Res.
UPLB	87.32	74.25	90.69	105.78	76.73	142.03	108.88	141.79	123.69	99.30	120.36	103.86
VISCA	17.33*	11.09	19.93	9.77	19.25	7.05	19.54	8.45	23.81	7.50	24.18	9.61
CLSU	6.61*	1.96	10.64	2.69	12.18	2.39	14.21	7.64	14.64	2.45	17.49	5.35
BSU	5.69*	(na)	5.96	2.90	6.99	5.85	10.48	4.17	11.54	7.58	14.30	8.71
USM	9.29	2.16	13.12	2.92	8.62	7.23	8.62	4.26	9.41	3.93	9.85	6.81
Average (1992-1997)	153.56											

* Based on GAA, otherwise, it is the actual expenditure.

Note: Figures in parenthesis include external grants.

na = not available

Source: David et. al (1998)

Table 8. Distribution of DA's R&D Expenditures by Offices, 1992-1997 (in million pesos)

AGENCY	1992		1993		1994		1995		1996		1997	
	Reg. A lot.	Ext. Res.	Reg. A lot.	Ext. Res.	Reg. A lot.	Ext. Res.	Reg. A lot.	Ext. Res.	Reg. A lot.	Ext. Res.	Reg. A lot	Ext. Res.
Regional Offices	211.50	22.76	192.80	11.32	225.47	16.72	257.34	10.92	286.22	18.17	na	na
Staff Bureaus												
BAR	10.79 ^a	-	11.37 ^a	-	14.68 ^a	-	17.18 ^a	-	18.55 ^a	-	na	na
BPI	17.40	-	17.40	-	32.97	-	33.02	-	44.27	-	47.57	-
BAI, BSWM, BPRE	50.39	1.58	36.87	30.90	46.41	11.32	51.59	16.84	60.61	19.52	85.24	40.44
Attached Agencies	179.36	7.05	214.42	9.38	336.78	11.25	405.22	49.78	513.19	68.03	532.20	(na)

^a Figures cannot be broken down into regular funds and external grants

na = not available

Source: David et. al (1998)

DA staff bureaus (BAR, BPI, BAI, BSWM, and BPRE) and attached agencies (FIDA, NTA, PCA, Philrice, SRA, PCC, NIA, NFA and CRDI).

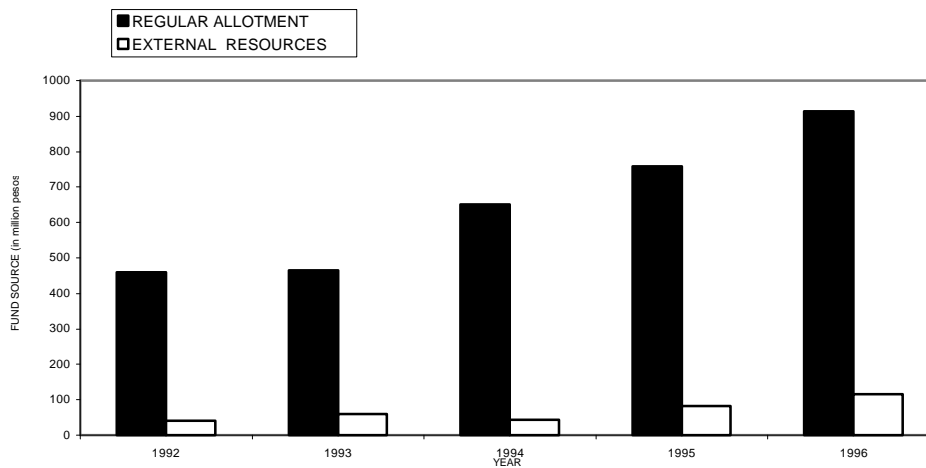


Figure 7. DA's Regular Allotment vis-a-vis External Resources Generated, 1992-1997 (in million pesos)

The distribution of research budget allocation for agriculture research and development varies among agencies and SCUs. In general, the research budget is apportioned for personnel services (PS), maintenance and operating expenses (MOE) and capital outlays. At DA, the expenditures for PS tended to be highest (56%) in all its regional offices, bureaus and attached agencies, whereas MOE and CO were 36% and 8%, respectively (Table 9).

Table 9. Distribution of Average (in %) Direct Budgetary Support for Agriculture R&D Across Agencies, 1994-1996.

AGENCY	PERSONNEL SERVICES	MAINTENANCE AND OPERATING EXPENSES	CAPITAL OUTLAY	TOTAL
PCARRD	41	57	2	100
DA	56	36	8	100
Reg. Offices	67	33	-	100
Bureaus	53	47	-	100
BAR	35	65	-	100
BPI	59	41	-	100
Attached Agencies	49	35	16	100

Source: PCARRD, DA

On the contrary, PCARRD's budget allocation for MOE (57%) was higher than its PS (41%), considering that the agency has fewer staff than DA.

Among SCUs, PS expenditures of BSU and UPLB ranged from 70% to 90% (Table 10). This apparent disparity in funds for salary against operational budget was believed to be a result of the Salary Standardization Law for government employees. This great disparity in research budget proportion likewise bears relevance on the efficiency in the conduct of research such as rendering research facilities underutilized, or generating external donor's support but primarily serving their own motives and purposes.

Table 10. Distribution of Average (in %) Budgetary Support for Agriculture R&D Across SCUs, 1992-1996.

AGENCY	PERSONNEL SERVICES	MAINTENANCE AND OPERATING EXPENSES	TOTAL
SCU	57	43	100
BSU	91	9	100
CLSU	54	46	100
UPLB	71	29	100
USM	9	91	100
VISCA	58	42	100

The economic importance of ornamentals has been recognized by the national research system. Under the DOST-PCARRD priority listing for priority commodities in the medium-term, ornamental plants fall within Priority III⁴, getting 3% of the research budget allocated. Data on actual allocation of PCARRD, DA and SCUs specifically for ornamentals are not reflected here. However, discussion on past studies on ornamentals would touch upon actual expenditures for R&D.

3.2.2 Manpower Resources

The availability and quality of the human resource complement of the national research system bear significance in the performance of R&D. A set of minimum human resource requirement for research institutions has been initiated by PCARRD. Standard requirements for various research disciplines are published on a separate volume. Nevertheless, this report lifted relevant information on minimum manpower requirements in crops/ornamental research as standard (Table 11).

By specialization in crop research, UPLB has more experts in plant breeding, crop protection and crop science. At the PHTRC, 2 PhDs specialized in postharvest physiology and technology and extension education and 3MS degree

⁴ Include ornamental and medicinal plants; dairy; pork; poultry; parks, wildlife and forest range.

Table 11. Minimum Manpower Requirements for R&D Capability in Crops Research.

R & D CENTER/DISCIPLINE	MULTI-COMMODITY				SINGLE COMMODITY			
	PhD	MS	BS	Total	PhD	MS	BS	Total
A. National Research Center	8	11	11	30	7	10	10	27
Post Production or Seed Technology	2	3	3	8	2	3	3	8
Propagation/Production or Improvement or Plant Nutrition	2	3	3	8	2	3	3	8
Processing/Product Development	2	2	2	6	1	1	1	3
Crop Protection	2	3	3	8	2	3	3	8
B. Regional Research Center	6	3	3	12	1	3	3	7
Post Production or Seed Technology	2	1	1	4	1	1	1	3
Propagation/Production or Improvement or Plant Nutrition	2	1	1	4		1	1	2
Crop Protection	2	1	1	4		1	1	2
C. Cooperating Station	4	6	6	16		3	3	6
Post Production or Seed Technology	2	2	2	2		1	1	2
Propagation/Production or Improvement or Plant Nutrition	1	2	2	5		1	1	2
Crop Protection	1	2	2	5		1	1	2

Source: PCARRD, 1992

holders in postharvest physiology and technology and production, economics/marketing and development communication pursue ornamental research. NCPC has 9 PhDs and 6 MS degree holders in the fields of plant pathology, genetics, entomology, and weed science. IPB has 5 MS staff engaged in ornamental research particularly on ornamental crops breeding of *Mussaenda*, indigenous orchids, *Hibiscus*, *Ixora*, *Bougainvillea*, *Hoyas*, *Medinilla*, *Colummela*, *Freycinetia* and *Canna*; propagation of exportable live ornamental plants (*Mussaenda*, *Aglaonema*, palms and *Freycinetia*); integrated pest management in selected exportable live ornamental plants; and micropropagation and dissemination of important crops (bamboo, ferns, palms, cutflowers, potted plants and ground covers). UPLB-Department of Horticulture has 10 PhDs and 3 staff with MS degree in postharvest, extension, physiology, breeding and genetics, tissue culture, landscape planning, environmental studies, production and management, chemistry, and extension.

Among other SCUs, BSU has more PhDs in horticulture (second to UPLB). CLSU, VISCA and USM apparently are far behind the minimum requirement. USM, however, has 16 MS degree holders in horticulture (Table 12).

Attached agencies of DA have the most number of technical personnel (194), followed by the regional offices (142) with PhD and MS degree holders combined. In relation to ornamental research, attached agencies enjoyed a substantial number of MS degree holders in plant breeding, entomology, and plant pathology. Staff bureaus, on the other hand, have more experts specialized in horticulture.

3.2.3 Facilities

Result of the 1997 assessment of the national or regional R&D centers' research facilities revealed that not even one met the standard provision of 144 sq.m. per researcher. Except IPB's experimental fields, other SCUs and research stations' are below the minimum standard; laboratory and communication equipment are inadequate; greenhouses and storage rooms need repairs.

3.2.4 Current Priorities for Ornamentals

Ornamental research falls under Priority III in the DOST-PCARRD Research Priority Areas. Under the Science and Technology Agenda for National Development (STAND), ornamental horticulture (cutflowers, foliage and other plants, live plants, and dried ornamentals) is grouped among export winners.

Table 12. Profile of R&D Personnel in Selected National and Regional Centers and Cooperating Stations in Agriculture and Natural Resources, 1997.

EDUCATION	NATIONAL R&D CENTER	REGIONAL R&D CENTERS			COOPERATING STATIONS
	UPLB	BSU	USM	VISCA	DA-BPI
PhD					
Actual	53	15	37	39	5
(Required)	(45)	(20)	(17)	(8)	(40)
MS					
Actual	206	36	72	69	42
(Required)	(64)	(26)	(21)	(11)	(55)
BS					
Actual	225	36	8	24	160
(Required)	(74)	(29)	(22)	(11)	(55)
TOTAL					
Actual	484	87	117	132	207
(Required)	(183)	(75)	(60)	(30)	(150)

Source: RMC, UPLB, PCCARD, 1995-1997

3.3 Review of Past and Ongoing Researches

3.3.1 Past Researches

From 1990-1998, 217 ornamental research studies were conducted by different institutions (Table 13). Of this total, 134 studies were completed, while 83 are still continuing. During the period under review, there was no record of termination. However, compared to other commodities, the total number of researches conducted on cutflowers and ornamental plants is alarmingly low. With the national government's thrust on food security programs and policies, non-food commodities such as ornamentals will experience lesser attention and assistance.

Table 13. Number of Completed and Ongoing Ornamentals R&D Projects, by Research Area, Philippines, 1990-1998.

RESEARCH AREA	COMPLETED	%	ONGOING	%	TOTAL
Production	33	25	10	12	43
Varietal Improvement	47	35	36	43	83
Protection and Pest Management	19	14	14	17	33
Post Production	14	10	3	4	17
Socio-Economics and Marketing	8	6	3	4	11
Integrated R&D	9	7	17	20	26
Others	4	3	-	-	4
TOTAL	134	100	83	100	217

Given the limited research funds, specific priority research areas in cutflowers and ornamental plants R&D were given emphasis. A total of 47 studies on ornamental improvement were undertaken, 33 on production, 19 on crop protection and pest management, 14 on postproduction, 9 on integrated R&D and 8 on socio-economics and marketing (Table 14). Researches (4) on plant nutrition and environmental impact assessment were also conducted during the same period. The significant number of production-oriented studies clearly indicates that research resources and energies are not well-distributed and thus, sacrificing other important areas such as postproduction, socio-economics, integrated R&D and nutrition-related studies.

The SCUs were the most productive in terms of the number of studies conducted contributing 69 (51%) studies of the total recorded (Table 15). DA's regional offices (Regions 1,3,4,6,7,10 and CAR) and BPI finished 61 studies. The SCUs conducted 10 (30%) studies on ornamental production, 25 (53%) on crop improvement, 11 (58%) on crop protection and pest management, 12 (86%) on postproduction, 3 (38%) on socio-economics, 7 (78%) on integrated R&D and 1

Table 14. Number of Completed Ornamental Research, by Research Area and Type, Philippines, 1990-1998.

TYPE OF ORNAMENTAL	RESEARCH AREA							TOTAL
	Ornamental Production	Ornamental Improvement	Ornamental Protection and Pest Management	Production	Socio-Economics and Marketing	Integrated R&D	Others ¹	
Anthurium	9	3	-	-	1	2	-	15
Orchid	3	19	1	1	-	-	-	24
Rose	5	3	1	2	-	2	-	13
Chrysanthemum	4	-	4	2	-	1	-	11
Gladiolus	1	1	-	-	-	-	-	2
Selected Cutflowers ²	4	6	4	2	-	-	-	16
Ornamentals in General	7	15	9	7	7	4	4	53
TOTAL	33	47	19	14	8	9	4	134

¹Included Nutrition and Environmental Impact Assessment

²Included foliage plants

Table 15. Number of Completed Ornamental Research, by Type and Agency, Philippines, 1990-1998.

AGENCY	TYPE OF ORNAMENTAL							TOTAL
	Anthurium	Orchid	Rose	Chrysanthemum	Gladiolus	Selected Ornamentals1	Ornamentals in General	
DA Regional Offices	7	2	2	3	0	6	13	33
1	1	1					1	3
3							1	1
4	1						2	3
6							1	1
7	3	1		3		2	2	11
10	1							1
CAR	1		2			4	6	13
DA	2						3	5
BPI	1	3	5	4	2	1	7	23
DOST		1						1
SCU	5	17	6	4	0	7	30	69
BSU	1		3				2	6
CMU						1		1
DSAC		2		1			2	5
DMMSU							4	4
ISU		1						1
MPSPC							1	1
NVSIT		3						3
RSC	1							1
RTC		1						1
SKPSC	1							1
USP	2							2
UPLB-IPB						2	7	9
UPLB-PHTRC		1	2	2		2	6	13
UPLB-NCPC			1	1			2	4
OTHER UPLB UNITS		8				2	4	14
USM		1					1	2
WVSU							1	1
BUCAF						1		1
PHILRICE						1		1
NO AGENCY		1						1
TOTAL	15	24	13	11	2	16	53	134

(25%) on other research areas. From the data gathered, SCUs showed to be more capable in conducting studies specifically in the areas of postproduction, integrated R&D, crop protection and pest management, and ornamental improvement due to the contribution of UPLB-IPB, UPLB-PHTRC, UPLB-NCPC, BSU and DSAC.

By type of ornamentals, orchids received the most research attention with 24 completed studies followed by anthuriums (15), roses (13) and chrysanthemums (11) as shown in Table 15. Studies (19) on orchids were highly concentrated on ornamental improvement such as hybridization *in vitro* culture and mass propagation practices. During the early 1990s, orchids generated more budget support to meet the needs of the booming orchid industry. Researches on productivity enhancing technique through varietal improvement were also given priority by national agencies and SCUs.

On ornamental production, anthuriums had the highest number of studies with 9, followed by ornamentals in general (7), roses (5), chrysanthemums and selected ornamentals (4), orchids (3) and gladiolus (1). Studies in this research area focused on fertilizer management and application, cultural management practices, adaptability trials and evaluation of irrigation methods. Ornamental protection and pest management and postproduction studies were heavily focused on ornamental plants in general with 9 and 7 researches, respectively. Studies on ornamental protection and pest management were concentrated on the control of insect pests infesting chrysanthemums. Damage assessment, disease identification and control, and identification of indigenous plants as pesticides for ornamentals in general were also undertaken. Postproduction researches were geared toward extending vase life of foliages and flowers through the utilization of ethylene absorbent and cold storage and improvement of postharvest handling practices among others. Research areas such as socio-economics and marketing, integrated R&D and nutrition-related studies were also highly focused on ornamentals in general.

A total amount of P25.61 million was spent on cutflowers and other ornamental plants research from 1990 to 1998. Among the research areas, ornamental improvement received the highest budget allocation of P9.15 million. Ornamental postproduction ranked second with research fund support of P4.18 million, then followed by ornamental protection and pest management with P4.08 million and ornamental production with P3.48 million (Table 16). The least funded research areas were socio-economics and marketing, integrated R&D and nutrition-related studies.

Of the P25.61 million allocated for completed cutflowers and other ornamentals research, 78% was managed by the SCUs (Table 17). The biggest budget allocation was given to UPLB which amounted to P13.45 million. This was distributed to IPB, NCPC, PHTRC and other UPLB units which undertook

Table 16. Budget of Completed Ornamental Research, by Research Area and Type, Philippines, 1990-1998.

TYPE OF ORNAMENTAL	RESEARCH AREA							TOTAL
	Ornamental Production	Ornamental Improvement	Ornamental Protection and Pest Management	Post-Production (P)	Socio-Economics and Marketing	Integrated R&D	Others ¹	
Anthurium	452,033	240,180	-	-	50,000	500,000	-	1,242,213
Orchid	397,130	4,448,699	1,244,241	-	-	-	-	6,090,070
Rose	106,057	33,019	20,000	-	-	363,000	-	522,076
Chrysanthemum	93,019	-	1,058,460	-	-	95,000	-	1,246,479
Gladiolus	22,019	150,428	-	-	-	-	-	172,447
Selected Cutflowers ²	68,000	1,301,714	548,401	-	-	-	-	1,918,115
Ornamentals in General	2,342,611	2,974,242	1,205,965	4,183,948	1,941,000	322,000	1,451,400	14,421,166
TOTAL	3,480,869	9,148,282	4,077,067	4,183,948	1,991,000	1,280,000	1,451,400	25,612,566

¹Included Nutrition and Environmental Impact Assessment

²Included foliage plants

Table 17. Budget of Completed Ornamental Research, by Research Area and Agency, Philippines, 1990-1998.

AGENCY	RESEARCH AREA							TOTAL
	Ornamental Production	Ornamental Improvement	Ornamental Protection and Pest Management	Post Production (P)	Socio-Economics and Marketing	Integrated R&D	Others ¹	
DA Regional Offices	440,983	438,856	84,000	-	55,000	28,000	10,000	1,056,839
1	40,000	87,000	-	-	-	-	-	127,000
3	-	14,000	-	-	-	-	-	14,000
5	50,000	-	-	-	20,000	-	-	70,000
6	-	210,856	-	-	-	-	-	210,856
7	187,883	74,000	58,000	-	20,000	28,000	-	367,883
10	20,100	-	-	-	-	-	-	20,100
CAR	143,000	53,000	26,000	-	15,000	-	10,000	247,000
DA	-	21,100	-	1,791,498	-	250,000	725,450	2,788,048
BPI	196,114	650,469	54,400	-	21,000	-	-	921,983
DOST	-	749,810	-	-	-	-	-	749,810
SCU	2,843,772	7,288,047	3,862,267	2,392,450	1,915,000	1,002,000	715,950	20,019,486
BSU	447,611	-	-	-	-	613,000	-	1,060,611
CMU	-	456,600	-	-	-	-	-	456,600
DSAC	45,000	100,000	-	-	-	275,000	-	420,000
ISU	-	211,248	-	-	-	-	-	211,248
MPSPC	-	-	-	-	1,865,000	-	-	1,865,000
NVSIT	-	1,375,000	-	-	-	-	-	1,375,000
RSC	-	-	-	-	50,000	-	-	50,000
RTC	-	763,706	-	-	-	-	-	763,706
SKPSC	21,000	-	-	-	-	-	-	21,000
USP	156,050	-	-	-	-	-	-	156,050
UPLB-IPB	450,000	3,211,996	800,000	-	-	-	-	4,461,996
UPLB-PHTRC	1,349,000	-	-	2,392,450	-	-	-	3,741,450
UPLB-NCPC	-	-	1,223,009	-	-	-	-	1,223,009
OTHER UPLB UNITS	375,111	1,093,497	1,839,258	-	-	-	715,950	4,023,816
USM	-	76,000	-	-	-	114,000	-	190,000
BUCAF	-	-	76,400	-	-	-	-	76,400
TOTAL	3,480,869	9,148,282	4,077,067	4,183,948	1,991,000	1,280,000	1,451,400	25,612,566

¹Included Nutrition and Environmental Impact Assessment

researches on cutflowers and other ornamentals. DA, its regional offices and BPI received a collective sum of P4.8 million (19%) while DOST received the least fund support.

UPLB, as the national research center, conducted substantial number of studies in cutflowers and other ornamental plants of which were contributed by graduate and undergraduate students. From 1990 to 1998, a total of 70 theses were finished (5 graduates and 65 undergraduates) (Tables 18 and 19). Of the total undergraduate theses, 22% were done on varietal improvement that includes development of *in vitro* and tissue culture, 18% on ornamental production, 17% on farm business and management, 14% on postharvest that includes the use of ethylene absorbent in packaging, 11% on market research, and 9% on protection and pest management and policy. On the other hand, 60% of graduate theses dealt on varietal improvement. Researches done by students with the proper guidance of competent faculty members could be of big help in addressing the immediate needs and scientific inquiries considering that ornamental research receives very limited financial support.

Among ornamentals, orchids received the highest research funding (Table 20). Since it is the most researched cutflower type, its budget amounted to P6.1 million. Of this budget, approximately P2.5 million was disbursed to varietal improvement researches (e.g. genetic improvement, documentation of technologies in orchid production and serological techniques in indexing orchids). Chrysanthemums and anthuriums came next with a budget allocation of P1.25 million and P1.24 million, respectively. The least funded research ornamental plants were rose and gladioli.

Selected cutflowers and ornamentals in general generated a research budget of P1.92 million and P14.42 million, respectively. Consequently, specific ornamental or cutflower type cannot be identified since studies had been conducted either in combination with other types in general.

Table 18. Number of Undergraduate and Graduate Thesis on Ornamentals by Field of Study, UPLB, 1990-1998.

Field of Study	Undergraduate Thesis		Graduate Thesis/Dissertation	
	Number	%	Number	%
Production	12	18	3	60
Varietal Improvement	14	22		
Protection and Pest Management	6	9		
Postharvest	9	14	1	20
Marketing Policy/Socio-Economics				
Market Research	7	11		
Farm and Business Mgt.	11	17	1	20
Policy/Program	6	9		
TOTAL	65	100	5	100

Table 19. Number of Undergraduate and Graduate Thesis on Ornamentals by College and Field of Study, UPLB, 1990-1998.

COLLEGE/FIELD OF STUDY	Undergraduate Thesis		Graduate Thesis/Dissertation	
	Number	%	Number	%
College of Agriculture				
Production	10	26	3	75
Varietal Improvement	14	36		
Protection and Pest Mgt.	6	15		
Postharvest	9	23	1	25
Total	39	100	4	100
College of Economics and Management				
Socio-Economics/Marketing/Policy				
Production Economics	2	8	1	100
Market Research	7	27		
Farm and Business Mgt.	11	42		
Policy/Program	6	23		
Total	26	100	1	100

Table 20. Budget of Completed Ornamental Research, by Type and Agency, Philippines, 1990-1998.

AGENCY	TYPE OF ORNAMENTAL							TOTAL
	Anthurium	Orchid	Rose	Chrysanthemum (P)	Gladiolus	Selected Ornamentals ¹	Ornamentals in General	
DA Regional Offices	299,983	83,000	40,000	86,000	-	103,000	444,856	1,056,839
1	40,000	59,000	-	-	-	-	28,000	127,000
3	-	-	-	-	-	-	14,000	14,000
4	20,000	-	-	-	-	-	50,000	70,000
6	-	-	-	-	-	-	210,856	210,856
7	156,883	24,000	-	86,000	-	53,000	48,000	367,883
10	20,100	-	-	-	-	-	-	20,100
CAR	63,000	-	40,000	-	-	50,000	94,000	247,000
DA	271,100	-	-	-	-	-	2,516,948	2,788,048
BPI	194,080	154,843	99,076	75,019	172,447	108,118	118,400	921,983
DOST	-	749,810	-	-	-	-	-	749,810
SCU	477,050	5,102,417	383,000	1,085,460	-	1,630,597	11,340,962	20,019,486
BSU	250,000	-	363,000	-	-	-	447,611	1,060,611
CMU	-	-	-	-	-	456,600	-	456,600
DSAC	-	100,000	-	95,000	-	-	225,000	420,000
ISU	-	211,248	-	-	-	-	-	211,248
MPSPC	-	-	-	-	-	-	1,865,000	1,865,000
NVSIT	-	1,375,000	-	-	-	-	-	1,375,000
RSC	50,000	-	-	-	-	-	-	50,000
RTC	-	763,706	-	-	-	-	-	763,706
SKPSC	21,000	-	-	-	-	-	-	21,000
USP	156,050	-	-	-	-	-	-	156,050
UPLB-IPB	-	-	-	-	-	701,996	3,760,000	4,461,996
UPLB-PHTRC	-	-	-	-	-	-	3,741,450	3,741,450
UPLB-NCPC	-	-	20,000	990,460	-	-	212,549	1,223,009
OTHER UPLB UNITS	-	2,576,463	-	-	-	472,001	975,352	4,023,816
USM	-	76,000	-	-	-	-	114,000	190,000
BUCAF	-	-	-	-	-	76,400	-	76,400
TOTAL	1,242,213	6,090,070	522,076	1,246,479	172,447	1,918,115	14,421,166	25,612,566

¹Included foliage plants

3.3.2 Ongoing Researches

Currently, 83 (38%) of the total 217 researches on cutflowers and ornamental plants are ongoing which commenced in 1996 and 1997 and have been pursued as of this report (Table 21). These researches are still focused on providing the needs of the industry in the areas of ornamental production (10), ornamental improvement (36), and crop protection and pest management (14). Again, postproduction (3) and socio-economics and marketing (3) studies received minimal attention. However, there is an increased interest in integrated R&D research with 17 ongoing studies.

By research agency, the SCUs handled a significant proportion of these on-going ornamental studies (50) led by UPLB. (Table 22). Concerns were more focused on ornamental improvement (36), integrated R&D (17), and crop protection and pest management (14).

Presently, by type of ornamental, orchids have the highest number of ongoing researches with 22 (26%), followed by anthuriums with 10 (12%) and chrysanthemums with 8 (10%). Researches on rose and gladiolus still remain to be the least prioritized ornamental types in terms of the number of researches conducted. Ornamentals in general though seemingly registering a significant number of researches being pursued, specific ornamental types are not however identified. This could be explained by the fact that some studies are being conducted either in combination with other ornamental plant types or in general.

Budget allocation for ongoing researches have increased as well amounting to a total of P32 million with most of it allocated to research on orchids (21%), anthuriums (19%) and chrysanthemums (7%). A total of P16.3 million (51%) went to research on ornamentals in general since it had the highest number of research conducted (Table 24).

By research area, ornamental improvement remains to receive the highest budget allocation of P17.55 million particularly on research projects such as efficient and systematic mass propagation of anthuriums, roses, orchids, chrysanthemums, and foliage plants (Tables 25 and 26). Ornamental protection and pest management were also highly favored with fund support of P10.3 million. Some of the studies along this concern were arthropod pest management in anthurium, disease management in foliage plants and integrated pest management practices on various ornamental plants. Research areas such as postproduction and production received minimal fund support. Integrated R&D, though having an increase in number of studies being undertaken, still experiences minimal support. As of this report, it has only received P279,000 in budget allocation. Furthermore, budget earmarked on socio-economics and marketing researches is nil. The imbalance in fund appropriation of the cutflower and ornamental research efforts is indicative of the lack of a centralized and focused development for the industry that will ensure its continued existence, growth and competitiveness.

Table 21. Number of Ongoing Ornamental Research by Area and Type, Philippines, 1990-1999.

TYPE OF ORNAMENTAL	RESEARCH AREA						TOTAL
	Ornamental Production	Ornamental Improvement	Ornamental Protection and Pest Management	Postproduction	Socio-Economics and Marketing	Integrated R&D	
Anthurium	-	5	4	-	-	1	10
Orchid	4	9	3	-	-	6	22
Rose	1	-	-	-	-	-	1
Chrysanthemum	1	2	2	-	1	2	8
Gladiolus	-	-	-	-	1	-	1
Selected Cutoffers ¹	1	1	-	-	-	4	6
Ornamentals in General	3	19	5	3	1	4	35
TOTAL	10	36	14	3	3	17	83

¹Included foliage plants

Table 22. Number of Ongoing Ornamental Research , by Research Area and Agency, Philippines, 1990-1998.

AGENCY	RESEARCH AREA						TOTAL
	Ornamental Production	Ornamental Improvement	Ornamental Protection and Pest Management	Postproduction	Socio-Economics and Marketing	Integrated R&D	
DA Regional Offices	1	1	0	0	0	0	2
4	-	1	-	-	-	-	1
CAR	1	-	-	-	-	-	1
DA	2	-	-	-	3	-	5
BPI	-	6	-	1	-	-	7
DOST	2	8	1	-	-	2	13
SCU	4	18	12	2	0	14	50
BSU	-	1	1	-	-	2	4
DSAC	-	-	4	-	-	1	5
DDMSU	2	2	-	-	-	1	5
UPLB-IPB	-	8	-	-	-	1	9
UPLB-PHTRC	-	-	-	2	-	-	2
UPLB-NCPC	1	-	1	-	-	-	2
OTHER UPLB UNITS	-	6	6	-	-	8	20
USM	-	-	-	-	-	1	1
WVSU	1	1	-	-	-	-	2
IAEA	-	1	-	-	-	-	1
PNRI	-	-	1	-	-	-	1
NO AGENCY	1	2	-	-	-	1	4
TOTAL	10	36	14	3	3	17	83

¹Included Nutrition and Environmental Impact Assessment

Table 23. Number of Ongoing Ornamental Research, by Type and Agency, Philippines, 1990-1999.

AGENCY	TYPE OF ORNAMENTAL							TOTAL
	Anthurium	Orchid	Rose	Chrysanthemum	Gladiolus	Selected Ornamentals ¹	Ornamentals in General	
DA Regional Offices	0	0	1	0	0	0	1	2
4	-	-	-	-	-	-	1	1
CAR	-	-	1	-	-	-	-	1
DA	-	-	-	2	1	1	1	5
BPI	1	-	-	1	-	-	5	7
DOST	2	5	-	-	-	1	5	13
SCU	6	15	0	5	0	3	21	50
BSU	-	-	-	2	-	-	-	2
DSAC	2	-	-	3	-	1	1	7
DMMSU	-	3	-	-	-	-	2	5
UPLB-IPB	-	1	-	-	-	1	7	9
UPLB-PHTRC	-	-	-	-	-	-	2	2
UPLB-NCPC	-	1	-	-	-	-	1	2
OTHER UPLB UNITS	4	10	-	-	-	1	5	20
USM	-	-	-	-	-	-	1	1
WVSU	-	-	-	-	-	-	2	2
IAEA	-	-	-	-	-	-	1	1
PNRI	-	-	-	-	-	-	1	1
NO AGENCY	1	2	-	-	-	1	-	4
TOTAL	10	22	1	8	1	6	35	83

¹Included foliage plants

Table 24. Budget of Ongoing Ornamental Research, by Type and Agency, Philippines, 1990-1999.

AGENCY	TYPE OF ORNAMENTAL						TOTAL
	Anthurium	Orchid	Rose	Chrysanthemum	Selected Ornamentals ¹	Ornamentals in General	
DA Regional Offices	-	-	45,000	-	-	20,000	65,000
4	-	-	-	-	-	20,000	20,000
CAR	-	-	45,000	-	-	-	45,000
BPI	21,000	-	-	-	-	146,200	167,200
DOST	1,219,823	2,372,078	-	-	-	1,470,763	5,062,664
SCU	5,037,006	4,304,249	-	2,533,822	108,000	14,355,567	26,338,644
BSU	-	-	-	2,443,822	-	-	2,443,822
DSAC	2,280,187	-	-	90,000	-	1,408,681	3,778,868
DMMSU	-	-	-	-	-	53,358	53,358
UPLB-IPB	-	-	-	-	108,000	5,026,042	5,134,042
UPLB-PHTRC	-	-	-	-	-	1,996,400	1,996,400
UPLB-NCPC	-	-	-	-	-	100,000	100,000
OTHER UPLB UNITS	2,756,819	4,304,249	-	-	-	5,272,086	12,333,154
USM	-	-	-	-	-	279,000	279,000
WVSU	-	-	-	-	-	220,000	220,000
PNRI	-	-	-	-	-	320,664	320,664
NO AGENCY	120,000	120,000	-	-	-	-	240,000
TOTAL	6,397,829	6,796,327	45,000	2,533,822	108,000	16,313,192	32,194,170

¹Included foliage plants

Table 25. Budget of Ongoing Ornamental Research, by Research Area and Type, Philippines, 1990-1999

TYPE OF ORNAMENTAL	RESEARCH AREA					TOTAL
	Ornamental Production	Ornamental Improvement	Ornamental Protection and Pest Management	Postproduction (P)	Integrated R&D	
Anthurium	-	2,879,541	3,518,288	-	-	6,397,829
Orchid	340,111	5,588,439	867,777	-	-	6,796,327
Rose	45,000	-	-	-	-	45,000
Chrysanthemum	-	2,080,822	453,000	-	-	2,533,822
Selected Cutflowers ¹	-	108,000	-	-	-	108,000
Ornamentals in General	1,650,763	6,892,234	5,484,795	2,006,400	279,000	16,313,192
TOTAL	2,035,874	17,549,036	10,323,860	2,006,400	279,000	32,194,170

¹Included foliage plants

Table 26. Budget of Ongoing Ornamental Research, by Research Area and Agency, Philippines, 1990-1998.

AGENCY	RESEARCH AREA					TOTAL
	Ornamental Production	Ornamental Improvement	Ornamental Protection and Pest Management (P)	Postproduction	Integrated R&D	
DA Regional Offices	45,000	20,000	-	-	-	65,000
4	-	20,000	-	-	-	20,000
CAR	45,000	-	-	-	-	45,000
BPI	-	157,200	-	10,000	-	167,200
DOST	1,810,874	2,928,694	323,096	-	-	5,062,664
SCU	180,000	14,203,142	9,680,100	1,996,400	279,000	26,338,642
BSU	-	2,080,822	363,000	-	-	2,443,822
DSAC	-	-	3,778,868	-	-	3,778,868
DMMSU	-	53,356	-	-	-	53,356
UPLB-IPB	-	5,134,042	-	-	-	5,134,042
UPLB-PHTRC	-	-	-	1,996,400	-	1,996,400
UPLB-NCPC	100,000	-	-	-	-	100,000
OTHER UPLB UNITS	-	6,794,922	5,538,232	-	-	12,333,154
USM	-	-	-	-	279,000	279,000
WVSU	80,000	140,000	-	-	-	220,000
PNRI	-	-	320,664	-	-	320,664
NO AGENCY	-	240,000	-	-	-	240,000
TOTAL	2,035,874	17,549,036	10,323,860	2,006,400	279,000	32,194,170

¹Included Nutrition and Environmental Impact Assessment

As of now, 81% (P26.3 million) of the P32.2 million allocated for ongoing researches is being managed by the SCUs with most of it appropriated to UPLB (61%). Then it was followed by DOST which administered P5.1 million on various research initiatives. DA and its regional and attached agencies disbursed only P232,200 (0.72%) of the total budget.

3.3.3 Technologies/Information Generated and Disseminated

From 1990-1998, substantial technologies/information were generated from various laboratories of concerned government and academic institutions. These technologies are subject to series of trials and piloting under farm field conditions. These are ready for dissemination when they meet the following criteria: general adaptability, economic profitability, social acceptability, and potential availability of support services.

Among the academe and government agencies, UPLB has generated the most number of ornamental technologies/information from the completed ornamental R&D projects from 1990-1998. It has generated 58 of the 67 reported technologies/information developed during the conduct of ornamental research in that period (Appendix Table 1).

During the period 1998-1999, PCARRD-DOST published 10 technologies/recommended practices as part of the Integrated Ornamental Horticulture R&D Program conducted by UPLB, the national coordinating agency (Table 27).

Table 27. Technologies Generated and Published in PCARRD-DOST Information Bulletin Series, 1998-1999.

AGENCY	TECHNOLOGIES GENERATED
UPLB-Plant Pathology	Serological Technique in Indexing Orchids for Viruses
UPLB-Dept. of Horticulture	Anthurium Production and Management Recommended Practices in the Production of Aglaonemas Mass Propagation of Mussaenda Using Mist System
UPLB-Institute of Plant Breeding	Mass Propagation Techniques for Songs Common Practices in the Production of Aglaonemas Mass Propagation Techniques for Dracaena godseffiana Mussaenda Propagation with the "Kulob" System Recommended Practices in the Production of Palms Recommended Practices in the Production of Freycinetia

The UPLB-Institute of Plant Breeding generated six of these technologies, which include:

- *Mass Propagation Techniques for Songs*

Song of India and Song of Jamaica are two of the most popular foliage plants. They are highly in demand materials in flower arrangement as filler and florist greens. They are also popular as centerpieces in landscaping. To meet the increasing demand for these foliage plants, propagation techniques such as “kulob” system, plastic tents or mist system were developed and disseminated.

- *Common Practices in the Production of Aglaonemas*

Aglaonemas are hardy foliage plants known for their showy and intricate leaf markings. There are four species raised by nursery owners namely: Silver Queen, Silver King, La Suerte and Manila Twirl. Propagation techniques commonly practiced include using shoot tip cuttings and nodal stem cuttings. Proper transplanting and care and maintenance practices were also disseminated.

- *Mass Propagation Techniques for Dracaena godseffiana*

Propagation techniques (“kulob” and plastic tent) for Dracaena godseffiana were also developed and disseminated.

- *Mussaenda Propagation with the “Kulob” System*

The “kulob” system of propagating Mussaenda was disseminated and adapted.

- *Recommended Practices in the Production of Palms*

Palms are foliage plants used as indoor plants or as landscape materials. It is propagated through seeds. Recommended practices such as proper way of germinating seeds and appropriate transplanting and care maintenance were being disseminated and adapted.

- *Recommended Practices in the Production of Freycinetia*

Freycinetia multiflora is an endemic plant which belongs to the family of pandans. These are usually propagated by shoot tips and stem cuttings. Its proper propagation, transplanting, and care and maintenance were also disseminated and adapted.

On the other hand, the UPLB-Department of Horticulture generated three technologies/information that include *anthurium production and management* practices which cover planting, watering, fertilization, propagation, harvesting and packing. *Recommended practices in the production of Aglaonemas* (“La Suerte”), a valuable ornamental foliage plant which is highly tolerant to interior environment, was also disseminated. It highlights the different propagation methods: by seeds, by shoot tip cuttings and by nodal cuttings. Moreover, it also generated the technology on *mass propagation of Mussaenda using mist system* or plastic tent method. The mist system is ideal for mass propagation of Mussaenda, collectively known as “Doñas”, in large-scale production.

The UPLB-Department of Plant Pathology, on the other hand, had developed a *serological technique in indexing orchids for viruses*. This involves the use of ELISA or Enzyme-linked Immunosorbent Assay for the detection and identification of orchid viruses.

Research-based technologies and information generated and disseminated were on orchids, chrysanthemums, roses and daisies, gladioli, liliiums, anthuriums, mussaendas and ferns from 1990-1998 (Table 28). These were through PCARRD-supported R&D activities.

Table 28. Ornamental Technologies/Information Generated and Disseminated, Philippines, 1990-1998.

ORNAMENTAL TYPE	AGENCY	TECHNOLOGIES/INFORMATION GENERATED
Orchids	UPLB UPLB UPLB UPLB DA-MES	Protoplast fusion in orchids Philippine endemic orchids Chemical induction of flowering in dendrobiums Documentation of location-specific orchid technologies New vanda and ascocenda hybrids
Chrysanthemums	BSU UPLB BSU BSU	Production practices Diseases affecting commercial farm Preservative solution composed of 0.1% chlorox (5.25% NaOCl, citric acid, and 2% sucrose) Survey of commercial chrysanthemum nurseries
Rose and Daisy	BSU BPI- LBNCRDC	Intercropping vegetables with roses to increase farm income Rose and daisy production
Gladiolus and Liliiums	BPI- LBNCRDC	Bulb plants growing under La Granja environment
Anthuriums	BSU	Anthurium varieties (12) grown in La Trinidad, Benguet
Mussaenda	UPLB	Mussaenda hybrids
Ferns	CMU	Spore culture of economically important ferns

Source: PCARRD Research Highlights 1994-1998.

For orchids, more technologies/information disseminated were on *protoplast fusion in orchids* which involves an *in vitro* method of producing new hybrids. It includes genetic manipulation through introduction of foreign DNA into the protoplast wherein improvement in horticultural characteristics can easily be induced. Regeneration of fused protoplasts using polyethylene glycol (PEG) as an agent in this process was achieved in *Phalaenopsis*, *Vanda*, and *Rhyncostylis*. Information about Philippine endemic orchids was also disseminated. It was based on the collection of more than 75 species, 50 of which have flowered. Research on the documentation of location-specific orchid technologies includes listing of proper production and postproduction technologies on specific orchid producing areas.

Other technologies generated for orchids also include the chemical induction of flowering in dendrobiums using benzyl adenine (BA). This technology exhibited 70%-90% flowering on *Dendrobium* species and is currently promoted in other producing areas. DA-MES also generated new vanda and ascocenda hybrids. Eight promising crosses from among the notably known hybrids and local varieties of *Vanda* (19), *Ascocenda* (7) and *Aerides* (1) are ready for dissemination especially on key producing areas.

A promising package of technology (POT) that will boost chrysanthemum production was developed and disseminated. Such POT on production practices include proper cultural, postharvest handling and marketing practices. Proper propagation, fertilization, watering and light applications in highly elevated areas were also recommended and disseminated. Information regarding the survey on diseases affecting commercial chrysanthemum farms was also disseminated. Diseases such as rust, seedling blight, white rust, stem rots and petal blights were identified and diagnosed. The use of biological control and proper application of fungicides such as Benlate and Score were also disseminated. On postharvest, a preservative solution on chrysanthemum was developed and is ready for dissemination. This solution is composed of 0.1% chlorox (5.25% NaCl), citric acid, and 2% sucrose which was generated by BSU for preserving chrysanthemums especially during transport. On the other hand, the survey of commercial chrysanthemum nurseries conducted had determined the actual production capabilities of local growers nationwide.

For roses and daisies, a package of production technologies was also generated. These technologies include the proper propagation, fertilization, watering and postharvest handling of the two cutflower types. Intercropping of vegetables with rose to increase farm income was developed by BSU and was disseminated to generate alternate source of income for the farmers when the price of rose is low through optimum use of land.

For bulb plants, varieties of gladioli and liliiums, can now be grown under La Granja environment through modification of some cultural management practices which were traditionally confined only in the cool areas of Los Baños,

Baguio, and Cebu. This technology was already disseminated in key producing areas.

For anthuriums, research-based information disseminated included the survey and evaluation of anthurium varieties grown in Benguet, which resulted in the characterization of flowers, flower development and longevity of the collected 12 anthurium cultivars.

For mussaendas, research-based information disseminated was on hybrids named after the Doñas or the wives of Philippine presidents. These hybrids are described as the most saleable and easy to grow. A technology on spore culture of economically grown ferns”, was generated and disseminated especially for Staghorn fern or *Platycerium grande* (Fee) which is a highly endangered and endemic ornamental fern. This technology was developed by CMU in response to the lack of planting materials due to the fern’s low rate of survival.

There were also significant ornamental technologies generated and adapted, which were developed by UPLB, the national coordinating center (Appendix Table 1). On crop protection, the UPLB-NCPC for example, developed technologies such as control of flower feeding insects by plastic bagging of roses, bulletin on diseases and insect pests of *Mussaenda* and their control, and mites control using high water pressure to reduce damages on cutflowers. The UPLB-PHTRC, on the other hand, developed technologies that were adapted and such technologies include establishment of refrigerated storage condition for local varieties, appropriate pulsing treatments (pre-storage addition of sugar for extending storage life), improved storage/transport of selected cutflowers and cutfoliage, and extending the vase life of cutflowers using preservatives (florafresh).

3.3.4 Constraints to Technology Adoption

By and large, the cutflower industry is unable to match demand preferences, and sustain supply levels to meet demand requirements. Low technology adoption is believed to be a result of inadequacy of information. This serves as a great challenge for the research community, wherein the government institutions play a significant role. In technology generation, the crucial test for utilization of a certain technology is the extent to which the knowledge generated and the technology derived from it have been disseminated and adopted by the end-users.

From the research sector, technology promotion is tasked to the extension system. Considering the present state and capacity of the national extension system, with the Local Government Code, technology adoption is hampered by limited manpower resources, training and financial support.

For cutflower production, however, research-based technologies necessitate expensive inputs. This renders only the large-scale growers to adopt them in their operations because of their desire for quality and more competitive produce. Adoption of improved technologies is very evident among large-scale growers. They are well-versed in propagation methods like tissue culture processes, making use of equipment comparable to those used by internationally known propagators. Large-scale growers of chrysanthemums, roses, orchids, and anthuriums even use highly mechanized water sprinkler systems and production technologies such as hydroponics.

On the contrary, access to these technologies is limited and to some extent nil to small-scale growers. They are unable to adopt these technologies because of financial constraints and lack of credit support.

4. Conclusions and Recommendations

4.1 Proposed Research Areas

(1) Varietal Improvement and Conservation

The quality and quantity of ornamentals primarily affect the market and the industry's performance as a whole. Production at the farm level, volume and desired quality, postharvest handling, delivery and cost-efficient operations bear significant relevance to profitability and sustainability of supply.

Inherent to these requirements is varietal improvement which should be pursued with high priority. Therefore, it is recommended that research should address the following areas:

- Commercial scale breeding of new varieties/hybrids from endemic/indigenous ornamental flora
- Development of a well-coordinated and sustainable genetic improvement program with emphasis on the utilization of endemic/indigenous genetic resources with market potential
- Generate a systematic conservation and utilization program of the country's ornamental flora genetic biodiversity
- Establishing a center (regional) for variety testing/trials for introduced and locally developed varieties.

(2) Ornamental Production

The ability to produce high quality ornamentals at competitive prices involves the means of production, material inputs, and the grower's skills. Means of production refers to the conditions under which crops are grown. Raw material inputs such as cuttings, fertilizers and crop protectants have a direct impact on quality and may account for the bulk of investment costs. Hence, the best suited

growing conditions should be determined. The technical skills and management of the growers are also critical.

- Production system development and improvement
- Propagation technologies
- Plant growth regulation
- Support media development and nutrition
- Water management
- Open and protected cultivation

(3) Crop Protection

Ornamentals are exposed to various types of pests at all stages of growth—from germination to maturity. If left unchecked, pests and diseases render substantial losses. It is therefore important to search for research interventions along these concerns:

- Development of environment friendly pest control strategies
- Development of strategies for managing possible incursion of exotic pests
- Generation of quarantine procedures based on physical treatments to replace chemical treatments.

(4) Postharvest/Postproduction

Postharvest systems play a significant role in determining the competitiveness of the industry. It has been observed and supported by various reports that postharvest handling system is the weakest link in the production-marketing chain for ornamentals. Ornamental growers have expressed the need to address the following:

- Development of storage products during periods of glut
- Development of packing house for specific ornamental products such as cutflowers and foliage, flowering pot plants and landscaping materials
- Improving the system for non-refrigerated transport of ornamentals using transport means other than air
- Program implementation of a quality assurance management for pooled marketing of produce from several small farms
- Testing of packaging and handling for various ornamentals in different distribution centers
- Product wastage reduction

(5) Socio-economics and Policy Advocacy

Considering the role of human or social factors in technology development, documentation and careful analysis of the socio-economic and political environments of the industry may provide sound judgement for policy formulation to improve the various systems to which the ornamental industry primarily depends on.

To assist the industry in the development of market opportunities to efficiently match their product to consumer requirements, the following areas must be addressed:

- Characterization of socio-economic and bio-physical environment
- Identification of market opportunities (benchmarking for specific crops)
- Supply and demand analysis
- Government policies: trade and investment, credit and regulatory policies (e.g. IPRs)
- Role of women in ornamental production/postproduction and marketing systems
- Socio-economic constraints to technology adoption

Priority should also be given to reviewing/assessing existing quarantine policies/procedures of target markets and other cutflower producing ASEAN countries.

4.2 Proposed Roles of the Public and Private Sectors

The public sector is comprised of institutions and organizations of government line departments, SCUs, research centers and stations which address various areas of concerns. These public institutions at the national and regional levels of responsibility have profound macro level impact on the performance of ornamental research in the country.

In ornamental research, the visible role of the public sector is in the area of setting directions for research, coordination and monitoring, verification and fine tuning studies in the growers' fields. Represented by the academe, the public sector also provides leadership in extension services, but more focused on education and training. With the devolution of the extension system, the public sector represented by the LGUs, carries out technology transfer activities. However, availability and technical capacity of responsive extension workers is another constraint of the ornamental industry, which has resulted to poor and unyielding technology transfer. Worst, technology transfer is undertaken using informal channels which compound the problem of poor management practices by end-users.

The need to pursue ornamental research and address the constraints of the industry is great, but the capacity of the existing institutional research-extension structure is invariably limited. The call now is for interdependence. With the limited resources given to ornamental research, the pooling of efforts, specialization and sharing of responsibilities will redound to mutual and equitable gain of both the public and private sectors.

The following areas have been identified to describe a more effective complementation of public and private sectors' engagement in ornamental research.

(1) Contract Research

Collaborative research projects should be explored by public research institutions (funding agencies as well as research agencies) with private organizations that have advanced laboratories and facilities on biotechnology, tissue culture and postharvest handling. Private sector-led research will even lessen bureaucratic red tapes which have been claimed to slow down research activities.

Along the same concept of contracting research, DOST provides research funds to private individuals who will pursue studies on entrepreneurship as a result of technology application. On market research, DA commissions UA&P and FRLD to conduct competitiveness studies of selected crops including orchids and assess the existing market intelligence and promotion system, respectively.

(2) Demand-Driven Research

Need-based type of ornamental research should be prioritized. In technology development, the private sector (as the end-user) should take part from the beginning of the technology development and utilization flow. This concept could be realistically operationalized through consultation with the private sector (i.e. breeders/propagators).

(3) Education and Training

As the natural homes of high level human resource complement, the public sector's (through the SCUs) role should be more visible in education and training. On ornamental R&D, more training courses should focus on sustained breeding programs, pest management, farm management, postharvest handling, and packaging. Education opportunities should be extended to private companies' technical staff. In return, SCUs should institutionalize the students' internship to private ornamental farms/companies engaged in production and trading.

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Appendix Table 1. Technologies/Information Generated/Developed from the UPLB Completed Ornamentals R&D Projects, 1990-1998.

ORNAMENT AL TYPE	TECHNOLOGIES/INFORMATION GENERATED	STATUS
Orchids	Embryology and embryo culture of Philippine Species Protoplast fusion in orchids Philippine endemic orchids Cytology of the Philippine Phalaenopsis and their hybrids Mass propagation of selected orchid hybrids (Phalaenopsis, Oncidium, Cattleya, Dendrobium and Vandaceous Orchids) Use of controlled release fertilizer in production of Dendrobium orchids Chemical induction of flowering in dendrobiums Orchid pilot production Production of semi-terete Vandas Documentation of location-specific orchid technologies Serological Technique in Indexing Orchids for Viruses Modified Atmosphere Storage/Transport of Orchids	Adapted Adapted Adapted Adapted Adapted Adapted Adapted Adapted Adapted Adapted Adapted For Dissemination
Mussaenda	Embryo rescue in Mussaenda Mussaenda hybrids Mass propagation of Mussaenda using mist system Use of plastic tent (“kulob”) system in potted mussaenda production Bulletin on diseases and insect pests of Mussaenda and their control	For Dissemination Adapted Adapted For Dissemination For Dissemination
Anthurium	Developed hybrids for anthuriums Mass propagation of anthuriums Production of anthurium potted plants Production and management of anthurium cutflowers	For Dissemination Adapted Adapted Adapted
Foliage Plants	Mass propagation of indoor plants Mass propagation technique for indoor plants with export potentials (Florida Beauty, Aglaonema, Microsorium) Improvement of selected foliage plants (Cordyline, Murraya, Aglaonema) Mass propagation techniques for songs Mass propagation techniques for Dracaena	Adapted For Dissemination For Dissemination Adapted

	godseffiana Tissue culture of different foliage plants (Dracaena, Homalomena, Spathiphyllum) Production and spore culture (Adiantum, Asplenium) Microsorium Growing foliage plants without soil Development of sustainable production systems for some indigenous plants Common practices in the production of Aglaonemas Recommended practices in the production of Aglaonemas Recommended practices in the production of palms Recommended practices in the production of Freycinetia	Adapte For Dissemination Adapted For Dissemination For Dissemination Adapted Adapted Adapted Adapted Adapted
Aster and Statice	Regulation of flowering and flower quality of Aster Production and management of aster Off season production of statice	Adapted Adapted Adapted
Roses, Chrysanthemums, Daisies and Gladioli	In vitro culture of gladioli Growth regulation of potted chrysanthemum Rapid corm production of gladioli Production of rooted chrysanthemum cuttings Diseases affecting commercial chrysanthemum farms Control of flower feeding insects by plastic bagging of roses Dry pack storage technique (without water) for roses, chrysanthemums and gladioli Improved storage of gladiolus corms	For Dissemination Adapted Adapted Adapted Adapted Adapted Adapted
Ornamentals	Formulated quickroot <i>In vitro</i> culture of Ilang-ilang, Bougainvillea, Bromeliad, Champagne palm, Bauhinia, strongylodon Use of efficient propagation methods	Adapted For Verification Adapted
Heliconia, Aloe and Lilium Carnation Gerbera	<i>In vitro</i> culture <i>In vitro</i> culture of Carnation <i>In vitro</i> culture of Gerbera	For Verification Adapted For Dissemination
Cutflowers	Mites control using high water pressure to reduce damages on cutflowers Establishment of refrigerated storage condition for local varieties Appropriate pulsing treatments- pre storage addition of sugar for extending storage life Extending vase life of cutflowers with cutflower	For Dissemination Adapted Adapted

	preservatives (florafresh) Postharvest handling of selected cutflowers Improved storage/transport of selected cutflowers and cutfoliage	Adapted Adapted For Dissemination
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Appendix Table 2. Ornamental Technologies/Information Generated and Disseminated, by Other Agencies, Philippines, 1990-1998.

ORNAMENTAL TYPE	AGENCY	TECHNOLOGIES/INFORMATION GENERATED
Orchids	DA-MES	New vanda and ascocenda hybrids
Chrysanthemums	BSU BSU BSU	Production practices Preservative solution composed of 0.1% chlorox (5.25% NaOCl, citric acid, and 2% sucrose) Survey of commercial chrysanthemum nurseries
Rose and Daisy	BSU BPI- LBNCRDC	Intercropping vegetables with roses to increase farm income Rose and daisy production
Gladiolus and Liliums	BPI- LBNCRDC	Bulb plants growing under La Granja environment
Anthuriums	BSU	Anthurium varieties (12) grown in La Trinidad, Benguet
Ferns	CMU	Spore culture of economically important ferns

Source: PCARRD Research Highlights 1994-1998.