6 The Papua New Guinea case study

6.1 Introduction

The White Paper on Agriculture (2005-2014) and the National Agriculture Development Plan (2007-2016) have identified floriculture as having considerable potential to develop into a major export industry and have provisionally allocated significant resources to the achievement of this potential. Yet PNG's current ornamental horticulture is a minor industry which is considerably smaller than that described for Fiji in chapter 4.

The potential for a developing a major ornamental horticulture industry in PNG is based on two distinct export opportunities:

- The export of temperate cut flowers and foliage: The agro-ecological conditions found in parts of the PNG Highlands provide the opportunity to produce high value temperate floriculture products similar to those exported by the successful East African industries.
- The export of products derived from PNG's unique indigenous orchids. PNG's wide range of diverse habitats has resulted in members of the *Orchidaceae* family becoming specialised so that the country has become richly endowed with endemic orchids, many of which are horticulturally attractive. There are opportunities to commercially develop these indigenous floriculture products in an environmentally sustainable manner.

This scoping study explores the feasibility, opportunities and requirements to develop these two distinctly different types of floriculture industries. Consideration is also given to the opportunities and requirements to develop a floriculture industry in PNG based on the local market along the lines of that described in the Fiji study.

6.2 An overview of the PNG ornamental horticulture industry

This overview deals with the two distinct segments of the PNG ornamental horticulture industry: the cut flower and foliage segment and the indigenous orchid segment.

6.2.1 The cut flower and foliage segment

For decades, villagers have sold rings of alpine flowers to motorists near Daulo Pass in the Eastern Highlands. These are worn or placed on vehicles to indicate that someone has been on a journey via Daulo Pass. Everlasting daisies are used as hair decoration in parts of the Southern Highlands and may be sold occasionally. Cut flowers are now sometimes sold in highland and lowland markets. However, unlike the situation in Suva or Honiara, flowers are not common items in fresh food markets. Such markets could be readily developed in PNG.

The cut flower growers

This profile of the PNG cut flower grower segment was largely compiled from information obtained during the field visit to PNG which was undertaken as part of this scoping study. The coverage is of cut flower growers in the Goroka District (Eastern Highlands); Mount Hagen District (Western Highland); Lae District (Morobe Province) and Port Moresby (National Capital District).

The Goroka District (Eastern Highlands)[29].

There are four cut flower grower groups reported to be operating out of the Eastern Highlands. These are:

- The Kerefa Women's Association
- The Notofana Group
- Gilaheka Group
- Komiufa Growers Group

Figure 1: Eastern Highlands cut flower groups

The Kerefa Association: has 70 members (including around 15 men) that grow a range of cut flowers and leaves. This group was founded in 2003 by Margaret Harvey, a Goroka based business woman. The group was organised to supply Port Moresby based florist Exotic Blooms. The Kerefa Association was the first group of flower growers with which Exotic Blooms worked. Members also supply flower arrangements to the Bird of Paradise Hotel and other Goroka business houses. A wide range of temperate flowers and leaves are grown, including various lilies, tuber roses, roses, carnations and cordyline leaves. A resource and training center was built by the Association and is currently utilised as the groups meeting venue.

Exotic Blooms has provided training to the Kerefa Association with funding provided by the ADB Smallholder Support Services Pilot Project (SSSPP).
Exotic Blooms principal, Sally Napolioni, describes the development of this relationship as a "trial and error" process in terms of training and marketing. Initially, the Kerefa Association made weekly shipments to Exotic Blooms. These are now much more intermittent.

The Notofana and Gipaheka Groups: The Notofana and Gipaheka Groups have 45 members and 80 members respectively. Notofana concentrate on growing tuberoses, while the Gipaheka group mainly produce cordyline leaves. Combined, the two groups cultivate over 45,000 plants and have established their own resource and training centers. Both groups supply Exotic Blooms (twice weekly) and Goroka business houses. Gipaheka are the source of the leaves for Exotic Blooms trial shipment to Melbourne.

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[29] Unfortunately the stakeholder meeting in Goroka did not proceed as planned due the flight cancellation by Air Nuigini. Information on the flower growing groups that were to attend this meeting was obtained from other sources including: Asian Development Bank 2005; Reports of the ADB Small Holder Support Services Pilot Project (SSSPP) who have been providing support for these groups; and interviews with John Hunt (Project leader SSSPP) and Sally Napolioni (Port Moresby based Exotic Blooms who buys cut flowers from these groups.

Komiufa Growers Group: This group is part of a proposed Komiufa integrated rural development area being promoted by environmental scientist Romius Waki (Gelm Ltd. There are ongoing discussions with a Singaporean investor who is interested in a joint venture for rose development.

Mount Hagen District (Western Highlands)

Some 50 women cut flower growers attended the Mt. Hagen stakeholder meeting held on July 25th, 2007. One participant grew indigenous orchids as a small business. The participants came from villages in and around Mt Hagen. They do not have a formal association, although they plan to form one. The women grow a range of temperate flowers, cordyline leaves, indigenous orchids and some tropicals such as heliconias. A few growers sell flower arrangements to the Highlander Hotel and to Mt. Hagen business houses. There have been no shipments made to Port Moresby or other outside locations. No flower sales were observed in the Mt Hagen market.

Figure 2: Participants at Mt Hagen stakeholder meeting

The participants in the stakeholder meeting described their floriculture activities and gave their reasons for growing flowers in order of importance as:

- household beautification
- decorating church
- plant collection
- income generation in local area (sales for weddings, funerals and graduation).

The floriculture aspirations of the Mt. Hagen participants were listed as:

- to plant flowers as a business
- to secure landscaping and beautification contracts with the Mt Hagen City Council
- to sell flowers to business houses, hotels, weddings, funerals and local markets
- to sell flowers to other provinces and overseas
- to develop partnership with floriculture industries in the Asia Pacific region.

The Mt Hagen participants ranked their major constraints and problems developing floriculture as an income earning opportunity as:

- pest and disease
- availability of planting material for new varieties
- theft

- transportation to market
- lack of packing material
- lack of finance
- lack of cooperation amongst growers
- lack of information of flower growing and flower arranging
- no florists in Mt Hagen.

The Mt Hagen participants requested assistance in the following areas:

- training in flower growing and flower arranging
- assistance in finding markets
- exchange visits with other flower growing groups in region
- information on new varieties and sources of seed.

Lae District (Morobe Province)

A total of 39 flower growers attended the Morobe stakeholder meeting at the National Agricultural Research Institute (NARI) Conference Center in Lae. The majority (31) came from the Morobe Province. Others came from as far a field as Maprik in the East Sepik, the Western Highlands and from Enga Province. The Morobe growers fell into 4 groups:

1. The wives of NARI research staff at Bubia who plant flowers around their houses in the NARI compound.
2. The Erap Group from the Markham Valley
3. The Butibam Village group
4. The Lae town group

Figure 3: Participants at Lae stakeholder meeting

Site visits were made to the nearby growers of indigenous orchids and heliconias. The most common orchid was Morobe Shower (*Dendrobium lineale* Rolfe), which has outstanding cut flower characteristics (extended seasonality, spray yield, outstanding appearance and long vase life). These orchids are only used in flower arrangements sold in and around Lae. There is a small (5 acres) commercial ginger and heliconia farm outside Lae. This business, owned by a mining company, air freights weekly consignments to the PNG Gardener florist in Port Moresby. There are no florists operating in Lae and no flowers were observed in the Lae market. Both areas offer opportunities for small and micro enterprise development.

Figure 4: Site visits to Lae growers

The Lae participants described their floriculture activities and gave their reasons for growing flowers in order of importance as:

- flowers to beautify home and surrounds
- grow orchids because of their low input requirements
- to participate in the flower display and competition at the Morobe Agricultural Show
- flowers on the farm to protect crops from pest and disease and to attract bees for pollination of fruits
- decorating church
- plant collection
- income generation in local area (sales for weddings, funerals and graduation).

The floriculture aspirations of the Lae participants were:

- to plant flowers as a business
- go home and encourage our women to grow flowers
- increase the number of flower shows to create markets
- create and operate a small market for all women to sell their flowers so we could then sell to big markets
- form an association and establish a wholesale/main supplier e.g. (mountain flowers) - so the main supplier buys from individual growers and supplies to their clients
- develop local and hotel markets.

The major constraints and problems identified by the Lae participants, in order of importance, were:

- lack of knowledge and skills in the field of floriculture i.e. how to grow, arrange, and maintain our flowers
- lack of awareness on the potential or opportunities available for these products
- no market – lack of information on marketing
- no organised network to meet demand
- pest and disease issues.

Assistance requested from the stakeholder participants:

- organised workshops and training sessions
- training in quality control and pest management
- attend floriculture conference where we can meet up with other women involved in floriculture around the Pacific
- use existing women networks to provide information on available markets
- conduct survey and observe different varieties of flowers like orchids etc. and tell us which flowers are best for sale overseas etc
- assist market research – both locally and international
- provide access to new and improved varieties
- the establishment of a central nursery to distribute planting materials to contract growers
- the establishment of a wholesale distribution centre
- the provision of a floriculture scientist.

A major floriculture focus for the Morobe Province is the annual Morobe Show run by the Morobe Province Agriculture Society. Growers compete in a wide range of categories in which small cash prizes are awarded. These are listed below:

- **Cut flowers other than orchids** (Annual, 1 bloom e.g.: Zinnia, Marigold, Aster; Canna, l head; Rose, Single garden bloom, freshly picked with foliage, side buds; Rose, single stem, cluster type; Pentas, collection 4 different colours; Anthurium, 1 bloom; Gerbera, single, 1 bloom; Lily, 1 bloom; Any other herbaceous perennial, 1 bloom or spray; Hibiscus, single, 1 bloom (rosa-sinesis hybrid); Hibiscus, double, 1 bloom (rosa-sinesis hybrid); Hibiscus, any other variety, 1 bloom; Frangipani, collection of 3; Ixora, large leaf variety, 1 head; Ixora, small leaf variety, 1 head; Ixora, collection of 3 different colours; Bougainvillea, single, 1 stem; Bougainvillea, double, 1 stem; Bougainvillea, double & single, 3 stems, all different; Mussaenda, double & single, 1 stem; Any other flowering shrub, 1 stem; Any other flowering tree, 1 stem, (e.g. Cassia); Allamanda, shrub type, 1 spray; Allamanda, shrub type, 1 spray; Heliconia psittascorium group, 1 head (not over 0.5m long); Heliconia Erect lobster claw group, 1 head (not over 0.5m long); Heliconia Pendent lobster claw group, (not over 0.5m long); Heliconia any other, erect, 1 head (not over 0.5m long); Torch Ginger, 1 head (not over 0.5m long); and any other Ginger, 1 head (not over 0.5m long).
- **Foliage, shrubs and decorative plants** (Collection of 3 Crotons - all different; Acalypha - one stem; Aralia - one stem; Cordyline - one stem; Any other foliage Shruh or plant – stem; Collection of any 3 foliage).
- **Floral art** (Petite arrangement - not larger than 20cm x 20 cm; Foliage in a basket; Multi coloured mass; 3 flowered arrangements with foliage).
- **Orchids** (Vanda, terete - one spray; Arachnis Maggie Oei - one spray; Arachnis, other varieties - one spray; Aranda - one spray; Any other Arandanthe, or allied hybrid - one spray; Dendrohium - one spray; Cattleya - one spray; Spathoglottis - one potted plant in flower; Any other native species - one spray; Any other hyhrid orchid - one spray)

The range of floriculture categories at the Show is an indication of the rich diversity of the ornamental horticulture base in the Province.

Port Moresby (National Capital District)

Port Moresby and the surrounding areas are dry and harsh and not naturally well suited to growing horticultural products. The high temperatures and lack of rainfall make for a harsh climate for many plants. There is one small commercial grower of tropical cut flowers (gingers, heliconias and anthriums) situated 10 km outside Port Moresby. Tropical cut flowers and orchids are also commercially grown at the Port Moresby National Botanical Gardens. Some Highland households in the settlements along the Sogari road (10 km outside Moresby) grow ornamentals as a source of cash income. They sell on the roadside and at monthly craft markets.

Figure 5: Participants at Port Moresby stakeholder meeting

A stakeholder meeting was held at the National Research Institute Conference Room on July 20th. In attendance was the President of the PNG Floral Arts Society, the former Director of the Port Moresby Botanical Gardens, three growers, two florists, youth group members and representatives the National Training Council.

The stakeholder meeting highlighted the lack of markets for floriculture products, noting that flowers and ornamentals were not sold in the Gordon and Koki municipal markets and that the development of these markets needs to be encouraged. Participants at the meeting stressed the need for training – both in the growing and arranging of flowers. There were expectations that this would be provided through the PNG Floral Arts Society, now that government had indicated willingness to contribute financially to the group.

Local marketing

In Port Moresby there is a small but growing floriculture marketing segment emerging. There are now five flower shops operating in the national capital. The florists use both local and imported cut flowers. Linden Blossom[30] was established more than a decade ago by a Dutch couple who are long term residents of Port Moresby. “The Flower Shop"[31] is an arm of the National Capital Botanical Gardens and sells only locally sourced flowers. The value of sales from the Flower Shop is reported to be between 10, 000 and 15, 000 kina per month. The main market for these flowers is weddings and conferences (particularly larger international and regional events). Demand tends to be higher in the second half of the year, when weddings are more frequent. The Botanical Gardens also has a tropical garden nursery with a range of potted plants for sale. The “PNG Gardener” has a flower shop in its garden supply outlet. Both cut flowers and potted plants are sold.

[30] *lindenblossom@global.net.pg*
[31] *ncbg@orchidspng.com*

An important recent development has been the establishment of flower shops in the two largest up-market supermarkets. Orchids in Bloom Ltd. have a flower shop at Gordons Food World. Exotic Blooms have their outlet in the Andersons supermarket. Exotic Blooms have been sourcing cut flowers and foliage from grower groups in the Eastern Highlands and occasionally from the Western Province. One of the participants at the stakeholder meeting is the leading flower arranger and operates her business from home.

There are no commercial florists reported to be operating in other urban centers. However, certain growers in Lae, Goroka and Mount Hagen supply flowers arrangements to selected hotels and business houses.

There is no wholesale market for flowers operating in PNG. This marks a significant difference with the situation described for Fiji, where the establishment of a wholesale market has been the driving force in the development of the domestic market for cut flowers.

The selling of flowers and plants in municipal markets is not a feature in PNG, unlike the situation described for Fiji and that which exists in Honiara and Port Vila. The absence of these markets poses a major barrier for micro enterprises wishing to enter the floriculture industry and is a major constraint to the development of the domestic floriculture market.

The main outlet for small growers around Port Moresby is road side sales and the monthly Ella Beach craft market. The Ella Beach Market has become a significant event that is growing. At the time of a visit to the Ella Beach Market in July 2007, there were 15 sellers of pot plant and cut flowers. The vendors were selling flowers and pot plants they had grown themselves. There were no middleman participants at this market. Most sellers came from settlements around Port Moresby and this was their main market outlet. These sellers reported that they earned K100 to K250 after deducting their entry fee and transportation costs. The large cemetery on the Sogari road approximately 10 km outside Moresby is another popular selling spot. The main customers were middle class people who drove out from Moresby to purchase plants. Weekly gross revenue was reported to range from K20 to K120. Some had regular customers come to growers small home nurseries.

Figure 6: Pot plant sellers on the Sogari Rd and heliconias at the Ella Beach craft market

Export marketing

From time to time there have been attempts to export tropical cut flowers and foliage from PNG. The most ambitious effort was in May 2003 when a test shipment of floriculture products (lilies, heliconia, gingers, celosias, orchid and cordylines) was made from Goroka in the Eastern Highlands to the Flower Auction House at Aalmsmeer in Holland. This trial was sponsored by the Eastern Highlands Province Governors Office. The shipment

arrived at Aalmsmeer in good condition. It was the cordyline leaves that created the most interest. The trial proved that a long distant shipment from the Highlands to Europe was technically feasible. The trial, not surprisingly, pointed to a number of problems that had to be addressed before commercial shipments could be contemplated. In the eyes of the promoters, none of these problems are seen as insurmountable (Blake, 2003). The report on the trial shipment concluded that:

Exotic leaves, particularly some belonging to the cordyline (ti leaf) family, were identified as the best starting point for floriculture exports. These leaves are robust and easy to pack. They are reported to be in strong demand and yield a very efficient weight volume ratio for air-freighting. Yet air freighting to Europe remains a risky and high-cost business with trans shipment first to Port Moresby and then Singapore (Blake, 2003).

It was hoped that the apparent success of this test shipment would provide the stimulus for the substantial floriculture business involvement necessary for successful export development. The vision of the promoters was that a floriculture nucleus enterprise would be established in the Goroka District. The nucleus enterprise would be responsible for all aspects of market development and marketing. The flowers would be grown by small holders under contract to the nucleus who provide supervision and direction. However, such investment is yet to materialise. A Singaporean investor is currently discussing a joint venture in rose development with the Komiufa Growers Group in the Eastern Highlands.

More recently there have been less ambitious efforts to export cordyline leaves to Australia. Exotic Blooms made a trial shipment of a selection of cordyline leaves to Melbourne in July 2006. The shipment was rejected by the Australian Quarantine. Live insects were found in the consignment and leaf stems were not denatured in accordance with AQIS requirements[32]. Exotic Blooms reports that these quarantine issues have been resolved and they have an approved quarantine treatment and they are ready to recommence shipments.

6.2.2 The indigenous orchid segment

A viable commercial orchid industry has yet to be established in PNG despite the size a diversity of the resource and the substantial international demand that has been identified.

The indigenous orchid resource

PNG has more indigenous orchid species than any other country in the world (Queensland Herbarium, 2007). The island of New Guinea is the center of distribution for orchids from two major genera Dendrobium and Bulbophyllum (www.orchidspng.com). Overall the country accounts for around 10% or some 30,000 of the world's known orchid species (www.orchidspng.com). Amongst the PNG species is the world's largest orchid (*Grammatophyllum papuanum*).

[32] *From AQIS website www.aqis.gov.au*
1. All propagatable cut flowers must be devitalised. Devitalisation may be undertaken in the country of origin by AQIS accredited treatment facilities, or on arrival in Australia. The list of accredited offshore devitalisation treatment facilities is provided below.
2. AQIS will monitor the effectiveness of all devitalisation treatments. Routine evaluation will be undertaken on samples of plant material collected from imported consignments, and where the treatment (either preshipment or on arrival at an AQIS approved facility) is found to be ineffective, AQIS will withdraw its accreditation or approval to conduct devitalisation treatments. Accreditation to treat will only be reinstated following identification of the cause of failure and appropriate corrective action.

PNG's reputation as a rich source of orchids dates back more than a century. The major pioneering, and the most influential, work on orchids in PNG occurred during two expeditions led by Rudolf Schlechter (one in 1901-2 and the other in 1907-8). With a majority of the land and islands of German New Guinea inaccessible Schlechter collected from the islands of New Ireland and New Britain, and on the New Guinea mainland in the vicinity of Aitape, inland from Astrolabe Bay, the western end of the Finisterre Range to the Ramu River, through the Bismarck Range to an altitude of 2,000 meters. The early findings of Schlecter are described in his famous work, Die Orchidaceen von Deutsch Neuguinea. It would be nearly another 50 years before the rich orchid source of the Highlands was discovered (www.orchidspng.com). During the period 1919 to 1923 Schlecter described numerous other species collected by other botanists. During this same period taxonomic work was being done in the then Dutch New Guinea by J.J. Smith, who described many species collected by others (1909-1930) (www.orchidspng.com).

The success of the *Orchidaceae* within New Guinea and its adjacent islands is the result of adaptation to diverse ecological conditions. The Papua New Guinea Orchid News website notes that although New Guinea shares species from adjacent regions, it is the wide range of diverse habitats that has resulted in members of the family becoming specialised and PNG has become richly endowed with endemic orchids. Many of these orchids are horticulturally attractive and/or are of considerable botanical interest. As a consequence PNG orchids have been highly sought after and extensively exploited for over a century. Unfortunately, as lamented by www.orchidspng.com there has been little or no benefit to PNG's rural people. There is now an opportunity to reverse this situation that is both commercially viable and environmentally sustainable.

Since Schlechter's time research of the Orchidaceae of New Guinea has been described as sporadic at best (www.orchidspng.com). As a result PNG's *Orchidaceae* is much less researched and understood than those of SE Asia or Central and South America. Ed de Vogel & André Schuiteman (2005) note that "surprisingly, only very few orchidologists worked on this amazing orchid flora, and about 90 percent of all species were described before World War II by only 5 specialists[33].

More recent times have seen some resurgence in PNG's orchid research activity. The Singapore Botanic Gardens and the National Herbarium of the Netherlands has carried out extensive work on describing PNG's lowland orchid species. This culminated in 1995 with the publication by Singapore Botanical Gardens of Peter O'Byrne "Lowland Orchids of Papua New Guinea"[34].

The National Herbarium of the Netherlands, is collaborating with the National Capital Botanical Gardens in Port Moresby, in the publishing of a series of CD ROMs that will eventually contain all known orchid species. This work has been supported by the PNG

[33] *New Guinea Orchids and the project "Flora Malesiana: Orchids of New Guinea on CD-ROM" Ed de Vogel & André Schuiteman Nationaal Herbarium Nederland, Leiden, The Netherlands.*

[34] *This 584-page book deals with some 269 species covering 55 genera. A review of this book described it as a massive undertaking in itself, is a bold start in making known to the orchid world the unusual and spectacular orchid flora of Papua New Guinea.*

Department of Environment and Conservation. To date, two CD ROMs have been produced and three more are in progress. As part of this collaboration, two field inventories were made in 2003 which resulted in approximately 2,000 live orchid collections (Vogel & André Schuiteman). Wolfgang H. Bandisch, former Director of the National Botanic Gardens, reports that some 2,000 named images have been added to the collection with another 3,000 or so to go.

CITES and PNG Orchids

All PNG orchids are covered by Appendix 2 of CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora). CITES is an international agreement between governments that aims to ensure that international trade in specimens of wild animals and plants does not threaten their survival. PNG and most other Pacific island countries are members of CITES. The trade in PNG orchids is regulated by a 2003 Act of the PNG Parliament. The export of wild collected plants is strictly prohibited. Under current regulations export of indigenous orchid plants is only permitted if they are second generation hybrids (F2) which were originally propagated from seed. These requirements preclude the viable commercial production of orchids due to the infrequency of flowering in the wild and the long lead time required for propagating from seed. Genuine New Guinea orchid plants, which are in high demand, are difficult to obtain from legal sources. There are some reputable nurseries and laboratories where genuine Papua New Guinea species and hybrids can be sourced by collectors[35]. Orchid conservation has been unsatisfactory in spite of efforts since 1990 to enforce the ban on the removal of adult plants from the country. This valuable resource is being degraded due to loss of habitat and over-collection of certain species driven by the illegal export of plants. Yet, the commercial and environmentally sustainable development of PNG indigenous orchids for the benefit of rural people is seen as a readily obtainable objective.

The orchid growers

The only legal income currently generated by rural people from indigenous orchids is from small scale eco tourism activities and from plants sales to local collectors. There are currently no commercial growers of indigenous orchids. In the past there were commercial orchid nurseries operating in PNG. However, these are no longer viable under PNG's CITES regulations. The administration of CITES in PNG, as was found to be the case in Fiji, has inhibited the sustainable commercial development of the resource. This has had an unintended negative consequence of endangering rather conserving rare species.

A visit was made to Niugini Highlands Orchids (NHO), an eco-tourism enterprise that operates outside Mount Hagen. This community based enterprise was established in 1997 following a visit by the founder to the Fuji Orchid Show in Japan. The enterprise has on display a collection of 115 wild indigenous orchids at Mt Kuta some 10 kilometres outside Mount Hagen Township. Orchid enthusiasts pay to visit this site and can also take an escorted visit into the wild

[35] *http://www.orchidspng.com/nurseries.html recommends Stockers' Nursery Malanda, Qld., Australia (gstocker@austarnet.com.au); Royale Orchids Peats Ridge, NSW, Australia (info@royaleorchids.com); Burleigh Park Orchid Nursery Thuringowa / Townsville, Qld, Australia (info@speciesorchids.com); Mountain Orchids North Ludlow, VT, USA (info@mountainorchids.com) .*

habitat to view orchids. NHO is seeking funding to expand and diversify their operations; the first component involves construction of a nursery located near the Mt Hagen Kagamuga airport. Considerable scope has been identified for expanding eco-tourism income generating activities linked to indigenous orchids.

The marketers

The trading in indigenous orchids is largely limited to supplying the illegal export market. According to Barnabos Wilmot (Manager Wildlife Enforcement Department of the Environment) the smuggling of indigenous orchids out of PNG is rampant, with an estimated detection rate of about 1 percent. This situation is a reflection of the very high demand for PNG's indigenous orchids and the lack of resources devoted to the enforcement of CITES. There is no detection infrastructure or equipment at the air and sea ports. The apprehension of smugglers depends on the Department of the Environment receiving "tip offs" from the public.

Under a collaborative program between the National Herbarium of the Netherlands and the PNG National Capital Botanical Gardens, there has been CITES compliant shipments of orchids from PNG. In 2003, under this program, "pickled" specimens were exported to the Leiden University where they were grown and eventually flowered for photographing. However, an overwhelming amount of paperwork was required to make these shipments, which is not compatible with the development of commercial orchid exports.

The conservation and the commercial development of PNG indigenous orchids

New Guinea orchids have been collected by botanists and collectors for more than a century. Yet very little is known about the conservation needs of most of the genera and species. According to Wolfgang Bandisch, this lack of understanding is due to inadequate information on the distribution, habitats and biology of orchids. The need to establish an orchid industry based on a flora conservation program is not being addressed. The potential and requirements of indigenous orchids appears not to be appreciated leading to inadequate government commitment and funding. Overall, there would seem to be a lack of appreciation by policy markers of the potential economic value of minor forest products such as indigenous orchids and the positive relationship between the economic utilisation of the resource and the conservation of the resource.

A "loss-loss" situation currently prevails with the development of PNG's indigenous orchids that provides no benefits to PNG's rural people and is depleting rather than conserving the resource.

- PNG's unique and valuable orchid resources are being smuggled out of the country due to lack of border control resources to enforce CITES. These smuggled orchids are then available for rapid multiplication through tissue culture and an income opportunity is lost forever for the people of PNG.
- The restrictive administration of PNG's CITES regulations preclude the opportunity of rural people legally making an income from their orchids. Thus, they have no financial interest in preserving the resource other than supplying the illegal trade.

The current policy needs to be adjusted to allow for the use of efficient propagation methods that do not threaten the survival of the species as required by CITES. Rather than being an insurmountable constraint to commercial development of the PNG indigenous orchid industry, CITES offers a major opportunity if the appropriate policies are adopted and implemented. The policy environment should encourage the propagation of orchids under laboratory conditions from which F1 and F2 hybrids could then be developed for export markets. These hybrids would be unique orchids certified under the provisions of CITES, which would give them a unique marketing advantage. The

frequency of visits by Japanese orchid enthusiasts is a reflection of the potential market interest in such orchids.

According to PNG Orchid News, an orchid conservation project built around commercial development was designed several years ago. The proposed project promoted the protection of Papua New Guinea's floral diversity by establishing a gene pool for endangered species of orchids and other flora (www.orchidspng.com). The intention was to establish laboratory facilities for research support for the project. This central facility was to be involved in the collection, storage and artificial propagation of plants. The project was to develop an export market for propagated plant species, conforming to CITES regulations. A major focus of the project was to assist in the development of village based horticultural farms to produce foundation seed and hybrid orchid plants on a commercial basis. The hybrid orchid plantlets would need to come from a central tissue culture laboratory from where they could be distributed to out-growers who would then grow them to marketable size. It was envisaged that the grown plants would then come back to a central facility for finishing and distribution to the market. The PNG Orchid News reports that the project eventually “got lost in the bureaucratic quagmire”. This scoping study explores ways that this project concept might be moved forward to implementation. Such a project would seem to be particularly important, in terms of its rural income generating potential and contribution to conservation of PNG’s indigenous orchid resource.

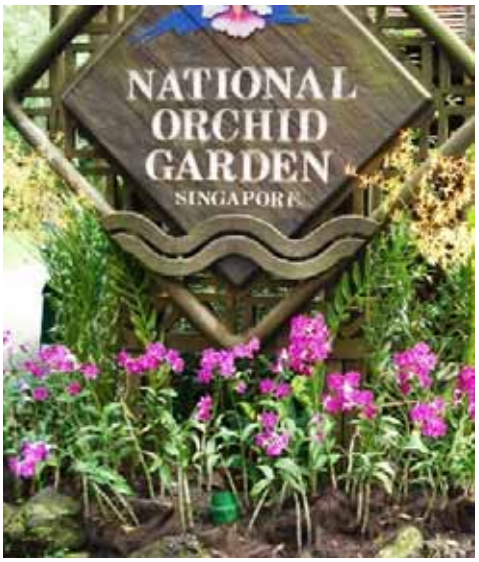
Indigenous orchids and the state of the Botanical Gardens

The depletion of PNG’s indigenous orchid resource and the absence of programs to develop a commercial industry based on resource conservation is reflected in the poor state of PNG’s Botanical Gardens, particularly the National Botanical Gardens (NBG) in Lae.

Figure 7: Existing infrastructure at the Lae Botanical Gardens

The National Botanical Gardens (NBG) covers an area of 56 hectares and is now administered by the National Forest Institute (NFI) The Lae NBG began development at its current site in 1949. In conjunction with the National Herbarium, these gardens became a consolidated centre for botanical research, education, and recreation. Throughout the 1960s and 70s, the NBG was renowned nationally and internationally. It became a major tourist attraction and an attractive recreation area for the residents of Lae.

A significant proportion of the estimated 3, 2000 known PNG orchid species were held at the NBG. Every year, the NBG mounted an orchid expedition to different parts of the country to bolster its collection. However, during the 1980s the condition of the Gardens rapidly declined in the face of massive budget cuts and changes in managements. As a result, within a few years the status of the NBG changed from a "world class botanical reserve to a poorly maintained park in a state of disrepair and neglect" (National Botanical Gardens Development Plan 2000)[36]. The orchid collection was substantially depleted and collection expeditions no longer held. Over the last few years there is reportedly some improvement in the state of the gardens with a modest increase in the funding allocation, although well below that proposed NBG Development Plan. The state of PNG's Botanical Gardens still remains well below their former glory.



What appears not to be realised by decision makers is that a well managed and funded botanical garden has the potential to generate substantial economic social and environmental benefits and as such represents a good investment of public funds. The experience of Singapore shows how important a thriving Botanical Gardens is in the development of an ornamental horticulture industry and the contribution such an investment can make to tourism, recreation amenity and education.

The National Orchid Garden is a main attraction within the Singapore Botanical Gardens. It has a collection of more than 1,000 species and 2,000 hybrids of orchid. The Singapore Botanical Gardens is a major international center for orchid research and breeding. It is noted that Peter O'Byrne "Lowland Orchids of Papua New Guinea" is published by the Singapore Botanical Gardens.

It is envisaged that a revitalized Lae Botanical Gardens could play a central role in the artificial propagation and hybridisation of indigenous orchids for commercial development along the lines proposed above. The implementation of the National Botanical Gardens Development Plan is seen as a priority in the development of the PNG ornamental horticulture industry and in particular the indigenous orchid industry. Apart from the social and environmental benefits, such an investment could be expected to give a high rate of economic return.

6.2.3 Trade in floriculture products

PNG's trade in floriculture products is minimal. According to the UNSD Comtrade Database, there were no official exports of floriculture products from PNG over the period 2002 to 2005. Over the same period, the database shows the value of floriculture product imports to be only USD32, 529. Discussion of these data at the Port Moresby stakeholder meeting revealed that some trade in floriculture products is not captured in the UNSD database. Internal Revenue Commission (IRC) data indicates a much higher levels of floriculture product imports (in 2004 10 tonnes of floriculture products were imported valued at around kina 140,000.) Ironically, a high percentage of these import are orchid plants from Singapore and Thailand that are sold at Port Moresby's annual International Orchid Show.

[36] *The Development Plan for the PNG National Botanical Gardens, Lae. Prepared by Roderick Spivey 2000.*

6.2.4 Economic contribution of the ornamental horticulture industry

The above discussion shows that ornamental horticulture, despite its considerable potential, contributes to the livelihood of only a small number of households in rural and peri-urban areas. At present, the industry makes not contribution to PNG's export earnings.

6.3 An assessment of PNG's comparative advantage in development of a substantial ornamental horticulture industry

On the face of it, PNG is a country that should be well placed to develop substantial horticultural export industries, including ornamental horticulture. PNG has a favourable climate, comparative abundance of land and labour as well as reasonably good water resources. The agro-ecological factors of the country make it suitable for the production of a wide range of ornamental plants and cut flowers on a year-round basis.

A brief assessment is provided below on the key determinates of PNG's comparative advantage in the development of a substantial ornamental horticulture industry. These determinants are:

- the agro-ecological environment
- market opportunities
- physical infrastructure
- the financing environment for agribusiness
- the policy environment
- the institutional environment.

6.3.1 The agro-ecological environment

Having a suitable agro-ecological environment is a fundamental necessary condition for establishing a substantial ornamental horticulture industry. There are sizable areas of PNG that meet this necessary requirement.

The range of altitude, temperature and soil variability of the country has created an enormous ecological diversity and a huge wealth of biological resources. Notable among the resources of PNG is the native vegetation. There are reported to be over 250 plant families in 1500-odd genera and some 15 to 20,000 species of vascular plants, of which over 50 percent of the plants are only found in PNG? (Muller, 2001)[37]. Variations in topography, rainfall, and vegetation cover provide an almost endless range of habitat for plants and the orchid flora. Generally speaking, each major type of habitat has its own orchid flora. Some species are widespread in area of similar habitat; others are confined to a very restricted locality (www.orchidspng.com).

The highland regions of PNG offer the best potential for horticulture and floriculture development. Parts of the highland region provide ideal conditions for growing temperate vegetables and flowers. At elevations of around 2,000 meters, the year round range of day time temperature is 22 to 30^{o}C and the night time temperature range is 6 to 12^{o}C. In most locations, at this elevation, there is considerable solar radiation. Rainy days are usually restricted to less than 100 per year. These are almost identical conditions to those found in the highlands of East Africa, Ecuador and Colombia, which are amongst the world's leading floriculture regions.

[37] *The Biodiversity in New Guinea by Kal Muller www.papuaweb.org*

The areas most suited to growing temperate horticulture crops are in the Western Highlands and Eastern Highlands. This is due to a combination of ecological conditions, population pressure and accessibility. In both areas, active interest in floriculture development was identified.

In the Western Highlands, the locations most suited to floriculture development are in the Mount Hagen District. The upper Wahgi, Kuna and Komun valleys have the most potential given the suitability of land, lack of agricultural pressure and reasonable roads providing access to markets (Papua New Guinea Rural Development Handbook 2001). The valley bottoms are at an elevation of 1,500 masl, with average rainfall ranges between 2500 and 2800 millimetres (Papua New Guinea Rural Development Handbook, 2001).

The Eastern Highlands Province of PNG is located in the central highlands and includes an area of around 8900 km2. Within the Eastern Highlands, it is the flood plains of Asaro Valley of the Goroka District that is well suited to temperate horticulture and floriculture development. The Asaro Valley lies at an altitudinal range of 1400-1600 masl, with an average rainfall ranges between 1800 and 2800 mm and there is a moderate dry season (Papua New Guinea Rural Development Handbook, 2001). The town of Goroka is in the middle of the district and well connected to Mt Hagen and Lae by the Highlands Highway. Most people in the occupied areas of the district benefit from relatively good road networks connecting them to the town of Goroka in less than an hour's drive. There are number of village based groups active in floriculture development in the District.

An overview of suitable conditions in the tropics for ornamental horticulture[38]

If one takes a global geographic view of the area in which Latin American and East African cut flower production is presently established, it is clear that there exists an Equatorial Belt approximately 19° latitude north and south of the Equator. Within this narrow latitude zone the following conditions favour cut flower production:

- Up to a minimum of 1700 hours of brilliant sun per year.
- Relatively stable and uniform diurnal day length and temperature rhythms.
- Absence of seasonal aspects of climate that require growing environment protection and modification controls, found outside these latitudes, permitting no more than simple plastic film roof structures.
- The potential to encounter the desired cut flowers ideal climate, by simply taking advantage of the phenomena of natural reduction of temperature with altitude.

(Zabeltitz, 1999)

For the production of plants, it is important to know the mean daily sum of solar radiation energy for each month. In the equatorial zone, the daily solar radiation is the same in the summer and winter, while the other zones show considerable differences between summer and winter.

The production of plant matter decreases almost linearly with radiation at low solar radiation values. Most important for photosynthesis, i.e. the growth of plants, is solar radiation power (W/m2). In the equatorial zone, solar radiation values do not drop below the minimum during the year. Plant growth in greenhouses is possible throughout the year. Flowering plant varieties are adapted to the day length. For tropical regions, varieties suited to the shorter day length in summer must be chosen.

[38] *This section draws heavily on work from FAO Plant Production and Protection Paper 154, Greenhouses and shelter structures for tropical regions by Christian von Zabeltitz, 1999.*

Although data on solar radiation power (W/m2) was not available for the regions of PNG discussed in this scoping study, Table 1 shows the total sunshine hours per year for the selected sites.

Table 1: Total sunshine hours per year at selected sites in PNG

	Sunshine hours (total per year)
Goroka	1764
Lae (Botanic Gardens)	2012
Mt. Hagen	n/a
Port Moresby	2478

Source: McAlpine et al., 1975

The cloud conditions and altitude above sea level produce significant deviations from the mean radiation distribution:

- Due to heavy cloud and high precipitation, the radiation in equatorial zones is constantly reduced. In regions with distinct rainy seasons, the decrease in radiation is limited to these seasons.
- With increasing altitude, radiation is intensified. Corresponding climatic conditions can be found, e.g. in the tropic plateaus of Ecuador, Colombia, Kenya and in this case PNG, near the equator.

Temperatures

The impact of temperature in any one location depends on radiation, season, altitude above sea level, distance from seas, and wind and cloud conditions. Therefore it is difficult to make general statements. For more detailed information, the local micro-climate of the location in question has to be examined. Very generally:

- Temperatures sink with increasing altitude above sea level. In tropic plateaus and mountains, temperature extremes do not change between summer and winter, but every 12 hours between day and night. In spite of high day temperatures, near zero temperatures can be reached during the night. This cannot be seen from the monthly means.
- The temperature amplitude grows with increasing distance from the sea.
- Extreme minimum temperatures can range below the biological optimum in highlands.

Table 2: Temperature data for selected sites in PNG

	Mean temp (deg C)	Mean max temp (deg C)	Mean min temp (deg C)
Goroka	20.1	25.7	14.6
Lae (Botanic Gardens)	25.9	29.6	22.1
Mt. Hagen	18.3	23.7	13
Port Moresby	26.8	31	22.6

Source: McAlpine et al., 1975

Precipitation

Water is a vital element for plant growth. In order to evaluate protected cultivation in a region, it is necessary to have information about the most important characteristics of rainfall, e.g., total quantity, seasonal distribution, intensity and frequency. The variability from year to year is also an important factor.

Together with precipitation, evapotranspiration is an important element, especially for the water supply (water balance) in open-field cultivation. In protected cultivations, the total water consumption of the plants is covered by irrigation.

Rainfall in tropical regions tends to occur in high intensities together with storms. Excess rainfall that the soil is not able to absorb flows away as surface run-off; it is not available to the plants and causes strong soil erosion. Generally speaking, rain intensities greater that 10mm/h are dangerous with regard to erosion. Such intensities, however, are a frequent occurrence in tropical regions.

Tropical humid climates suffer from intense rainfall, whereas sub-tropical climates have large areas with very little rainfall. Usually, rainfall shows the biggest variation where the total quantity of rain is smallest.

Table 3: Rainfall data for selected sites in PNG

	Avg. annual rainfall (mm)
Goroka	1921
Lae (Botanic Gardens)	4419
Mt. Hagen	2586
Port Moresby	1145

Source: McAlpine et al., 1975

Evapotranspiration

Evapotranspiration and its relation to rainfall is important for: the evaluation of plant growth; the calculation of water consumption for irrigation; and the need to collect and store rainwater for dry periods. Evapotranspiration is the evaporation of water from soil and plants. It depends on: solar radiation; air temperature; surface temperatures of plants and soil; the vapour-pressure gradient; wind and air turbulence; and the growth stage of the plants.

Unfortunately there was no data available for evapotranspiration in the selected regions of PNG evaluated in this scoping study.

6.3.2 PNG's agro-ecological environment for exotic tropicals

The coverage here is indicative and is restricted to anthuriums, gingers, heliconias, leaves and ferns.

Anthuriums

Anthuriums are native to the rain forests of South America. Thus they are well suited to the hot humid conditions that prevail along the coastal and lowland areas of PNG. The temperature range for anthuriums is between 14^{o}C and 35^{o}C, with an optimum day time temperature of about 22^{o}C. The upper limit of the acceptable temperature range depends on humidity. Good flowering requires high humidity. In the lower humidity conditions found around Moresby anthuriums will feel distinctly uncomfortable. Thus to successfully grow commercial anthuriums around Port Moresby would require measures to either reduce the temperature or increase the humidity. Anthuriums need semi shade conditions. Too much light can cause the colours to fade. If there is little or no shade the leaf temperature will be well above the air temperature causing the leaf to burn and plant growth to be slowed.

The climatic conditions around the Lae area are comparable to those found in Suva and Mauritius. Mauritius is the world's largest anthurium exporter located in the tropics. Suva is the nucleus of anthurium production in Fiji. The range between daily maximum and minimum temperatures is almost identical for Suva and Lae (Table 4).

Table 4: Temperature comparisons – Suva and Lae

	Mean max temp (deg C)	Mean min temp (deg C)
Suva	29.6	23.1
Lae (Botanic Gardens)	29.6	22.1

Source: Fiji Islands Bureau of Statistics
McAlpine et al., 1975

The Lae Botanic gardens recorded overall annual rainfall is slightly less than that recorded for Suva. Lae's hours of sunshine are nearly identical to that of Suva. Overall rainfall/humidity conditions in both locations can be regarded as optimum for anthuriums.

Table 5: Rainfall and sunshine comparisons – Suva and Lae

	Total hours of sunshine (Avg. annual)	Avg. annual rainfall (mm)
Suva	1911.5	3355.9
Lae (Botanic Gardens)	2012	4419

Source: Fiji Islands Bureau of Statistics
McAlpine et al., 1975

Gingers and heliconias

Gingers and heliconias require hot, wet conditions to flourish. Thus they do best in the lowland, high rainfall areas of PNG such as Lae. Lae with an average annual rainfall of 4419 mm and mean temperature of 25.9 deg C is an ideal location for ginger and Heliconia production. To grow gingers and heliconias commercially in the areas surrounding Port Moresby will require irrigation. These plants like lots of water and well-drained soils rich in organic matter. The minimum temperature must exceed 5 ^{o}C, where temperatures are not limiting; flowering is year-round if moisture and nutrition are adequate.

Dendrobium orchids

The conditions required for optimum dendrobium orchid production are:

- bright sunshine a high percentage of the time
- good drainage – native epiphytes in trees dry out within 15 minutes of rain
- warm day temperatures (between 24^{o}C and 30 ^{o} C with night-time lows not falling below 18 ^{o} C
- low to moderate rainfall not exceeding 10cm monthly
- good air movement but without regular strong winds
- a level site with good drainage.

These conditions are largely met in and around Port Moresby. In Fiji the dendrobium orchid growers are centred on the dry western side of the island near Nadi, where some of the better growers achieve yields comparable to that of Hawaii's growers. The climatic conditions of Port Moresby are compared to those found in Nadi below in Table 6. Generally speaking Port Moresby is a bit harsher than Nadi with regards to temperature and rainfall.

Table 6: Climate comparisons between Nadi and Port Moresby

	Avg. annual rainfall (mm)	Mean max temp (deg C)	Mean min temp (deg C)	Total sunshine hours
Nadi	1686.8	30.2	21.5	2555.9
Port Moresby	1145	31	22.6	2478

Source: Fiji Islands Bureau of Statistics
McAlpine et al., 1975

Dendrobium orchid yields in other areas of PNG such as Lae could expect to be quite low as is the case in Fiji where the production level of dendrobium growers in the Suva area is less than ½ that achieved by there Nadi counterparts. Dendrobium production in both Fiji and Hawaii experience considerable seasonal variation, with around a 50 percent reduction in yield experienced during the winter months (May through August in Fiji), the same seasonality can be expected in and around Port Moresby.

Potted plants and Leaves

The plant biodiversity found in PNG's forest is incredibly diverse. There also exists a wide range of climatic and ecological zones that provide the necessary conditions of plant growth for a plethora of different plant types.

Foliage leaves from many commercial varieties thrive in the high rainfall areas of PNG. Often these plants need little or no care and produce profusely their foliage. Apart from the leaves that are already used commercially it is assumed that are a great number of native plants found in the forest areas that possess the characteristics necessary to be good cut foliage.

Croton is a common garden plant found in landscapes around the country. It propagates very easily from cuttings and is tolerant of many types of soil. In the high rainfall areas of PNG this plant thrives with little or no assistance.

Climatic conditions in all growing areas of PNG are suitable for a variety of potted plants. Partial shade supplied by sarlon cloth is used in commercial nurseries while the majority of potted plant producers just grow under trees and around their compound.

A wide variety of palms are grown in PNG and almost all are well suited to the climatic conditions found here provided they are planted in the correct media. Commercial palm nurseries often benefit from being located in the high rainfall areas because this reduces the amount of hand watering.

Overall assessment

There exists excellent growing conditions for tropical's in the New Guinea lowlands and islands, in particular Lae is well suited for anthurium, ginger, and heliconia production. Areas around Port Moresby have potential for good potential for dendrobium orchid production.

6.3.3 PNG's agro-ecological environment for temperate cut flowers

The coverage here is indicative and is restricted to roses, tuberose, marigold, jasmine and carnations.

Roses

The majority of commercial rose varieties require a mild temperate climate for good yields, high quality and minimal pest and disease damage. In tropical countries these requirements are often met in the high altitude areas. It is at this altitude that the lower day and night time temperatures are found that are conducive to high quality rose production.

Parts of the PNG highland region provide ideal conditions for growing roses. The elevation of the two climate recording sites in Goroka and Mt. Hagen is 1565 meters above sea level and 1630 meters respectively. Christian von Zabeltitz, in 'Greenhouses and shelter structures for tropical regions' reports: "at elevations of around 2,000 meters, the year round range of day time temperature is 22 to 30^{o}C and the night time temperature range is 6 to 12^{o}C. In most locations, at this elevation, there is considerable solar radiation. Rainy days are usually restricted to less than 100 per year. These are almost identical conditions to those found in the highlands of East Africa, Ecuador and Colombia, which are amongst the world's leading floriculture regions."

Rose production in the lowland areas and islands of PNG will face substantial constraints due to the climate associated with these areas. The hot and moist conditions that are found in these areas while presumable lead to higher than usual downey mildew pressure which is limiting factor to high quality rose production.

Tuberose

Tuberose prefers to grow in an open sunny location, away from the shade of trees. It requires warm and humid climate although flowering is profuse under mild climate. Under extremes of high (>40° C), or low temperatures the spike length and the quality of the flowers is severely affected. A temperature range from 20-30° C is considered to ideal for this crop. A place protected from strong winds is preferable. The climate in Goroka and surrounding areas is well suited to tuberoses.

Marigold

Marigold requires a mild climate for luxuriant growth and flowering. The optimum temperature range for its profuse growth is 18-20° C. Temperatures above 35° C restrict the growth of the plants, which leads to reduction in flower size and number. In severe winter, plants and flowers are damaged by frost.

Jasmine

Jasmine prefers a mild tropical climate. Jasmine is commercially grown in India under open field conditions. The ideal requirements for successful cultivation of jasmine are mild winter, warm summer, moderate rainfall and sunny days. Jasmines grow well up to 1200 m. A well-distributed annual rainfall of 800 to 1000 mm is optimum for growth and development.

Carnations

Land between 2,500 and 4,000 feet in elevation is suitable for the year-round production of carnations. Water supply must be considered in land selection for carnation production. Carnations are best grown at an even temperature, as fluctuations accentuate calyx splitting. Goroka and Mt. Hagen districts would have areas that are suitable for carnation production.

Overall assessment:

Available evidence indicates that world class production conditions exist for temperate cut flowers in some Highland locations.

6.4 Market opportunities

6.4.1 Exotic tropicals

Export markets

Tropical products are estimated to make up 4-5 percent of the total floriculture trade valued at approximately € 400-500 million annually, of which orchids and anthuriums make up 90 percent of this trade. Leonhardt (2006) identifies good growth in demand for tropical floriculture products in travel and tourism; luxury hotels, resorts and restaurants. However, a study by Rikken (2006) on the market for tropical flowers and foliage in the European Union would suggest there would be little opportunity for a remote new entrant such as PNG obtaining a market share. The Rikken study found that there is worldwide overproduction of tropical flowers, with some importers moving away from tropical flowers because of decreasing prices and lack of demand.

The 2003 test shipment of tropicals from Goroka to Aalmsmeer in Holland shows that it is technically feasible to export cut flower to Europe. However, air freighting floriculture products from PNG to Europe would be a risky and high-cost business in comparison to competitors in Africa and South America. There would seem to be little justification for European importers to look to remote PNG as an alternative source of supply. Thus it is hardly surprising that there has been no follow up interest in PNG as a supply source since the once off shipment in 2003. This is despite the high expectations of the promoters and the favourable comments made about the quality of the leaves that were sent.

There are market trends that in the longer term could potentially favour new entrants such as PNG. From 2008 onwards Kenya, under the Cotonou Convention, will lose its preferential access to the European Union. Kenya will not be classified as a “Least Developed Country” a category that will be retained by competitors such as Ethiopia, Uganda and Tanzania and presumably PNG. Kenya and Ecuador have been subject to increasing environmental and trade unionist pressure for its excessive and misuse of pesticides. A new entrant such as PNG has the opportunity to commence operations based on a more acceptable and certifiable set of environmental, health and safety standards.

More immediate markets for tropicals could be expected to lie closer to home in Oceania and Asia. Gingers and heliconias, from all sources, are excluded from the Australian market due to quarantine restrictions. However, even if these restrictions were lifted it is unlikely that gingers and heliconias grown around Lae could complete with the Darwin and N. Queensland based Australian industry. There is a very small market available for gingers and heliconia in New Zealand (PITIC, 2003). However, nearby Fiji and Samoa send minimal volumes of gingers and heliconias to New Zealand. For PNG, without direct flights to New Zealand accessing these markets cannot even be contemplated.

Exotic Blooms’ report to the ADB SSCF Pilot Floriculture Project indicates a readily available market in Australia for exotic leaves from the Highlands. This market was estimated at around a tonne a week[39]. The report also records the availability of significant markets in Europe. Exotic Blooms optimistic view is not supported by the Sydney based Pacific Islands Trade and Investment Commission (PITIC) who did an assessment of floriculture shipments from Fiji and PNG[40]. The PITIC report found that the landed price from both countries was more than 50 percent to 200 percent higher than Australian

[39] *Exotic Blooms “Report on the ADB SSCF Floriculture Project for Notofana Womens Group and Gipaheka Womens Group in Goroka, Eastern Highlands, August 2006.*

[40] *Robyn Ekstrom: Coordinator - Export and Enterprise Development Pacific Islands Trade and Investment Commission: robyn.ekstrom@pitic.org.au*

wholesale prices. PITIC reported major issues in volume, consistency of supply and quality (species, colours, sizes, post harvest handling and packaging) and noted that "post-harvest handling, refrigeration and cool chain integrity needs to be established or we can forget it" (PITIC, 2003). The PITIC identified very few importers even interested in dealing with Pacific islands and even for those interested the volumes were seen as too low and risk is perceived as too high compared with Asian suppliers. A typical reported reaction was "why drop an established Asian supplier that provides the right product at the right price every week" (PITIC, 2003).

Japan probably offers the best potential prospect for tropicals. Japan is one of the world's largest flower importing countries[41] – with niches available for high-quality exotic flowers. There is a direct flight Port Moresby to Narita, thus shipments would be feasible. It is also of note that a Singaporean investor is discussing a joint venture in rose development with the Komiufa Growers Group in the Eastern Highlands. Again shipments are feasible with Air Niugini operating a direct flight from Port Moresby to Singapore.

Figure 8: Heliconias and foliage for sale at the Japanese auction house

Domestic markets

It is the domestic market that in the foreseeable future offers the best demand prospects for tropical cut flowers and foliage. In PNG, the local market demand is seriously constrained by the absence of a wholesale market, erratic supply, and high prevailing prices. The Fiji scoping study showed that the establishment of a wholesale market has allowed the entry of new floriculture businesses that have driven market development. The narrow local market experiences unpredictable highs and lows related to special life cycle events – deaths, births and marriages. However, with the development of a wholesale market, florists in Fiji have been able to secure contracts with local businesses and churches to overcome these fluctuations in demand. The development of wholesale markets in PNG could be expected to have a similar positive impact on the demand for floriculture products.

The total potential market for tropical cut flowers and foliage is estimated at several million kina. This estimate is based on the Fiji experience - adjusted for the population, income level and income distribution.

[41] *In 2003 Japan imported 34,000 tonnes of floriculture products valued at 23,690 million yen (JETRO 2003)*

6.4.2 Temperate cut flowers

If temperature flowers such as roses were readily available at a reasonable price, a worthwhile domestic market could be expected amongst the growing urban middle class. Exotic Blooms has imported roses from Australia for Valentines Day.

Exports of temperate flowers from PNG would likely be sent to Asia. Japan is a major importer of cut flowers with over 1.6 million Euros traded in 2001 (AIPH / Union Fleurs: International Statistics Flowers and Plants 2006). This same source records over 57 countries that exported cut flowers to Japan in 2001.

6.4.3 Indigenous orchids

An indication of the interest in PNG's indigenous orchids is seen in the Papua New Guinea Orchid News website, launched on Oct 25 1998, which has had over 2.3 million visits. The popular interest in PNG orchids is also reflected in a feature in the Qantas/Air Pacific in-flight magazine (August 2007) under the banner "Orchid Delight: PNG sets scientific pulses racing". To quote:

The previous WWF expeditions to the Kikori region surrounding Lake Kutubu discovered some 300 species many of these have been confirmed as new species. The orchids collected by this group varied enormously in terms of size, shape and colour – we have found tiny orchids with flowers only a couple of millimetres in diameters to those with flowers several centimetres across.

The market for PNG indigenous orchids can be divided into two broad segments:

- "bringing the world to PNG orchids" (the eco-tourism market – which is not dependent on CITES compliance)
- "sending PNG orchids to the world" (the export market – which is dependent on CITES compliance).

"Bringing the world to PNG orchids" (eco-tourism)

Over the last decade, over 2-million people "have come to PNG orchids" via the magnificent Papua New Guinea Orchids News website that was developed by Wolfgang H. Bandisch, former Director of the National Botanic Gardens. This has created significant awareness on a potential global market. A fraction of these people have been attracted to visit PNG and to observe these orchids in their natural environment. Such visitors spend money in rural areas and provide an incentive to conserve the resource. If only one half of one percent of the people who visit the PNG Orchids website decided to visit the country to observe the orchids first hand, this would represent around 50, 000 visitors per year. This would make an immense contribution to the livelihoods of rural people.

Some of the orchid eco-tourists belong to a small but dedicated group of enthusiasts like those described in the June 2007 issue of the Orchadian. Entitled "What an Adventure: An Orchid Tour of Papua New Guinea," this excerpt from the article articulates the enthusiasm of the tour group:

The return trip to Ambua Lodge produced another surprise. A large tree had fallen along side the road, so we had to stop and see if any orchids were there, in this endangered environment. Most of the plants were dead but several were found alive and saved by returning them to the Ambua Lodge for replanting. Among the plants recovered were Dendrobium subacaule, Glossorhyncha species and others. There was also the surprise of finding unnamed species within the Latourea section of Dendrobium. Before leaving Ambua Lodge, we had another quick trip viewing orchids in the wild. Several unknown Bulbophyllum species were seen along with many spectacular Cadetia species, Calanthe species, Coelogyne fragrans, Dendrobiums cuthbertsonii, Dendobiums finisterrae, Dendrobiums subclausum, Dendrobium vexillarius and a Phreatia species with small

white flowers on very long inflorescences. On this walk were two 'wow' plants. Possibly an undescribed Coelogyne was the first plant seen. This plant with its bright yellow flowers and a beautiful red brown labellum must be closely related to Coelogyne fragrans. An undescribed Bulbophyllum was the second major find. This had grown into a clump about one metre square and was in full flower, forming a mass of white and orange, the sepals and petals were almost translucent to white the labellum was large and a vivid orange. Keeping in mind that many of the orchid species of New Guinea are described, from my observations and a search in Schlechter's Orchidaceae of German New Guinea I believe many more are yet to be described including this stunning species (Orchadian Vol 15, No 8, June 2007.)

However, for most tourists interested in PNG's natural environment, orchids represent another attraction along with birds of paradise, spectacular scenery and exotic cultures. There is no doubt significant scope for the expansion of eco-tourism in PNG, including tourism specifically related to orchids. This development will depend on more investment of the type proposed by Highlands Orchids (NHO) and more promotion of PNG's unique eco-tourism attractions. In the future, tourists and visitors might be able to purchase hybrid PNG orchid plants to carry back to their home countries as gifts and souvenirs of their PNG experience. The tourism "carry on" trade is a significant part of Hawaii's floriculture industry[42]. However, such a development will depend on having CITES compliant, and other phytosanitary, protocols in place. The development of this market is thus likely to be a by-product of the development of commercial orchid exports.

The overall development of the tourism based orchid market faces the same constraints that limit the growth in tourism numbers to PNG generally. These constraints include the poor market perception of PNG's law and order situation, air service and other infrastructure limitations. Total non-resident visitor arrivals are estimated to currently stand at only around 70, 000, compared with some 600,000 for Fiji.

Export markets for indigenous orchids

It is anticipated that it would be potted hybrid orchids that would be exported. The best market opportunities are identified for small plants with large flowers.

Rittershausen et al. (2001) in discussing the market for potted orchids notes:

…other dendrobiums, particularly miniature species from Papua New Guinea such as D. Cuthbertsonni are coming to the fore, being prized for their compact size and incredibly colourful flowers, and their willingness to produce good hybrid forms (p, 104).

Orchid collectors represent a significant niche market opportunity. However, it is expected that the main market for PNG potted hybrid orchids would be as upmarket household beautification items. The target would be high income consumers in large Asian cities who live in confined residential spaces. They will largely buy their potted orchids through supermarket chains which are increasingly providing the main outlet for floriculture products.

Small potted orchids, unlike cut flowers, are a relatively non perishable item. Thus the export of indigenous orchids would not face the almost insurmountable supply chain constraints faced by aspiring exporters of cut flowers and foliage from PNG. It would be a realistic option to devise systems that assembled orchid plants at Lae for direct sea freight to Asian markets. As such, the problem of cost and capacity of air freight is avoided

It will be difficult to enforce patents on plants once they have left the country. Thus it must be expected that any PNG hybrid that is popular in the market will be tissue cultured by a

[42] *In 2001 the value of "Hawaii Food and Floriculture Products" sold to departing tourists was $US102 million (Department of Business and Economic Development and Tourism).*

competing business. A sustainable market strategy for PNG will involve a combination of two components:

- The development of a certification program that would enable orchids to be sold as "genuine PNG sourced orchids".
- A breeding program in place that allows for the ongoing pipeline of new genuine PNG hybrids ready for introduction into the market. Being at least one step ahead of the tissue culturing by competitors is seen to be readily achievable. As noted in the White Paper on Agriculture, repeated sectional and intersectional crossing and backcrossing to generate newer types has almost limitless possibilities. PNG already has a significant number of primary orchid hybrids that would provide a basis for kick starting the development such an industry.

6.4.4 Physical infrastructure

Adequate physical infrastructure is also a basic necessary condition for the efficient marketing of perishable horticulture products. Epstein (1999) describes the inherent transportation constraints faced by the fresh produce industry:

The PNG varied topography with its mountainous areas that are interspersed with deep valleys, coastal plains and numerous islands create serious problems for an effective intra – country food distribution system. As there are no railways, PNG depends on road, sea and air transport. None of these transport means offer cost effective options to ensure satisfactory food supplies to Port Moresby. There is only one highway that links the Highlands to the coast and that ends in Lae; there is no direct road linking the Highlands with the capital. The lack of maintenance of the highway between Mt. Hagen and Lae has resulted in extreme deterioration of the road surface. This constitutes now a serious hazard to trucks and cars and in turn is reflected in the high transportation costs. Shipping between Lae and Port Moresby is not always regular and demand for space exceeds availability. This means that the quality of fresh produce deteriorates in Lae while waiting for shipment to Port Moresby. In principle the shipping of fresh produce by air from the Highland to Port Moresby is preferable in terms of ensuring quality maintenance, but in practice air connections are unreliable and airlines prefer to carry passengers rather than freight and therefore space is often not available and freights are prohibitively high (p. 18).

PNG, unlike the situation described in the East African floriculture areas, falls well short of meeting basic infrastructure requirements. Transportation constraints are likely to offset any advantages PNG may have in terms of agro-ecological conditions

Roads

The establishment of the Highlands Highway in the mid-1960s led to the establishment of the coffee industry, which is now the nation's most important industry. It also opened up the prospect of PNG having a major commercial produce industry taking advantage of the excellent growing conditions. However, the Highway has nowhere realized its potential due to inadequate maintenance, lack of supporting feeder roads and poor security. Encouragingly there is now a major upgrading program in place using national and aid funding. Secondary and rural feeder roads are often in a state of disrepair or non existence. However, rural roads in the Goroka District of the Eastern Highlands, an identified area for floriculture development, are relatively good. A major constraint is that there are no direct road links to the main Highland production areas, the main urban center of Port Moresby and the international airport. Fresh produce therefore must be transhipped by air or sea. This situation is unlikely to change in the foreseeable future

Overall assessment: Poor

Airfreight

The movement of cut flower products to markets depends on airfreight. Air Niugini provides a twice daily Dash 8 service in the main provincial centers, including Goroka, Mt. Hagen and Lae. AirLink a second tier airline also provides some scheduled services and there is a small air freighter that offers charter services[43]. In 2003, at the time of the trial shipment (floriculture products from Goroka to Aalmsmeer (Holland)), AirLink had plans to invest in a dedicated ATR42 aircraft to provide a freight service for ten tonnes capacity of cargo from the Highlands to Port Moresby. These plans have not yet materialised. The situation remains that the overall domestic airfreight capacity is limited; freight rates are high[44] and the quality of service is less than satisfactory. Exotic Blooms reports that consignments have been off loaded an average of once every two weeks. The Goroka stakeholder meeting for this scoping study had to be cancelled due to numerous flight cancellations. There are no cool store facilities available at any of the regional airports.

International air freight capacity is limited. There are currently daily Air Niugini flights (Boeing 767) from Port Moresby to Brisbane. The same aircraft makes weekly scheduled flights to Singapore and Narita, Japan. At present Port Moresby is PNG's only international airport. There are no scheduled freight services to and from Port Moresby.

Overall assessment: Poor

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[43] This is a single engine PAC 120 owned by Oilmin Field Service Ltd. It has a freight capacity of 1.2 tonnes and is chartered at a rate of K1,400/hours.

[44] Below are the current Air Niugini listed domestic air cargo rates. Relatively light floriculture products usually command a significantly higher volumetric rate. Exotic Blooms reports an Air Niugini freight rate of K7/kg for the transportation of floriculture products from Goroka to POM.

Air Niugini

March 2006

CARGO TARIFFS INFORMATION

DOMESTIC CARGO RATES - EFFECTIVE 27th MARCH 2006

Currency is Papua New Guinea Kina (PGK)

(TACT - Domestic)

RATES PER KILOGRAMS in PGK (KINA)

Basic Charge Per Shipment - Pgk 30.00

Rates are subjected to VAT 10%

ALOTAU	GUR																					
BUKA	9.50	BUA																				
GOROKA	5.65	9.85	GKA																			
HOSKINS	6.40	4.55	6.65	HKN																		
KAVIENG	8.25	4.75	8.65	2.95	KVG																	
KUNDIAWA	5.90	10.15	6.30	7.10	8.70	CMU																
LAE	5.10	7.20	5.45	3.50	5.45	5.80	LAE															
LIHIR ISLAND	9.20	13.40	9.60	10.35	11.70	9.70	9.00	LNV														
MADANG	6.15	8.25	6.60	4.75	5.60	6.70	2.20	10.05	MAG													
MANUS ISLAND	8.05	5.95	8.40	6.35	3.30	8.65	4.45	11.90	5.15	MAS												
MENDI	6.65	10.90	7.10	7.80	9.40	7.20	6.45	10.45	7.45	9.20	MDU											
MOUNT HAGEN	6.20	10.45	1.80	7.40	9.20	6.85	6.00	10.15	7.10	8.95	7.60	HGU										
POPONDETTA	4.05	8.35	4.45	5.25	7.10	5.00	3.90	7.90	4.90	6.75	5.35	5.00	PNP									
PORT MORESBY	3.15	7.40	3.50	4.55	6.15	3.80	2.75	7.10	4.00	5.90	4.50	4.10	2.00	POM								
RABAUL/TOKUA	7.90	3.10	8.35	2.50	2.55	8.55	5.00	11.80	6.15	4.85	9.30	8.85	6.75	5.85	RAB							
TABUBIL	11.00	14.95	11.45	11.80	13.60	11.40	10.40	15.05	11.45	13.35	12.25	11.55	9.40	8.50	13.30	TBG						
TARI	7.20	11.40	7.65	8.40	9.85	7.75	7.10	11.10	8.05	9.65	1.65	8.15	5.95	5.05	9.85	12.85	TIZ					
VANIMO	9.30	11.30	9.70	10.55	7.65	8.75	9.15	13.20	4.40	5.35	10.70	10.25	8.15	7.20	9.20	14.65	11.25	VAI				
WAPENAMANDA	6.95	7.75	7.35	8.20	9.75	7.45	6.75	10.80	7.80	9.50	8.90	7.95	5.60	4.80	9.65	12.40	8.85	11.15	WBM			
WEWAK	7.65	9.65	8.10	6.40	9.15	8.30	3.85	11.60	2.85	6.90	9.10	8.60	6.45	5.50	7.90	13.00	9.60	2.75	9.45	WWK		

Telecommunications

A key element in the successful marketing of perishable products is the timely communication between growers, traders, buyers and transport providers. The great strides that have been made in telecommunications globally are now starting to be felt in produce marketing in Pacific island countries like Fiji and Samoa. The growers and traders in the PNG Highlands are only now starting to reap the benefits of the telecommunications revolution. However, this situation is expected to dramatically improve with the competition provided by Digicel Pacific's entry into the mobile telecommunications sector.

Overall assessment: Relatively poor but likely to improve considerably in the near future.

6.4.5 The financing environment for agribusiness

The commercial agriculture sector has been seriously constrained by the non-availability of affordable finance. There has been a dramatic decline in levels of financing for rural enterprises as a result of the traditional sources of financing being seriously weakened over the last decade. The commercial banks have largely withdrawn from rural lending, with the exception of the oil palm industry. This can be largely explained by the way the Government's large budget deficits have been financed. Until recently government expenditure has consistently exceeded revenues, often by substantial margins. These deficits could have been financed either by borrowing internationally or locally. PNG government opted for the latter option, selling Government Treasury Bills (TB) to the commercial banks. High foreign debt has been avoided by local funding of the budget deficit. However, with only a small local market available for funds, the selling of Treasury Bills drove up interest rates to exceptionally high levels. This made borrowing for investment in rural areas uneconomic. With the commercial banks being able to earn "super normal" profits by lending to government, there was no incentive to lend to productive sectors such as agriculture. In August 1999, the TB interest rate peaked at 28.0 percent per annum (Bank of Papua New Guinea, 2003). In 2004, for the first time in 13-years, a budget surplus was achieved. As a consequence, the TB interest rate fell below 5 percent making it worthwhile for banks to consider lending opportunities in productive sectors. The TB interest rate currently stands at around 4 percent (Bank of Papua New Guinea, 2007). However, there still remains reluctance from the commercial banks to lend to the agricultural sector unless these loans can be fully secured. Land usually cannot be offered as security and most agribusiness assets have low salvage value and thus are of limited value as security.

Overall assessment: somewhat poor but improving.

6.4.6 The policy environment

In recent years, the PNG government has produced two major long term policy documents on the agricultural sector that for the first time has made significant reference to an ornamental horticulture sector. These are: the White Paper on Agriculture (2005-2014: Toward National Food Security) and the National Agricultural Development Plan (2007 – 2016).

The White Paper on Agriculture

The White Paper identifies the potential of the cut flower and foliage segment in the chapter dealing with horticulture, where it is notes that:

Flowers, like many agro-forestry plants, provide fragrance use in pharmaceutical industry to produce essential oils, perfumes, cosmetics, and ornamental decorations. Flower oil marketing is commercially viable in other developing countries when supported with adequate processing and marketing facilities.

However, the White Paper is silent on how "adequate processing and marketing facilities" might be encouraged and developed.

Encouragingly a stronger case is made in the White Paper for the commercial development of the indigenous orchid segment, where it is stated:

Many orchid varieties found in the country are unique to PNG. Each habitat has its own orchid flora. Some species are widespread in areas with similar habitat; while others are confined to very restricted localities. Many orchids have considerable horticultural potential. Repeated sectional and intersectional crossing and backcrossing to generate newer types has almost limitless possibilities.

The White Paper's Policy Statement and Policy Objectives for Floriculture are listed below:

The Policy Statement for Floriculture:

- The Government shall promote floriculture to supply niche markets.

The Policy Objectives for Floriculture:

- To encourage more participation of individuals and farming communities in floriculture.
- To provide incentives to encourage private sector investment in the floriculture industry.
- To encourage post harvest technology development including preservation, processing and packaging of various flowers for local and overseas niche markets.
- To develop market access for export of native flowers.

The National Agricultural Development Plan

The Plan for the first time articulates strategies to develop a floriculture industry in PNG. These are listed under Horticultural Crop Development (objective 5) as:

- Assessment of opportunities, constraints and potentials of the various types of flowering plants for a floriculture industry in PNG. This will involve a nation-wide survey that was to be conducted in 2007. This study is yet to be undertaken despite an allocation of K700, 000 in the National Budget for this purpose.
- Promote floriculture and capacity building for women and youth in rural and peri-urban areas. This will involve four awareness trainings a year per region. K2.05 million is budgeted over 10 years, with K250,000 in 2007. Some of the 2007 allocation was used to support meetings of the PNG Floral Arts Society that was launched in September 2007.
- Identify funding sources for reviewing the floriculture industry in 2007.
- Increased production through establishing regional nurseries and distributing cuttings. The target is one nursery in each region with 30,000 cuttings distributed per year. K400,000 allocated per year over 10 years.
- Identify domestic and export markets for the cottage floriculture industry. K300,000 allocated per year over 10 years.

The National Agricultural Development Plan has a total notional financial allocation to floriculture development activities of K9.75 m., with K700, 000 included in the Ministry of Agriculture and Livestock's 2007 Budget.

Assessment of the policy environment

It is encouraging that for the first time, floriculture has been included in overall national policy and long term plans for the agricultural sector. Furthermore, there have been significant financial allocations to achieve the floriculture objectives outlined in the White Paper and Plan.

Absent from the White Paper and National Agricultural Plan is any reference to how agribusiness will be encouraged to invest in the ornamental horticulture sector. Such investment has been critical to the success of the East African floriculture export industries.

The strong recognition in the White Paper of the commercial potential of indigenous orchids provides a strong overarching policy framework under which the necessary specific policies to facilitate development of the sector can be put into place. This is now necessary as neither the White Paper nor the Plan make reference to the requirements for developing the indigenous orchid sector. The commercial development of this sector, which has considerable income generating potential, is currently stifled by the absence of such a policy.

Mr Kanawaii Pouru, Managing Director of the PNG Forest Authority, provided support for the need to formulate and enact an appropriate policy for the development of minor forest products, including orchids. Mr Bob Tate, CEO for Papua New Guinea Forest Industries Council[45], indicated that members of his Council would be interested in investing in sustainable commercial orchid development provided there was appropriate policy framework in place.

Overall assessment: An overarching policy framework to support ornamental horticulture development is now in place. Specific policies are now required to attract investment in various segments of the industry.

6.4.7 The institutional environment for floriculture development

Industry organisations

There are a number of groups and associations involved in PNG's floriculture industry. These are mainly fragmented grower groups as described above. A PNG Floral Arts Society (PNGFAS) has been recently formed, with support from MAL, to be the umbrella organisation for the PNG floriculture industry. The principal promoters of PNGFAS participated in the World Bank sponsored study tour of the Fiji floriculture industry in 2005. MAL sponsored an official launch in October 2007 and provided funding for a series of provincial workshops. In its present form, it is difficult to see how PNGFAS can be the driving force in industry development, the way the East African industry organisations, such as the Ethiopian Horticulture Producer-Exporters Association, have been. The PNGFAS has no legal basis upon which it can raise funds to finance its activities and does not involve commercial segments of the industry.

Overall assessment: fragmented and weak with respect to commercial industry development.

[45] *R. (Bob) Tate PO Box 229 Waigani N.C.D. tel 675 3259458; email fiapng@datec.net.png.*

Research, extension and training organisations

PNG has the longest standing and most comprehensive research system within the Pacific islands. Lowland and highland national agricultural research stations have been established in PNG since the 1920's. In order to cater to the diverse agro-ecological environments and the associated agricultural systems, research stations were opened in a wide range of sites including Central, Morobe, and Western provinces. Prior to 1980, the then Department of Primary Industry, now the Ministry of Agriculture and Livestock carried out most of the agriculture research. In the early eighties, the National Agricultural Research System (NARS) was reorganised and commodity-specific research institutions were formed. The National Agriculture Research Institute (NARI) was established in 1996 for research into food crops, alternative cash crops, spices, essential oils and livestock. NARI currently has no specific research activities specifically devoted to ornamental horticulture. However, NARI's recent senior appointment in post harvest handling has considerable experience in post harvest handling of ornamentals in the Philippines. She has expressed considerable interest in undertaking similar research with PNG's floriculture products. It is encouraging to note that NARI Conference Centre was provided as the venue for the Lae stakeholder meeting for this scoping study. The wives of NARI staff are amongst the most active in floriculture development in the Morobe Province.

In the recent past, National Capital Botanical Gardens in Port Moresby has been involved with research activities in collaboration with the National Herbarium of the Netherlands. This research has involved the eminent orchidologists Ed de Vogel and Art Vogel. As a result of this work, the understanding and knowledge of PNG orchids has been greatly enhanced. This work is likely to show that the total number of orchid species endemic to PNG will exceed the so far assumed number of some 3,000 species. These research activities are supported by the NCBG's tissue culture facilities, which remain operational despite severe financial constraints.

Under the provincial government reform, the provincial agriculture extension function was decentralised to the provinces. Ornamental horticulture is not included in programs of the provincial extension services. Overall, the Provincial extension is regarded as ineffective and has not delivered the anticipated results in promoting the growth of agriculture based industries and active participation of provincial farmers in agriculture development (National Agriculture Development Plan 2007-2016, p. 8).

Ornamental horticulture has been included in the portfolio of the ADB funded Small Holder Support Services Pilot Project (SSSPP) in the Eastern Highlands. Support has been provided to Exotic Blooms to provide extension and training to three village groups who ship flowers and foliage to Port Moresby. The Project manager has expressed interest in extending these arrangements to other locations.

There are no courses in ornamental horticulture offered by PNG's education and training institutions. In the past NCBG offered a wide range of ornamental horticulture courses, which included: basic orchid culture; advanced orchid culture; growing orchids for profit; improve your home garden; and garden plant care and propagation. Despite their popularity, these courses are no longer offered due to budget cuts and the changing management priorities.

Overall assessment: very weak

6.4.8 Regulatory bodies

Quarantine

The national quarantine functions are managed by the National Agriculture Quarantine and Inspection Authority (NAQIA), a statutory authority established by an act of Parliament in 1997. NAQIA has a dual mandated responsibility under the Act to:

- Preserve and protect the animals, plants and fish from exotic pests, diseases and weeds in the interest of national, social and economic development.
- Facilitate international trade through export and import risk analysis, and quality assurance systems thereby contributing to the Government's objective of export driven economic recovery policy.

Growing international trade, greater mobility and climate change make PNG's boarders increasingly more vulnerable to new pests and diseases. Many of these have the potential to seriously damage natural resources, threaten the economy and endanger food security.

Although PNG is currently relatively free of the major pest and diseases, it faces major challenges to the sustainability of its agriculture and resource base. The most recent out break of the late potato blight in the highlands and cocoa pod borer in Keravat, East New Britain province and Aitape in Sandaum province are classic cases of how pests and diseases can affect the socio-economic activities in a given area.
NAQIA provided the phytosanitary certificates for Exotic Blooms foliage shipments to Melbourne and provided advice on the quarantine treatment requirements for Australia. There are surprisingly no restrictions placed on importation of orchids into PNG. Potted hybrids orchids are regularly imported for international orchid shows. NAQIA has a critical role to play in facilitating the importation of improved planting material which is needed for the commercial development of the temperate and exotic tropical flower segments. A special focus on meeting this requirement is needed.

The cost of efficiently maintaining an effective quarantine and inspection service in such a large and dispersed country is very high. NAQIA is required to service the nine international ports of entry to minimise bio-security threats and assist in facilitating trade activities. However, according to the National Agriculture Development Plan 2007-2016, the funding for NAQIA has been inadequate to meet these requirements (p. 51).

Overall assessment: The inadequate funding and resources of NAQIA poses long term threats to the ornamental horticulture industry.

CITES and it administration

All PNG orchids are covered by Appendix 2 of CITES and their trade is regulated by a 2003 Act of the PNG Parliament. CITES is administered by the CITES Management Authority in the Department of the Environment. The export of orchids requires the verification of adherence to strict rules on how material is sourced from the wild and propagated. Under current regulations orchid propagation must originate from collected seed and not from cuttings. This poses a major constraint in terms of the infrequency of flowering and the long lead time propagating from seed. Also under the current interpretation of the PNG CITES Act, export certificates are not issued for primary (F1) hybrids. Thus potential exports are restricted to F2 hybrids. The inadequacy of these regulations for commercial development of the indigenous orchid industry is the lack of an appropriate policy for dealing with the development of minor forest products.

The enforcement of CITES is the responsibility of the Ministry of Environment's Wildlife Enforcement Department. The Department has a staff of three covering the whole country and has no detection equipment at the international ports. Thus the detection rate on

orchids being smuggled from PNG is extremely low – reported to be less than 1 percent by the Manager of Enforcement.

Overall assessment: There is policy in place to allow for the administration of CITES that would allow for the sustainable development of the indigenous orchid industry. Inadequate resources are devoted to the border enforcement of CITES thus there is a high rate of indigenous orchid smuggling.

6.5 Overall assessment of PNG comparative advantage in ornamental floriculture

6.5.1 Cut flowers and foliage

PNG offers some outstanding agro-ecological conditions for cut flowers and foliage and some niche market opportunities have been identified. However, in terms of overall export market development these are more than offset by intractable marketing and other constraints.

The table below provides a summary comparison for PNG and East Africa for the various factors that impact an exporting country's competitiveness:

Table 7: Comparison of PNG and East African floriculture exporters

Competitive factors	East African floriculture exporters	PNG
agro-ecological conditions	Outstanding in parts of the highlands	Outstanding in parts of the highlands
infrastructure (roads, power, telecommunications and water supply)	Generally good in areas best suited to floriculture production	Poor in most areas suited to floriculture production
frequent and reliable airfreight capacity	A feature of the East African industries	Adjudged the most critical limiting factor in PNG
proximity to global markets	Close direct access to Europe, the largest market. Direct access to North American and emerging Middle East market	Reasonable proximity to Asian markets – but severely constrained by direct air links.
wage rates in a labour intensive industry	Low particularly in Ethiopia and Tanzania	Relatively high compared with most East African producers.
ornamental skill levels	Reasonable as a result of training provided by a number of institutions in most countries.	Low given no training provided.
Government support for the industry	Strong government support for the industry, reflected in the attractive incentives in place particularly for foreign investors.	Recent government announcements support the development of the industry although concrete incentives not in place.
Access to land on long term basis.	Land made available to horticulture investors on long term basis	Long term access to customary land a major constraint to agribusiness investment in PNG. Innovative solutions have been developed in the palm oil industry that could be applied to ornamental horticulture
Donor support for sector	Characterised by high level of donor support, particularly directed at the private sector	Minimal donor support to date – anticipated that this will change as a result of this scoping study.

Overall conclusion: It is highly unlikely that PNG would be able to establish a cut flower export industry comparable to the industries of East Africa and Central America. However, a much more modest cut flower industry could be developed built around a significant expansion of the domestic market with some niche export of specialty products such as leaves.

6.5.2 Indigenous orchids

PNG offers some outstanding agro-ecological conditions to produce hybrid orchid plants for which there is strong export demand from markets in reasonably close proximity. These plants are less perishable than cut flowers and foliage. Thus the intractable marketing constraints identified for cut flowers have less of an impact on the competitiveness of these products. However, the development of this industry will depend on the resolution of institutional and legal constraints associated with CITES.

Overall conclusion: PNG has the potential to establish a major commercial indigenous orchid industry built around exporting hybrid plants and expanding eco-tourism activities provided regulatory and policy issues pertaining to CITES are overcome.

6.6 Requirements to realise opportunities

6.6.1 Cut flowers and foliage

A five fold increase in PNG's domestic market for floriculture products is seen as a realistic prospect if the identified constraints can be ameliorated. The inadequacy of physical marketing infrastructure (roads, telecommunications, airfreight capacity etc.) was identified as a major constraint. Poor physical infrastructure impinges on agricultural development generally but particularly constrains horticultural development due to the perishability of the products sold. The development of all PNG's horticulture industries depends on adequate public investment being made in physical infrastructure, particularly transportation infrastructure.

Working within the limits imposed by the existing infrastructure, there are measures that can be taken to expand the cut flower and foliage segment of the industry. Such measures lie in areas of training, skill upgrading and institutional development.

Training and skill upgrading

There is a need to develop basic skill levels in the growing, handling and arranging of floriculture products. This particular need was identified as a priority by participants' at all three stakeholder consultations. A useful first step would be to re-establish a revised set of courses offered by the Port Moresby National Botanical Gardens. A similar curriculum could be developed as part of the proposed redevelopment of the Lae Botanical Gardens.

The University of the South Pacific as part of its adult education outreach program has over the years operated a very successful floral arts course in member countries. Most of the 30 odd small florists in Fiji obtained their initial training through this program. It is these viable micro enterprises, who have the required high level of artistic skills that drive the rapidly growing demand for cut flowers in the domestic market. A high rate of return can be expected from such training. It is recommended a similar program be included in the adult education programs of PNG's tertiary education institutions. These floral art training courses could be developed and delivered in collaboration with PNG Floral Arts Society and would be a very worthwhile use of the National Budget allocation to MAL to support the development of floriculture. Technical assistance in curriculum development will be necessary.

South Sea Orchids in Fiji developed basic training materials to support their training programs for out grower suppliers. These materials included simple illustrative manuals on growing and handling orchids, anthuriums gingers and heliconias supported by posters. SSO has also published a simple manual: “Floriculture in Fiji as a Small and Micro Business”. This material is used as the basis for workshops across Fiji to assist in the development of viable floriculture businesses. Financial support for the development of this training material has been provided by the EU’s CTA. These training materials have contributed significantly to the competency levels of micro enterprises participating in the Fiji floriculture industry. The SSO/CTA Fiji training materials generated a considerable amount of interest amongst participants at the PNG stakeholder workshop for this scoping study. The Mount Hagen meeting passed a resolution that a similar set of training material be produced for the PNG Highlands and a request be put to CTA for financial and technical assistance. There was particular interest in the development of a manual for tuber roses. The preparation of training materials would also be an appropriate project to be undertaken under the auspicious of the PNG Floral Arts Society. There would be good scope for intra regional cooperation through SSO in the preparation of appropriate training materials.

CTA is planning a regional study tour to Fiji in collaboration with SPC and SSO. This will enable participants from the region to observe first hand SSO’s production and marketing arrangements and business operations. Leaders from the various active PNG floriculture groups would benefit greatly from participating in this study tour. It is expected that two or three participants from each regional country would be funded by CTA. Given the number of active floriculture groups operating in PNG it would worthwhile for MAL to fund some additional participants to take advantage of this once off opportunity.

Trained professionals are needed to provide the required training and supervision to develop an ornamental horticulture industry. As a first step, ornamental horticulture needs to be included in the curriculum of the relevant tertiary institutes such as the Vudal Agricultural University in East New Britain. This should include landscaping and nursery trades. It is recommended that technical assistance be provided in curriculum development. The industry also needs at least two or three people to be trained in floriculture from an appropriate overseas institution, such as Charles Darwin University in Darwin, Australia or the TAFE institute of North Queensland or the University of Hawaii College of Tropical Agriculture and Human Resources.

6.6.2 Institutional development

Facilitating the development of wholesale markets for floriculture products

For the foreseeable future, the main opportunities for the development a PNG cut flower industry lie in expanding the domestic market. However, growth in domestic demand for floriculture products has been seriously constrained by the absence of a wholesale market, erratic supply, and the high prices that prevail. This was the situation in Fiji a decade ago prior to the establishment of SSO’s wholesale markets. With the establishment of the wholesale markets, Fiji’s small growers have been able to concentrate their energies on producing quality cut flowers without concern as to whether there would be buyers for the flowers when ready to harvest. On the other hand, the florists were now aggressively promoting their products assured that a dependable supply base at a reasonable price is in place. The result was a significant expansion in the market for these flowers. The core local market for cut flowers is based on unpredictable highs and lows related to special life cycle events – deaths, births and marriages. However, florists with the development of the wholesale market have been able to secure contracts with local businesses and churches to supply arrangements on a weekly basis to overcome these fluctuations in business.

The PNG floriculture industry could benefit from technical assistance in the establishment of wholesale marketing arrangements. This would include the establishment of small markets in the main provincial centers. PNG participation in the CTA/SPC/SSO study tour to Fiji would be a useful starting point by providing exposure to a successful Pacific islands marketing system. However, the study must be followed up soon after by a specific technical assistance project to the PNG industry. This TA will advise on marketing arrangements that will allow for expansion of the domestic market. Part of the terms of reference would be to provide advice on developing cut flower and pot plant sales within municipal food markets.

Industry organization development

Both the Fiji and PNG scoping studies identified the need for an industry organisation that provided sound industry leadership in the areas of policy formulation, dealing with government and other agencies, education and information, setting standards, and promotion. To be successful, such an organisation needs to be small (low overheads), commercially orientated and sustainable. It is recommended that technical assistance be provided to assess the feasibility and requirements for the PNG Floral Arts Society becoming such a body.

6.6.3 Participation in the ginger and heliconia variety survey

After visits to Hawaii and Australia as part of this scoping study, it became apparent that the ginger and Heliconia segments in both Fiji and PNG were operating with a rather limited pool of available varieties. The markets in Australia and Hawaii rely upon the new and exciting flower types to keep customers interested in tropical flowers. On closer investigation and stakeholder interviews, we learned that there were actually more varieties in the case study countries than were available to florists and flower arrangers or the public at the market selling points. Many of these rare varieties were with collectors or in overgrown backyards.

It is therefore proposed to conduct a ginger and Heliconia variety survey in the Pacific with as many countries participating as possible. Plants will be surveyed, identified, photographed, and assessed for stem length, time of flowering and vase life. With this information in hand individual countries can work to commercially develop some of the varieties that have good potential. With a larger regional database there is the possibility for breeding programs and germplasm exchange.

6.6.4 Information on new varieties and sources of seed

For PNG to be able to successfully expand its temperate cut flower and exotic tropical flower segments industry, the industry needs access to the best possible planting material. For temperate cut flowers such as roses, there has been rapid technological change in terms of new varieties suitable to high land tropical conditions. It can be expected that the varieties that are available are likely to be far superior to what is currently present in PNG. For many tropicals, there are extensive breeding programs going on all over the world producing unique and superior varieties. The NT DPI has carried out breeding programs on heliconias and curcumas at their Bermiah farm in Darwin, Australia.

The PNG industry needs basic information on what planting material is available, its desirability in terms of the market and suitability to PNG conditions. Any technical assistance in this area would have to work in close collaboration with the farm supply companies and NAQIA. It is the farm supply companies that will source and import the seed and then promote and support its distribution. PNG has an advantage, compared with other PICs, of having well developed farm supply companies. NAQIA will need to be able to develop import protocols that maintain quarantine security but allow for the efficient and timely importation of floriculture planting material.

6.6.5 Indigenous orchids

It is the indigenous orchid segment of the ornamental horticulture industry that has been identified as having the greatest potential for development as a substantial rural income generating industry. Furthermore, the inadequacy of physical marketing infrastructure poses less of a binding constraint on commercial development of this sector. With the main constraints to development of the indigenous orchid sector lying in the area of policy, it is possible to have a major impact without large investments of public funds.

A policy for the sustainable commercial development of minor forest products

As discussed above, the application and administration of CITES in PNG has precluded investment in the sustainable commercial development of the indigenous orchid industry. As a result of this lack of investment, rural people have forgone substantial income opportunities and this unique resource has been depleted through lack of conservation incentives and illegal smuggling activity. To overcome this problem, PNG needs to develop an appropriate policy for the conservation and commercial management of indigenous orchids and other minor forest products. Providing technical assistance in the development of this policy is a major recommendation arising from this PNG Scoping Study.

A collaborative regional exchange program under the auspices of SPC

The Fiji Scoping Study identified the opportunity of a collaborative indigenous orchid exchange program between PNG, the Solomon Islands and Fiji under the provisions of CITES. The Fiji study noted that the Fiji indigenous orchid *Dendrobium tokai* was crossed with *D. phalaenopsis* (Cook Town Orchid) from Queensland Australia to develop the first University of Hawaii orchid hybrid. Marika Tuiwawa, Curator of the University of the South Pacific Regional Herbarium, identified the potential as follows:

There is great potential for utilising some of the Pacific plant species in breeding programs to develop a hybrid product that is completely unique to the Pacific. Genetic material can be gathered from various Pacific countries and brought to one place under the umbrella of an organization like SPC for the purpose of crossing these varieties to get a completely unique plant species (in particular, orchid species). This hybrid species can then be distributed back to the Pacific Islands (most likely the floriculture circles) for mass propagation and distribution (export or otherwise) and the opportunity for income generation. The potential revenues from a unique Pacific orchid species are enormous. Once the hybrid gets more than two generations away from its original wild type then it no longer comes under the CITES umbrella. The most obvious Pacific countries to collaborate on something like this are the Melanesian countries (Personal communication July 2007).

However, to achieve Tuiwawa's vision requires a coherent minor forest products policy in all three countries that encourages investment and sustainable commercial development has to be in place. Because of the opportunities for the Melanesian countries to collaborate in the development of their indigenous orchid industries, it recommended that any assistance in policy development cover all three countries.

Initial discussions have also been held with University of Queensland at Gatton Native Floriculture Department on the possible collaboration on such a breeding program. A more exhaustive scoping study on the feasibility of this project will need to be done and the most appropriate collaborative partners identified.

Investing in the National Botanical Gardens

The implementation of the National Botanical Gardens Development Plan was identified as a priority in the development of the PNG ornamental horticulture industry and in particular the indigenous orchid segment.

The experience of Singapore has shown that thriving Botanical Gardens is central to the development of an ornamental horticulture industry. Such a facility also has considerable tourism and recreation benefits.

It is envisaged that a revitalised NBG would play a central role in the artificial propagation and hybridisation of indigenous orchids for commercial development. Lae is seen as an ideal strategic location for such a facility, given that it has road links to a wide range of areas where primary material would be sourced and to where the village out growers of the hybrid plants would be located. It also has an international sea port for shipment to Asian markets.

The NFI in 2000 commissioned the preparation of a development plan for the Lae National Botanical Gardens. The Spivey Report (2000) outlines a five year K 872,006 investment program for the Lae Gardens, which covered scientific, educational and recreational components. No action was taken on the proposed Development Plan, although it was not clear if the Plan was accepted or rejected.

The redevelopment of the Lae Botanical Gardens needs to be revisited, taking the Spivey Report as a starting point. The required report should be in the form of a feasibility study that includes a thorough cost-benefit analysis. The cost-benefit analysis is needed to demonstrate to decision makers, both in government and private sector, the substantial returns that can be obtained from such an investment. It is suggested that expertise from the Singapore Botanical Gardens should be utilised in the carrying out this feasibility study. A suitable public private sector partnership will be necessary for this redevelopment to be successful and sustainable. The Papua New Guinea Forest Industries Council could be a potential private sector partner in the redevelopment, if it included a substantial commercial indigenous orchid component. It would be expected that this feasibility study would be used as a basis to attract private investment in the venture.

6.7 Recommendations for ACIAR/SPC involvement with the PNG ornamental horticulture industry

This scoping study makes a number of recommendations on actions to facilitate the development of the PNG ornamental horticulture industry. In a number of areas there is potential for ACIAR/SPC involvement. The identified areas are listed below along with collaborating partners.

- Policy development for minor forest product development (ACIAR with the PNG Forest Authority, CITES Management Authority).
- The development of framework for indigenous orchid hybridisation for Melanesian countries that is compliant with CITES and facilities the exchange and commercial development of indigenous orchids (ACIAR/SPC with USP Herbarium, National Herbarium Netherlands, Leiden, University of Queensland at Gatton, country CITES Management Authorities).
- Adult education programs for ornamental horticulture and floral art (SPC, USP, UPNG, UNITECH (University of Lae), PNG Floral Arts Society, CTA (EU), SSO (Fiji))
- Technical support for national tertiary institutions in the development of ornamental horticulture skills (ACIAR/SPC, Charles Darwin University, TAFE institute of N. Queensland, Vudal University).
- Survey and evaluation of gingers and heliconias in PNG and Fiji (SPC, PNG Floral Arts Society, SSO (Fiji)).
- Technical advice on the establishment of wholesale marketing system in PNG (ACIAR, PNG Floral Arts Society, SSO).

- Feasibility study and a plan for the re-development of the Lae National Botanical Gardens (AusAID/ACIAR, National Forest Institute, Singapore Botanical Gardens).
- Providing information on new varieties and sources of seed (ACIAR, DPI (NT), PNG farm supply businesses, NAQIA, PNG Floral Arts Society).
- Industry organization development (ACIAR, MAL (PNG), DPI (NT), PNG Floral Arts Society).