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Research and development and innovations in floriculture: lessons from the market giants for developing countries like Sri Lanka

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Abstract

Floriculture has become one of the growing industries in the present world. In the year 2013, the global floriculture exports reached US\$ 21.6 billion while showing a 22% increase over the past five years. Sri Lanka being a small island, has not shown a rapid growth in the floriculture business over the past five years, the country has been a continuous supplier of floriculture produce to the world market, reaching its total floriculture trade value worth Rs. 14.1 million in 2013. Among the floriculture assortment that the country produces for the world market at present, cut foliage/tops (~53%), live plants including rooted cuttings (~44%), cut flowers (~1.5%) and flower seeds (~1%) are the four main items, dried flowers and other decorative floriculture items also in minor quantities. One of the biggest constraints that Sri Lanka faces is the insufficient investments on large scale floriculture ventures, making most of the businesses medium- to small-scale. To thrive in the global business the scale of production matters. Moreover, we have mostly been depending on the available varieties for ages. Therefore, it is high time for the country to think about the competitive novel varieties. Even though the people are knowledgeable with higher literacy rates, until now, the postharvest handling of floricultural produce has not been practiced satisfactorily. Besides, the facilities available for training, research and innovation are insufficient to support the growth of the industry.

Keywords: global businesses, market competition, market development, market innovation, market supplier, trade value

INTRODUCTION

As identified under the national research priorities, incorporation of 'new thinking' and 'broad thinking' (think-new and think-big) in projecting the floriculture market for the future is obligatory to uplift the status quo of the industry. In this regard, the following research areas and innovative thinking need further detailed emphasis; exploring new species and developing new cultivars, novel propagation protocols and techniques, improved plant growth and management and innovative postharvest management practices. All these things are discussed in this study.

PRESENT STATUS OF THE FLORICULTURE INDUSTRY

Global floriculture industry: the business

Floriculture has become one of the growing industries in the present world. In the year 2013, the global floriculture exports reached US\$ 21.6 billion while showing a 22% increase over the past five years (ITC, 2014). The Netherlands, Colombia, Germany, Belgium and Italy are the top five countries that dominate in the export trade with almost 70% market share of the total exports, whereas Germany, The Netherlands, the United States of America, the United Kingdom and France have been the top five importers over the last couple of years with a market share of about 53% of the total imports in 2013 (ITC, 2014).

Sri Lankan floriculture industry: where do we stand in the world trade?

Even though Sri Lanka being a small island, has not shown a rapid growth in the



floriculture business over the past five years, even though the country has been a continuous supplier of floriculture produce to the world market, reaching its total floriculture trade value worth Rs. 14.1 million in 2013 (Figure 1).

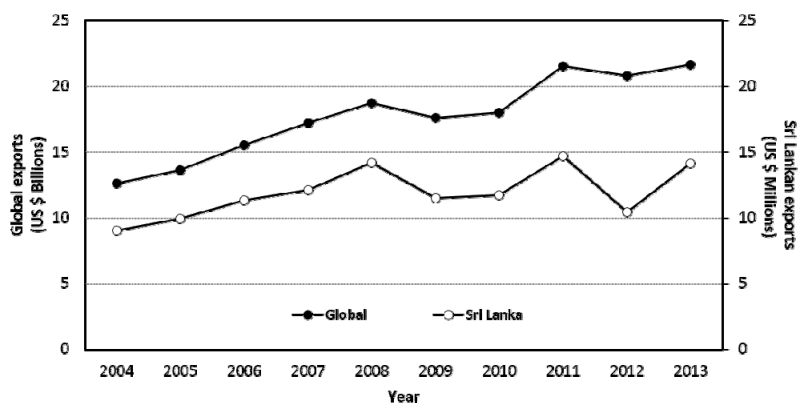


Figure 1. Market trends in the floriculture business of the world and Sri Lanka over the period of ten years from 2004 to 2013. Data source: International Trade Centre (ITC) (2013).

As shown in Figure 1, it is apparent that Sri Lankan floriculture business with the world over the last ten years is highly sensitive to the trends in the global floriculture business. With all these fluctuations however, the country has been supplying its floriculture produce to The Netherlands, Japan, Saudi Arabia, the United Kingdom, Germany and the United Arab Emirates, being the top six buyers of Sri Lankan floriculture produce in the year 2013 (ITC, 2014).

Among the floriculture assortment that the country produce for the world market at present, cut foliage/tops (~53%), live plants including rooted cuttings (~44%), cut flowers (~1.5%) and flower seeds (~1%) are the four main items, though we do produce dried flowers and other decorative floriculture items also in minor quantities. The organized floriculture produce exports from Sri Lanka emerged during the early 1970s (Dhanasekera, 1998) with cut flowers however, after several years of experience Sri Lanka has realized that cut foliage and live plants were much better products to compete in the international trade. The trends in the exports of these three items over the past ten years are depicted in Figure 2. Having affected by the changes in the global market, Sri Lanka's position in the global floriculture trade has dropped from 47th place in 2009 to 52nd place in 2013 (ITC, 2014). The cut foliage exports from Sri Lanka however, were considerably stable around the 21st place (in 2013) in the world ranking during the period of 2009-2013 (ITC, 2014).

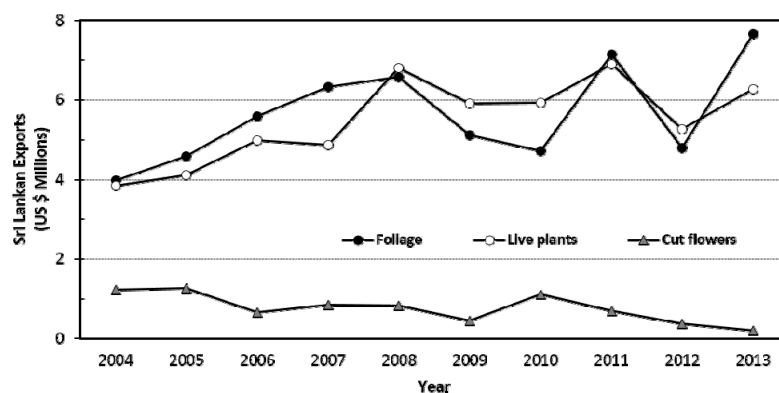


Figure 2. Floricultural exports from Sri Lanka over the period of ten years from 2004 to 2013. Data source: International Trade Centre, 2013.

Market giants, fragile markets and market competition

The global economic crisis experienced during the year 2009 negatively affected the consumption of floriculture produce worldwide putting the small scale producers in a dilemma of to be with the trade or to quit (Berkmen et al., 2009). However, the economic crisis has not shaken the European flower and plant markets to any considerable degree. Even during that period, the EU continued to be the largest producer worldwide with over 40% of the global revenue and the most intensive consumer of flowers and plants with 500 million Europeans (Altmann, 2012). Not only do the European giants such as The Netherlands and Germany consume the most of the world floriculture produce, but also they dominate in the production as well. The recent trend has been that the aforementioned countries together with some other European countries such as Belgium, Italy and Denmark cater to the 85% of the demand for floriculture produce in the Europe (EuroStat, 2014). This has created an enormous pressure on countries like Sri Lanka.

Since the dawn of the 21st century, despite the fragility of the global economy and the economic crisis towards the later part of the first decade, Sri Lanka was able to retain her major buyers namely, The Netherlands, Japan, the United Kingdom and Germany. France, Denmark, Italy, Switzerland and China are among the countries in which we are in a losing streak over the last ten years (ITC, 2014) where the country has to pay immediate attention on.

During the latter part of the 20th century, Kenya was under the spotlight for being a major competitor with the Sri Lankan floriculture produce in the world trade. After several years however, Kenya has climbed up in the world floriculture exports reaching the 7th place in 2013 with a market share of nearly 3.5%, overtaking the giants like Denmark. This is a classical eye-opening example for the Sri Lankans to think about what made Kenya so successful in the world floriculture trade. Moreover, it is of paramount importance to see the success stories of the emerging countries in the world floriculture business in 2013, who were in par with, or well-below Sri Lanka in the year 2004 (Table 1).

Table 1. Ten-year growth in floriculture exports during the period of 2004-2013 of selected countries (in the order of exports in 2004). Source: Floriculture Statistics, International Trade Center.

	Floriculture exports (US\$ millions)		Growth %
	2004	2013	
Sri Lanka	9.0	14.1	57
Czech Republic	9.0	51.1	468
Peru	7.4	14.9	103
Slovakia	7.1	17.2	142
Ireland	6.2	18.3	197
Viet Nam	5.3	37.3	608
Egypt	5.1	65.3	1182
El Salvador	4.4	21.7	393
Greece	4.3	14.9	247
Ethiopia	2.7	187.6	6733
Lithuania	2.4	96.0	3915
Latvia	0.9	34.9	3866
Kazakhstan	0.1	27.6	41722

POTENTIALS AND CONSTRAINTS TO DEVELOP THE FLORICULTURE INDUSTRY OF SRI LANKA

As discussed in the previous sections, Sri Lanka is continuing to produce floricultural items to the world market. To be more successful in the market competition, it would be better if we could identify the potentials/advantages to reinforce on those and the constraints to mitigate them.

One of the biggest potentials that Sri Lanka has is the favorable geographical location. Tropical and sub-tropical climates within several kilometers apart, facilitate growing a wide variety of floricultural plants within the island. Being positioned in a central location in the world-map which helps in finding diverse clients for the country's produce, presence of relatively knowledgeable people with high literacy rate, possessing a range of rich native flora which could be developed to meet the needs of the floriculture industry and the tax benefits with BOI incentives are amongst the notable potentials (CARP, 2011).

Constraints do hinder the development of any commercial venture in line with that, one of the biggest constraints that Sri Lanka faces is the insufficient investments on large scale floriculture ventures, making most of the businesses medium- to small-scale. To thrive in the global business, the scale of production matters. Moreover, we have mostly been depending on the available varieties for ages. Therefore, it is high time for the country to think about the competitive novel varieties. Even though the people are knowledgeable with higher literacy rates, until now, the postharvest handling of floricultural produce has not been practiced satisfactorily. Besides facilities available for training, research and innovation are insufficient to support the growth of the industry.

MARKET COMPETITION, RESEARCH AND DEVELOPMENT, AND INNOVATIONS

To be successful over the competitors, research and development (R&D) and innovations are of great importance. The giants in the floriculture trade such as The Netherlands, Japan, Germany and Kenya have been successful over the years, simply because of the well-structured R&D plans that they are adopting (Rikken, 2011). On the other hand, the governments of the said countries support the innovations in the field of floriculture unconditionally.

Research and development and innovations in floriculture: the national priorities

In 2006, Sri Lanka Council for Agriculture Research Policy (SLCARP) has formulated the National Committee on Floriculture Research and Development (NCFRD) to promote the development of all aspects of floriculture from production through processing to marketing. With the untiring support of the stakeholders collectively, the NCFRD has identified the national research priorities in floriculture for the period of 2012-2016 (Table 2; CARP, 2011).

Research and development and innovations in floriculture: think 'New', think 'Big'

As identified in the list of national research priorities (Table 2), incorporation of 'new thinking' and 'broad thinking' in projecting the floriculture market for the future is obligatory to uplift the status quo of the industry. In this regard, the following research areas and innovative thinking need further detailed emphasis.

1. Exploring new species and developing new cultivars.

Thus far, Sri Lankan export assortment has been largely relying on a set of species which has been the scenario for many years (Table 3). This 'limited product assortment' is identified as one of the limitations in the export-oriented floriculture business in Sri Lanka (EDB, 2011). As countries like The Netherlands do, Sri Lanka too needs to think of introducing new species or new cultivars to the world floriculture trade. It is true that, Sri Lanka cannot catch up the momentum of 'developing our own new cultivars', nevertheless, we should be able to grasp the latest emerging trends in no time, or else to introduce demanding species from elsewhere with care.

Table 2. National research priorities of Sri Lanka for the period 2012-2016. Source: Sri Lanka Council for Agriculture Research Policy.

Key research areas	Specific research focuses
1 Identification /improvement/ production of novel ornamental plants and cut flowers to the industry	<ul style="list-style-type: none"> - Usage of genetic modification, genetic improvements of cut foliage, cut flowers fillers, dried items - Marketing research to identify potential of the industry
2 Mass propagation of quality planting materials	<ul style="list-style-type: none"> - Use of tissue culture methods for plant propagation could be researched with emphasis on cost of production - Mass propagation housing structure (low electricity usage)
3 Developing new crop management and production techniques	<ul style="list-style-type: none"> - Introduction of new growing media - Identification fertilizer applications to get maximum production from unit area - Production under protected environment, CO₂ enrichment, etc.
4 Postharvest technologies to improve vase life of the products	<ul style="list-style-type: none"> - Value addition of the products - Incensement of vase life of the products - Dry flower production
5 Pests and diseases control methods	<ul style="list-style-type: none"> a. Usage Integrated Pest Management (IPM) methods for floriculture sector b. Management of Bacterial Blight <ul style="list-style-type: none"> - Screening of varieties against bacterial blight and indication of resistance - Development cultural control package to manage Anthurium bacterial blight - Use botanicals and microbial bio control agents to manage <i>Xanthomonas</i> bacteria c. Management of pest and diseases of cut flower varieties <ul style="list-style-type: none"> - Identification of sustainable environment conditions for diseases incidents - Development of a disease management package for poly tunnels - identification of causal organism of each important disease and pesticide recommendation -development of prediction system for disease and pesticide recommendation - development of prediction system for disease management d. Managements of leaf spot and leaf blight of cut foliage varieties (specially in palm varieties) <ul style="list-style-type: none"> - Development of cultural and disease management packages - Identification of least toxic chemicals to manage cut foliage disease - Development of methods to minimize post-harvest diseases of cut foliage
6 Development of sustainable cost effective cultivation methods for different agro ecological zones	<ul style="list-style-type: none"> - Designing and construction of green houses, net houses for low cost less use of electricity - Construction of net houses and propagator houses - Irrigation methods and water harvesting methods - Water requirements for floriculture plants
7 Development of cut flower and foliage industry as micro enterprises to upgrade the income of the housewives	<ul style="list-style-type: none"> - Feasibility of anthurium, orchid and gerbera cultivation - Feasibility of popular cut foliage.

Table 3. Sri Lankan export assortment in the floriculture business. Source: EDB (2011).

Key products	Species/cultivars
Decorative foliage	<i>Draceana sanderiana</i> , <i>Draceana massangeana</i> , <i>Cordyline</i> , <i>Aglaonema</i> , <i>Adiantum</i> , <i>Calathea</i> , <i>Maranta</i> , <i>Codiaeum</i> , <i>Monstera</i> , <i>Pothos</i> , <i>Pandanus</i> , <i>Philodendron</i> , <i>Miscanthus</i> , <i>Anthuriums</i> , <i>Diffenbachia</i> , <i>Scindapsus</i> , <i>Caryota urens</i> , <i>Chrysalidocarpus</i> , <i>Aspidistra</i>
Rooted/unrooted young plants and indoor pot plants	<i>Draceana sanderiana</i> , <i>Draceana massangeana</i> , <i>Codiaeum</i> , <i>Aglaonema</i> , <i>Scindapsus</i> , <i>Draceana marginata</i> , <i>Cordyline</i> , <i>Pleomele reflexa</i> , <i>Polyscias</i> , <i>Livistonia</i>
Cut flowers	Roses, Carnations, Gerbera, Chrysanthemum, Lilies, Gypsophila, Limonium, Anthurium
Landscaping plants	<i>Plumeria</i> , <i>Gardenia</i> , <i>Codiaeum</i> , <i>Ixora</i> , <i>Hibiscus</i> , <i>Cassia</i> , <i>Bouhinia</i> , <i>Bougainvella</i> , <i>Allamanda</i> , <i>Jasmine</i> , <i>Acalypha</i> , <i>Neem</i>
Tissue cultured plants	<i>Ananas</i> , <i>Musa sp.</i> , <i>Cordyline</i> , <i>Dracaena</i> , <i>Syngonium</i> , <i>Philodendron</i> , <i>Ficus</i>

Among the new species (introduced) that the Sri Lankan producers can flourish on, *Gaultheria shallon*, *Capsicum annum*, *Brassica oleracea*, *Christia obcordata* 'Swallow tail' and *Albuca spiralis* 'Frizzle Sizzle' are some of the notable species. The 'hybrid cactus' which is a graft between *Hylocereus* spp. and *Gymnocalycium* spp. can be another potential candidate (Figure 3). Demanding new *Anthurium* and orchid cultivars of leading floriculture companies such as Anthura, new FLOREGENE® carnation cultivars and red-pigmented *Aglaonema* are some of the new varieties that Sri Lanka can rely on.

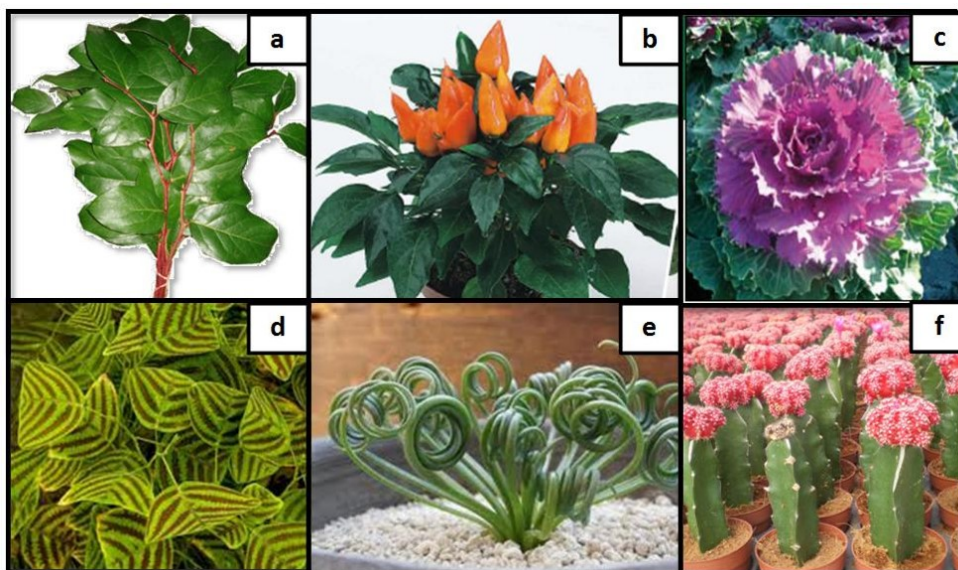


Figure 3. Potential species that can be introduced to Sri Lankan floriculture industry. (a) *Gaultheria shallon* (b) *Capsicum annum*, (c) *Brassica oleracea*, (d) *Christia obcordata* 'Swallow tail', (e) *Albuca spiralis* 'Frizzle Sizzle' and (f) 'hybrid' grafted cactus.

Though time consuming, a better viable solution for finding new cultivars for the export market is to develop our own species or cultivars. Several research studies have contributed to this field of study. Genetic modification of *Rosa Pinna* (*Clerodendrum philippinum* Schauer) with gai mutant gene for improved plant architecture (De Silva et al., 2015), altering the branching habit of Poinsettia (*Euphorbia pulcherima* Willd.) (Karunananda and Peiris, 2010) and modification of plant architecture of *Iramusu* (*Hemidesmus indicus* L.) by in vitro colchicine treatment (Nagahatenna and Peiris, 2008) are

amongst the significant contributions in relation to production of new plant forms for the industry. In addition, Ranil et al. (2015) have unearthed the potential of using ornamental Pteridophytes in the Sri Lankan floriculture Industry. The potential of using local cultivars and biotypes of lotus (*Nelumbo nucifera*), blue water lily (*Nymphaea nouchali*), jasmine (*Jasminum multiflorum*) and araliya (*Plumeria rubra*) should also be given a special attention.

2. Propagation protocols and techniques.

Tissue culture and micropropagation techniques have become popular even at the small scale, thus researchers are trying to come up with new tissue culture protocols for propagation of ornamental plants. Among several researches, studies done for Gladioli (Dharmasena et al., 2011), *Chirita moonii* Gardner (Wijayarathne et al., 2009), *Cryptocoryne* sp. (Herath et al., 2008) and *Hemidesmus indicus* (Nagahatenna and Peiris, 2007) stand out. Domestication of micropropagation is also now possible under Sri Lankan conditions with all credits to the CSUP technique (Peiris et al., 2012). Innovations in plant propagation such as Ellepot® by Ellegaard, Denmark are worth considerable attention by researchers.

3. Plant growth and management.

Most of the researchers prefer to research on the growth and development stages of ornamental plants. Investigations on the optimum spacing, proper fertilizer programmes, sustainable watering methods and pest and disease management protocols have become very much popular among researchers, to name a few; light/shade effects on growth performances of *Codiaeum vaiegatum* 'pictum' (Devi et al., 2012), *Anthurium* (Perera and Beneragama, 2012a, b), *Ophiopogon* (Beneragama and Sangakkara, 2011), *Dracaena sanderiana* (Srikrishna et al., 2011), growth hormones and potting media on *Ophiopogon* (Herath et al., 2011), poinsettia (Karunananda and Peiris, 2010, 2011), low-maintenance in ornamental plants (Wickramaratne and Beneragama, 2011), new training techniques for roses (Palansooriya et al., 2011) and use of human urine as a low-cost fertilizer for *Dracaena sanderiana* (Ranasinghe et al., 2014).

Moreover, our researchers and those involved in floriculture business must be made aware of the recent advancements in terms of innovations in the floriculture trade in developed countries. Use of ultra low volume (ULV) sprayers to apply chemicals and fertilizers, use of Nivola® sulphur evaporator by NIVOLA B.V. in controlling greenhouse diseases, energy efficient Dosatron® fertilizer injectors by DOSATRON, USA, for fertigation, self-watering planters to save time (e.g., Grobal® planters) and wave-length specific 'green power' LED lighting by Philips® to control growth performances are noteworthy. The application of ICT in floriculture business has also gone a long way now by having plant health apps such as Field Scout GreenIndex® by Spectrum Technologies Inc. and Koubachi® Wi-Fi plant sensor that work on smartphones.

4. Postharvest management practices.

As all floricultural produce are perishables, extending the postharvest life while maintaining the quality is of great importance. Sri Lankan researchers have been sufficiently addressing the issues related to postharvest handling of flower products, however, the field is still open for new studies with a significant scientific merit. 1-Methylcyclopropene (1-MCP) is considered as one of the break-through chemicals in the field of postharvest technology in the recent past. Even though this environmental-friendly, harmless 1-MCP is being used world-wide; still this chemical is new to the floriculture industry of Sri Lanka. Several research studies have been carried out with 1-MCP on floriculture produce under Sri Lankan conditions; *Calathea lancifolia* (Gunawardena et al., 2013), lotus (Rajapakse and Beneragama, 2012), *Nil Manel* (Sriwarnasingha et al., 2014) and *Alstromeria* (Obadamudalige et al., 2014). All these studies show the potential use of 1-MCP in extending the postharvest life of such commodities. Apart from 1-MCP, many other chemicals have also been tested on various species; various chemical combinations on cut leaves of *Dracaena* (Subhashini et al., 2011) and *Calathea zebrine* (Perera and Damunupola, 2011) are two

examples.

THE GOVERNMENT INTERVENTION

In terms of policy making at the national level, Sri Lanka Council for Agriculture Research Policy (SLCARP) overlooks the floriculture sector of Sri Lanka, being the central body that coordinates floriculture-related work. To ease the burden of SLCARP, in year 2006, the SLCARP has formulated the National Committee on Floriculture Research and Development (NCFRD) aiming to develop all aspects of floriculture, from production through processing to marketing. The NCFRD is an eleven-member committee consisting public and private sector stakeholders (CARP, 2011). The two biggest tasks of the NCFRD are to streamline the resources for floriculture and to set up research priorities for the industry (EDB, 2011). In addition, an annual workshop (National Symposium on Floriculture Research – NASFLOR) is organized by the SLCARP, providing an opportunity for the scientists attached to universities and research institutions to present their findings on floriculture research to the industry stakeholders.

Institutional support should be there to enhance the quality of floriculture research in Sri Lanka. In line with that, several government institutes such as Universities (Faculties of Agriculture, Science and Engineering), Department of National Botanic Gardens and Department of Agriculture (including Horticulture Research and Development Institute – HORDI, Institute of Postharvest Technology – IPHT, National Plant Quarantine Service – NPQS) do collaborative research hand-in-hand targeting cutting-edge outcomes. However, the collaborative research culture in the field of floriculture needs to be promoted and facilitated further. Moreover, the collaborative research work with the private sector also needs a boost though at present, the collaboration between the public research institutes and the private sector organizations, floriculture produce exporters for example, is at a satisfactory echelon.

To promote R&D in floriculture, the government encourages R&D work done by the private sector and has offered various tax concessions for R&D in the annual budget allocations. Apart from that, there are government-owned funding bodies making funding opportunities competitive to all researchers in the floriculture sector. National Science Foundation (NSF), National Science and Technology Commission (NASTEC) and SLCARP provide these funding opportunities annually.

One of the serious complaints from the researchers over the past several years was that, they do not have the access to quality journals, so that their quality of research work could be affected. Even though the situation still remains at a skeptical stage, the University Grants Commission and the National Science Foundation has made some appreciable attempts to provide that service to the Sri Lankan scientists.

The money spent on research from the government might be questioned where the researchers are answerable. For example, 2013 Budget provided Rs. 9 billion for direct expenditure on research and related work done by researchers in Government research institutions. In the same year, the National Research Council received an additional Rs. 250 million to meet research related expenses. There was a proposal in the same year to grant a triple deduction for research expenditure and a lump sum depreciation for capital expenditure on required equipment and development of laboratory facilities to encourage private sector engagement in research and innovation. Looking at all these, one cannot say that the funding opportunities are not available within the country. The authors' only concern is whether the researchers do a proper justification for the money that they receive for research, as there are some researchers who carry out research only to expand their 'list of publications'. On the other hand, there can be very important outcomes from the research; however, because of the high recognition in promotions, researchers tend to publish their results in 'high-quality' international journals which only a handful of Sri Lankans have the access to read.

THE PRIVATE SECTOR INVOLVEMENT

Jaeger (2010) in his World Bank Technical Paper argues that a commercial

horticulture sector needs government policies that provide an environment in which the sector can thrive. It does not necessarily mean that the direct intervention from the government in its activities is needed; rather, the government should recognize the need for a vigorous private sector as the engine of commercial growth. As mentioned in the previous section, the government institutes are always willing to carry out collaborative research with the private sector organizations. One of the ways is that the companies who are directly involved in floriculture could come up with the research problems so that the outcome of the research would surely be beneficial for the betterment of the industry. In such instances, those private sector organizations can fund the projects as they will be benefitted anyway. The recently emerged Sri Lanka Institute of Nano Technology (SLINTEC) can be considered as one of the promising research institutes for future floriculture-related research.

SRI LANKA FLOWER COUNCIL (SLFC)?

Even though there are government-backed organizations available to support research & development and innovations, to date, there is no any governmental body that is looking after the sales and the business, except the Export Development Board (EDB). In most of the countries where the floriculture industry is well-developed, the total business is run by a 'flower council'. The Flower Council of Holland is the marketing and sales promotion organization of the cut flower and houseplant industry of The Netherlands. Kenya also has displayed a rapid progress over the years since the establishment of the Kenya Flower Council (KFC) (Rikken, 2011). Thus, it is high time for Sri Lanka also to think about establishing the 'Sri Lanka Flower Council' under the government patronage to haul up the status of the Sri Lankan floriculture industry, making it more competitive with a higher bargaining power.

CONCLUDING REMARKS

The way that the Sri Lankan floriculture industry is heading is not conducive at all. The biggest challenge that the country faces is the market competition. To face these challenges successfully, all stakeholders will have to get-together and have a dialogue on the way-outs. Research and development in the field of floriculture need out-of-the-box thinking. A key component of competitiveness is the ability to innovate. Without an innovative capacity, any industry will fall behind its competitors. As we have all the required resources within the country, the human resource in particular, nothing is impossible. Over the years Sri Lanka fell behind other countries gradually in floriculture exports despite its enormous natural resources due to lack of proper planning. Planning is only possible through organizations like "The Flower Council" as it cannot be done by individuals or private sector alone. Therefore, it is high time now to have "The Flower Council" established and serve to upgrade the floriculture industry which has a high potential to increase the gross national product (GNP) of the country.

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