

# **An Assessment to International Trade and Marketing Opportunities in the Horticultural Sector in Sri Lanka**

## **Final Report**



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## **Abbreviations**

Avg – Average

CAGR – Compound Annual Growth Rate

CIF – Cost, Insurance and Freight (Import Price)

DOA – Department of Agriculture

ERP – Enterprise Resource Planning

FOB – Free on Board (Export Price)

GAP – Good Agricultural Practices

Ha - Hectares

HORDI – Horticultural Crop Research and Development Institute

IoT- Internet of Things

ISTA – International Seed Testing Association

IT – Information Technology

JV – Joint Venture

Kg – Kilogram

LKR – Sri Lankan Rupees

Ltr - Litre

OP- Open Pollinated

PIB – Partnership in Business

RTD – Ready to drink

RTE – Ready to eat

T – Tons

TOR – Terms of Reference

UN – United Nations

UPOV – International Union for the Protection of New Varieties of Plants

## 1.0 Executive Summary

Agriculture in Sri Lanka is one of the sectors which has been given a prominent focus for a number of years where paddy cultivation is identified as the most important crop. However, over the years the horticulture sector which includes fruits and vegetables has been gaining significant prominence and is a major contributor to the overall agriculture sector. Sri Lanka's ability to grow a variety of fruits and vegetable crops year round under different climatic zones has led to a keen interest both locally and internationally to further develop this sector due to the identified high potential. In recent times the potential and interest for the horticulture sector has intensified due to government policy and the Covid pandemic.

This report presented for the purpose of all stakeholders in the Dutch horticulture sector outlines the current situation and gap analysis of the Sri Lankan horticulture sector with a particular focus on various recommendations on the areas in which Dutch private sector companies can engage with the Sri Lankan horticulture sector. The report draws particular attention into the following areas.

- Recent innovations in the sector and the need for further technological influence especially on the areas of drip irrigation systems, optimum use of input materials, greenhouse and other protected agriculture technologies.
- The requirement for the introduction of post and pre harvest technologies and knowledge dissemination on farmer growing and cultivation techniques.
- Creation of value additions of horticultural crops currently cultivated with the potential of supplying to both the local and international markets.
- The various barriers in the local market that has led to a shortage of high quality seeds and planting materials.
- The opportunity to provide protected agricultural systems such as hybrid greenhouse models along with related inputs and the opportunities to address need areas in nursery management.
- Opportunities to provide drip, boom and sprinkler irrigation systems.
- The requirement of non-chemical plant nutrition and plant protection products in light of the recent total ban on chemical fertilizers and plant protection products by the Sri Lankan government.

- An analysis of the crop types that are grown in the country along with the import and export varieties.
- Challenges faced in the local horticulture industry with relation to the external and internal environment showcasing the bureaucratic barriers and the lack of development of farmer knowledge on pre and post-harvest techniques.
- The opportunity for Dutch seed companies to provide high yielding hybrid seed varieties that are demanded in the local market and the required market development work in order for the Dutch to enter the local market.
- The requirement for post-harvest technologies such as cold chain storages etc. to minimize post-harvest crop losses.
- Development of centers of excellence, agri innovation centers and nucleus/contract farming models with the collaboration of Dutch companies and Sri Lankan private sector, together with government agencies.
- The opportunity to provide agricultural extension services and horticultural training particularly on the use of IT in agriculture, agri entrepreneurship etc.
- Opportunities that are present to provide soil management services, including soil remediation.
- The demand for producing identified floral crops in collaboration with Dutch technology.

The information provided in the report are based on the surveys conducted which included collecting qualitative and quantitative data through questionnaires and most importantly extended interviews conducted among selected players in the horticulture sector in Sri Lanka which included farmer groups, large scale agriculture companies, small and medium scale agriculture companies, agri startups, fruit and vegetable processors, fruit and vegetable export companies, government agencies etc. The results and other details of the survey are showcased in the annexure. The recommendations that are provided in this report are an extension of the key points that were highlighted by the relevant stakeholders during the discussions held with them.

Whilst scope for engagement by Dutch companies is significant, several policy issues need to be addressed and some intermediate approaches are recommended in this report which by themselves offer interesting opportunities.

## 2.0 Situation and Gap Analysis of the present Horticulture Industry in Sri Lanka

Agriculture is one of the most common and recognized sectors in Sri Lanka. Approximately eighty different varieties of fruits and vegetables are grown in various agro-climatic regions of the country. Being a country with natural resources with different climatic zones and geographical locations, Sri Lanka allows for a continuous harvest throughout the year. Since the progression of the horticulture sector in the 1970s, a considerable volume of fruits, vegetables, ornamental products consisting of floriculture and landscape horticultural produce have been produced and traded in Sri Lanka.

In the year 2019, Sri Lanka produced nearly 3 million metric tons of vegetables and over 1 million metric tons of fruits. (see pages 15 and 16 under section “2.3 Horticultural Outputs and Economic Returns” for types of crops and quantities) These extents have been relatively static over the past three years with decline in extents of some crops. Of the farmers who cater to the demand of the vegetables and fruits to the industry of agriculture, the majority are small producers or home gardeners whose individual extent of land does not exceed a hectare (see section 5.0 Annexure – Survey Methodology and Results for details of surveyed farmer profile). As a subdivision of agriculture, horticultural growers’ density is comparatively higher than the typical agricultural producers. Horticulture is defined as the use of special techniques and methods for the cultivation of plants, including methods used to prepare the soil for planting seeds or planting tubers. The present domain of the horticulture industry in Sri Lanka is evolving and includes cultivation, plant propagation, breeding of plants, production of crops, plant physiology as well as biochemistry and genetic engineering. The use of biotechnology is also poised to enter the domain of horticulture in Sri Lanka. Moreover, in order to obtain substantial quality crop yields, increasing the nutritional value of the crops, cultivating pest and disease resistant crops and adjusting to environmental stresses, extensive research is being conducted in Sri Lanka with the assistance and guidance of the Horticultural Crop Research and Development Institute (HORDI) and local universities, some of whom are working in partnership with international research organizations and institutions. The world population is expected to reach 9.7 billion by 2050, according to UN estimates. Thus, global demand for vegetables and fruits continues to rise due to the growing population and dietary requirement changes. Global food demand is expected to increase by 50% by 2050 compared to 2013, offering significant opportunities for horticulture companies.

In the 1990s, Sri Lankan subsistence farming, where growing crops only sufficient for one's own use alone, became insufficient to meet the growing demand for the vegetable and fruit markets. Furthermore, plantation agriculture on large land extents done in Sri Lanka are not effective in terms of land usage due to the current systems used. Single crops such as tea, rubber, coconut and sugarcane are grown as a monocrop for the entire year with deployment of large capital and labour. The contemporary horticultural industry in Sri Lanka requires development based on the demand by analysing the trends and technological insertions adopted by leading countries in the areas of agronomy systems, irrigation systems concerning water management efficiency, climate change adaptability, protection against natural disasters such as floods, droughts, and pest infections etc.

The Green Revolution and the use of modern technology have become popular around the world and tend to use a variety of techniques such as high yielding robust varieties, hybrid seeds, modern irrigation systems and infrastructure, synthetic fertilizers and pesticides to improve the efficiency of agricultural processes. However, in Sri Lanka, the agriculture sector has undergone a significant transformation, but in recent years the productivity level has stagnated due to several factors such as low technology use, poor agricultural extension and phytosanitary and other procedures for import of good quality seeds and fertilizer/plant nutrition products. Furthermore, this has been exacerbated by the global Covid 19 pandemic, raising concerns on food security and income of farmers. An immediate impact of the pandemic is the disruption to the local agri food supply chain from which the opportunity has arisen to provide logistics services mainly in the areas of cold chain and storage systems. The pandemic has also contributed to a change in the agricultural eco systems where the demand for processed agricultural products as opposed to fresh produce is on the rise. Furthermore, the need for use of digital marketing activities in the agri space is also a widely explored opportunity globally and locally. Sri Lankan agro-ecosystem, which is largely based on traditional practices is failing to meet increasing demand due to depletion of resources such as land, labour, and water due to urbanization and other industrial activities. Therefore, the need for using new technologies, trends and efficiency in utilizing resources to improve productivity is on the rise. However, fruit varieties such as Pineapple, Passion Fruit, Rambutan and selected vegetable varieties have achieved local and international quality standards (Eg: Sri Lanka Standards Institute Certificate, HACCP, Global GAP certificate, Sri Lankan GAP certificate, USDA organic certification, EU organic certification, ISO 22000) which are major strengths for Sri Lankan products in entering the international markets (refer pages 18 – 20 under section “2.3 Horticultural Outputs and

Economic Return” for breakdown of Sri Lanka’s import and export performance). Sri Lanka has been a country that has been predominantly focused on the development of paddy crops over the past few decades. Presently Sri Lanka produces an estimated 4.5 metric tons of paddy per hectare. Although the paddy sector has thrived over time, the Sri Lankan horticultural sector has been lagging behind and has not reached its full potential due to the insufficient attention given to improve the yield of horticultural crops. The yields of most horticultural crops are below those prevailing in regional countries such as India, Thailand, Vietnam etc.

## **2.1 Technology and Recent Innovations in the Sector**

In the present context, the adaptation of advanced technologies in the agricultural/horticultural industry of Sri Lanka is limited not only among farmers but also with agribusinesses. Horticultural companies are aware that technology can create an impact for long term business sustainability. However, the absence of such technologies in Sri Lanka and costs of acquiring such technologies is preventing wide scale use in the sector. Based on responses from lead farmers and horticultural companies a few key areas have been identified as required technologies such as crop cultivation methods under poly tunnels, use of drip irrigation systems, optimum use of input materials, pest and disease mitigation methods, postharvest management techniques, cold storage and cold chains, processing, packaging and transportation methods etc. Furthermore, in order to streamline the technological procedures, several spaces and gaps have been found for enhancing infrastructural projects, applied research and development and the use of advanced technology etc. Based on survey findings the use of advanced technology for post and pre harvest stages, knowledge of the farmer's cultivation and growing methods have been identified as areas that need to be improved. Traditional farming techniques are prevalent in this sector where due to lack of accessibility and knowledge regarding new technological trends, farmers are lagging behind when compared to South Asian countries like Bangladesh and India. Therefore, Dutch companies have the opportunities to create a significant impact on the Sri Lankan horticulture sector employing technological expertise. From a business angle the model to be explored with relation to this would have to be a public private partnership model where certain infrastructure resources such as land and other inputs have to be provided by the government while the technology and marketing to be provided by the private sector represented by the Dutch and Sri Lankan companies. The specifics of these engagements will need to be structured by the engagement of the Dutch Partnership in Business (PIB) and local chambers of commerce in partnership with the relevant government institutions (refer recommendation 3.4, 3.5). The main potential buyers in this respect would be



the Sri Lankan entrepreneur led agri business development companies with a heavy focus on those with a startup culture. Thus far these types of services have been provided through bilateral arrangements between international research organizations and Sri Lankan Department of Agriculture (mainly with relation to rice/paddy).

Horticultural export companies in Sri Lanka have commented that they are keen to explore opportunities to create value additions for horticultural crops presently being cultivated while maintaining the nutrients and vitamins provided with the ultimate goal of supplying to the international markets. Based on market demand both locally as well as globally the emerging demand from Sri Lanka is for fruits in juice forms, dehydrated and innovative RTE/RTD (ready to eat/ready to drink) forms. Furthermore, an increasing demand is also visible heavily for horticultural products in the nutraceutical and dermatological sectors. Production and value chain management needs to be technically sound to meet the highly variable market trends and cater to the nutrition and healthy food demand in this sector.

Following are recent developments in horticultural industry in terms of technologies;

1. Vegetable based cropping systems such as organic farming and ecological farming have gained momentum to use as a solution for overuse of natural resources and high external input use. Sri Lanka was well on the road to developing a sustainable organic farming system with the government research institutes also completing several initiatives for organic food production. Thus opportunities exist for installing and operating organic food production systems whether in open fields or via protected agriculture. Furthermore, commercial scale vegetable based cropping systems in rain shelters and film-plastic greenhouses are emerging due to the high value of their productions. The recent banning of all chemical fertilizers and crop protection products provides opportunities for novel solutions for growing of crops in greenhouses and through protected agriculture.

2. Intensive commercial home gardening has been used throughout the year due to excessive reliance on external inputs by using shallow wells with sprinklers. With the promotion of home gardening by the government we see the opportunity for the Dutch to provide their technologies, however to be beneficial to the Dutch companies these technologies will have to be provided to the large scale companies. In the home garden and urban agriculture area, government has supported growers with seeds and planting material and advisory services to develop this

activity. As a result, increased interest is seen in vertical farming, rooftop and small scale hydroponic/aquaponics systems.

3. The Department of Agriculture in collaboration with the private sector, developed e-agriculture services through mobile phone apps that provides guidance and advice to farmers on crops that should be cultivated to receive a better market price and to support farmers by creating market linkages etc.

4. The National Food Production program is being developed in order to streamline seed and propagation material management information system, QR code for Sri Lanka GAP certification and progress tracking systems.

5. Nano technology related research and development has been carried out in this sector to provide slow release fertilizer, nano fungicidal formulations, organic acid based weedicides and seed coating to minimize the fertilizer adverse effects and improve soil remediation and rehabilitation. Based on the responses received from startups and horticultural companies who are actively engaged in the agri-tech space in Sri Lanka, the following are a few key areas that they are currently engaged in and are focusing on.

- Use of technologies such as horticultural lighting control systems to optimize plant cultivation, smart irrigation controllers which monitor moisture conditions and automatically adjust watering to an optimum level, climate controllers to manage the temperature in different climatic zones, custom production mapping and super oxygenation systems.
- Specialized versions of hydroponic technology (Aeroponic systems) where plants have been grown in the air without using soil, and where roots are sprayed using a nutrient water solvent.
- Towers built using PVC pipes which uses Arduino based microcontroller to automatically control the flow of nutrient solution which are able to send data of fluid level and temperature level via smartphone apps.
- Internet of Things (IoT) powered devices which can be fixed in the land, soil moisture sensors, pH value and humidity sensors to monitor the plants and crops.
- Technologies to upload the farm into cloud base platforms.
- Smart precision irrigation systems and crop specific intelligence which are used to enhance the quality of agricultural produce and the crop yield.

- Data-based approaches used to reduce crop water use and plant stress levels (caused by water and the environment)
- Smart pest management activities
- Smart farm manager apps with the objective of removing manual faults in irrigation cycle
- Centralized monitoring of farms with enhanced transparency in the end to end movement of stocks and cash flows starting from farms
- Monitoring of various data points for every harvest with predictive data analytics
- Seed to fork traceability

## 2.2 Horticultural Inputs

This section covers the key inputs used in the horticultural sector in Sri Lanka including seeds/planting material, nursery management and growth media, irrigation, plant nutrition and plant protection inputs.

### 2.2.1 Seeding and Planting Materials

In Sri Lanka, the agriculture industry seed market is distinguished into two main categories. They are based on the variety of crops such as grains and cereals, vegetables, and other crop types and product varieties such as hybrid seeds, conventional seeds and varietal seeds. Seeds have been identified as the most efficient means of propagating crops and maintaining and transmitting genetic enhancements made by plant breeders. Seeds are considered as the key ingredient in terms of expanding, diversifying and improving crop production. The responses obtained from farmers stipulates the current growing need for quality seeds that can provide better yields, pest resistance, drought tolerance and herbicide tolerance.

Based on research conducted by “FAO, Mordor Intelligence” on the Sri Lankan seed market, the seed market is expected to achieve a CAGR of 3.1% in the next five years. Although vegetable production in the country has gone down since 2018, the demand for quality seeds has increased with the population growth. The current seed market is fragmented due to the presence of local players marketing certified seeds.

According to the guidelines given by the International Seed Testing Association (ISTA), the Department of Agriculture has been following their protocols on seed certification programs since its inception. However, global level practices such as varietal purity (e.g. molecular assessments) and seed health (e.g. conducive environmental incubation and identification, liquid plating assay, enzyme-linked immunosorbent assay) are not being practiced in Sri Lanka.

Since 2010 the Department of Agriculture stepped into the process of new seed variety registration which was previously carried out by the individual seed companies through their own trials prior to selection and introduction. However, the new process is still being fine-tuned.

Based on the report of 'Seed Certification Service by Department of Agriculture Peradeniya' in Sri Lanka around 90% of the seed requirement is imported with bean, radish and tomato being the most common vegetables in the upcountry areas (cold season vegetable & spices). New improved varieties have been released periodically and they are being multiplied by the Department of Agriculture. However, the annually estimated 33% (62,200kg in 2017) of the total vegetable seed requirement are imported to meet the needs of the national low country's (warm season) vegetable seeds requirement. Based on the data released by the Department of Agriculture, 25 tons of fruit seeds and 199 tons of vegetable seeds were imported into the country in 2019. Furthermore, biochemical technologies, molecular and tissue culture have made significant progress in the rest of the world and in Sri Lanka, however none of them are still employed to improve these exotic seeds or vegetative propagation vegetable crops in the absence of environmental stimulants. Limited research has been found for enhancing viability through prolonged storage and packaging in locally produced low country seeds (e.g. tomato, capsicum, brinjal, okra, beans, pumpkin) where the seeds lose their viability during storage.

In the foreign seed market, seed treatments such as film coating, pelleting and priming are considered to be vital aspects during the process of germination and seedling emergence, however the use of these treatments are limited in the local horticulture industry. Formal public and private sector quality assured seed suppliers for vegetables and fruit market are approximately 25% to 30% while the rest of the requirement is filled by the informal suppliers. The formal seed sector's produce is more expensive than the informal sector as they have to undergo expensive quality assurance procedures. Even though locally produced formal seeds are much cheaper compared to imported seeds, the quantities available in the local market is

comparatively much lower and are insufficient to meet the demand during the crops growing season.

Based on discussion conducted with farmer groups and key horticulture sector players the following were identified as the main reasons for the lack of adequate amounts of seeds and planting material.

1. Inability to multiply certified seeds in the absence of suitable land and other resources and the required foundation/basic seeds.
2. The local seed market does not warrant investment for primary breeding and research into seed technology
3. Bureaucratic procedures for importation of high quality hybrid seeds and planting materials as explained above
4. Large field isolation spaces are required due to the cross-pollinated nature of the crop species.
5. Shortage of labour and high wages lead to higher production costs.
6. Certain agro climatic zones are restricted for seed production.
7. Growers are reluctant to get involved in seed production as fresh market fruits and vegetables are cheaper than seed production.

### **2.2.2 Nursery Management with the use of Growth Media and Transplants**

Nursery management in the Sri Lankan horticulture sector is still unscientific and is at a nascent stage. From the survey and subsequent discussion conducted, growers of horticultural crops and agri businesses are aware of global best practices in nursery management. However, knowledge and information on how to sources and use such technologies is a constraint.

In the global platform, a number of studies have been conducted on the nursery medium and soilless (hydroponic) growing systems. Research has been conducted in the Sri Lankan context by comparing performance with alternative growing/nursery media and growing systems (Eg: seedling trays). However, further development has not been done to develop value-added potting media products. As a mainstream exporter in coco peat (soil) to the horticulture industry

in the world, Sri Lanka has the potential to develop innovative value added growing media for horticultural crops. Machine transplanting of seedlings raised in trays is not practiced in Sri Lanka. Most of the local growers raise their seedlings in beds in open fields/protected areas allocated for nurseries. However, shortcomings have been witnessed in the use of media and plant nutrition in nursery management resulting in poor germination and poor quality plants. Grafting, for the propagation of fruits and vegetables, is also not widely practiced in Sri Lanka.

Local horticulture companies are not able to address the upper market sector for fruits and vegetables in neighboring countries such as Maldives as production for these upper market segments have to come from modern horticulture production systems such as greenhouses, protected agriculture systems etc.

Dutch companies who have developed hybrid greenhouse models in other Asian countries do have the opportunity to introduce similar models and help provide greenhouse systems to Sri Lankan companies who have currently developed greenhouses but are looking to further improve the technologies used in order to better cater to the markets in the neighboring countries (refer recommendation 3.11).

### **2.2.3 Irrigation**

Irrigation methods such as boom, drip, and sprinkler irrigation together with reusable or biodegradable plastic mulching techniques are used for open field cultivation to save water with efficient irrigation. In the humid tropical conditions of the country, benefits of using water saving irrigation are demonstrated by crops such as tomatoes, brinjal, sweet pepper, cabbage and certain fruits. Except for the intensive open field continued cropping systems used in Kalpitya and Nuwara Eliya, micro irrigation is limited in vegetable and fruit crop cultivation due to its high initial cost. Therefore, sprinkler irrigation is popular in in these areas due to cost efficiency and low water retention properties of the soils. At present in Sri Lanka, appropriate irrigation systems and drainage technologies are required due to unpredictable rainfall patterns and climatic changes which have an adverse impact on horticultural crops. Furthermore, water saving irrigation methods such as drip, sprinkler, and precision surface irrigation, aided with mulching are used minimally. Thus there are huge opportunities for Dutch companies to market such systems to small and medium agri enterprises in Sri Lanka

## 2.2.4 Plant Nutrition

Based on the survey findings farmers and growers tend to use a high percentage of chemical and synthetic fertilizers in order to obtain the expected yields though they are generally aware of the negative impact of excessive use of chemical fertilizers. This is due to lack of knowledge on awareness on optimal use of fertilizers based on soil condition and yield potential of the respective horticultural crops. Value added plant nutrition products such as granules, pellets, slow/controlled release fertilizers, deep placements, nitrification and volatilization inhibitors, super granules, and decision support software-assisted precision application methods are known to some large farmers and horticulture companies. Popular supermarket chains in the country as well as agri exporters currently rely on inorganic plant nutrition products. However, in view of Sri Lanka's total ban on inorganic fertilizers and plant nutrition products huge opportunities have arisen for organic fertilizers and non-chemical plant protection products. If Dutch companies have such non chemical products in their portfolio these can be introduced very quickly to the horticulture sector in Sri Lanka. However, pricing of these products must be affordable and in addition training will also have to be provided on the use of such products.

### Import quantities of fertilizers by local public and private sector companies (t/Ltr)

	2017	2018	2019
Urea	197,486	476,888	375,439
TSP	28,114	87,782	78,891
MOP	85,197	165,322	169,506
SA	65,923	78,747	63,689
Kieserite	13,699	13,297	12,637
ZnSO <sub>4</sub>	300	722	1,154
DAP	2,707	3,621	2,860
CES	411	1,281	853
Granular mixtures (t)	12,038	18,698	15,338
Liquid mixtures (Ltr)	258,833	366,697	152,458
Other	6,287	4,474	3,605

In Sri Lanka, issues have begun due to misuse of chemical fertilizers in major growing areas such as the mid country which has led to groundwater pollution, fixation of nutrients and increase of residues of nitrate etc. Chronic kidney disease has spread in the North Central

Province and adjacent farming areas due to heavy usage of phosphate fertilizer along with the pesticides (Glyphosate) which are the main source of arsenic in the affected areas. Therefore, hydroponic is one of the main strategies, where the plant can be grown in non-soil media maintaining a great deal of precision in plant nutrient management. In Sri Lanka, hydroponic recommendations have been developed primarily in application dosage, electrical conductivity, and pH management for greenhouse tomato, bell peppers, green cucumber, and lettuce etc. In the current context, hydroponics, fertigation (injection of fertilizers) solutions and low cost fertilizers are being the demanding factors for the growth of the agricultural sector.

### **2.2.5 Protection of Plants**

Vegetable and fruit crops have high susceptibility to pests and diseases particularly due to tropical conditions. In order to protect crops and increase yields, farmers require suitable crop protection products in time. Lack of knowledge and information on required crop protection products including dosages and application technologies leads to farmers misusing and overusing chemical fertilizers. Farmers and horticultural companies are aware of the health and environmental hazards due to the excessive use of pesticides and chemical fertilizers. As a result, horticultural companies comment that availability of targeted and non-chemical crop protection products would provide clear advantages, particularly for export of horticultural products from Sri Lanka. Availability of alternative pest control systems including integrated pest management systems also offers advantages to horticultural companies. Furthermore, the application of poultry manure for reducing root-knot nematode attacks, polythene sleeves for fruit fly control, pheromone traps and the use of botanicals such as seed or leaf extracts of neem, garlic and many other plant species are some of the alternative pest control strategies used. However, these technologies need to be made commercially viable based on the feedback from horticulture companies and lead farmers. Apart from training that is required to be given to farmers, the government quarantine and other procedures need to be streamlined to permit imports of biological agents such as predator insects and other organisms. Given the current encouragement to non-use of chemical inputs, Dutch companies together with their existing or potential local partners could canvas the government authorities to facilitate such imports.



### **2.3 Horticultural Outputs and Economic Returns**

The most commonly grown fruits in Sri Lanka are banana, lime, mango, orange, papaya, passion fruit, rambutan, pineapple, durian, woodapple, watermelon, jack, guava, soursop, dragon fruit and avocado which are grown at an estimated extent of 112,676 hectares.

The main types of vegetables grown in Sri Lanka consist of tropical (dry zone) and temperate (wet zone) vegetables grown at an estimated extent of 84,191 hectares. The types of vegetables and quantities are shown in the table below. (Source – DOA).

	2017			2018			2019		
	Extent (ha)	Production (t)	Avg yield (t/ha)	Extent (ha)	Production (t)	Avg yield (t/ha)	Extent (ha)	Production (t)	Avg yield (t/ha)
<b><u>Up country</u></b>									
Bean	7,723	87,385	11.31	7,344	83,966	11.43	6,461	65,450	10.13
Beetroot	2,162	34,192	15.81	2,234	51,004	22.83	1,805	30,048	16.65
Cabbage	4,224	99,616	23.58	4,202	111,141	26.45	4,153	116,577	28.07
Carrot	3,687	71,607	19.42	3,125	71,051	22.73	3,553	80,767	22.73
Knolkhol	1,139	14,148	12.41	1,289	19,502	15.13	1,338	15,306	11.44
Leeks	2,214	56,045	25.31	2,026	51,330	25.34	2,102	31,879	15.17
Radish	2,850	49,506	17.37	3,057	63,137	20.65	2,676	44,244	16.53
Tomato	5,329	80,839	15.17	6,712	101,404	15.11	5,869	77,916	13.28
<b><u>Low country</u></b>									
Ash plantain	6,580	72,702	11.05	7,301	81,200	11.12	5,335	63,460	11.90
Ash pumpkin	579	8,785	15.17	827	8,920	10.78	720	10,252	14.24
Ladies fingers	6,827	61,429	9.00	8,368	68,515	8.19	6,851	72,226	10.54
Bitter gourd	3,183	37,012	11.63	4,306	47,611	11.06	3,402	40,970	12.04
Brinjal	9,665	108,856	11.26	10,834	129,212	11.93	9,877	134,863	13.65
Capsicum	3,208	26,952	8.40	3,675	32,307	8.79	3,095	26,414	8.53
Cucumber	2,446	31,446	12.86	3,228	43,942	13.61	2,555	34,864	13.65
Red pumpkin	6,159	82,934	13.47	8,469	123,261	14.55	6,863	97,473	14.20
Snake gourd	2,335	28,849	12.36	2,696	33,514	12.43	2,361	29,806	12.62
Luffa	4,410	46,188	10.47	4,498	46,124	10.25	3,523	38,108	10.82

Cultivation is mainly at smallholder and home garden level. However, in recent times crops such as mango, pineapple, passion fruit and banana have been grown at a commercial level, but growing technologies do not give farmers consistent and good yields. The table below gives a snapshot of some of the fruit crops and its quantities grown in Sri Lanka. (Source – DOA)

	2017			2018			2019		
	Extent (ha)	Production ('000 fruits)	Production (t)	Extent (ha)	Production ('000 fruits)	Production (t)	Extent (ha)	Production ('000 fruits)	Production (t)
Banana	49,307	62,549	750,587	45,497	72,010	864,120	44,671	56,139	673,668
Lime	10,798	247,655	12,383	10,094	316,260	15,813	10,238	334,546	16,727
Mango	28,272	433,523	151,733	28,440	493,529	172,735	27,460	444,136	155,448
Orange	6,891	46,990	7,048	6,840	56,788	8,518	6,742	59,213	8,882
Papaw	6,975	57,479	86,219	6,271	48,521	72,782	6,178	52,562	78,843
Passion fruit	470	7,313	731	481	7,538	754	508	8,846	885
Pineapple	4,783	42,229	52,786	5,543	34,651	43,314	4,665	35,834	44,793
Rambutan	5,899	409,686	14,339	6,297	664,968	23,274	6,929	709,468	24,831
Avocado	2,923	30,606	10,100	3,213	50,542	16,679	3,453	49,881	16,461

Fruit and vegetable production in Sri Lanka is affected due to adverse weather conditions with rainfall being the main source of irrigation. In addition, insufficient high yielding varieties and good agronomy practices affects yields and farmer incomes. Vegetable production in Sri Lanka has declined in the last few years, owing to pest attacks and uneven weather conditions. Armyworm infections, dry weather conditions and inadequacy in land used have led to the decline of crop yield in the country. Exceptions are for fruit crops such as pineapple, mango and papaya where some high yielding varieties have been introduced.

Based on the demand for fruits and vegetables for domestic and export markets, potential exists for rapidly increasing yields. From the survey of Sri Lankan exporters of fruits and vegetables the demand for good quality fruit crops such as mango, papaya, watermelon is expected to grow substantially. The main bottleneck is the local supply chain constraints mainly due to agronomy practices and inconsistent quality and quantities. Local demand for fruits and vegetables is also growing substantially and in recent times is fueled by demand for immunity boosting food caused by the global pandemic.

The scope exists for improving both yields and farmgate prices for the identified crops that have got demand in the domestic and export markets. Local marketeers such as supermarkets and exporters of fresh and processed fruits estimate that purchase volumes can be significantly increased from farmers if targeted farmgate prices can be obtained. For example, in recent times farmgate prices of pineapple have been around LKR 100/kg (0.42 EUR/kg) while desired farmgate prices are LKR 45-50/kg (EUR 0.19-0.21/kg). If farmers can improve yields and reduce units, significant volumes can be generated.

Currently several initiatives, including European Union funded projects technical assistance modernization programs are seeking to support the development of the horticulture sector. Local horticulture companies have commented that provision of new technologies as well as access to high quality planting materials is expected to significantly improve incomes for farmers and good returns for all stakeholders

Based on data released by the Department of Agriculture in terms of import and export of horticultural produce, the majority of imports with regards to quantity consists of apples, mandarin, orange, cauliflower while the major export items are banana, papaw, capsicum, bean and pumpkin. The tables below showcased the import and export performance data in the country. (Source – DOA)

### Import performance of Fruits

	2017			2018			2019		
	Quantity (t)	Value (Rs'000)	CIF value (LKR/kg)	Quantity (t)	Value (Rs'000)	CIF value (LKR/kg)	Quantity (t)	Value (Rs'000)	CIF value (LKR/kg)
Dates (fresh)	645	82,864	128.54	306	33,679	110.15	556	96,227	172.96
Dates (dried)	7,991	1,439,455	180.14	8,943	1,755,528	196.31	6,711	1,455,640	216.91
Orange (fresh)	8,686	958,118	110.31	8,356	939,628	112.45	7,773	949,217	122.12
Mandarin (fresh)	6,041	331,048	54.80	10,961	603,704	55.08	9,384	547,953	58.39
Grapes (fresh)	7,258	2,281,410	314.34	7,387	2,436,268	329.83	7,223	2,501,211	346.28
Grapes (dried)	2,429	484,936	199.65	2,644	755,509	285.79	2,629	787,596	299.54
Apple	26,720	3,727,484	139.50	27,253	4,302,246	157.86	23,442	4,044,236	172.52
Pears	377	51,497	136.75	355	50,802	142.97	534	96,134	180.05
Cashew	2,270	750,079	330.48	2,534	917,657	362.08	528	140,471	266.00
Strawberry	0.86	679	787.09	0.28	545	1,909.75	5	1,367	285.71

### Export Performance of Fruits

	2017			2018			2019		
	Quantity (t)	Value (Rs'000)	FOB value (LKR/kg)	Quantity (t)	Value (Rs'000)	FOB value (LKR/kg)	Quantity (t)	Value (Rs'000)	FOB value (LKR/kg)
Cashew	60	144,458	2,426.51	72	134,534	1,878.74	56	126,962	2,250.13
Banana (fresh)	15,018	2,560,906	170.52	17,015	2,403,277	141.25	17,926	2,551,964	142.36
Pineapple (fresh)	1,002	347,179	346.58	688	264,151	383.89	592	260,078	438.98
Pineapple (dried)	204	419,261	2,054.48	107	178,962	1,668.68	51	104,836	2,040.65
Papaw	5,072	532,290	104.94	5,857	573,801	97.97	10,011	1,029,129	102.80
Lemon (fresh)	539	70,386	130.65	289	68,598	236.97	111	20,811	187.89
Lemon (dried)	59	28,295	475.85	135	52,316	388.80	31	11,467	368.08
Mango (fresh)	222	89,957	404.93	310	141,486	455.75	528	272,475	516.27
Mango (dried)	2	4,734	2,212.64	8	13,611	1,708.37	46	102,695	2,209.25
Avocado (fresh)	31	9,508	305.34	40	16,543	416.07	108	44,139	409.47
Strawberry	12	12,091	1,011.75	13	15,703	1,188.53	8	8,069	1,000.89
Mangosteen (fresh)	4	1,006	273.00	0.45	365	804.87	2	736	357.92
Watermelon	104	16,775	161.88	44	8,544	193.30	230	28,977	125.86
Guava (fresh)	63	22,952	361.51	95	41,672	439.72	119	54,432	458.89
Guava (dried)	2	738	348.81	45	5,187	114.11	63	30,129	480.05

### Import Performance of Vegetables

	2017			2018			2019		
	Quantity (t)	Value (Rs'000)	CIF value (LKR/kg)	Quantity (t)	Value (Rs'000)	CIF value (LKR/kg)	Quantity (t)	Value (Rs'000)	CIF value (LKR/kg)
Tomato	7	17,148	2,602.04	5	16,777	3,464.00	4	18,363	4162.90
Carrot	14	15,097	1,044.05	124	23,050	185.33	1	1,919	1,721.52
Capsicum	6	10,000	1,607.17	-	-	-	-	-	-
Cauliflower	64	6,024	93.66	89	8,544	95.36	83	8,601	103.37
Cabbage lettuce	0.07	16	216.80	0.05	4	83.33	0	6	42.55
Cucumber	-	-	-	6	9,964	1,692.79	3	2,536	934.06
Peas	0.04	101	2,713.53	0.009	8	887.78	0	74	804.23
Bean	0.64	376	591.94	1.1	398	348.42	1	282	551.37
Asparagus	4	6,345	1,781.98	4	6,386	1,729.52	1	2,751	2,447.78
Mushroom	13	1,840	146.70	0.5	113	236.52	0	10	49.55

### Export Performance of Vegetables

	2017			2018			2019		
	Quantity (t)	Value (Rs'000)	FOB value (LKR/kg)	Quantity (t)	Value (Rs'000)	FOB value (LKR/kg)	Quantity (t)	Value (Rs'000)	FOB value (LKR/kg)
Tomato	63	30,362	478.72	14	2,231	162.13	2	396	237.50
Carrot	1	1,029	997.33	102	5,370	52.41	8	4,212	537.84
Capsicum	18	7,974	431.70	82	31,977	389.72	70	35,854	510.01
Cauliflower	0.13	35	276.72	0.69	391	567.43	0	198	406.53
Cucumber	8	2,124	271.39	13	4,169	317.29	11	3,537	329.93
Peas	0.21	130	627.78	0.03	19	774.16	0	225	500.04
Bean	32	12,609	397.57	141	71,818	508.54	86	43,412	502.18
Leeks	2	563	305.37	8	2,260	264.71	6	2,702	420.02
Mushroom	2	2,149	990.55	1	1,087	752.04	2	1,626	719.11
Pumpkin	-	-	-	459	44,835	93.93	873	65,229	74.73

## **2.4 Challenges faced in the Horticultural Industry**

### **2.4.1 Physical/regulatory (external) environment**

Sri Lanka faces a number of challenges with regards to regulatory hurdles in terms of bureaucratic barriers, import restrictions, phytosanitary/quarantine restrictions and inconsistent agricultural policies. As stipulated by respondents of the survey there are many bureaucratic barriers faced especially in seed importation and certification and fertilizers and plant nutrition products which are in the process of being streamlined. While modern growing systems such as greenhouse horticulture and protected agriculture are promoted, the regulatory environment has to be facilitated to encourage use of the required technologies. With the recent immediate ban on chemical fertilizers and crop protection products, government policies are being revamped to encourage imports of organic inputs and this has not yet been formalized at the time of writing.

Furthermore, due to the lack of adoption of global best practices by the Sri Lankan horticultural sector, the required systems are not in place with regards to safeguarding proprietary plant varieties (Eg: breeders' rights). Since Sri Lanka has not yet signed off on the UPOV (International Union for the Protection of New Varieties of Plants) convention, international seed companies are reluctant to bring the best varieties to Sri Lanka. Be that as it may, international players introducing new seed varieties to Sri Lanka also have to contend with the regulatory processes to obtain the necessary approvals prior to commercial introduction.

### **2.4.2 Internal environment**

A major barrier for the development of the horticultural sector in Sri Lanka is the lack of development of knowledge of the farmers and the local implementation of global best practices. The lack of knowledge in terms of modern technological practices adopted in horticulture and the usage methods of high quality fertilizers and other crop protection inputs by the local farmer and smallholder horticultural companies are a significant hurdle that the Sri Lankan horticultural sector is yet to overcome. The survey conducted with farmers reveal that 72.9% of the respondents have expressed a need for a higher level of knowledge and technology to improve their yields and incomes. Although farmers seem to be generally aware of available solutions with regards to modern horticultural practices, they are reluctant to use such solutions due to their lack of knowledge on how to use such technologies as well as the perceived high cost of such technologies. Thus change management practices including agricultural extension work to educate farmers and smallholder companies are severely lacking in the country. A positive trend



is the increasing availability of agriculture apps both as online marketing and technology platforms. Increasingly, the use of agri tech solutions using digital technologies are promoted by government agencies as well as several local IT companies.

Access to markets for horticultural products is another major challenge faced by growers and processors in the horticulture sector. 70.5% of the survey responses received from the agri business sector and startup companies shows that there is a huge gap between market demand locally and globally and the supply of horticultural products available in Sri Lanka. Thus it is clear that the absence of market driven value chains for commercial horticultural crops is a serious constraint to development of the sector.

The poor state of post-harvest technologies including cold chain management and warehousing also affects the development of the horticultural sector.

## **2.5 Recent Government Policies and Regulations Implemented in the Agriculture Sector**

- The standard corporate income tax rate for companies in Sri Lanka is 24%. However, a lower rate of 14% is applicable to those engaged in agro processing while income tax is exempted (0%) for those in agro farming.
- Value Added Tax (VAT) on import of agricultural tractors, agricultural machinery, agricultural seeds, agricultural plants have been exempted
- Sri Lanka has signed the Bilateral Investment Promotion and Protection Treaty and the Double Taxation Avoidance Treaty with Netherlands
- Based on the “Imports and Exports (Control) Regulations No.10 of 2021” temporary suspensions have been placed on the import of agricultural products (most vegetables and fruits)

## 2.6 Financing Schemes Available

- The World Bank Agriculture Sector Modernization Project has committed USD 125 million with the objective of increasing agriculture productivity, improving market access, and enhancing value addition of smallholder farmers and agribusinesses in the Sri Lanka. Recently a new agreement was signed between the European Union (EU) and the World Bank for a grant of EUR 25 million to support the modernization project
- In 2021 the EU provided a grant of EUR 10 million to help improve food safety, quality and promote organic agriculture. The components are to be implemented by Food and Agriculture Organization (FAO) and United Nations Industrial Development Organization (UNIDO) with implementing partner GIZ (Germany) to support the local organic market
- The International Fund for Agricultural Development (IFAD) commenced the Smallholder Agribusiness Partnership Program in 2017 and is set to end in 2023 with a total cost of USD 104 million where IFAD and other stakeholders have committed to finance the project. (being renegotiated for extension)
- In addition, other agencies such as USAID and the Market Development Facility supported the Australian government (MDF) also support the agriculture sector with grant funding and other interventions.
- Concessionary funding schemes are available from local banking partners

### 3.0 Potential Areas for Intervention and Recommendations

Based on the study conducted with information obtained from key players in the Sri Lankan horticultural sector the following observations were made on the areas of how the Dutch companies could involve with the Sri Lankan horticulture sector in the long run. These recommendations are prioritized based on potential business engagements for the Dutch companies with the Sri Lankan horticulture sector.

#### 3.1 Provision of seeds and planting materials

The Sri Lankan horticultural sector has traditionally depended on Open Pollinated (OP) varieties of seeds for the main fruit and vegetable crops cultivated in the country. However, the need and potential for improving yields based on the success with the main agricultural crop of rice was recognized by the government and other stakeholders from the 1970s onwards. Thus, hybrid varieties, particularly for vegetables began to be introduced initially by work done by the Department of Agriculture supported also by imports of selected hybrid varieties. The imports were done through local seed marketing companies who sourced, identified hybrid seed varieties mainly from Europe with Dutch companies providing the lead. At present there are a few Dutch seed companies who have established themselves in Sri Lanka. In addition, Indian and Japanese seed companies are also now present in the market. Based on farmer responses and views expressed by the seed importing companies, the use of hybrid seeds is expected to increase. The following table showcases the contribution of hybrid seeds to the local vegetable market (Source: Seed and Planting Materials Association of Sri Lanka)

Crop	Hybrid Seed Share	Crop	Hybrid Seed Share
Beet	25%	Ridgegourd	100%
Carrot	40%	Bittergourd	100%
Cabbage	100%	Cucumber	100%
Leek	0%	Butternut	0%
Kohlrabi	20%	Radish – long	0%
Radish – round	0%	Okra	100%
Lettuce	0%	Eggplant – long	100%
Cauliflower	100%	Eggplant – round	100%

Capsicum	40%	Snakegourd	0%
Tomato	100%	Beans	0%
Green Chillie	100%	Long bean	0%
Pumpkin	100%	Wing bean	0%

Hence a strong business case exists for aggressive marketing of hybrid vegetable seeds, providing improved yields and qualities for crops already using hybrid seeds. For those crops where hybrid seeds are not used or fully used Dutch companies have excellent opportunities to penetrate the market.

A key challenge however is to seek improvement to the statutory processes for approval for such hybrid varieties. Currently approval for any variety is only granted after two seasons of trials conducted by the Department of Agriculture and submission of documents including ISTA certificates. Key crops such as tomato, beans, cabbage, carrots, chillies, radish, brinjals among the vegetables and watermelon, papaya, pineapple, avocado, orange and lime among the fruits offer the highest potential in view of local demand and the need for improving yields and reducing cost of production. In addition to the above, seeds for lettuce varieties also are increasing in importance based in the cultivation extents in greenhouses. While seeds and planting materials of these varieties may not have breeding focus in tropical countries, the emergence of collaborating breeding work in countries such as India, Thailand and Vietnam offer interesting opportunities. Indian seed companies in partnership with European counterparts have developed well adapted varieties suitable for tropical countries. Good examples are specialty seeds such as cucumber, bell pepper, chillies which have been introduced to Sri Lanka via Indian partners of European seed companies. Hence, Dutch companies who already possess such adapted hybrid seeds or have such products in the pipeline have a strong case for introducing such varieties to Sri Lanka.

The success of a market entry strategy for hybrid seeds would be very dependent on market development work done collaboratively with local seed company representatives, farmers and agricultural extension workers.

## 3.2 Promoting non-chemical plant nutrition and crop protection products

Sri Lanka is taking a bold step to completely ban all chemical fertilizers and crop protection products whether for use in conventional agriculture or modern agriculture such as in greenhouses etc. As a result, huge opportunities present themselves for organic fertilizers and plant protection products. The Department of Agriculture has over the last two decades conducted research on the use of such organic products with varying results. However general conclusion is the balanced use of organic and inorganic products offer the best results given local conditions. Also some interest has been shown for use of botanicals and soil/plant pathogen based products but these are at an early stage. Hence, the scope exists for Dutch companies to trial such non-chemical products if these are available in their portfolio (those that have been developed and tested in tropical markets) or to conduct research on use of such organic products.

In addition to pests and diseases, weeds have posed a big threat for crop cultivation in Sri Lanka. Approximately 940 kilolitres and 140 tons of herbicide were imported by Sri Lanka in 2019 (DOA). Recent need for solutions is the emergence of invasive weed species (Eg: *Kalanduru Cyperus Rotundas* etc.) for which no effective solution has yet been found.

## 3.3 Introducing Post Harvest Technology

The post-harvest fruit crops losses in Sri Lanka are estimated at around 30% to 40%. It was reported by the Committee on Public Accounts (COPA) that 270,000 metric tons of fruits and vegetables are wasted annually emphasizing the importance of preserving fruit employing agro-cold chain warehousing, canning and dehydration. Presently there are no major cold chain systems being operated on a commercial scale in the country for the use of farmers which has led to significant post-harvest losses. There is a need to maintain forward and backward collaboration with stakeholders and nucleus farms-contract farming modules in order to stimulate fruit production.

Furthermore, vegetable prices have increased due to seasonal price patterns, crop damages and insufficiencies in supply. Therefore, price vulnerabilities and supply issues will necessitate the needs of increasing the cold storage facilities, improve supply chain management, absorb current best practices and techniques such as crop cultivation, enhance post-harvest processes with the intent of leveraging efficiency in the vegetable industry.

Apart from common user cold storage facilities for farmers, opportunities exist for provision of cold rooms and cold chains for marketeers and processors of horticultural crops such as tomato, pumpkin, watermelon, brinjals, cabbage, bean, carrots and leeks. Key challenges in introducing post-harvest technology products would be the capital costs, financing instruments and cost-benefit analysis. Sri Lanka has seven major supermarket chains and growers and exporters handling fresh fruit and vegetable products and these are serviced through supply chain linked to growers, collecting centers and logistics intermediaries. Scope exists for improving the cold chain across these businesses.

### **3.4 Development of Private Sector led Centers of Excellences**

Centers of Excellences should be developed spearheaded by joint private and public sector stakeholders with the involvement of Dutch counterparts who would be able to provide technical expertise to conduct research into new technologies to be used in the Sri Lankan horticultural industry at a wide scale. The Dutch partners would be able to lend their expertise to these Centers of Excellences to conduct much needed research and provision of appropriate technologies. Key technologies required are in the areas of seed and planting materials, nutrition management, growing systems, drip irrigation and water management, agro-cold chain warehousing, canning and dehydration and temperature controlled storage and warehousing. Centers of Excellence could also provide packaging and transport solutions. Dutch companies can showcase and present the various products and services they are able to offer for the local players with the objective of creating long lasting sustainable partnerships. The entry of Dutch seed companies, fertilizer companies, agri education service providers and modern equipment and technology providers would be greatly facilitated by the joint establishment of such Centers of Excellence.

Sri Lankan private sector companies have strong interest in developing market driven agricultural value chains and with the involvement of the local chambers of commerce and industry associations together with relevant government agencies, Dutch companies would find involvement in such centers of excellence as excellent entry points into the Sri Lankan horticulture sector. India provides an excellent example of how such centers of excellence have provided successful and sustainable entry of European horticulture companies. These are easily replicable in Sri Lanka. Two current initiatives by the World Bank and the European Union (Agriculture Sector Modernization Projects) are investing in such projects.

### **3.5 Private sector agricultural innovation centers**

The opportunity is present for interested Dutch companies who are targeting different elements in the value chain to come together and form the concept of an innovation hub. The innovation centers can be designed as public private partnerships with Dutch and Sri Lankan business chambers providing the required leadership. Key players in the Sri Lanka horticulture sector (largely comprising the private sector and small, medium enterprise sector) require training in agricultural innovation processes. Stakeholders can be brought into these innovation hubs as well, tying it up to the agri modernization project partly funded by the European Union. These innovation hubs will also provide the opportunity for the Dutch companies to present about the agricultural extension services and explain to the local players about the advantages of the technologies they are offering to the markets. Through these practices, the opportunities would arise to overcome the barrier of lack of usage knowledge of the modern horticultural solutions that are present in the market of which the smallholder farmers are generally aware of but lack in terms of practical application and ability to conduct cost-benefit analyses.

### **3.6 Nucleus farms/contract farming models and required technologies**

The promotion of nucleus farms in a nucleus farm-contract farm model led by the private sector and supported by Dutch technologies is strongly recommended. Such nucleus farms would serve as the center of market driven agricultural value chains. The Chambers of Commerce in Sri Lanka and the Dutch Partnership in Business program (PIB) are recommended to be the drivers of this concept. Various local private sector companies have already set up model nucleus farms while several emerging investors in the Mahaweli areas are in the process of setting up nucleus farms for crops such as mango, papaya, ginger, turmeric etc. Such existing and planned initiatives in nucleus farms by Sri Lankan companies are very receptive to investment by Dutch investors as evinced by respondents to the survey of companies.

### **3.7 Agricultural extension services/training via IT platforms**

Long distance training of farmers is required, including the use of IT in agriculture and agri entrepreneurial training. Based on the survey done with farmers as well as horticultural companies there is a clear need for agricultural extension services. These are best provided via appropriate digital intervention including use of smart phones and within a framework of agri

enterprise resource planning (ERP) systems. There is also an emphasis on the need for the use of low cost and appropriate cold chain storages including solar based village level systems. In order to disseminate the required knowledge, training and village level systems, cohorts of farmer groups would need to be formed who would be able to receive the benefits as a single collective organization thus ensuring the effectiveness of the activities carried out.

In terms of technological knowhow, use of IT in farming activities and agri-entrepreneurship, the knowledge advancement of Sri Lankan farmers is quite low. The drawback and disadvantage faced by Sri Lankan farmers due to this lack of knowledge is clear in the fact that when compared to India and emerging agri economies such as Bangladesh, when cultivating horticultural crops (Eg: brinjals and ladies fingers), Sri Lanka is lagging behind in terms of yield (on average around 20-30% lower) of which the reasons can be traced back to factors such as poor cultivation material, insufficient modern agricultural practices, use of modern technologies and size of the farm holdings.

### **3.8 Formal horticultural training**

Based on the survey findings the need is present to develop change agents/agents of transformation where farmers, agripreneurs and horticulturists need to be provided training in all aspects of agriculture/horticulture. Some Dutch institutions are ideally suited to provide such training. Furthermore, Dutch experts also have the opportunity to disseminate expert knowledge by conducting programs to students of vocational training schools and final year agriculture graduates of state universities who have well established agriculture departments that work closely with public and private sector companies.

Majority of education courses relating to agriculture is provided by the public sector through state universities. The Faculty of Agriculture and Plantation Management at the Wayamba University offers undergraduate and postgraduate courses on bio systems technology and plantation management. Other state universities such as the University of Peradeniya, University of Ruhuna, Eastern University, Rajarata University also provide undergraduate and postgraduate programs on agri business/agri resource management and technology, green technology, food science and technology, plant biology conservation and breeding, agricultural economics, crop production.

Increasingly, based on responses from organized growers, interesting gaps exist for provision of agri technology information and for collaborative research and development assignments. With



renewed interest for investment in horticulture, current and potential investors require agri technology to build their businesses to commercially viable levels. Hence, Dutch institutions with a strong focus on modern agricultural education via assignments/consultancies or short courses have the potential to collaborate with local horticulture companies.

### **3.9 Supporting development of selected import substitution horticultural crops**

The government of Sri Lanka is presently encouraging the cultivation of “16 soubhagya crops” – mostly import substitution crops such as maize, chillie, green gram, cowpea, black gram, soya bean, big onion, red onion, gingelly, potato, groundnut, finger millet, horse gram, turmeric, ginger and garlic where government has already banned imports of turmeric and ginger and in the future the rest of the 14 identified crops will be restricted or banned. Based on the survey results farmers, growers and horticultural crop processors see a strong need for agronomical and technological support for the commercial development of these crops. Thus we see an opportunity for Dutch companies to provide the required technologies and seeds/planting material through local agents to the Sri Lankan markets. Opportunities also exist for Dutch companies to partner or collaborate with local horticulture companies in jointly developing the required high quality seeds/planting materials and other inputs.

### **3.10 Providing support for developing “non-traditional crops” and super foods that are trending in the local and global markets**

Sri Lanka has the potential to grow a wide range of crops due to its bio-diversity and many stakeholders have been experimenting on different crops. Based on the survey and discussion held with agripreneurs it is clear that the opportunities for the growing of non-traditional crops such as moringa, jack fruit, pumpkin, aloe vera, curry leaves, pandan leaves, rambutan, baby corn, asparagus etc. is existent. However, these stakeholders have been finding it difficult to develop the required growing systems and to generate the optimum yields/qualities because of a combination of factors such as the land size, lack of technology (water management and nutrition management systems) and inaccessibility to markets. The agripreneurs have also assessed these crops to provide economic returns. Thus the opportunity exists for Dutch companies to provide their expertise to overcome these barriers which can lead to immediate export of the surpluses to Europe, middle east and Asian countries at competitive prices. These

crops also have a high potential for value addition which would lead to developing sustainable market driven horticultural value chains.

### **3.11 Supporting the development of protected agriculture and related inputs**

There are a number of Sri Lankan companies who are carrying out greenhouse projects and there is a need for these companies to obtain high quality hybrid seeds and also knowledge on technologies relating to using crop specific delivery of fertilizers to the root system of the plants either through drip irrigation/ aeroponic and hydroponic systems. However as highlighted by the survey responses from the agri-tech startups and horticulture companies there is a major need and interest to promote semi-automatic and fully automatic greenhouse cultivation. The recommendations mentioned in 3.4 and 3.5 could be the way to achieve this. In the area of protected agriculture as well as net house cultivations, the use of products and technologies relating to spacing, trellising, staking and fencing etc. which may be available with Dutch companies could be marketed to Sri Lankan horticultural projects by highlighting yield improvements and economic advantages.

Sri Lankan startups and companies have expressed clear need to obtain technological advancements, relevant high quality seeds and growing techniques for their greenhouses and protected agriculture systems (indoor plant factories etc.) while there seems to be interest from the Dutch institutions as well to develop and provide required knowledge on the advancement of hybrid greenhouse models and manage cultivation in protected structures. Thus there is a clear business to business possibility present for the Dutch to engage with Sri Lankan parties in this space.

### **3.12 Promoting biological pest control products and systems**

Along with the need present in greenhouse cultivation, the survey findings received from the local horticultural companies and Dutch companies reveal that the opportunities exist for biological pest control through use of beneficial insects, botanical extracts, microbial-based products, bio-stimulants, natural nutrition products and pest monitoring systems that are ideally suited to be implemented in closed and controlled cultivation environments.

### **3.13 Opportunity for collaborative plant breeding for selected varieties of tropical crops**

Opportunities exist for Dutch seed companies/plant breeders to collaborate with Sri Lankan counterparts (in partnership with relevant government agencies) to produce selected varieties of high yielding tropical crops such as brinjals, okra, beans, tomatoes, bitter melon, luffa and snake melon etc. Sri Lankan farmers mostly grow OP varieties but 68.4% of farmers have expressed the desire to cultivate higher yielding varieties of such crops which would give them higher incomes.

Though long delayed Sri Lanka has set in motion the process for being a signatory to the UPOV convention. However, in addition Sri Lanka is setting up domestic legislation for protection of breeders and farmers' rights. This may take some time to realize.

### **3.14 Targeting groups of farmer collective associations to provide required technology**

Fragmented nature of the land and relatively small farm size offers the opportunity for use of appropriate technology through consolidation of land. In providing various technologies relating to modern cultivation and post-harvest solutions such as cold chain storage it would make business sense to provide these solutions to identified farmer collective organizations who are connected with the private sector.

### **3.15 Opportunities for soil management services**

Opportunities exist in using satellite, drone, sensor driven technologies identifying specific geographical and targeted farms, farmer landholdings for soil management via appropriate nutrition and other remediation measures. Since Sri Lanka is now in the early stages of using drone based technologies for mapping crop cultivation, fertilization and pest management, products and solutions for soil analysis and other diagnostic needs, provision of such products and services by Dutch companies offer interesting opportunities. With the recent focus on organic cultivation and the ban on chemical fertilizers and crop protection agents, attention has been drawn to the need for remediation of soils in different parts of Sri Lanka. Sri Lanka can

benefit from Dutch technology and knowledge on soil remediation. For example, companies in the tea plantation sector have shown interest in soil remediation in the tea plantations and Dutch companies may have opportunities of providing products and consultancies. Tea plantations amongst the larger tea farmers and tea small holders (accounting to 70% of total tea plantations) require soil remediation and yield improvement solutions consequent to the ban on chemical fertilizer and crop protection products.

### **3.16 Promoting cultivation of roses and floriculture**

Sri Lankan floriculture and foliage companies highlight the high demand for floral crops such as roses, anthurium, chrysanthemums, petunia, orchids, gerbera and foliage plants. Currently most productions are done via home gardening systems and potential exists in upscaling these into commercial cultivation systems. Sri Lankan companies have expressed the desire to look at joint JV partnerships with Dutch companies, especially to explore the possibility of exporting floricultural products such as chrysanthemums and lilies to the Netherlands. There has also been interest from certain companies to obtain planting material and technical knowhow to produce large scale rose farms in the country. These were views expressed by local horticulture companies in the survey.

## 4.0 Conclusion

The recommendations and points highlighted in this report are based on the information and feedback received from key players in the horticulture industry in Sri Lanka ranging from the requirements of the micro level farmers to the small and medium enterprises to the agri-tech startups and the high end agricultural companies of the country. Input was also obtained from selected Dutch companies involved in the horticulture space. It should be noted that for the long term development and improvement of the sector, attention should be given on women empowerment as well which is evident in the fact that 66% of the workforce participants identified through the study are women held households.

The points highlighted by the majority of the respondents of the survey stress on the factors of the improvement of technology and technical knowhow of farmers with the ultimate goal of leading to a long term improvement in yields of the horticultural crops in the country with preference to the introduction of new varieties which are also encouraged but face severe regulatory hurdles.

The recommendations mentioned are of practical value that can be implemented in an actionable manner in partnership with local horticultural sector players for the benefit of the industry. The very nature of the recommendations implies different timelines for their effective implementation.

Specifically, it is possible to prioritize the following areas for immediate entry or expansion by Dutch horticulture companies.

- 1) Seeds and planting materials specifically selected hybrid and high yielding varieties
- 2) Non – chemical liquid and solid plant nutrition products
- 3) Post harvest technologies that would help reduce approximately 40% of the post-harvest crop losses in Sri Lanka
- 4) Greenhouse systems and protected agriculture inputs
- 5) Biological pest control products and systems
- 6) Provision of agri education and extension services
- 7) Provision of soil management services

In addition to the above the entry or growth strategies for Dutch companies to the Sri Lankan horticulture market could be via,

- 1) Agency representation
- 2) Direct investment in marketing
- 3) Licensing/ franchising
- 4) Value chain partnerships
- 5) Joint ventures
- 6) Foreign direct investment
- 7) Investment in stock market in listed agri/horticulture companies

The method of market entry would be based on a careful evaluation of the market potential and economic returns based on the products and services offered by the Dutch companies.

Furthermore, streamlining of the bureaucratic processes mentioned in the report have to be addressed as voiced by the survey respondents. The respondents have stressed on that factor that unless these development issues are addressed the individual players in the agri private sector in Sri Lanka will not be able to effectively engage with Dutch businesses. Hence, the case for consideration of promoting centers of excellence showcasing Dutch products, agri innovation centers and the development of nucleus farms/contract farming models. This report also highlights the need for intervention and support for Sri Lankan horticultural processors and marketers of value added products where partnerships with Dutch horticulture processors would result in win-win outcomes for all.

We are of the strong opinion if the recommendations mentioned are implemented, the horticultural sector in Sri Lanka can be developed in a responsible and sustainable manner for the benefit of all stakeholders including participating Dutch horticultural companies.

## 5.0 Annexure - Survey Methodology and Results

### Objectives and conceptual framework of the survey

The objective of the survey was to find out what are the potential areas Dutch private sector to collaborate with Sri Lankan horticultural sector. Design of the research is deductive, where the concept and hypothesis are built based on the possibilities of the Dutch private sector can engage with the Sri Lankan horticulture industry. Accordingly, the independent variables were conceptualized based on the TOR.

Five factors namely farming inputs, agricultural supply chain, solution for product quality improvement, consultation and market promotion and knowledge and technical know-how were expected to influence the international trade and marketing opportunities in the horticulture sector in Sri Lanka.

Accordingly, the following hypotheses were developed using the conceptual framework. Based on the core objective of the survey and the hypotheses, the most influential factors that contribute towards the potential areas Dutch private sector to collaborate with Sri Lankan horticultural sector.

“H 1 a” is considered as the Alternative hypothesis and “H 1 0” is the Null hypothesis.

Alternative hypothesis is given below;

H 1 - Farming inputs impact and influence International trade and marketing opportunities in the horticulture sector in Sri Lanka.

H 2 - Agricultural supply chain impacts and influences International trade and marketing opportunities in the horticulture sector in Sri Lanka.

H 3 - Solutions for product quality improvement impacts and influences International trade and marketing opportunities in the horticulture sector in Sri Lanka.

H 4 - Consultation and market promotion impacts and influences International trade and marketing opportunities in the horticulture sector in Sri Lanka.

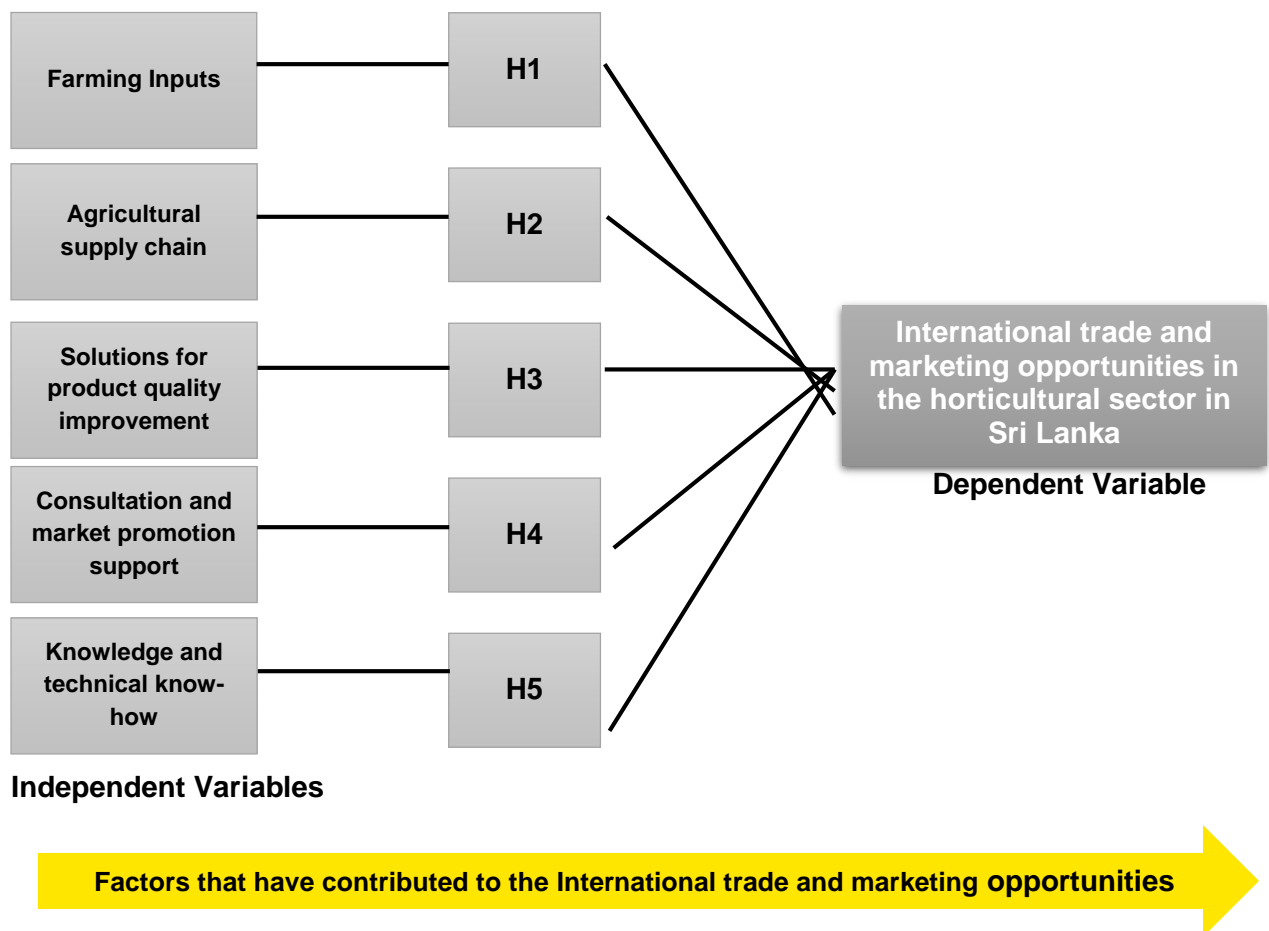
H 5 - Knowledge and technical know-how impacts and influences International trade and marketing opportunities in the horticulture sector in Sri Lanka.

A bivariate analysis was used to determine the relationship between the independent and dependent variables, and the p value of the test was used in hypothesis testing to assist in supporting or rejecting the null hypothesis. The p value is the evidence against a null hypothesis. The smaller the p-value, the stronger the evidence that the null hypothesis should

be rejected. The below are indicators that are used to determine the significance of the relationship of the dependent and independent variables (and leads to the rejection of the null hypothesis)

- If  $p > .10$  “not significant”,
- If  $p \leq .10$  “marginally significant”
- If  $p \leq .05$  “significant”
- If  $p \leq .01$  “highly significant.”

**Figure 1 – Conceptual Framework for the survey**





## Sampling Design

### Population

The population is defined as the members and farmer groups of Sri Lanka Agripreneurs' Forum, Sri Lanka Fruits and Vegetables Exporters' Association, Horticulture producers from databases of the Department of Agriculture and Farmer Organizations, Regional Offices of the Ministry of Mahaweli Development, Department of Export Agriculture and Horticulture products exporters from the Sri Lanka Export Development Board, the farmers and representatives who directly contribute for the horticulture sector.

### Sample Size

Size of the sample is derived as per the sampling table of Krejcie & Morgan (Year 1970), based on 95% confidence level and 5% confidence interval.

### Sampling Technique and Data collection

The sample was selected through probability sampling, in which the Stratified Sampling technique was used in the study where the population is divided into subsections (groups) based on the obtained population. The stratified sampling technique minimizes the sample section biasness and nullifies sampling error since it is a probability sampling technique.

**Table 1 – Strata based sample**

<b>Horticulture Industry of Sri Lanka</b>	<b>Members (companies) and Farmer groups</b>	<b>Population (N) =</b>
		<b>160,893</b>
	Sri Lanka Agripreneurs' Forum	N= 260
	Fruits and Vegetables Exporters'	N= 43
	Horticulture producers from databases of the Department of Agriculture and Farmer Organizations	N= 40,000
	Regional Offices of the Ministry of Mahaweli Development.	N= 120,000
	Department of Export Agriculture	N= 380
	Horticulture products exporters from the Sri Lanka Export Development Board.	N= 210
	<b>Total Sample = 383</b>	

This quantitative research study uses both primary and secondary data for the analysis. Primary data is collected by means of a structured questionnaire covering international trade and marketing opportunities in the horticultural sector in Sri Lanka. Furthermore, data used to denote the trends and opportunities in the horticulture industry were assessed through conducting verbal interviews with respective parties.

Curated interviews were carried out with 3 representatives each from the following target groups;

- I. Large scale corporates involved in horticulture production drawn from the databases of the Sri Lanka Agripreneurs' Forum and Sri Lanka Fruits and Vegetables Exporters' Association.
- II. Officials from the Department of Agriculture
- III. Importers and providers of inputs such as machinery, equipment, planting materials and seeds etc.
- IV. Selected farmer organizations
- V. Providers of nutrition products such as fertilizers
- VI. Providers of technology for horticulture products such as irrigation systems, greenhouses etc.
- VII. Providers of agriculture extension services
- VIII. Representatives from the Sri Lanka Food Processors' Association
- IX. Agri startups

Furthermore, structured questionnaires were also provided to certain selected Dutch companies and institutions (Hollandoor, Rijk Zwaan, East West Seed, Oxfam, Koppert, Solidaridad) in order to obtain input on the various areas in which they would like to engage with the Sri Lanka horticulture sector.

### **Structure of the Questionnaire**

The structure of the questionnaire comprises of three subsections.

The first subsection assesses the demographic information of the respondents which covers the respondents age, gender and experience. The second subsection is designed to understand the current status of the farmers and companies while the third subsection consist of five point Likert scale which was used as a nominal scale to ascertain responses.

## Method of Data Analysis

The "P-value" (sig value) test was used to determine if the relationship exists. If the relationship exists, the "R-value" test was used to determine the strength of the relationship. Data processing and analysis was conducted with the assistance of the Statistical Package for the Social Sciences (SPSS).

## Data Presentation and Analysis

### Survey Response

383 questionnaires were distributed among the companies and farmer groups of the horticulture sector and 74.21% were completely answered to the given questionnaire.

**Table 2 – Survey Response**

<b>Distributed</b>	<b>Responded</b>	<b>Effective</b>	<b>Effective Response rate</b>
<b>383</b>	<b>310</b>	<b>285</b>	<b>74.21%</b>

### Reliability Measurement of the data collection instrument

Internal consistency was measured using Cronbach alpha value for each variable. Reliability testing was conducted to verify, whether the questionnaire was reliable for further analysis. A Cronbach alpha value within 0.8 and 0.9 for a construct is termed as 'good' whilst an alpha value above 0.9 is termed 'excellent'. The Cronbach's Alpha value for the developed total questionnaire was 0.862, and hence the questionnaire was considered reliable for further analysis.

**Table 3 – Reliability Statistics**

<b>Variable</b>	<b>Actual test Cronbach's Alpha</b>	<b>Strength of Association</b>	<b>No of Items</b>
Farming Inputs	.896	Good	4
Agricultural supply chain	.894	Good	4
Solutions for product quality improvement	.869	Good	4
Consultation and market promotion	.894	Good	3
Knowledge and technical know-how	.902	Excellent	3
International trade and marketing opportunities in the horticultural sector in Sri Lanka	.872	Good	3
<b>Total</b>	<b>.866</b>	<b>Good</b>	<b>21</b>

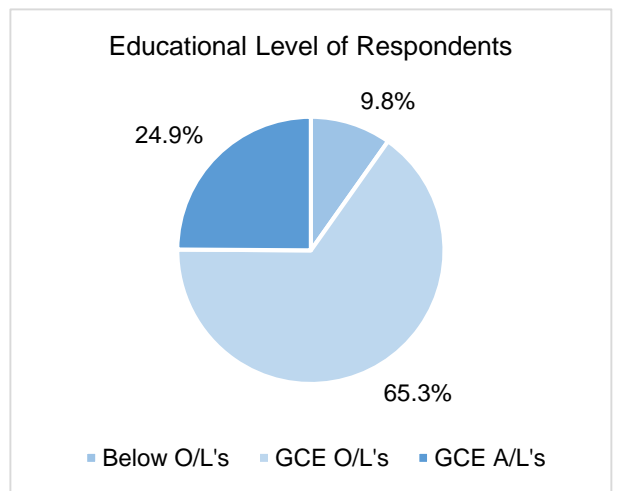
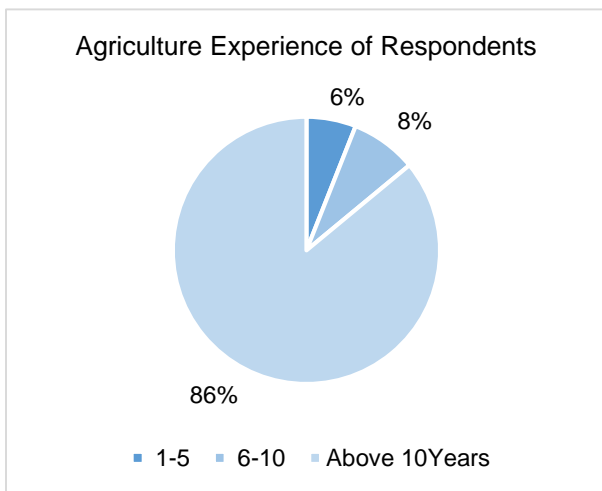
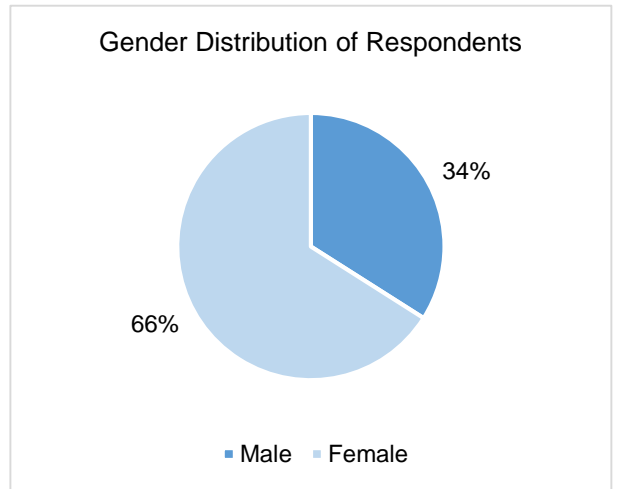
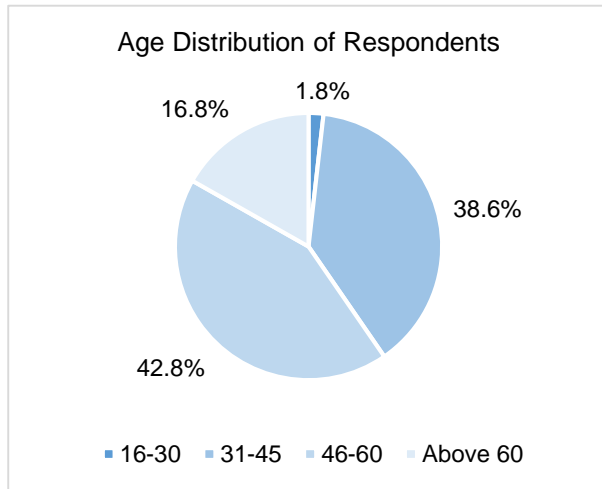
### **Sample Representation**

#### Farmer groups

66% of the respondents were females, while males' respondents were 34%. The majority of the farmers and members who responded belonged to the age group of 46-60 years, which is 42.8% and 38.6% represented the age group of 31-45 years. A significant majority of 86% that responded to the questionnaire having to above 10 years of agricultural experience, while other farmers who were having less than 10 years of agricultural experience collectively contributed only 14%.

Most of the customers that were randomly selected had passed the G.C.E. O/L examination (Ordinary Level exam) and G.C.E. A/L examination (Advance level exam). This represented 90.2% of the total sample. The educational level of 9.8% of the respondents were below O/L's.

**Figure 2 – Characteristics of the sample respondents**



## Bivariate analysis of the variables

A bivariate analysis was required to assess whether there was impact to the dependent variable (International trade and marketing opportunities in the horticulture sector in Sri Lanka) from each individual independent variable considered for the study.

Pearson Product Moment Correlation Coefficient (r) was used to test hypothesis which consequently provides conclusive evidence on the nature of the relationship. The two tailed method was used to assess the correlation since the alternative hypothesis was non-directional. This test checks whether there is a relationship between independent and dependent variable. The p value of the test is used in hypothesis testing to assist in supporting or rejecting the null hypothesis.

### Testing the Relationship between Farming inputs and International trade and marketing opportunities in the horticulture sector in Sri Lanka.

The hypothesis defined to test the impact of Farming inputs on International trade and marketing opportunities in the horticulture sector in Sri Lanka is given below.

*H 1 0 - Farming inputs does not have an impact on International trade and marketing opportunities in the horticulture sector in Sri Lanka.*

*H 1 a - Farming inputs have an impact on International trade and marketing opportunities in the horticulture sector in Sri Lanka.*

**Table 4 – Correlation between Farming Inputs and International trade and marketing opportunities**

<b>Correlations</b>			
		Farming Inputs	International trade and marketing opportunities
Farming Inputs	Pearson Correlation	1	.128*
	Sig. (2-tailed)		.031
	N	285	285
International trade and marketing opportunities	Pearson Correlation	.128*	1
	Sig. (2-tailed)	.031	
	N	285	285
*. Correlation is significant at the 0.05 level (2-tailed).			

According to table 4, the correlation test returned a p-value of 0.031 which is less than 0.05 ( $p < 0.05$ ). Hence, the alternative hypothesis can be proven (**H 1 a**). The Pearson correlation value is 0.128. Thus, it is statistically evident that there is a positive relationship between Farming Inputs and International trade and marketing opportunities in the horticulture sector in Sri Lanka.

**Testing the Relationship between Agricultural supply chain and International trade and marketing opportunities in the horticulture sector in Sri Lanka.**

The hypothesis defined to test the impact of Agricultural supply chain on International trade and marketing opportunities in the horticulture sector in Sri Lanka is given below.

**H 2 0** - *Agricultural supply chain does not have an impact on International trade and marketing opportunities in the horticulture sector in Sri Lanka.*

**H 2 a** - *Agricultural supply chain has an impact on International trade and marketing opportunities in the horticulture sector in Sri Lanka.*

**Table 5** – Correlation between Agricultural supply chain and International trade and marketing opportunities.

<b>Correlations</b>			
		Agricultural supply chain	International trade and marketing opportunities
Agricultural supply chain	Pearson Correlation	1	.188**
	Sig. (2-tailed)		.001
	N	285	285
International trade and marketing opportunities	Pearson Correlation	.188**	1
	Sig. (2-tailed)	.001	
	N	285	285
**. Correlation is significant at the 0.01 level (2-tailed).			

According to table 5, the correlation test returns a p-value of 0.001 which is less than 0.05 ( $p < 0.05$ ), and hence the alternative hypothesis can be proven (**H 2 a**). The Pearson correlation value is 0.188. Hence, it is statistically evident that there is a positive relationship between

Agricultural supply chain and International trade and marketing opportunities in the horticulture sector in Sri Lanka.

**Testing the Relationship between Solutions for product quality improvement and International trade and marketing opportunities in the horticulture sector in Sri Lanka.**

The hypothesis defined to test the impact of Solutions for product quality improvement on International trade and marketing opportunities in the horticulture sector in Sri Lanka is given below.

*H 3 0 - Solutions for product quality improvement does not have an impact on International trade and marketing opportunities in the horticulture sector in Sri Lanka.*

*H 3 a - Solutions for product quality improvement have an impact on International trade and marketing opportunities in the horticulture sector in Sri Lanka.*

**Table 6 – Correlation between Solutions for product quality improvement and International trade and marketing opportunities in the horticulture sector in Sri Lanka.**

<b>Correlations</b>			
		Solutions for product quality improvement	International trade and marketing opportunities
Solutions for product quality improvement	Pearson Correlation	1	.159**
	Sig. (2-tailed)		.007
	N	285	285
International trade and marketing opportunities	Pearson Correlation	.159**	1
	Sig. (2-tailed)	.007	
	N	285	285
**. Correlation is significant at the 0.01 level (2-tailed).			

According to table 6, the correlation test returns a p-value of 0.007 which is less than 0.05 ( $p < 0.05$ ), and hence the alternative hypothesis can be proven (**H 3 a**). The Pearson correlation value is 0.159. Hence, it is statistically evident that there is a positive relationship between Solutions for product quality improvement and International trade and marketing opportunities in the horticulture sector in Sri Lanka.



**Testing the Relationship between Consultation and market promotion and International trade and marketing opportunities in the horticulture sector in Sri Lanka.**

The hypothesis defined to test the impact of Consultation and market promotion on International trade and marketing opportunities in the horticulture sector in Sri Lanka is given below.

***H 4 0** - Consultation and market promotion does not have an International trade and marketing opportunities in the horticulture sector in Sri Lanka*

***H 4 a** - Consultation and market promotion have an International trade and marketing opportunities in the horticulture sector in Sri Lanka*

**Table 7 – Correlation between Consultation and market promotion and International trade and marketing opportunities in the horticulture sector in Sri Lanka.**

<b>Correlations</b>			
		Consultation and market promotion	International trade and marketing opportunities
Consultation and market promotion	Pearson Correlation	1	.221**
	Sig. (2-tailed)		.000
	N	285	285
International trade and marketing opportunities	Pearson Correlation	.221**	1
	Sig. (2-tailed)	.000	
	N	285	285
**. Correlation is significant at the 0.01 level (2-tailed).			

According to table 7, the correlation test returns a p-value of 0.000, which is less than 0.05 ( $p < 0.05$ ), and hence the alternative hypothesis can be proven (**H 4 a**). The Pearson correlation value is 0.221. Therefore, it is statistically evident that there is a positive relationship between the Consultation and market promotion and International trade and marketing opportunities in the horticulture sector in Sri Lanka.

**Testing the Relationship between Knowledge and technical know-how and International trade and marketing opportunities in the horticulture sector in Sri Lanka.**

The hypothesis defined to test the impact of Knowledge and technical know-how on International trade and marketing opportunities in the horticulture sector in Sri Lanka is given below.

*H 5 0 - Knowledge and technical know-how does not have an International trade and marketing opportunities in the horticulture sector in Sri Lanka*

*H 5 a - Knowledge and technical know-how have an International trade and marketing opportunities in the horticulture sector in Sri Lanka*

**Table 8 – Correlation between Knowledge and technical know-how and International trade and marketing opportunities in the horticulture sector in Sri Lanka.**

<b>Correlations</b>			
		Knowledge and technical know-how	International trade and marketing opportunities
Knowledge and technical know-how	Pearson Correlation	1	.275**
	Sig. (2-tailed)		.000
	N	285	285
International trade and marketing opportunities	Pearson Correlation	.275**	1
	Sig. (2-tailed)	.000	
	N	285	285
**. Correlation is significant at the 0.01 level (2-tailed).			

According to Table 7, the correlation test returns a p-value of 0.000 which is less than 0.01 ( $p < 0.01$ ) and hence the alternative hypothesis can be proven (**H 5 a**). The Pearson correlation value is 0.275. Hence, it is statistically evident that there is a positive relationship between the Knowledge and technical know-how and International trade and marketing opportunities in the horticulture sector in Sri Lanka.

## **Summary of data analysis**

Based on the data analysis performed, International trade and marketing opportunities in the horticulture sector in Sri Lanka appears to be significantly and positively correlated with the five variables considered for the survey. The highest correlation is witnessed from the knowledge and technical know-how, which is 0.275. The lowest correlation of 0.128 emanated from the farming inputs. Therefore, knowledge and technical know-how has contributed most towards International trade and marketing opportunities in the horticulture sector in Sri Lanka.

## **Research limitations**

Since the research focused on the International trade and marketing opportunities in the horticulture sector in Sri Lanka, and how it is impacted/influenced by the five other factors that are considerably qualitative, the information gathered through questionnaires may be ambiguous and may not always be 100% accurate. Further, the nature of feedback of the participants would depend on the respondents' mood and some might be reluctant to expose the real facts due to individual insecurities.

In addition, the study has been conducted among the selected farmer groups and members' associations while some of the individual horticultural farmers and informal groups were not taken during the study. These customers' representation of the total population can be seen as another limitation of this study.