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**ANALYSIS OF SUPPLY CHAIN MANAGEMENT OF
HORTICULTURAL NURSERIES**

By
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(2014-11-160)

THESIS

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requirement for the degree of*

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2016**

DECLARATION

I, Rajasree P. (2014-11-160) hereby declare that this thesis entitled **“Analysis of supply chain management of horticultural nurseries”** is a bonafide record of research done by me during the course of research and that the thesis has not previously formed the basis for the award of any degree, diploma, fellowship or other similar title, of any other University or Society.

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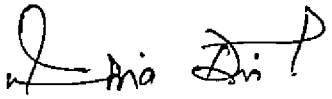
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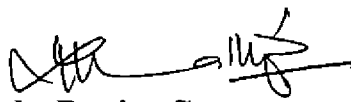
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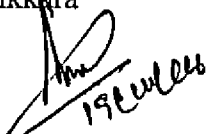
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RAJASREE P.

***With deepest gratitude and warmest
affection,***

Dedicated to

***My parents, brother and
grandmother...***

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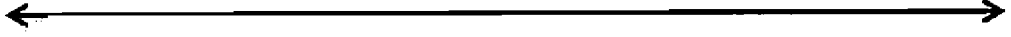
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Introduction



1. INTRODUCTION

Over the years, horticulture has emerged as one of the potential agricultural enterprise in accelerating the growth of economy. Its role in the country's nutritional security, poverty alleviation and employment generation programmes is becoming increasingly important. India with diverse soil and climate, comprising several agro-ecological regions provides ample opportunity to grow a variety of horticulture crops. Horticultural crop production adds a significant part to the total agricultural output of the nation. They have high export value and high yield per unit area and provide higher returns per unit area. The importance horticultural crops can be supported by the benefits like waste land utilization, provision of raw materials for many agro based enterprises and women empowerment through providing employment opportunities to both skilled and unskilled workers in the society. Cultivation of these crops is labour intensive and as such they generate lot of employment opportunities to the rural population. Apart from this, they play an important role in the nutritional security of a country as they are the main sources of vitamins and minerals. In recent years horticulture has surfaced as one of the most important agricultural enterprise with vast potential in expediting the growth of rural as well as urban economy of our country.

The scenario of horticultural crops in our country has become very encouraging. The percentage share of horticulture output in agriculture has become more than 30 per cent and horticulture sector contribute 20 per cent to the total agricultural labour force of our country. Fig.1 shows the area and production of horticultural crops in India over the years. Over the last decade, the area under horticulture grew by about 2.7 per cent per annum and annual production increased by 7 per cent. During 2013-14, the production of horticultural crops was about 277.4 million tonnes from an area of 24.2 million hectares. As per 2014-15 statistics, horticultural crops occupy an area of 23.41 million hectares and contributing to 281 million tonnes production in the country (GOI, 2016).

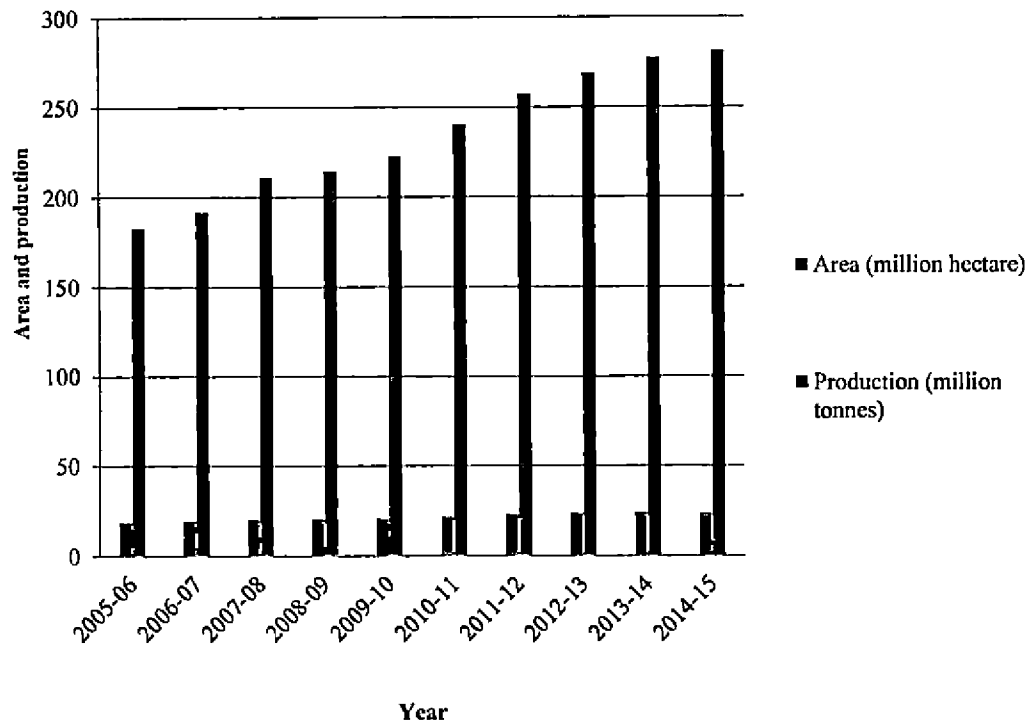


Fig.1. Area and production of horticultural crops in India

Horticulture sector has always been the thrust area of Kerala's agricultural scenario also. Kerala's predominance of commercial horticulture is of national importance in terms of valuable foreign exchange earned through exports and foreign exchange saved through import substitution. The state has virtual monopoly in pepper production (81 %), rubber (92 %), cardamom (74 %), and coconut (44 %), besides coffee (22 %), cashew (15 %) and tea (8 %). Kerala contributing 88 per cent of export earnings from pepper, 72 per cent from cardamom, 54 per cent from cashew kernels, 56 per cent from ginger and 21 per cent from turmeric (Sivagnanam, 2013). Table 1.1 furnishes the area and production statistics of major horticultural crops in Kerala for the year 2013-14.

Table 1.1. Area and production of major horticultural crops in Kerala (2013-14)

Crop	Area ('000 hectares)	Production ('000 mt)
Banana	62.26	531.29
Mango	77.15	457.06
Papaya	16.64	103.42
Pineapple	8.00	75.56
Arecanut	100.00	100.01
Cashew	49.10	33.37
Rubber	548.22	648.22
Cocoa	13.25	12.32
Coconut*	808.64	5921.00
Cardamom	39.73	12.91
Ginger	4.53	21.52
Turmeric	2.43	6.25
Pepper	84.06	29.41
Tea	35.01	63.48
Coffee	85.35	66.64

(NHB, 2014)

* Production of coconut in Million nuts

Success of any horticultural production programme mainly depends upon the quality of seeds and planting materials supplied for the production. Unavailability of adequate quantity of quality seeds and planting materials has been reported as one of the most important problems affecting the development of the horticulture sector in the country. With the increasing demand for quality seeds and planting materials, the importance of horticultural nurseries is also increasing. Horticultural nursery industry thus plays an important role in the rural economy of our country. The Planning Commission's Working Group on

Horticulture and Plantation Crops for 12th Five Year Plan (2011) has reported that even though there was an increasing trend in case of area of horticultural crops in the country, the system of production planning for quality seeds and planting materials for horticulture crops proportionate with crop and variety wise targets for area expansion has not been put in place. The growing significance of horticultural crops in the economy especially on trade and commerce has necessitated the need to have a well-designed and properly monitored system for production of quality planting materials.

In India Seeds Act and Nursery Registration Act are in operation since 1966. But according to the report of Working Group on Horticulture, Plantation Crops and Organic Farming for the 11th Five Year Plan (2007-12), the Nursery Registration Act is in operation in only eight states in the country. Punjab, Maharashtra, Himachal Pradesh, Uttar Pradesh, Uttarakhand, Jammu and Kashmir, Orissa and Tamil Nadu are those eight states having Nursery Registration Act in force. States like Andhra Pradesh, Assam, Bihar, Goa, Haryana, Karnataka, and Kerala is having a system of registering or monitoring with respect to horticultural nurseries and rest of the states do not have any legislation with respect to horticultural nurseries. At present in India, about 6330 registered horticultural nurseries are there under private and public sectors. Apart from this lot of unregistered horticultural nurseries are there. The state wise detail of registered horticultural nurseries in India is given in appendix II.

Horticultural nurseries play a prime role in wealth generation and socio economic status of the farmers. It provides employment opportunities for technical, skilled, semi-skilled and unskilled labour. Nursery itself can be a remunerative enterprise in the changing national scenario. Working Group on Horticulture, Plantation Crops and Organic Farming for the 11th Five Year Plan (2007-12) has reported that both private and public sector nurseries play an important role in the development of horticulture sector in the country. But the private sector nurseries in most of the states are not monitored and regulated properly. Most of the existing plant nurseries do not have modern infrastructural

facilities like greenhouses, mist chambers, nursery tools and machineries and most of these nurseries follow traditional methods and they often sell planting materials of unknown pedigree at very high prices. The report pointed out the requirement of a formal system of quality maintenance of planting materials supplied through horticultural nurseries.

The study entitled 'Analysis of supply chain management of horticultural nurseries' aims to analyse the supply chain management of horticultural nurseries in the state.

Specific objectives of the study

- To understand the supply chain management in horticultural nursery industry
- To study the income and employment potential of horticultural nursery business and
- To identify the constraints of horticultural nursery business

Scope of the study

Horticultural nursery industry is considered as a sunrise industry and recent years have witnessed mushrooming of plant nurseries all over the country. Plant nurseries play a crucial role in the development horticulture sector and also in employment generation. Monitoring of the production protocols, nursery management and evaluation of the activities of the nurseries have always received less attention from the government and policy makers. Research studies relating to the plant nursery management in India are very less in number. Detailed information about plant nursery management and business will be an asset for the researchers and policy makers for imparting improvements in plant nursery business. It would also be helpful to the prospective entrepreneurs to make investments in plant nursery business.

Limitations of the study

Most of the social science researches are based on the primary data collected from a sample of respondents. The respondents' unwillingness or inability to provide accurate and right answers for the questions posed is one of the major limitations of every social science research. Even though we are taking very much care to avoid the errors inherent in the social surveys, one cannot fully eliminate them. Moreover, as majority of the plant nursery owners does not have the nature of keeping the records of their daily nursery activities and sales and many of them are not willing to reveal details of nursery practices, volume of business etc., the level of accuracy of the observations is limited.

Presentation of the thesis

The thesis titled 'Analysis of supply chain management of horticultural nurseries' is presented under the following five headings. First chapter 'introduction' includes a brief note on the importance and current status of horticultural industry and horticultural nursery business in India, scope and objectives of the study and the limitations of the study. Similar works in the same and related areas of research are presented in the second chapter 'review of literature'. Third chapter is on 'materials and methods' which encompass the details of design of the study and various methods adopted for carrying out the research work and its analysis. The results of the study and its interpretations are described in the fourth chapter 'results and discussion'. The fifth chapter is 'summary' which encapsulates the striking findings and its implications in the whole study.

Review of literature



2. REVIEW OF LITERATURE

Literature review is an important part as far as any research work is considered. It provides a theoretical basis for the researcher and also helps in determining the nature of the research work. Thorough examination of the past studies in related research field will give a clear picture about each and every aspect of the research. It provides more insight into what we are going to do and what all are the progress in our field of study.

Even though plant nursery industry is considered as a sunrise industry in our country, which plays an important role in the development of sound horticulture sector, only less attention is seen given in monitoring its activities, quality control and also in evaluating its role in the economy. In this chapter, a critical examination of the existing research works done in the same and related fields of study is attempted.

The literature review on the research work is presented under the following headings.

2.1 Supply chain management

2.2 Horticultural nursery business

2.3 Income and employment potential of horticultural nursery business

2.4 Constraints in the horticultural nursery business

2.1 SUPPLY CHAIN MANAGEMENT (SCM)

2.1.1 Concept of supply chain

Christopher (1998) defined supply chain as the network of organizations that are involved in the various processes and activities, through upstream and downstream linkages, which create value in the form of products and services to the ultimate consumer. In other words, a supply chain includes different parties or

firms in both upstream *i.e.*, in supply side, downstream *i.e.*, in distribution and the final consumer.

A more holistic definition of supply chain was given by Mabert and Venkataramanan in 1998. They defined supply chain as “a chain of facilities and activities which carry out the functions of raw material procurement, flow of materials between the facilities, product development and distribution of products to the end users and the after-market support for sustainment.”

van der Vorst *et al.*, in 2007 opined that supply chain includes producer, suppliers, processors and also transporters, retailers and the ultimate consumers. So in a wider sense, supply chain consists of product development, marketing operations, finance, distribution and customer services.

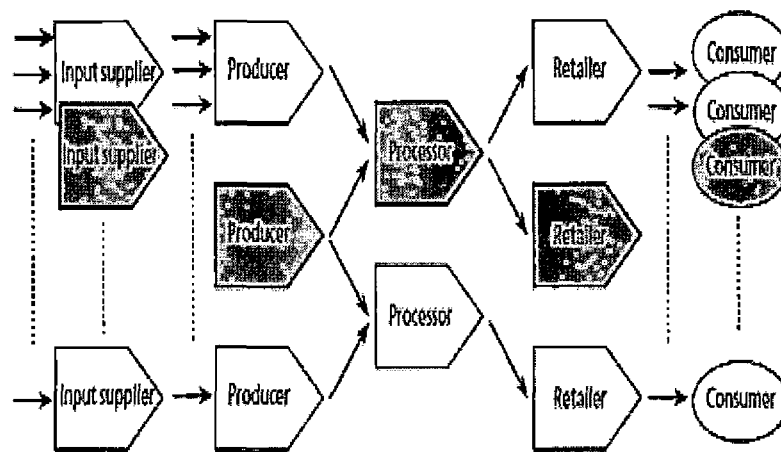


Fig.2. Generic supply chain

(van der Vorst *et al.*, 2007)

Fig.2 represents a generic supply chain. It is the total supply chain network and the shaded areas represent a supply chain within the total supply chain network. In a total supply chain network each firm belongs at least one supply chain, which means a supply chain network usually comprises of multiple suppliers and customers.

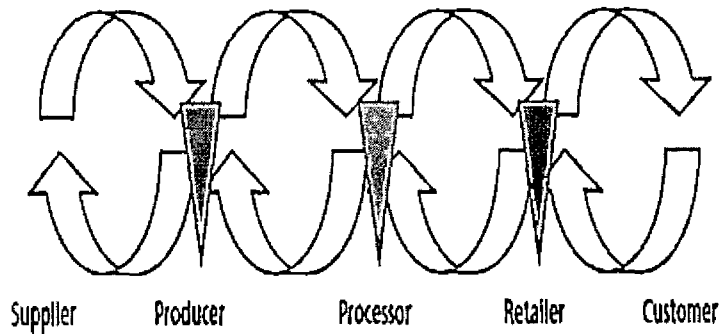


Fig.3. Cycle view of supply chain

(van der Vorst *et al.*, 2007)

Fig.3 shows the 'cycle view' of supply chain. It is a traditional view of supply chain. According to this traditional view, the processes in a supply chain are split up into a series of cycles, each performed at the interface between two consecutive stages. Each cycle is separated from other cycles via an inventory, so each of them can work separately, standardise their own functions and is not affected by 'problems' in other cycles (van der Vorst *et al.*, 2007).

Supply chains are information driven and integrated and it enables the organizations to reduce costs, adds value to the products, extend the resources and help to retain the customers. The success of the supply chain is measured in terms of how well it coordinates the activities across the chain to create value for the consumers, while increasing the profitability of every actor in the chain. The supply chains of agricultural commodities in India are filled with challenges due to various issues inherent within the agriculture sector of the country. The challenging issues include dominance of small and marginal farmers, fragmented supply chains, inadequate processing and lack of proper marketing infrastructure (Anonymous, 2010).

2.1.2 SCM in horticultural business

The concept of SCM dates back to 1980s. But its relevance has been apparent since the early 1990s only. Cooper and Ellram (1990) defined SCM as “an integrated philosophy to manage the total flow of a distribution channel from supplier to the ultimate customers”. Larson and Rogers (1998) defined supply chain management as integration of activities within and between the vertically linked enterprises with a view to provide complete satisfaction to the consumers.

Supply chain activities include procurement of raw materials, production, assembling, warehousing, distribution across the channels, delivery to the consumers etc. This means SCM is concerned with planning, implementing and controlling of efficient and effective sourcing of raw materials, production and delivery of product and related services from the spot of origin of materials until the final product reaches the hands of the ultimate consumer (Bowersox *et al.*, 1999).

According to Lummus and Vokurka (1999) supply chain management includes all those activities starting from the raw material procurement till the finished products reaches the hands of the ultimate consumers.

Chandrashekar and Murthy (2010) conducted a study on the management of fruits and vegetables supply chain and networks. The study mainly concentrated on HOPCOMS (Horticultural Producers’ Cooperative Marketing and Processing Ltd.) in Mysore. Member farmers of HOPCOMS, its procurement centre and retail centres, and consumers constitutes the supply chain. They suggested that timeliness and quality should be the main objectives of a good supply chain management system in order to give complete satisfaction to the consumers.

Jadhav *et al.* (2010) analysed the supply chain of raisins in Western Maharashtra. The study found out that there is ample scope for the raisins marketing in Maharashtra. They opined that creation of linkages among the

farmers and consumers, improvement of infrastructural facilities and creation of favourable government policies will further add to the marketing of raisins in both local and export markets.

In their study on value chains and retailing of fresh fruits and vegetables in Andhra Pradesh, Reddy *et al.* (2010) observed that the development of modern retail chains has created new food value chains in the state which in turn led to the curtailment of price and production risks and there by increased the returns of farmers.

Saha *et al.* (2010) conducted a study on the supply chain in vegetables crops in Ranchi, Jharkhand. Primary data were collected by survey method from 150 farmers from two blocks in Ranchi. They found out that the keeping quality and volume of output were the determining factors in the choice of the supply chain. Shorter supply chains were preferred in case of perishable commodities. The study revealed that small farmers used to sell their produce immediately after the harvest and they usually sold to large merchants whereas the marginal farmers usually sold directly to the consumers. The study concluded that the adoption of efficient supply chain would help the farmers to increase their income even without increasing their production.

Shinoj *et al.* (2010) carried out a study in Punjab to assess the Jatropha based biodiesel value chain. They stated that Jatropha based biodiesel industry would be a profitable venture only if operated at sufficient economies of scale, which in turn is determined by the level of forward and backward integration with biodiesel distribution channels and seed markets respectively. The biodiesel value chain in India was characterised by the lack of integration among the members of the chain. Other problems identified in the chain were less developed seed markets, lack of adequate processing infrastructure and ill-defined biodiesel distribution channels.

A study was conducted by Sidhu *et al.* (2010) to analyse the supply chain of onion and cauliflower in Punjab. They calculated the cost and returns from the

cultivation and also identified different supply chains and the margins associated with the chains. They concluded that studying the supply chain systems of crops like vegetables are very much important and needed for enhancing the marketing efficiency and for the betterment of producer and consumer surplus.

In his study titled 'Efficiency of value chain: a study of dairy farming in Haryana', Singh (2010) analysed the effect of value chains in the dairy sector in Haryana. The value chain is formed through milk union or cooperative societies. The research work has revealed that there is a significant difference between the technical efficiency of farmers who are the members of the value chain and those who are not engaged in the chain. The study has suggested the expansion of supply chain network of cooperative milk societies in the state for increasing the profitability of the dairy farmers.

2.2 HORTICULTURAL NURSERY BUSINESS

Banik and Haradan (1972) defined nurseries as a place where seedlings are raised and conserved until planting. Nurseries may be classified into various categories depending on various parameters such as: a) Durability (e.g. permanent nursery, temporary nursery); b) Media (e.g. poly bag nursery, bed nursery); c) Species; d) Economic consideration (homestead nursery, commercial nursery) and e) Use (e.g. fruit, flower timber and vegetable nursery). Nurseries have the common goal of producing planting materials for improving sites (Clamp, 1995). Based on type of ownership and ultimate goal of their establishment, nurseries are classified into private and public nurseries (Adebanjo *et al.*, 1996). The aim of any private nursery business is to make profit while public business enterprise has the motive of catering to the welfare of the society.

The places where seedlings are raised for planting purposes are known as nurseries and in the nursery, the young seedlings are looked after from sowing to develop in such a way as to be able to tolerate the hard field conditions (Mason, 2004).

Munjuga *et al.* (2013) defined nursery as a well-managed site which is designed to produce seedlings and grow them until they reach required maturity for final planting. Plant nurseries are playing an important role in many of the agricultural development programmes. Nurseries vary in their size, types of seedling produced, value of business, facilities, operations etc. Plant nurseries can be of informal small scale nurseries and large commercial nurseries.

In their study to identify the constraints faced by small scale tree nursery business in highlands of East Africa, Nieuwenhuis and O'Connor (2000) found out that the tree nurseries in the region plays an important role in the sustainable development of the local communities in the study area.

A research work titled “A study on tree seedling nursery of SDC and their socio-economic impact among the nursery owners of Joypurhat district” was conducted by Ahammed (2003) in Bangladesh. He reported that nursery business is one of the most important income based activities in Bangladesh and it has helped to reduce poverty in the country and raise the living standards of poor sections in the society.

Roy (2003) stated that nurseries are playing an important role in the field of plant conservation. He also stated that the increased demand for medicinal plants created by the popularity of herbal medicines has created a great opportunity to earn foreign exchange by exporting raw materials for herbal products.

A study was conducted by Fakayode *et al.* (2008) to understand the viability and resource use in ornamental plant nursery business in Nigeria. They stated that the production and use of ornamental plants or floriculture has significant potential for increasing food production and income in Nigeria. Like other agricultural crops, the production of flowering or ornamentals crops play crucial role in the developing economies. Vegetable and ornamental horticulture gardens have been regarded as an important source of income and employment in the country. The income that accrues from commercial ornamental plant

production through the sales of flowers and other ornamental plants was very significant and had contributed substantially to the nation's economy.

Forest nurseries play a vital role in the success of afforestation and reforestation programmes of the respective governments. They also support small scale plantations and tree farming by catering for the increasing demand of planting materials (Edralin and Mercado Jr, 2010).

Gregorio *et al.* in 2010 conducted a study on the seedling nursery business in Leyte Island in Philippines. They stated that nursery seedling production is the most common practice for raising planting stock and the use of plants produced from nursery is generally the most efficient and effective way of establishing a forestry plantation in the tropics.

Nursery business is very much exigent with respect to money, care and attention. At the same time nursery industry is very much affected by unpredictable weather conditions like dry weather, excess rainfall, hail storm, frost damage etc. There are so many factors affecting the profit of the nursery industry. All those factors have equal importance in determining the overall profit of the business. Like any other business enterprises, nursery business also demands for attention, care and hard work. If attention, care and hard work are given with other inputs, there is no doubt about higher output from nursery business (Zubair and Saleem, 2010).

The nursery business has a positive impact on the economy of Bangladesh in terms of poverty reduction and women empowerment. Along with tree plantation programmes of government agencies, NGOs and other professional bodies, people's awareness and environmental factors also increased the demand for quality planting materials in the country. With this increased demand for seedlings, more and more people including women are involving in the nursery business by establishing newer nursery enterprises throughout the country (Anonymous, 2010).

Plant nursery business has to play an important role in the future development of horticulture. Thorough planning is required for making nursery business a profitable venture. Physical resources like land, water, labour, transport, market communication facilities etc. as well as financial resources and technical know-how are very much important as far as nursery business is considered (YCMOU, 2012).

A study was conducted by Kabir *et al.* (2013) to find out the knowledge level of nursery owners of Rangpur district (Bangladesh) in the production and marketing of seedlings. They stated that nursery business is an interesting and wonderful business, as the production of plants has the potential for providing remunerative income as well as employment to people. Like any other farming business, nursery business also appears as simple on the surface, but is very complex and requires knowledge and skill in production, labour management and marketing. The nursery industry is much diversified and its success depends upon imagination, determination, planning and good management of the major resources.

2.3 INCOME AND EMPLOYMENT POTENTIAL OF HORTICULTURAL NURSERY BUSINESS

Perkins (1973) conducted a study on economics of ornamental nursery management in Florida. He found out that even though there was a great pressure from inflation and increased market competition, the nurseries in the study area have increased their profit. During the period of 1965 to 1971, the average level of profit of nurseries in Florida was increased from US \$ 4909 to US \$ 18183.

A study was conducted by Uva (2000) to understand the economic dimensions of the green house industry in New York. He estimated the total sales revenue from New York's greenhouse industry which accounted to US \$ 206.8 million during 1997. In addition, the New York nursery industry directly employed over 7000 people in 1997. The initial contribution of the industry was 4385 full time equivalent jobs and 67.5 million US dollar as pay roll. He

estimated the total output and employment for New York State using IMPLAN input output model and the total output (initial plus indirect and induced) and employment were estimated to be \$ 321 million and 5850 full time equivalent jobs.

In their study on analysis of employment in Illinois nursery industry, Waliczek *et al.* (2002) found out that on an average of 70 employees were there in a nursery including sales staff, office staff and seasonal staff. Results from the study indicated that wages earned by the labourers were very low. Due to this low wage there was a difficulty in recruiting and retaining good employees. But the study concluded that nursery industry in Illinois is very valuable industry in providing employment opportunities to the rural poor and as well as strengthening rural economies.

Carman and Rodriguez (2004) carried out a study on the economic contributions of the nursery industry in California. The study estimated the economic impact of the nursery industry and lawn and garden retailing industry which was around 10.3 billion US dollar during 2001. They also estimated the job opportunities created by the nursery industry in California which accounted around 81,011 jobs in 2001. The nursery industry and the lawn and garden setting industry together accounted for 1.17 per cent of total employment generated in California during the study period.

Jorgensen (2004) stated that ornamental horticulture industry creates plenty of job opportunities to both skilled and unskilled labourers. Because of its less physically demanding nature, this industry can provide equal job opportunities to both male and female workers. Apart from this ornamental horticulture industry has a vast potential for generating income from exports also. Ornamental horticulture business can be considered as a sustainable and feasible business option, provided training, education and research should be there with respect to the practical aspects of export of plants and reestablishment.

Hall *et al.* (2005) conducted a research study on green industry in United States. They estimated the impact of green industry on the economy of United States in 2002. Result of the study showed that during 2002, the green industry in United States has generated \$147.8 billion in output and more than 19 lakh jobs.

A study was conducted by Hodges and Haydu (2006) to assess the economic impacts of horticultural industry in Florida. Direct employment in 2005 from surveyed firms totaled 22,494 persons, including 7,811 employees in nurseries, 5,541 in landscape services, and 9,142 by horticultural retailers. 65 per cent of the total employees were full time employees and 35 per cent as part-time, temporary or seasonal employees. Part-time employment was reported by 81 per cent of nurseries, 78 per cent of landscape firms and 88 per cent of retailers.

Mailuma *et al.* (2006) conducted the socio economic analysis of tree seedling production in nurseries in Abuja, Federal Capital Territory (FCT) of Nigeria. They concluded that nursery business in the study area is profitable and the owners got an average profit of N277, 108 from a nursery of size 0. 2 ha. They were of the opinion that, if adequately exploited, small-scale private nursery enterprises have the prospect of yielding economic returns to the operators, while also providing environmental benefits.

Aiyeloja and Larinde in 2006 also stated that small-scale nursery establishments are highly profitable business ventures in Nigeria.

Hodges and Haydu (2007) conducted a study to analyze the growth and challenges in Florida's environmental horticultural industry. They reported direct employment of 22,494 persons in the industry in 2005 in which 7811 employees were from nursery industry, 5541 in landscape services, and the rest 9142 were horticultural retailers. About 65 per cent of the total jobs were full time jobs and the rest 35 per cent were part time or seasonal jobs. They also estimated the total output or the revenue generated from the industry which was \$12.64 billion during 2005.

Flower farming is one of the most important and profitable enterprise as far as the agriculture sector in Pakistan is considered. It is highly labour intensive than the cultivation of other horticultural crops like vegetables are considered. The investment in this sector would yield high returns for the growers (Zeb *et al.*, 2007).

A survey was conducted by USDA's National Agricultural Statistical Service in 2009 to study the economic profile of the Maryland horticultural industry. In 2007, there were 18,588 workers employed by Maryland's state-licensed nursery and landscape businesses. Over half (59%) of the industry employees were employed for at least 150 days and the remainder were seasonal workers. Total wages paid by the sampled population in 2007 were \$451 million and labour overhead totaled 13.2 per cent. The labour overhead includes items such as payroll taxes, worker's compensation, benefits, and other costs of hiring and processing foreign labour. Out of the 18,588 total workers employed, 3,143 workers were reported as migrant workers, who were either foreign or domestic.

Haque *et al.* (2007) conducted a study to analyze the socio economic status of plant nursery business in Gazipur and Jassore districts of Bangladesh. Forty private plant nurseries, four government nurseries and six NGO nurseries were selected for the study. The study revealed that returns per ha per year of private, government and NGO nurseries were Tk. 215766, Tk.120149 and Tk. 535961 respectively. They also estimated the benefit cost ratio of the nurseries, as 1.43, 1.37 and 1.50 respectively for private, government and NGO nurseries.

Babalola (2008), while studying the small-scale private nursery enterprises in Ibadan, opined that small scale nursery enterprises have the potential to provide reliable job opportunities to educated as well as uneducated people in the society.

Shukla (2010) studied the plant nursery business in Udaipur district of Rajasthan to assess the socio economic status of plant nursery owners in the study area. He opined that plant nursery business has vast potentials of generating employment and income to the owners. He estimated the net returns from the

plant nursery business in the study area which accounted Rs. 145226.5 per year. The estimated BC ratio was 1.44.

Asiedu *et al.* (2012) conducted a study to assess the prospects and challenges of nursery business in Ghana. They opined that there was a greater reliance on a combination of family labour and hired labour in the nursery industry (55%) with 15 per cent using hired labour alone.

A study was conducted by Larinde and Santus (2014) to understand the economic contribution of small scale nursery industry in Port Harcourt, Rivers State of Nigeria. Small scale private plant nursery enterprise is a self-employment business that could contribute to income generation and socio-economic development of a state. They estimated the average profit of a small scale private plant nursery enterprise in Pourn Harcourt which was around N123, 000 per annum with a rate of return of 355.56 per cent. The benefit cost ratio of the nursery enterprise was found to be 2.76.

2.4 CONSTRAINTS IN THE HORTICULTURAL NURSERY BUSINESS

Wilson and Leones in 1995, examined the management practices and strategies of whole sale nursery operations in Arizona, near California. In their study they found out that market demand, competition, capital, land and management were the top five factors in descending order of their importance which limited the expansion potential of nursery business in the study area.

In a study on production and management practices of Australian nurseries, Brumfield and McSweeney (1998) found out that increasing number of nurseries and consequent competition in the industry and lack of professionalism are the major constraints in the Australian nursery industry.

Adedundan and Adeniyi in 2015 studied the ornamental plant nursery business in Nigeria. Their study came up with the view that the most prevalent limitation to the nursery business in the study area was the lack of adequate land to capitalize the farms. Insect attack was another problem reported by them.

Garber and Bondari (1998) conducted a survey on the retail garden outlets in Georgia. The study was conducted to understand the business characteristics and the factors affecting the performance of retail garden industry in Georgia. They identified several factors having the potential for negative impact on the sales of planting materials in Georgia. Adverse weather (25.9%), competition from mass merchants (23.4%) and a slowing economy (21.5%) were the three most frequently listed factors, for all firms.

A study was conducted by Nieuwenhuis and O'Connor (2000) on small scale tree nurseries in highlands of East Africa. The aim of the study was to identify the constraints faced by the tree nurseries in the region in fulfilling the requirements of farmers about the range and quality of seedlings supplied to them. Lack of regular supply of high quality seeds, technical knowledge and training facilities to nursery managers and credit constraints were the important problems reported by them.

In their report, the Working Group on Horticulture Development (fruits, vegetables, tuber crops, floriculture, medicinal & aromatic plants, spices, plantation crops including tea, coffee and rubber) for the 10th Five Year Plan (2001) opined that poor infrastructural facilities and lack of trained manpower are the major problems affecting the performance of horticultural nursery industry in India.

Brumfield and Moufa (2002) reported that like other producers in agriculture, nursery producers also face risk from so many sources like production, marketing, finance, legal or institutional and human resource risk which affect their viability and profitability. Production risk concerned with variation in the level of output due to uncontrollable events like weather, pests and diseases, input availability and its quality, technical challenges etc. Availability of markets and price risks are included in the market risk. Three basic components of financial risk are interest rate risk, liquidity and solvency. Changes in the policies and regulations that affect the greenhouse and nursery business are the reasons for

legal and environmental risks. Human resource risk is concerned with the events associated with greenhouse operators, their families, employees etc.

Muhammad *et al.* in 2003 conducted a study to assess the risk management needs of nursery business in Tennessee. According to their study the limitations which hindered the expansion of nursery business were lack of skilled labour, capital, market demand and environmental regulations. The study also indicated weather as another limiting factor.

Brumfield (2004) conducted a study to find out the strengths and weaknesses of the New York nursery industry. Twenty one respondents were surveyed for the study. Respondents indicated the lack of capital, non-availability of good hired labour, competition from other growers, labour and fuel costs, low demand for the products, government regulations and taxes as the greatest deterrent factors to the expansion of their business.

Merhaut and Pittenger (2005) opined that market demand unpredictability of weather and water supply were the foremost important problems faced by the whole sale nursery industry in California. They also indicated that governmental and environmental regulations are not as strong as required. So they have only less impact on the nursery business in California.

Hodges and Haydu (2006) studied the threats faced by the members of the Florida Nursery, Growers and Landscape Association. Majority of respondents indicated drought, water availability and water use restrictions as the major threats in the industry (57%). 61 per cent of the respondents indicated increasing costs of production as important threat while 53 per cent indicated increasing energy costs as a constraint. In addition, low prices for products and lack of professionalism were also cited by the respondents.

In their study on managing risk for nursery producers, Schuch and Teegerstrom in 2006 has reported that nursery producers constantly had to balance many risks related to production, employees, the market, and the climate.

In his research work titled 'Improving the Effectiveness of the Forest Nursery Industry in Leyte Province, the Philippines' Gregorio (2007) stated that the small scale forest nursery business sector in Philippines was not well organized. Scarcity of resources and low level assistance from various institutions were the main problems affecting the individual nursery groups (private nurseries) in Philippines. Most of the support measures were mainly focusing on community nurseries only. Yet these support measures were not sufficient to make them self-supporting. Lack of access to sources of germplasm, high cost of transportation, inadequate species choice etc. were also affecting the operational effectiveness of nursery industry in Philippines.

Haque *et al.* (2007) conducted a study in Jessore and Gazipur districts of Bangladesh to assess the socio economic status of horticultural nursery business in Bangladesh. According to their study non availability of improved seeds or seedlings was the major constraint for private and NGO nurseries. The crucial problem faced by government nurseries was the lack of adequate funds. Other problems faced by the nursery business in the study area included low price of sapling and seedling, pest and diseases, lack of technical know-how and efficient labour, inadequate irrigation and credit facilities etc.

A survey was conducted by USDA's National Agricultural Statistical Service (2009) to understand the economic profile of Maryland horticulture industry. They reported that credit constraints, labour shortage, competition, taxes and weather were the most important factors affecting the nursery business in the study area.

A study was conducted by Mukundi and Kariuki (2007) to understand the role and challenges of informal plant nurseries in urban centre of Kenya. Quality of soil and water, lack of formal or skilled training for operators, unavailability of suitable planting material, low plant establishment rates, limited market outlets, high competition between nurseries, space limitation and low prices for produce etc. were the important problems affecting nursery industry in the study area.

In a study designed to find out the marketing channels and the performance of marketing system in the nursery industry in Northwest frontier province of Pakistan, Zeb *et al.* (2007) found out that non availability of credit facilities was the major constraint faced by the respondents followed by lack of irrigation facilities

Ajayi and Babalola (2008) from their study on public nurseries in Nigeria, has identified the factors affecting the efficiency of nursery business in the study area. Inadequate funding, problem of pilfering, poor infrastructural facilities, lack of nursery inputs like chemicals, equipment and implements and non-availability of standard humidity propagators were the problems identified by them. Low demand for some species was another problem reported by them.

Fakayode *et al.* (2008) carried out a study to examine the viability and resource use in ornamental plants nursery business in Nigeria. The study indicated that inadequate funding was the major constraint to ornamental plant production in Nigeria and they suggested the provision of adequate funding to farmers in order to boost the ornamental plants production in the country. They also identified pest and diseases, poor market and water shortage as other limitations to the ornamental plant nursery business in Nigeria.

NHB (2010) has observed that majority of the plant nurseries in India are operating in the private sector. These nurseries play an important role in the multiplication and sale of the planting materials. Lack of adequate infrastructure facilities is one of the major problems faced by them. Most of them are selling planting materials of unknown pedigree. This is a threat as far as the quality of planting materials is considered. Availability of standardized root stocks and maintenance of healthy stocks of elite varieties are considered as important factors in maintaining the quality of the planting materials produced in the nurseries.

A seedling nursery survey was conducted by Gregorio *et al.* (2010) in Philippines to understand the problems faced by the nursery sector and to find out the ways to improve the operational effectiveness of the horticultural nurseries.

The foremost important problem, as far as the nursery sector in the study area considered, was the lack of access to the sources of germplasm. This problem was more prominent among individual and communal nursery owners. Credit constraint was another problem faced by individual and communal nurseries. As far as the government nurseries are considered, labour shortage and pilfering were reported as the major problems.

Shukla (2010) reported that inadequate supply of improved seeds and seedlings, low price of saplings and seedlings, damage of seedlings, lack of efficient labour, attack of insect and diseases, lack of technical know-how, inadequate irrigation and credit facilities etc. were the major constraints faced by the nursery owners in Udaipur district of Rajasthan.

In the final report of the project titled 'Enhancing tree seedling supply via economic and policy changes in the Philippines nursery sector' Herbohn *et al.* (2011) stated that forest nursery industry in Philippines was inefficient in producing and supplying quality planting materials to the tree farmers in the region. Nursery industry in the region was affected by various combinations of social, financial, technical and political impediments. Private nursery owners in the region have less education and they were unaware of the importance of production of quality planting material. Credit constraints, lack of access to germplasm of a wide species base and marketing problems had an adverse effect on the tree nursery owners in Philippines.

Asiedu *et al.* (2012) examined the prospects and challenges of nursery industry in Ghana. They found out that lack of affiliation with government, professional bodies and NGOs were the major problem in the nursery industry in Ghana. 95 per cent of the respondents never belonged to any governmental or non-governmental organizations and were not in receipt of any form of help from any of the organizations. They also stated that it has also not provided opportunity for training to improve the skills of nursery men or the necessary inputs from research to increase variation in the types of plants cultivated. Lack of access to

quality planting material was also a crucial problem faced by the respondents (85%). Other constraints included seasonal nature of produce patronage, unreliability and unavailability of a cheaper source of water for irrigation, variability in the pricing of produce, theft cases, pest infestation, inadequate space in built up areas etc.

Lawal *et al.* in 2012 carried out a study to assess the economics of floricultural plant production in Kwara state of Nigeria. The study revealed that inadequate capital for the expansion of the floriculture business was the main constraint faced by the respondents in the study area. 78.1 per cent of the respondents were facing the problem of lack of capital to expand the scale of production followed by the problem of low demand (24.4%). The problem of water shortage and pest and diseases were faced by 29.3 per cent and 12.2 per cent of the respondents respectively.

Labour intensive businesses like nurseries are affected by issues related to the labour pool, human resource management, and turnover of labour and staff etc. Mechanization or automation can help in managing some of the labour related issues. In order to manage the production risks associated with weather and marketing, nursery operators are advised to choose different insurance products (Schuch and Teegerstrom, 2012).

A study was conducted by Kunuku *et al.* (2013) to analyze the profitability and constraints of commercial floriculture business in East Godavari district of Andhra Pradesh. The major problems identified were, inadequate availability of labour followed by lack of continuous electricity supply, inadequate availability of raw materials like suitable soil and water for irrigation, mortality of plants and lack of transportation facilities. The other problems included marketing related issues, pests and diseases, price fluctuations and credit constraints.

Saud *et al.* (2013) conducted a research study on nursery business in Harbin region in China. The study was based on the interview conducted among the nursery owners. Water availability, credit constraints, pest and diseases were

the major problems reported by them. Besides, the nursery owners demanded fertilizers and pesticides at low price, training on new methods in nursery propagation and management and provide bank loans with easy procedures and installments.

A study was conducted by Larinde and Santus in 2014 to assess the small scale private plant nursery enterprise in Pourt Harcourt in Rivers state of Nigeria. The constraints or the limitations to the establishment of small scale nursery enterprises in the study area, outlined by the nursery owners included inadequate funds (26.2%), poor marketing (25.5%), water shortage (25.0%) and pest and diseases (23.5%).

The review of literature on the research problem being addressed brought home the fact that even though plenty of research studies are available regarding horticultural nursery business internationally, studies on nursery business in the Indian context, that too in the supply chain management aspect, are very rare. Most of the studies on nursery business concentrated on the marketing, economic and management aspects of nursery business. Even though studies are available in the supply chain management aspects of other industries like construction industry, studies on supply chain management of horticultural nursery industry are very less in number in international literature also. Detailed studies have not been conducted in Kerala on plant nursery management and its economic analysis, other than a few studies on the management aspects of the crops. Hence the relevance of this study which need to be assessed for its economic and policy significance.

Materials and methods



3. MATERIALS AND METHODS

This chapter details the design of the study and the methods adopted for carrying out the research work and its analysis. Location of study, sampling design, method of data collection and the tools used for analysing the data are explained here.

3.1 Location of study

The study on 'Analysis of supply chain management of horticultural nurseries' was conducted in Thrissur district of Kerala which is considered as the hub of horticultural nursery business in the state.

Thrissur, known as the cultural capital of Kerala, is located in the central part of the state. The district lies between North latitudes $10^{\circ} 10'$ and $10^{\circ} 46'$ and East longitudes $75^{\circ} 57'$ and $76^{\circ} 54'$ with an average altitude of 2.83 meters. The total geographical area of the district is 3029.19 sq. km. Thrissur city is situated in midland region of Kerala, with an extended part of Palakkad plains. The district shares its boundary with Palakkad and a part of Tamil Nadu in the East, Arabian Sea in the west, Malappuram and Palakkad in the North and Ernakulum in the South.

The Thrissur city features a tropical monsoon climate. Summer last from March to May followed by the South-West monsoon from June to September. October and November form the post monsoon season. The average annual rain fall is 300 cm. South West monsoon generally sets in during the last week of May. On an average there are 124 rainy days in a year. The maximum average temperature during summer season in the district is 33 degree Celsius and the minimum is 22.5 degree Celsius. During winter the maximum average temperature recorded is 29 degree Celsius while the minimum temperature recorded during winter is 20 degree Celsius. Major soil types observed in the district are laterite soil, brown hydromorphic soil, hydromorphic saline soil, coastal alluvium, riverine alluvium and forest loamy soil. Land utilization pattern of Thrissur district is presented in table 3.1.



Fig.4. Location of study

Table 3.1. Land utilization pattern of Thrissur district

Sl. No.	Particulars	Area (ha)
1	Total geographical area	302919
2	Forest	103619
3	Land put to non-agricultural use	37613
4	Barren and uncultivable land	259
5	Land under miscellaneous tree crops	191
6	Cultivable waste	8279
7	Fallow other than current fallow	8256
8	Current fallow	9515
9	Still water	6328
10	Water logged area	320
11	Social forestry	147
12	Net area sown	128385
13	Area sown more than once	49233
14	Total cropped area	177618

(Source: GOK, 2015)

Thrissur is an agriculturally important district of Kerala. Paddy is the important crop in the district and rice farming is the largest agricultural practice pursued by the majority of the people. It is followed by tapioca and coconut. The major irrigation projects in the district are Peechi, Vazhani, Chalakudy and Cheerakuzhi which ensures water availability throughout the year. Cropping pattern of the district is presented in table 3.2.

Table 3.2. Cropping pattern of Thrissur district

Sl. No.	Crop	Area (ha)
1	Paddy	22274
2	Coconut	87177
3	Fruits	23763
4	Rubber	15550
5	Spices & condiments	16607
6	Vegetables	3109
7	Tea	530
8	Others	8610
9	Total cropped area	177618

(Source: GOK, 2015)

For the detailed study of plant nursery business, a sample survey was conducted in Thrissur district. Thrissur district could be considered as the centre of horticultural nursery business in the state. In the district nursery business is mainly concentrated around Mannuthy area. Proximity to Kerala Agricultural University might be the one of the reason for concentration of nursery business in and around this area. So this area is purposively chosen for the detailed study of plant nursery business.

3.2 Sampling design

Primary data were collected using sample surveys with the aid of structured interview schedule. The prepared interview schedule was pretested to assess its reliability. A pilot survey was conducted to check the reliability of the interview schedule and based on the results of the pilot survey; the interview schedule was again modified to its final form.

For the final study 40 nurseries were randomly selected which included both private and government nurseries. Details of the nurseries were collected from Principal Agricultural Office, Krishi Bhavan, Agri-Horti Nursery Association and also through local enquiries. The selected nurseries were classified into three groups based on their area of operation. The classification is given below:

Category 1 (symbolised as C-1) - area less than 50 cents

Category 2 (symbolised as C-2) - area between 50 cents and 2 acres

Category 3 (symbolised as C-3) - area more than 2 acres

3.3 Collection of data

The data collection was carried out during the period of March 2016 to June 2016 using pretested interview schedules. The interview schedule was prepared with the help of available literature through vast literature review and its reliability was checked by conducting a pilot study in the location. Information collected during the pilot study was used to modify the interview schedule. The final interview schedule is given in the appendix. This structured, pretested interview schedule was used to collect data from the selected group of respondents. Data regarding the socio economic profile of the respondents and basic details of the nursery were collected from the respondents. Information regarding cost and returns from the business, supply chain management and production and marketing aspects were also collected. The data regarding nursery registration is collected from the office of Principal Agricultural Officer and

Krishi Bhavan. The collected data were tabulated and analysed to arrive at results and to draw conclusions from it. The various concepts used in the study, their measurement and valuation are discussed below.

3.4 Descriptive statistics

Descriptive statistics were used to analyse the statistical facts and patterns in the collected data. This was mainly used to interpret the data on profile of respondents and general information on horticultural nursery business in the study area. Here the descriptive statistical tools such as frequencies, percentages, averages and mean values were used. Findings on descriptive statistics were presented in the form of tables and graphs.

3.5 Mapping of supply chain

A supply chain diagram enables the flows of products, key actors and processes in the chain to be seen clearly, ensuring that none of the key elements of the chain are ignored.

The supply chain mapping was done as per the method proposed by Vermeulen *et al.*, 2008. Here the approach is to work together as a group to draw box and arrow diagram to show functions, product flows and economic actors along the supply chain from producers through to end consumers. Focus group discussions and interactions were conducted for mapping the supply chain.

3.6 Supply chain performance

In order to measure the performance of supply chains, a Supply Chain Performance Index (SCPI) was developed. It was based on the supply chain performance model proposed by Aramyan *et al.* (2006) with suitable modifications. A conceptual frame work was developed by Aramyan *et al.* to measure the performance of agri food supply chains. SCPI was developed as a comprehensive one incorporating the effects of three dimensions of the supply chains, *viz.*, efficiency, flexibility and quality. Efficiency was measured in terms of cost reduction and profit in the supply chain while flexibility measured in terms

of fill rate, lead time and customer satisfaction. Quality of the products is also taken as an indicator in measuring supply chain performance.

Two most common supply chains in the study area were identified (i.e., supply chain of plants produced in the nursery and supply chain of plants purchased from other nurseries) and Supply Chain Performance Index was estimated. Supply Chain Performance Index advocates a set of supply chain performance indicators as a combination of 1) efficiency (cost reduction and profit), 2) flexibility (fill rate, lead time and customer satisfaction) and 3) quality (quality of products produced in the nursery and purchased from other nurseries).

Supply Chain Performance Index was worked out using the following formula.

$$SCPI = \frac{\sum_{i=1}^n x_i}{\text{maximum } \sum x_i}$$

x_i is the score obtained for each of the measures.

Here the respondents were asked to rate each of the dimensions on a ten point scale by comparing the performance of the identified common supply chains in the location, i.e., out of ten how much score they will assign to fill rate, lead time and customer satisfaction aspects of their business activity. The perception of the respondent about each dimension of supply chain performance was measured by comparing two major supply chains in the study area.

3.6.1 Various concepts and definitions used in supply chain management

Various concepts and definitions used in supply chain management are described below.

3.6.1.1 Supply chain

Supply chain “refers to all those activities associated with the transformation and flow of goods and services, including their attendant information flows, from the sources of raw materials to end users” (Ballou, 2004).

3.6.1.2 Supply chain management

SCM is defined as a co-ordinated approach for managing the flow of goods from suppliers to ultimate customers, and the ultimate goal of supply chain management is to meet customer service objectives while minimizing inventory and related costs (Carter and Ferrin, 1995).

3.6.1.3 Supply chain map

It is the visual representation of the flows of information, processes, and money between actors in the supply chain in both upstream and downstream in the supply chain (Gardner and Copper, 2003).

3.6.1.4 Supply chain mapping

Supply chain mapping is the process of accounting for every material, every process and every shipment involved in bringing goods to market.

3.6.1.5 Supply chain efficiency

Efficiency measures how economically a firm's resources are utilized to achieve a predetermined level of customer satisfaction (Neely *et al.*, 1995). Efficiency here is used to describe how well a company optimizes the supply chain to maximize profitability.

3.6.1.6 Flexibility

Flexibility is the organization's ability to meet an increasing variety of customer expectations without excessive costs, time, organizational disruptions, or performance losses. In other words it is the ability to change or react with little penalty in time, effort, cost or performance (Grigore, 2007).

3.6.1.7 Fill rate

The fill rate is the fraction of customer demand that is met through immediate stock availability, without backorders or lost sales (Maher *et al.*, 2012).

3.6.1.8 Lead time

It is the moment from customer places an order to the moment it is ready for delivery (Maher *et al.*, 2012).

3.6.1.9 Customer satisfaction

It is a marketing term that measures how products or services supplied by a company meet or surpass a customer's expectation (Krajewski *et al.*, 2007).

3.7 Cost concepts

3.7.1 Activity Based Costing (ABC)

Total cost incurred in one year in horticultural nurseries was worked out using ABC costs.

ABC is a costing methodology which identifies activities in an organization and assigns cost of each activity with resources to all products and services according to the actual consumption by each. This model assigns more indirect costs into direct costs as compared to conventional costing (CIMA, 2008). Farm costs are classified into six groups by the estimation committee on Cost of Cultivation, Government of India, 1981. According to this classification farm costs come under six categories and they are Cost A₁, Cost A₂, Cost B₁, Cost B₂, Cost C₁ and Cost C₂. Later in 1991 Cost C₃ has been added to this classification. It accounts for the management input of the farmer (Acharya and Agarwal, 1987).

a) Cost A₁ - It represents all the actual expenses incurred in the production process by the owner both in the form of cash and kind. It includes value of hired human labour and machine labour, value of material inputs, interest on working capital, land revenues, depreciation on implements and machinery used in the farm.

b) Cost A₂ - It is equal to Cost A₁ plus rent paid for leased land.

Scattered production units are an important feature of nursery business in the study area. i.e., many of the nurseries are having separate production units and sales outlets. Full details of the owned capital assets (excluding land) were not given by the respondents. So, due to fear of under estimation of costs, in the analysis only the cost at Cost A level has been attempted.

3.7.2 Cost of material inputs

Cost of material inputs includes all the expenditures incurred by the nursery owners on material inputs like planting materials, potting mixtures, poly bags and pots, fertilizers and manures, plant protection chemicals etc. and has been accounted on the basis of actual price paid by the nursery owners.

3.7.3 Value on human labour

It is measured in terms of man day equivalents and one man-day is the productive work accomplished by a worker in eight hours of a day assuming average efficiency. Three women are considered as equivalent to two men (Reddy *et al.*, 2004).

$$\text{Man equivalent days} = \text{Women days} \times 2/3$$

Family labour and child labour were not utilized in the nurseries. So, family labour and child labour were not taken into account during cost calculation. Hired labour was valued based on the prevailing wage rates of the location.

3.7.4 Interest on working capital

Interest on working capital was estimated at the rate of seven per cent per annum. It is the interest rate of commercial banks on short term agricultural loans of less than three lakh rupees.

3.7.5 Land revenue and land rents

Land revenues and land rents are important components in the cost calculation. Since some of the nurseries are grown in the residential premises,

land revenues and land rents do not seem to be relevant cost component. In such cases land revenue and land rents have not been include in the cost calculation.

3.7.6 Depreciation

Depreciation was worked out by the straight-line method at the rate of 15 per cent for shade house and 10 per cent for irrigation system, tools and equipments (Reddy *et al.*, 2004).

3.8 Constraints in the horticultural nursery business

During pilot survey, the major constraints in plant nursery business in the study area were identified through the interactions with the respondents and also through local enquiries. The respondents were asked to rate the constraints according to their importance as perceived by them. The ratings adopted were as follows: 1= not important, 2= less important, 3= important and 4= very important. Mean rank for each of the constraints were estimated and the constraint with highest mean rank was identified as the most important constraint affecting the nursery business in the study area.

Results and discussion



4. RESULTS AND DISCUSSION

The primary data collected through the survey using pretested questionnaires were subjected to various statistical methods of data analysis for arriving at the results of the study. This chapter includes the findings of the study and discussions which are presented under different headings and subheadings.

The first session in the chapter is on supply chain management of horticultural nursery business. It is subdivided into horticultural nursery business in Thrissur, profile of respondents, general information on nursery business in the study area and mapping of supply chain and supply chain performance. The second session in the chapter is on economic analysis of horticultural nursery business. Here an attempt was made to work out the extent of employment generation and the economics of nursery business in the study area. Constraints faced by the nurseries in the study area are discussed in the last session of the chapter.

4.1 SCM in horticultural nursery business

4.1.1 Horticultural nursery business in Thrissur

4.1.2 Profile of respondents

4.1.3 General information on nursery business in the study area

4.1.4. Mapping of supply chain and supply chain performance

4.2 Economic analysis of horticultural nursery business

4.2.1 Employment generation in the nursery business

4.2.2 Economics of horticultural nursery business

4.3 Constraints in horticultural nursery business

4.1 SCM in horticultural nursery business

4.1.1 Horticultural nursery business in Thrissur

The horticultural nursery industry in Thrissur has experienced considerable growth in the last two decades. The nursery industry has witnessed mushrooming of plant nurseries in the district during the last two decades. It is mainly concentrated in Mannuthy region, in an around Kerala Agricultural University. The industry has had a significant presence in the region for the past 30 years. So, Mannuthy area is purposively selected as the location for the study of nursery business. The nursery industry represents a diverse group of businesses, production systems and allied providers; aligned with strong domestic supply chain integration. At present there are more than 500 nurseries in Mannuthy region. These nurseries are of different size and selling a variety of plants and planting materials to the customers. All the sampled nurseries in the area are mixed nurseries with a diverse group of plants and they also offer various services to the customers other than the supply of planting materials.

During the survey the following factors could be identified as the reasons for the mushrooming of plant nursery business in the study area.

a) Proximity to Kerala Agricultural University (KAU)

The main reason for the concentration of nursery business in the study area, as perceived by the nursery owners, is the proximity to Kerala Agricultural University. The nurseries in the region are found concentrated around KAU. The good will of KAU is one of the important factors attracting the customers to Mannuthy region for purchasing plants. Besides, KAU also provides variety of training programmes to people in the field of plant nursery business. KAU also provides training in budding, grafting and other plant propagation methods which is very much helpful for the nursery owners and labourers working in the nursery. Most of the oldest nurseries in the region got the privilege of trainings of KAU.

The proximity to university is also helpful in getting technical advice in nursery management.

b) Availability of plain land for starting nursery

Availability of plain land is another factor that adds to the mushrooming of plant nurseries in the study area. Area without water logging is important for nursery business. Plain lands near to road sides and lands with good transportation facility also contribute to the concentration of nursery business in the area.

c) Availability of water round the year

Availability of water is an important factor in determining the success of horticultural nursery business. Like any other agricultural activity, water is very much critical input for nursery business. Peechi irrigation project, built across the Manali River, is serving as the source of water to the agricultural and related activities in the region. This ensures adequate water for all agriculture related activities in the region.

d) Proximity to National Highway

The success of any business activity is dependent on the logistics facilities. Nearness to national highway is another attractive factor adds to the success of the nursery industry in the study area. Most of the nurseries in the study area are seen purchasing plants from other states like Andhra Pradesh, Karnataka, Maharashtra and West Bengal. At the same time nurseries and customers from other states are also seen purchasing from the sample nurseries. Hence, nearness to national highway has very much contributed to the success of nursery business in the locality.

4.1.1.1 Characteristics of nursery business in the study area

From the sample survey conducted, the following observations are made on the horticultural nursery business in the study area.

a) Scattered production units

Scattered production units are an important feature of nursery business in Thrissur district, especially in Mannuthy area. Most of the nurseries are operating in leased in lands near the road side. Some of the nurseries are located in remote areas of Mannuthy. Such nurseries have sales outlets near the main road side. Area of the nurseries varies from 10 cents to more than 10 acres.

b) Nursery business as village cottage industry in the location

Another peculiarity of the nursery business in the study area is the development of plant nursery business as a village cottage industry. Those people who have house and land near roadsides starts nursery business as a subsidiary source of income. They start small scale nurseries in front of their houses without heavy investments. Family labour is mainly utilized in these nurseries.

c) Large scale purchase of plants from outside Kerala

Majority of the nurseries in the area are not seen maintaining their own sources of mother plants. They purchase plants for sale from other states namely Tamil Nadu, Andra Pradesh, Karnataka, Maharashtra and West Bengal. Own planting material production activity in the area is low when compared with the purchase from other nurseries is considered.

d) Predominance of labourers from other states

Like any other agricultural sector, nursery industry in the study area is also facing the shortage of local agricultural labourers. From the survey it is identified that in most of the nurseries, labourers are from outside Kerala especially from West Bengal and Orissa. The nursery owners have to provide accommodation facilities also to them. The local female labourers found to have been substituted by labourers from outside. The shortage of female labourers has been attributed to the implementation of Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS). Another reason attributed for the labour shortage is that,

many of the labourers have started their own nursery business after acquiring experience and training in the plant nursery management.

e) Low wage rate to the labourers

Wage rate of nursery labourers are comparatively low when compared to the market wages of agricultural labourers. On average female labourers are getting Rs. 225-300 per day while male labourers from outside Kerala are getting Rs. 300 per day. The female wages are on par with the paid MGNREGS wage rate prevalent in the state. But this low wage rate is being compensated by the provision of regular employment almost throughout the year.

f) Less developed infrastructural facilities

In most of the small and medium scale nursery enterprises, the infrastructural facilities are not well developed. The survey showed that there are nurseries in the study area without infrastructural facilities like rain shelters, poly houses, office buildings, drip and sprinkler irrigation etc. But large scale nursery enterprises are having all the infrastructural facilities.

g) Presence of Agri - Horti Nursery Association (AHNA)

The nursery owners in the study area have registered an association namely, Agri - Horti Nursery Association. Around 150 nurseries are the members of this association. The association has two agri super markets in the area where sales of agricultural implements, nursery tools, chemical and organic fertilizers, and organic pesticides are carried out. The members of the nursery association get the inputs at reduced rates from the agri super market.

h) Services other than supply of plants

Some of the nurseries in the study area provide services like garden setting and landscaping, polyhouse construction and settings, seeds, organic fertilizers and organic pesticides, coloured pots and other garden setting items apart from the supply of plants.

i) Container nursery and field nursery

Both container and field nursery are seen in the study area. In container nurseries the plants are grown in containers like plastic pots, earthen pots, fiber pots and polythene covers. According to the type and size of the containers, the price of plants varies. In field nurseries plants are grown in the field and on customer demand, the plants are uprooted and sold. Lawn grass, some palms and bamboos etc. are grown in field nurseries. Coconut is grown both as container nursery as well as field nursery crop.

j) Predominance of wholesale business

Even though both wholesaling and retailing methods of sale are observed, most of the nurseries in the study area are wholesale nurseries. Wholesale of plants is the main method of sale in the region. Nurseries from all over Kerala and neighboring states, farmers, homesteads, garden setting contractors, corporates etc. are the major customers of the nursery industry.

4.1.2 Profile of respondents

Socio economic details of the respondents are important indicators as far as the social science researches are considered. Here the parameters like gender, educational qualification, main occupation, ownership status etc. were studied. These parameters will give a brief picture of socio economic conditions of the sample respondents. This will help in the better reading and explanation of the results of the study.

A post stratification of the samples in the study area was done on the basis of the operational area of the nurseries. Accordingly the sample nurseries were classified into three categories.

Table 4.1. Classification of nurseries based on the operational area

Category	Area of the nursery	Frequency
C- 1	<50 cents	10 (25.00)
C- 2	50 cents – 2 acres	21 (52.50)
C- 3	>2 acres	9 (22.50)

(Figures in the parenthesis indicate per cent to total)

The category C-1 includes those nurseries with an operational area of less than 50 cents. Category C- 2 and C- 3 includes nurseries with operational area in between 50 cents to two acres and area more than two acres respectively. Table 4.1 furnishes the classification of nurseries based on their operational area. From the table it could see that most of the nurseries (52.50 per cent) come under the category C-2. Category C-1 contains 25 per cent of the respondents. Category C-3 includes nurseries with an area more than 2 acres and 22.50 per cent of the respondents come under this category.

Out of the total sampled nurseries three nurseries (7.50 per cent) were public sector nurseries and the rest 92.50 nurseries were private nurseries. The details of private sector nurseries were only used in describing the profile of nursery owners in the study are.

4.1.2.1 Gender of respondents

Table 4.2. Gender wise distribution of respondents

Gender	Frequency
Male	34 (91.89)
Female	3 (8.10)

(Figures in the parenthesis indicate per cent to total)

Table 4.2 furnishes the distribution of respondents according to their gender. The classification of respondents based on gender revealed that out of the total respondents only three were females and rest were males, i.e., 91.89 per cent of the total respondents were male and only 8.10 per cent were female. Category wise analysis showed that out of the total three female respondents, two belonged to the category C-2 and one belonged to the category C-1.

The high percentage of males engaged in the nursery business conforms to similar result by Asiedu *et al.* (2012) who reported that the nursery industry in Ghana is dominated by males (80 %). The research works by Fakayode *et al.* (2008), Enesi *et al.* (2016), Adedundan and Adeniyi (2015) also conforms to similar result that nursery industry is male dominated.

4.1.2.2 Age of respondents

The respondents in the study area are classified in to three categories based on the age group. The categories were respondents with age less than 35 years, age in between 35-55 years and respondents with age more than 55 years. Table 4.3 represents the details of the respondents based on their age. Majority of respondents (83.78 %) in the study area are comes under the age group 35-55 years followed by 13.51 per cent of the respondents in the age group more than 55 years. Only 2.70 per cent of the respondents come under the age group less than 35 years. Category wise analysis of respondents also revealed that majority of the respondents comes under the age group of 35-55 years. All the respondents in the category C-1 and C-3 and 68.42 per cent of the respondents in the category C-2 are belonged to the age group 35-55 years. The results drive home that younger generation are less involved in the horticultural nursery business.



PLATE 1: Survey in the study area

Table 4.3. Age wise distribution of the respondents

Age group (in years)	Frequency			
	C-1	C-2	C-3	Total
<35	0 (0.00)	1 (5.52)	0 (0.00)	1 (2.70)
35-55	10 (100.00)	13 (68.42)	8 (100.00)	31 (83.78)
>55	0 (0.00)	5 (26.31)	0 (0.00)	5 (13.51)
Total	10 (100)	19 (100)	8 (100)	37 (100)

(Figures in the parenthesis indicate per cent to total)

4.1.2.3 Educational status of respondents

Education is considered as one of the important factors in determining efficiency in any field of activity. The distribution of respondents according to their educational achievement is furnished in Table 4.4. It could be seen that 59.45 per cent of the respondents are having high school level of education. 27.02 per cent of the respondents had graduation and above level of education. The respondents with higher secondary level of education accounted 13.51 per cent of the total sample. All the respondents have above high school level education. The category wise analysis of the results showed that majority of the respondents in the category C-1 (60 %) and C-2 (78.94 %) were having high school level education. But it should be noticed that 75 per cent of the respondents in the category C-3 have graduation or above level of education.

Table 4.4. Education wise distribution of respondents

Educational status	Frequency			
	C-1	C-2	C-3	Total
Primary	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
High school	6 (60.00)	15 (78.94)	1 (12.50)	22 (59.45)
Higher secondary	2 (20.00)	2 (10.52)	1 (12.50)	5 (13.51)
Graduation and above	2 (20.00)	2 (10.52)	6 (75.00)	10 (27.02)
Total	10 (100)	19 (100)	8 (100)	37 (100)

(Figures in the parenthesis indicate per cent to total)

4.1.2.4 Occupation of respondents

Table 4.5 furnishes the details of distribution of respondents based on their occupation. 72.97 per cent of the total respondents were having nursery business as the sole source of their income. 27.02 per cent of the respondents were having other business activities along with the nursery business. Category wise analysis revealed that 50 per cent of the total respondents in the category C-1 are having other business activities along with nursery business and majority of the respondents in C-2 and C-3 (84.21 per cent and 75 per cent respectively) are having nursery business as their sole source of income.

Table 4.5. Distribution of respondents based on occupation

Occupation	Frequency			
	C-1	C-2	C-3	Total
Nursery business only	5 (50.00)	16 (84.21)	6 (75.00)	27 (72.97)
Nursery business + Other occupation	5 (50.00)	3 (15.78)	2 (25.00)	10 (27.02)
Total	10 (100)	19 (100)	8 (100)	37 (100)

(Figures in the parenthesis indicate per cent to total)

Enesi *et al.* (2016) in their study on private nursery enterprises in Oyo State, Nigeria similarly identified that nursery business was the sole source of income of 70 per cent of the respondents. But the result contradict the findings by Asiedu *et al.* (2012), who reported that nursery business was used as a supplementary source of income by 55 per cent of the nursery owners in Ghana.

4.1.2.5 Years of experience in nursery business

Like education, year of experience is also an important parameter in the successful running of any business enterprise. Table 4.6 furnishes the distribution of respondents based on their years of experience in the nursery business.

From the table 4.6 it could be observed that majority of the respondents (51.35%) are having more than 15 years of experience in the field of horticultural nursery business. 18.91 per cent of respondents come under the category of less than five years of experience. Another 18.91 per cent of the total respondents are having an experience of 11- 15 years and 10.81 per cent of the respondents are with an experience of 5-10 years in the horticultural nursery industry. The category wise analysis of respondents showed that half of the respondents in the category C-1 are having less than five years of experience in the nursery field.

More than half of the members in the categories C-2 and C-3 are having an experience of more than 15 years in plant nursery business.

From the observations on years of experience of the owners in the plant nursery field, it could be concluded that the horticultural nursery business in the study area is very well established with a long history of experience. But at the same time the nursery industry in the locale attracts newer entrepreneurs into the field also. It is noticeable from the data that 18.91 per cent of the total respondents are having an experience of less than five years in the horticultural nursery industry.

Table 4.6. Distribution of respondents based on years of experience in nursery business

Years of experience	Frequency			
	C-1	C-2	C-3	Total
< 5 years	5 (50.00)	2 (10.52)	0 (0.00)	7 (18.91)
5-10 years	3 (30.00)	1 (5.26)	0 (0.00)	4 (10.81)
11-15 years	1 (10.00)	4 (21.05)	2 (28.57)	7 (18.91)
>15 years	1 (10.00)	12 (63.15)	6 (71.42)	19 (51.35)
Total	10 (100)	19 (100)	8 (100)	37 (100)

(Figures in the parenthesis indicate per cent to total)

4.1.2.6 Nursery ownership details

Table 4.7 represents the distribution of the respondents based on the ownership of the nursery. It is clear that majority (90.9 per cent) of the respondents are the sole owners of their respective nurseries. Only three nurseries are having partnership mode of operation.

Table 4.7. Ownership of the nursery

Ownership status	Frequency
Sole	34 (91.89)
Partnership	3 (8.10)

(Figures in the parenthesis indicate per cent to total)

The analysis of profile of the nursery owners in the study area shows that only three nurseries are having women as owners (Table 4.2). Out of these three nurseries two nurseries are under the partnership mode of ownership. Majority of the nurseries (52.50 per cent) in the study area are having an operational area ranging between 50 cents to two acres (Table 4.1). Majority of the respondents comes under the age group of 35-55 (Table 4.3) and having level education up to high school or more (Table 4.4). It is interesting to note that among the 27.02 percent of the respondents with degree and above education level, one respondent was with B.Sc. Agriculture degree and another one was a B.Sc. Botany graduate. Majority of the respondents in the study area are having an experience of more than 15 years (Table 4.6) and nursery business is the major source of income for 72.97 per cent of the respondents (Table 4.5).

4.1.3 General information on nursery business in the study area

4.1.3.1 Nursery registration

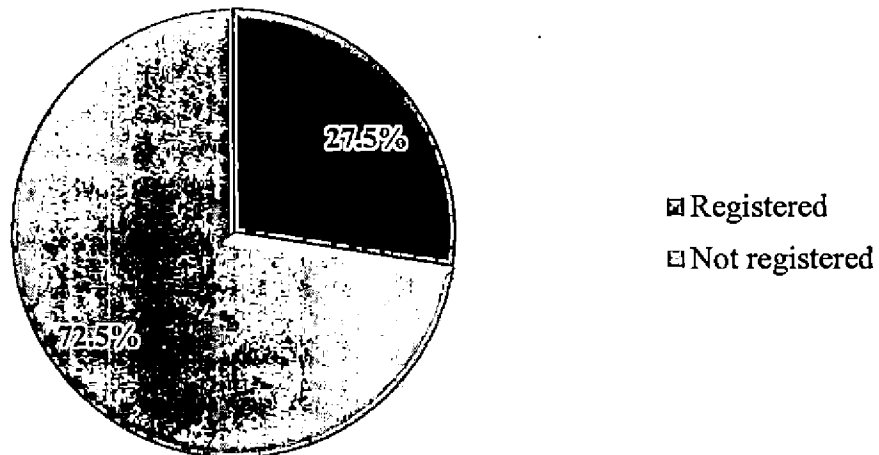
Seeds Act and Nursery Registration Act have been in operation in India since 1966. In 2004 Seeds Bill has been introduced by the Central government and the clauses 23 and 24 of Seeds Bill details about the nursery registration. According to this bill no person shall conduct nursery business unless the nursery is registered under respective state governments. Under the clause 23 the Nursery Registration, holder shall keep the records of origin of every planting materials and performance of mother plants in the nursery. The record holder should furnish the details of production and sales in the nursery and price of planting materials to state governments. He is also responsible for keeping the nursery plants and mother plants free from pests and diseases. Even though a well laid out Act is in the vogue, at present the Nursery Registration Act is in force only in some states like Punjab, Maharashtra, Himachal Pradesh, and Jammu & Kashmir. States like Kerala, Karnataka, Andhra Pradesh, Bihar etc. have only some monitoring and registration mechanism with respect to horticultural nurseries. In these states horticultural nursery registration is not mandatory; which means that apart from licence under Panchayathi Raj Act, horticultural nurseries doesn't need any prior approval from the government. In the absence of any formal system of quality assurance for horticulture planting materials, it is not feasible to put any kind of quality control related restrictions on horticultural nurseries which do not have adequate production related infrastructure and pedigreed mother plants.

Table 4.8 furnishes the details of nursery registration in the study area. It is well understood from the table that majority of the nurseries (72.50 %) in the study area are not registered. Only 22.50 per cent of the total sampled nurseries have registration. Category wise analysis showed that category C-1 doesn't have any nursery which is registered. 33.33 per cent of the nurseries under C-2 and 44.44 per cent nurseries under C-3 are registered nurseries.

Table 4.8. Nursery registration status

Status	Frequency			
	C-1	C-2	C-3	Total
Registered	0 (0.00)	7 (33.33)	4 (44.44)	11 (22.50)
Not registered	10 (100)	14 (66.66)	5 (55.55)	29 (72.50)
Total	10 (100)	21 (100)	9 (100)	40 (100)

(Figures in the parenthesis indicate per cent to total)

**Fig.5. Status of nursery registration in the study area**

Asiedu *et al.* (2012) in their study on nursery industry in Ghana similarly reported that 95 per cent of the sample nurseries did not affiliated to any governmental organizations.

The details regarding the requirements for nursery registration in the state are collected from Principal Agricultural Office and Krishi Bhavan. The minimum

requirements for nursery registration in the state as gathered from the Agriculture Development and Farmers Welfare Department are furnished below.

- For government approval nurseries should have a minimum area of 50 cents in panchayath areas, 15 cents in corporations and 20 cents in municipality.
- The owner should have BSc agriculture or Botany graduation or the nursery should be under the guidance of an Agriculture graduate / Agri diploma/ B.Sc. Botany graduate.
- Irrigation facilities should be there in the nursery.
- An office should be there for the nursery.
- Mother plants orchard should be there with mother plants labelled correctly and planted with required isolation distance.
- Nursery must maintain registers like stock register, work register, sales register and bill book.

Government approval is to be given to the nurseries based on the above criteria.

The registered nurseries in the study area are evaluated based on the above criteria and the following observations were made.

- All the registered nurseries in the study area are having an area of 50 cents or more and are of having required facilities for irrigation.
- All the registered nurseries are under the ownership or under the guidance of an agri expert.
- Registered nurseries in the area have office building facilities.
- Deviation from the requirements of nursery registration is observed with regard to proper maintenance of registers. Only few of the registered nurseries in the study area are maintaining all the required registers.
- In case of maintaining mother plants also, some of the registered nurseries were seen purchasing mother plants from unauthorized sources.

- All the sampled Government nurseries have maintained the required registers and all the registers in government nurseries are filled up to date.
- Mother plants orchard is there for all most all the seedlings produced in the government nurseries and the purchase of mother plants for government nurseries is from recognised farmers, or through Krishi Bhavan and other government agencies.

4.1.3.2 Ownership of land

Fig.6 shows the details of ownership of land. Majority of the nurseries (55%) operating in own land of the nursery owner and 37.50 per cent of the nurseries are operating in leased in land. Sample survey showed that 7.50 per cent of the nurseries operate both in own land and in leased land. Some of the nursery owners reported that unavailability of land and rent rate are the factors affecting the expansion of their business.

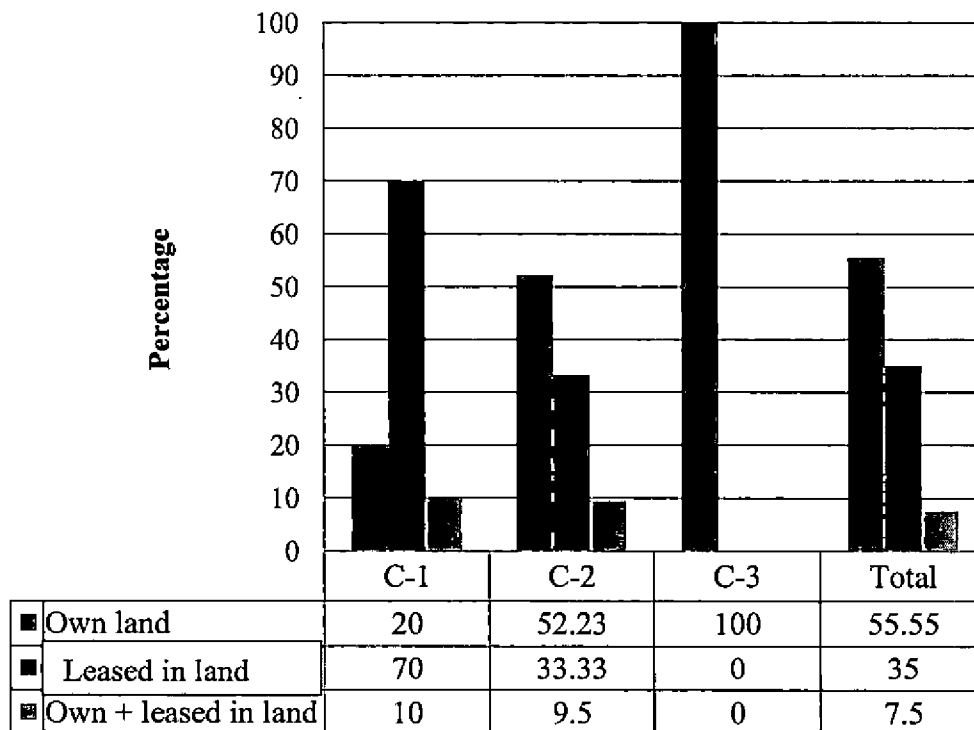


Fig.6. Ownership of the land

4.1.3.3 Production and purchasing of plants by nursery owners

Horticultural nurseries undertake distribution of planting materials, both produced in the nursery itself and purchased from other nurseries. In 92.50 per cent of the nurseries both purchase and production activities are there. Again in these 92.50 per cent of nurseries, except for a few nurseries, most of the nurseries are producing fewer plants in the nursery and are purchasing majority of their plants offered for sale from other nurseries. From this it is clear that plant production activity in the area is not up to the mark, even though the locality is very well known for plant nursery business. All the government nurseries are producing all the plants in the nursery using their own source of mother plants or purchased source of mother plants from other recognised mother plant sources.

Table 4.9. Distribution of nurseries based on the production and purchasing of plants by nursery owners for sale

Category	Frequency
Nurseries producing all the plants offered for sale	3 (7.50)
Nurseries purchasing all the plants offered for sale	0 (0.00)
Nurseries with both production and purchase of plants	37 (92.50)

(Figures in the parenthesis indicate per cent to total)

4.1.3.4 Source of technical assistance

Nursery growers seek technical advice on various issues relating to crop management. The positioning of large number of nurseries around KAU in Mannuthy is often justified by the technical support also to some extent. Table 4.10 shows the source of technical assistance to the plant nursery owners. The results revealed that most of the nursery owners (57.50 %) seek technical advice from members of nursery association and Plant Protection Chemicals (PPC) dealers. The respondents revealed that in case of pest and disease management

majority are seeking the help of plant protection chemical dealers including nursery association. Only 27.50 per cent of the nursery owners were seeking knowledge from KAU, even though the university is very much near to them. The sort of assistance sought included identification of pests and diseases and its remedial measures and soil testing. Category wise analysis showed that 66.66 per cent of the respondents under the category C-3 and 23.80 per cent of the respondents under the category C-2 were approaching KAU for technical support while none of the respondents in the category C-1 was seen approaching KAU for technical advice.

Table 4.10. Source of technical assistance

Source	Frequency			
	C-1	C-2	C-3	Total
Kerala Agricultural University	0 (0.00)	5 (23.80)	6 (66.66)	11 (27.50)
Agriculture Development and Farmers Welfare Department	1 10.00	3 (14.28)	2 (22.22)	6 (15.00)
Neighbours and friends	9 (90.00)	13 (61.90)	1 (11.11)	23 (57.50)
Total	10 (100)	21 (100)	9 (100)	40 (100)

(Figures in the parenthesis indicate per cent to total)

- All the sampled Government nurseries have maintained the required registers and all the registers in government nurseries are filled up to date.
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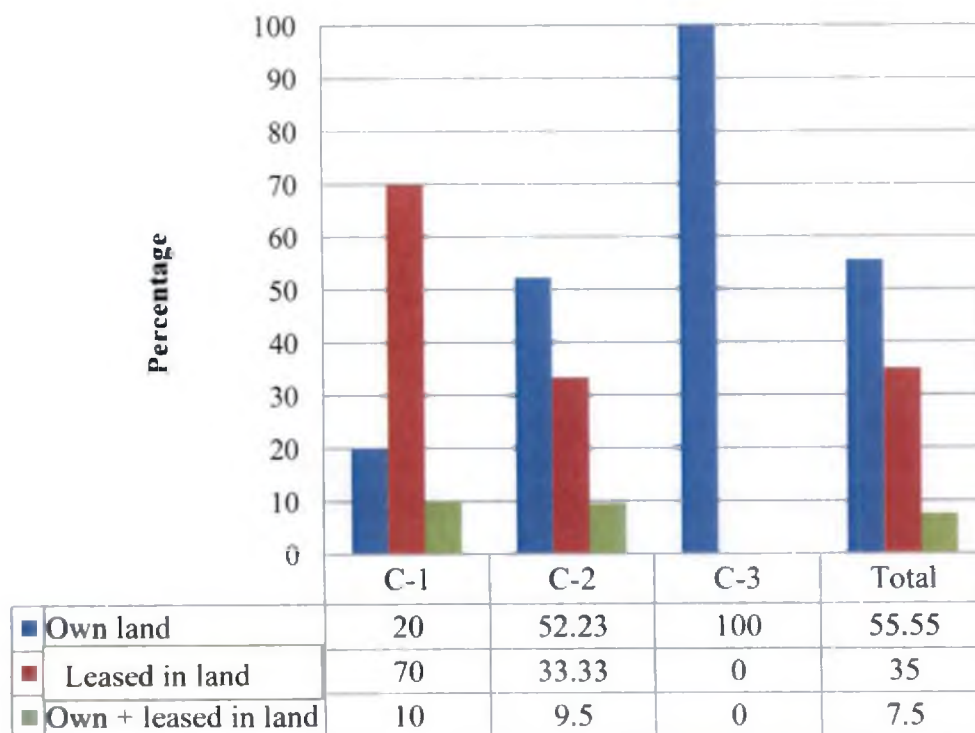


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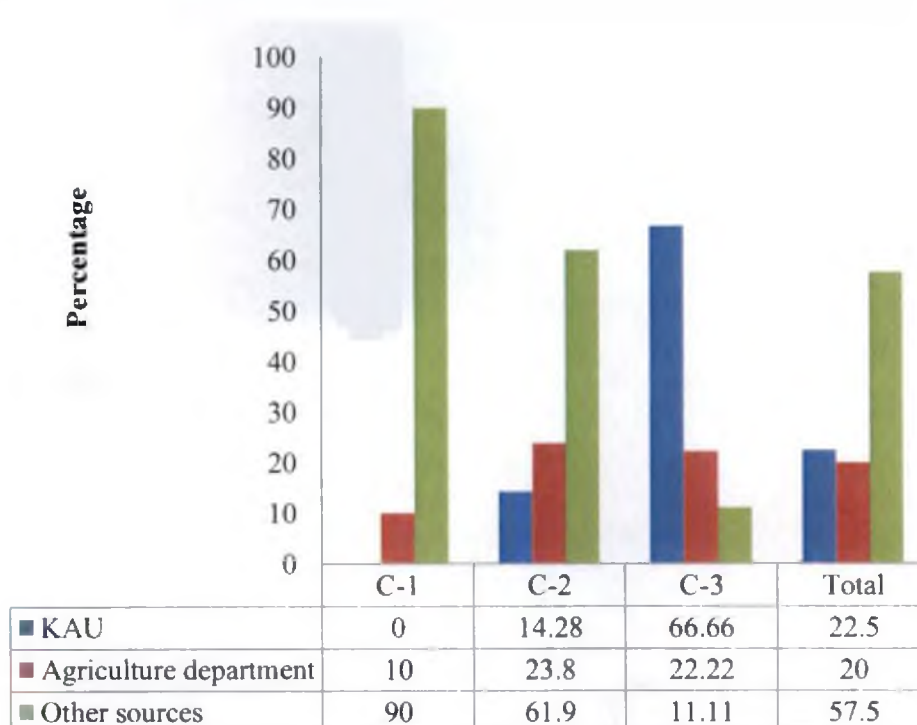


Fig.7. Source of technical assistance

4.1.3.5 Source of irrigation and method of irrigation

The distribution nurseries based on their source of irrigation is presented in the Table 4.11. Well, tube well, pond and canal are the sources of irrigation and majority of the nurseries have open well for irrigation purpose. Nearly 77.50 per cent of the nurseries have either well or tube well only as the source of irrigation. 20 per cent of the nurseries have both well and pond for irrigation purpose. All the nurseries coming under the category C-3 are having more than one source of irrigation. 2.5 per cent of the nurseries have canal water as irrigation source.

Table 4.12 furnishes the distribution of nurseries based on the method of irrigation. Manual irrigation, sprinkler irrigation and drip irrigation are the methods of irrigation generally followed in the nurseries. Manual irrigation by labourers using hose is found in all the nurseries. Sprinkler irrigation is found in about 37.50 per cent of the nurseries and only 12.50 per cent of the total nurseries having drip irrigation. The category wise analysis showed that drip irrigation is found only in nurseries under the category C-3. About 55 per cent of the nurseries

under this category are having drip irrigation. Sprinkler irrigation is found in all the three categories of nurseries. 77.77 per cent of the nurseries coming under the category C-3, 33.33 percent of nurseries under the category C-2 and 10 percent of the nurseries under C-1 are having sprinkler irrigation.

It is evident from the table 4.12 that medium and large scale nurseries are having the irrigation facilities like sprinkler and drip. In case of medium scale nurseries also only a few of the nurseries are having these irrigation facilities. It could be concluded that the modern irrigation infrastructure is not well developed in case of small and medium scale nurseries in the study area.

Table 4.11 Source of irrigation

Source of irrigation	Frequency
Well/ Tube well	31 (77.50)
Well/ Tube well + Pond	8 (20.00)
Canal	1 (2.50)

(Figures in the parenthesis indicate per cent to total)

Table 4.12. Method of irrigation

Method of irrigation	Frequency			
	C-1	C-2	C-3	Total
Drip	0 (0.00)	0 (0.00)	5 (55.55)	5 (12.50)
Sprinkler	1 (10.00)	7 (33.33)	7 (77.77)	15 (37.50)
Manual	10 (100)	21 (100)	9 (100)	40 (100)

(Figures in the parenthesis indicate per cent to total)

4.1.3.6 Infrastructure facilities

Table 4.13. Infrastructure facilities

Infrastructure facility	Frequency			
	C-1	C-2	C-3	Total
Rain shelter	8 (80.00)	13 (61.90)	9 (100)	30 (75.00)
Shade house	1 (10.00)	3 (14.28)	5 (55.55)	9 (22.50)
Polyhouse	0 (0.00)	4 (19.04)	5 (55.55)	9 (22.50)
Office building	3 (30.00)	9 (42.85)	8 (88.88)	20 (50.00)

(Figures in the parenthesis indicate per cent to total)

75.75 per cent of the total sample nurseries own rain shelter. Poly house facility is found in 22.50 per cent of the total nurseries, 22.50 per cent of the nurseries having shade houses and 50 per cent of the nurseries having office building facilities. Nearly $\frac{1}{4}$ of the total nurseries (24.24 %) do not have any of the protected cultivation structures like rain shelter, shade house or polyhouse. Lack of such protected structures often lead to crop loss due to hostile weather, pest and disease conditions.

4.1.3.7 Products available in the nursery

All the nurseries in the study area are mixed nurseries with a wide range of product portfolio. Since the nursery production is season or weather dependent and the demand of planting materials may fluctuate even within the seasons, this wide range of products will help the nurseries in overcoming the problems of fluctuations in the demand. Here an attempt was made to categorize the various products and services available in the nurseries in the study area.

Table 4.14. Products available in the nursery

Products	Frequency
Plantation crops	40 (100)
Fruit plants	40 (100)
Vegetables	7 (17.50)
Medicinal plants	2 (5.00)
Flowering plants	38 (95.00)
Foliage	37 (92.50)
Palms & Bamboos	35 (87.50)
Tissue culture plants	4 (10.00)
Lawn grasses	4 (10.00)
Seeds	4 (10.00)
Compost and coir pith	6 (15.00)
Garden setting items	3 (7.50)

All the nurseries have plantation crops and fruit plants. 17.50 per cent of nurseries have vegetable seedlings production. In five per cent of the nurseries medicinal plants are kept for sale in large scale. Flowering plants are another major item in the nurseries and only five per cent of the nurseries are not having them. Ornamental palms and bamboos are there in 87.5 per cent of the nurseries. Tissue culture plants with hardening facility, lawn grasses and seeds are seen in 10 per cent of the nurseries. 15 per cent of the nurseries are having compost and coir pith blocks among their products and in 7.5 per cent of the nurseries having garden setting items among the product mix.

4.1.3.8 Major plants species in the nursery

The horticultural nurseries in the study area in general were found to produce and sell a variety of plant species. An attempt is made here to categorize them under the major types is given in the table 4.15.

Table 4.15. Major plant species in the nursery

Category	Available plants
Fruit plants	Mango, Jack, Apple, Banana, Rambuttan, Pulasan (<i>Nephelium mutabile</i>), Mangosteen, Sapota, Rose apple, Guava, Noni (<i>Morinda citrifolia</i>), Garcinia, Mosambi, Litchi, Durian (<i>Durio zibethinus</i>), Fig, Grapes, Longan, Plum, Peach, Papaya, Miracle fruit, Passion fruit, Pomegranate, Cocoa, Acid lime, Bilimbi. Bread fruit, Butter fruit, Cashew, Citrus, Egg fruit, Kokum, Lovi lovi, Malayan apple, Soursop, Tamarind, West Indian cherry , Karonda cherry, Star fruit, Peach, Ambazham, Langsat, Pistha, Dragon fruit, Jaboticaba, Malpighia, Cherry, Bush orange, Snake fruit, Maranka, Keledang, Variegated sapota, Velvet apple, Abiou, Wood apple, British cherry, Peanut butter, Australian chestnut, Gac fruit, Jujube, Milk fruit, elephant apple, Baraba, Lakota, Jamaican Star Fruit, Sweet tamarind, Seedless njavaal, Pear, Avocado
Ornamental plants	Rose, Ixora, Taberna, Orchid, Anthurium, Plumeria, Adenium, Chempak, Hibiscus, Bottle brush, Marigold, Gulmohar, Divi divi, Peltoforum, Tabubia, Millingtonia, Rodida, Lauropetla, White cassia, Lilly, Bougainvillea, Water lily, Agave, Araucaria, Asoka, Begonia, Jasmine, Cactus, Casuraina, Cassia, Copper pod, Euphorbia, Fern, Ficus, Gerbera, Golden Cypress, Heliconia, Lotus,

	Manimaruth, Tube rose, Polyalthia, Malpigia, Eugenia, Ball aralia, Musanda, Aglonima, Melostoma, Dressena, Thilandcia, Murraya, Quisqualis, <i>Tacca chandarari</i> , Petunia, Euphorbia, Legistonia, Alamanda, Crossandra, Cosmos, Dahlia, Clitoria, Table rose, Balsam, Hydrangea, Tecoma, Croton, Srilankan Jasmine, Pichy, Canna Varieties, Dracina, Bridal bokka, Ginger lily, Archeria, Juneferes, Exofolima, Pandanus, Safflora, Sinchonia, Starlet, Black lily, White amaranthus, Colroma, Thuja, Terminalia, New decoma, Limonia, Thai pandanus, Arelia finger, Black euginea, Botelaca, Gulfinea creeper, Butterfly ficus, Yellow ficus, Zebra erathium, Legostomia, Furcaria, Eucajamia, Kalyan ram, Kalathia, Iranthimum, Moon light, Yesterday today, Fan tree
Palms & bamboos	Foxtail, Red palm, Finger palm, Kindia palm, Cycas palm, Golden bamboo, Buddha Bamboo, Painting Bamboo, Chinese bamboo, Nullino, Variegated bamboo, Ornamental bamboo, Yellow bamboo, Nolina, Royal palm, Schampia palm, Pencil palm, New bamboo, White bamboo, Multiflex green bamboo, Lathi bamboo, Assam bamboo, Phoenix palm, Bamboo miniature, Black bamboo
Medicinal plants	Poopadiri, Palvalli, Eunthu, Karinjotta, Chuvanna akil, Vella akil, Ingipullu, Thrikolpakonna, Putranjeeva, Neermathalam, Samudrapacha, Kodangal, Maravoori, Manchadi, Mantharam, Karimuthuku, Palmuthuku, Kunderikkam, Incha, Cheru, Uruvanch, Attuvanchi, Nilanarakam, Ganapathinarakam, Marotti, Ekanayakam, Stevia, Bhadraksham, Plasu, Kattujadhi, Payin, Nagapoomaram, Nagalingamaram, Vella erukku, Punna, Ambazham, Chittamruthu, Karimaram, Kallurvanchi,

	Vayangatha, Thanni, Manithakkali, Elam, Vella kadambu, Erattimathuram, Neelakoduveli, Vellakoduveli, Kanjiram, Vetti, Manimaruthu, Aryaveppu, Nilappana, Bangla thippali, Karimaruthu, Padakizhagu, Pachotti, Kattupunna, Vettila, Krishna thulasi, Karpoorathulasi, Aduthinnappala, Cheenikka, Gugulu, Karimanjal, Malangara, Chandanavembu, Kottam, Vahnni, Mala veppu, Panal, Vilar, Edampiri Valampiri, Neyvalli, Boothamkolli, Alpam, Thambakam, Mullillathottavadi, Pothina, Kattuvizhal, Vizhalari, Peenar, Puthirichunda, Kalcheda, Nagavally, Ramba ela, Nannari, Chathuramulla, Kallathi, Kallal, Perumkurumba, Poovarasu, Aval, Orilathamara, Kasthoorivenda, Vazhana, Agasthyathulasi, Kattupadavalam, Chittarutha, Ramacham, Vishamooli,
Plantation crops & spices	Coconut, Arecanut, Nutmeg, Cardamom, Clove, Pepper, Vanilla, <i>Garcinia cambogia</i> , Turmeric, Ginger, Tea, Coffee, Allspice
Grasses	Korean grass, Buffalo grass, Umbrella grass, Carpet grass, Ribbon grass

4.1.3.9 Promotional activities

Table 4.16 shows the promotional methods adopted by the nurseries in the study area. It is understood from the table that more than half of the nurseries (54.54%) do not adopt any promotional activities. 39.39 per cent of the nurseries have their own website in the net. Nearly 10 per cent of the nurseries participate in tradeshow as a promotional measure while 6.06 per cent of the nurseries use television for promotion. A sizeable part i.e., 18.18 per cent of the respondents uses hoardings and boards among their promotional measures while 15.15 per cent of the nurseries advertise through magazines to promote their product and services.

Table 4.16. Promotional activities

Promotional activity	Frequency
Internet	13 (39.39)
Television	2 (6.06)
Magazines	5 (15.15)
Trade show	3 (9.09)
Hoardings	6 (18.18)

(Figures in the parenthesis indicate per cent to total)

From the survey it is found out that large scale nurseries are mostly using promotional methods while medium and small scale nurseries are less involved in promotional activities like advertisements in magazines, television and internet, and participating in trade shows. From this we can conclude that there is a positive relationship between size of the firm and budget allocated for promotional activities. Especially in case of trade shows, only large scale nurseries are participating. According to them trade shows have direct and indirect sale effects. It will help to make contact for future sales, display and promotion of products and to understand what is new in the market.

Hinson (1998) and Ekanem *et al.* (1998) reported similar findings in their study on nursery business in Louisiana and Tennessee respectively.

4.1.3.10 Method of sale

Wholesale and retailing form a major part of the supply chain. Both wholesale method of sale i.e., selling in bulk quantities and retail method of sale i.e., selling in small quantities are found in the nurseries in the study area. In wholesale method of sale other nurseries and garden setting contractors would purchase planting materials from the sampled nurseries in bulk quantities while in retailing individuals would purchase in small quantities. In wholesale method of

sale the planting materials are sold to the final customers indirectly i.e., through other nurseries and garden setting contractors while in retailing the planting materials are directly purchased by the ultimate customer.

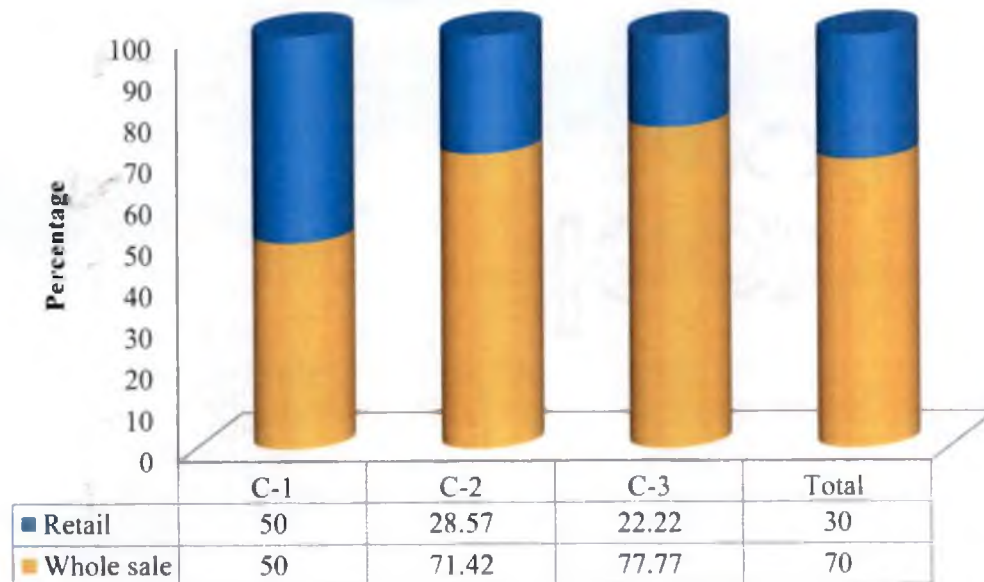


Fig.8. Method of sale

Figure 8. shows the major method of sale in the nurseries. In 70 per cent of the nurseries the major method of sale was whole sale. Category wise analysis also showed that in 50 per cent of nurseries in C-1 and more than 70 per cent of nurseries in C-2 and C-3, the major method of sale is whole sale. In public sector nurseries, the major method of sale was retail.

In their study on marketing trends and business management practices for nursery industry in California Merhaut and Pittenger (2005) reported that nearly 60 per cent of the planting materials are sold through wholesale method to landscapers, retailers and re-wholesalers in the study area.

Brumfield (2001) conducted a market research study on greenhouse industry in Monroe County. Most of the firms in the study area have both wholesale and retail method of sale. But as contradictory to the present study, majority of the sales in the Monroe County greenhouse industry is through retail.

He also reported that smaller greenhouses tend to have more of retail sale and larger greenhouses have high percentage of wholesale method of sale.

4.1.3.11 Customer profile

Figure 9. furnishes the customer profile details in the nurseries. Customer profile showed that more than half of the nurseries have their regular set of customers for purchase of products. They included other nurseries both inside and outside the state; garden setting contractors, farmers, corporate buyers and other individual buyers. Category wise analysis also showed that in half of the nurseries under C-1 and C-2 and more than 75 per cent of the nurseries under C-3, the major portion of the sales was through regular customers. Majority of customers in public sector nurseries are irregular customers.

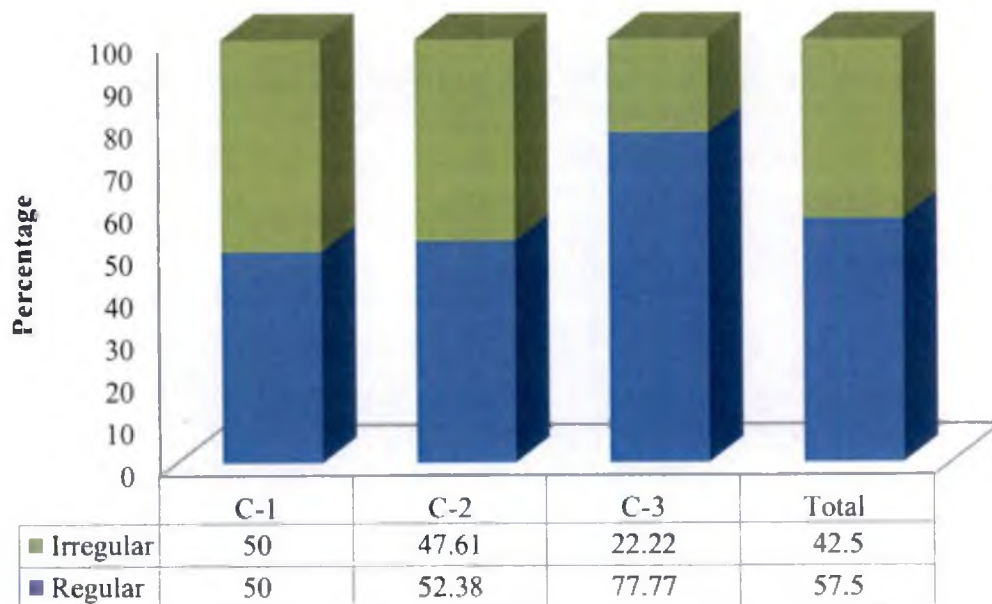


Fig.9. Customer profile

Merhaut and Pittenger (2005) similarly reported that more than 75 per cent of the clientele in the California nursery industry were regular customers.

4.1.4 Mapping of supply chain and supply chain performance

Supply chain “refers to all those activities associated with the transformation and flow of goods and services, including their attendant information flows, from the sources of raw materials to end users” (Ballou, 2004). Functions, product flows and actors are the major components of a supply chain. The basic functions of supply chain are collection, production, wholesale, retail and consumption. The set of supply chain functions is a good starting point for constructing the supply chain diagram. Mapping of supply chain will help to develop a shared understanding of the structure and performance of the industry (Vermeulen *et al.*, 2008). Supply chains in the nursery business in the study area were identified through focus group discussions and interactions with respondents. While mapping the supply chains, private sector nurseries and public sector nurseries were treated as two distinct sets.

4.1.4.1 Supply chain of private sector horticultural nurseries

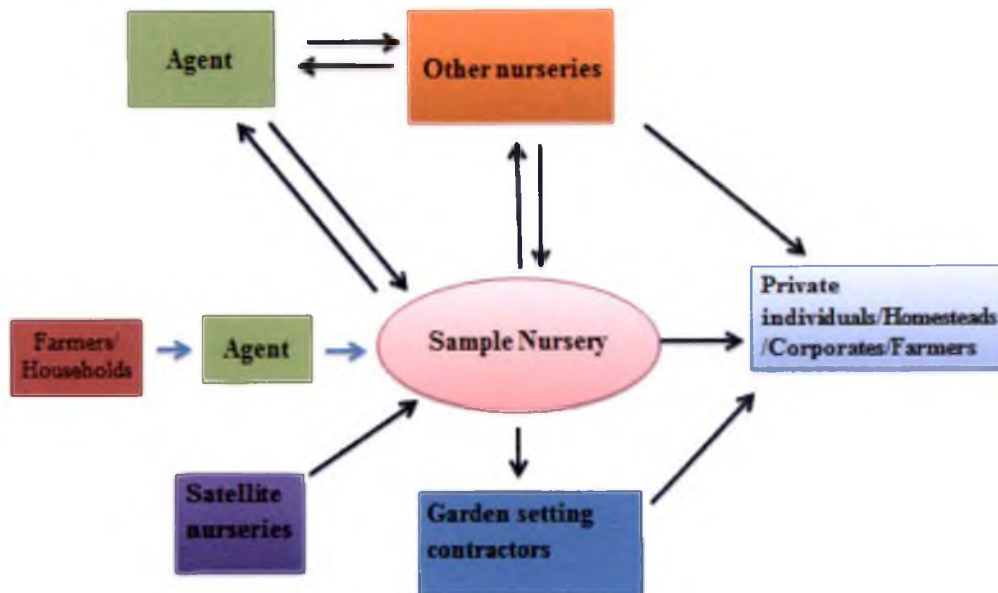


Fig.10. Supply chain map of private sector horticultural nurseries

In case of private sector nurseries two major categories of supply chains were identified, i.e., supply chain of plants produced in the nursery and supply chain of plants purchased from other nurseries. Fig.10. depicts the supply chain map of private sector nurseries in the study area.

The individual supply chains in the supply chain map of private nurseries in the study area are described below:

Chain 1: *Sample nursery - Customers*

This is the simplest supply chain in which the plants that are produced in the nursery are sold to the customers.

This chain is of two types, i.e., direct selling of planting materials to customers or selling indirectly through garden setting contractors or through other nurseries. Here garden setting contractors act as the middle men between the nurseries and customers (Homesteads, Corporates etc.) or other nurseries will purchase from the sample nursery and resell the planting materials to customers. This type of wholesale purchasing by other nurseries is one of the common chains identified in the region. This supply chain is found for the plants for which the source of mother plants is available in the nursery. Plants like coconut, mango, jack etc. and ornamental plants like jasmine, hibiscus, bougainvillea etc. are supplied through this supply chain by majority of the nurseries in the study area.

In case of plants which are easily propagated through cuttings and seeds, most of the nurseries in the study area try to develop their own mother plant source by using cuttings or seeds which are purchased earlier from other nurseries. Some of the nurseries in the area provide garden setting items and some nurseries also help in setting up of gardens on a payment basis.

Chain 2: *Farmers/ Households - Agent - Sample nursery - Customers*

This chain is prevalent if the mother plant source is not available in the nursery itself. An agent will be there collecting and distributing planting materials from mother plants sources from other sources including farmers and households.

This supply chain is most common in the case of coconut, pepper etc. The agent will collect coconut seeds, pepper cuttings etc. for seedling purpose from farmers and households and supply to the nurseries who in turn will use them for making seedlings for sale. The main disadvantage of this supply chain is with regard to the quality of mother plant sources being used. If the mother plants of unknown pedigree are used for the propagation, the quality of seedlings produced will be affected. Both direct selling of planting materials to the final customers and indirect selling through other nurseries is seen in this chain also.

Chain 3: *Satellite nurseries – Sample nursery - Customers*

This supply chain is observed in the case of the large scale nurseries which will identify those farmers with good quality mother plants and assign them with the duty of producing seedlings from the identified mother plants for supply to the nurseries. Another method in this supply chain is that the nursery owner will assign the production of seedlings to private individuals after providing all the inputs and mother plants and the seedlings and planting materials thus produced would be bought back by the nursery. This is a type of subcontracting mostly on commission basis. The peculiarity of this chain is that usually the satellite nurseries would remain as the feeders for one single major nursery in an area. This decentralised model of production contributes significantly in providing local employment and income to the participating families. It is also a cost effective method, as the nurseries need not have to maintain large areas for production and mother plant sources.

The above mentioned chains are seen in nurseries having their own sources of mother plants or purchased source of mother plants. Two more supply chains were identified where the source of mother plants are not available in the nursery or in the locality.

Chain 4: *Other nurseries (inside and outside Kerala and outside India) – Sample nursery - Customers*

In this supply chain, the nurseries would purchase potted plants from other nurseries inside and outside Kerala. This is a kind of whole sale supply chain in which the nursery owners directly purchase planting materials from other nurseries without the help of any intermediaries through orders placed to other nurseries through mail or phone call. The plants thus purchased are sold to the customers.

The large scale nurseries in the study area are importing plants from other countries like Thailand, Philippines, Australia, and China also.

Chain 5: *Other nurseries (inside and outside Kerala) - Agent – Sample nursery - Customers*

This is one of the most common supply chain identified in the study area through which bulk volume of plants are transacted. This supply chain is seen in case of plants transacted inside India only. Here orders would be placed through an agent who will supply the planting materials to the nurseries. The nurseries would contact the agent for the purchase of plants from other nurseries. These types of chains rely on the good will of the agent in their business.

Registered nursery - Government agencies – Farmers

In addition to the above mentioned chains, in the case of registered nurseries another supply chain is identified in which the specific plants produced in the registered nurseries would be purchased by respective Government agencies or departments for distributing to farmers through various government schemes and programmes.

4.1.4.2 Supply chain of public sector horticultural nurseries

The following supply chains were identified for the public sector nurseries.

Chain 1: *Sample nursery - Customers*

Chain 2: *Farmers/Krishibhavan/Government agencies (Collection of planting materials from good quality mother plants)–Sample nursery - Customers*

The first supply chain is similar to the supply chain 1 of private sector nurseries. Public sector nurseries usually maintain their own sources of mother plants for majority of the plants produced in the nursery. For the rest they would collect planting materials or mother plant materials from recognised farmers through Krishi Bhavan and other government agencies. Field quality verification by expert team would be done periodically to ensure the quality of the mother plant materials.

Chain 3: *Sample Nursery - Government agencies – Farmers (through government schemes)*

In this chain government agencies will collect seedlings from the government nurseries for distributing among the farmers through various government schemes. This chain seen in case of registered private sector nurseries also.

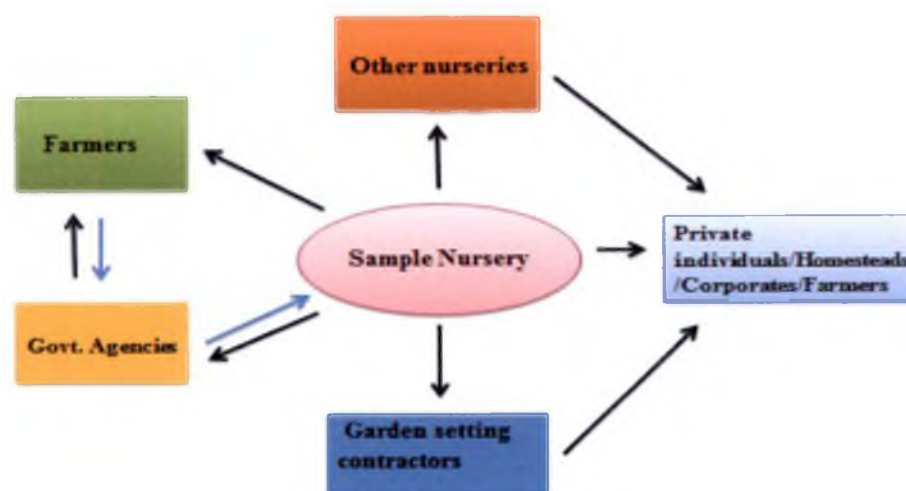


Fig.11. Supply chain map of public sector nurseries

4.1.4.3 Functions in the supply chain

a) Production of plants using own source of mother plants or purchased source of mother plants in the nursery or in satellite nurseries

In majority of the nurseries in the study area planting material production activities are very less. Lack of own source of mother plants is the main reason for this. Nurseries having their own sources of mother plants produce plants in the nursery itself. Some others purchase mother plants from farmers, private individuals or from farms of agricultural departments. In such cases sometimes the purchase of mother plants is routed through agents. But in such case, there may be a possibility of collection of mother plants from unrecognised sources by the agent which would affect the quality of seedlings produced in the nursery.

Here the propagation activities like grafting, layering etc. are done by the skilled labourers in the nursery as piece work or as 'quotation work' given to skilled labourers outside the nursery. Another practice found in some of the nurseries is that the nursery owner will provide mother plants and other necessary inputs to private individuals and assign them to produce plants for the nursery. In some cases the nursery owner will identify farmers or individuals having mother plant sources and assign them with the duty of producing plants for the nursery.

b) Purchasing of plants for resale from other nurseries

It is commonly seen that in all the nurseries and more prevalent among small nurseries. Here plants are purchased from other nurseries inside and outside Kerala and resale them to customers. Some of the nurseries even importing plants from other countries also.

c) Purchasing of plants from other nurseries and growing and repotting before resale

Another activity found in the sampled nurseries was that the purchased plants were grown in the nurseries for a sufficient period of time and after wards



PLATE 2: Nursery business activities – some glimpses

re-potted to bigger sized poly bags and pots. These plants will be offered for sale at much higher rates. This is practiced by all the nurseries in the study area.

d) Developing source of mother plants using purchased plants

In case of plants which are propagated through cuttings, the nurseries are found to develop their own source of mother plants or propagate them using the purchased plants. This method is commonly used for the propagation of plants like ixora, jasmine, bougainvillea, melostoma, taberna etc.

e) 'Barter system' in inter nursery purchase

A system similar to barter system is found among the large scale nurseries in the study area. This is a type of wholesale business among the nurseries, a part or full of the transactions are made by the exchange of plants among the nurseries.

4.1.4.4 Supply chain performance

Supply chain performance refers to the extended supply chain's activities in meeting the requirements ultimate customer, including the availability of the product, its on-time delivery, and all the required inventory and capacity in the supply chain to deliver that performance in a responsive manner (Hausman, 2004).

From the sample survey it is identified that almost all of the nurseries have regular suppliers and customers in their supply chain. But none of these supply chain relations have any contractual agreements. These regular suppliers and customers play an important role in the success of the nursery business. It is the mutual trust and faith among the parties in the 'unwritten contracts' that define the strength of the nursery business.

The performance of supply chain was measured by the model proposed by Aramyan *et al.*, 2006 with suitable modifications. Performance was measured for the two major supply chains identified, i.e., supply chain of plants produced in the nursery and supply chain of plants purchased from other nurseries. A Supply

Chain Performance Index was developed on the basis of three dimensions of the supply chain *viz.*, efficiency, flexibility and quality.

Table 4.17. Performance of supply chain of horticultural nurseries

Supply chain	Supply Chain Performance Index
Plants produced in the nursery	0.86
Plants purchased from other nurseries	0.80

The Supply Chain Performance Index of plants produced in the nursery was estimated to be 0.86 and that of plants purchased in the nurseries was 0.80, which indicates that the supply chain of plants produced in the nurseries was slightly more efficient than supply chain of plants purchased from other nurseries. In other words, both these chains could be concluded as good performing ones.

4.2 ECONOMIC ANALYSIS OF HORTICULTURAL NURSERY BUSINESS

An attempt was made to analyse the employment generation and cost and returns from plant nursery business in the study area. The reluctance on the part of nursery owners in revealing their actual cost and returns, lack of proper maintenance of records on purchase and use of inputs, plants, sales etc. posed serious limitations in the accurate estimation of the costs and returns of nursery business. Another problem encountered is that all the plants produced or purchased in a year need not be sold in the same year and would be carried forward. The nurseries depended on the previous year's demand to assess their production target, and as such proper production records were not maintained by majority of nursery owners. Hence in working out the economics of the nursery business, the researcher had to rely on the recall by the owner mostly and

approximation on various aspects to be done to some extent. Because of these difficulties, cost and returns were calculated based on the previous one year's data only.

4.2.1 Employment generation in the nursery business

The survey results showed that the nursery business in the area could provide employment and income opportunities to local labourers as well as labourers from other states. Employment generation in category C-1 was found to be 2.33 man-days per day. In categories C-2 and C-3 the employment generation was found to be 4 man-days per day and 20.66 man-days per day. The average working days in a year is 260 days with 8 hour per day work. So, total employment generation in an year in different categories of nurseries was found to be 605.80 man-days per year in C-1, 1040 man-days per year in C-2 and 5373.33 man-days per year in C-3. The average size of nurseries under the category C-1 was 30 cents and that of C-2 and C-3 were 80 cents and 6 acres respectively. Most of the local labourers are females. Predominance of labourers from other states is found as a feature of nurseries in the study area. On an average a female labour gets a wage rate of Rs. 225- 275 per day while labourers from other states are getting Rs 300/ day. Nursery industry was also found to provide employment opportunities to skilled labourers for doing budding, grafting and layering as quotation work.

A general situation observed in the study area is that many of the labourers who after acquiring sufficient skill training on nursery technique as labourers in the horticultural nurseries where they are working, have turned out to be entrepreneurs by starting their own nursery business. This is a welcome gesture as far as the local economic development is considered, but a challenge to the already existing nurseries.

Table 4.18 shows the labour pattern in the nurseries. It is clear from the table that in 45 per cent of the nurseries, labourers from outside Kerala are working. 55 per cent of the nurseries engaged local labourers alone. This

indicates that nursery industry plays an important role in providing income and employment opportunities to the rural poor in the study area.

Table 4.18. Pattern of labour use in the nurseries

Category	Frequency
Nurseries with local labourers (Keralites) alone	22 (55.00)
Nurseries with labourers from outside Kerala	18 (45.00)

(Figures in the parenthesis indicate per cent to total)

Government nurseries also provide plenty of employment opportunities and skill based trainings to native labourers. At the same time all the labourers in the government nurseries are native labourers. Table 4.19 showed the details of employment generation from the nursery business in the study area.

Table 4.19. Employment generation in the nurseries

Category	Man-days/day	Man-days/year
C-1	2.33	605.80
C-2	4	1040.00
C-3	20.66	5373.33

4.2.2 Economics of horticultural nursery business

Scattered production units are an important feature of nursery business in the study area. i.e., many of the nurseries are having separate production units and sales outlets. Full details of the owned capital assets (excluding land) were not

given by the respondents. So, due to fear of under estimation of costs, in the analysis only the cost at Cost A level has been attempted.

The category wise details of cost incurred in the nursery business in the study area are given in the table 4.20.

Table 4.20. Input wise cost incurred in the nursery business (2014-15)

Items of cost	C-1(Rs./year)	C-2(Rs./year)	C-3(Rs./year)
Planting materials and plants from other nurseries	721000	1200000	4800000
Manures and fertilizers	15000	37500	7800
Plant protection chemicals	5000	10600	30000
Potting mixture	42700	61000	660000
Pots and poly bags	128000	240000	666000
Labour charge	192400	455000	1755000
Power charge	6000	9600	15000
Depreciation	15000	27000	81000
Total(at Cost A ₁)	1125100	2040700	8290800
Land rent	54000	120000	-
Total(Cost A ₂)	1179100	2160700	8290800

Table 4.21 furnishes the details of cost incurred per acre per year in the plant nursery business in the study area. The cost incurred per acre per year in the nurseries under the category C-1 was found to be Rs. 2,308,750. In nurseries

under the categories C-2 and C-3 the cost incurred were found to be Rs. 2,700,875/acre/year and Rs. 1,381,800/ acre/ year. The low cost per acre per year in C-3 category may be due to economies of scale.

Table 4.21. Cost incurred (Rs. per acre per year)

Category	Cost (Rs./acre/year)
C-1	2,308,750
C-2	2,700,875
C-3	1,381,800

4.2.2.1 Share of different components in Cost A

Fig.12 shows the share of different components in the Cost A in three categories of the nurseries. The major share of cost in all three categories of nurseries was accounted for the purchase of plants and planting materials. Labour charge was the second most important component in the cost per year of nurseries and it accounted nearly 20 percent of the total cost in a year.

Mohanani (2015) studied economics of orchid flower trade in Kerala. The results of the study similarly reported that cost of planting material constituted the major share (80%) in Cost A₁, followed by hired labour (7%).

Brumfield and McSweeney (1998) similarly found out that largest annual expense was labour for Australian nurseries and nurseries producing potted ornamental plants in the United States. But cost of plants and planting materials were the largest annual cost than labour in other nurseries in United States.

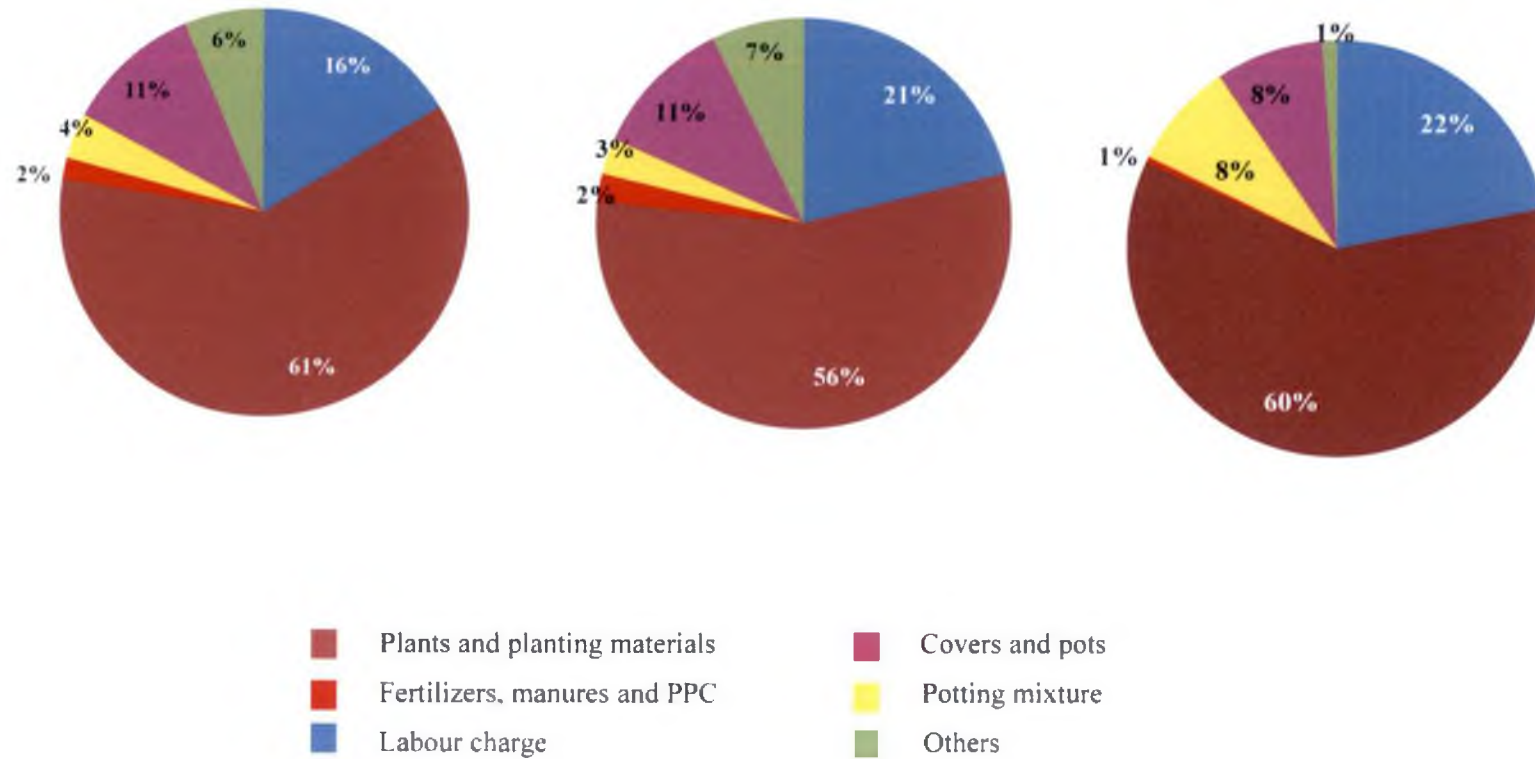


Fig.12. Share of different components in Cost A

4.2.2.2 Returns

Total returns in the case of plant nursery business are constituted of income from the sale of nursery plants. Total returns per year from nursery business are presented in the table. The total returns per acre per year of nurseries under the category C-1 was found to be Rs. 3,630,333. In case of nurseries under the category C-2 the estimated returns/acre/year was Rs. 4,468,125. A return of Rs. 2,709,166/acre/year was found in the nurseries comes under the category C-3. The return per acre per year was found to be low in the case of nurseries under the category C-3. This may be due to the under estimation returns in this category.

Table 4.22. Returns from nursery business

Category	Returns (Rs/ acre/year)
C-1	3,630,333
C-2	4,468,125
C-3	2,709,166

4.2.2.3 Benefit Cost Ratio

Benefit Cost Ratio is an important measure which deals with the profitability of the business. Because of the difficulties in getting information on the economics of the nursery business, as the business is very complex one, costs and returns were calculated based only on the previous year's data collected from the nursery owners. Hence BC ratio is not discounted.

BC ratio was found to be well above unity in all the categories of nurseries. It indicated that the investment is of worth in all the categories. The estimated BC ratio of category C-1 was 1.56 and C-2 was 1.65. A higher BC ratio was estimated in category C-3 which is 1.92. So we can conclude that nursery business in the study area is a profitable venture.

Table 4.23. Benefit cost ratio of nursery business

Category	BC Ratio
C-1	1.56
C-2	1.65
C-3	1.92

Haque *et al.* (2007) in their study on plant nursery business in Gazipur and Jessore districts of Bangladesh also estimated the benefit cost ratio of plant nurseries in the region as 1.43. Hegde and Patil (2007) reported that the estimated benefit cost ratio of mango fruit plant nurseries in Karnataka was around 1.9. The benefit cost analysis of private plant nurseries in Oyo State, Nigeria revealed that the nursery business is a profitable venture with 1.35 as BC ratio. The studies conducted by Ajayi and Babalola (2007) and Shukla (2010) also reported that the nursery business is a profitable venture with more than one benefit cost ratio (1.5 and 1.44 respectively).

Balamurugan *et al.* (2014) in their study on production, post-harvest handling and marketing of cut-flowers in Tamil Nadu has reported that flower production in Tamil Nadu is a highly profitable business with BC ratio nearly 2.

Sharma *et al.* (2014) studied economic feasibility of major flower crops in Himachal Pradesh. Benefit cost ratio (BCR) was estimated to be 2.37, 2.01, 1.89, 2.39 and 2.89 for carnation, gerbera, liliun, chrysanthemum and rose, respectively.

Jahan (2009) reported that the production of flowers is a profitable business as the returns are double than cost, which indicate high profitability. These results are also in line with the study of Dadlani (2003) and Manzoor *et al.* (2001).

4.3 CONSTRAINTS IN HORTICULTURAL NURSERY BUSINESS

During the pilot survey an attempt was made to understand the constraints faced by the nursery owners in the study area. The following were the constraints identified which are affecting the nursery business in the study area. The respondents were asked to rate the constraints according to their importance in a continuum starting from 1= not important to 4= very important. The constraints were prioritised on the basis of the highest mean rank obtained (Table 4.23).

Table 4.24. Constraints in the nursery business

Constraints	Rank
Weather related problems	8
Pests and diseases	7
Land availability	5
Labour shortage	4
Competition from new nurseries	1
Credit constraints	6
Availability of raw materials	2
Cost of raw materials	3

The most important problem affecting the nursery business in the study area as stated by the nursery owners is the competition from other nurseries. Since the plant nursery business in the district is clustered in the region with more than 500 nurseries, all the nursery owners are facing the challenge of market competition. The problem of mushrooming of nurseries is adversely affecting small and medium sized nurseries than the large nurseries. But, from a market point of view, market competition could not be considered as a constraint, it is rather an opportunity for markets to develop.

The second most important problem affecting the nursery business in the study area is found to be the availability of raw materials. Soil, sand and coir pith are the important raw materials for the nursery industry. But at present, the availability of them is becoming an important constraint in the study area. Availability of soil is the most important problem affecting the business. Soil, sand and coir pith are used by the nursery owners as potting mixture, so their shortage would affect the business. In order to compensate the unavailability of sand, nursery owners are using coir pith. But coir pith is not a suitable growing medium for all types of plants. Use of cow dung in the potting mixture is found to aggravate the weed problems.

The cost of raw materials is yet another constraint stated by the nursery owners. Due to the unavailability of sand, coir pith is used in the potting mixture. But the cost of coir pith is very high. The high cost of raw materials is more affecting small and medium sized nurseries than the larger nurseries.

Scarcity of labourers, especially skilled women labourers have also been identified as an important constraint by the plant nursery owners in the study area.

Many of the nurseries in the study area are operating in leased lands. Land availability is another factor affecting the possibility of expansion of the nursery business. Most of the small and medium sized nurseries in the study area are operating in leased lands and the nursery owners have to bear the burden of high rent rates for the land. Some of the nursery owners opined that unavailability of land at reasonable rates is a factor affecting their business expansion plans.

Only a few of the nursery owners rated credit constraint as an important problem they are facing in the business. From this it is clear that nursery business in the study area is very much profitable.

Pest and diseases and weather related issues are the other problems listed by the nursery owners in the study area. Every agricultural activity is very much dependent on weather parameters and very much affected by pests and diseases.

Even though the plants are kept in the nursery for a short period of time, nursery plants are not free of pest and diseases. Pest like mites, caterpillars, other sucking pests, leaf folders, thrips, mealy bugs, termites etc. and diseases like yellowing, blight, mosaic etc. are seen in nursery plants. From the survey it is found out that excess rain fall during rainy season is affecting the business. It is mainly due to the fact that most of the small and medium sized nurseries in the area doesn't have proper infrastructural facilities like rain shelter. So during the rainy season this is affecting the nursery plants. Water availability is not a problem as far as the nursery business in the region is considered. This is mainly because the area is getting plenty of water from Peechi dam during summer period.

The study conducted by Brumfield and McSweeney (1998) similarly identified that increasing number of nurseries entering in the market is considered as the major constraint by the nursery owners in Australia. Guijarro *et al.* (2001) also reported competition as one of the major constraint faced by the plant nurseries. Brumfield (2001), in his study on greenhouse industry in Monroe County, reported competition as one of the major factor affecting the business in the study area.

The study conducted by Kunuku *et al.* (2013) also reported labour shortage as one of the major constraint faced by the nursery owners in East Godavari district of Andhra Pradesh. Haque *et al.* (2007) similarly reported lack of efficient labour as one of the constraint faced by the nursery owners in Gazipur and Jessore districts of Bangladesh.

Mou (2012) reported high cost of raw materials as the major problem faced by the flower farmers of Bangladesh.

As contradictory to the findings of the study, Fakayode *et al.* (2008) reported inadequate funding as the major problem to the ornamental plant production. Haque *et al.* (2007) reported lack of credit as first ranked problem for government plant nurseries in Gazipur and Jessore districts of Bangladesh. Larinde and Santus (2014), Enesi *et al.* (2016) and Asiedu *et al.* (2012) also

reported lack of financial support as the major constraint faced by the plant nursery owners.

Summary



5. SUMMARY

Horticultural nursery industry has been an important component in the agricultural base of our country. The role of nurseries in rural economy, in terms of income and employment generation is well acknowledged. The study was conducted with the specific objectives to study the supply chain management, income and employment potential and constraints faced by horticultural nursery business in the study area.

Primary data on horticultural nursery business was collected from Thrissur district of Kerala. 40 respondents were selected through simple random sampling method for an in depth study of supply chain management of horticultural nurseries. A post stratification of the sample was done based on the operational area of nurseries and accordingly nurseries were classified into three categories. All the nurseries with an operational area of less than 50 cents were classified under the category C-1. Category C-2 included nurseries with an area of 50 cents – 2 acres and the category C-3 included nurseries with area of more than 2 acres. The profile of nursery owners and general information on nursery business were also attempted. Descriptive statistics like frequencies and percentages were used to interpret the data on the profile of nursery owners and general information on nursery business. Supply chains in the study area were identified and the Supply Chain Performance Index was estimated. Cost incurred in nursery business was worked out using ABC cost concepts. Employment generation in the nurseries was also estimated.

Analyses of profile of nursery owners revealed that majority of the respondents were male with education level above high school. Majority of the respondents in the category C-3 were having an education level above graduation. Large scale nurseries were operated by resource rich, educated entrepreneurs. Nearly 70 per cent of the respondents had more than 10 years of experience in the horticultural nursery business. Infrastructure facilities in the nurseries showed that

in large scale nurseries the facilities were well developed while small and medium scale nurseries had limited infrastructure facilities.

Nursery registration status in the study area showed that out of the total 40 sampled nurseries, only 27.5 per cent of the nurseries were registered nurseries. This indicates that for planting material production and distribution, unregistered private sector nurseries dominate the horticultural nursery business. In the absence of any system for monitoring and evaluation the plant nursery business, any kind of quality control mechanism on nursery activities was found very difficult. This warrants the need for a proper mechanism and protocol for nursery management including nursery registration and accreditation. Regular review of the nurseries and periodical renewal of the accreditation may be helpful.

Two major categories of supply chains were identified, i.e., supply chain of plants produced in the nursery and supply chain of plants purchased from other nurseries. Five supply chains were identified in case of private nurseries under these major categories.

Supply chain of private sector nurseries were

Chain 1: *Sample nursery – Customers*

This is the simplest supply chain in which plants produced in the nursery are sold to the final customer.

In this supply chain the plants which are produced in the sample nursery are offered for sale to the customers. It can be of two types: a) direct selling of planting materials to customers and b) selling indirectly through garden setting contractors or other nurseries. Here garden setting contractors act as the intermediary between the nurseries and customers (Homesteads, Corporates etc.) or other nurseries will purchase from the sample nursery and resell the planting materials to customers. This chain is seen in case of those plants for which mother plant source is available in the nursery.

Chain 2: Farmers/ Households - Agent - Sample nursery – Customers

This chain is prevalent if the mother plant source is not available in the nursery itself. An agent will be there, for collecting and distributing planting materials from mother plant sources from farmers and households. So, the nursery will purchase tubers, seeds etc. from farmers and households for which an agent will act as the middlemen between farmers/households and the sample nursery. This supply chain is mostly observed in case of crops like coconut, pepper etc.

Channel 3: Satellite nurseries – Sample nursery - Customers

This supply chain is observed in the case of large scale nurseries which will identify those farmers with good quality mother plants and assign them with the duty of producing seedlings from the identified mother plants for supply to the nurseries. The nursery owners are also found to assign the production of seedlings to private individuals, after providing all the inputs and mother plants and the seedlings and planting materials thus produced would be bought back by the nursery.

Chain 4: Other nurseries (inside and outside Kerala and India) - Sample nursery - Customers

In this supply chain, the nurseries in the study area would purchase potted plants from other nurseries inside and outside Kerala. This is a kind of whole sale supply chain in which the nursery owners directly going purchase from other nurseries without the help of any intermediaries through orders placed to other nurseries through mail or phone call. The plants thus purchased are resold to the customers.

Chain 5: Other nurseries (inside and outside Kerala) - Agent – Sample nursery - Customers

This is the most common supply chain identified in the study area through which bulk volume of plants are transacted. In this supply chain the orders would be placed through an agent who will supply the planting materials to the nurseries.

The nurseries in the study area would contact the middlemen for the purchase of plants from other nurseries.

The supply chains identified for public sector nurseries are as follows.

Chain 6: Sample nursery – Customers

This supply chain is similar to the chain 1 of private sector nurseries.

Chain 7: Farmers/Krishi Bhavan/Government agencies – Sample nursery - Customers

Public sector nurseries usually maintain their own sources of mother plants for majority of the plants produced in the nursery. For the rest they would collect planting materials or mother plant materials from recognised farmers through Krishibhavan and other government agencies.

Chain 8: Sample nursery - Government agencies – Farmers (through government schemes)

In this chain government agencies will collect seedlings from the government nurseries for distributing among the farmers through various government schemes.

Supply chain performance of two major categories of supply chains, i.e., supply chain of plants produced in the nursery and plants purchased from other nurseries was measured for which a supply chain performance index was estimated. The SCPI of chain involving plants produced in the nurseries was 0.86 and that of plants purchased from other nurseries was 0.80.

According to ABC cost concept the cost incurred per year (Cost A) was estimated for all the categories of nurseries. For category C-1 the average cost per year was estimated to be Rs. 1,179,100. While in case of C-2 and C-3 the average cost per year was found to be Rs. 2,160,700 and Rs. 8,290,800 respectively. The major share of the cost incurred was for the purchase of plants and planting materials followed by labour charge.

The total returns per year of horticultural nurseries were estimated. The estimated returns per year of nurseries under C-1 were Rs. 1,847,000. In C-2 and C-3 the returns estimated to be Rs. 3,574,500 per year and Rs. 16,255,000 per year respectively. The BC ratio of C-1 was found to be 1.5 and that of C-2 and C-3 were 1.6 and 1.9 respectively. So the nursery business in the study area was found to be a profitable venture.

The major constraint in the nursery business as perceived by the respondents was the proliferation of new nurseries in the study area. This is mostly affecting small and medium nurseries. Availability and cost of raw materials were the next most important problems as far as the nursery business in the study area was considered. Labour shortage, unavailability of land for business expansion, credit constraints, pest and diseases and weather related problems were also affecting the business environment in the study area.

Policy suggestions

Lack of proper registration and monitoring mechanism leading to the proliferation of nurseries and unhealthy management were identified as major issues in the horticultural nursery business. Horticultural nursery business should be under the ambit of regulation and control and more effective implementation of the rules regarding plant nursery business in our country is suggested. There should be a well-defined mechanism for monitoring the activities in the nurseries and maintaining the quality of planting materials produced in the nurseries. A coordinated effort starting right from the grass root level organizations like Panchayats and Department of Agriculture is required in this regard.

Training programmes and seminars in plant nursery management should be organized for nursery owners and labourers in the nursery. Collaborative efforts from the part of government agencies and private nursery owners for the transfer of new techniques in plant propagation, nursery management practices, and record keeping should be there. Capacity building programmes have to be

undertaken to improve the nursery management skills and planting material production skills.

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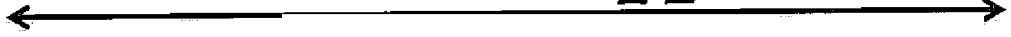
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Appendices



Appendix I: Area and production of horticultural crops in India

Year	Area (million hectare)	Production (million tonnes)
2005-06	18.7	182.8
2006-07	19.4	191.8
2007-08	20.2	211.2
2008-09	20.7	214.7
2009-10	20.9	223.1
2010-11	21.8	240.5
2011-12	23.2	257.3
2012-13	23.7	268.8
2013-14	24.2	277.4
2014-15	23.41	281.0

(Source: GOI, 2016)

Appendix II: State wise details of registered horticultural nurseries in India

State	Number of nurseries under		
	Public sector	SAU's/ ICAR Institutes	Private sector
Andra Pradesh	57	-	913
Arunachal Pradesh	20	-	37
Assam	4	-	82
Bihar	127	27	126
Chhattisgarh	106	1	-
Gujarat	23	14	335
Haryana	25	1	36
Himachal Pradesh	78	-	648
Jammu & Kashmir	77	-	348
Jharkhand	157	2	-
Karnataka	28	-	15
Kerala	64	26	30
Maharashtra	136	42	1300
Madhya Pradesh	270	-	-
Manipur	12	-	41
Meghalaya	31	-	-
Mizoram	9	-	8
Nagaland	2	-	15
Orissa	92	-	62
Punjab	24	7	39
Rajasthan	27	6	22
TamiNadu	74	-	285
Tripura	41	-	9
Uttar Pradesh	79	-	-
Uttarakhand	23	12	176
West Bengal	6	-	80
Total	1592	138	4607

(- data not available)

(Source: Rathakrishnan *et al.*, 2014)

Appendix III: Interview schedule

**KERALA AGRICULTURAL UNIVERSITY
COLLEGE OF HORTICULTURE, VELLANIKKARA
DEPARTMENT OF AGRICULTURAL ECONOMICS**

**Analysis of the supply chain management of horticultural nurseries
Schedule for data collection from horticultural nursery owners**

Declaration

The information provided will be used only for the research work for thesis for Master's Degree and the identity of the respondent/ information provided by them will not be revealed to a third party

Serial No:

Date:

Socio economic profile of the nursery owners

1. Name of the respondent:
2. Address & Contact No:
3. Age:
4. Gender:
5. Educational qualification:
6. Occupation:
7. Annual income:
8. Years of experience in nursery business:

General information about the nursery

9. Name of the nursery:
10. Location:
11. Year of establishment:
12. Type of ownership: Sole Partnership Public
13. Total area of the nursery:
14. Nursery registration details:

a) Registration number :

b) Year :

15. Registers kept in the nursery:

16. Requirements for nursery registration

Requirements	Awareness	Observation
Progeny orchard		
Mother plants are labelled in the progeny orchard		
Keeping required isolation distance		
Following KAU POP recommendations		
Requirements for irrigation		
Quality of planting materials are ensured		
Office building is there for keeping the registers in the nursery		
All the four registers are kept in the nursery		
All the registers are filled up-to-date		
Price list of plants		
Visit Assistant Director of Agriculture		

Employment generation

17. How many labourers are there in your nursery?

		Permanent		Temporary		Skilled		Unskilled	
		Family	Hired	Family	Hired	Family	Hired	Family	Hired
Male	Last year								
	Current year								
Female	Last year								
	Current year								

18. Wage rate to employees:

Wage rate per day (in Rs.)			
Skilled		Unskilled	
Male	Female	Male	Female

19. Has the employees undergone any training programme? If yes, give details

Products and services available in the nursery

20. Major plant types and seasons of sale

Plant category	Seasons of sale	Most demanded plants
Fruits		
Vegetables		
Ornamental plants A) Flowering plants B) Foliage		

C) Grasses		
Palms/ Trees		
Medicinal plants		
Seeds		
Others (Specify)		

21. Which are the plants having demand throughout the year, irrespective of the season?

22. Are you importing any plants? If yes, which are major plants imported and from where you are importing them?

23. Which are the major export destinations and most demanded plants for export?

24. Production and sales in the last year

Plant category	Quantity produced	Sales	Price/ unit quantity

25. Other services from the nursery (If any):

Production and management practices

26. Sources of seeds and planting materials:

27. What are the season wise activities in the nursery?

28. Sources of irrigation: Well Bore well Pond

29. Method of irrigation (Indicate approximate proportion)

Overhead: _____

Drip: _____

Other types: _____

30. Approximate quantity of water used per day

31. Inputs used in the nursery (Last year)

Inputs used	Quantity	Price/unit quantity	Total cost
Fertilizers			
Plant protection chemicals			
Potting mixtures			
Containers			

32. Infrastructural facilities

Nursery structure	Year of establishment/ purchase	Area	Number	Approximate cost
Rain shelter				
Green house				
Glass house				
Transportation vehicles				
Others				

33. Extent of adoption of technologies generated

Technologies	Present / Absent
Micro grafting	
Tissue culture lab facilities	
Introduction of exotic/ new crops	

34. What are the production practices followed in your nursery?

35. How will you ensure the quality of planting materials produced?

36. Major pest and diseases and their management practices

Plant category	Pests	Diseases	Management practices

Marketing practices

37. How many trade shows have your firm represented last year?

38. Who all are your customers?

39. What percentage of your sales is to regular customers?

40. What percentage of your sales is whole sale?

41. What percentage of your sales was made last year using the following sales methods?

Trade show orders: _____ Telephone orders: _____

In person orders: _____ Internet orders: _____

42. How much you spend on advertising each year:

43. Promotion methods:

Promotion method	Approximate cost/year
Internet	
Radio	
TV	
Magazine	
Participating in trade shows	

Factors affecting management and planning

44. Rate the importance of the following factors in determining the prices of your products

Factors	Rating			
	1	2	3	4
Cost of production				
Competitors price				
Grade of plants				
Market demand				
Uniqueness of product				
Previous year's price				
Others(Specify)				

1 = Very important 2 = Important 3 = Minor importance 4 = Not important

45. Rate each of the following factors impacting your business according to their importance

Factors	Rating			
	1	2	3	4
Weather related problems				
Pest & Diseases				
Water availability				
Land availability				
Labour availability				
Market competition				
Credit constraints				
Others (Specify)				

1 = Very important 2 = Important 3 = Minor importance 4 = Not important

46. What are the risk management strategies followed in your nursery

Supply chain performance

47. Do you have any partnership agreement with any of your suppliers and customers? If yes how long has it been in existence?

	Name of the agency	Year of starting of association	Materials/ plants transacted	Approximate quantity per year	Approximate value/ year
Suppliers					
Consumers					

48. Do this partnership include any contractual agreement?

49. How do you value this partnership agreement in influencing your business?

1 = Very important 2 = Important 3 = Normal 4 = Less important 5 = Not important

50. Assess the performance of supply chains by ranking the following dimensions of the supply chain

Dimensions of SC performance	Score	
	Plants produced in the nursery	Plants purchased from other nurseries
Supply chain efficiency a) Cost reduction b) Profit		
Flexibility a) Fill rate		

b) Lead time		
c) Customer satisfaction		
Quality of products		

51. Linkages and contribution of various institutions in nursery business

Institutions	Contributions
Agricultural department	
Kerala Agricultural University	
Banking institutions	

52. What is your advice to prospective entrepreneurs interested in nursery business?

Abstract



**ANALYSIS OF SUPPLY CHAIN MANAGEMENT OF
HORTICULTURAL NURSERIES**

By

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(2014-11-160)

ABSTRACT OF THE THESIS

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(Agricultural Economics)

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ABSTRACT

Success of any horticultural production programme mainly depends on the quality of seeds and planting materials used for the production. Unavailability of adequate quantity of quality seeds and planting materials is one of the most important problems affecting the development of the horticulture sector. Even though plant nursery industry is considered as a sunrise industry in our country, only less attention is given in monitoring its activities, quality control and also in evaluating its role in the economy. The present study attempted to understand the supply chain management, income and employment potential and constraints of horticultural nursery business in the study area.

Thrissur district, which is considered as the hub of nursery business in Kerala, was purposively selected as the location of study. 40 nurseries were selected by simple random sampling method. The sample nurseries were classified on the basis of their operational area as C-1 (<0.5 acre), C-2 (0.5 acre- 2 acre) and C-3 (>2 acre). Accordingly, 52.5 per cent of the nurseries in the study area come under the category C-2, followed by C-1(25%) and C-3(22.5%). Pre-tested interview schedules were used to collect information from sample nurseries. Secondary data were collected from Krishi Bhavan, Principal Agricultural Office and various published sources.

The nursery registration status in the study area showed that only 27.5 per cent of the sample nurseries were registered nurseries. All the nurseries under the category C-1, 66.66 per cent of the nurseries under C-2 and 55.55 per cent of the nurseries under C-3 were not registered.

Supply chain mapping was done to identify the supply chains of horticultural nurseries in the study area. The identified supply chains were Chain 1: Sample nursery – Customers (direct or indirect), Chain 2: Farmers/Households – Agent – Sample nursery – Customers (direct or indirect), Chain 3: Satellite nursery – Sample nursery – Customers (direct or indirect), Chain 4: Other nurseries – Sample nursery – Customers (direct or indirect) and Chain 5: Other

nurseries – Agent – Sample nursery – Customers (direct or indirect). Chain 1, 4 and 5 are the most common supply chains in the study area.

Chain 1: Sample nursery - Customers

This is the supply chain in which the plants produced in the nursery are supplied to the ultimate consumer. This chain can be of two types, i.e., direct selling of planting materials to customers or selling indirectly through garden setting contractors or other nurseries. Here garden setting contractors act as the middle men between the nurseries and customers (Homesteads, Corporates etc.) or other nurseries will purchase from the sample nursery and resell the planting materials to customers.

Chain 2: Farmers/ Households - Agent - Sample nursery – Customers

Here the mother plant source is not available in the nursery. So, in this supply chain an agent will be there for the collection of planting materials from mother plants sources from farmers and households. This supply chain is most common in case of coconut, pepper etc. Here the agent will collect coconut, pepper cuttings etc. for seedling purpose from farmers and households and provides to the nurseries and the nurseries will use them for making seedlings for sale. The main disadvantage of this supply chain is that mother plants of unknown pedigree may be used for the propagation. This supply chain will affect the quality of seedlings produced, if the mother plants are collected from unrecognised sources. This chain also can be of direct or indirect.

Channel 3: Satellite nurseries – Sample nursery - Customers

Here in this supply chain the large scale nurseries will identify those farmers with good quality mother plants and assign them with the duty of producing seedlings from the mother plants they have for the nurseries. Another method in this supply chain is that the nursery owner will assign the duty of the production of seedlings to private individuals and all the inputs and mother plants are also provided by the nursery owner himself.

Chain 4: Other nurseries (inside and outside Kerala and outside India) -Sample nursery -Customers

In this supply chain, the nurseries in the study area are purchasing potted plants from other nurseries inside and outside Kerala. This is a whole sale supply chain. In this supply chain the nursery owners will directly purchase plants from other nurseries without the help of any intermediaries or order will be placed to other nurseries through mail or phone call. The purchased plants will be resold to their customers.

Chain 5: Other nurseries (inside and outside Kerala) - Agent – Sample Nursery - Customers

This is the most common supply chain identified in the study area through which bulk volume of plants are transacted. This supply chain is seen in case plants transacted inside India only. In this supply chain an agent/ middlemen will be there in between other nurseries and the sample nurseries in the study area. The nurseries in the study area will contact the middlemen for the purchase of plants from other nurseries.

The following supply chains are identified for public sector nurseries.

Chain 1: Sample nursery – Customers

It is similar to the Chain 1 of private sector nurseries.

Chain 2: Farmers/Krishibhavan/Government agencies (Collection of planting materials from good quality mother plants) – Sample nursery -Customers

Public sector nurseries are having their own mother plants sources for almost all the plants produced in the nursery. These nurseries will collect planting materials from recognised farmers through Krishi Bhavan and also through other government agencies for which they don't have good source of mother plants.

Chain 3: *Sample nursery - Government agencies – Farmers (through government schemes)*

In this chain government agencies will collect seedlings from the government nurseries for distributing among the farmers through various government schemes. This chain is observed in case of registered private sector nurseries also.

The efficiency of supply chain was measured using the model proposed by Aramyan *et al.*, 2006 with suitable modifications. Including the dimensions of efficiency, flexibility and quality of planting materials in the chains, a Supply Chain Performance Index (SCPI) was developed. The SCPI of the chain consisting of plants produced in the nursery was 0.85 and that of plants purchased from other nurseries was 0.80. Hence, out of the two most common supply chains in the study area, the chain with own production of plants was identified slightly more efficient than the supply chain involving purchase of plants from other nurseries.

Employment generation and income from the nursery business was also worked out. Nurseries under the category C-3 on average generated 5373.33 man-days per year followed by C-2 1040 man-days per year and C-1 605.8 man-days per year. The estimated BC ratio of nurseries under C-3 was 1.92, followed by 1.65 in C-2 and 1.56 in C-1. The nursery business in the study area was identified as a profitable business and they contribute substantially to the income and employment generation in the locality.

According to the nursery owners, market competition was the major constraint affecting their business, followed by unavailability of raw materials and cost of raw materials. Labour shortage, land availability, pest and diseases and weather related issues were the other problems faced by the nursery owners in the study area.

Horticultural nurseries being the providers of seed material for long term investments in farming, supply of quality planting material is of utmost importance. Hence, measures have to be taken to monitor and evaluate the activities in the nurseries in order to ensure the quality of planting materials produced in the nursery. Lack of proper registration and monitoring mechanism leading to the proliferation of nurseries and unhealthy management were identified as major issues in the horticultural nursery business. Horticultural nursery business should be under the ambit of regulation and control and more effective implementation of the rules regarding plant nursery business in our country is suggested. There should be a well-defined mechanism for monitoring the activities in the nurseries and maintaining the quality of planting materials produced in the nurseries. A coordinated effort starting right from the grass root level organizations like Panchayats and Department of Agriculture is required in this regard.

Training programmes and seminars in plant nursery management should be organized for nursery owners and labourers in the nursery. Collaborative efforts from the part of government agencies and private nursery owners for the transfer of new techniques in plant propagation, nursery management practices, and record keeping should be there. Capacity building programmes have to be undertaken to improve the nursery management skills and planting material production skills.

