

## CHAPTER 2: LITERATURE REVIEW

The emphasis of this chapter is given to literature found on similar researches carried out in the world. It comprises of initiating with the industrial back ground and the importance. The industry was divided in to three main sectors (Figure 1.3) and all the relevant issues will be discussed in detail. For the purpose of justifying the literature in a constructive manner, statistical figures and tables were incorporated where ever possible. It was also emphasize the current Sri Lankan Cinnamon industry position in the global market.

It will be further reviewed the impact of the technological applications. Although it is not directly based on the study it will become one of the most influential factors to upgrade the industry. The final part of the chapter will provide significance of the product positioning strategy in the global market with the support from past literature findings. These aspects were given the special emphasis in search for a vital tool to gain the competitive edge from the international market.

### 2.1 Importance of the Industry



University of Moratuwa, Sri Lanka.  
Electronic Theses & Dissertations  
[www.lib.mru.ac.lk](http://www.lib.mru.ac.lk)

Cinnamon tree could be grown successfully within the ideal conditions prevail in Sri Lankan soil. Those areas spread mostly on the southern coastal belt and Ratnapura district (Appendix 5). Subsequently it has been converted to an industry which is mostly important for the international market and enabled to secure a considerable market share.

But there are proof to justify that the Cinnamon was grown initially in the central province areas. Because some places with in Kandy, Matale, Belihuloya, Haputale areas and in Sinharaja forest it is found very ancient Cinnamon cultivations even today (Rupasinghe 2011, 3).

Therefore it is evident that the climatic conditions prevailing in inlands are also helpful for the successful cultivation (Figure 2.1 (a)).

a. In Entire Sri Lanka;



b. In Galle District;



*Figure 2.1: Cinnamon Cultivated Areas*

Figure 2.1 (b) indicates the areas where the Cinnamon cultivated land-density is relatively high within the Galle district and it is shown by the grey area.

Unlike the other plantations the Cinnamon is mainly dependent on how much sunshine it receives throughout the year. Therefore it is not possible to couple with other categories as an inter-crop except for coconut. But in these situations the crop spacing needs to be maintained in such a manner to receive the direct sunlight for each plant (Dias and Sumanasena 2000).

As shown above the southern coastal belt is the suitable area for Cinnamon cultivation. It has been identified major and minor areas of Cinnamon cultivated lands among the region where the minor areas mostly consist of the newly cultivated lands (Figure 2.1 & Appendix 5).

Cinnamon provides direct impact to the economy while extending indirect impacts to the social, political and technological environments. The importance of the industry has significantly increased after it directly connected with the social life of the community. Different parts of the tree have different usages and surprisingly it includes totally different essential chemicals differing in a large scale from one to the other. Due to the special heat trapping capacity of the Cinnamon leaves it is also incorporated as the base material for horse-barns in relatively cold climatic countries. And the Cinnamon sticks left behind after the peeling process are used for making ornamental products and also as an effective fire wood material especially for boilers (Appendix 6). Flowers are used as a medicine for the 'Ayurvedic' medicinal purposes. These are some of the additional purposes of the Cinnamon.

When the commercial viability of the various products extends up to the global market level the importance increases and starts generating significant incomes. It leads to improve the production processes and marketing activities in various forms to meet global customer requirements. But there is no any single product manufactured out of Cinnamon supplied to the export market. But it is evident that Cinnamon is used as a raw material for many product ranges at international level. Therefore the objectives should be to produce such diversified products and obtain the competitive edge affecting the entire range of parameters relating to the country's development.

Increasing figures of volumes and the values of the major export Cinnamon products from the year 2002 to 2008 (Appendix 7) show how important this crop to Sri Lankan economy. It has an ability to improve the GDP with the minimal effort. The importance is not only driven from the export market but also assisted by the consumable Cinnamon products at domestic market. The consumption of spices in local tourist hotels has increased as a result of the boom in the tourism sector. Since this product is very essential for certain Sri Lankan & Indian type curries and also used in many forms to enhance the taste and quality of the meals the consumption has naturally increased.

It is also encouraging to note that the “International Association for Perfumery Industry (IAPI)” has standardized to include 1% of the Cinnamon oil in any perfume manufactured internationally (Rupasinghe 2011, 14).

## **2.2 Decline of the Industry**

Even though the industry performs with a slight positive growth in the export market, the Cinnamon cultivated land extent had declined over the past decades. Most of the large and medium scale Cinnamon cultivators are disappointed with the current situation of the industry. Nowadays it is mostly seen as small scale cultivation units within the industry as a result (Rupasinghe 2011, 14).

Cinnamon total production and the average yield have been decreased without a considerable change in the extent of cultivation during the last two decades. Although Cinnamon has secured a considerable share in the export market, there is a stagnant market in terms of export quantity and values, particularly for its value added products. Eventually, the average retail prices of Cinnamon products have also become stagnant despite of short term fluctuations. The grower’s involvement in producing quality Cinnamon products has drastically diminished.

During the recent decades the motivation and the consideration towards the industry among the cultivators has also has diminished. There are no proper benefits and supports extended for the Cinnamon value chain players in the industry and day by

day the cost of supplies has also increased. This has led to increase the cost of production. But there seems no proper strategy to cover this additional cost from the buyers due to the existing system and their high bargaining power. That directly affects to lose the interest of these Cinnamon value chain players day by day (Paligasnghe 2011).

Although the Cinnamon auctions become a better solution in above situations few major traders are somehow capable enough to demolish such events providing bad experiences. Unavailability of authorized body to protect against this monopoly seems a big problem (Ranasinghe 2011).

### **2.3 Industry Issues in the Plantation & Maintaining Sector**

Plantation and Harvesting is considered as a one unit and the all the issues falling under these two separate sections will be combined together. Since it has already been discussed the history and the importance of this invaluable crop, it is better to concern other characteristics too.

#### **2.3.1 Botanical characteristics:**

The botanical classification of the *Cinnamomum zeylanicum* is as follows:

##### **Domain:**

**Eukarya** - Eukarya is one of the three domains of life that includes Eukaryotes, organisms that contain a “true nucleus”. Organisms also have membrane bound organelles like mitochondria. Eukarya includes all of the plants, animals, and fungi.

##### **Kingdom:**

**Plantae** - Organisms are capable of performing photosynthesis to acquire nutrients.

##### **Phylum:**

**Magnoliophyta** - Organisms with flowering structures (flowers).

##### **Class:**

**Magnoliopsida** - Organisms are dicotyledons and have two seed leaves or cotyledons in the embryo contained in the seed.

##### **Order:**

**Laurales** - Organisms are members of the basal group of dicots. (arise from the base of a stem.)

**Family:**

**Lauraceae** - Organisms are aromatic evergreen trees or shrubs.

**Genus:**

**Cinnamomum** – Organisms have aromatic oils in their leaves and bark.

**Species:**

*Cinnamomum zeylanicum* - “True Cinnamon” is different from other species that belong to the same genus Cinnamomum.

Cinnamon is a natural producer in its environment and provides not only just sugar but is constantly omitting oxygen out into the environment. Cinnamon forms flowers and reproduces sexually by seeds enclosed in an ovary. Its flowers house the female reproductive structures, the carpel, including the ovary, style, and pollen tube and the male reproductive structures, the stamen, including the anther and filament. Pollen grains are called microspores and are required to fertilize the megaspore, the female egg. Pollen is carried to the carpel by means of wind, insects, or other pollinators (Pittman, Ethno-Siu).

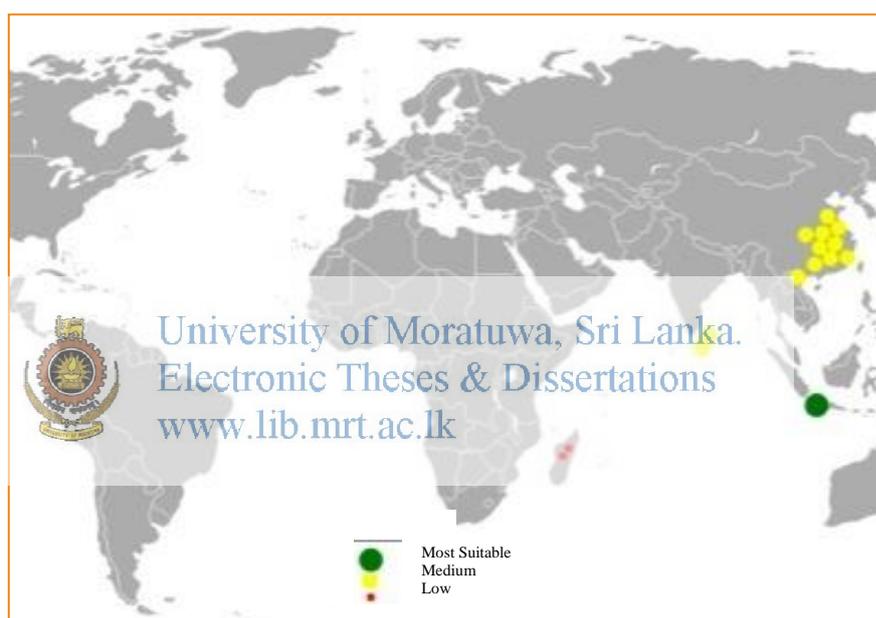
*C. zeylanicum* cross-fertilizes, meaning the pollen and egg are typically from separate organisms. During fertilization the pollen lands on the sticky stigma of the style and travels down the pollen tube where it reaches the ovule and fertilizes the egg. The seed develops in the ovule and are protected by the pericarp or ovary wall. This is the fruit of the plant (Figure 2.2) and houses the seeds. Cinnamon seeds are dicots, meaning they have two cotyledons (Anon 1973, 13-20).



*Figure 2.2 : Cinnamon Fruits*

### 2.3.2 Climate and the soil

For a Cinnamon seed to germinate it requires an average temperature of 20° - 30° C, rainfall of 1250 - 2500mm and elevation of 300 - 350m from sea level. The countries where these ideal conditions prevail at global level are shown in figure 2.3. It also prefers deep, well-drained moist soil that is either loam or sandy and has no root disturbances. Loam soil is a mix of sand, silt or clay and organic matter. The typical life span of a Cinnamon tree in nature is forty to fifty years. However it is different for Cinnamon trees that are harvested for product (Bawappa et al. 2005, 3-4).



*Figure 2.3 : Global Regions suitable for Cinnamon Cultivation*

The quality of the bark is greatly influenced by the soil and ecological factors. The best quality bark is obtained from plants cultivated on sandy soils mixed with humus. Although a higher bark yield could be obtained through planting on other types of soils unfortunately the Cinnamon quality will become inferior (i.e.: the bark becomes coarser).

### 2.3.3 Varieties and potential crop improvement strategies

There are several species of Cinnamon found in South-East Asia. In addition to the cultivated Cinnamon types (*Cinnamomum zeylanicum* or *C. verum*) there exist four other species (Table 2.1) of Cinnamon which are endemic to Sri Lanka (Wijesekera, Ponnuchamy and Jayewardene 1975, 47-69). With the use of these genetic resources Cinnamon plants with elite characteristics can be developed.

Potential technologies available for propagation are identified as ‘Tissue culture technique’ and ‘the selection of vegetative propagated plants’. The second technique is widely practiced in the current scenario. Additionally “Controlled cross pollination technique” is also incorporated in crop improvement.

Table 2.1 : Cinnamon Species found in Sri Lanka

Botanical Name	Common Name	Description
<i>Cinnamomum multiflorum</i> (Wight)	Wal Kurundu or Mal Kurundu	A small tree commonly found in forests
<i>Cinnamomum ovalifolium</i> (Wight)	Wal Kurundu	A small tree rather common in forests
<i>Cinnamomum litseifolium</i> Thw.	Kudu Kurundu	A large trees rare in the mountain zone
<i>Cinnamomum citriodorum</i>	Pangiri Kurundu	Very rarely found

Source : Navaratne and Punchihewa, Faculty of Agriculture

Seven different types (Cultivars) of Cinnamon (*Cinnamomum zeylanicum*) with commercial value are available in Sri Lanka based on pungency of bark and petiole, texture of bark and the structure of leaves. However no botanical descriptions of such varieties are available. Details of them are as follows (Table 2.2):

Table 2.2 : Different Cultivars of *Cinnamomum zeylanicum* in Sri Lanka

Botanical Name	Local / Sinhalese Name
Cinnamomum Type 1	Pani Kurundu, Pat Kurundu or Mapat Kurundu
Cinnamomum Type 2	Naga Kurundu
Cinnamomum Type 3	Pani Miris Kurundu
Cinnamomum Type 4	Weli Kurundu
Cinnamomum Type 5	Sewala Kurundu
Cinnamomum Type 6	Kahata Kurundu
Cinnamomum Type 7	Pieris Kurundu

Source : Navaratne and Punchihewa, Faculty of Agriculture

Two more types of Cinnamon were developed by Cinnamon Research Station at Palolpitiya very recently. They are considered superior over the other types and they were named after two of the most invaluable kings ‘King Dutugemunu’ and ‘King Wijayabahu’, who ruled Sri Lanka. To praise and tribute for their great commitment for the country the two species were named as “Sri Gemunu” and “Sri Wijaya” and their basic improved characteristics are shown in Table 2.3.

Table 2.3 : Characteristics of Cinnamon types Sri Gemunu and Sri Wijaya

Description	Sri Gemunu	Sri Wijaya
Bark Harvest	1100kg	1300kg
Bark oil quality	3.2%	1.4%
Leaf oil quality	3.4%	2.9%
Cinamaldihyde content – in Bark	74.7%	48.4%
Eugenol content – in Leaf	88.5%	90.5%

Source : Rupasinghe 2011, 20.

Spacing of Cinnamon plants is a critical factor in obtaining the optimum yield. It is also dependent on the number of plants per planting point, harvesting frequency and plant nutrition. Higher yields with superior quality of Cinnamon quills were obtained from closer spacing of 1.2m x 0.6 m when compared to wider spacing (1.2m x 1.2m

or 1.2m x 0.9m). Closer spacing leads to tall, straight stems with restricted development of lateral branches. Therefore it is advocated to cultivate in the closer spacing although it leads to difficulties in harvesting and control of pest and diseases on the other hand.

Cinnamon can be established by planting seeds at stake or planting Cinnamon balls. But much better results are obtained by planting seedlings raised in polythene bags under nursery conditions. The latter system permits better selection of planting materials since established selections or vegetative propagated plant materials are not available. In order to improve the efficiency of vegetative production, plant training coupled with harvesting at 6 cm above the collar region at an angle of 45° inward cut is recommended. The highest percentages of bark and leaf oil are obtained when the Cinnamon sticks were harvested after 18 months period (Abeykoon 2000).

Cinnamon is a potential spice crop for inter cropping with coconut in low country intermediate zone of Sri Lanka. An experiment was commenced in 1995 at Narammala to find out the suitability and appropriate plant density of Cinnamon for intercropping with coconut in semi wet, intermediate low country region. Higher growth and yield were obtained in 120 cm x 60 cm with 3 rows and the lowest were in 120 cm x 90 cm with 2 rows and the difference was significant ( $p=0.005$ ). Cinnamon leaf water potential at 120 cm x 60 cm, 3 rows was -13 bars and the critical value may be below -18 bars. This indicates the potential for further expansion of Cinnamon into relatively drier areas. Growth, leaf water status and yield trends indicate that 120 cm x 60 cm spacing with 3 rows of Cinnamon between two rows of Cinnamon appeared to be a suitable planting system for intermediate zone for intercropping with coconut (Dias and Sumanasena 2000).

#### **2.3.4 Propagation**

Two major methods of Cinnamon propagation are ‘Seed propagation’ and ‘Vegetative propagation’, and the selection of the best mother plant is vital aspect in both the situations.

The selection criteria depend on the following characteristics (Wijsekera, Jayewardene and Rajapakse 1974, 1211-20).

- Erect stems with smooth bark
- Vigorous growth
- Easiness of peeling the stem bark
- Free from pest and diseases
- Good quality characteristics (sweetness, pungency, flavour...etc.)
- Dry bark yield (Current average yield in Sri Lanka 470/ha/yr)
- Oil yield - Leaf & Bark (current average oil yield - 0.9% for both leaf and bark oil where it could reach 3% in selected varieties)
- Oil Quality (Percentage of Eugenol in leaf oil and Cinnamaldihyde in bark oil)

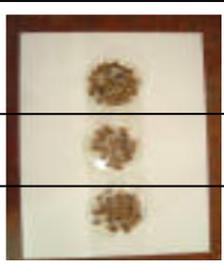
### **Seed propagation**

This is a very simple method and the collected fleshy fruits are left in heaps for about 2-4 days in shade in order to soften and rot. Then the pulp is removed and allowed to air dry. Over fermentation the partially filled seeds and the damaged seeds should be excluded by hand sorting. Only the large and medium sized seeds are selected for further process (Table 2.4).



University of Moratuwa, Sri Lanka  
Electronic Theses & Dissertations  
www.lib.mrt.ac.lk

*Table 2.4 : Cinnamon Seeds Classification*

	<b>Category</b>	<b>Length (mm)</b>	<b>Width(mm)</b>
	Large	>12.5	>9.9
	Medium	8.5 - 12.5	6.1 - 9.9
	Small	<8.5	<6.1

*Source : Navaratne and Punchihewa, Faculty of Agriculture*

The seed viability could fall drastically if kept stored for a long time. Therefore seeding should be done without much delay. At around seven weeks of storage

germination percentage falls almost to zero. So prepared seeds can be kept for around 6 months period by mixing with sand and storing in air tight poly bags under dark conditions without any problem.

Then it should follow the 'Raising seedlings in poly bags method', which is the recommended method. Polythene bags of 12.5 cm x 20 cm size and thickness of 250 gauges with a potting mixture composed of equal parts of top soil and well decomposed cow dung is used to raise seedlings. At least 8 seeds per bag is sown and thinning out is necessary to keep 5 to 10 seedlings per bag. Field planting is carried out after 3 months period and these potting bags can be kept for a maximum of 8 months, if correct potting mixture is used (Bawappa et al. 2005, 5-7).

Potting mixture comprised of the following contents in volume basis.

Top soil (1) : Sand (1) : Cow dung (1) : Coir dust (1)

### **Vegetative propagation**

This propagation method comprised of three different types. They are discussed in detail as follows.



University of Moratuwa, Sri Lanka.  
Electronic Theses & Dissertations  
[www.lib.mrt.ac.lk](http://www.lib.mrt.ac.lk)

#### **a. Propagation by stem cuttings**

Cinnamon can also be propagated by cuttings of young one-leaved shoots or by layering. Partially matured shoots (Semi hard wood) with a node are removed from selected mother plants with desired characteristics. Single node shoots are prepared by making sloping cut just above the node (length of cutting 1"). Cuttings should be put into water immediately and maintained in water until planted in polythene bags. Polythene bags 12.5 cm wide and 20 cm long should be pressed to be firm. The filled polythene bags should be put together, within frames made of bamboo or suitable supports to give beds not more than 1 m wide. The soil under the pots should have been forked over to ensure good drainage. 2-3 cuttings should be placed in each bag. The bed of polythene bags and cutting must be kept moist. In order to prevent water

losses through evapo-transpiration, the bags must be covered with polythene and this type of an arrangement is known as ‘simple propagator’. It is important to protect from direct sunlight. After 2 months, the shade has to be removed gradually for hardening of plantlets. The rooted plantlets are ready for planting in 6-8 months (Figure 2.4).



Figure 2.4 : Propagator under a Shade house

#### **b. Propagation in Vitro**

In this type of propagation technique there is a potential for rapid multiplication of selected plant species with desired characteristics. The possibility of using Plant Tissue Culture techniques for the rapid multiplication of *Cinnamomum zeylanicum* has been established. Ravishankar Rai and Chandra (1987, 81-88) induced multiple shoots from hypocotyls segments of seedlings on Murashige and Skoog's basal medium supplemented with each Naphthalene acetic acid (NAA) and 6-Benzyl Amino Purina (BAP) at 0.5 mg/L. However there is no information about the adoption of Tissue Culture technology for commercial micro-propagation of Cinnamon so far.

#### **c. Air Layering**

The possibility of propagation of *Cinnamomum aromaticum* Nees (Cassia) through Air Layering has been recorded. According to Krishnamoorthy and Rema (1994, 48-49), propagation of Cassia has been achieved through air layering with 50% to 87.5% success depending on the time of the year.

### 2.3.5 Field planting

On flat lands Cinnamon can be planted in straight lines and on sloping lands planting on the contour lines is recommended. Spacing can be adjusted according to land type (Appendix 8).

Planting hole having the dimensions 0.3 m x 0.3 m x 0.3 m can be filled with top soil. Preliminary research has shown that addition of 25 g of Rock Phosphate seems to have a positive effect on root development and the researches are still being carried out. At 1.2 m x 0.9 m spacing one acre occupies 3,600 planting points. Planting must be done at the onset of rains at a rate of 5 plants per hole. Planting holes could also be sown direct with prepared seeds during the rainy season.

Vacancy filling should be done in timely manner, if not the yield is reduced and weed will grow resulting in pest attacks. Transferring of nursery plants in to larger poly bags with the same mixture and allowing them to grow up to 1 1/2 years can be used in vacancy filling (Bawappa et al. 2005, 8).



University of Moratuwa, Sri Lanka.  
Electronic Theses & Dissertations  
[www.lib.mrt.ac.lk](http://www.lib.mrt.ac.lk)

### 2.3.6 Maintenance

This is also a very crucial aspect when considering the productivity of the Cinnamon cultivation. Because there are few valuable aspects to be concerned in the Cinnamon plantation for the effectiveness and it will directly affect the productivity and the long run sustainability within the plantation. They are discussed in detail as follows:

#### a. Soil management

When the land is sloppy the adaptation of soil conservation measures are very important. Following steps should be followed in better soil management system:

- Digging of contour drains at suitable distance depending on the slope and the rainfall. The drains should be deep enough to allow for settlement of eroded soil.

- Mulching with pruned branches and weeds
- Follow recommended spacing

Burying of weeds and pruned leaves around the root stocks is beneficial. Gathering earth up to the root stock without mounting should be done as Cinnamon is a surface feeder. The root stock should be exposed to sunlight to allow new shoots to develop and to prevent termites attacking the root stock (Bawappa et al. 2005, 8).

#### **b. Fertilizer application**

This is an important aspect for commercial cultivation of Cinnamon to improve the productivity, as the crop is normally grown as a long-term monoculture crop. In the absence of fertilizers, the supply of nutrients available in the soil will become exhausted leading to mineral deficiencies and drop of yield. Further it will cause to reduce the content of the bark and leaves. Therefore the optimum application will vary from one region, plantation or field to another in accordance with local conditions. The DEA of Sri Lanka recommends the best fertilizer mixture and the quantities for Cinnamon cultivation in Sri Lanka (Appendix 8).



University of Moratuwa Sri Lanka  
 Electronic Theses & Dissertations  
[www.lib.mrt.ac.lk](http://www.lib.mrt.ac.lk)

The quantity of Fertilizer required will also vary according to the age of the plantation. The recommended rates of fertilizer for young plantations on annual basis are shown in Appendix 8.

The above quantities of fertilizer have to be applied as two splits at six months intervals. The soil should be under moist conditions and therefore it is recommended to apply fertilizers at the commencement of the rains for the best results. Fertilizer needs to be applied at 50 cm radius around the plant or between rows. After applying the fertilizer it is important to fork it into soil.

It has found in the case of symptoms of magnesium deficiency, the application of Dolomite at the rate of 500 kg/ha, 2-3 months prior to the application of the

recommended fertilizer mixture will be advantageous. Maintaining the soil pH value around 4.5-5.5 facilitates better absorption capacities of nutrients by Cinnamon roots.

On the other hand for mature plants it should be considered a different method. After 3 years period Cinnamon plantation is considered as mature. The dose of fertilizer should be doubled for every successive application thereafter. However the fertilizer requirement may be determined according to the yield potential as well (Bawappa et al. 2005, 10-11).

### **c. Training the plant and pruning**

Training of the plant is done to make sure a strong base which is capable of producing a greater number of healthy stems. When the seedlings attain the age of about 2 years and the diameter of the base of the stem is about 4-6 cm the main stem is coppiced or cut back to a height of about 4-6 cm from the ground level. The cutting is done with a sharp Keththa at an angle of 30° in such a way that the cut faces the inside of the clump. This will promote the tillers from the base and only three strong and straight tillers are left for better results. All the other shoots should be removed to promote the growth of these shoots as main stems.

After 1-2 years the main stems are harvested (pruned) alternately. It is necessary to allow each base of the pruned stem to initiate 3 healthy new stems. This would generate 5-8 stems for harvesting after 8-10 years from a single bush per year. It is also important to remove side branches of main stem to promote strong growth of stem which will make it easy to peel the bark. In addition pruning of side branches will expose the base of the plant to sunlight to initiate more tillers from the base (Bawappa et al. 2005, 10).

### **d. Replanting**

When Cinnamon plantations are around 40-50 years old, the ability of regenerating new stems is minimal and this will result in decreased yield. Therefore the

replacement of old or low yielding plantations becomes necessary. If large scale plantation is being contemplated it becomes worthwhile to consider the possibility of distilling the root bark to produce the *Camphor-rich root bark oil* used in pharmaceutical preparations (Bawappa et al. 2005, 12).

### 2.3.7 Pests and diseases

There are no major pests affecting the production of Cinnamon. However in certain areas of Sri Lanka the leaves are found to be attacked by minute arthropods causing gall-formation which results in decrease in leaf oil yield by about 20%. The gall forming mites could be brought under control by spraying a systemic insecticide. According to the Bawappa et al. (2005, 13) there are two types of galls formed in Sri Lankan conditions:

#### a. Gall forming mites - *Erioplytes boisi* Gerber

Galls can be found on the lower surface of the leaves. Galls are pinkish in colour at the beginning and then turned to green over maturity. Mites lay eggs in the leaf tissue and gall formation starts immediately.



University of Moratuwa, Sri Lanka.  
Electronic Theses & Dissertations  
[www.lib.mrt.ac.lk](http://www.lib.mrt.ac.lk)



Figure 2.5 : Galls at Maturity on lower surface

#### b. Jumping Plant louse- *Trioza cinnamini* boelli

Galls can be found on the upper surface of leaves. The eggs are laid on the leaf surface and the gall formation appears to be due to the feeding effects of emerging nymphs.



*Figure 2.6 : Galls at Maturity on upper surface*

Cinnamon Wood Borer (Clear wing moth) is the moth damaging the base of the bush by making holes for laying eggs. In about 4-5 years period whole bush may collapse. The other pest known as Shoot Borer feeds on the tender shoots which results in dying off the upper part of the shoot. Meanwhile Sing et al. (1978, 24-27) reported that there are several major pests, including Cinnamon Butterfly (*Chilasa clytie*), Shoot and Leaf Webber (*Sorolopha archimedioides*), Leaf Miner (*Acrocercops* sp.) and Chafer Beetle (*Popillia*) which distributed in all the Cinnamon growing tracts of India and Sri Lanka.

Apart from these pests, several diseases of Cinnamon have also been reported.

**a. Rough bark**

This is a fungal disease and it will reduce the quality of bark by reducing peeling ability and oil quality. It could be controlled by using Bordeaux mixture, Champion or Follicar.

**b. White root**

This is also a Fungal disease and commonly taken place when rubber plantations are replaced by Cinnamon. This disease affected plants cannot be recovered but further spreading can be prevented by applying sulfur dust.

**c. Leaf spot taken or leaf blight (*Colletotrichum gloeosporoides*)**

Symptoms of this disease are seen as brownish leaf spots and they may enlarge to make large lesion. Spraying 1% Bordeaux mixture or any other copper fungicide may be necessary to control the disease.

**d. Black sooty mould (*Stenella* sp)**

The blackish growth on the leaf surface is the characteristic symptom of this disease. The fungal growth is confined only to the surface and no penetration into

leaf tissues. Since this disease is not severely affecting on the yield, application of fungicides is not necessary.

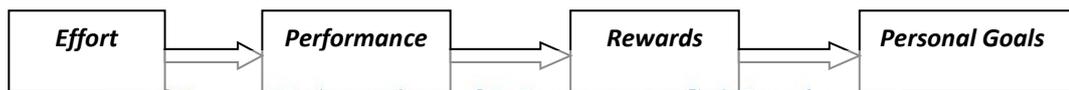
### **2.3.8 Future trends**

Germplasm enhancement or genetic improvement of the crop has not been attempted until recently to meet the requirements of the industry. In the late seventies, the DEA has started a program of collection, conservation and evaluation of the Germplasm of Cinnamon crop.

At the first stage of screening program 100 accessions were selected on the basis of morphological and yield data. In order to strengthen the Cinnamon industry, Germplasm collection, breeding and genetic research are vital aspects. Establishment of two isolated seed gardens using these Germplasm in wet and intermediate zones has been proposed to provide planting material for the new and replanting programs in the major Cinnamon growing areas. Identification of genetic markers for quality and yield characters through molecular techniques and initiation of a program for production of pure lines and analysis of their combining ability has been suggested (Wijesinghe and Pathirana, 2000).

The open-cross pollination habit of the plant has lead to highly heterogeneous plantation in growth, morphology and quality characters. Even though some superior land races have been identified, homogenous plantations could not be established due to lack of sound vegetative propagation techniques. Cinnamon is hard to root & woody species thus cannot be cloned through traditional vegetative propagation techniques, which are generally applicable to other tree species. Vigorously growing plantlets could be produced within a period of 6-8 months and are ready for field planting. Field performance of vegetative-propagated plants is remarkable under good management practices. Successful root initiation could not be obtained in micro shoots so far (Dayatilake, 2000).

Value chain players of the industry always look for commercial benefits on individual basis but not to develop the whole industry as a one unit. That concern might show good results in short run. It is clear that people's motivation rises along with the expectations that will support to fulfill their aspirations (Figure 2.7). The issue is that the some stakeholders may also look at it in the same point of view and provide negative outcomes to the industry on a large scale since it doesn't confirm to their objectives (i.e.- Most of the NGOs are not directly supporting for this industry since it couldn't be substantially increase the GDP according to their expectations).



University of Moratuwa, Sri Lanka.

Electronic Theses & Dissertations

www.lib.mrt.ac.lk

Figure 2.7 : Expectancy Theory represented Graphically

## 2.4 Industry Issues in the Harvesting & Processing Sector

Cinnamon is ready for harvesting after 2-3 years after initial planting, when the plant reaches a height of 1.5-2 m with three to four shoots and the bark turns to brown colour. The main shoot is coppiced or cut back to a height of about 6 cm from the ground level. Two to three crops are taken annually depending upon the rainfall. Harvesting is carried out from May to August - 'Mahamosama'. During this period bark peels off easily.

### 2.4.1 Harvesting of Cinnamon

It is in details discussed the important factors relating to the harvesting process and the steps performed in each process activities with the necessary equipment incorporated in the field as follows:

#### **Step 1 – Cut suitable trees**

Skilled peeler can visually identify maturity level and keeps several immature shoots for the next harvest. The peeler makes a cut and lifts the bark to test bark level of detachment. If there is any difficulty in peeling, the peeler rejects the shoots.



*Figure 2.8 : Cinnamon Tree cutting and Transporting*

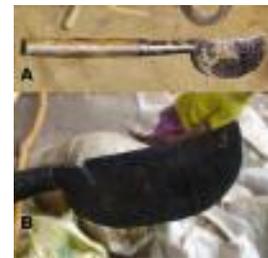
After harvesting and removing leaves the sticks are collected, tied and carried to the open area for further cleaning. Peeling ability of bark is low during fruits borne and late flushing periods.

In General Cinnamon can be harvested throughout the year except during the above mentioned periods which in average is about two months. Peeling is quite difficult during the dry periods when soil moisture depletes. Adoption of mulching practices with Cinnamon leaves is a good practice to conserve soil moisture.

All the harvesting operations are done by a simple tool called the Ketta, which has a very sharpen blade and long handle. The blade is made of quality steel and local blacksmith usually fabricate it from a disposed leaf spring.

### **Step 2 - Removing knots**

Peeler holds the stick in one hand and works with the other hand with Ketta along the stick and removes all the knots. Usually men are engaged in this job at standing or sitting position. After removing knots, scratch should be in a button shape.



Removing knots

View after removing knot

Ketta



University of Moratuwa, Sri Lanka.  
*Figure 2.9 : Removing Knots*  
Electronic Theses & Dissertations  
[www.lib.mrt.ac.lk](http://www.lib.mrt.ac.lk)

### **Step 3 - Scraping**

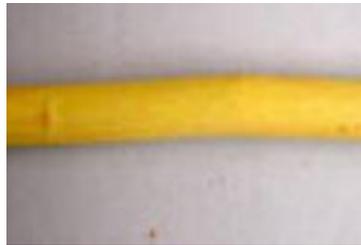
Scraping is the cleaning or removing the outer corky tissue layer from the sticks. It is not laborious but time consuming. Traditional hand tool Koketta is used for this purpose. There are two types of tools, one with curved sharpen blade and other with a blade and small handle. That is called 'Sawthtuwa'. Curvature of the blade is selected to match the diameter of the stick.

Sometimes two or three scraping tools with different curvature are used for efficient scraping. Understanding the physical quality of the sticks (roughness, maturity) is very important for proper scraping. Therefore mechanization of this step is complicated.

Stillness and physical properties of the sticks (stick diameter, number of knots, straightness...etc.) are the affecting factors for the scraping time.



Peeler performs scraping



Scraped bark



Traditional Koketta & Modified Koketta

*Figure 2.10 : Scraping Process*

#### **Step 4 - Rubbing**

Historically bark was detached without the rubbing process. Subsequently a piece of wooden rod (Keppitiya kotu) was used for rubbing process. Then a copper rod was used and then it was further replaced by the brass rod. Average diameter, length and weight of the brass rod are 15mm, 20.3 cm, 110g respectively.



University of Moratuwa, Sri Lanka.  
Electronic Theses & Dissertations  
[www.lib.mrt.ac.lk](http://www.lib.mrt.ac.lk)

Rubbing is the most laborious step in Cinnamon processing which helps to detach the bark from the stick very easily. Time taken for rubbing vary with the diameter of the stick, crookedness and other abnormalities, number of knots, season, cultivars...etc. During the off season extra effort has to be applied for rubbing. After 4-6 hrs of rubbing, performance of the peeler falls down resulting bark damages and producing poor quality quills.

Peelers usually change their posture to prevent muscle pain. About 40-60 strokes have to be applied around selected length of the sticks for proper rubbing and 9-30 N of vertical force have to be applied during rubbing. During the rubbing process bark sap oozes, this indicates that the proper rubbing is carried out. On the other hand extreme rubbing too damages the bark.



Rubbing process



Result of Rubbing process



Brass Rod

*Figure 2.11 : Rubbing Process*

### **Step 5 - Peeling**

This is the most skilled and time consuming step in the Cinnamon processing. Just after rubbing stick is examined to decide the maximum length of the bark portion that can be peeled off to make outer cover of the quill. Then make two cuts around the sticks with maximum length of intervals using a small pointed knife. A longitudinal slit is drawn from end to end and the knife is worked carefully between the bark and hard wood to raise the bark. Finally the other longitudinal slit is drawn opposite to the first slit. Bark can be detached in two equal halves with the little knife. When the diameter of the stick is higher bark can be divided into three or four strips as necessary. The rest of the bark left on the bended sticks and close to the knots or other bark abnormalities can't be detached as complete peels to make outer cover of the quill and therefore detached as small strips to fill the quills.



Peeling process with Small knife



Un detachable bark



Easily detachable bark

*Figure 2.12 : Peeling Process*

### **Step 6 - Shade drying before quill making**

After peeling the bark, long pieces are used to make the outer cover of the quills and are kept for 2-3 hours for shade drying. During this period bark curls inversely. In rainy season this period is extended up to 5-8 hours. At present rope racks or steel racks are used to shorten the drying period.



*Figure 2.13 : Shade Drying*

### **Step 7 - Quills making**

Cinnamon quills are prepared by experienced peelers to maintain uniform thickness throughout the stick. Bark halves are packed one inside the other until cigar like quills are formed. When it reaches the required length the end is trimmed with scissors and it is gently lifted and kept on the mat for drying. The hollow inside of the quills is then packed with pieces of thin bark, which are unsuitable to use for the

outer cover of the quill. A pair of scissors and a measuring stick of 106.7 cm long attached with a wooden lifter called Pethi Kotuwa are used for Quills making.



*Figure 2.14 : The Art of Quills Making*

Standard length of a quill is 106.7 cm but trimmed with a pair of scissors when it is necessary. Quills are air dried and pressed by hand to stack properly. Quills will be covered by Gunny bags to prevent from direct sunlight. The processed quills will be bundled in to 45 kg each for the marketing purposes.

According to the interviews and discussions with these value chain players a skilled labour can produce 4 to 5 kg of dried processed Cinnamon per day. To achieve this target it is required to peel about 50 sticks per day, consuming 10 to 15 hrs. Shortcomings of these existing techniques are low efficiency in the entire process and incorporating high labour cost which is generally about 50 % of the income.

#### **2.4.2 Major Cinnamon products, production processes and characteristics**

Cinnamon has a variety of uses and it's every part has unique distinctive purpose. Its bark, leaves, roots, fruits & flowers and the stem consist of different chemical substances which are varying in a wide scale. They are commercially very vital and therefore incorporated in various manufacturing industries as a raw material for different applications.

##### **A. Cinnamon bark products**

As highlighted in above discussions Cinnamon quills represent the most valuable product originated from the Cinnamon bush according to the existing knowledge.

Depending on the characteristics of the Cinnamon bark they are graded according to the International Standard (Appendix 9 : *ISO 6535:1997*). The physical comparison of the above grades could be easily carried out by the naked eye very closely.

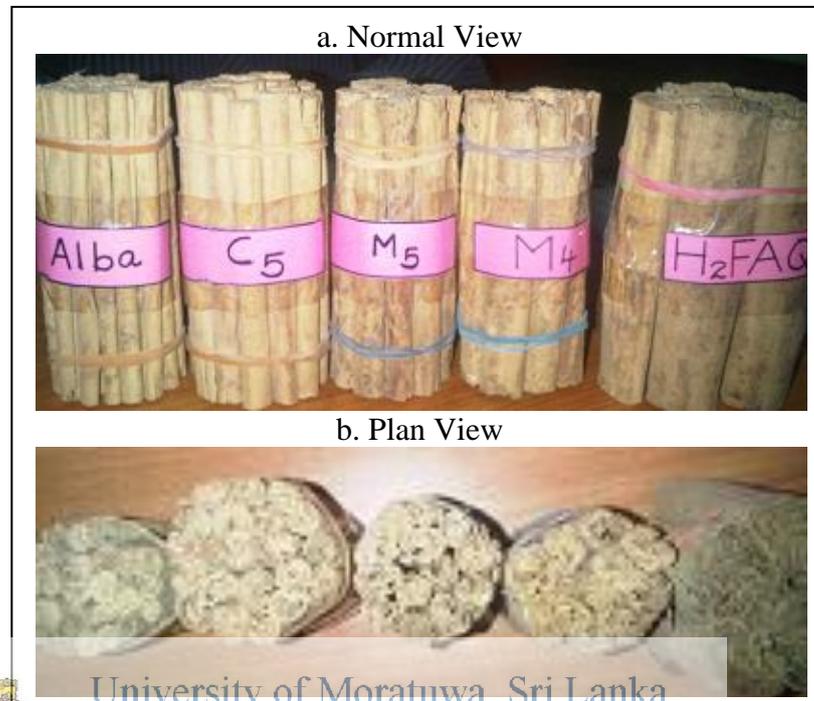


Figure 2.15 Physical Appearance of different grades of Cinnamon Quills  
University of Moratuwa, Sri Lanka.  
Electronic Theses & Dissertations  
[www.lib.mrt.ac.lk](http://www.lib.mrt.ac.lk)

However there are several by products generated during the processing of quills. They are classified into 3 major commercial groups namely Quillings, Featherings and Chips as identified in the market.

#### a. Quillings

Broken pieces and splits of all grades of Cinnamon quills are named as Quillings. The main characteristics of quillings are their shapes and the sizes. The aroma and taste of quillings are the same as the quills, even though they are marketed as medium quality Cinnamon. It contains featherings and chips but their quantities should not exceed 3% by mass. If proper precautions are not taken during the processing, extraneous matter including pieces of wood, stem or twigs may get

mixed with the quillings. Quillings are separated from the quills in the preparation of quills and they are separately dried in shade followed by sun drying.

### **b. Featherings**

They are feather like pieces of inner bark consisting of shavings and small pieces of bark left over in the process of making quills. Scraping of the bark or small twigs and stalks of Cinnamon shoots including a minimum quantity of chips are also considered as featherings. The product is marketed as medium quality Cinnamon.

### **c. Chips**

Chips are not peeled out from the stem. Instead they are scraped off greenish brown mature thick handpicked, pieces of bark, which are inferior in quality. Outer bark which has been obtained by beating or scraping the shoots also includes in chips.

Chips are graded into 2 categories:

- 
- University of Moratuwa, Sri Lanka.  
Electronic Theses & Dissertations  
[www.lib.mrt.ac.lk](http://www.lib.mrt.ac.lk)
- *Grade 1* - Those containing small featherings obtained by scraping very small twigs. They contain a small amount of other bark material too.
  - *Grade 2* - Those containing inner and outer bark and pieces of wood.

Depending on the extent of being free from extraneous matter such as refuse and dust the chips are further divided into 4 categories. They are named as type 1, 3, 0 & 00. Hygienic conditions, free from dust, mould and other pathogenic organisms are important common aspects of the production of Cinnamon quills, quillings, featherings or chips.

Consumers directly use them in most of the food formulations. It has been reported that compounds such as Cinnamic Aldehyde & Eugenol found in them both are growth retardants of microorganism (Senanayake, Wills and Lee 1977, 2032-33).

## B. Cinnamon Leaf oil production

According to the available statistics steam distillation is the preferred method adopted in leaf and bark oil distillation. There are about 200 stills in operation. Most of these distillation units are spread in Batapola, Meetiya goda, Galle and Matara areas. Among the distillers very few were processing bark oil (Paligasinghe, 2011).



a.) Feeding Cinnamon Leaves (after undergoing distillation) as fire material



b.) Collecting Cinnamon leaf oil



c.) Cinnamon leaves loaded still



d.) Furnace - Cinnamon Leaves under fire to vaporize water

*Figure 2.16 : Traditional Leaf oil Distillation unit at operation*

Steam Stills have 5 main components namely Furnace, Boiler, Condenser, Oil collector and Smoke Tower (Figure 2.17). Most of the stills are found to be

'Meetiya goda type stills', made of stainless steel and sold at Rs 300,000/-. A modified still is introduced by ITI, which costs around Rs.3.7 mln. The ITI made stills have very limited use due to high price.

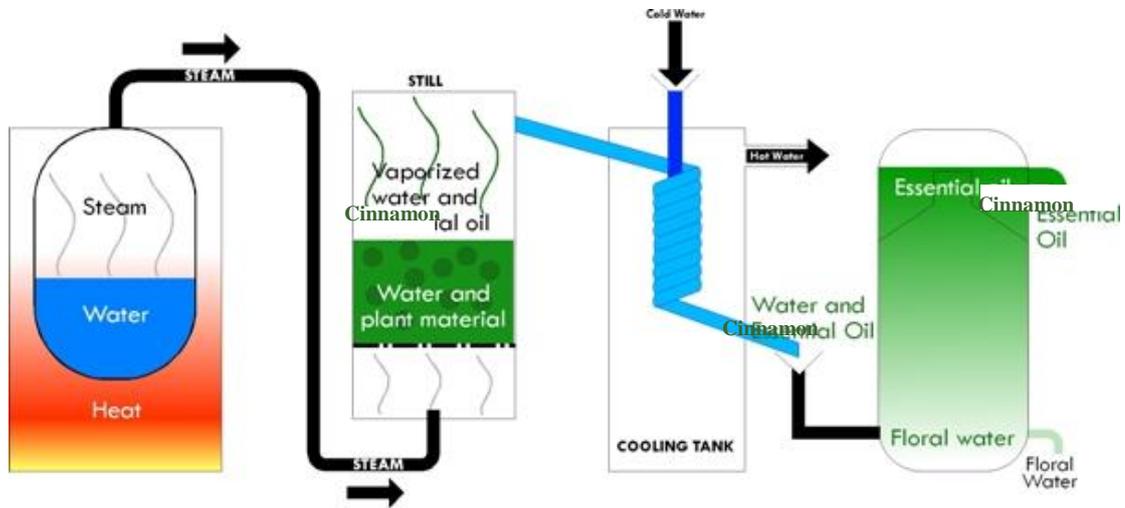


Figure 2.17 : Main Components of Steam Distillation Process

Major importers of Cinnamon Leaf Oil from Sri Lanka (Table 2.5) are worth noting with distinct specialization of the EEG and US market.



University of Moratuwa, Sri Lanka.  
 Electronic Theses & Dissertations  
 Table 2.5 : Market Share of the Leaf Oil Market  
[www.lib.mrt.ac.lk](http://www.lib.mrt.ac.lk)

Importer	Market share (%)
US	57.00
UK	14.40
Germany	6.07
France	4.40
Spain	4.83
Italy	3.30
India	4.12

Source : EDB statistics, 2010

174 leaf bundles could be collected on average from one hectare field. A bundle is about 40 kg in weight and about 7 bundles are manually compacted in the still, which is capable of producing about 3-4 bottles of leaf oil. Collectors are paid about Rs 1,000/- for the collection of 7 bundles by the distiller and from which Rs. 35-45/- per each bundle goes to the owner (Ranasinghe, 2011).

### C. Cinnamon Bark Oil Production

Bark oil distillation is mainly done with '*Katta*' (i.e.: Rough barks) which provides the lowest quality bark oil (i.e.: '*Katta Thel*'). In super quality bark oil production quills, quillings and featherings are incorporated. Most of the super bark oil producers use their own bark in the form of quills for distillation. Purchasing of quality bark material from regular suppliers will definitely help to keep the confidence line high in super bark oil trade (Jayawardene 1978, 25).

Very few Cinnamon processors engage with bark oil distillation technology. Most of the processors carry out the bark oil distillation incorporating the same facilities available for leaf oil distillation. Once again the Steam distillation is the mostly adopted technology in the process and the single ownership or family ownership is dominant within the industry.

Fractionation of bark oil is rarely done in Sri Lanka. Only very few companies including *EOAS organic Pvt. Ltd.* are involved in this process. Anyway the demand lies on normal Cinnamon bark oil, but not on fractionated oil (Encyclopedia of Spices, s.v. "Cinnamon Bark Oil").

#### 2.4.3 New approaches for Cinnamon processing and way forward

It is evident that the Department of Agriculture Engineering - University of Ruhuna (UOR) is playing a major role in developing the Cinnamon industry. It had commenced a research program in the year 1997 to study the whole processing steps and attitudes & habits of the peeling groups to design and test appropriate devices for overall Cinnamon processing (Navaratne and Punchihewa, Faculty of Agriculture).

It was focused to enhance the following areas:

- Replace the laborious steps by new strategies for production
- Shorten the time consuming steps

- Keeping peelers health and comfort
- Modernize the process to attract new generations
- Promote phyto - hygienic production to meet higher demand of export market
- Product diversification

Considering the above facts the following equipment and devices are already developed under this program to match with each step of the existing production process.

### **For Cinnamon Quills Production:**

#### **a. Scraper**

A simple improvement to ‘Ko Ketta’ is made by doubling the scraping surface with a provision to manual adjustment of the scraping surface using a spring mechanism. Scraping surface of the device can be changed to suit the diameter of the Cinnamon stick.



*Figure 2.18 : Scraper*

Preliminary results of the applicability of the device revealed that time consumption for scraping is reduced by 30% when the suggested mechanism is used.

#### **b. Cinnamon rubbing machine**

‘RUWEEKA\_CG’ is the name given for the rubbing device which was introduced by the UOR after a series of experiments. This device replaces the heavy labour involvement by increasing the efficiency up to 59.7%. This device consists of brass ended spindles, springs, nuts and casein. Spindles are mounted on spring in a circular arrangement in three planes on the casing. Springs provide optimum force evenly on

entire surface of the sticks for rubbing. That reduces the heavy labour involvement and operation could be done by a single person easily. People can engage with rubbing process in better working posture preventing muscle pain and fatigue.

Operation could be done by inserting the scraped sticks through the spring loaded spindles and moving several strokes. In this way entire sticks could be rubbed in 25 seconds.



Figure 2.19 : Cinnamon Rubbing Device - RUWEEKA\_CG

RUWEEKA-PG is patented by Weerasinghe and Pushpitha (2004) as an improved design of RUWEEKA-CG by scaling and incorporating the suitable mechanisms to insert the stick. The efficiency improvement is also significant with compared to the existing manual system (Table 2.6).



University of Moratuwa, Sri Lanka  
Electronic Theses & Dissertations  
www.lib.mrt.ac.lk

Table 2.6 : Efficiency of Rubbing process with RUWEEKA Machine

Method of Rubbing	Time requirement for the stick (mean value)
Manual	72 seconds
RUWEEKA-CG	25 seconds

Source : Pushpitha, 2006

The following device is also working in the same principle but shows some improvements and sticks up to 5.6 cm diameter can be processed with it. A simple mechanism is incorporated to the device which helps for inserting sticks to the rubbing device without any difficulty. Pressing or pulling the handle of the mechanism spring-loaded spindles can expand at once to insert the stick and then shrink it. Machine mounted in a stand could be rotated around its horizontal axis. This helps to change the rubbing ends of the sticks easily (Figure 2.20).



Figure 2.20 : RUWEEA-PG Machine

### c. Cinnamon processing bench

This device helps to improve and modernize the Cinnamon processing by enhancing the quality and quantity of the production, adhering to peelers comfort and health.



Cinnamon processing is very tedious and slow job at the moment. People used to work wearing dirty clothes in un-hygienic state, sitting on the floor as a group with poor working posture. It causes health hazards, postural stress, fatigue and pain. During this process impurities are mixed with products. This newly designed Processing Bench consists of basically rotating comfortable chair with half rounded table which could be adjusted to suit with personal body dimensions.

These equipments are now adopted in the estate sector, who takes the lead to change the technology of peeling by adding new production lines.

### **For Cinnamon Leaf Oil Production:**

The ultimate quality level of the distilled Cinnamon leaf oil is dependent on the selection of the high quality raw material at the initial stage. According to the research carried out at Research Station at Thihagoda and the Agriculture Faculty Mapalana, it was assessed the best resting period for Cinnamon leaves prior to distillation to maximize the leaf oil output and its quality. Cinnamon leaves with twigs and without twigs were experimented with three replicates. Samples were subjected to distillation, in daily intervals for 5 days, to detect the optimum resting time; quantity and quality of the leaf oil.

Average oil yield resulted by distilling leaves with twigs was 1.8%, but when leaves alone was subjected to distillation, oil yield was 2.32% which was significantly high by 28%. The maximum oil yield was observed after a resting period of 5 days in both treatments. The average oil yield of leaves resulted after 5 days was 2.63% and that of leaves with twigs was 2.32%. At this stage, the moisture content of leaves and leaves with twigs were 18% and 28% respectively. The Eugenol content observed in leaves alone was 10.8% higher than that of leaves with twigs. Cinnamaldehyde content of leaves were lower by 160% than that of leaves with twigs.

In the field evaluation test, the oil yield observed by distilling pure leaves was 1.28, which was significantly higher than that of leaves with twigs 0.87. It was observed that 60% of the total oil yield was obtained in first hour of distillation of the pure leaves. In the case of leaves and twigs, the oil content within the first hour was 30%. Moisture content of about 18% is observed as the optimum moisture content to get high quality and maximum yield within short period of pure leave distillation.

It was revealed that the average oil yield of 2.32% could be achieved when pure leaves were used for distillation which is 28% increment compared with 1.8% of oil which could be obtained when leaves with twigs were subjected to distillation (Kodikara, 2002).

### **For Cinnamon Bark Oils:**

A study was conducted on comparative assessment of quality and quantity parameters of the Cinnamon bark oil based on the method of processing and resting period. A laboratory experiment was conducted at the Cinnamon Research Station, Thihagoda and the field evaluation was conducted at the research farm at UoR.

Cost-Benefit analysis was conducted to assess the best method for Cinnamon bark oil distillation and it was assessed the economical aspects of quills production compared to bark oil distillation. It was observed that optimum moisture content of the peeled bark for the oil distillation is about 18%- 20%. Under the machine operation, maximum oil obtained from the scraped and non-scraped bark was observed in 5 days after the peeling. However for the manual operation was observed in 7 days after the peeling. It was revealed that peeling by the prototype machine for Cinnamon bark oil distillation is economical and time saving.

Machine peeling of Cinnamon sticks with or without scraping of the outer bark didn't have any significant difference on Cinnamon bark oil yield and the quality. From the cost-benefit analysis, it was revealed that best method for bark oil production is non scraped bark prepared by machine and the bark oil production seemed to be more profitable than the quill preparation. The oil yield gained in the laboratory unit was 1.07%, which is much higher compared to the yield gained in industrial unit of the faculty which constituted only 0.47% (Kumara, 2003).

Cinnamon bark contains commercially important volatile oils. These oils can be separated by steam or hydro distillation. The yield of oil could be 0.7% to 1.5%. The chemical composition of volatile oil is analyzed by 'Gas Liquid Chromatographic method'. Cinnamic Aldehyde is the most important chemical and oil is graded according to its percentage. Overall organo-leptic properties of oil depend on the large number of chemicals present at correct proportions (Senanayake, 2000; Angmor, Dicks and Evans 1979, 342-347).

## 2.5 Industry Issues in the Marketing & Sales Sector

Marketing becomes the crucial determining factor for any industry's success. It is the step enabling to gain return for the investment while competing with the existing competitors in winning the game. When it compared the purpose of the Cinnamon products against the total Cinnamon production it can be summarized as follows (Table 2.7).

*Table 2.7 : Use of Cinnamon bark products Vs Total Cinnamon Production (in mt.)*

Type of use	1993	1998	2001	2005	2009	Average (%)
Exports	8,755	9,401	11,074	12,356	14,576	77%
Household Consumption	500	500	900	1,170	2,140	7%
For Oil extraction	1,293	935	1,485	1,623	1,857	10%
For medicinal industry	500	500	500	500	600	3%
Other uses	250	250	250	250	250	2%
Unreported exports	500	500	500	500	500	1%
<b>Total Production</b>	11,798	12,088	13,494	15,898	19,923	100%

Note:

*House hold consumption* – obtained from the Consumer surveys of Census and Statistics Department

*Volume of Oil extraction* – derived from the oil exports figure and converting that into bark products by using the standard formula

*Unreported exports* – limited statistics from the Customs Department

*Source: Present Situation and Future Trends of Cinnamon Industry in SL, 2006*

It is evident that there is a very huge demand for the Cinnamon from the export markets even at current situation where there is neither considerable value addition nor a range of diversified products. Therefore the main concern regards to the Cinnamon industry should be focused on the international market without any second thought.

Further the main reasons for increase in the demand in the above values on annual basis are as follows:

- Expansion of newly cultivated lands especially in non-traditional areas
- Subsidy schemes of the DEA
- Activation of the advices provided by the DEA
- Increased fertilizer application

97% of the cultivators are operating the parcels less than 1 ha of Cinnamon, which cover about 72% of the total acreage. In around 28% of the total area, Cinnamon is being cultivated as a pure crop and in the rest of the area Cinnamon is mixed with other tree species.

There should be a steady supply throughout the year to become a dominant market player in the international market. Therefore local Cinnamon lands should be given the priority to promote Cinnamon cultivation among the small holders. In order to achieve this DEA is administering an extension approach inclusive of a package deal. Execution of new planting and replanting subsidy schemes for the extension and promotion of Cinnamon is the strategy of the present extension approach. As a short term strategy it is proposed to execute a different assistance package based on the past experience along with the present development program to cater to the needs of the average farmer. This package may include financial assistance as an incentive to adopt recommended cultural practices to cater to the needs of the different farming systems (Rupasinghe, 2000).

Cinnamon can have a variety of product ranges in a more diversified manner. It is not an easy task to focus a niche market and directly target it. Therefore according to Angmor et al. (1972, 416-20), the prime concern is to continue research & development activities to begin with a broader picture and then gradually focus into means to narrow down to specific niche markets (Figure 2.22). That will be a very effective strategy with the logical framework facilitating the decision making process aligned with the long term objectives.

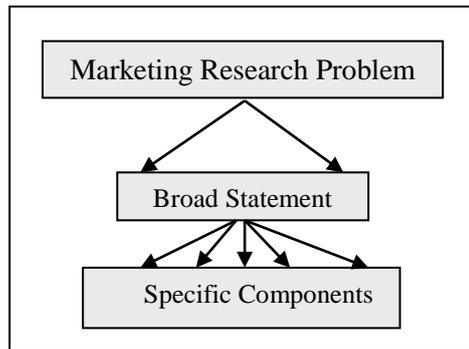


Figure 2.22: Specific Area focus through the Market Research

Since there are wide spread of applications as a natural product in culinary, food and beverages, liquor, medicine and perfumery industries the viable new product range will also be broaden. Mexico and Latin American countries act as the world’s largest market place for Cinnamon products, from where the distribution is done to other countries. Mean while USA, Europe and India has become the major buyers from them.

Enormous avenues will be opened for investors and researchers to engage with technology improvement, product diversification and introduce the processing and packaging beauty to diversified products through the proper exploitation (Figure 2.23).



Figure 2.23 : Some of the Cinnamon diversified products

The probable solutions for this state could be further analyzed by using the ‘*Ansoff’s Market Alternatives*’ as shown in Figure 2.24. It suggests 4 different marketing alternatives with many potential applications under each probable condition. It helps to focus specific applications with great uniqueness.

	Existing Product	New Product
Existing Market	<b><i>Market Penetration</i></b>	<b><i>Product Development</i></b>
New Market	<b><i>Market Development</i></b>	<b><i>Diversification</i></b>

Figure 2.24 : *Ansoff’s Market Alternatives*

Source : QuickMBA, 2010

*Market Penetration* :

The option under market penetration refers to the supplying of the same existing products of Cinnamon (which are supplied by the Cinnamon manufacturers and the sellers) for the same existing markets. Therefore in order to build the industry it is necessary to focus the market promotional aspects primarily and there is a better chance to focus the 4Ps and 7Ps as required.

*Market Development* :

Under market development strategy it is focused on supplying the same existing products but for the new markets. Therefore it is necessary to grab more buyer countries to buy the existing products. There is a huge competition with the Cassia which is the only substitute available for Cinnamon. Cassia is very low in quality and not suitable due to cancer causing substances. Therefore those countries buying Cassia should be targeted on supplying True Cinnamon through proper marketing channels and proper marketing promotional activities.

Product Development :

This is the option which is very essential and needs to consider with high weight. Because there is a huge vacuum existing for new products of Cinnamon generally associated with the R&D activities. It is evident there are many uses for which Cinnamon could be used. Entire Cinnamon tree has separate usages and therefore there is an unexplored huge area where the importers from the other countries could make use of.

Market Diversification:

This alternative almost similarly associated with the above discussed strategy - Product Development. The only difference being the targeting of these discussed new products for new market segments. Therefore once the above discussed strategies under the product development alternative are implemented this will become a much easier aspect through the Cinnamon industries perspective. But this will lead innovations to appear more regularly in the market. Therefore it also could be given a high weight and importance.



University of Moratuwa, Sri Lanka.  
Electronic Theses & Dissertations  
[www.lib.mrt.ac.lk](http://www.lib.mrt.ac.lk)

The remaining issue is that there are no adequate resources and supports from the government to carry out these types of research activities, especially connected to the marketing aspects. There will be a tremendous impact in the export market through proper marketing promotions. Identification of the niche markets and positioning with the right product are the essentials. Highlighting the market focus emphasis is similarly important to position your product in the right market place. Market positioning implies how the customer perceives the product and its characteristics such as features, benefits, comparative advantages...etc. according to their perceptions.

To create an effective brand image it is very important to identify the customer behaviour, their changes and applying the necessary strategies to meet exact or above customer needs requirement and surprise them positively. Since most of these products are very competitive and there is a high price elasticity of demand, issues could be set off from the value addition activity for marketing aspects. But there

exists a possibility to add value directly to the product or to the supply chain (Figure 2.25).

Improvements of the value chain activities provide greater satisfaction to the international customer through purchasing their products in more convenient manner. It is one of the current issues which need a better solution but in an immediate fashion (Hindle 2008).

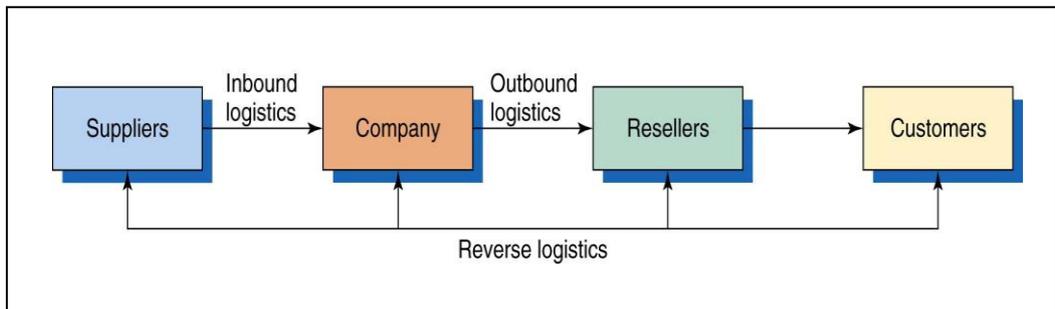


Figure 2.25 : Supply Chain Indication

With respect to marketing aspects, many experts in the industry have examined & proved that not only the product and supply chain providing impact to the industry but also the price becomes a very sensitive factor. Surveys indicate that the price is also playing a major role in the export market. Therefore it is recommended that it is the high time to implement a value based pricing mechanism (Figure 2.26) to cater to top end markets with reasonable profit margin in the industry (Hindle 2008).

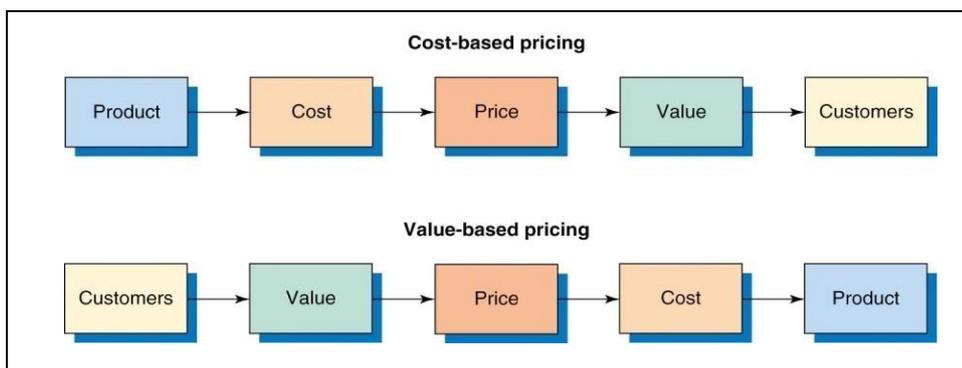


Figure 2.26 : Cost based Vs Value based Pricing

Another key issue in marketing sector is the inability to create a brand image for the Cinnamon industry in Sri Lanka. From the past it was popular as the True Cinnamon, but no special concern is given to promote it internationally (i.e.: Although the True Cinnamon is also popular at international level, no proper strategies were undertaken to promote and gain competitive edge). Therefore it is a timely important factor to promote the brand image to get a good mark up, since we have the ability to provide the best quality products. This will also restrict other secondary level competitors promoting their low level products and getting high revenues for their inferior quality products.

It is a necessity to create awareness and promote True Cinnamon through effective marketing communication channels. Organizing attractive advertising campaigns to cover large target audiences, sales promotion activities in the short term to cater for international customer bases, participating in international trade exhibitions...etc. are some of the important and much needed marketing strategies. Promotional campaigns are especially necessary at the time of expanding the global market. These strategies should be implemented in a consistent manner to maintain the market share in a steady growth. Because Sri Lanka's current engagement on above aspects is at the minimal level.



University of Moratuwa, Sri Lanka  
Electronic Theses & Dissertations  
www.lib.mrt.ac.lk

## **2.6 Impact of Technological Applications**

There is a significant impact from technology to the plantation sector and especially for a multi beneficial industry like Cinnamon. Technology can assist not only plantation and manufacturing but also the sales and marketing sector to improve the industry in a consistent manner. It is a must for the Sri Lankan Cinnamon industry to produce Cinnamon diversified products in a range with possible forms. Subsequently it contributes to consider further improvements in product and process developments aligned with the productivity improvement (Figure 2.27).

Hemakumara (2006, 23) states that Cinnamon is also one of the important plantation that could be converted to sub products by efficiently improving the process

technology. The right technology and innovation will upgrade the process giving substantial impact to the competitive edge at the time of marketing.

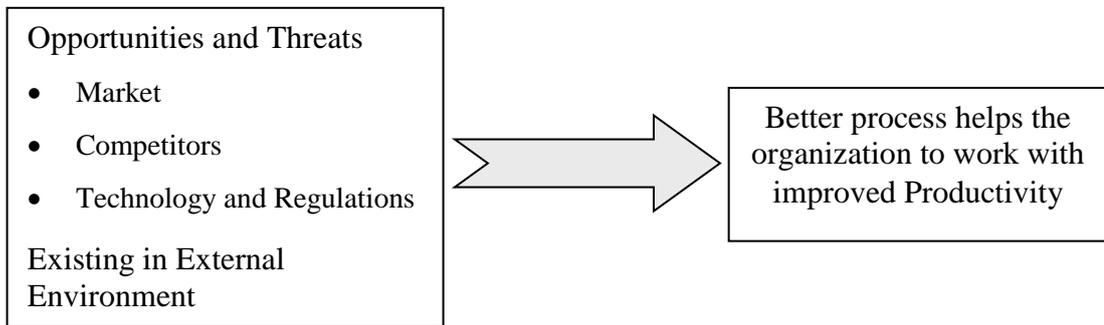
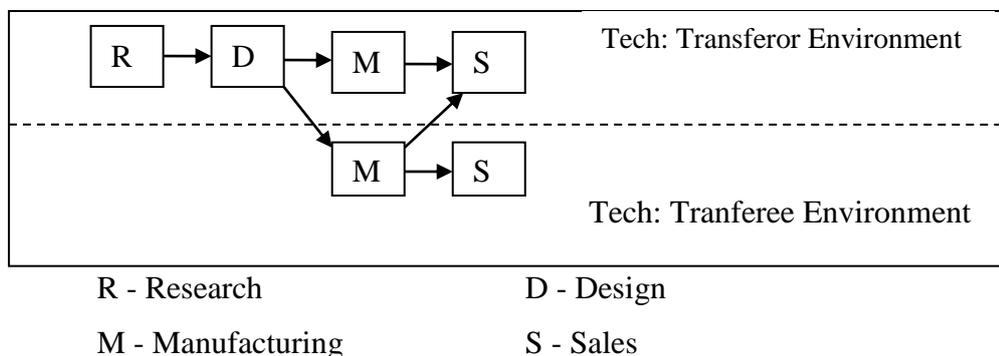


Figure 2.27 : Process Innovation

Process development in the industry should primarily focus the Cinnamon plantation sector. After identifying the environmental signals relating to associated costs, market potential, customer needs and perception, competitors...etc. it is needed to design a right strategy matching the plantation sector. Identification of the suitable technological application for an activity will definitely reduce the cost of production. This key aspect is followed by the search, selection and need to find out a suitable sustainable solution/ alternative. The final step is to engage with correct implementation & learning through monitoring and evaluation of the performance. Some professionals practice the above process concept in a correct manner which leads their findings to reduce the cost of production especially in the plantation sector in practice (Sheffield 2007).



R - Research  
 M - Manufacturing  
 D - Design  
 S - Sales

Figure 2.28 : Technology Transfer Model (Manufacturing intensive)

Manufacturing intensive technology transfer model (Figure 2.28) should be carefully analyzed and probably the application has to be modified accordingly. Because there are no direct technology transferors for this sector who are experienced in applying the technology for this type of plantation sector. On the other hand Sri Lankan conditions are the best suited for True Cinnamon plantation and therefore the applications should focus the local conditions very much. Therefore special concern is needed in selecting the transferor and the process should be so strategic to protect the competitive edge. In this context the parties involved should have a thorough understanding of the entire sector aligned with the objectives and efficient incorporation of technology application mechanisms.

## 2.7 Industry Position in the Global Market

True Cinnamon is native to Sri Lanka and there is a huge demand from the international market from the history. Therefore it has derived the comparative highest position by this wonderful tree.

Few other countries are involved in the plantation of Cinnamon and they are trying to give a considerable competition to the Sri Lankan True Cinnamon industry in the future. On the other hand there are many stakeholders in this industry including government, non-government, private and other foreign countries. Some of them are directly linked with the value chain activities and therefore industry wide strategy is very essential focusing everyone to face these potential competitors with confidence.

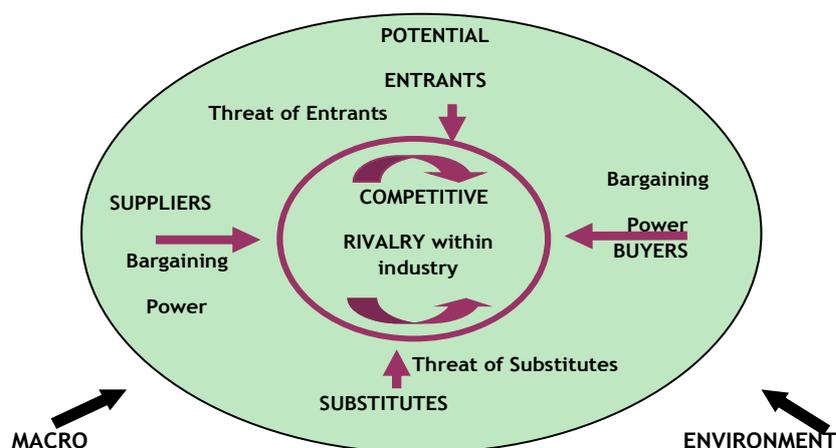
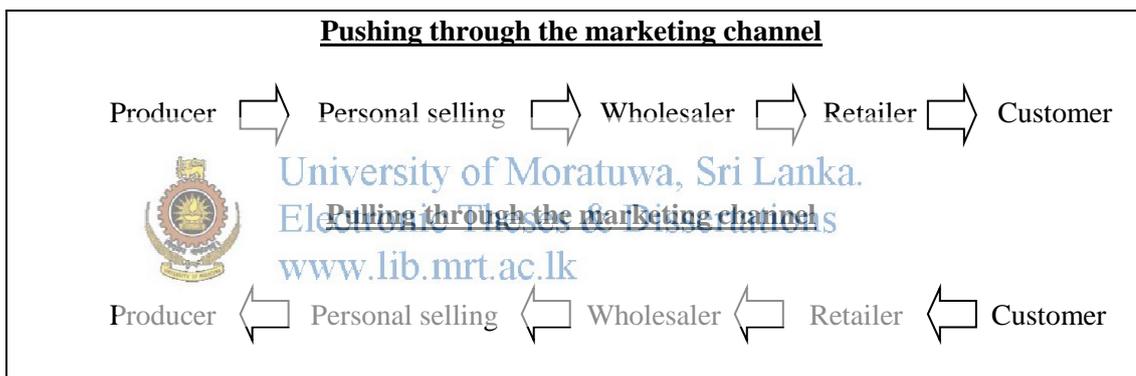


Figure 2.29 : Porter's Five Forces Model

Above model will help to analyze the potential areas by which the competitive forces are initiated and the characteristics of them. The Porter's five forces model (Figure 2.29) illustrates that the threat is not only come from within the industry, but it arises in many other forms. Substitute products, new entrants to the market and bargaining power from both the suppliers and the buyers are the constituents of it. Therefore to meet this stiff competition the industry has to upgrade their quality standard in a continuous manner through improving the processing and operational aspects with the help of new technology. In order to achieve this vital aspect it is required a special concern on applying strategic direction (QuickMBA, 2010).

According to the international marketing concept most of the industries turns around from product pushing situation to pulling position (Figure: 2.30).



*Figure 2.30 : Market Push & Pull Strategies*

This concept has resulted due to the continuous supply of novel value added products improved through consistent R&D activities. This will help to gain the competitive edge through increasing the price and improving the volumes by catering to new global markets. Within the international market conditions the Cinnamon marketing should focus operating within a Cinnamon monopolistic situation through maintaining that conditions for future sustainability. Policies should always provide market driven solutions and they should not be in temporary form but in permanent strategic form to fulfill industry requirements. These solutions will lead to achieve long term economic objectives providing the industry edge as expected.

## 2.8 Technology Competency

It is evident that there are many research findings in all three sectors considered above in the Cinnamon industry. But majority of the research has been conducted for the plantation sector while very few for the marketing sector. Therefore there is a significant gap in the industry marketing aspects and needs to be fulfilled through proper R&D activities. Main research objective should focus to gain the competitive edge through proper value addition and related activities. Accordingly the main concerns of the conceptual model are Technology Competency & the Market Orientation.

Technology Competency is the technological knowledge which enables to implement any solution in a more practical manner in achieving business objectives with full confidence. This is the core competency influencing to improve the productivity and efficiency. Therefore both the qualitative and quantitative factors should be focused in gaining the competitive edge.

When it considers the Technology competency as the main construct/ contributor it is found that there are many dimensions/ variables which lead to demonstrate it. Goedde (2006) explains knowledge as one of the crucial factors giving substantial impact to the technology competency. Knowledge will help to carry out the technical operations successfully & apply the knowledge in a more meaningful manner to add value in improving the efficiency of the process.

Experience will successfully assist to handle any issue pertaining to technology & finding a suitable solution. However research findings indicate that both the knowledge & experience provide comprehensive competency to improve operational effectiveness & cost efficiency. Further it develops & trains the relevant staff to fulfill long-term industrial sustainability.

Experts in the industry also reveal the importance of technology, especially as the main contributor to gain the competitive advantage in the process sector in manufacturing value added products. They explore technological innovativeness &

creativity is playing a significant role in technological competency of any industry. In particular innovation should enable not only to implement new findings and improve process efficiency but also to meet marketing & business objectives. The internal & external exposures of an organization also provide an impact to the technology competency (Sheffield 2007). Technological strategies aligned with organizational vision & objectives and the internal management support need to collectively focus the technology competency of the organization.

Attitudes & perception are the important variables leading to build technology competency in a constructive manner in any organization. Primarily there should be a positive thinking towards technology and then it is needed to follow up with overall management perception. When it is believed the technology to solve problems it is immaterial to consider the probable outcomes such as risks and other negative factors. However other external factors like amount of technology literacy, complexity of technology & understandability of proposing techniques also affecting the attitude or likeness. Ultimately it provides a positive or negative impact to the technology competency.



University of Moratuwa, Sri Lanka.  
Electronic Theses & Dissertations  
[www.lib.mrt.ac.lk](http://www.lib.mrt.ac.lk)

## **2.9 Market Orientation**

One of the most important construct leading towards competitive edge is the Market Orientation. Literature reveals that even though the industry has a good harvesting or manufacturing process it couldn't sustain unless it receive a competitive edge from the target market.

According to the research conducted by Narver & Slaten (1990), Lado & Olives Rivero (1996) and Sargent & Mohammed (1999) it was revealed there are three main dimensions which affect market orientation. They are Customer orientation, Competitor orientation and Inter functional orientation. The first two factors are external factors while the third being internal.

Most important variable is the customer orientation among the 3 dimensions stated above. Findings emphasis serving customer needs & strategizing to reach them in a consistent manner plays a major role to align with the company strategies. Under competitive environment provision of more value added products comparative with the competitors' products makes it a distinct competitive advantage. The strategies implemented during the pre & prior sales stages should focus on surprising the customers. Therefore it is important to monitor and evaluate all these activities in a pre planned manner to meet the long term objectives.

Right pricing & the selection of the correct distribution channels are also equally important indicators in evaluating the customer orientation. In global competitive environment marketing communication strategies such as attractive advertising campaigns, suitable sales promotion & sponsorships...etc. also have a similar importance. These collective aspects have a high impact to market expansion and diversification.

 [www.lib.mrt.ac.lk](http://www.lib.mrt.ac.lk) University of Moratuwa, Sri Lanka.  
Electronic Theses & Dissertations  
Competitor orientation is similarly important to a greater extent under market orientation. It is more vital when the products are in the competitive stage. Diversified products always have high price elasticity against the demand & the supply. According to Porter's five forces the competitiveness comes from five directions as we have discussed above. It is the industry capability to act against all these competitive forces and survive as necessary. With respect to relative position in the industry it is necessary to gather competitive market information & identify unique strengths & weaknesses of the competitors. That information should be the foundation for the implementation of necessary strategies in reaching the marketing objectives.

In evaluating competitor orientation, it is necessary to provide products and services beyond customer expectations and surprise them. This leads to increase the perceived value of the product & make more profits. There is the possibility to apply this aspect throughout the supply chain to gain a competitive edge in the international market.

Coordination is one important internal criterion in meeting overall business objectives. At this juncture, the whole organization's responsibility is to look in to marketing perspectives & then streamline their creativeness in meeting the customer expectations. These marketing activities should not be linked within the process but should be aligned with other processes in satisfying the needs.

All the processes must communicate & exchange information within & outside the organization. This helps to understand the expectations & build core-competencies by make use of individual strengths and exchanging resources if required. When the customer value is created in this manner it will assist to enhance the volumes as well as the profits in a sustainable manner. This is the necessity to gain the competitive edge in the industry.



University of Moratuwa, Sri Lanka.  
Electronic Theses & Dissertations  
[www.lib.mrt.ac.lk](http://www.lib.mrt.ac.lk)

## 2.10 Summary of Literature Review

Literature review explores the researches carried out relative to the Cinnamon industry on various aspects to improve this vital indigenous crop for Sri Lanka. The True Cinnamon brand name has to be promoted at global level and subsequently it is important to conduct R&D activities and diversify the market as required.

Being a main export of the country it has secured a substantial market share and naturally Cinnamon has become a great contributor to Sri Lankan economy. But the stakeholders especially the relevant authorities had not concerned on promoting this vital industry. It is significant the gaps related to Marketing & Sales Promotion activities at international level. These gaps need to be fulfilled not only to protect as an industry in the long-term but to gain the competitive edge and secure the monopolistic situation at global level.

This research carries out in finding out the technical implications in the industry through extending the emphasis on marketing aspects to develop the whole sector. Therefore it is considered the performance development of the entire value chain players to keep the monopolistic condition among the Cinnamon exporters.



University of Moratuwa, Sri Lanka.  
Electronic Theses & Dissertations  
www.lib.mru.ac.lk