

RESEARCH ARTICLE

## Minimizing Issues and Information Gaps in Value Chain of Cinnamon Industry in Sri Lanka through ICT based Intervention: A Case Study

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**Abstract:** Cinnamon (*Cinnamomum zeylanicum Blume*) is indigenous to Sri Lanka which holds a virtual monopoly of cinnamon in the world accounting for around 90% of the global trade. Because of its industrial applications and medicinal properties, there is a growing demand for true cinnamon in the world. Major drawbacks of the cinnamon industry in Sri Lanka are low productivity and quality, poor value addition, lack of market information, smallholdings, poor accessibility, and inadequate and unsatisfactory extension services. This study identified the stakeholders and services in Sri Lankan cinnamon industry and proposed a model for the local cinnamon value chain by analyzing existing literature, established knowledge and qualitative discussions. Further, a questionnaire-based survey was carried out to ascertain the gaps in the local value chain of cinnamon and to determine the gaps that can be effectively addressed through ICT-based interventions. Survey results showed that nearly 75% of farmers obtained a yield less than 650 kg ha<sup>-1</sup> year<sup>-1</sup>; 15% of the farmers received a yield less than 300 kg ha<sup>-1</sup> year<sup>-1</sup>. According to the survey, 91% of the farmers used mobile phones to receive relevant information to the industry while 32% and 22% had used smartphones and Wi-Fi facility, respectively. Further, study revealed that cinnamon growers face difficulties in obtaining quality planting material, modern agro-technology, technical know-how and advisory service in cultivation and processing, business development services, experienced peelers and market behavior when required. Around 90% of the stakeholders expressed that they are interested to receive relevant information related to weather, agro-technology, support services, market information, etc. on a mobile-based application. Therefore, an information flow model; key functions and their behaviors for the proposed mobile-based information system are presented in this research. Hence, ICT enabled mobile platform shows great promise in improving the yield, quality, and profitability of cinnamon industry in Sri Lanka.

**Keywords:** Information/Knowledge Gaps, Challenges in Cinnamon Industry, Value chain, ICT in Agriculture, Information flow model, Mobile-based platform

### Introduction

Cinnamon is engaged with the lives of people in Sri Lanka by emotionally, socially, and economically (Dalglish et al., 2007). It is the most important crop in the spice sector (Kaul et al., 2003) and one of the export commodities of Sri Lanka from the pre-colonial era to up to date (Jayasinghe et al., 2016).

Because of its aromatic properties and culinary values, cinnamon has gained wide acceptance in food and beverage industries. Besides, it possesses many other useful properties that have found application in a myriad of industries including pharmacological, nutraceutical, pesticide, perfumery, cosmetic, soap and liquor/liqueur (Abeyasinghe et al., 2009). Furthermore, Sri Lanka is the world's largest

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exporter and producer of true cinnamon. But it still has not been able to fulfill the demand for true cinnamon in the world market (Fonseka et al., 2018; Samarawickrema, 2015).

Cinnamon is originated in the central hills of Sri Lanka including Kandy, Matale, Haputale, Belihull Oya and Sinharaja forest range. Currently, cinnamon cultivation is concentrated along the coastal belt from Negambo to Matara. It has also made inroads to the inland of Kalutara, Ambalangoda, Matara and Ratnapura (Lanka, 2010). It is mainly cultivated in Galle, i.e. more than 10,644 ha (35%) followed by Matara (27%), Ratnapura (12%) and Kalutara (6%) districts (Ambalangoda, 2018). The Southern province accounts for nearly 70% of the cinnamon production in the country. However, cinnamon is still mainly grown on smallholdings of about 0.5 ha with over 70,000 smallholders engaged in cinnamon cultivation. Thus, only 5-10% of the crop is in the range of 8-20 ha. There are nearly 30,000 ha are under this crop providing livelihood to over 350,000 families including around 30,000 peelers and 16,000 processors. The estimated annual production of cinnamon is about 22,341 MT in Sri Lanka (DEA, 2017).

True cinnamon is a native of Sri Lanka which holds the virtual monopoly of this product in the world spice market (Uragoda, 1984). Alba is the best quality grade and produced for special export orders (Ravindran et al., 2003). Although Sri Lanka is the leading exporter of true cinnamon, this meets competition from the similar, but lower-priced cassia. Annual trade of cinnamon in the world from 7,500 to 10,000 tons and Sri Lanka contributes 80-90%. Most of the remaining stock has come from Seychelles and Madagascar (Takeda et al., 2008). USA and Mexico are the main markets as well as Colombia, Peru, Ecuador, Spain, Chile, Guatemala, and Bolivia are the other countries that buy a considerable amount of Ceylon Cinnamon (Export Development Board (EDB), 2018). Foreign exchange earned from cinnamon accounts for almost 17 billion LKR, which is 49% of the earnings of export crops in 2012 (Jayasinghe et al., 2016).

Although the cinnamon has great industrial potential, the performance of the cinnamon industry in Sri

Lanka has not in its potential due to the influence of many drawbacks. Cinnamon is still mainly grown by smallholdings (Samarawickrema, 2015). The national average productivity of cinnamon is 445 kg ha<sup>-1</sup> year<sup>-1</sup> and it is far below the potential yield, 1,000 kg ha<sup>-1</sup> year<sup>-1</sup> (Jayasinghe et al., 2016). Poor productivity is due to the aging of the crop, poor maintenance, pest, and disease incidence, etc. (Jayasinghe et al., 2016).

Ceylon cinnamon is having a great demand across the world. But, in the global market, get the maximum profit for the product is an issue. ICT is an emerging field in agriculture, which focuses improvements of agriculture and rural development. Therefore, it is essential to use modern innovative technologies to improve the key areas of cinnamon production such as cultivation, production, standardization, and marketing (Baddegamage, 2014).

According to (Samarawickrema, 2015), there is some information available on the cinnamon supply chain. However, currently there is no central database for this. Information on cinnamon growers is stored in the Department of Export Agriculture district offices. However, there is no accurate information about small producers, large producers, collectors, dealers, and independent peelers (Samarawickrema, 2015). Information on the exporters is recorded in the Export Development Board. The categorization of large and smallholders may vary based on their definitions. Peelers are the most important category in the production process, and they must be updated with the technologies, market needs and trends and standards in this domain. The collectors are the next category who collects cinnamon from farmers, sorts, and grades of cinnamon. Therefore, they should be updated with the above requirements that are similar to the peelers. They could use information systems and websites to gain relevant information to maintain product qualities. The exporters must use business to business portals, interactive and informational websites, and modern ICT tools for marketing, promotions, and communication. Certification authorities are normally using international standard websites and ICT tools. Although the buyers have not much control over the other parties and government, they can directly contact exporters, certification authorities, and other categories by accessing the latest prices, details of the demand via the ICT

channels. However, the interrelation between the above six categories via ICT will give a competitive advantage to the cinnamon industry in Sri Lanka to achieve sustainable development in this industry (Baddegamage, 2014).

Modern ICT can be utilized for providing timely, accurate, relevant information and services to the farmers in innovative way (Mahant et al., 2012). Among the ICT tools ordinarily owned and used by people are mobile phones and its adoption has been rapid (Martin & Abbott, 2010) and widely recognized as a potentially transformative technology platform for the developing world (Masuki & Kamugisha, 2010). An integrated mobile platform for accessing information and knowledge may help in strengthening the value chain and assisting the farmer by decreasing transactional costs (Mittal & Mehar, 2012).

Therefore, it is of the utmost importance to realize the potential of the crop by improving production, quality and profitability of cinnamon through the adoption of modern agro-technology, improved management, provision of the requisite business development services and market information and improved compliance with the food safety and phytosanitary standard.

Based on the above problem definition three main research objectives were identified. They are 1) *to identify the stakeholders and services in Sri Lankan cinnamon industry and model a local cinnamon value chain* 2) *to ascertain the gaps in Sri Lankan cinnamon value chain* 3) *to determine the gaps that can be effectively addressed through ICT-based intervention.*

## Materials and Methods

To fulfill the first objective mentioned above, the existing cinnamon value chain was analyzed to understand the barriers and to improve the global competitiveness of the industry. This will be helpful to identify a potential area for ICT intervention to improve global competitiveness. Information required for the analysis was gathered from existing literature, established knowledge, information and

knowledge gathered from the qualitative discussions. For the qualitative interviews, mainly two groups were interviewed in Matara district: (1) subject matter experts, who have extensive technical and industry knowledge and (2) key informants, who are primary value chain actors (stakeholders or services) and have operational and business knowledge.

Using the generic agricultural value chain model adapted from (Miller & Jones, 2010), the impending analysis attempts to build a rudimentary industry-specific value chain for cinnamon. This is achieved by assessing the contribution of each value chain actor in the above model (i.e. generic agricultural value chain mentioned in (Miller & Jones, 2010) with the existing cinnamon value chain.

Matara district can be divided into 16 Divisional Secretariat Divisions (DS Divisions), each headed by a Divisional Secretary. It belongs to second-level administrative division and the second major cinnamon growing area in Sri Lanka. Cinnamon farmers were the main target population of second and third objectives of this study. Besides, discussions were carried out with peelers, input suppliers, traders, exporters, and service providers in this area. There are 10 Extension Officer (EO) ranges in Matara district and 05 EO ranges have been selected where Kamburupitiya, Matara, Hakmana, Akuressa and Deiyandara areas. 05 DS Divisions have been selected under this EO ranges accordingly: Kirinda, Thihagoda, Hakamana, Malimbada and Mulatiyana.

Mainly we divided samples according to the multistage sampling technique. The Purposive sampling method had been used to select EO ranges and DS divisions. A simple random sampling method had been used to select farm families in each DS division. 20 Cinnamon farmers were selected randomly in each DS division who registered on the agrarian service center. The primary data were collected through a personal interview with the help of a pre-tested structured questionnaire; Informal discussions have been done by farm visits and discussions with key stakeholders in the local cinnamon value chain and government officers (Agricultural directors, Research officers and Extension officers, etc.). The secondary data were

collected from relevant institutions (Department of Export agriculture - Matara, National cinnamon research and training center - Thihagoda, Matara and Agrarian service centers in each DS division), Thesis, Research articles and Internet etc. Finally, data were tabulated in Microsoft Excel and analyzed through appropriate statistical methods using SPSS software (25.0).

### Results and Discussion

First part of the study (for the objective 1) analyzed the stakeholders and services with respect to the Sri Lankan cinnamon industry and modeled the local cinnamon value chain. Based on the below analysis, this study proposed a model for Cinnamon value

chain for Sri Lanka. The proposed model can be visualized as in Figure 1 and the key components of the proposed model were described below.

Actors (stakeholders or services) in the value chain are categorized into three major groups such as *value chain suppliers*, *financial services*, and *support services* (see Figure 1). It seems that the cinnamon value chain is quite basic. However, the complexity of the relationships can increase after growers depending on the scale of operations. This will be very helpful in identifying the potential areas for ICT intervention and improve global competitiveness. Hence, value chain analysis is a suitable approach for visualization of the whole process in terms of the system.

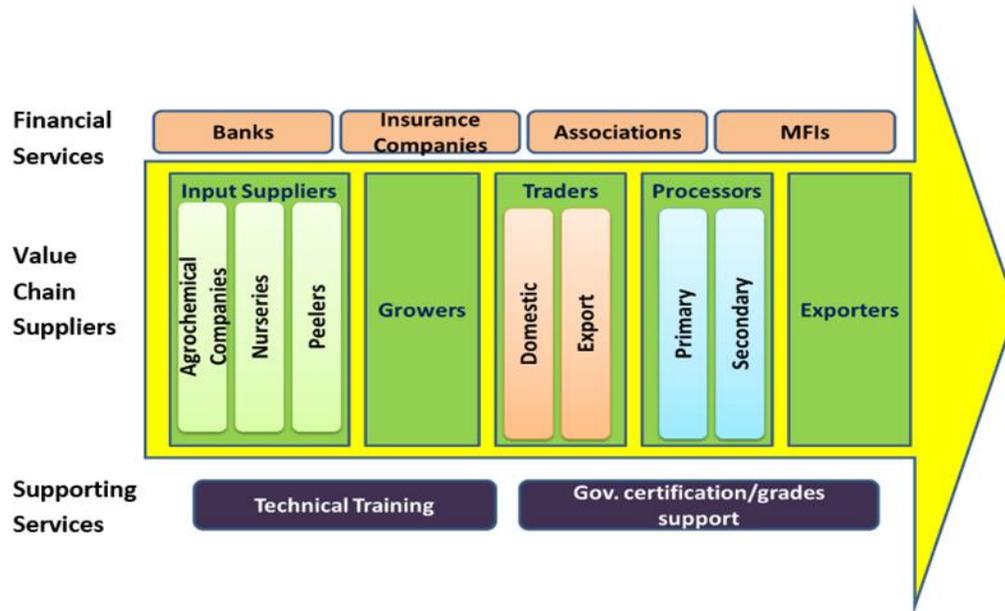


Figure 1: Proposed model for Cinnamon value chain in Sri Lanka

#### Primary Actors:

**Input suppliers:** The main input suppliers are nurseries providing seedlings, agrochemical companies and peelers.

**Growers:** The growers own the land, purchases all inputs, treat plants, and sell produce to traders. One distinctive feature of the cinnamon industry is that peelers are compensated based on a profit-sharing

arrangement. Due to the higher bargaining power of peelers, they demand about 40-50% of the profits.

**Producer groups:** In the cinnamon industry there are no producer groups. The value chain is relatively short, and growers sell directly to traders, processors, or exporters.

**Traders:** There are only few large-scale traders in the market. Traders buy and process cinnamon in their facilities. Usually, they engage in primary processing

resulting in a commodity rather than a value-added product. The main function of traders is to collect unprocessed cinnamon from producers. There are two types of traders: (1) traders focus on the export market and (2) traders focus on the domestic market. Traders supplying for the domestic market are usually small players. The domestic supply is small and sometimes large traders may sell products to domestic businesses.

**Processors:** Processing can be categorized into two groups: (1) *primary processing* - where preparing cinnamon to be marketed as a generic commodity, and (2) *secondary processing* - where value is being added to generic cinnamon. Unlike primary processing, secondary processing requires a substantial investment. There are several primary processors are in operation, but there is a dearth of secondary processors. Sometimes processors sell waste and by-products to other buyers who make other products (for example oil).

**Exporters:** The function of the exporters is to find the market and supply cinnamon to these markets. Exporters can either export generic cinnamon or value-added products or both. They are the main risk-takers of the entire value chain. Exporting has high barriers to entry because it requires a substantial investment.

### Financial Services

**Banks:** Banks play a major role in any type of value chain providing capital and liquidity. However, in the existing generic agricultural value chain, the bank plays a very limited role. There is no interaction between growers or input suppliers and the banks. The main reason for the lack of interaction is the lower credit worthiness of other actors.

**NBFIs (non-bank financial institutions):** The situation is quite similar when it comes to NBFIs such as insurance. Typically, processors and exporters would be the only interaction points for NBFIs. The reason is the scale of operation, only the later actors would have a critical mass to afford such services. On the other hand, cinnamon is a staple crop with minimum variations in price and propensity to be exposed to diseases.

**Private investors & funds:** Most cinnamon producers are smallholders and it is a minor export crop. It has been not able to attract major large-scale investments due to the size of the industry. Therefore, the proposed cinnamon value chain does not have private investors and funds (see Figure 1).

**Cooperatives/associations:** The cinnamon industry in Sri Lanka is not well organized. Other than the exporters, other value chain actors' function in silos. Association can improve and strengthen the position of a value chain actor such as growers or input suppliers. More than the financial assistance, associations help exporters to lobby and explore business opportunities.

**Microfinance institutions (MFIs) and community organizations:** There is a weak interaction between growers and MFIs. Certain smallholder growers may rely on MFIs to provide funds to buy inputs.

### Supporting Services

**Technical training:** Technical training is provided by the government agencies mainly to growers on cultivation and harvesting practices. Besides, the same agencies provide technical training to primary processors on preserving and improving quality. Training is available for peelers as well.

**Business training:** Business training is an essential support service for a competitive value chain. However, there is no dedicated business training providers within the value chain. Exporters may obtain training in this area by following general courses, but there is a need for specialized training/courses. This is one of the reasons the cinnamon producers and processors lack innovation and business drive.

**Specialized services:** This is another crucial service to become globally competitive. Specialized services are important to improve efficiency, add value and improve productivity. Some of the essential specialized services are marketing and branding and consultancy services. Due to the scale of the industry there is no room for such services to prosper (for

these services to existing, the industry should be large enough to gain economies of scale).

**Certification & grading:** At the moment grading is done at the level of the exporters. There are some agencies to support this task. Furthermore, institutions such as SLS and ISO are providing quality certifications for cinnamon processors.

There are many challenges and issues in the cinnamon industry in Sri Lanka. But major challenges identified during this study were mentioned here.

**Quality:** The quality of the cinnamon product is determined by the thickness of the bark, appearance, aroma, and flavor. The bark is quality highly influenced by the soil and ecological conditions. Importers mostly considered the color and general neatness for the perfect appearance. The quality of the final product is affected at all stages of growing and processing. Thick branches produce coarse bark and plants grown under shade condition produce inferior quality quills. Good quality cinnamon can be identified through it should be the light brown color with wavy lines, produce a sound of fracture when broken and should not be thicker than a thick paper. Also, good quality ground cinnamon bark contains 0.9 to 2.3% essential oil depending on the variety (Thomas et al., 2012). Besides, darkish brown patches discovered on the surface of cinnamon are called foxing. Therefore, grading depends on the amount of foxing, size, and color. Quills free from foxing are considered to be great. Normally, grading is carried out by the exporters and not by the producers. The finest and smoothest quality grades are evaluated as five zeros and coarsest as zero. However, over-matured barks are generally coarser and can be obtained an advantage by a weight factor. Here high quality five zero quills can be sold to a higher price in the market. Alba is the best quality grade and produced for special export orders (Ravindran et al., 2003). Cinnamon quality degradation is mainly caused by the absence of suitable processing facilities and improper knowledge of quality parameters.

**The threat of Substitutes:** Cassia is a product that is being used as a substitute for true cinnamon. The

consumers do not know the distinction between cassia and true cinnamon since both are marketed under the name cinnamon. Due to its cheaper price, cinnamon is losing its market position.

**The scale of the Industry:** Most growers are smallholders. Due to this, the cost of production is high (the growers are unable to achieve economies of scale).

**Industry Practices:** The growers are unsystematic and provide lesser priority to cinnamon cultivation among other crops. The attitude is such that the growers are complacent; they do not want to maximize profits.

**Traditional Technology:** The local technology is very labor-intensive, and the labor cost is very high due to the dearth of peelers. The peelers are coming from a certain caste system and due to this reason; it is very difficult to train new peelers (social stigma).

**Monopolies:** Monopolies run by exporters are one of the impediments to the industry. They control the price and keep large margins. They have also barricaded the new entrants to the industry.

**Dissemination of Knowledge:** There is an issue of diffusion of knowledge from researchers to the growers. Growers do not optimize land usage and do not treat the plants properly. Proper maintenance of the crop can significantly enhance the yield. There is no effective mechanism for the cinnamon research station to reach out to the growers and advise them.

**The attitude of the Peelers:** The peelers have a negative attitude towards new technology and very inflexible when it comes to change. This is the biggest impediment to the modernization of the industry. Peelers are much concerned about the quantity than the quality. They intentionally would not go for the highest quality claiming that they are unprofitable (higher opportunity cost in making Alba grade cinnamon).

**Barriers to Entry:** It is very difficult for a newcomer to enter into the market and become a grower due to information asymmetry. The critical information is not available freely for such entrepreneurs.

Furthermore, peeler management is quite challenging even for a veteran grower as there are many aspects to be tackled. Thus, the grower must know each step of the process very well and the peeler activities need to be closely tracked.

The second part of this study revealed that (for the objectives 2 and 3), the majority of farmers have a cinnamon land area less than 1.5 ha while 9% of farmers have in between 1.5-4 ha and only 3% of farmers have more than 4 ha of land. This indicates that the majority of lands were smallholdings. Due to this, the cost of production is high then growers are unable to achieve economies of scale. 58% of farmer lands were situated in the interior side and 42% of farmers have the cinnamon lands in roadside. According to the analysis one of the reasons for the low productivity of cinnamon was due to land proximity. Therefore, when compared to the roadside; interior side farmers faced many problems during cinnamon cultivation and its transportation (see Figure 2(a)).

The most important final target or challenge of farmers is a potential yield. Survey results indicate that only 2% of farmers obtained the yield of more than 1,000 kgha<sup>-1</sup>yr<sup>-1</sup>. The majority of farmers (63%) obtained yield between 300-650 kgha<sup>-1</sup>yr<sup>-1</sup> and 11% of farmers received less than 300 kgha<sup>-1</sup>yr<sup>-1</sup> (see Figure 2(b)). So, the results clearly show, nearly 75% of farmers obtained low yield and farmers have not applied good management practices for the cinnamon production. The study explained that expenditure for the cinnamon cultivation was high for more than 1,000 kgha<sup>-1</sup>yr<sup>-1</sup> yield category. Figure 3 indicates that the relationship between land proximity and problem of collecting planting materials. The Chi-square test result indicates the P value (0.000) less than the significance level (0.05) and there was a statistically significant association between above two variables. Further, Figure 4 indicates that the relationship between land proximity and problem of finding peelers. Based on the Chi-square test, there was a statistically significant association between land proximity and problem of finding peelers.

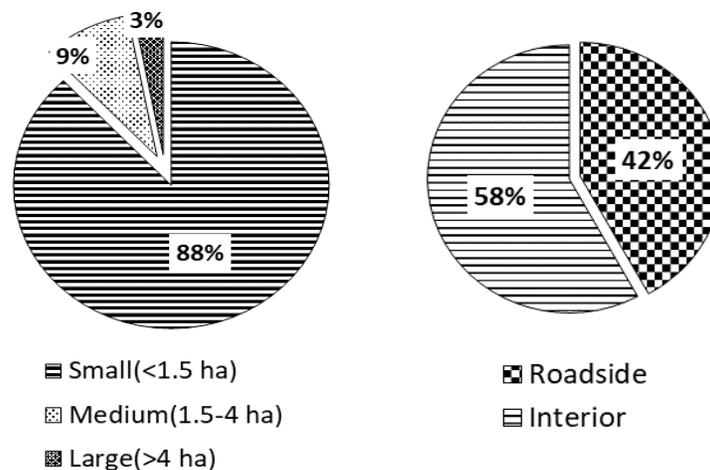


Figure 2: (a) Land extent and proximity in the sample

The main income was identified from five different income sources. Among those, major income sources among the surveyed population were cinnamon cultivation, other agricultural activities, government jobs and business. Nearly three-quarter of the population relied on cinnamon cultivation. The other agricultural activities such as tea, paddy cultivation, etc. government jobs and business accounted for 15%, 8% and 4% respectively. This information

shows that cinnamon cultivation has played a pivotal role in the livelihood of the people in the Matara district. Moved on to the education level of the farmers, 17% of farmers have passed up to grade 08, 55% of farmers have passed GCE O/L, 19% of farmers have passed GCE A/L and 9% of farmers went through higher education. Comparatively literacy level of the majority of farmers is good.

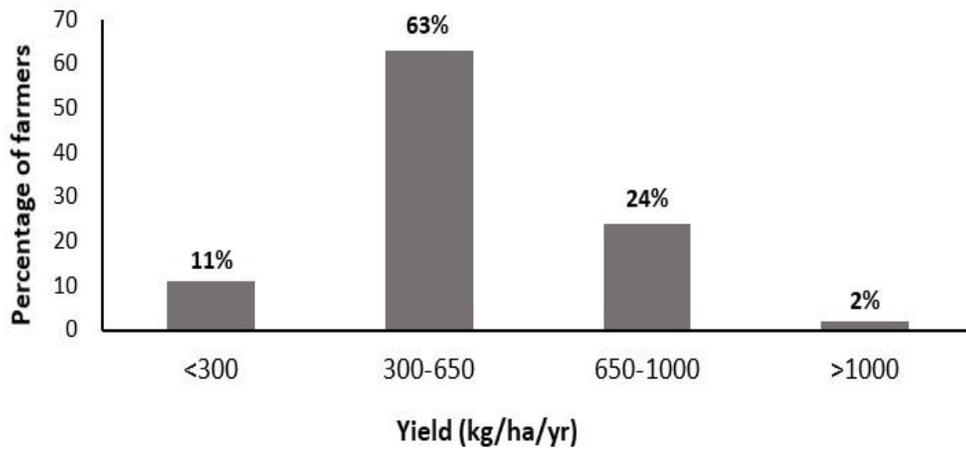


Figure 2: (b) Comparison of cinnamon yield

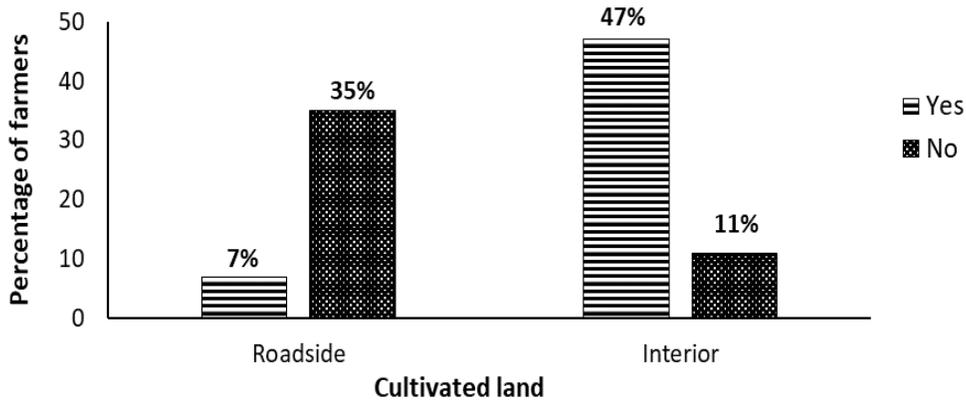


Figure 3: Relationship of land proximity and the problem of collecting planting materials

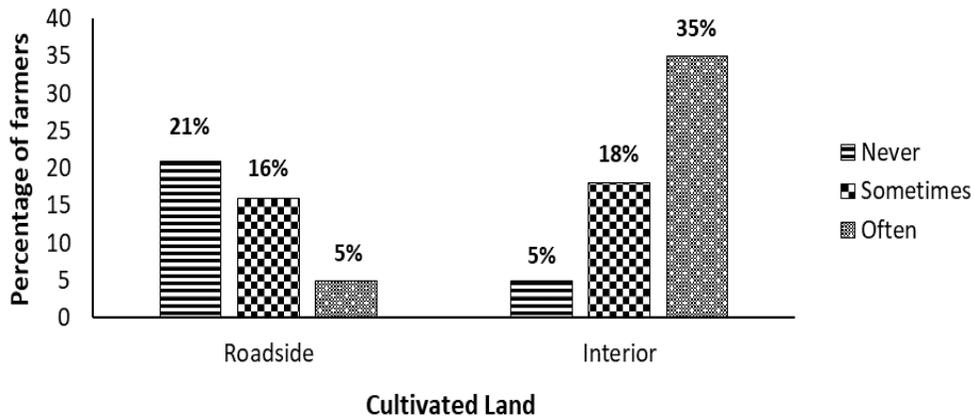


Figure 4: Relationship of land proximity and the problem of finding peelers

The extension officers are a group of important stakeholders of the cinnamon industry in Sri Lanka and provide extension services to the farmers throughout the cinnamon cultivation. Analysis shows that 59% of farmers said Extension Officers (EOs) have visited to their field while 41% of farmers mentioned that EOs have not visited their field. Besides, majority of farmers (45%) have low satisfaction with the extension services, 31% and 24% of farmers have moderate and high satisfaction with the services, respectively. Due to the difficulties on find out exact locations, EOs visited the cinnamon field frequently situated on roadside compare to the interior side.

Financial services play a major role in the cinnamon value chain of Sri Lanka by providing capital or financial aid. Further, results show that 94% of farmers did not get the support from financial institutions while only 6% of farmers got the support from them. Normally, some financial institutions have given capital or loan facilities to the farmers. Therefore, ICT can play a big role in developing links between farmers and financial institutions.

The graph Figure 5 indicates that most of the farmers have mobile phones. Thus, developing a mobile-based application can be an effective tool in technology transfer and providing information about other services. The study also revealed that the majority of farmers used mobile phones for the routine activities and farmers who did not use mobile phones were in the old age category.

Furthermore, the study compared the willingness of ICT application among the farmers using Wilcoxon signed rank test. Results show that, the calculated Z values were higher than 1.96 ( $Z_1 = -9.155$ ,  $Z_2 = -7.898$ ). It concludes the usage of a mobile application (Statement 1) and management dashboard (Statement 2) are important in resolving information gaps in the cinnamon industry. But, when comparing the mean values of above two statements, the first statement (1.73) has higher value than the second statement (1.08). Therefore, stakeholders in the cinnamon industry have a high willingness to establish a mobile-based application for information gaps.

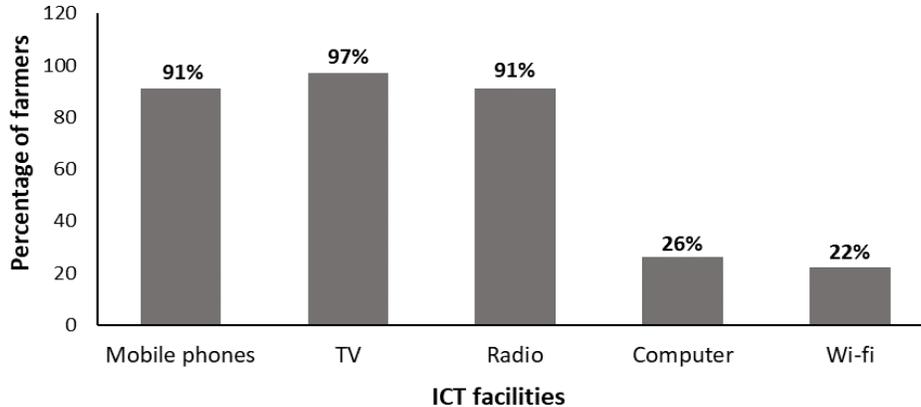


Figure 5: Uses of ICT facilities among farmers

According to the research findings, we identified information needs and where the real root causes exist within the farming community and observed that there is a clear information gap among the actors in the cinnamon industry as there is no proper coordination and/or information flow among them. Then, the information flow model for the mobile-based application has been designed to address the

gaps identified in the present scenario. Figure 6 shows that all the actors in the value chain of the cinnamon industry in Sri Lanka based on three major categorizations, such as value chain suppliers, supporting services and financial services. Further, it depicts information flow among these categories through the mobile platform.

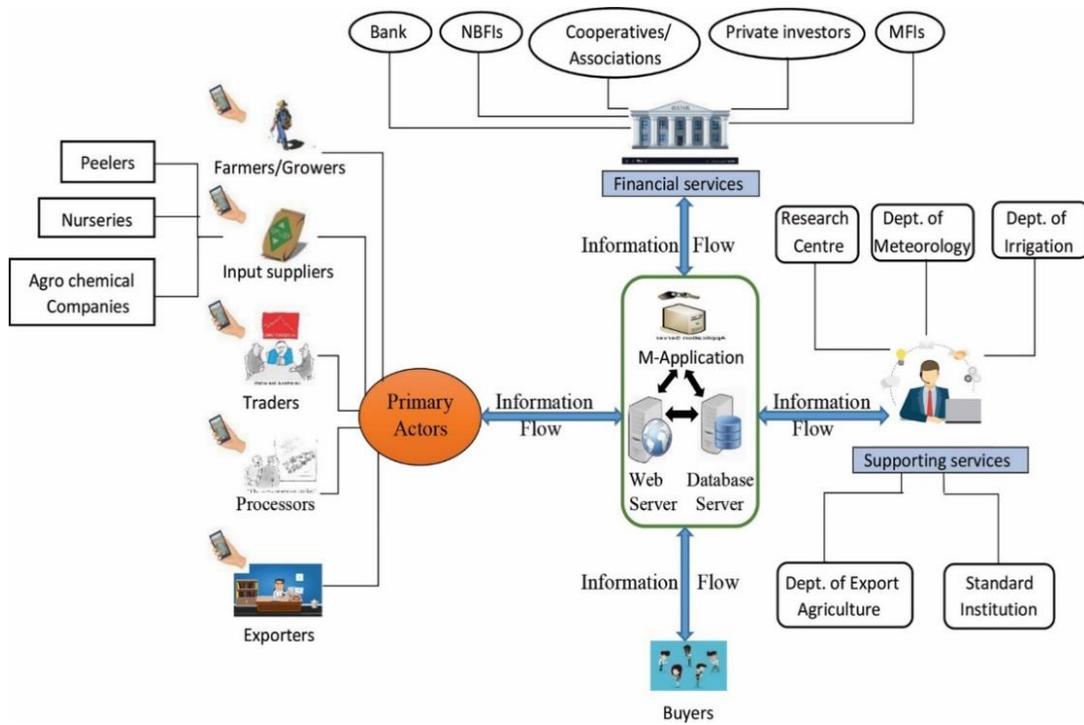


Figure 6: Information flow model of actors in the cinnamon industry in Sri Lanka

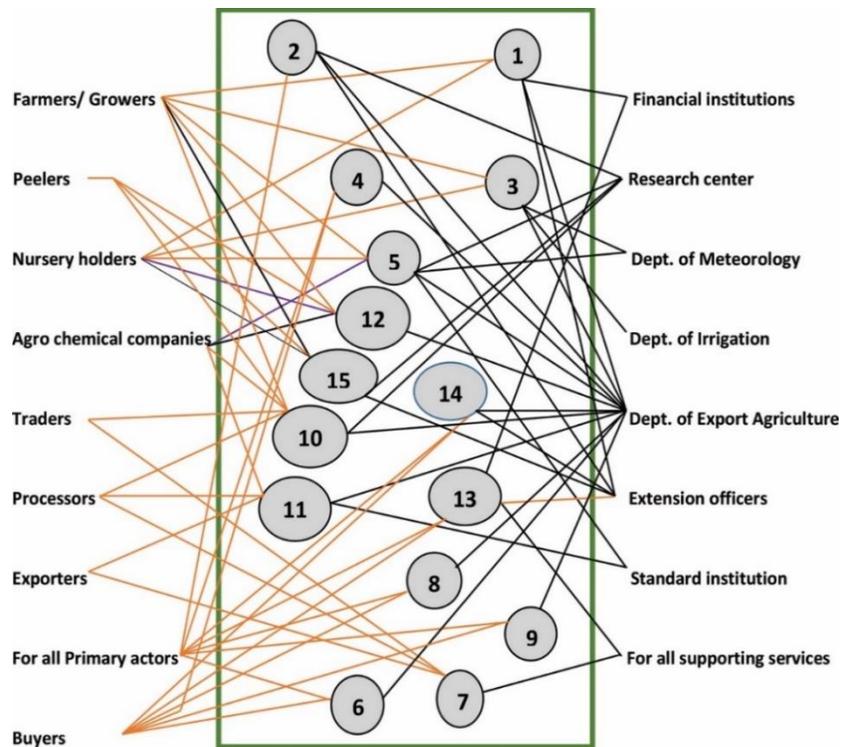


Figure 7: (a) Key functions and behaviours of proposed mobile-based information system for cinnamon industry in Sri Lanka

### Functionalities

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- 1 - Providing liquidity & capital
- 2 - Publish new innovation & research findings
- 3 - Weather data updates
- 4 - Publish state wise updates & advertisements
- 5 - Publish articles, videos, PDFs & documents related to the cinnamon production
- 6 - TV, Radio programs about cinnamon
- 7 - Specialized services (marketing, branding & consultancy services)
- 8 - Hotline service for queries
- 9 - Registration services
- 10 - Technical and business training & quality improvement programs
- 11 - Providing SLS & ISO certificates
- 12 - Get inputs for the production
- 13 - Get market price updates
- 14 - Providing contact information about existing stakeholders
- 15 - Queries regarding management practices of cinnamon

### Communication channels

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- Information input party
- Information output party
- Both parties

Figure 7: (b) Explanation of key functions and communication channels in Figure 7 (a)

The Figure 7 (a) indicates that what are the key functions or information required for each actor in the cinnamon value chain (for examples: information on liquidity & capital; services on marketing, branding and consultancy; inputs for production; etc.) and how they link each other to get the right information at right time in right format. Each function numbered in Figure 7 (a) and

communication channels mentioned in Figure 7 (a) are explained in Figure 7 (b).

The proposed integrated mobile-based application will help to:

1. Improve two-way communication among actors
2. Reduce transaction costs
3. Provide relevant and timely information to the target person
4. Help to make better decisions at the right time

## Conclusion

To develop ICT-based solutions to enhance the cinnamon industry in Sri Lanka, it becomes necessary to closely examine the whole production process and the value chain to identify areas/gaps where ICT-based interventions could make an impact.

First part of this study, the existing literature, established knowledge, information and knowledge gathered from the qualitative discussions held in Matara district were analyzed. As a result of that, the actors in Sri Lankan cinnamon industry were identified and a model for the local cinnamon value chain was designed and proposed (Figure 1). Further, major barriers and challenges to improve the global competition of the industry were identified.

The second part of the study revealed that, the cinnamon growers faced serious difficulties in obtaining quality planting material, modern agro-technology, know-how, technical training, professional advisory service, experienced peelers, and information on market behavior of cinnamon promptly. That has posed a constraint to improving the yield, quality of cinnamon and obtaining the best possible price for their produce. Analysis of this study showed that, 91% of the cinnamon growers use mobile phones while 32% use smartphones and over 90% of the farmers expressed keen interest in obtaining prompt information on their mobile phones. Further, the majority of the farmers (nearly 75%) obtained a yield of less than 650 kg ha<sup>-1</sup>year<sup>-1</sup> and around 15% of the farmers obtained a yield of less than 300 kg ha<sup>-1</sup>year<sup>-1</sup>. This indicates that the majority of farmers obtained a yield far below what is achievable under good management. Yield gap was mainly due to non-adoption of the recommended agronomic practices, inadequate and unsatisfactory extension service, the dearth of and lack of information on peelers available in the region, predominance of small holdings (88%) and lack of market information and meteorological data when needed. Therefore, an integrated functional model for use on an ICT enabled mobile platform was designed, which can improve two-way communication, linking all the actors and can help to make decision at right time. This will enable farmers to get necessary advice and instructions related to agro-technology, information on weather, input suppliers, service providers and market on a mobile platform, which

could contribute to improving yield, quality and profitability of cinnamon.

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