

In Search of Stimulative Strategies

An Analysis of Sri Lankan Vegetable & Fruit Supply Chain



**YBTER Congress Proceedings
2013**

Young Business Technology & Entrepreneurial Researchers (YBTER)

**In Search of Stimulative Strategies:
An Analysis of Sri Lankan Vegetable and Fruit
Supply Chain**



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Faculty of Commerce and Management Studies

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Acknowledgement

As the second consecutive year, this is the pioneering attempt to organize the YBTER Congress 2013 which is business technology undergraduate students' academic event in the Department of Commerce and Financial Management (DCFM). With the successful outcomes from the previous YBTER 2012, this time we are heading the YBTER 2013 with "*In Search of Stimulative Strategies: An Analysis of Sri Lankan Vegetable and fruit Supply Chain*". During this research we had to face enormous challenges on the way to the final outcome this congress and at the same time with the support of so many people around us, we were able to overcome all the barriers coming before us. Thus, the YBTER Congress 2013 is an outcome of genuine effort of so many people who work with us. There are many individuals who helped us to make this event a success. On behalf of the YBTER 2013 organizing committee first our sincere thanks goes to Dr. C. Pathirawasam, Head of Department Commerce and Financial Management for his valuable support for this event and the Association of Business Technology. We are also thankful to Dr. D.M. Semasinghe, Dean of the Faculty of Commerce and Management Studies for the invaluable support given to make this event successful. Further, our sincere gratitude goes to Dr. C.N. Wickramasinghe,

senior lecturer, Department of Commerce and Financial Management for his encouragement and support extended on this to make it success. Our sincere gratitude also goes to all the lecturers at the Department of Commerce and Financial Management for their valuable contribution as the members of editorial board of the congress proceedings. Last but not least we are thankful to all the business technology final year and third year students and non-academic staff of the DCFM for their contribution, commitment and enthusiasm to make YBTER congress 2013 a reality.

H.M.U.S.R. Samarasinghe

Congress Chair

Young Business Technology & Entrepreneurial Researchers
(YBTER) 2013

Preface

Young Business Technology & Entrepreneurial Researchers (YBTER) congress is yet another pioneering effort of the final year Business Technology students. In fact YBTER congress is the major academic event of the Students Association of Business and Technology (ABT). Since YBTER congress began its journey as the first ever undergraduate student congress held in University of Kelaniya, as the second consecutive year this time they are heading YBTER 2013 congress proceeding with **“In Search of Stimulative Strategies: An Analysis of Sri Lankan Vegetable and Fruit Supply Chain”**. The vegetable and fruit industry supply chain in Sri Lanka is a contemporary topic that most people talk about thus the recent dilemmas showed the significance of studying it. Price mafia, Fruits and vegetables damages and waste and vegetable going perished due to inappropriate methods of picking, packing, storing and transportation and insufficient information flow are the major handicaps that have come up recently.

Therefore it is very important to study the whole supply chain and find out the necessary remedies in order to develop Sri Lankan fruit and vegetable industry.

Young Business Technology and Entrepreneurial Researchers (YBTER) are the combined research group consisting of final

year undergraduates from Business Technology study streams of Department of Commerce and Financial Management. The aim of the YBTER congress 2013 is to do a comprehensive analysis on vegetable and fruit supply chain in Sri Lanka in order to identify the major difficulties as well as dilemmas faced by all the parties involved in vegetable and fruit supply chain in Sri Lanka thus proposing sustainable solutions to avoid them. The issues addressed in this book are not unknown matters yet no one still pays attention to the significant inefficiencies. Through this congress, authors expect to illustrate relevant possible solutions which are not practiced in Sri Lanka. Hence this congress proceeding is expected to stimulate the readers awareness of unidentified dilemmas and missing solutions to allow relevant authorities to rethink of best adoptive strategies in terms of Sri Lankan vegetable and fruit supply chain. Last but not least I would like to express my sincere thanks to reviewers, editorial board and supervisory board for their enormous contribution given in making this proceeding success.

H.A.H.Hettiarachchi

Editor in Chief

Bcom (sp) Business Technology (Hons) Kel'ya

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University of Kelaniya

Head's Message



It gives me an immense pleasure to issue this congratulatory message to YBTER Congress 2013 organized by the Students Association of Business and Technology of the Department of Commerce and Financial Management, University of Kelaniya. Supply chain management has become a contemporary topic in today's world and plays a pivotal role in today's business operations. With regard to the Sri Lanka's vegetable and fruit supply chain, what can easily be seen and recognized is high price fluctuation and wastage of fruits and vegetables making the condition inclement for almost all the parties involved in vegetable and fruit supply chain. These issues should be addressed promptly and carefully thus providing benefits to all the parties involved in the supply chain of fruits and vegetable market. Consequently, Vegetable and fruit price remaining high is a significant issue when it reaches to consumers as they have to bear the unnecessary cost involved in the supply chain. This major issue can be attributed to the inefficiencies and weaknesses of fruit and vegetable supply chain management. As I believe proper implementation of vegetable and fruit supply chain can be a panacea to these issues mentioned earlier.

Tracing the roots of the prelude of today's world sophistication and advancement in the lives of people, technological advancement bears witness playing a major role where in. I hope that this congress will further advance our knowledge on supply chain management and related areas there by addressing to the issues associated in the fruit and vegetable supply chain in Sri Lanka. I wish all the success for the congress and highly appreciate the effort made by the congress.

Dr. C. Pathirawasam

Head,

Department of Commerce and Financial Management

University of Kelaniya

Dean's Message



The Young Business Technology and Entrepreneurial Researchers (YBTER) associated with the students Association of Business and Technology of the Department of Commerce and Financial Management, Faculty of Commerce and Management Studies has come forward in organizing its annual research congress for the second consecutive year. First and foremost, I congratulate for this great event which is very rare among student fraternities in Sri Lanka. The underlying theme of the congress and the research articles would be crucial for the development of the food and supply chain in Sri Lanka. I am enthusiastically waiting for the participant's suggestions for the development and solutions to complex problems of the contemporary agricultural industry, which would assist for the rapid economic growth of the country.

The success of a faculty systems from both academically and professionally qualified academic staff and creative, knowledgeable and determined undergraduates. The effort made by undergraduates of the faculty in order to create and instill an academic culture is a commendable step in this regard. The congress will provide solutions for the current issue in the

vegetable and fruit industry in Sri Lanka. Therefore, YBTER 2013 will be the first step of a long journey to enhance the academic culture among undergraduate students of the Faculty of Commerce and Management Studies. Thus, YBTER 2013 will give tremendous opportunities to students to enhance their skills, competencies and knowledge which is necessary to be a 21st century student.

It's indeed a great pleasure extending my sincere wishes to the students and the staff of the Department of Commerce and Financial Management for the utmost dedication extended for the event and I wish all the success for their future endeavors.

Dr. D.M. Semasinghe

Dean,

Faculty of Commerce & Management Studies

University of Kelaniya

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Sri Lankan Vegetable and Fruit Supply Chain: A Comprehensive Overview

G.N.M. WIMALAWEERA
H.M.U.S.R. SAMARASINGHE

Introduction

Vegetable and fruit supply chain has always been a contemporary topic creating news among media, academia, state institutes in Sri Lanka. Vegetable price fluctuations, excess supply and wastage are the most common and recent dilemmas that are famous in vegetable and fruit supply chain thus this issue is common to most of the Asian countries. As a developing and an Asian country, agriculture is one of the key elements in the Sri Lankan economy, and still most of the citizens are engaged in agricultural activities. As per the reports by the central bank of Sri Lanka (Central Bank Reports), it showed that in the year 2012 31% of the population is still engaged in the agricultural sector though it has decreased compared to the data in 1986/1987 and 1996/1997 which were respectively 47.7% and 37.7%. Harvesting vegetables and fruits is one of the main agricultural activities in Sri Lanka thus two types of vegetables are grown namely low country vegetables and up country vegetables. The table below shows few examples of vegetables grown in the up country and low country together with few fruits grown there in.

Low Country Vegetables	Up Country Vegetables	Fruits
Lady's fingers	Beans	Bananas-Ambul
Capsicum	Carrot	Bananas-Kolikuttu
Bitter gourd	Leeks	Bananas-Seeni
Snake gourd	Cabbage	Bananas-Anamalu
Pumpkin	Knol khol	Papaya
Long beans	Radish	Passion fruit
Luffa	Tomatoes	Wood apple
Turkey Berry (Thibbatu)	Butter beans	Avocado
Winged beans	Cauliflower	Orange
Lime	Red bell pepper	Grapes
Ash Plantains	Green bell pepper	Pine apple

*Source: Hector Kobbekaduwa Agrarian Research and Training
Institute, Sri Lanka (<http://www.harti.gov.lk>)*

Sri Lanka produces more than 800,000 metric tons of vegetables and fruits annually. Apart from the local consumption, vegetables and fruits are exported to Middle East countries such as United Arab Emirates, Saudi Arabia, Qatar, and Kuwait. Importantly, Maldives, United Kingdom, India, Pakistan, Qatar, Saudi Arabia, Germany and India are the top countries importing fruits from Sri Lanka. Carrot, leeks, cabbage, cauliflower, salad leaves, beetroot, beans, bell pepper, cucumber, pumpkin, bitter gourds are the vegetables exported. Pineapple, melon, bananas, young jackfruit, lime, papaya are some of the fruits exported. As per the central bank of Sri Lanka, in 2009 the vegetable export amount was 43,937 million LKR, in 2010 it was 59,531 million LKR and in 2011 the export amount was 62,392 million LKR. Sri Lanka has now entered in to a new phase after ending the 30 years of civil war where Northern Province and eastern province also are actively engaged in vegetable and fruit production. Annual report 2012 by central bank showed that fruit and vegetable production in the eastern province have improved to 7.3% in 2012 from 4.3% in 2011 while that of the north western province has increased to 10% in 2012 from 8.4% in 2011. So it seems vegetable and fruit production has increased continuously.

Dambulla Dedicated Economic Center and Its Importance



There are 12 dedicated economic centers in Sri Lanka. They are Dambulla, Thabauththegama, Nuwaraeliya, Kappetipola, Kurunduwaththa, Welisara, Veyangoda, Narahenpita, Embilipitiya, Meegoda, Piliyandala and Rathmalana. Out of other 12 dedicated economic centers Dambulla DEC was the first and the oldest center which has the highest number of operations. Dambulla Dedicated Economic Center (DEC) is the main trade hub for fresh vegetable and fruit distribution in Sri Lanka. From the inception of its operations in 1999 as a dedicated economic center now its operations have diversified up to 144 stalls. Traders and the farmers from all around the island reach with their harvest every day. The main objective of Dambulla DEC establishment was to accumulate all the vegetable and fruit harvest from all around the island in order distribute them easily as well as

eradicate inability of selling the harvest by farmers. Estimated average volume of sale per week of Dambulla DEC is 26,500 Mt. Transaction volumes at the Dambulla DEC are high on Tuesdays and Saturdays. The main reason for this demand increase is, Dambulla DEC is the major vegetable and fruit supplier for small scale weekly market sellers. Reasons for the arrival of most farmers to Dambulla DEC is, it being the main centre out of all the other centers, having the highest number of stalls as well as situated in the central part of Sri Lanka. For example Nuwara Eliya DEC is specialized for up country vegetables and kappetipola DEC is specialized for vegetables like potatoes, beans, and cabbage thus almost all kinds of vegetables and fruits reach Dambulla DEC. The normal active hours for a day at Dambulla DEC is 3 PM till midnight.

Vegetable and Fruit Supply Chain in Sri Lanka

In general Supply Chain Management (SCM) is simply defined as; A set of organizations directly linked by one or more of the upstream and downstream flows of Product, Service, Finance and Information. The SCM spans all movement and storage of raw materials, work in process inventory, and finished goods from point of origin to point of consumption. In organizations every product reaches to an end user; represents the collective effort of multiple organizations and all these organizations belong to the

relevant supply chain. Maximizing customer values and achieve a sustainable competitive advantage becomes the ultimate objective of this managing supply chain.

The organizations link supply chain together through physical flows and information flows of up and down stream. A physical flow involves the transition; movement and storage of goods and materials. They are the most visible part of the supply chain. Information flows are also important as physical flows because it allows the various supply chain partners to coordinate, develop long term plans and to control the day today flows of goods and materials up and down.

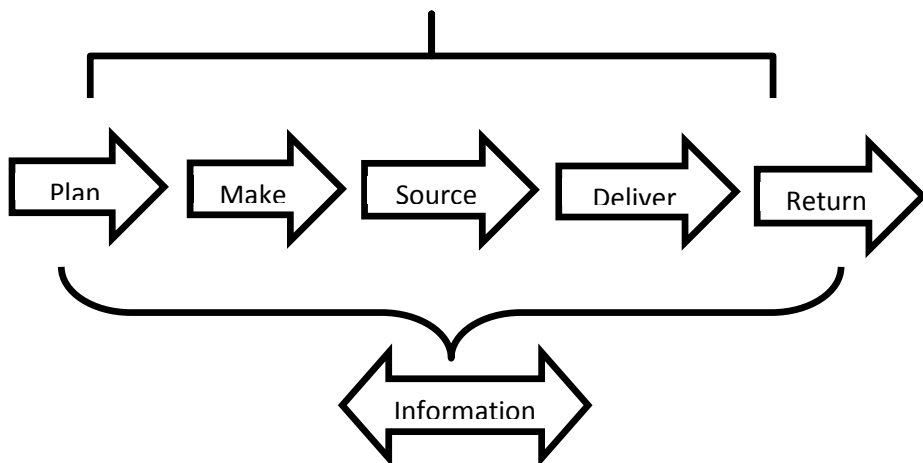
In terms of vegetable and fruit supply chain management, it is the utmost essence of the whole process as mentioned above. Normally in the vegetable and fruit supply chain farmers, suppliers, intermediaries, retailers, middlemen, wholesalers and customers as the main parties that can directly be identified but still not limited to them. When the customer information flow reaches upwards to the chain, farmers will deliver the harvest to the subsequent tier of the vegetable and fruit supply chain. Likewise physically goods arrive through a flow.

In addition to that the information flow is also vital in vegetable and fruit supply chain. Information sharing with each and every

supply chain partner is important. It is very important in vegetable and fruit supply chain because vegetables and fruits are perishable goods. The flow of information should be very quick and it should correctly address the relevant parties at the right time.

If the information flows are quick and accurate between the supply chain members then the problems associated to vegetable and fruit supply like wastages and unnecessary price changes won't happen.

Elements of Sri Lankan Vegetable & Fruit Supply Chain



There are basically five basic components which can be identified in terms of Sri Lankan vegetable and fruit supply chain management.

1) Plan

Plan is the strategic portion of Supply Chain Management. A plan or strategy must be developed to address how a given good or service will meet the needs of the customers. A significant portion of the strategy should focus on planning a profitable supply chain. When relating to the vegetable and fruit supply chain, in order to reach customer demand for vegetables and fruits, all the parties in the supply chain process must have a coherent strategy on how to manage the resources in order to provide better goods and services effectively and efficiently. It is apparent that varied distribution channels are being adopted at DEC's specially Dambulla DEC which can be identified as ultimate plans on how the vegetables and fruits are going to reach the final customer. Some farmers bring their harvest directly to Dambulla DEC and sometimes intermediaries are involved. Then the vegetables and fruits are directly bought by either whole sellers or retailers or in some cases retailers buy the harvest from whole sellers instead of directly buying from Dambulla DEC and eventually customers buy them from the retailers. As a part of planning most important thing is to develop a set of metrics to monitor the supply chain

which will ultimately deliver high qualities and values to customer.

2) Source

Source or develop revolves around building a strong relationship with different parties of the supply chain. This involves building a solid bond among suppliers (fertilizer, Pesticides, etc.), farmers, middlemen, whole sellers, retailers and the end consumers. This phase includes not only identifying reliable suppliers but also planning methods and techniques for delivery and payment. It is important to be extremely careful in selecting reliable suppliers [farmers, whole sellers and retailers]. At Dambulla DEC, it is quite obvious that the bond among varied suppliers and the ultimate customer is more or less fragile and not reliable. Hence developing a set of pricing, delivery and payment processes with suppliers along with a set of metrics for monitoring and improving relationships are a must.

3) Make

This component is related to the quality assurance, packaging and scheduling for delivery of the vegetables and fruits. This is by far the most metric-intensive portion of the supply chain, measuring quality levels and worker productivity. Here each party of the vegetable and fruit supply chain is responsible in scheduling the

activities necessary for vegetables and fruits to be tested, packed and prepared for delivery. This element ensures the flow of harvest and that way provide the ultimate customers with fresh and non-tampered fruits and vegetables.

4) Delivery

This component is related to the logistic activities of the supply chain management. In this step, receiving customer orders and delivery of vegetables and fruits are planned. Suppliers coordinate receipts of orders; fulfill the orders via a network of transportation mediums to deliver vegetables and fruits as well as implement a billing and invoicing system to facilitate payment. Yet in reality, the warehousing is less reliable since the vegetables and fruits cannot be stored for longer periods as they are highly perishable and farmers and suppliers at Dambulla DEC are lacking the luxury of affording high technological equipment like high-end freezer warehouses to store the goods for a particular time. Furthermore, the operations run at Dambulla DEC are less demand driven. Therefore, customer orders are being received a lesser concern when it comes to deciding on supply of vegetables and fruits.

5) Return

As the name suggests, customers may return defective products [rotten and tampered vegetables and fruits] at this stage. Usually this is the most problematic step in the supply chain management. Suppliers are supposed to create a proper network for receiving information related to tampered and excess vegetables/fruits and also support customers who have issues with delivered products by addressing their problems.

It seems at Dambulla DEC that there is no proper system to receive customer complaints on defective products.

6) Information

Information plays a vital role in tying up all five major components of supply chain management. It is paramount to have a proper information flow amongst the supply chain activities and the supply chain members. Yet, one of the major issues encountered at Dambulla DEC is the lack of communication where the supply chain members (farmers, traders, whole sellers, etc.) are mostly held in darkness since they lack information to proceed with their day today business activities.

Current Status of Sri Lankan Vegetable & Fruit Supply Chain

Traditional supply chain management system is not demand driven system thus it is always focused on the assets and products. In traditional supply chain management, organization strategy will be on throughput and asset utilization. Traditional organizations set performance goals for each functions to be managed in isolation with no or little attention given to inter-functional relationship. By making use of local information to make demand forecast and passing them on to downstream partners, where information distortion will be created. Traditional supply chain system take longer response time to react to market place changes, because of that unable to meet the dynamic demand patterns, supply chain inventory becomes obsolete as demand for certain product disappears. Higher inventory level is another feature which leads to inventory obsolescence thus the reason is increased variability (bullwhip effect).

Sri Lankan vegetable and fruit supply chain is the typical example for traditional supply chain management. It's a 100% non-demand driven system. It takes lots of time to respond hence the vegetable and fruit supply chain cannot react to the market changes accordingly. That is the reason in some seasons the certain types of vegetables are wasted. Vegetables like cucumber

is among the most wasted vegetables because supply is more than the demand. Yet it's another possible reason for the vegetable and fruit wastage. So it is really necessary to change the traditional supply chain in order to minimize the wastage. Not only the wastage, higher inventory levels sometimes leads to price discriminations as well as less demand and high supply will lead to low prices. Then the farmers won't get a reasonable price for their harvest. It is suggested that Sri Lankan vegetable and fruit supply chain be incorporated a demand driven strategies unlike the traditional supply driven mechanism.

Back End of Sri Lankan Vegetable and Fruit Supply Chain

A. Climate Conditions

Sri Lanka is an island which is situated in the Indian Ocean and lies between latitude $5^{\circ} 55'$ and $9^{\circ} 50' N$ and longitude $74^{\circ} 42'$ and $81^{\circ} 53' E$. The total land area is 65,614 km². Sri Lanka has a mixed climate with no such clear experience about four seasons, spring, summer, winter and autumn thus Sri Lanka has different types of climates in certain areas. Nuwara Eliya always has the lowest temperature out of other districts in the country. Anuradhapura, Kebithigollawa, Kathragama and Dambulla are the areas that have a high temperature in most of the times in the year. Sri

Lanka is divided in to three major agro ecological zones on the basis of annual rain fall. They are;

- Wet zone (more than 2000mm)
- Intermediary zone(1000mm-2000mm)
- Dry zone (less than 1000mm)

These three major ecological zones again divided in to sub 24 ecological zones. Having different climates in different areas has been helped growing various types of vegetables all over the country. Vegetables like carrot, cabbage, tomatoes, beetroot needs cool climate almost 15° c – 20°c. Vegetables like pumpkin, cucumber, chilies are not required a cool climate. Apparently that is the reason to dividing the vegetables in to low country and up country vegetables.

B. Soil Conditions

Though Sri Lanka has variety of soils, most of the soil varieties are good for cultivating vegetables and fruits. The table below proves that fact.

Type of soil	Description	Crops cultivated
Reddish brown earth soil	Red and yellow brown in color. Slightly acidic.	Good for Chillie, Onion, Cashew

Non calcic brown soil	Can see in dry zone. Color is dark brown to ash brown	Good for Green gram, Kaupi, Chillie
Red yellow podsolic soil	Soil is red, yellow and brown. Has a thick layer.	Good for vegetables, fruits
Reddish brown latosolic soil	Has a moderate texture. Can be seen in Nuwara eliya, Kandy, Mathale.	Good for vegetables, fruits
Immature brown loamy soil	Color is varied to dark brown to ash brown.	Good for vegetables, fruits
Solodized solonetz soil	Can see in Mannar, Hambanthota	Not suitable for vegetables and fruits
Grumosol soil	Soil can be seen in Jaffna, Mannar. Black soil.	Good for vegetables, fruits

Source: http://www4.schoolnet.lk/edusoft/agriculture/grade-12_13/more.php?main=main4

C. Watering

Watering is the most crucial aspect of crop cultivation specially for vegetables and fruits. There are certain ways of Sri Lankan farmers watering their cultivations.

- **Pulley well**

Used to raise water to higher elevation, this uses man power. The capacity of water that rose is minimum thus very common and ancient method among farmers.

- **Adhiya well**

Adhiya well is lowered up to water level and raised water very popular in northern and eastern part of Sri Lanka. Moderately deep water can be raised.



- **Centrifugation pump**

Active method of raising water by using electricity or hydro carbon as fuels. When using the pump for longer period of time, it is very expensive. But this is the most popular method among farmers.

- **Displacement pumps**

Most displacements pumps are operated by man power. Therefore it is easy to maintain and pump is operated by electricity or fuels.

Sri Lanka is enriched with all the basic requirements to cultivate vegetables and fruits. Suitable climate as well as proper soil is available in Sri Lanka to grow vegetables and fruits. Natural disasters like droughts are very rare in Sri Lanka. So the water supply is provided smoothly in addition to monsoon. So Sri Lanka has all the facilitating conditions for cultivating vegetables and fruits.

D. Fertilizer Usage and Pest Control

The forms of fertilizers available in Sri Lanka are as dust, granule or liquid. In most of the fertilizers it gives only one nutrient. (E.g. Magnesium, potassium)



Fertilizer types recommended by the ministry of agriculture are,

- Organic fertilizer - component of hay, leaves, plants, paddy husk, livestock waste
- Livestock fertilizer - cow dung or poultry wastage
- Compost - wastage of crops, wastage from household

Control of pesticides act (amendment) no. 06 of 1994 is the parliament act which governs pest control in Sri Lanka. All commercially used pesticides in Sri Lanka are imported. There

are about 20 pesticide types used in agriculture and three most commonly used types are listed below.

To control fungi	Fungicide
To control insect pests	Insecticides
To control weeds	Weedicides

Vegetable & Fruit Distribution Flow

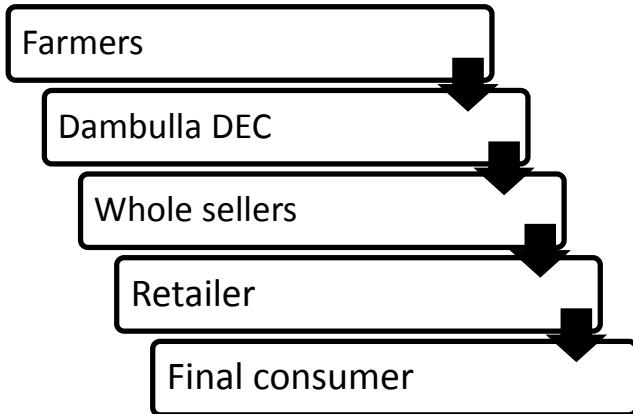
There are certain types of distribution flows associated from the point of farmer reaping their harvest until the harvest reaching to final consumer. Dambulla DEC is assumed to be the main exchange point in these distribution flows. Such vegetable and fruit distribution chains observed are;

1st Flow

In this vegetable and fruit distribution flow farmers bring their harvest directly to Dambulla DEC by their own transport system or hiring vehicles for transportation (mostly farmers hire vehicles such as Lorries since they do not own any vehicle). At Dambulla DEC premises farmers will sell their harvest to buyers (mostly for whole sellers).

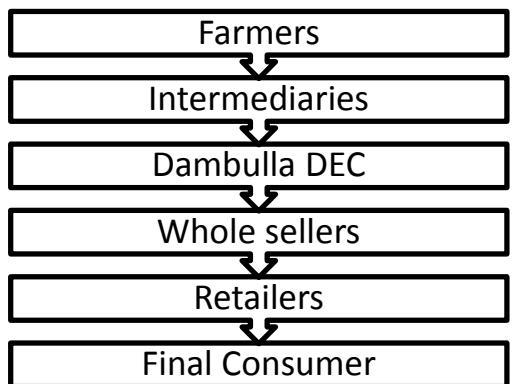
In this process, simply harvests move within the Lorries (farmers Lorries to whole sellers Lorries) instead of unloading and storing at Dambulla DEC premises. No such intermediaries or

middlemen are existed in this flow. Then whole sellers sell the harvest to retailers consequently ending up the process by reaching the harvest to final consumer. Sometimes super market chains act as whole sellers or retailers in this flow and other distribution flows as well.



2nd Flow

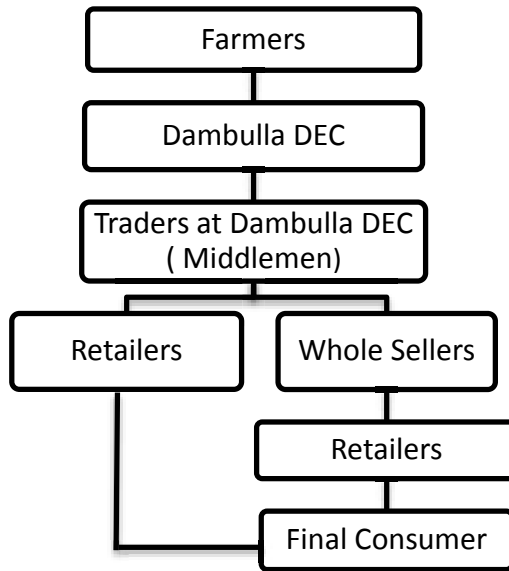
There is another distribution flow that can be identified where Intermediaries act on behalf of the farmers. Those intermediaries buy the harvests from the farmers on the spot (mostly harvesting fields) and bring them to



Dambulla DEC to sell. Intermediaries who are mainly business men with having transporting facilities bring the harvest to the Dambulla DEC with the intention of selling them to whole sellers. Once the whole sellers took the harvest then goods will reach to the final consumer through retailers.

3rd Flow

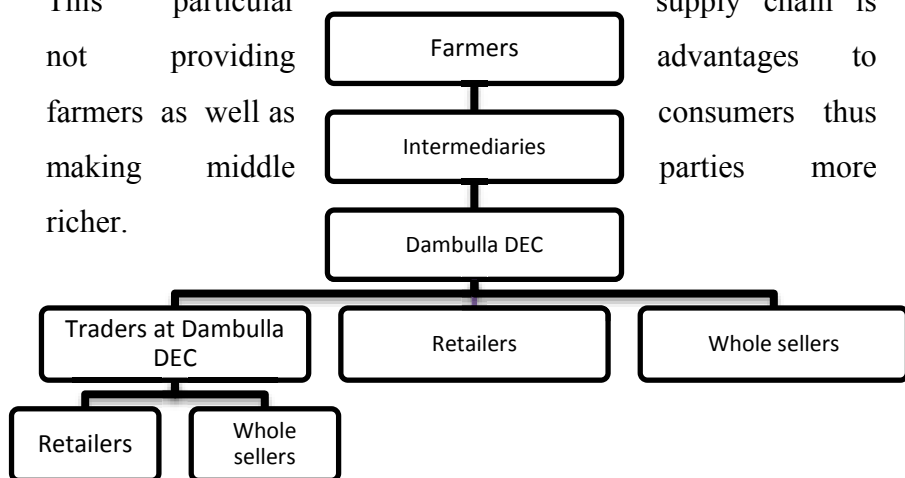
In Dambulla DEC there are 144 stalls thus these stalls are owned by the traders who are supposed to buy vegetables and fruits from farmers in large quantities and resell those to retailers and whole sellers (mostly). These traders are playing a role of middlemen. When the farmer brings their vegetables and fruits to the Dambulla DEC these traders are buying those from them. Some farmers are bringing their harvest to selected trader/traders. The main reason for which is traders are helping and financing to certain farmers where farmers are bound to sell their harvest only to those traders. Once traders have bought the harvest they resell them again to retailers, whole sellers, and street sellers keeping a considerable profit margin (Commission).



4th Flow

Above process is similar to 2nd flow where intermediaries directly go to the farmers and buy vegetables and fruits from them. The main reason to sell the harvest to intermediaries because farmers cannot bear the transportation cost by themselves. Then the intermediaries who transport the vegetables and fruits to the Dambulla DEC will act as sellers. Wholesalers, retailers, street sellers are supposed to buy vegetables and fruits from them. Normally intermediaries are not obliged to traders thus normally intermediaries wont supply the vegetables and fruits for specific trader. If the traders want they also can buy vegetables and fruits from them. This form supply chain is more complicted and it has more intermediaries involved in the sale of vegetables and fruits.

This particular supply chain is not providing advantages to farmers as well as consumers thus making middle parties more richer.



Quality of Harvest

Traders seek for the highest quality products, specially goods from Nuwara Eliya get more price than the others since those goods are deemed to be best in quality and the weather conditions are probably good for most of the vegetables and



fruits grown in Nuwara Eliya. So it is clear that weather condition is an important factor which affects the quality of harvest. When there are heavy rain falls in Nuwara Eliya, Welimada areas thus it generates difficulty in selling the vegetables and fruits for a higher price. This was revealed by farmers who came to Dambulla DEC from Nuwara Eliya. Especially when the harvest get over wet due to rain falls the possibility of perishing is high, E.g. Carrot.

Methods of transporting are also affecting to quality of harvest. Gunnies are mainly used for packing in order to transport the vegetables and fruits. For fruits like tomatoes wooden crates are used. Mostly farmers hire Lorries to bring their harvest to the Dambulla DEC and those Lorries might not have proper cover

(hood) to protect (specially from sun burn, rain falls) the vegetables and fruits while transporting. So lack of proper transportation mechanism apparently leads to low quality of goods received to Dambulla DEC and consequently to final consumer. It was seen clearly that method of transporting is a main factor which is affecting to quality of harvest specially for most perishable goods like tomatoes, chillies, onions, etc.

Price Determination

The table below shows the general price determination mechanism which can be seen at Dambulla DEC. The prices of vegetables and fruits are determined by the daily vegetable and fruit supply and demand. The quality of the harvest is another main crucial factor that is affecting to the price determination. If the demand is high for vegetables or fruits then the price will be acceptable for vegetables and fruits. But in order to have an acceptable price there should be high supply to meet the required demand.

Table: Price Determination at Dambulla DEC

Supply	Demand	Price Determination
High	High	Acceptable price
High	Low	Bargain Price
Low	High	High Price
Low	Low	Acceptable Price
High	No	Throw away

Price determination for the goods like green leaves is slightly different. Farmers who have their own fields (termed as ‘Koratu’) bring their harvest by Lorries to Dambulla DEC and they will get a fixed price at Dambulla DEC. For an example Rs.5 per bunch of green leaves. Apparently prices of green leaves won’t change according to the supply or demand in the market. If they couldn’t sell the green leaves at the economic centre, they will bring it back to the field and re harvest it thus green leaves farmers probably never throw away their harvest. Some farmers bring the vegetables like carrot and beetroot with mud and soil, and some farmers bring those without soil and mud. Apparently that will have an impact to price variations though the vegetables or fruits are the same. Impact is vegetables with mud and soil get a lesser price. Clean vegetables and fruits get a slightly high price.

Pricing

It is apparent that there is a significant change in prices when goods reach to the final consumer starting from the farmers point. Thus it is necessary to identify reasons for such variations and parties who grab a significant amount of profit margins. Given below is a recent price variation of few commodities.

Table: Whole sale and Retail Prices

Vegetable (per 1 kg)	Whole sale price (Rs.)	Retail price (Rs.)
Beans	100 -120	180- 200
Carrot	100-110	180-200
Leeks	100-110	140-160
beetroot	85-100	120-140
knolkhol	60-65	110-120
Cabbage	50-65	80-100

*Prices of 21st may 2013 to 27th of May 2013 at Dambulla DEC

It is claimed that mostly third parties (traders/middlemen) involved in vegetable and fruit supply chain in Sri Lanka gain more than any one from keeping the commission without significant contribution to the value chain of the supply flow thus creating a price mafia/distortion.

Another particular example is;

Farmer brings green leaves to the
Dambulla DEC Rs 5.00 per bunch

Customers buy the bunch at Rs. 25.00
per bunch from retailers

}
Rs. 20 to
intermediaries

Commissions

Commission taking is widely seen at vegetable and fruit supply chain in Sri Lanka. There are two types of commission taking that can be seen;

- I. Traders at Dambulla DEC give commissions (bribe) to intermediaries (who come with farmers harvest) to bring the goods to them at reasonable price.
- II. Once traders buy the goods from farmers/intermediaries then they will keep a considerable margin (commission) and re sell those to whole sellers/retailers. This is the most common form of commission taking where traders (middle men) get commission without any effort or value addition. This has affected vegetable and fruit price fluctuation mostly. The table below is just an example for such commission rates at Dambulla DEC.

Price Range	Commission
Rs 1 - Rs 10	Rs.50 cents
Rs 10 - Rs 30	Rs 1
Rs 30 - Rs 60	Rs 2
Rs 60 - Rs 100	Rs 3
Rs 100 and above	Rs 5

This commission is taken by the stall owners (traders) at Dambulla DEC.

Traders at Dambulla DEC helps the farmers by giving financial assistance, fertilizer, seeds. So farmers who get the benefit will deliver their harvest to them thus on behalf of the assistance traders take the commission.

Vegetable & Fruit Transportation

Normally gunnies were used to transport (from the farmers point till retailers point) the vegetables and fruits except wooden boxes used for tomatoes. Vegetables sent in gunnies is no hassle to



farmers as they do not have to collect bags after the sale as those bags go along with the vegetables to the trader.

Though they use gunnies and wooden boxes for vegetable and fruit transportation, as a solution for post harvest wastage, government of Sri Lanka introduced plastic crates instead. Thus according to the special Gazette issued on October 2011, enforcement of 'Crate Law' severely impacted to the vegetable



and fruit market in Sri Lanka by prohibiting the use of gunnies for the transportation of the vegetables and fruits island wide. This law was enforced to reduce spoilage of goods while transporting.

According to the Institute of Post-Harvest Technology; “in order to prevent the serious losses occurring in fruits and vegetables during post operations from farmer to consumer, amounting to 30-35% of the annual production a project funded by the Treasury under the guidance of the Ministry and Agrarian Services has been implemented since 2006 to introduce plastic crates to farmers, collectors and wholesale traders at subsidized rate for transportation”. So it was found out that one of the main reasons for vegetable wastage is improper transporting methods.

But when it comes to using crates, vegetables and fruits packed in plastic crates might cost around ten times than gunnies thus those have to be returned to the farmer since traders have no necessity of getting vegetables with crates hence crates cannot be disposable as the gunnies.

Though traders took the vegetables with crates, farmers might not get reasonable price for the crates and ended up with a loss more than use of gunnies. Besides a gunny sack can hold about high volume of vegetables, while a plastic crate can hold only relatively low volume.

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In Search of Hidden Facts inside the Supply Chain of Vegetables and Fruits:

Revealing Unsolved Problems

H.A.H. HETTIARACHCHI

“After a serious crisis where hundreds of tons of vegetables perished as a result of oversupply, bad weather and the resulting drop in quality, the wholesale price of vegetables at the Dambulla Dedicated Economic Centre is picking up slowly. Traders and farmers expect the prices to stabilize in the coming weeks”

(Sunday Observer, 2013 May 12)

Introduction

‘Dambulla Dedicated Economic Centre’ (Dambulla DEC), the main trade hub for fresh vegetables and fruits distribution in Sri Lanka has faced lot of challenges recently. With the inception of its operations in 1999 as a dedicated economic centre now its operations has diversified up to 144 traders and the farmers from all around the island reaching with their harvest every day. Estimated average volume of sale per week at Dambulla DEC is 26,500 Mt (Ministry of Co-operatives and Internal Trade, 2013). Recent dilemmas, such as use of crates for vegetable and fruit transportation, price manipulations and other mafias in the vegetable and fruit industry are popular among the Sri Lankans.

Due to these significant problems at Dambulla DEC, It is important to look at certain hidden facts behind the vegetable and fruit supply chain that the most of people (especially responsible authorities) in Sri Lanka are not aware about. This qualitative research was done based on the facts (mainly through interviews) found from Dambulla DEC during recent visit. Further this article illustrates the relevant research findings from the farmers and traders' point of view and it justifies them by extracting the recent facts revealed through media channels as well.

Determining Demand and Supply of the Vegetables & Fruits

Do the farmers produce the vegetables & fruits based on the consumption needs of the end consumer?

According to the market analytics, given the prediction of the supply and demand of vegetables & fruits, supply of most of the vegetables & fruits are exceeding the predicted demand. It is estimated that vegetables and fruits annual production is more than 800,000 metric tons in Sri Lanka (Sri Lanka Export Development Board, 2013). Excess supply is basically due to the fact that farmers are particularly not aware of the expected demand and produce whatever vegetables or fruits that they are capable of cultivating with no concern about the possible demand

or the supply of the vegetables and fruits they cultivate. Empirical findings revealed that farmers were not shifting or rotating their crop cultivations to other vegetables or fruits and they tend to produce what they are capable of, irrespective of the demand for those crops. According to the interviews conducted with the farmers and traders at Dambulla DEC, researchers found a significant psychological impact of the farmers that they tend to produce vegetables & fruits in large quantities, which were previously generated high profit while selling them either by farmer himself or farmer known by that particular farmer. This is one of the key issues leading to the substantial wastage of those vegetables and fruits due to the lack of awareness of the demand of the vegetables and fruits. Most importantly, since the ethnic war is over, arrival of the northern and eastern goods seems to increase the supply of the vegetables and fruits further. Though there's an export demand for certain vegetables and fruits, only the highest quality goods seemed to be exported thus leading to a significant wastage as those less quality fruits and vegetables are considered to be eliminated from the consumption despite being able to be used locally.

What is the impact of the imported seeds to the vegetables and fruits supply and demand?

It's important to look at the seeds that are imported for; those imported seeds have a significant influence on maintaining the demand and supply of the vegetables and fruits. Most of the time farmers depend on imported seeds on their cultivations and more the seeds are imported, higher the supply of the crop yield is brought to the market unless there are restrictions for those imports. Even though, it seems that the government has intervention on controlling imported seeds by tariffs, still farmers haven't controlled their supply as expected. An interview with certain traders at Dambulla DEC specifically illustrated that imported seeds should be controlled in order to restrict the oversupply of vegetables and fruits.

The Hidden Relationship between Farmers and Traders

“We are agreed or liable to sell our goods to the trader in Dambulla market since that trader has invested on our farming, most importantly financing for our fertilizer cost. So there is no doubt that we have to sell our goods to them in return”

Green Chilies Farmer at Dambulla DEC

Even though, it's apparent that vegetables and fruits whole sale price is determined by the supply and demand of certain vegetables and fruits, there are hidden agreements between the trader and farmer where farmer has lack of power to influence the selling price. Such agreement takes the shape of trader providing financials sponsorship for farmers to cultivate thus making the farmers liable on providing or selling the vegetables and fruits to those traders. So the price determination is questionable leaving the doubt whether the farmer receives a reasonable price to their crops and also it is significant that farmers cannot move to another market or trader beyond Dambulla DEC thus this sort of an agreement where the farmer loses his bargaining power due to the fact that farmers finding it easy to get financials from the traders rather than approaching to banks or other financial institutes leave them option less.

“We figure out our lives depend on what we gain by selling the goods. All what we want is to have a reasonable price for our goods regardless of the profit earned since we always live with uncertainties and debts”

Carrot Farmer at Dambulla DEC

In fact due to this kind of agreements middleman or the trader has a potential benefit of gaining a huge profit where farmer can do nothing at all. So it's questionable whether this is a kind of mafia

or not; but at the end of the day farmer remains with a small amount of money. Apparently lack of government and financial institutes (specially micro finance) assistance and influence lead to this implication on this hidden relationships.

Impact of Kerosene for Vegetable and Fruit Cultivation

Use of kerosene for vegetable and fruit production is a significant fact even though the implication of price increase in kerosene has not been recognized by the relevant authorities. Kerosene is heavily used by the farmers for their cultivations in order to pump water to their crop field. Moreover, most of the time using water pump machines which are operated by using kerosene at all times has created an issue.

Although recent hikes on kerosene prices had a major impact on vegetable and fruit prices, it has not been taken a notice or a proper measurement by the relevant authorities to provide a support for the helpless farmers where farmers are not getting sufficient amount of money to set off the loss incurred due to the price hikes of kerosene.

Traders/Middle men

Is it possible to avoid middle men?

“Products from Nuwara Eliya were also sent to Dambulla and re-priced before being transferred to Colombo. Investigations also revealed that traders in Dambulla were offering higher commissions to middle men than Colombo to attract them to Dambulla. This has enabled them to dominate the market.”

(The Sunday Times, 05th July 2009)

It is apparent that Dambulla traders were dominating the vegetable and fruit market (It is also known that seventy percent of the harvest of vegetables and fruits reaches Dambulla DEC from where those were distributed



wholesale to markets like the Manning Market). Taking the advantage of the government’s policy of non-intervention in vegetables and fruits distribution and sales both the whole sellers and middlemen make a substantial profit by means of the investment made at the beginning of cultivation and consequently

depriving the bargaining power of farmers to price their crop yield.

What actually happens at Dambulla DEC is when lorry loads of vegetables and fruits are brought there, they unload at one point where the middlemen/traders come and look at the loads. The price fixing mechanism operates then and there as the middlemen – so called farmer society or association – examine the vegetables and the prices are fixed on the spot. The profits are pocketed by the pulse feeling (they termed it as “Naadi”) middlemen and they pocket huge profits. Usually the pricing of vegetables and fruits were determined these small self-styled group of people who call themselves the association of vegetable and fruit farmers but are no farmers at all but middlemen, a sort of mafia fixing vegetable and fruit prices at the expense of the consumer. In this underhand deal, neither the farmer nor the consumer makes any gain but this group makes huge profits. Most of those, who had come to occupy the stalls as sub-tenants are those represented by the fake associations controlling the entire wholesale trade at Dambulla DEC. While researching, we took a notice that the Ministry of Co-operatives, Internal Trade and agrarian services were not concerned about looking in to the plight of the farmers who are not making any profits from the artificially inflated vegetable and fruit prices.

Though the current Trade Minister Johnston Fernando made a new move to purchase vegetables from the farmers directly and sell these through CWE (Cooperative Wholesale Establishment) outlets, it was found that no such mechanism heavily operating at Dambulla DEC and it has not made an impact on the vegetable and fruit prices as there are only a very limited number of CWE



outlets spread countrywide and almost none in certain areas. On the other hand although authorities have tried to decentralize the whole sales markets, there is no such evidence found that farmers from different areas who were reaching to Dambulla DEC were moving away, importantly northern farmers.

“We have a counter-plan to control the prices. We will allow the producer to directly bring his produce to markets, avoiding the middle men. Under this plan, the government hopes to set up centres in Jaffna, Kilinochchi, Medawachchiya and Batticaloa enabling the farmers to bring their produce directly to these places” Former trade minister Bandula Gunawardena said.

(The Sunday Times, 05th July 2009)

Is it true that supermarket chains in Sri Lanka buy vegetables directly from farmer?

Even though, one particular local supermarket chain advertises that they are buying the fresh vegetables and fruits from the farmers, it was found that it is no such a mechanism operating where middleman still exists to supply the goods with considerable profit margin. As a result of which still poor farmer faces difficulties when trying to fix the required selling price for their goods.

Determining Vegetable & Fruit Whole Sale Prices

How the vegetable and fruit whole sale price is determined?

Interviews conducted with the farmers and traders at Dambulla DEC revealed that not every trader gives the same price as the other does. Thus for some particular vegetables like tomatoes, not every trader, gives the same price.

Most of the time trader seeks for highest quality products. Specially goods from Nuwara Eliya get more price than the others goods brought from elsewhere in the country as those goods are deemed to be best in quality and also based on the interviews conducted with some traders, they expressed that there are some farmers who are very reliable and honest providing the best quality products without any fraud whereas there are dishonest

farmers doing frauds such as increasing the weight of gunny by putting water and putting defective vegetables and fruits inside gunnies. However, traders seem to be aware of those frauds and they set the prices based on the quality of goods after checking them before buying from the farmers. However, some farmers might get the expected price where as others not. Even though, some trade shops at Dambulla DEC owned by one particular owner and operated by certain other individuals thus determining the prices of vegetable sounds like a mafia. Most of the farmers at Dambulla DEC claimed that lack of government intervention on determining the vegetable and fruit wholesale prices and pointed out that the price setting mechanism doesn't have any control limits like minimum and maximum wholesale price for each vegetable and fruit available according to day today supply of specific vegetables and fruits enabling the traders to play a price mafia.

Vegetables and Fruits Wastage

How the wastage happens and who bears the wastage cost?

“Annually, Rs. 20 billion is wasted due to poor packing and improper transportation. About 20-30% of fruits and vegetables go waste, while another 10% is discarded, as they don't meet the standard sizes. Lorries that can hold 5,000 kg of vegetables are

*loaded with 10,000 kg of vegetables, leading to a lot of spoilage”
Said by Trade minister Johnston Fernando.*

(The Sunday Times, 18 December 2011)

Recent dilemmas in vegetable and fruit market in Sri Lanka are mainly about the post-harvest losses due to transportation the goods and inability of selling the vegetable and fruit stocks at the whole sale markets like Dambulla DEC due to excessive supply. It is evident that approximately 900 Lorries arrive at Dambulla DEC per day. In the meantime, on transportation most of the vegetables and fruits perish as a result of being overloaded Lorries with goods.

“I used to bring watermelon by this rented mini lorry which can load approximately 1900 kgs at its full capacity and by the end of the destination at Dambulla market, approximately 30 kgs will be removed due to damages while transportation.”

Watermelon Farmer at DDEC

Farmers all over the island reach Dambulla DEC with their crops where particular vegetables have oversupply and farmers finding it difficult to sell those even at a



lower price than they expected. Due to such wastes, wastage cost has to be borne by the farmer since traders don't have any involvement for such wastage.

“Stocks of vegetables are being discarded at the Dambulla Economic Centre once again due to difficulties in selling these produce. The Secretary of the Traders' Association of the Dambulla Economic Centre, I.G. Wijeynanda, says the vegetables are going to waste due to the excessive supply and the lack of consumers at the centre at present. He added that about 30,000 kilograms of vegetables go to waste each day.”

(www.newsfirst.lk, 22 April 2013)

Why is it impossible to use crates instead of gunnies in transportation?

According to the special Gazette issued in October 2011, enforcement of 'Crate Law' severely made an impact to the vegetable and fruit market in Sri Lanka by prohibiting the use of gunnies for the transportation of the vegetables and fruits island wide. This law was enforced to reduce spoilage of goods while transporting. However; government had failed to address this practical issue that arises with which. While researchers were recently investigating at Dambulla DEC, it was a surprising fact that none of the farmers/traders seemed to be using crates for the vegetable or fruit transportation or handling. There were gunnies used all over the centre except for wood boxes/crates. Wooden boxes and crates seem to be used for tomato packing. Even though this law affects small-scale farmers severely, the government has neither scrapped nor withdrawn the rule and the rule doesn't seem to be followed.

In the process of agriculture produce transporting the resultant losses are in the region of 30% in respect of vegetable and 40% in respect of fruit. This project has been launched with the objective of minimizing those losses. Under the project 11,800 plastic crates were distributed during past two years with the target of increasing same up to 150,000 by the end of 2010. It has been targeted to meet the 50% of the requirement i.e. to 200,000 crates anticipated in 2011. During 2010

year, 844 awareness and training programme on important of using plastic crates were conducted. Accordingly it was possible to spread knowledge among all parties involved in the supply chain on the use of plastic crates. (Ministry of Agriculture, 2013)

While looking at the facts in Dambulla DEC, researchers found that there were lot of constraints on adopting the crate law although government has seen a narrow scope and lack of practical usage. Government officials justify the vegetables and fruits wastage and importance of crates use as;

“A vegetable vendor from Nuwara Eliya transports 1,000 kg of vegetables to the Colombo Manning Market and approximately 40 percent of his vegetables are damaged due to poor handling (400 kg of vegetables). The consumer is forced to pay a high price for such vegetables as the vendor will have to recover the cost of the waste by increasing the final price of vegetables”

(Sunday Observer, 8 January 2012)

While researching deep on this crate scenario, researchers were able to find qualitative facts from the farmers and traders explaining the lack of



possibility of crate implementation. Few farmers and traders among those people illustrated that wastage cost is less when considering about the transportation cost.

“It is manageable to bear the cost of using gunnies for handling and transporting rather than taking an unbearable cost of crates”

Pumpkin Farmer at Dambulla DEC

As per the interviews had with a few farmers at Dambulla DEC, they demonstrated that; Vegetables and fruits sent in gunnies is no hassle to farmers as they do not have to collect



bags after the sale. As those bags go along with the vegetables/fruits to the trader, each bag/gunny costs Rs. 30 and farmer has to bear the cost of the gunnies at the point of the sale to the trader and farmers get only Rs. 10 per gunny incurring Rs. 20 loss for each gunny. But when it comes to using crates, vegetables packed in plastic crates might cost around Rs. 400 – 500 (Size – Small 30Kg) which have to be returned to the farmer since traders have no necessity of getting vegetables or fruits with crates. Hence, crates cannot be disposable as gunnies. Though,

traders took the vegetables with crates, farmers might not get reasonable price for the crates and ended up with a loss more than use of gunnies. Besides a gunny sack can hold about 50 kg of vegetables, while a plastic crate can hold only about 28-30 kg. Additionally one farmer pointed out, these crates do not have a cover therefore there is a possibility of vegetables being stolen or matter of safety in transport whereas gunny sacks are sealed before being sent to the economic centre.

“I use a rented Dimo lorry to transport my vegetables, and carry 15 gunny sacks in one trip. I tried with crates and found I have to do two trips”

Capsicum Farmer at Dambulla DEC

“Gunny sacks are easy to carry, while a crate would be a painful task. As the quantity of vegetable in a crate is less, we will have to do many rounds. It is easy to carry and release the load when the vegetables are in gunny sacks”

Natami at Dambulla DEC

According to the statement of the above Natami it is apparent that handling gunnies can be done easily and cheaply whereas crates require more labour and effort. Moreover, Farmers and traders have pointed out the fact that there might be a hidden relationship



or underhand deal between crate manufacturers and government because of which government is trying to implement it but, no evidence has been found to prove a claim as such.

“It is good that the government has decided to cut down the number of vegetables that needs to be transported in plastic crates such as capsicum, salad, tomatoes, bitter gourd, knolkhol and carrots should be transported with care, but vegetables such as beet, brinjals and radish need not to be carried in crates”

Trader at Dambulla DEC

“The required estimated per capita consumption of vegetables is 75 kg per person per annum. The current figure is 33.7kg per person per annum. This shortfall in vegetable consumption can be bridged to a large extent by minimizing the waste of fruits and

vegetables. The annual production cost of fruits and vegetables is in excess of Rs. 35 billion. It is estimated that Sri Lanka's annual production of vegetables is 700,000 tons. Based on the available waste figures, 40 percent of the 700,000 tons will be 280,000 tons per annum. In rupee terms, this damage reflects Rs. 14 billion”

(Sunday Observer, 8 January 2012)

Why complementary industries were not established around Dambulla DEC?

It was apparent that there are vegetable and food waste inside Dambulla DEC due to inability to sell the excessive stock. But researchers questioned that why there were no complementary industries like Sauce, ketchup, cordial, jam, etc. established around Dambulla DEC where those industries can get a huge advantage of establishing around Dambulla DEC like getting perishable goods such as tomatoes in better quality, lower price in lesser time.



So ultimately researchers were able to find considerable facts, rather hidden facts associated with the vegetables and fruits supply chain in Sri Lanka. But still there is a room for further

investigations since vegetable and fruits market has many dilemmas needing considerable attention from the responsible authorities indeed.

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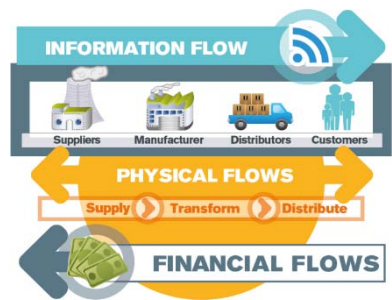
Power of Information & Communication and Institutional / Personnel Guidance: Implications to Vegetable and Fruit Supply Chain

G.G.K FERNANDO

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Introduction

Information plays a predominant role in the supply chain management since it ties up all its supply chain activities and thus the smooth flow of information is a

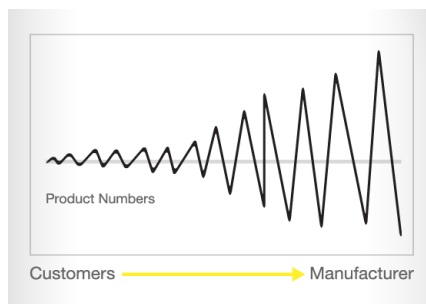


prerequisite for successful supply chain management. Availability of accurate and reliable information at the right time is vital for supply chain members as they depend on this information in making decisions. Yet, according to the current scenario in Sri Lankan vegetable and fruit supply chain, there is no proper information and communication system visible. Miscommunication and lack of information is one of the major issues that leads to vegetable and fruit wastage in Sri Lanka. Therefore, running a smooth flow of information amongst the supply chain members along with its activities is crucial in

maintaining a successful and profitable vegetable and fruit supply chain.

Lack of Communication and its Consequences

In Sri Lanka, there are many farmers who grow the same vegetables and fruits without knowing what others are and thus they keep on growing what they prefer. Due to the supply of particular vegetables or fruits the supply increases rapidly while the demand doesn't get increased respectively. As an example, carrots are grown in up-country as well as in mid-country hence carrot farmers in both the areas farm as much as they can. But at the end of the day, up-country farmers get a considerable demand for their carrots since up-country vegetables are more relatively larger in size and higher in quality, grown with proper weather conditions than that of mid-country. Apparently others may not get a price as they expected where mid-country farmers end up with a huge loss since there was no such proper communication links between farmers as what to produce in what quantity and what not.



There is another side of this story where technically it's called as 'Bullwhip Effect' which means that actual demand magnifies through the supply chain causing a huge problem. For example, let's consider that there is less supply for a particular kind of vegetable where it has a higher demand as well as a higher price.

Therefore, farmers think that they can earn profits if they start farming that particular vegetable and as a result the supply will increase. But in the actual scenario, demand increases due to less supply. Therefore, farmers won't be able to get profited as expected. Not only that, ultimately this will lead to vegetables and fruits wastage/throw away due to excess supply. This problem occurs mainly due to lack of communication throughout the vegetable and fruit supply chain thus with a proper communication could overcome this problem. But there is no such a proper mechanism available in Sri Lanka on this matter. Intervention of agricultural institutes will be able to mitigate such problems if they come up with proper plans to improve the communication between the farmers as well as relevant authorities.

The intermediaries also play a critical role in vegetable and fruit supply chain thus having a bigger risk in their hands. Their role is to buy vegetables and fruits from the farmers and

transport those vegetables and fruits to Dambulla DEC where they can sell that harvest at the market price and may earn profits or incur losses based on the available market price thus it depends on daily demand and supply conditions. So the main difficulty is how intermediaries may be able to predict the market price and the current supply of particular vegetables and fruits where they can decide worthiness to purchase the harvest from farmers. Apparently this type communication link is still not properly established and because of that sometimes they couldn't even cover up the fuel cost. In addition, when there is a high supply for particular vegetables and fruits at Dambulla DEC, they have to wait for a long time may be till late in the night to sell their goods since there is excess supply of vegetables and fruits, the brokers/traders who rule the Dambulla DEC know that they don't need to pay a big amount for those vegetables and fruits thus the market prices fall down. So they keep the intermediaries/farmers waiting longer time in order to get that harvest at a less price. At the end of the day, those intermediaries have to sell their vegetables and fruits at a very low price than they expected or even they may have to throw away the harvest. This has been happening due to lack of proper communication to the intermediaries.

Brokers/traders are the most powerful part in the vegetable and fruit supply chain in Sri Lanka and thus they are the people who control this vegetable and fruit market. But they may be disappointed when there is an excess demand in vegetables and fruits at Dambulla DEC since their margins are going to decrease. When there is an excess demand, farmers/intermediaries who come to Dambulla DEC may not agree to the prices of some brokers since there are many traders who are willing to buy vegetables and fruits at a higher price. On the other hand when there is an excess supply at Dambulla DEC, wholesalers and retailers who visit Dambulla DEC may not agree to the prices of some brokers since there are many traders who are willing to sell vegetables and fruits at a lower price. Again due to lack of proper communication it has led to incur disadvantages to the traders.

Importance of Informational and Communicational Support

It is apparent that lack of communication has a major impact on vegetable and fruit supply chain in Sri Lanka thus all the parties were negatively affected due to improper information and lack of communication. There are relevant authorities/personnel who play a key role on mitigating communication and information barriers within the vegetable and fruit supply

chain. Though majorly they act as information and communication intermediary, their tasks are not limited as such. It is important to have their service reliably in order to streamline the vegetable and fruit supply chain and thus it is necessary to identify the existing role of agricultural authorities/personnel as well as availability of facilitating information and communication systems.

A. Institutes and Personnel

Agricultural authorities and personnel are the ones who have the whole idea about the vegetables and fruits supply chain and having core information about its operations. So it's their job to keep connections with the farmers as well as the other supply chain members such as intermediaries, traders, etc. They have to keep communicating with the farmers and give necessary advice as to what to farm and not according to the prevailing market conditions thus integrate the whole vegetable and fruit supply chain by creating a common communication methodology. Acknowledging farmers is the key to streamline the supply chain process where these authorities/personnel can create demand driven mindset by providing a sufficient knowledge on consumer requirements, farming techniques, etc. They can change the farmers' way of thinking. But unfortunately it is questionable whether those

authorities/officers do their job as it is. It is apparent that farmers don't get enough information through those Agricultural Officers.

Below listed are the few most important Agricultural Authorities in Sri Lanka;

- I. Ministry of Agriculture -
<http://www.agrimin.gov.lk/web/>
- II. Department of Agriculture -
<http://www.agridept.gov.lk/>
- III. Hector Kobbekaduwa Agrarian Research & Training Institute (HARTI) -
<http://www.harti.gov.lk/>
- IV. National Food Promotion Board -
<http://www.nfpb.lk/home.php>
- V. Institute of Post Harvest Technology -
<http://www.ipht.lk/>
- VI. Sri Lanka Council for Agricultural Research Policy -
<http://slcarp.lk/>
- VII. Ceylon Fertilizer Company Ltd -
<http://www.lakpohora.lk/web/>
- VIII. Ministry of Cooperatives and Internal Trade -
<http://www.trade.gov.lk/web/index.php?lang=en>

Ministry of Agriculture

Agriculture is one of the main forces in Sri Lanka. So the Ministry of Agriculture as the prevailing government authoritative has identified that it is Ministry's responsibility to provide necessary guidance for the agricultural activities, thus the country can walk down to the prosperity and better developments in order of agriculture.

Few major goals of the Ministry of Agriculture are,

1. Supportive agricultural policy for food, spices and allied agricultural crops.
2. Stable prices for agricultural products.
4. Timely implementation of projects.
5. Increase production in selected crops.
6. Efficient and effective implementation of accelerated food production programme.
7. Efficient and effective use of foreign funds.
8. Customer friendly and result oriented administrative system.

“Api Wawamu, Rata Nagamu” is one of the main projects handled by the Ministry of Agriculture. Increasing the production of essential food items is one of the main objectives of the programme thus enhancing contribution of agriculture to the GNP. Ensuring food and nutrition security of the people, improve consumption pattern of the people, reduction of foreign exchange spent on food imports annually, increase youth involvement in agriculture are among the objectives of the programme.

Proposed activities of the programme;

1. Promotion of home gardening - This concept ensures that the consumers can harvest vegetables, fruits, green leaves, herbals in the garden in order to fulfill their daily needs.
2. Increasing the food production - Under this programme, measures have been taken to increase the production of following fruits and vegetables. Fruits like banana, papaw, mango, grapes, delum, avocado, mangoosteen and rambutan. Vegetables like beans, brinjals, ladies fingers, wing beans, tomatoes and long beans.
3. Production and organizing of organic manure - Promotion programme for organic fertilizer production and utilization increasing the organic fertilizer production and utilization is one of the main objectives. Besides improving the soil

fertility, increasing the crop production, minimizing the chemical usage are the other objectives. The programme has been implemented in Ampara, Hambanthota, and Trincomalee.

Hector Kobbakaduwa Agrarian Research & Training Institute [HARTI]

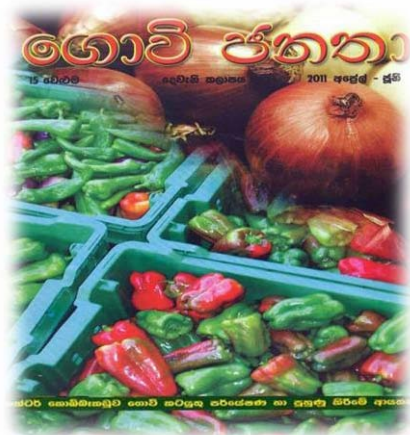
The HARTI was established in order to generate a range of policy analysis that would cover those key determinants of human and resource development in the agrarian sector. The institute was established in 1972 as a statutory board in collaboration with the UNDP/FAO, which functions under the Ministry of Agriculture. It has developed into the premier national institute in the field of socio-economic research relating to the use of land and water in Sri Lanka and has also developed the requisite skills and infrastructure for providing relevant training to farmers, field workers and managers in both the state and non-state sectors.

Below are the few major activities they are engaged with;

- Collection, analysis and dissemination of market information
- Investigation on marketing issues
- Analysis on consumer behavior
- Evaluation of government development programmes

- Impact assessment of agrarian and rural development projects and programmes
- Conducting surveys to establish benchmark conditions
- Analysis of agricultural policies
- Conducting feasibility studies on proposed development projects
- Researching on problems related to the input supply and support services
- Conducting research on water resources management and irrigated agriculture
- Studying environmental and natural resources management issues

Specially magazines like “Govi Janatha” which are published by HARTI were distributed to farmers by Provincial Agricultural Officers. “Govi Janatha” magazine is the best communication mode between the research centre and the farmers. HARTI has a division called Agricultural Resource Management (ARM). The



division conducts research under farming systems, agricultural knowledge systems, etc. So this division is capable of doing more research on developing technologies to vegetable and fruit harvesting. Apparently it is pathetic that the valuable research done was limited to repositories thus researches should be used as solutions for real world problems.

Institute of Post-Harvest Technology [IPHT]

The Institute of Post-Harvest Technology (IPHT), operating under the Ministry of Agriculture, functions as the main institution in Sri Lanka engaged in improving the post-harvest technology of rice/other grains, field crops, fruits and vegetables, spices through research, training & extension, consultancy, advisory and other development activities such as providing & creating opportunities for rural sector. Most of the Sri Lankan people have never heard about such a kind of institute thus farmers stick into the traditional methods of farming.

In Sri Lanka yet, their ultimate findings and suggestions along with necessary programs are neither conveyed to the farmers nor practiced by them. This is a major issue yet to be solved. Hence, government can take necessary steps to ensure the actions and all the endeavors taken by these institutes are not just limited to a gimmick used to attract the media and try their

best to make use of them to spread awareness. Most of the countries use different post harvesting technologies to reduce their vegetable, rice and fruits wastage. Sri Lankan government also has taken steps to conduct the post harvesting programmes in order to reduce the wastage.

B. Information and Communication Systems

Recent dilemmas in vegetable and fruit industry in Sri Lanka emphasize the need of reliable flow of information and communication stream in order to ensure the sustainability of the vegetable and fruit supply chain. This section will demonstrate the available communication and information systems currently running in the industry and further potential information systems that can be adopted in order to streamline the vegetable and fruit supply chain activities.

- **Daily Food Commodities Bulletin by HARTI Sri Lanka**

Daily food commodities bulletin shows the wholesale prices of daily price changes of up country vegetables and fruits, low country vegetables and fruits with the approval by the head of marketing and food policy division.

Web link:

http://www.harti.gov.lk/index.php?option=com_content&view=article&id=181&Itemid=108&lang=en

- **Weekly Food Commodities Bulletin by HARTI Sri Lanka**

Market prices and amounts related to varied food items in Sri Lanka are provided under this bulletin and market and geographical area wise product prices are updated on weekly basis. Areas are based on where the dedicated economic centers are located. Retail prices are not available in this bulletin like the other bulletins.

Web Link:

http://www.harti.gov.lk/index.php?option=com_content&view=article&id=163&Itemid=107&lang=en

- **Monthly Food Commodities Bulletin by HARTI Sri Lanka**

A synopsis of market prices and amounts of varied food items in Sri Lanka. The details are updated on monthly basis. By this bulletin, the price changes and specially in which months the significant differences occur can be seen. In this bulletin not only data, descriptions about the target production, but the price, demand and supply are also included.

Web Link:

http://www.harti.gov.lk/index.php?option=com_content&view=article&id=164&Itemid=120&lang=en

- **Govi Gnana Seva (GGS)**

Govi Gnana Seva (GGS meaning "Farmer Knowledge Service") is a nonprofit company attempting to reduce price volatility in the agricultural markets of Sri Lanka and thereby improve farmer livelihoods on a sustainable basis.

It currently collects and disseminates agricultural prices from



three wholesale markets including the one at Dambulla DEC,

Sri Lanka, which is the largest in the country (accounting for nearly 80% of the wholesale trade in agricultural commodities).

The other two markets are the economic centers in Meegoda and Narahenpita. It was proposed that the number of markets

covered will be increased in the near future and eventually all the existing markets will be covered. Having started as a pilot

project in 2003, GGS price information is now available nationwide via a partnership with Dialog Telekom (the largest

mobile operator). Farmers can now avail of accurate real-time, wholesale price information via a variety of technologies: Web,

WAP, SMS, USSD and via a call center. In addition the service is available in English as well as the two national languages of

Sinhalese and Tamil. Chronic volatility of vegetable prices due to unplanned cultivation leading to farmer poverty,

demonstrated the critical importance of linking cultivation with sale and the initiative to provide forward bids and offer prices is the first step in infusing to bridge this gap. GGS will also be supported by LIRNEasia, a regional ICT think tank and U.S Agency for International Development (USAID) who will work towards improving data collection systems and expand the outreach to ensure that farmers receive accurate, timely and actionable price information thereby enabling them to make better decisions and build more successful agri-business operations. Even in the most remote areas, farmer's organizations now check Dambulla prices on GGS before deciding to harvest their produce, giving the ability to either bring forward or postpone the actual harvest by a day or two depending on the prices.

GGG Web Link:

http://tradenet.dialog.lk/search_pricelists.aspx?id=18

- **Government Information Centre**

This service is introduced with the purpose of organizing and presenting information in the Government Information Centre (GIC) web [<http://www.gic.gov.lk/>] in a citizen-friendly, intention-



based manner. The Re-engineering Government Program of ICTA has initiated a number of e-services and enabled projects to increase the efficiency of the citizen service and information delivery mechanism of the government. The Re-gov program initiated the GIC project to provide such information in all 3 languages (Sinhala, Tamil and English) through the call centre and SMS service (GovSMS) by Dialing/SMS 1919. There is a sophisticated place dedicated to agriculture, livestock and fisheries in GIC. Under the above place, the services offered by the Government Information Centre are;

- Approval and registration
 - Permit and licenses, subsidies and assistance for agriculture, livestock and fisheries
 - Agriculture and livestock & fisheries development
 - Training and extension services
- **'Govi Sahana Sarana' - 1920 Agriculture Advisory Service**

This is a call centre solution conducted as one of the major programs to assist farmers in solving their varied issues such as agriculture related technical matters, inputs and marketing



Call to 1920

Agriculture Advisory Service

issues. This service is established at the Audio Visual Centre of the Department of Agriculture, Peradeniya. The service can be contacted by farmers for their queries over any land phone during office hours, simply by dialing 1920.

Objectives;

- To offer quick advice to farmers over the phone on their queries
- To refer experts or relevant literature and give advice within 72 hours, when the problem is complicated
- To maintain a digital database on the queries for further action and report generation

● **Mobitel Agri Price Information Index**

Hector Kobbekaduwa Agrarian Research and Training Institute (HARTI) provides daily whole sale price information collected from Pettah, Kandy, Dambulla, Meegoda, Norochcholai, Thabuthegama, Nuwaraeliya and Kappetipola markets. Information is fully verified and validated by HARTI and entered to the system according to the market and product availability. Now Mobitel customers (mainly who are farmers) can dial 6666 to connect into the IVR (Interactive Voice



Response) which is available in Sinhala and Tamil Languages. Information can be browsed product wise or market wise. If product wise is selected, required product code needs to be entered. In the case of a wrong code is entered, the list of products will be read out to the customer. If customer wishes to select by the market, they can get all the products of Pettah, Kandy, Dambulla, Meegoda, Norochcholai, Thabuthegama, Nuwara Eliya and Kappetipola.

- **Agriculture Management Information System**

The Agriculture Management Information System is basically established with the purpose of providing information related to vegetables and fruits of Sri Lankan market. This includes providing details related to the suppliers and buyers and of course market information. This system is handled by the Department of Agriculture in Sri Lanka. Information is available on fertilizer, finance, storage, machinery, packaging, pesticides, processing, seeds and planting materials.



Web Link: <http://www.agmis.net/searchagmisnew.php>

- **Wiki Goviya**

Wiki Goviya is introduced with the primary goal of promoting agriculture in an aesthetically pleasing means of ICT to bridge the information gap of



rural farmers with the rest of the world. This is the latest addition to the ICT based agriculture extension campaign of the Audio Visual Centre of the Department of Agriculture. This project expects the collaborative contribution of agriculture community (AC) through the participatory approaches of the web technology. There are three main links in the site. They are agriforum, learning, and agripedia. Agriforum is the place to do discussions about the developments and criticisms in the agricultural sector. Learning link is for raising the knowledge about the crops where the information is available in English and Sinhala. Agripedia provides the facility to correct the information about agriculture. Anyone can update it.

Web link: <http://www.goviya.lk/index.php/en/>

C. Agro Education

Lack of updated knowledge, information and technology has caused many farmers to suffer harvest losses. Therefore it is important to consider about the available educational opportunities to enhance their agricultural knowledge.

Institute of Agro-Technology and Rural Sciences

The Institute of Agro Technology and Rural Sciences which comes under the University of Colombo has given the opportunity for farmers to learn more and address the shortcomings that they are facing. Online courses for the farming community have been introduced under this institute. Programmes that teach the farmers on agro technology in four levels which include certificate course level, diploma, higher diploma, and degree levels are provided to farmers interested in pursuing the subject for their advancement. Earlier, the farmers had no idea about computing but now, they are computer literate. They also introduced an orientation programme for information technology to the farmers before starting the course, to which the farmers have adapted well. Now farmers are using the internet to explore new methods of farming which have increased their harvest and income. Most farmers show great interest in the course because it is in Sinhala. Currently there are about 5000 farmers involved in programmes provided by the institute and institute has successfully ended four batches.

Services offered;

- Extension and consulting
- Technology transfer
- Workshop and training programmes

- Awareness programmes for students/farmers

Web Site: <http://uciars.cmb.ac.lk/>

Information Sources

http://www.harti.gov.lk/index.php?option=com_content&view=article&id=181&Itemid=108&lang=en

http://www.harti.gov.lk/index.php?option=com_content&view=article&id=163&Itemid=107&lang=en

http://www.harti.gov.lk/index.php?option=com_content&view=article&id=164&Itemid=120&lang=en

http://tradenet.dialog.lk/search_pricelists.aspx?id=18

<http://www.stockholmchallenge.org/project/2010/govi-gnana-seva-ggs>

<http://globalfoodchainpartnerships.org/cairo/presentations/Hars hadeSilva.pdf>

http://www.gic.gov.lk/gic/index.php?option=com_info&id=8&task=cat&lang=en

http://www.harti.gov.lk/index.php?option=com_content&view=article&id=192%3A%3Amobitel-agri-price-information-index&catid=1%3A%3Alatest-from-harti&lang=en

<http://www.agmis.net/searchagmisnew.php>

<http://www.goviya.lk/index.php/en/>

<http://uciars.cmb.ac.lk/>

Effects of Farming Technology on Vegetable and Fruit Supply Chain in Sri Lanka

C.N. WICKRAMASINGHE

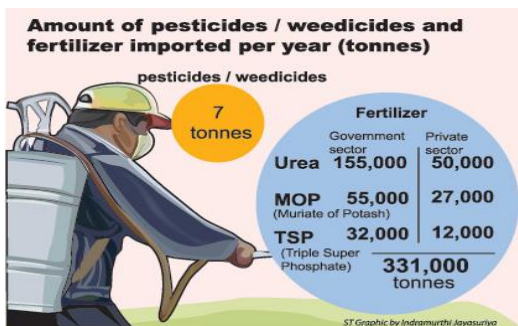
Serious price fluctuations, perish of vegetables and farmers' grievances are famous discussions on the vegetable and fruit supply chain in Sri Lanka. However, so far the discussions always raise the finger at middle members of supply chain. Especially the wholesalers at Dambulla DEC are accused for doing "mafia" to change the price to get unethical financial gains. However, analysis has not been gone to deep enough to get constructive evaluation of vegetable and fruit supply chain in Sri Lanka. During the study, the researchers focused on two major elements in vegetable and fruit supply chain problem in Sri Lanka; cost of production and excess supply. As far as the nature of the vegetable and fruit supply chain in Sri Lanka is concerned, root causes are seems to be stemmed from the counterproductive farming practices and technologies used by the farmers. This chapter will discuss the back-end supply chain problems and issues that initiate high cost of production and over supply during the seasons.

Mono-Cropping and its Effect on Vegetable and Fruit Supply Chain

Farming practices in Sri Lanka are basically coming from traditional roots. Even though institutions like Heक्टर Kobbakaduwa Agriculture Research Institute (HARTI) work on introducing new farming methods to the farmers, the majority of the farmers still farm by their own experience and expectations. In fact, there is no sound technical or agricultural knowledge behind the farming practices in Sri Lanka. According to the findings Mono-Cropping has been the most popular farming practice among Sri Lankan farmers.

Mono-cropping is the high-yield agricultural practice of growing a single crop year after year on the same land, in the absence rotation through other crops. By involved in Mono-cropping farmers become specialists in specific crop such as potato, carrot, leeks or cucumber. Even though this practice is very popular among Sri Lankan farmers it is counterproductive in various ways and ultimately negatively effect to the cost of production.

Mono cropping is harmful for vegetable and fruit supply chain because of number of reasons. First, it severely depletes the soil, as the plant will strip the soil of the nutrients it needs. This forces farmers



to use fertilizers, which can disturb the natural balance of the soil and contribute to a host of environmental problems, from pollution to desertification. This practice can also contribute to the proliferation of crop pests and diseases, which can be a serious liability when a farmer's land is planted exclusively with one crop.

As the recent discussions on high percentage of Arsenic content in low grown farming soil might be an outcome of heavy usage of fertilizers and pesticides. Growth of the annual fertilizers and pesticides sales in Sri Lanka indicates that farmers are trying to get high yield in Mono-cropping through heavy use of fertilizer. This practice continuously make the farmers fertilizer dependent and they are keep using fertilizers to get expected level of harvest. According to the general comments of farmers, cost of high quality seeds and kerosene fuel has heavily increased their

cost of production. Further, unpredictable weather patterns also increase the damages and wastage of the yield. Moreover, serious grievances arise for increased fertilizer and pesticides prices, as farmers are heavily depend on them. When the harvest is heavily depend on the fertilizers and pesticides beyond the natural environmental sources, cost of production increases up to uncontrollable level.

Expected prices for harvest sometimes can go beyond the natural supply-demand mechanism in the Dambulla DEC. It is evitable at the Dambulla DEC, where some of the buyers bargain with farmers by saying “How can I sell this, if I buy for your price”. As every member of the vegetable and fruit supply chain expect a reasonable profit. Whole sellers at Dambulla DEC, their whole sale buyers and then the retailers also need to keep a margin and they need to cover all the direct and indirect cost of the supply chain. Therefore, irrational increase of cost of production due to less productive Mono-cropping practice harmful for all supply chain members and finally to final consumer need to bare it.

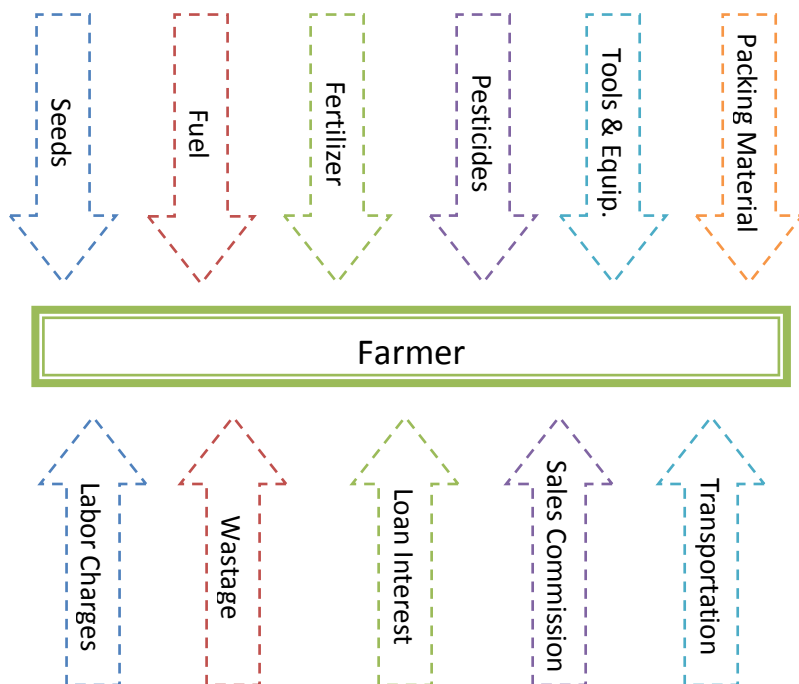


Figure: Cost Centers of Vegetable and Fruit Farming

Mono-Culture and its effect on Vegetable & Fruit Supply Chain

Sometimes mono-cropping and mono-culture used to define farming a single crop in a farm. However, by definition Mono-Culture is broader than the Mono-cropping. According to the formal definition, Mono-Culture is the cultivation of a single

crop on a farm or in a region or country. In Sri Lanka there are clearly define agriculture spatial patterns and there are certain vegetables and fruits, which are cultivated in specific zone of the country. Farmers in specific region used to cultivate limited varieties of crops that popular in their zone. Hence, relatively large number of framers cultivate same crop in their farms and hardly any farmer who think differently and cultivate



different varieties of crop without following the majority. As far as this is the common practice, individual farmers involve in Mono-cropping and region or zone become Mono-Culture.

NuwaraEliya is one of the districts located in wet zone in Sri Lanka reputed for prestige vegetables like Carrots, Beans, Radish, Cabbage, Leeks and Potato. Even though there are small numbers of verities of crops basically NuwaraEliya has agricultural behavior related to Mono-Culture. As far as the unique weather condition and other environmental conditions,

there is relatively high and stable demand for Nuwara-Eliya vegetables. Therefore, farmers in NuwaraEliya have relatively stable demand and high price due to limited supply of Nuwara-Eliya vegetables and fruits. However, due to Mono-cropping practice, Nuwara-Eliya farmers also heavily depend of fertilizers and pesticides. Therefore their cost of production is getting higher and higher each year.

Apart from Nuwara-Eliya, farmers in other regions in Sri Lanka do not have serious crop diversity. The varieties available are limited and therefore large number of farmers tends to cultivate crops that have



relatively low demand. Hence, the price determined at the Dambulla DEC for these vegetables and fruits have always been lower than the prestige vegetables like Carrots, Beans and Leeks. Vegetables like Cucumber, Squash, Pathola, Vatakolu, Sweet Potato and also sometimes Tomato have been suffering from low demand and hence receive low prices at Dambulla DEC in certain periods of time. Sometimes due to zero demand

some of the vegetables and fruits have to throw away as there is no one to buy those at any price.

In a situation like large scale vegetable throw away, immediate blame is going against the Dambulla DEC whole sellers. They were accused by saying they are purposely change the demand to get unethical financial gain from the business. However, when analyzing the supply chain at the Dambulla DEC, it is



evitable that, when there is no significant demand for any vegetable, at evening hours around 7.00-8.00 P.M. whole sellers at Dambulla DEC reluctant to buy vegetables from farmers or their agents as buyers are moving away from the market rather than coming in at that time. The farmers and their agents also need to go back to their villages, so they have to sell their harvest at the demanding price even it is below their cost. Otherwise they have no option rather than throwing away their harvest. According to the farmers and whole sellers at Dambulla DEC this kind of thing happen very rarely and if it happens, it is for highly perishable vegetables like Kakiri, Cucumber or at sometimes Tomato.

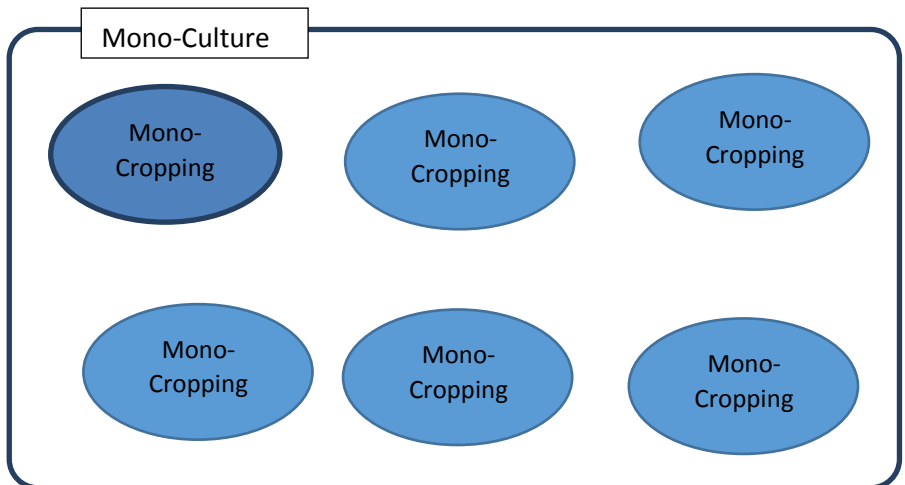
There have been discussions on avoiding excess supply of certain vegetables and fruits by educating farmers; however



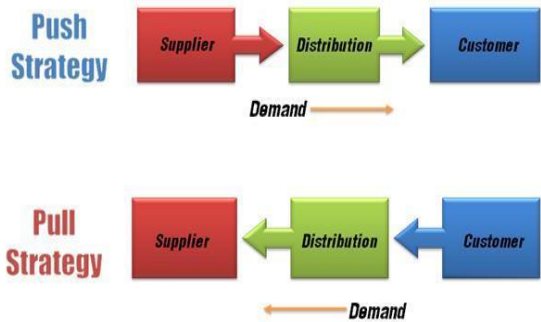
Mono-culture farming has been well established in specific zones. Farmers tend to follow each other and learning by themselves. Therefore the scope is limited and need to have serious mind changing mechanism to break their traditional way of thinking. Responsible authorities are not taking sufficient efforts to educate the farmers to avoid large scale Mono-cropping and Mono-culture farming. As all the farmers start to cultivate in their farms in same time period of the year, with similar crops and finally get the harvest approximately similar time period of the year. Therefore, large number of farmers bring their harvest to the Dambulla DEC during the specific vegetable season. As there are large number of farmers bring their harvest within short-time span, some of the vegetables and fruits get over supply. As far as there are unique demand for certain prestige vegetables like Carrots, Beans, Leeks and

Potato, they get reasonable price even at the harvesting season and at least they are not thrown away. But dry zonal vegetables like Kakiri, Cucumber, Pumpkin and even Tomato do not receive reasonable price during the harvesting season mainly due to oversupply.

There are two major issues in existing farming practice in Sri Lanka. First, as individual farmers cultivate vegetables and fruits in Mono-cropping where the cost of production is high even for the dry zonal vegetables. Second, the farmers in the dry zone cultivate the vegetables and fruits in Mono-Culture. That creates over supply in the season.



Therefore, vegetable and fruit supply chain in Sri Lanka is significantly influenced by the farmers' agricultural practice. According to the analysis, Sri Lankan vegetable and fruit supply chain is following the "Supply Push Strategy", where supply is not considering the potential demand at a given time. In Mono-cropping and Mono-culture, farmers



are not flexible to satisfy the consumer requirements at right time. However, it is time for farmers to think about "Demand Pull Strategy" controlling the cost of production and their supply in rational way to satisfy the consumers and their demand changes. How can this be achieved? This is the burning problem that remains unanswered. Even though it is due since long time, the change is not impossible. Sustainable short-term and long-term socio-technological initiatives would bring therequired changes to the back-end problems and issues in vegetable and fruit supply chain in Sri Lanka.

CONTEMPORARY TOPICS ON VEGETABLE & FRUIT INDUSTRY: LEAN & AGILE SUPPLY CHAIN MANAGEMENT

R.S.L.S. KUMARA

M.D.D. JASINTHA

Introduction

Lean supply chain management is not exclusively for those organizations who manufacture products, but who wants to streamline their processes by eliminating waste and non-value added activities. Organizations have a number of areas in their supply chain where waste can be identified as time, costs, inventory etc. thus to create a leaner supply chain, organizations must examine each aspect of the supply chain. Similarly lean principles can be implemented in context of vegetable and fruit supply chain in Sri Lanka.

Agility is designated as a capability which contains organizational structure, information systems, logistic processes and mindsets. An agile system signifies flexibility and hence heightened responsiveness to changes. Thus, having a supply chain that is agile is a necessity in a market where the demand levels fluctuate regularly. As such, it becomes necessary to limit production when the demand is low in order to prevent

unnecessary costs pertaining to manufacturing and product storage. In terms of Sri Lankan vegetable and fruit supply, it is important to have a demand driven mechanism where agility supply chain management principles can be applicable.

Lean Vegetable & Fruit Supply Chain Management

The concept of “Lean,” is focused on eliminating non-value added activities. Regaining the lean supply chain may mean addressing many of the same issues that create the problems of extra and unnecessary time, inventory and costs involved in the supply chain. When it comes to applying the lean aspects to the vegetable and fruit supply chain in Sri Lanka, it is more or less related to reducing excess inventory/vegetables passing through the supply chain. This excess inventory reflects the additional time taken for supply chain operations. Hence, the supply chain can be made perfect and lean through avoiding wasteful time and inventory. Following factors are the characteristics that ensure lean supply chain management.

Elimination of Waste

The lean methodology is sharply focused on the identification of 'Muda' (waste) associated with valued process and eliminates it systematically. Waste reduction is often a good place to start in the overall effort to create

a lean supply chain because it can often be done with little or no capital investment. One popular area of waste in processes is excess



inventory/vegetables. Inventory reduction attempts to reduce inventory through practices such as, JIT (Just in Time) and modern approaches to supply chain management have led to lower inventory levels. Cycle time or lead-time reduction is another target area of waste reduction. Cycle time is the time required to complete a given process. The overall vegetable and fruit supply chain process is made up of many sub-processes such as cultivating vegetables and fruits, cropping, transporting and storing etc. Cycle time reduction is identifying and implementing more efficient ways of completing the operation. Reducing cycle time requires eliminating or reducing non-value-

added activities. All the 7 wastes defined by the lean management principles were seen to be associated with vegetable and fruit supply chain in Sri Lanka. Yet the vegetable and fruit supply chain encountered at the Dambulla DEC is more or less conservative and most of the waste occurred due to improper way of transporting vegetables and fruits. Hence none of the parties of the supply chain are interested in adopting any of the modern approaches to eliminate waste. Time is another factor affecting the vegetable and fruit wastage. Time means supply chain must be able to supply vegetables and fruits at the right time in the right ripe condition. In Sri Lanka most of the farmers harvesting vegetables and fruits not at the correct ripe condition and there is also delay in storing and transporting. So when vegetables and fruits come to the customers, there is high possibility to wastage.

High Level of Efficiency

There are many methodologies and tools of ensuring a high level of efficiency in a lean supply chain management. When it comes to the vegetable and fruit supply chain in Sri Lanka, almost all the farmers, wholesalers and retailers do not practice modern techniques to achieve efficiency since they are dwelled in a conventional attitude.

Quality Assurance

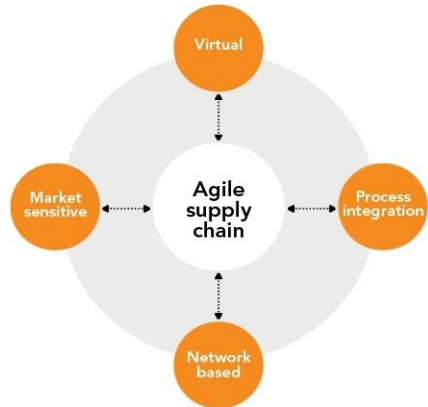
The idea of TQM (Total Quality Management) is to systematically and continuously remove the root causes of poor quality from the value processes. Quality assurance focuses on the prevention of failures or defects in a process by analyzing the root causes and sustaining the improved process by documenting the standard operating procedure and continuous training. In the vegetable and fruit market it begins with the cropping or before cropping. Quality of vegetables and fruits should come with cultivation and remain until end consumption. Therefore farmers should use proper fertile seeds or plants and required fertilizers for their cultivations. Harvesting should also be done at the correct time and pluck them well. The most important and difficult stage of quality assuring is at the transportation. It should be in well defined manner in packaging vegetables and fruits because those are highly perishable and when they are packed well, it ensures a proper transportation. In Sri Lanka mostly the root causes of poor quality in vegetables and fruits are due to lack of knowledge about quality, non-concern about quality in transporting and unpredictable weather.

Smooth Operation Flow

The well-publicized operation flow is a key driver of lean supply chain management. It requires materials and products flow 'like water' from the supplier through the production process onto the customer. The vegetable and fruit supply chain in Sri Lanka had certain oversights in their operation flow. Here the most significant flaw was the miscommunication which definitely hinders the smoothness of the operation flow since it eventually misjudges the supply and demand. The operation flow to be smooth, it is vital to have the vegetables and fruits handed to the end customer from the suppliers with no tampering or delays. In Sri Lanka the above mentioned fact is more significant which causes wastage of vegetables and fruits. Sri Lankan farmers predict supply and demand according to their experience. But it is more effective if they decide their supply by communicating with vegetable and fruit markets.

Agile Vegetable & Fruit Supply Chain Management

Agile means the ability to react and adapt to changes according to the demand and supply, in other words it is the flexibility towards the demand and supply in the supply chain. It is an operational strategy focused on inducing velocity and flexibility in the supply chain. All organizations have supply chains depending upon the size



of the organization and the type of product manufactured or service provided. These networks obtain supplies and components, turn these materials into finished products and then distribute them to the customer. This supply chain process comprise with customer orders, order processing, inventory, scheduling, transportation, storage, and customer service. To coordinate these activities, information management is essential.

In Sri Lankan vegetable and fruit supply chain, it is quite difficult to adapt changes in the demand and supply because of several reasons such as,

- **Lack of information about supply and demand**

In terms of Sri Lankan vegetable and fruit market, there is not enough information available regarding its day to day supply-demand conditions and such information collecting methods or any third party that distribute information among farmers, buyers and customers. Due to these reasons, farmers cultivate along; then majority may cultivate the same crop and it increases the supply and finally bring down the prices.

- **Beliefs and expectations**

As a traditional country, Sri Lankan farmers change their cultivation by looking at competitor rather than observing the market. Farmers follow some other cultivators who earned much previously and due to that reason, supply of specific vegetable or fruit increases and it affects badly to the farmers' income.

- **Intermediaries between farmers and final customers**

Normally there are three or more layers (intermediaries) between farmers and end customers in Sri Lankan market. Each and every intermediary tries to gain benefits at their levels. They form imagination on vegetable/fruit deficit and increase prices for end

customers and at the same time they buy vegetables/fruits from farmers at low prices by showing surpluses.

As such due to so many reasons as above mentioned, it is difficult to adopt agile into Sri Lankan vegetable/fruit market without eliminating such barriers.

Agile is always market driven, the focus is on quickly satisfying the supply chain, the chain of events starts from a customer's order inquiry through complete satisfaction of that customer at the end. All physical events are enacted quickly and accurately. The faster materials, information, and decisions flow through an organization, the faster it can respond to the demands of the market. The keys are flow and time. Actually vegetable/fruit market agility is very difficult in its nature because even information or material passed quickly, it takes a specified time to grow and harvest. The difference between supply chain management and supply chain agility is the extent of capability that the organization possesses. Key to the success of an agile supply chain is the speed and flexibility with which these activities can be accomplished and the realization that customer needs and customer satisfaction are the very reasons for the network. Customer satisfaction is paramount. Achieving this

capability requires all physical and logical events within the supply chain to be enacted swiftly, accurately, and effectively. The faster parts, information, and decisions flow through an organization, the faster it can respond to customer needs. Achieving agility starts with the point of supply, through the factory or farm, and shipment through agile distribution only the value adding activities. Natural points of delay are eliminated and simplified. The information flow or chain should be linked at every point, so that information flow is direct without interruptions and delays. Business cycle times are being reduced to the time which actually takes to effectively process information.

The vegetable and fruit supply chain in Sri Lanka still does not move towards the agility aspect since it adopts more of conservative approaches and adaptation to current change is not its strong point. Yet, the adoption of agility aspect would support in making the process more efficient, accurate and swift. Following short term remedial actions can be proposed in terms of vegetable and fruit supply chain agility in Sri Lanka.

Delay in Harvesting

According to the responses of the farmers and buyers, transaction volume at the Dambulla DEC is high on Tuesdays

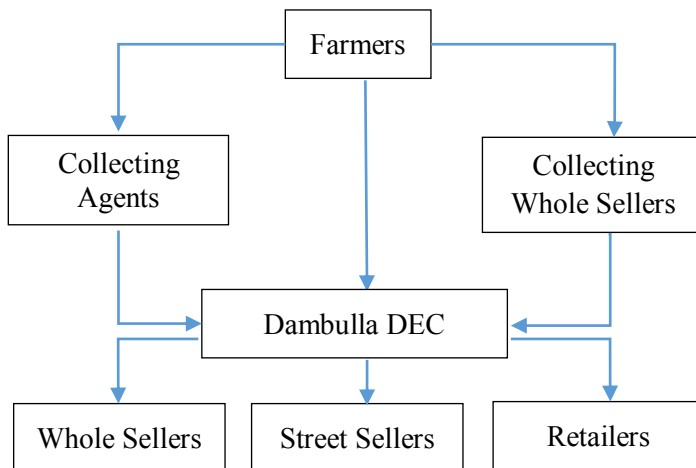
and Saturdays. The reason for this demand increase may be that Dambulla DEC is the major vegetable supplier for small scale weekly market sellers. There are popular weekly markets on Sundays and Wednesdays in most parts of Sri Lanka. Sellers at Sunday Markets are purchasing vegetables on Saturdays and sellers at Wednesday markets purchase vegetables on Tuesdays. Further, on certain days, there is high demand for some vegetables and lower or no demand for some vegetables. If the wrong vegetable has excess supply on a wrong day, those vegetables will get a very low demand. If the farmers or vegetable suppliers at Dambulla DEC can provide their supply by understanding the demand spatial patterns, they might be able to get the supply-demand balance in the market to get an acceptable price. Daily newspapers, Hector Kobakaduwa Agriculture Research Institute and other mass media disclose daily, weekly vegetable prices at Dambulla DEC. If the farmers are rational, they can delay their cultivation, change their crops and sometimes delay their harvesting process according to the price variances. However, such strategic behavior was unable to observe among the farmers and agents of the farmers. It might be due to their farming practice, educational level, urgency of money and lower expectations. However, agricultural authorities should educate these farmers to manage their harvest according to the potential demand forecast.

Type of vegetable has significantly influenced on the short term supply control mechanism. The vegetables such as Carrots, Leeks, Cabbage, and Radish are coming from Nuwara Eliya and surrounding areas. As life cycle of these vegetables is relatively long, those vegetables can be kept in the field without harvesting for a short period of time, when there is short term price drop in the market. However low grown vegetables like ladies fingers and bitter gourd have to be harvested on specific dates. Otherwise the vegetable become overgrown. Hence, short term supply control of low grown vegetables is a problem.

Adopting Agility on Destination

According to the farmers and their agents explanations, they are well aware of the vulnerability of getting lower prices for their vegetables at Dambulla DEC at certain days but they keep on visiting Dambulla DEC expecting to get a reasonable price each time. Vegetable trade is treated like a “Gamble” and farmers and their agents consider Dambulla DEC as their gambling center where on some days they win and some days they lose. These farmers and their agents never look into next layer of the supply chain to identify who are the buyers and where do they take these vegetables. According to the nature of the customers of Dambulla DEC, most of the transactions are B2B in nature. That

means buyers at Dambulla DEC wants to resell the vegetables they purchased at Dambulla DEC for another retailer or end consumer.



According to the findings, some farmers and their agents send their vegetables directly to Colombo, Meegoda and other areas getting relatively high prices. Farmers and their agents at Dambulla DEC do not want to go one or two steps further through the supply chain where they can sell their harvest for new set of buyers with a slight increase of transportation cost. If the farmer or agents can check average vegetable prices at Dambulla DEC (as daily vegetable prices available in both online and offline forms), some of them can send their harvest to another destination, if they feel Dambulla DEC prices are not

fair enough. This would be an appropriate strategy for low grown vegetables where farmers can apply the delay strategy effectively. Owing to agility of destination, Dambulla DEC will not get excess supply and therefore the prices would be raised up to acceptable levels.

Furthermore, the farmers who send their harvest to other destinations would also get reasonably high prices. Therefore it will create Win-Win situations for all supply chain members.

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Possible Remedies for Sri Lankan Vegetable and Fruit Supply Chain Difficulties

W.I.S.R. FERNANDO

A.B. NUGAPITIYA

Introduction

It is apparent that there are considerable facts that signify much attention worth paying at the crisis on vegetable and fruit supply chain in Sri Lanka. Technological as well as administration aspects are the major cause leading to these problems needed to be addressed. This article will discuss and suggest the possible remedial actions in order to overcome difficulties seen at the vegetable and fruit supply chain in Sri Lanka.

A. Harvesting Technologies

1. Tunnel Farming

Seasonal farming has a major impact on vegetable and fruit production in Sri Lanka thus production is determined by the weather conditions. Though, the natural weather condition is appropriate in Nuwara Eliya district right throughout the year for cultivation, other areas in Sri Lanka experience only two seasons facilitating cultivation named Yala and Maha mostly due to the availability of water. Even the soil plays a vital role

when it comes to growing certain vegetables and fruits thus not all the vegetables and fruits can be grown in the same soil. For an example watermelon and tomatoes can be grown in the same soil type.

Tunnel Farming is a technique that continues farming even during off-seasons as well as any other weather conditions. According to this method, vegetables and fruits could be grown

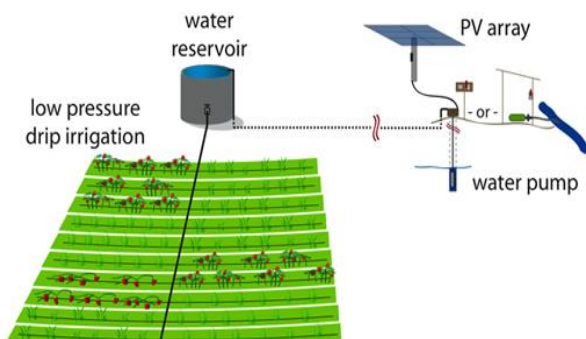


successfully with absence of soil and replaced by nutrient based solutions [Hydroponics] thus the concern for relevant soil of certain areas is eliminated. Furthermore, great success could be gained by covering the plants with plastic-clad semi-circular structure tunnel. There are many perks of adopting hydroponic method of cultivating plants. The vegetables and fruits get constant flow of nutrients as they are dissolved in the irrigated water system thus creating crops of high quality. Tunnel farming also helps in getting an early and high production of vegetables and fruits. For this very reason, the duration of availability of the vegetables and fruits can be increased and the prices can be maintained at a stable rate. Farmers would be able to produce

larger yields of vegetables and fruits on a small area of land despite of the weather conditions and furthermore soil borne diseases could be reduced or eliminated. Tunnel farming could be suggested as more of an effective way of cultivating crops in off-season. Tunnel farming not only helps to get early crop, it also helps in getting more production per acre compared to traditional farming. On the other hand the employment opportunities generate and income of the farmer increases hence it gives maximum profits on crops. Importantly it adopts the best use of fertilizers and irrigation system.

2. Solar Powered Drip Irrigation

Drip irrigation is an efficient mechanism for delivering water directly to the root of plants.



According to the image below the PV (Photovoltaic Array) will supply power to water pumping and the water will be stored in the water reservoir. The reservoir then distributes water to a low pressure drip irrigation system. Sizing of pumps, reservoirs, and

fields are based on water availability and estimated needs for the harvesting area.

From a technical standpoint, solar-powered pumps and low-pressure drip make an ideal pairing. First, drip irrigation applications in the developing world have been limited by reliable access to water (e.g., ICRISAT Briefing Note 7, 2007). Solar-powered pumps provide a low-maintenance, long-term solution. Additionally, they can be used together in a direct-power system (no batteries) because the solar radiation (which governs pump speed) is also the main driver of evapotranspiration (how much water crops need). Thus, the pump works faster when it is sunny and the plants need more water, and vice-versa. While training is necessary for use and maintenance, the systems are simple to operate and repair. This solar powered drip irrigation system will be mostly advantage dry zone farmers. Using the solar powered drip irrigation farmers can save water up to 50% hence it is a good solution for saving kerosene used for water pumping. At the same time this system will reduce the cost of labor, fuel and weeding. Another major advantage of using the solar powered drip irrigation for dry zone is, farmers can cultivate the vegetables and fruits in the off seasons too. So the unnecessary price fluctuations won't be happen in the off seasons for vegetables and fruits. Ministry of

Agriculture of Sri Lanka launched sola powered drip irrigation in 2005 under the Sustainable Agriculture Water Management Project (SAWMP). The main objective of the project was to increase farm productivity, raise farmers' income and improve the lives of rural farmer families living in the dry zones of Sri Lanka.

3. Multi Cropping

Multi cropping refers to growing many crops in the same land during a particular season. This technique makes effective use of inputs such as soil, water, fertilizer, etc. Thus output per unit of area increases with



manifold returns to the growers. Multiple cropping could also help in maintaining soil fertility provided suitable crops such as legumes. An important aspect of multiple cropping is utilization of nutrients more efficiently as the crops growing on the same piece of land simultaneously would have different nutritional requirements.

Diverse food outputs are obtained through multiple cropping, thus providing a chance of choice for using food commodities.

Multiple cropping is also important from marketing point of view. As getting more than one crop simultaneously so even if the selling price of one commodity is less in the market, the other will be there to compensate. There is also minimization of pest damage as crops of a particular species are more prone to a particular type of pest infestation. When different types of crops are grown together, chances of pest infestation are reduced as one crop may provide cover to the other against such agents through biological control. One good combination is tomatoes and onions growing together.

B. Logistic Technologies

1. Flexible Plastic Crates

It was apparent that the use of plastic crates becoming a failure in transporting vegetables and fruits in Sri Lankan context. Reasons for such failures were basically due to high in cost compared to gunnies, not strong enough to hold up the weight of vegetables (e.g. pumpkin) and increase the number of trips to bring the vegetables thus transportation cost should be bared for the return trip too.



Flexible crates can bring down the above issues at some point where some countries are successfully using those to enhance their vegetable and fruit transportation. Though there won't be significant improvement for the quantity that can be stored compared to the traditional plastic crates, flexible crates can be folded after unloading the vegetables and fruits where farmers/intermediaries can at least minimize the transportation cost to a certain extent. Folding crates can be brought back without any extra effort and lesser space.



The workers who unload the vegetables in Dambulla DEC complained that carrying the plastic crates are difficult when comparing to gunnies. Traders complain that they need to pay double for unloading than the previous. Plastic crates with handles are also available in order to avoid difficulty of carrying where those can be pulling instead of lift.

C. Institutional Intervention

1. Complementary Industries

When there is a market condition where lack of ability to sell the excessive stock of certain vegetables and fruits at Dambulla DEC thus causing massive wastage (throw away) of vegetables and fruits. It could be suggested that complementary industries such as Sauce, Ketchup, Cordial, Jam, etc. could be established around Dambulla DEC since it could be more advantageous for perishable goods such as tomatoes where those can be bought in better quality, lower price in lesser time thus reducing the wastage and unproductive throw way.



According to the former president of Dambulla DEC, there was a sauce making factory in Nalanda near Dambulla. The operations of the particular manufacturing failed since the manufactured tomato sauce was contaminated turning the red color to black. Consequently, authorities halted the sauce making operation rather than finding better solutions. Winding up is not the final solution and what matters is finding solutions thus over supply of fruits like tomatoes can be used to produce complementary products and also products like jam, chutney, pickles can be another example for successful complementary products. It was found out that sometimes cucumber and tomatoes were wasted because of excess production where Cucumber can be canned to export. In addition to that those can be used for beauty related products. In order to motivate those industries, relevant infrastructure should be established around Dambulla DEC. Infrastructure should include the relevant equipment, resource personnel, proper land and building etc. Government can start a programme with regard to acknowledging complementary products. At the same time government can motivate the participants from the private sector to manufacture jam, cordial, chutney, etc.



2. Micro Financing

Almost all the Sri Lankan financial institutes including banks offer micro financing facilities. Micro financing is a facility providing loans, savings and insurance for those who have low level of income mostly



farmers and small businesses. Agricultural sector is one major aspect in micro financing schemes. The micro finance schemes provide credit in terms of lands, fertilizers and most importantly the guidance for young farmers who want to adopt latest technologies. In addition to that, knowledge relating to land development, land protection, soil development, risk management, food security and market information were also provided. It is clear that banks have come out of the frame of micro finance and different banks offer different services to farmers. Most of the commercial banks in Sri Lanka offer loans for agricultural sector thus there are special micro finance companies in Sri Lanka established with the main purpose of agricultural micro financing. For example PrimeGrameen Micro Finance Ltd, etc. Giving credit loan is only a one aspect in micro finance thus insurance and savings are the other aspects in micro finance.

But mostly farmers are resistance to accept micro finances due to number of difficulties. The basic requirements that need to be fulfill are very complicated and also guarantees are required. Due to those reasons farmers tend to reach traders and ask for financial assistance since they can easily get financial services from them with lesser effort. Farmers mostly believe in government financial institutes but due to lack of ability to provide micro finance facilities farmers may end up with massive debts to traders and unethical agreements to provide the harvest at unprofitable prices. So financial institutes can contribute towards providing micro finance facilities to vegetable and fruit farmers.

In order to make farmers aware of micro finance facilities, financial institutes can arrive to economic centres like Dambulla DEC and meet farmers and their needs. Even those micro financial institutes can do their promotional campaigns within the centre hence it is a good place because large number of farmers are arriving to Dambulla DEC. Then farmers also get to know about these loan progarmmes. Through more oraganized and secured loan grants farmers can be more independent. So this method is very effective to avoid the farmer–trader conflicts. Importantly, there should be a proper monitoring

system to monitor whether the given loans are put in to actual work and result oriented.

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Towards Sustainable Vegetable and Fruit Supply Chain Management

G.G.I.T. Gunathilake

D.D.K.S. Dayarathna

Introduction

Supply chain sustainability is a holistic perspective of supply chain processes and technologies that go beyond the focus of delivery, inventory and traditional views of cost. This



emerging philosophy is based on the principle that socially responsible products and practices are not only good for the environment, but are important for long-term profitability. In practice, supply chain sustainability can include reducing energy cost, any form of waste and application of green technologies within transportation and logistic networks. A larger shift involves a deeper level of collaboration with internal and external supply chain partners to re-examine delivery methods, products, packaging and measurement systems.

Sustainable vegetable and fruit supply chain management is the act of farming, managing, distributing vegetables and fruits using principles of ecology while concerning society and business in order to provide better nutritional quality embedded goods to final consumer. It has been defined as an integrated system of practices having an overall application that will last over long term.

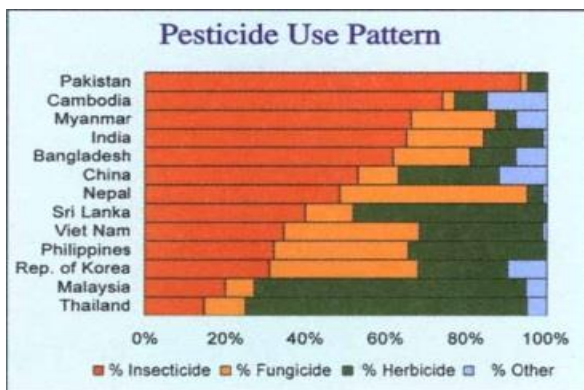
Sustainable Farming

Sustainable farming can essentially be described as the practice of farming ecologically rather than focusing only on the economic viability of the crops. In addition, sustainable farming also involves using non-renewable resources effectively, growing nutritious food and enhancing the quality of life of the farmers as well as consumers. Besides, the obvious benefits, sustainable farming also allow farmers to transform their farms into giant recycling centers. They can turn crop waste and animal manure into fertilizers, use crop rotation to enrich the soil and reroute rainwater to fuel the irrigation system. Not only does this save money, but it also conserves natural resources. Sustainable farming also lowers the need for chemicals and pesticides and it makes the transition to a more organic, clean farming process which is a lot more feasible. Sustainable

farming practices lead to crops that are better for both health and the environment.

Impact of Agrochemicals

Pesticides are designed to kill and because of their action mode is not specific to one species, they often kill or



harm organisms other than pests, including humans. The World Health Organization (WHO) estimates that there are 3 million cases of pesticide poisoning each year and up to 220,000 deaths, primarily in developing countries. The application of pesticides is often not very precise and unintended exposures occur to other organisms in the general area where pesticides are applied. Children, indeed any young and developing organisms



are particularly vulnerable to the harmful effects of pesticides. Even very low levels of exposure during development may have adverse health effects. Pesticide exposure can cause a range of neurological health effects such as memory loss, loss of coordination, reduced speed of response to stimuli, reduced visual ability, altered or uncontrollable mood and general behavior and reduced motor skills. These symptoms are often very subtle and may not be recognized by the medical community as a clinical effect. Other possible health effects include asthma, allergies and hypersensitivity and pesticide exposure is also linked with cancer, hormone disruption and problems with reproduction and fetal development. Pesticide formulations contain both "active" and "inert" ingredients. Active ingredients are that kill the pest and inert ingredients help the active ingredients to work more effectively. These inert ingredients may not be tested as thoroughly as active ingredients and are seldom disclosed on product labels. Solvents which are inert ingredients in many pesticide formulations may be toxic if inhaled or absorbed by the skin. Children are at greater risk from exposure to pesticides because of their babyishness: relative to their size, children eat, drink, and breathe more than adults. Their bodies and organs are growing rapidly which also make them more susceptible; and in fact, children may be exposed to pesticides even while in the womb.

According to a recent study which was conducted by Hector Kobbakaduwa Agrarian Research and Training Institute (HARTI)

revealed that Sri Lankan farmers are applying pesticides before 7 days of plucking the crops whereas it

is recommended to stop applying pesticides prior to 14 days of plucking hence the farmers are acting beyond the instructions. During the study HARTI collected samples of cabbage, beans, potatoes and leeks for testing. The result was scary as it contained harmful residues of chemicals which might lead to kidney diseases.

It was found out in the study that Sri Lankan farmers are using overdose of chemicals in order to avoid the problems. Some farmers have used double dose than the requirement. As such it is obviously harmful to the vegetables and fruits. Therefore, it is high time to monitor the quality of pesticides too.

Dangers of lead and arsenic poisoning

Arsenic poisoning

Nerve damage

Skin damage:

- Hyperkeratosis (scaling skin)
- Pigment changes

Increased cancer risk:

- Lung
- Bladder
- Kidney and liver cancers

Circulatory problems in skin



Lead poisoning

High levels of lead

- Mental retardation, coma, convulsions and death

Low levels of lead

- Reduced IQ and attention span, impaired growth, reading and learning disabilities, hearing loss and a range of other health and behavioral effects.

Sources: Alliance to End Childhood Lead Poisoning and news wires

The Denver Post

Organic Fertilizers

Having such problems in the vegetable and fruit industry, there is a reasonable question as to whether the vegetables and fruits that people eat are health conscious. Organic fertilizers provide the solution in an expected way. Organic fertilizers are mostly derived from animal or vegetable waste. Available organic fertilizers in Sri Lanka are;

1. Effective Microbial Solution (EM) and Fruit Tonic

Farmers of Ampara have produced this organic fertilizer by using three kilos of papaya, three kilos of banana, three kilos of pumpkin, two eggs, and three kilos of jiggery and ten liters of water. Applying EM to the soil, it changes the soil composition and nourishes the soil.



Apart from the above, farmers have found out many other organic fertilizer varieties. They have applied them in toothier crops and have gained positive results. Most importantly, these



fertilizers are fully merged with the environment. Not only the health effects but also organic fertilizer gives more and more profits to the farmers. In addition to fruit tonic, there are fish tonic,



coconut tonic and horn fertilizer among the organic fertilizers. Ingredients for most organic fertilizers are spoilt milk, coconut, fish waste, cattle urine, jaggery, cow dung and toddy.

2. Animal Manure

Dung and urine of animals are used as fertilizers. Cattle manure, goat manure and poultry manure are used in Sri Lanka in an extensive way. Poultry manure has a high level of nitrogen. Application of manure in an unprocessed way is not recommended. To avoid the nitrogen deficiency it is recommended to apply manure weeks before planting.

3. Compost

Compost is a decomposition state of organic materials. Usually, the process is naturally happening, but the process can be handled by controlling factors like temperature and moisture. It was revealed recently that the traditional compost does not give the expected outcome.

As a remedy, Department of Agriculture in Sri Lanka has introduced following standard method to prepare quality compost;

- Green leaves 1/3
- Dried leaves 1/3
- Animal manure 1/3

When using green leaves for compost making, mixing of tithonia and gliricidia will give the best results. Compost can be made by barrel method, basket method and heap method.

Suitability;

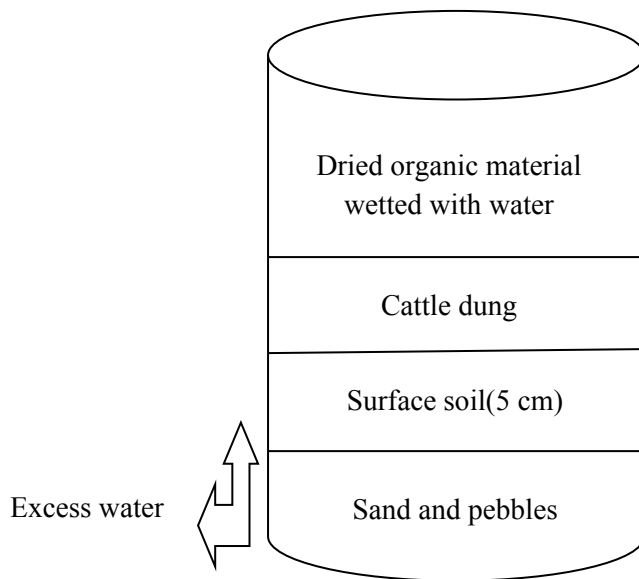
- Heap method- suitable for areas with heavy rain fall
- Pit method -suitable for areas with less rain fall
- Barrel method - suitable for home gardening



4. Vermicomposting

Vermicompost is produced by using worms. Vermicompost improves the soil, water holding capacity, etc.

Structure of a Vermicomposting barrel



Integrated Plant Nutrient System(IPNS)

A system that uses organic and inorganic sources of plant nutrients to improve soil fertility for the sustainable management is known as Integrated Plant Nutrient System (IPNS). Objectives of this system are improving the fertilizer efficiency, managing the money invested on fertilizer production, and to establish a stable plant nutrient management system. Low cost, high yield, high profit, profit from waste, food conservation and environmental conservation are main benefits of IPNS.

Methods of IPNS;

- Crop rotation, in time land preparation, soil and water conservation can be considered as agronomic methods.
- Use of hay, green manure, farm yard manure and compost are the methods of recycling organic matter.
- Using bio fertilizer.
- Optimizing soil pH, dissolving off excess mineral, correcting soil nutrient deficiencies and establishment of suitable irrigation methods are considered for proper soil utilization.

Crop Rotation;

Beans, cabbage and carrot crops can be rotated as all three require same type soil composition and the climate.

Advantages of using organic fertilizer

- Improves the soil structure
- Improves the soil aeration
- Improves the soil perforation
- Improves the water retaining capacity
- Decreases soil erosion
- Low cost



Disadvantages of using organic fertilizer

- No quick response
- Long production time
- Short term storage
- Large space needed to store the fertilizer

Crop Rotation

Crop rotation is probably the oldest and simplest system used to maintain the health of soil. While it might not seem so to the non-farming community, crop rotation has a logical order, chosen the crops planted today can help replenish the nutrients that the previous crops depleted from the soil. In most cases, the system is simple: Cultivate grains after legumes or row crops after grains in order to maintain soil fertility, reduce erosion and weather damage. One of crop rotation's biggest advantage is that it can prevent the transmission of disease bacterial wilt, crown rot, tan spot and number of pests can be deterred easily by rotating crops because most of these diseases and pests affect a specific type of crop and can eradicate them by switching on to a different crop in the next rotation.

Crop Diversity

To help protect crops against disease and pests, farmers can plant variations of the same species, getting seeds from different growers to ensure small but important differences among the plants. These variations ensure genetic diversity, which make the crops stronger. For example, if 10 varieties of corn are planted at the same time, mixed together, chances of pest attack won't affect all of them, reducing the need for pesticides and

cutting down on crop loss thus in turn results in less financial distress.

Cover Crops

Farmers grow cover crops to help with insect management, soil quality and fertility, pest control and water conservation. Many cover crops have no commercial value and are usually planted around edible crops. One example of a cover crop is clover, which can provide soil protection during cold weather, help with water filtration and suppress weeds. Grow clover between rows of fruit trees could help control erosion and prevent the ground from freezing. Farmers might also grow cover crops to help replenish organic matter or to increase soil microorganisms.

Integrated Pest Management

Integrated pest management is a combination of different techniques to create an effective pest control system. Monitoring and identifying pests is the first step. Not all pests need to be



eliminated. Some don't cause major damage to the crops and it might make more financial sense to just let them be than to start

a large-scale battle to exterminate them. Prevention is also part of integrated pest management. By using techniques like choosing pest-resistant crops, rotating crops and using beneficial insects, the risk of pests settling in is smaller. When it's the time to attack pests, targeted spraying is the best. This means not only spraying the specific areas that are affected, but also using chemicals that target only one specific pest and don't put beneficial insects or other wildlife at risk in the process.

Attracting Beneficial Animals



One of the best ways to get rid of pests and harmful insects is to invite in their natural predators. Bats and birds are the two most obvious choices. Both typically stick around if they have a place to nest and it usually means that the farmers will need to build some type of artificial shelter in the form of wooden boxes or small sheds. The next step in organic pest control is to ensure that beneficial insects also stick around. Ladybugs, beetles, green lacewing larvae and fly parasites all feed on pests, including aphids, mites and pest flies. Before long, they'll be feeding on harmful insects.

Soil Fertility

Keeping farm's soil healthy is essential as crops get most of their nutrients directly from the soil. In fact farm sustainability depends more on soil than on any other factor, including human help and intervention. It doesn't mean that the farmers can't do anything about the health of their soil, though. In fact, a number of techniques are available to help to improve its health. Tillage practices, which consist of plowing, turning and airing the soil, have been around for centuries and are still as useful as ever. Many farmers leave some crop residue on the ground before they till to add to the richness of the soil. Adding organic matter, such as manure or cover crops, can also help the soil. Other organic compounds that can be added to the ground as fertilizer include alfalfa meal, wood ash, animal byproducts, rock and mineral products, and alumino-silicate materials.

Physical Removal of Weeds

While this might be impractical for large farms whereas smaller crops can easily be taken care of without the use of chemicals. Hand removal is labor intensive and usually only reserved for specific areas where machines can't reach or where the crops are too fragile. Most of the physical removal of weeds is done through the use of agricultural machinery or tools. Mowing and

grazing are especially effective before weeds produce seeds. Not only does this prevent the weeds from reproducing but the weeds can also become mulch if not removed. Burning old crops is also an option, but one that should be approached carefully. Not only burning can damage the soil and the local wildlife, but it's also dangerous to the workers.

Water Management

There are two major problems in water management in farms: the poor performance of irrigation systems and water waste. The best way to manage water usage in farms is to choose native crops, since these will be more used to the local weather and able to stand longer periods without rain. Selecting drought-tolerant crops is also a key for farmers who live in dry areas. The next step in the effective management of water resources is to have an efficient irrigation system in place because inefficient systems can deplete rivers, degrade soil and affect wildlife. Limited irrigation is a practical solution for sustainable farming. Mulch and other cover crops can help retain water thus the soil stays moist longer. It's also possible to set up a system that collects rainwater and feeds it into the irrigation system. Some farms even set up recycling systems so they can reuse municipal waste water for irrigation.

Vertical Farming

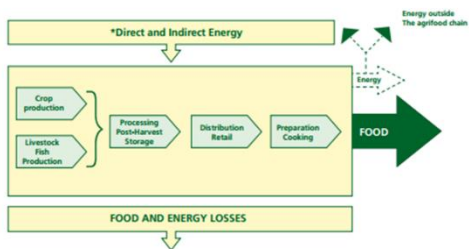
Many agricultural experts are proposing vertical farming as a solution to increase crop production or as a way to avoid soil



depletion. Vertical farming or farmscraping (farming + skyscrapers) is the practice of growing crops in vertical structures rather than on the ground. A vertical farm would be self-sustaining, with solar and wind energy providing power and a water system recycling wastewater and collecting rainwater. Vertical farming could be the secret to restoring soil health, getting rid of pesticides and reducing energy consumption and carbon-dioxide emissions. In fact, vertical farming could easily become the single best answer to sustainable farming ever devised.

Sustainable Energy

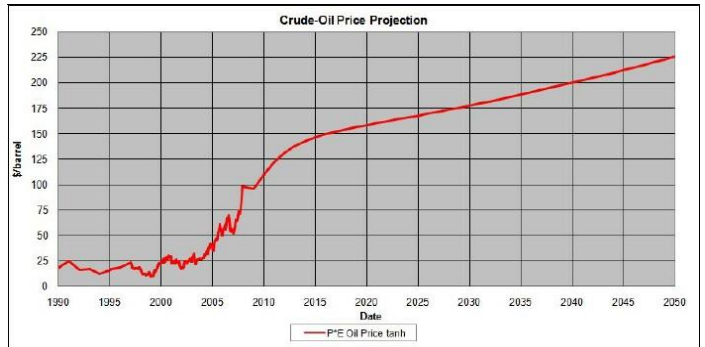
Energy is needed in all steps along the vegetable and fruit supply chain: in the production of vegetables and fruits; in post-harvest operations; in food storage and processing; in food transportation and distribution; and in food preparation.



There are two types, direct and indirect energy used in the vegetable and fruit supply chain. Direct energy includes electricity, mechanical power, solid, liquid and gaseous fuels. Indirect energy refers to the energy required to manufacture inputs such as machinery, farm equipment, fertilizers and pesticides. The type of energy used in the vegetable and fruit supply chain and how to use it will in large part determine whether vegetables and fruit systems will be able to meet future food security goals and support broader development objectives in an environmentally sustainable manner.

Over the last several decades, the availability of cheap fossil fuels has made a significant contribution to feeding the world. However, cheap energy sources appear to be becoming progressively scarcer and energymarkets more volatile and this has triggered higher energy prices. Modernizing food and agriculture systems by increasing the use of fossil fuels as was done in the past may no longer be an affordable option. It needs to rethink on the role of energy when considering options for improving

food systems. Historical trends indicate an evident



link between food prices and energy prices thus higher fuel costs increased the cost of producing and transporting agricultural commodities. A vegetable and fruit sector that is less dependent on fossil fuels could help stabilize its prices for consumers and reduce financial risks for vegetable and fruit producers and others involved in the vegetable and fruit supply chain.

Renewable energies such as bioenergy, solar, wind, hydro and geothermal can be used in vegetable and fruit supply chain systems as a substitute for fossil fuels to generate heat or electricity for use on farm operations.

Alternative Energy Sources

While solar and wind energy are well known, there are many other ways to harness energy from alternative sources. Some forms of alternative energy depend on



the location of the crops. For example, hydroelectric power might be an option for larger farms near a source of running water, and geothermal heat pumps might work if the type of soil allows for digging deep wells to take advantage of the Earth's heat. Biofuels are another clean source of energy. Biodiesel, for example, can be manufactured from cottonseed oil, and it's not only a cheap source of energy but also a very clean method. Solar energy tends to be the most versatile, however farmers can use it to heat water and buildings and also for crop and grain drying. It can also be stored in photovoltaic cells and

used for everything from powering electrical fencing and lighting to running equipment such as pumps and heaters. Alternative energy equipment usually requires a hefty investment to get started, though, and this is often what prevents some Sri Lankan farmers from trying it.

Sustainable Vegetable and Fruit Logistics

The concept of food miles gives an argument to buy vegetables and fruits which have travelled the shorter distance from farm to the super market or retailer. The long distance transportation of vegetables and fruit is associated with additional emissions. The common approaches of food miles are;

- The embodied energy of supply chain infrastructure such as ambient transportation, which varies according to the distribution strategy.
- The effect of varying degrees of logistic technologies on transport emissions.
- The different types of fuel used (e.g. petrol, diesel, ethanol) and its different contribution to global warming.

Growing to Sell Locally

Grow and sell in the same town and not to worry about the pollution created by having to transport, package and store crops. Growing and buying locally is a key to sustainability as it enriches the community, minimizes energy consumption and

protects air and soil quality. That's even before the food-packaging industry adds the plastic and paper waste required to store and transport the food safely. Growing and selling locally also encourages farming in small scale enabling faster turnovers. This in turn, pushes more money into the local economy, benefiting the buyers and eventually the farmers in return. Small farms that work and sell locally are also more likely to engage in local business, buying seeds, farming products and equipment from local businesses and producers. Locally grown produce benefits town's economy and the environment as a whole and may even find that fruits and vegetables are tastier. Yet this concept is contradictory since not all the crops are grown within same city in Sri Lanka thus can implement at a certain level.

Sustainable Management

Horticultural Crop Research and Development Institute (HORDI)

Horticultural Crop Research and Development Institute (HORDI) was established under Department of Agriculture in 1994. HORDI's responsibility is to develop technologies concerning vegetables, fruits, roots, tuber crops and floriculture. They generate and disseminate cost effective, eco friendly and sustainable technologies that will increase production, improve quality, reduce post-harvest losses and adding value.

The important researches' conducted by HORDI;

- Breeding of high quality & high yielding varieties of fruits vegetables and root and tuber crops.
- Crop management including crop establishment, pruning training etc.
- Technology for conventional and rapid propagation of planting material.
- Environmentally friendly, safe and economically viable pest management technologies.
- Soil productivity enhancement through nutrient management.
- Technology for cultivation in hydroponic and poly tunnels.
- Technology for production of organic vegetables and fruits.
- Technology for minimizing post-harvest losses, agro processing and food product development.

The valuable services offered by HORDI are;

- Consultation on planning and development of horticulture enterprises.
- Analytical services of soil, plant, fertilizer and water.
- Pests & disease diagnostic services.

- Consultation on land use patterns and soil & water conservation.
- Consultation on methods of minimizing post harvest losses, agro-processing and food product development.
- Human resource development in horticulture through collaboration with national & international research & educational (universities, technical colleges, farm schools) organizations.

Plant Genetic Resources Centre

Plant Genetic Resources Centre was established at Gannoruwa in 1989. It ensures the country's plant genetic resources and also promotes its benefits to the country. Plant Genetic Resources Centre is responsible for planning, implementing and co-ordination activities related to conservation of plant genetic resources. It is actively engaged in exploration, collection, introduction, multiplication, evaluation, conservation, documentation and distribution of the genetic diversity of crops and their related species. Its facilities are also used to conduct biotechnology studies, especially for conservation, evaluation and enhancement of genetic resources.

Information Sources

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