FACTORS INFLUENCING VEGETABLE FARMERS' DECISIONS

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FOREWORD

Excess supply typically drives prices down, benefits consumers and hurts producers. Scarcity drives prices up, hurts consumers and benefits farmers. Of course one cannot ignore the intervening play of middlemen. The situation spawns all manner of 'enterprising' operators and encourages practices such as hoarding in the case of less perishable commodities such as grain. Quite apart from exacerbations caused by logistical issues such as storage and transportation, not forgetting innovative and effective mechanisms that can mitigate post-harvest loss and protect farmers from hard-nosed collectors backed by big bucks and covered by political patronage, the old adage that knowledge empowers still holds true.

Often success and failure is a product of whether or not informed decisions were made. Of course full knowledge alone is not sufficient, in the very least; it allows farmers to choose courses of action that are relatively less risky. Sometimes it comes down to decisions about which crop to cultivate. The multiplicity of factors affecting yields, the need for aggregate harvests to be 'right' so that neither producer or consumer is adversely affected, the 'good headache' of having a wide range of choices and the 'bad headache' of not being able to access information on multiple factors, do not make for 'ease of decision.'

Information, happily, is not akin to extracting oil from likely reserves. On the other hand, it is important to find out what kind of information is important, what information is available and what is not, before formulating strategies to deliver reliable, comprehensive, relevant and timely information to those who require it. It is in this sense that inquiring into factors influencing farmers' decisions when it comes to crop selection is important.

The research team that carried out this study has in the process of mapping out the decision-making processes across regions and crops, has in fact opened a window into multiple processes associated with vegetable cultivation. The complexities have been meticulously captured and the policy implications carefully extracted. The team has, inter alia, shown that more detailed consideration of each element in the decision-making process is necessary, especially in order to understand the overall political economy of vegetable cultivation and how it shapes lives, livelihoods and life-chances of the farmers.

Malinda Seneviratne / Director

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EXECUTIVE SUMMARY

Fluctuation of vegetable supply usually to price volatility occurs when demand remains constant. Farmers' decision on choosing vegetable crops bears heavily upon variation in supply. It is often assumed that the root cause of the price fluctuation problem is the lack of information pertaining to required quantities. How much to cultivate and when, then, are questions if unanswered produces speculative behaviour on the part of the farmer.

This study examines factors that determine farmers' decisions regarding which crops to cultivate. It is framed by the availability and accessibility of information required for intelligent decision-making by vegetable growers.

Eight districts were selected from major vegetable producing districts in Sri Lanka; Anuradhapura, Badulla, Nuwara Eliya, Kandy, Kurunegala, Puttalam, Ratnapura and Hambantota; with a total sample of 480 farmers, using the multi-stage random sample technique. The primary data was collected from the 2018/2019 *Maha* and 2019 *Yala* seasons. Secondary data was gathered through key informant interviews and in the course of the literature review.

The study revealed that the availability of the information is not an issue in Sri Lanka. A total of eleven information-sharing tools have been developed by the year 2019 in Sri Lanka, but farmers in the main were hardly aware of them. In contrast knowledge of the hotline of the DOA (1920 call centre) was acknowledged by 33% of the vegetable growers and around 12% of the farmers said they were aware about HARTI's marketing prices sharing hotline. "Govi Mithuru App", "Krushi FM Web Radio" and "Govipola app" were known to only 3-4% of the farmers. Knowledge of other apps was even less. In any case, most of the vegetable farmers (around 65%) were unable to access information-sharing tools because they had only feature phones and land telephones. Nearly 30% of the farmers, however, have enough facilities to access information using applications and tools. Therefore, it was observed that there was a mismatch between the availability of information-sharing tools and the capacities and readiness of the farming community to access them.

The vegetable growers have on the other hand employed other means of accessing relevant information with one-third of the farmers making use of extension services. Around 20% obtained information thought to be necessary from agrochemical outlets while a fourth simply inquire from farmers in the community itself considering the fact that knowledge is acquired through practice.

Around 48% of the vegetable growers obtained cost-effective returns. On the other hand, around 86% have received enough income to cover their cash costs. Unfortunately, around 14% of the vegetable growers were unable to cover their cash costs.

The multinomial logit model generating estimates for up-country vegetables revealed that selected factors influence farmers 'decisions regarding crops to be cultivated. The

cultivated/expected extent of the particular crops in other areas was one of the key determinants of crop choice in the case of farmers who grew beans, beet, cabbage, capsicum, carrot, knol-khol and leeks. Beet, cabbage, capsicum, knol-khol and leeks producers, it was found, based decisions on weather data. New market ventures and entrepreneurship information were considered by the all up-country vegetable farmers except those who grew radish. Bean, cabbage and leeks producing farmers ' decision has been motivated by the opinions of others in the neighborhood. Availability of the seeds was taken into account by farmers who cultivated beans, beet, cabbage, capsicum, carrot and leeks. Fertilizer availability for those who eventually decided to grow beet, carrot and radish producers was considered. The availability or otherwise of pesticides has not concerned knol-khol, leeks and radish producers. Bean, cabbage, capsicum, knol-khol and leeks growers were sensitive to production costs. Formal credit availability hadn't influenced the decision to grow knol-khol, leeks and radish but the availability of informal credit had shaped the decisions of all up-country vegetable growers. The availability and accessibility of water was factored in by bean, beet, cabbage, capsicum, carrot and leeks growers while for those who grew knol-khol and radish this was a non-factor. The availability of labour and having their own money were key determinants for all up-country vegetables. The market price of the previous season has influenced farmers who decided to cultivate beans, beet, cabbage, carrot and leeks. The bean, beet, cabbage, carrot, leeks and radish cultivators had given thought to issues of marketability. Seed costs have influenced the decision to cultivate capsicum, carrot, leeks and radish while yields expected mattered when considering all crops except beet. Expected/forecasted price of the crops, market demand and taste of the crops were not significant for any up-country vegetables.

The output of the estimated multinomial logit model for low-country vegetables also demonstrated that selected factors influenced the decision of crop selection. Farmers who grew snake gourd, cucumber, okra, luffa, long bean, tomato and *elabatu* have thought about the cultivated/expected extent of the particular crop in other areas. Expected/forecasted price has been considered by pumpkin, snake gourd, cucumber, okra, luffa, long bean and *elabatu* growers. Bitter gourd, luffa, long bean and *Elabatu* producers had considered the market demand for these crops. All low-country vegetable growers except those who cultivated winged bean and *thumba* stressed the importance of predicted climatic/weather data. All of the low-country vegetable growers showed interest in information about new market ventures and entrepreneurship. The availability of the seeds has been considered by all low-country vegetable growers excluding those who cultivated winged bean and *thumba*. The bitter gourd, okra, luffa and *kekiri* producing farmers have thought about the availability of fertilizer when selecting those crops. The bitter gourd, long bean and tomato cultivating farmers had been worried about the availability of pesticide. Production costs related to the crops were considered by those who cultivated snake gourd, cucumber, luffa, *kekiri* and tomato. The taste of crop was not significant for any crops in low-country vegetables except in the case of long bean, winged bean and *kekiri*. Formal credit availability encouraged the cultivation of bitter gourd and *elabatu* cultivation while the availability of informal persuaded some to grow bitter gourd and long bean. Water availability and accessibility had been considered by pumpkin, cucumber, okra, brinjal, luffa, long bean, tomato and *elabatu* producers when they were selecting crops. The pumpkin, okra and tomato cultivated farmers have thought about the availability of the labour. Farmers who had their own capital were encouraged to cultivate pumpkin, cucumber, bitter gourd, okra, brinjal, luffa, *kekiri*, *thumba* and *elabatu*. The market prices of the previous season persuaded some farmers to grow pumpkin, cucumber, okra, brinjal, tomato and *elabatu*. Pumpkin, cucumber, brinjal, long bean, kakiri and tomato producing farmers had been influenced by issues of marketability. Seed cost was a key determinant for all low-country vegetables except winged bean. Snake gourd, winged bean, *kekiri* and *thumba* producing farmers were not concerned about yields but for cultivators of all other low-country vegetable growers this was an important consideration.

Since knowledge of information-sharing applications was poor, an awareness programme to correct this needs to be implemented by the Ministry of Agriculture. Given poor accessibility at the grass-root level, promoting mobile hotlines is recommended for sharing information, especially since information-sharing methods by way of the internet would not be as effective due to limited access.

The majority (around 70%) of farmers were still dependent on individuals they knew for relevant information, therefore an information transmission system from the national level to the ground level through a third party would be more effective as opposed to attempts to target individuals. Therefore, it is necessary to design a systematic mechanism for sharing information from top to bottom. To develop a strong network with the field officers and enrich them with updated information related to support for decision making is recommended.

To increase the cost-effectiveness of vegetable cultivation, it is necessary to either enhance productivity or reduce the cost of production since 52% was unable to secure cost-effective returns. Reducing production cost would require the cost of seeds,agrochemicals and fertilizers to be reduced. It is recommended that tax relief be provided for selected vegetables coupled with an agreement for vendors to reduce seed prices, complemented by a fertilizer subsidy for vegetable growers as an incentive.

The Dambulla Dedicated Economic Centre can be used as the main information-sharing hub because it is the prime price-determining vegetable market in Sri Lanka. On the other hand, a lot of farmers engage in the Dambulla wholesale market. Establishing a centre for disseminating market information near the DEC is recommended. Preparation and implementation of a production plan at zonal levels to stabilize the supply of the vegetables catering to the demand is suggested. Encouraging collective marketing strategies among farmers and reducing the commission of Dedicated Economic Centres are also recommended.

Since potential yields constitute the prime determinant of decisions made by vegetable growers, it is recommended that yield information be prominently displayed on seed packets and at sales outlets. It is also recommended that information about pest and disease attack for different crops be provided at such outlets. Price forecasts and costs of production can also be communicated to among vegetable growers using all media platforms. Developing a data gathering and sharing system with the cooperation of seed outlets, both public and private, and giving farmers access to the relevant information is also recommended.

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ADA	–	Assistant Director of Agriculture
ASC	–	Agrarian Service Centre
DDA	–	Deputy Director of Agriculture
DEC	–	Dedicated Economic Centre
DOA	–	Department of Agriculture
DS	–	Divisional Secretariat
FAO	–	Food and Agriculture Organization
GAP	–	Good Agricultural Practices
ICT	–	Information and Communication Technologies
OFC	–	Other Field Crops
ML	–	Multinomial Logit

CHAPTER ONE

Introduction

1. Background of the Study

Vegetable marketing involves farmers (producers), collectors and other brokers (middlemen), wholesalers, retailers, supermarkets and consumers. Extreme price fluctuation in the vegetable market, usually a product of either oversupply or scarcity, is a common phenomenon and this has particularly adverse effects on both producer and consumer compared with other stakeholders. It is in this context that information can play a critical role in price stabilization.

Information, clearly, provides the ability to make effective decisions in any economic transaction. On the other hand, imperfect information causes an imbalance of power. This in turn can lead to market inefficiency. There are costs involved of course; information related costs from 70 percent of the total transaction costs, which is 15 percent of the total production cost incurred by farmers who sell their produce at Sri Lanka's largest wholesale agriculture market (Ratnadiwakara et al, 2008).

Since profit is a driving factor for the development of any business, farmers also expect a return on their investment. However, unlike other entrepreneurs, farmers do not have sufficient knowledge of market demand for their crops (Silva, 2005). They typically grow crops they are used to cultivating and take the harvest to the wholesale market themselves or through a collector. The reality is that most farmers are unaware of quantities required and when. The root cause of the problem may be the imperfect information. The buyer can determine in advance what is required, but individual farmers are not aware of this. The ultimate result is a mismatch of demand and supply leading to volatile price movements, and the farmer being forced to sell at prices that may not even cover expenses (Silva, 2005).

This imperfect information occurs in each and every stage when the farmer makes decisions related to the production process. If the farmers can decide what crops are cultivated, what extent of land should be cultivated with each crop and when production is best supplied to the market, it would greatly enhance profitability and in turn wellbeing. This necessitates access to information such as details of varieties, availability of seeds, fertilizer, past performance of the particular crops/varieties, pests and diseases, agro-chemicals, cultivated and expected extent in a particular season, production costs, weather conditions, demand and expected prices.

2. Justification of the Study

Vegetable farmers have to make all kinds of decisions such as what crop to cultivate and when, when to harvest, when to transport the harvest to the market, as well as consider factors pertaining to the following season. Sometimes a farmer might act based on the highest reported price for a particular crop in the récent past or make choices considering what crops are usually cultivated in the particular area. Another may target a special festival/cultural event expecting an increase in demand. Most farmers, however, tend to consider the cost of production, resistance to pests and diseases, and the past performance of the selected crops. Such behaviour however may not be prompted by awareness of demand. The mismatch in demand and supply that often ensues can lead to price volatility.

The reality is that most farmers are unaware of what is required, how much is required and when it is required. The buyer can determine in advance what is required, but individual farmers are not aware of this. The ultimate result is a mismatch of demand and supply leading to volatile price movements and farmers ending up with prices that may not even cover his expenses (Silva, 2005). Since information asymmetry leads to lower prices and income, farmers have expressed a willingness to pay a premium to get quality information (Arinloye et al, 2016). Price expectation based on previous seasons ’price signals was the main factor considered by farmers in selecting the type of vegetable/s to grow in the following season. The other main factors considered by the farmers were individual preference, availability of alternative water sources, potential harvesting frequency and influence of external parties (Champika, 2016).

Information is known to be an essential element in the decision-making process. When information is not available for everyone asymmetry ensues. Information asymmetry may be defined as a sort of cartography of access to, and knowledge about, a particular fact, i.e., not everyone has the same access and not everyone knows what is happening. Therefore, we are in a scenario where, on the same subject, data or event, we have incomplete interpretations (Silva and Felix, 2012). Information is one of the key factors in decision making.

3. Problem Statement

Vegetable production fulfills in part the food requirement of people. However, agriculture is also practiced as a business and therefore vegetable farmers are driven by the possibility of profit. Since the vegetable sector comprises of two equally important factors, production and marketing, there is a value chain which comprises stakeholders from producer to consumer. Therefore, the profit goes the producer depends on the actions of every stakeholder. Similarly, such actions influence the price that consumers have to pay.

Profit, in the case of a vegetable farmer, depends on selling price, type of vegetable, the quantity of vegetable, credit facilities and cost of production which is determined by the cost of inputs such as planting material, fertilizer, labour, technology and irrigation. If the farmer knows the required quantity of each vegetable, the volumes produced by other farmers and other factors that bear upon profit, he can decide what to grow and when in order to maximize profits. Information on the price at which his production is likely to be sold is helpful when bargaining with buyers. Therefore, information is important in reducing the cost of transaction relevant to activities of the stakeholders in the value chain. Imperfect information in the input and output markets could mislead when it comes to decisions related to crop selection.

The actions of stakeholders of a vegetable value chain determine the welfare of both vegetable producers and consumers. Stakeholders utilize resources and incur costs but are willing to do so since they expect benefits to be generated. As the utilization of a resource has a tradeoff, every stakeholder is faced with a set of choices. Therefore, the welfare of the farmer and consumer can be enhanced through efficient resource allocation (or prudence when deciding from a set of choices). A decision on resource allocation (making choice) with regard to a particular action depends on the information of that action and tradeoffs of resource allocation. On the other hand, inefficient allocation of the resources leads to welfare losses of the producer and consumer.

Research Questions

The individual farmers' decision-making process may be based on several factors. However, at the end of the production process, it is very difficult to control the market surplus/deficit. Therefore, the policymakers are required to address the governing factors of farmers' decision-making. The key questions that policymakers have to consider are;

- What is the information/data required to make effective and efficient production decisions?
- What information exists and how can it be used to make better economic decisions for vegetable cultivation?
- What are the prevailing factors related to accessing available information and identifying bottlenecks and how can conditions of imperfect information to be overcome?
- What type of data/information has been used by vegetable farmers to make decisions with regard to the following season or cultivated time?

4. Objectives

Main objective

To identify prevailing information imperfections of the vegetable sector and ascertain measures required to reduce or eliminating information asymmetry, and thereby derive strategies that can be formulated to enhance the efficiency of resource allocation in the vegetable sector of Sri Lanka.

Specific objectives

1. To examine availability and accessibility of information required by vegetable growers in Sri Lanka to make decisions.
2. To understand factors/determinants leading to farmers' decision-making process in the vegetable production sector.
3. Formulating strategies to reduce or get rid of the prevailing information imperfections of the vegetable production sector in Sri Lanka.
4.

CHAPTER TWO

Literature Review

2.1 Theoretical Background

Homogeneity of the different vegetables, a large number of buyers and sellers actively participating in the market, freedom of entry and exit from the market could be observed in the vegetable market. Therefore, neither producers nor consumers are able to influence market price which is determined by demand and supply of the market. Thus the buyer and seller would act as price takers. Prices of agricultural commodities are more volatile than the prices of the most non-farm goods and services and play a central role in economic theory in guiding production and consumption as well. The production decisions of farmers or the buying decisions of consumers are both governed solely by the prices. The nature of the demand for farm products is also a factor in price instability. For many foods, price changes tend to have a small effect on consumer purchases (Tomek, 1990).

A theoretical supply curve is based on the assumption that the producer seeks to maximize net returns. However, agricultural supply functions are often price-inelastic and therefore a decline in demand results in declining prices with relatively small changes in quantity supplied. In agricultural production, once a decision to produce has been made, important time lags exist between planning or breeding and the realization of the output. The difference between actual and expected yield is a measure of yield risk. The theoretical supply curve normally assumes that risks are held constant (Tomek, 1990). Accordingly, demand and supply curves for agricultural products can be derived as depicted in Figure 2.1.

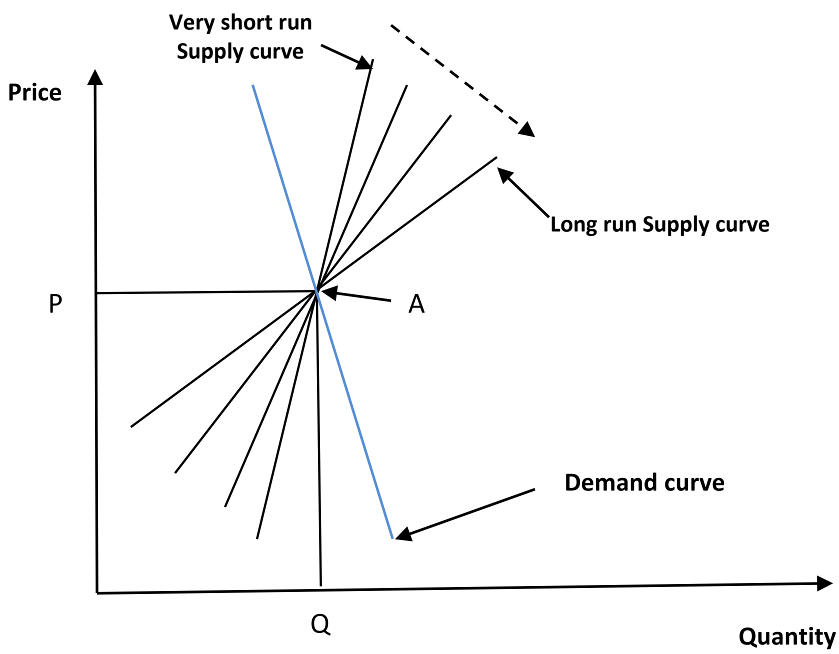


Figure 2. 1 Demand and Supply Curves for Agricultural Products

If we assumed that point A was the equilibrium in the market, P and Q indicate equilibrium price and quantity. In this context, the supply curve would shift left or right due to inadequate supply or oversupply while demand is constant. According to Figure 2.2, market equilibrium will change from point E1 to E2 to point E3. When the supply curve shifts towards the right prices will decrease from P1to point P2. While the supply curve will move from line ab to ef, the equilibrium market prices will increase up to P3. Thus, the prices and quantity will automatically change with respect to the demand and supply in the competitive market. Therefore, movement of the supply curve will create a welfare loss to both producer and consumer. The area of the P1FE3P3 indicates consumer welfare losses and P1E1GP2 represented welfare losses of the producer.

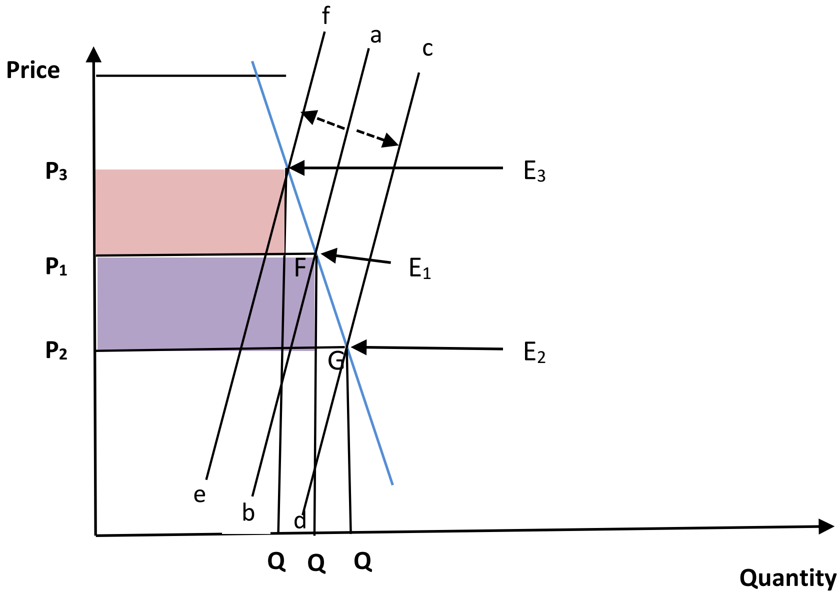
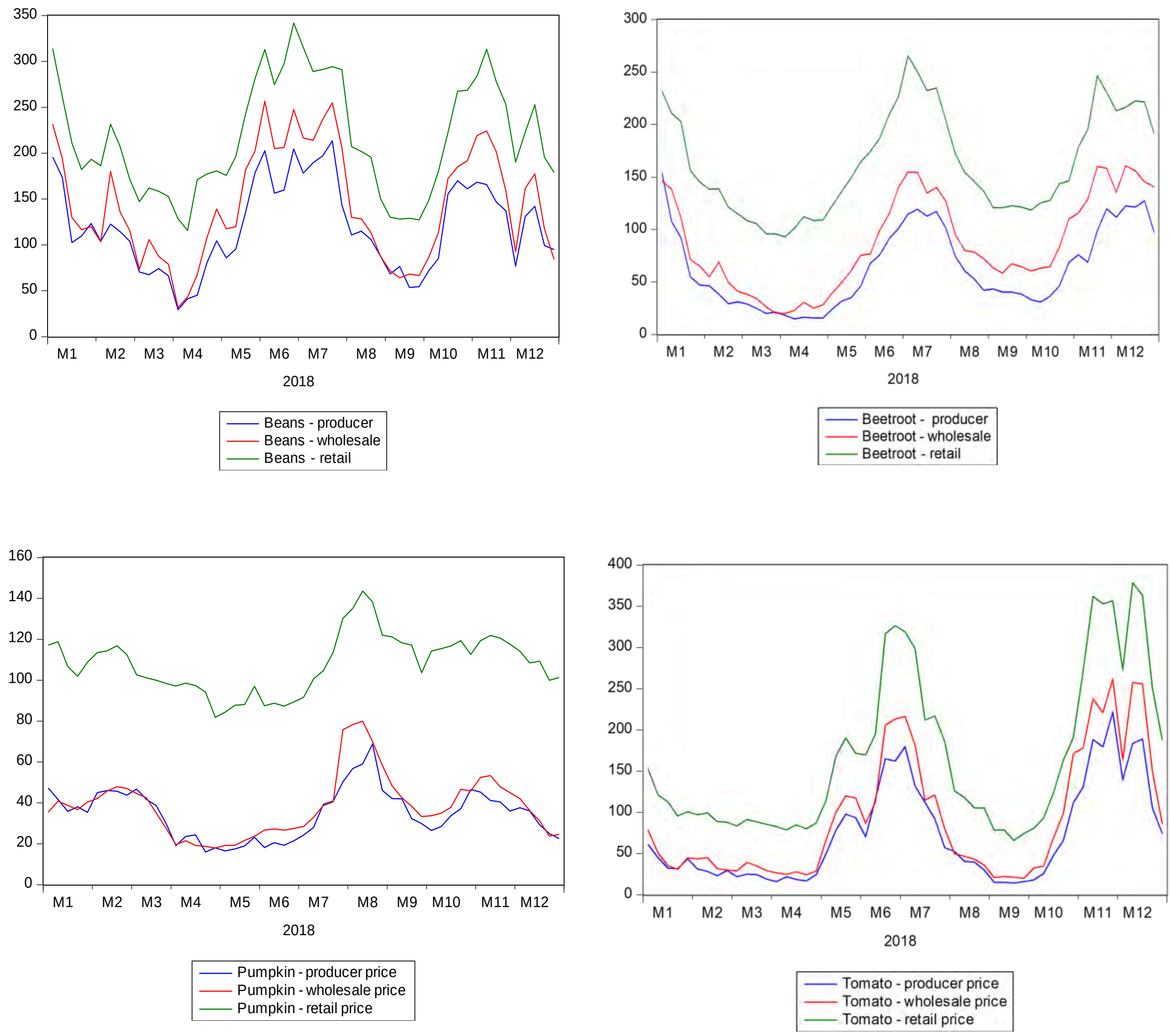


Figure 2. 2 Welfare Losses of the Consumer and Producer

Vegetable price fluctuation has been frequently observed over the years in Sri Lanka. For example, both wholesale and retail prices for vegetables have declined from March to May and from August to September. On the other hand, the highest prices were recorded from June to July and from October to November. This seasonal price variation pattern could be observed for all vegetables in Sri Lanka (Figure 2.3). Therefore, the welfare losses of both producers and consumers in the vegetable market occur in several specific months. Otherwise, this market disparity may yield any benefits to either the producer or consumer.

Usually vegetables are available in markets throughout the year and there are two seasons during which vegetable production is higher than in other months. This seasonality of vegetable production results in fluctuation of vegetable production. Since vegetables cannot be kept for longer time period in stores, seasonality of production and perishable nature cause high price variations.

In addition, the selection of types of vegetables in a particular season also causes marketing problems. Sometimes farmers tend to cultivate vegetables that fetched good prices in the previous season. As a result production could be higher than the demand, leading to marketing problems (Figure 2.3).



Source: Marketing, Food Policy and Agri-business Division, HARTI

Figure 2. 3 Weekly Price Behaviour Patterns of Vegetables in 2018

Therefore, farmers should consider the demand before selecting vegetables for cultivation; otherwise resources invested will not yield expected profits.

Farmers 'decisions are critical because of their impact on farm productivity and profitability. Farmers have to consider many factors before arriving at any decision regarding farm and non-farm activities, since decisions have their roots in the past and reflects upon futuredecisions (Dury, *et al.,* 2012). The physical, economic and personal factors, crop profiles and availability of resources were the factors impacting choice of the crops (Greig, 2009). Making farm credit, market information, and crop management technologies more accessible to farmers are recognised as being associated with opportunities to expand vegetable-based agribusiness (Mariyono, 2018).

2.2 Determinants of Farmers' Decisions on Farming Activities

Decision making in farming is complex and coupled with multifaceted dimensions. Simply, many factors may influence farmers 'decision making. Many studies reveal that farming environment is complex and uncertain due to aspects of various origins (Ketteler, 2018; Mariyono, 2018). Furthermore, farmers can be influenced by their surroundings and the information given by the community. Farmers frequently make decisions based on their intuition or gut feeling rather than a scientific base (Beckford, 2002). Intuitive decisions are mostly based on farmers' previous experience related to farming. This is more prominent when the farmer acquires maturity in the field. There are several major factors that influence farmers' decision making on the cultivation process. These factors can be broadly categorized as economic, physical, personal, crop, resource availability and accessibility, and information.

2.1.1 Economic Factors

Economic factors mainly comprise of prices and costs. Farmers are considered as individual private entities. Thus, their primary intention is to maximize profit while minimizing the cost drivers (Greig, 2009). Also, essentially farms are businesses with economic objectives. Therefore, finance is a strong factor in farmers' decision-making process. Most farmers consider farm gate prices when selecting the crop to cultivate. However, some go about it from the other direction. The main agricultural cost drivers consist of input costs such as seeds and planting materials, labour, machinery, agrochemicals, capital and other related costs. Supporting activities such as storing and transportation are also vital. Transportation could be further classified as types of transportation available, time taken and the cost of moving raw materials. This is a sub-category of logistics in agriculture (Huylenbroeck & Damasco-Tagarino, 1997). The cost incurred in adopting new technology to improve productivity is another economic factor. The installation of a new sprinkler system is an example of this. It should be noted that vegetable cultivation in dry areas in Sri Lanka adopts sprinkler systems.

Apart from the investment cost it is important to understand the maintenance cost incurred by farmers. Such systems require regular maintenance for efficient execution. In addition to the cost drivers, farmers always seek higher margins. Farm-gate price does not always depend on the quantity and quality of production. Farm-gate price also depends on prices of other commodities, the effect of substitutes, market structure and other factors (Mariyono, 2018). It is obvious that farm gate prices may decrease in oversupply situations. This is prominent in the vegetable sector in Sri Lanka. The effect of subsidies also affects costs and final prices. In theory, this policy provides farmers with a measure of economic stability and provides consumers with affordable prices. However, in some instances, this policy encourages farmers to create an oversupply of a narrow range of crops regardless of current market conditions (Gartenstein, 2017).

2.1.2 Physical Factors

Soil and topography are considered the most important physical factors in agriculture. Agricultural ecological zones in Sri Lanka are also demarcated according to the topography, soil type and climate factors. Soils differ in respect of physical and chemical composition. They may be fine or coarse, porous or non-porous. In general, fine soils like loam or silt are very fertile. The chemical composition of the soil determines productivity (Gupta, 2018). It is also noted that continuous cultivation may heavily affect soil structure thus leading to a decrease in soil fertility. Therefore, soil management and conservation techniques are important when engaging in constant cultivation. This could be evaded through land fallow, crop rotation and by using organic manure. All these factors indicate that the condition of the soil compels farmers to make decisions (White, *et al*., 2012). The topography is also important for decision making on agriculture since it determines the extent of soil erosion, methods of cultivation that are possible and mode of transportation. For example, in hilly areas usage of machinery and other transportation facilities are limited.

Another important aspect is infrastructure facilities such as pre and post storage, processing facilities, telecommunication types and modes, mode of transportation, ways and means of trading and exchanging agriculture. Without proper infrastructure facilities, farmers are unable to deliver their output to the consumers. This is also referred to as a logistic arrangement and coined as a supply chain. This includes market structures as well. Agricultural infrastructure is one such major aspect which generates competitiveness in agricultural value chains and sustainable food production (Munyanyi, 2013). Agricultural infrastructure thus includes all of the basic services, facilities, equipment and institutions needed for the efficient functioning of the agriculture sector (Warner, *et al*., 2008). It is also equally important to understand the factors which help create market structures within the area. Farmers' decision making significantly varies from one market structure to the next.

2.1.3 Personal Factors

Personal characteristics and behaviour of farmers directly influence their decision-making process on farming. Farmers are assumed to be rational while pursuing the maximization of self-interest. However, due to the environmental factors in which farmers operate, they cannot be completely rational. Personal behaviour is also influenced by the cognitive ability of the farmer (Sun, *et al*., 2018). This refers to the ability to think and understand the context. Thus, cognitive ability strongly affects the decision-making process of the farmer. Furthermore, strong physiological factors such as age, education level and experience influence the farmer's decision-making process. In addition to these factors, family attributes and family traditions are also important aspects of decision-making. 'Family tradition has been identified as the most influential aspect in the Dominican Republic. Intuition is also a personal factor that can be significant (Ketteler, 2018). In Sri Lanka, many of farmers rely on intuition.

Different personal factors contribute to different decision making patterns in agriculture and make it more and more complex as a system. That is why the decision-making process in agriculture is complex (Bradford, 2009). Education level is important to understand the farmer's behaviour in agricultural activities. Farmers who possess a higher educational level rely more on their knowledge and skills. On the contrary, farmers who do not possess adequate educational qualifications rely on their previous experience in agriculture. Aged farmers are more resistant to acquiring novel technology and know-how. Instead, they practice traditional methods which sometimes reduce productivity. Gender is also important. In general, Asian countries matriarchy is more prominent than in European and American region. However, the agricultural sector in many Asian countries including Sri Lanka is a more a male dominant sphere. Nevertheless, there have been many instances where the decision-making process is influenced by family members (Greig, 2009).

2.1.4 Crop Profile

In general, farmers' favorable crop profile includes resistance to pest and diseases, quick maturity dates and life cycles, and quality of consumer attraction for the yield. Thus, farmers tend to avoid some crops which attract particular pests and diseases or are associated fertility requirements that make the production of the crop difficult or too risky (Jaffe, 1989). Farmers also consider crop rotation and diversification to mitigate unfavorable conditions in farming. Sri Lankan potato farmers in the up-country rotate the cultivation from time to time as an essential requirement of potato cultivation. In some cases, farmers maintain several crops at once per season to mitigate risk in the cultivation (Dury, *et al*., 2012). The choice of crops and their allocation to plots are at the core of farming system management. This involves many stages in the crop production process even in the case of small scale cultivation. Hence, the selection of the ideal crop profile is a challenging activity in farming. Cropping plan decisions are indeed crucial steps in the production processes and have considerable effects on the annual and long-term productivity and profitability of farms.

An appropriate cropping profile should fulfill multiple objectives at once and take into account a larger number of factors and their interactions. Hence, both cropping plans and crop selection are of utmost importance. When referring to the cropping plan, the farmer has to consider different crops and their spatial distribution within the farming land (Navarrete and Bail, 2007). Most vegetable farmers in Sri Lanka engage in small scale farming. Hence, crop rotation and diversification are common. On the other hand, crop rotation is practiced to break weed and disease cycles, and for reducing dependence on external inputs. Crop diversification is also as a result of land heterogeneity. Thus, farmers select different crop profiles due to different reasons. Therefore, the crop profile is also an important aspect when making farming decisions.

2.1.5 Resources Availability and Accessibility

The availability and accessibility of land, labour, capital and management or entrepreneurship determine the production possibilities of farming (Gerry, 2000). Since resources are scarce, an efficient production process requires the efficient use of land, water, machinery, structures, commercial inputs, labour and management skills. However, the strength of the complement differs from one farmer to another. Inefficient management and utilization of resources may lead to poor performance and ultimately to critical failure (Martin-Clouaire and Rellier, 2011; Alassaf, *et al*., 2011). They argued that farmers who settled on marginal lands where limited land is available ended up with lower farm productivity due to inadequate management practices. Furthermore, farmers could not achieve economies of scale nor mitigate the high cost of production. Another prominent constraint is inadequate labour. The cost and availability of labour are considered a major problem that farmers face in agriculture.

The basic inputs for farming such as seeds, chemicals and availability of water are of utmost importance for efficient production. In general, farmers are used to cultivating hybrid vegetable seeds with the intention of getting higher yields. However, costs and types of seeds vary across time. The decision on seeds and other vital inputs required for farming also depends on availability of and access to the particular resource. In most cases, farmers are compelled to use inappropriate farming inputs due to unavailability within the area of operation. This leads to poor resource allocation and management (Huylenbroeck and Damasco-Tagarino, 1997). Otherwise, the availability of resources at affordable prices would enhance the accessing capacity of farmers. The availability of water also differs based on the topography and climate. Heavy drought or rains may affect cultivation creating either water scarcity of oversupply respectively. Services such as training and extension are also regarded as important resources in farming in addition to physical resources. However, the inadequate and therefore lack of influence of extension officers adversely impact farmers' decision making (Greig, 2009).

2.1.6 Information

In the modern world, information is identified as the most powerful tool to achieve wonders. In economics, market structures are formed based on the availability of information. The market structure of perfect competition is ideal and it is based on 100% availability of information (McGee, *et al*., 2010). An efficient and effective decision-making process is based on the amount and quality of information received by the respondent (Abumandil and Hassan, 2016). Poor quality of information often leads to poor decision-making and adversely affects the cultivation process. This is why systems of disseminating and sharing information constitute a key factor impacting the success of modern agricultural systems around the globe (Kelly, 1993). The continuous flow of accurate information through different modes may enhance farmer knowledge and can directly increase both production and marketing aspects of agricultural commodities. In other words, it lessens inefficiencies in all farming activities.

The farmer is the principal node of agricultural production and the player whose input is most crucial in decisions about how, when and what to produce. Timely and accurate information is pivotal for the farmer to decide the optimal combination of resource allocation in the production process. This ultimately derives the efficiency in the marketing process (Kuruppu, *et al*., 2019). Currently, there are numerous ways to disseminate agricultural information. However, the central question is whether that information reaches the farmer. Since the information has to be valuable for the farmers' decision-making process. It is also possible to look at the value that resulted from decisions based on the information. Value for the user is typically associated with perceived usefulness (Top, 2015). If a farmer doesn't obtain correct information at the right moment, it is unlikely that the ideal decision would be made. Hence, it always creates a gap between the farmer and the market. Therefore, quantity and quality of information are vital in farmers' decision-making process.

2.3 Effective Information-Sharing Methods in the Agriculture Sector

The success of any business organization is dependent on the quantity and quality of the information based on which decisions are made. This is also true in agriculture as well. Farmers could improve productivity, profitability and decision-making processes regarding cultivation by sharing their knowledge, experiences and having better access to pertinent information (Howland, *et al*., 2015). Thus, sharing accurate information is of utmost importance to take advantage of market opportunities and manage continuous changes in agricultural production systems. Many countries adopt different agricultural information sharing tools, techniques and methods to enhance the sector growth. The market information system is one such popular system used by many countries to facilitate both producers and consumers. Therefore, there is a need to understand the methods, functions and use of particular agricultural information systems in order to manage and improve them (Demiryurek, *et al*., 2008).

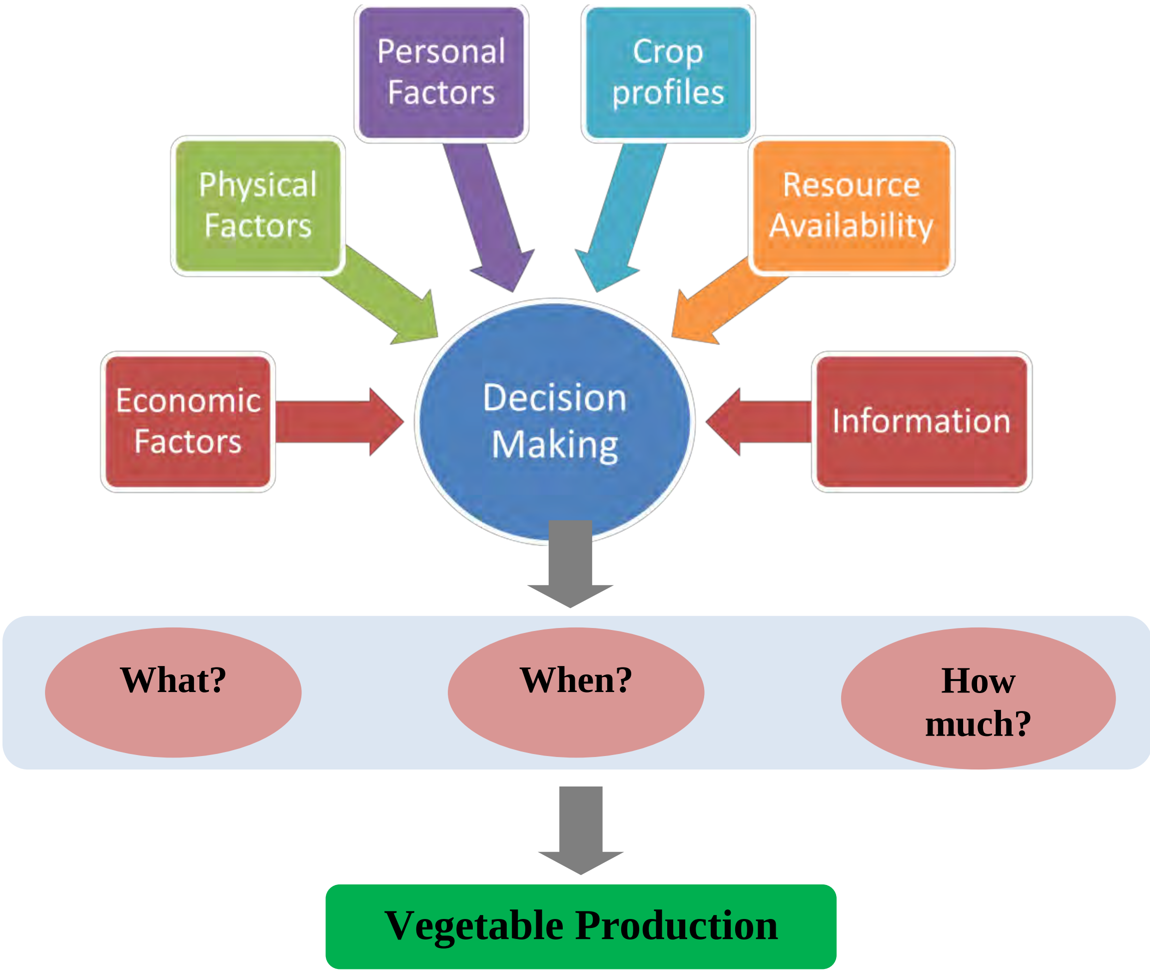
Iinformation can be defined in many ways. Further, information is associated with data and viewed as a type of input. Most importantly, Information is any type of pattern that influences the formation or transformation of other patterns (Abumandil and Hassan, 2016). There are numerous methods to share information in agriculture such as print media, digital media, mobile networks, awareness and training programmes and through field officers. Information is considered as a national asset in many developed countries. Thus, there are also numerous barriers when sharing and accessing information. Mass communication is one such popular information sharing method around the globe. Some of the mass communication appliances are radio, television and newspapers. With the development of technology, communication methods have drastically changed over the years. Currently, information is shared via Information and Communication Technology (ICT).

ICT is the process of gathering, distributing, and communicating information through computers and computer base networks (Parmar, *et al*., 2019). This has been further shaped by the introduction of mobile phones. Various mobile applications related to agriculture have become a game-changer in the sector deriving it to achieve unprecedented successes. The development of ICT can and has facilitated prompt dissemination to a much larger audience regardless of distances (Ajayi, *et al*., 2018).

Apart from the technological perspective many countries also disseminate information manually through agriculture officers and other relative officers in the field. This is a prominent practice in many developing countries including Sri Lanka. In many Asian and African countries, information is shared through training programmes and farmer visits. Many farmers also prefer to acquire information through these channels since it is real-time action. This is also a success because officers could intervene directly with farmers (Osondu and Ibezim, 2015). However, the main issue in this channel is the reactive rather than proactive nature of response. In other words, farmers can only acquire information as and when such programmes and visits happen and not on a day to day basis. Moreover, the information flow is not continuous. Farmers are not able to access information at the right time. Thus, the agriculture sector as a whole faces all manner of lapses. It is also important to understand that availability of information is a strong factor that affects the market structure. Thus, improvement in the quality and quantity of information is crucial to achieve efficiency and effectiveness in the marketing process.

2.4 Conceptual Framework

When vegetable growers decide to cultivate crops, they consider certain factors. The individual behavior could be explained the following conceptual framework in vegetable cultivation (Figure 2.4).



vegetable farmers are also maters in these decisions.

After deciding what to produce, they think about when to produce. Vegetable farmers decide the crop establishment time considering all physical factors related to the crops and notions of what kind of demand there would be and consequently the envisaging of good prices in the market. Most farmers operate within the seasonal structure while some try to off-season cultivation.

Once vegetable farmers select crop/crops (what to produce) and crop establishment time (when to produce), they think about the cultivation extent, i.e. whether to use available lands fully or partially or rent land for cultivation. Based on this they obtain a subjective assessment of potential yield. If farmers have good information that makes for better forecasting they can accordingly adjust their cultivation plans. They would divide their lands and other resources considering quantity (how much) and in this way, ultimately, efficiency of resource allocation and utilization would be enhanced.

CHAPTER THREE

Methodology

3.1 Data Collection

The primary data required for this study was collected from the 2018/2019 *Maha* and 2019 *Yala* seasons through a sample survey using a structured pre-tested questionnaire. Secondary data was gathered from the Department of Census and Statistics, Department of Agriculture, Provincial Agricultural Departments, Agrarian Service Centers (ASC) and published and unpublished reports and other relevant literature. Key informant interviews were applied to collect other necessary information from relevant officials.

3.2 Study Locations

The representative sample was selected from the major vegetable growing districts in Sri Lanka. To select relevant districts, data available in the Department of Agriculture with respect to extents under the crops was used. Accordingly, Badulla, Nuwara Eliya, Puttalam, Anuradhapura, Hambantota, Ratnapura, Kurunegala and Kandy districts were selected for this study considering the top three highest extent reported district of vegetable cultivation during the 2018/2019 *Maha* season (Table 3.1). Those districts have been selected after ranking with respect to the number of crops cultivated within top three highest extents during the 2018/2019 *Maha* season. Consequently, those districts with at least three crops cultivating among the top three in terms of extent cultivated during this season were selected for the study.

Table 3. 1 Major Vegetable Producing Districts in *Maha* 2018/2019 Season

Vegetables	Cultivated Highest Extent			Districts Selection		
Up-country Vegetables	**First District**	**Second District**	**Third District**	**District**	**1st-3rd extent reported crops**	**Rank**
Beans	Nuwara Eliya	Badulla	Ratnapura	**Badulla**	9	1
Beetroot	Nuwara eliya	Puttalum	Badulla	**Anuradhapura**	8	2
Cabbage	Badulla	Nuwara Eliya	Puttalam	**Puttalam**	7	3
Capsicum	Puttalam	Badulla	Anuradhapura	**Nuwara Eliya**	7	4
Carrot	Badulla	Nuwara Eliya	Jaffna	**Hambantota**	7	5
Knol-khol	Badulla	Nuwara eiliya	Kurunegala	**Ratnapura**	4	6
leeks	Nuwara Eliya	Badulla	Kandy	**Kurunegala**	4	7
Radish	Badulla	Nuwara Eliya	Puttalum	**Kandy**	4	8
Low country Vegetables						
Pumpkin	Anuradhapura	Hambantota	Monaragala	Monaragala	2	
Snake Gourd	Hambantota	Anuradhapura	Kandy	Batticaloa	1	
Tomato	Badulla	Nuwara Eliya	Kandy	Jaffna	1	
Cucumber	Hambantota	Monaragala	Kurunegala			
Bitter Gourd	Hambantota	Anuradhapura	Kandy			
Okra	Batticaloa	Puttalam	Ratnapura			
Brinjal	Anuradhapura	Hambantota	Badulla			
Luffa	Anuradhapura	Hambantota	Ratnapura			
Long Bean	Puttalam	kurunegala	Hambantota			
Winged Bean	Ratnapura	Anuradhapura	Mahaweli H			
Kekiri	Puttalam	Anuradhapura	Kurunegala			

Source: Department of Agriculture

3.3 Study Population and Sample Size

The entire commercial level vegetable growers in Sri Lanka were considered as the study population. There was no well-established national level database with regard to vegetable growers in the country. Without a known population size of the vegetable growers in Sri Lanka, it is difficult to draw a representative sample for commercial level vegetable growers in Sri Lanka. On the other hand, with respect to imperfect information among vegetable growers in Sri Lanka there's no significant variance across districts. Therefore, considering costs and also time constraints 60 commercial vegetable growers from each of the eight districts to make a total of 480 (60*8 districts) respondents were selected for the study.

3.3.1 Sample Selection

The multi-stage random sampling technique was employed to select a representative sample. In the first stage, eight districts were selected based on the 1st to the 3rd highest extent of all vegetables that were cultivated in the 2018/2019 *Maha* season. At the second stage, two reputed commercial level vegetable producing Divisional Secretariats (DS)/Assistant Director of Agriculture (ADA) areas were selected from each district following discussions held with the respective Deputy Directors of Agriculture (DDA) and 30 farmers selected from two/three Agrarian Service Centers (ASC) in each DS/ADA area.

The selection of the ASCs was done following the discussion held with ADAs in order to capture the variations in those selected areas because these officials have a better understanding of particularities. Thus, two ASCs were selected from certain ADA areas while three were picked from others. The ultimate goal was to take a representative sample from the selected districts. We requested a name list of the commercial level vegetable producers from one or two villages of each selected ASCs where vegetable cultivated was highest. Finally, village level farmers were selected randomly.

Sample areas and sample size (480) are show in table 3.2. Accordingly, three ASC areas were selected from Wariyapola and Polpithigama in Kurunegala, Bandarawela in Badulla, Embilipitiya in Ratnapura, Nochchiyagama in Anuradhapura district. We took 20 farmers from Kalpitiya and 10 farmers from Wanathawilluwa since there are more farmers represent in the former location than in the latter. There are provincial and Mahaweli administrative locations are in Nochchiyagama of Anuradhapura district and therefore allocated sample size was equal in each instance. In addition 15 farmers have been selected from other ASC areas. However, the deviation of the sample size in the DS/ADA level has not varied.

Table 3. 2: Sample Selection Areas of the Study

District	DS/ADA	ASC
Kurunegala (60)	Wariyapola (30)	Auwlegama (10)
		Boraluwewa (10)
		Kobeigane (10)
	Polpithigama (30)	Madahapola (10)
		Kubukgate (10)
		Melsiripura (10)
Kandy (60)	Medadumbara (30)	Udispattuwa (15)
		Dambagahapitiya (15)
	Pahathahewahata (30)	Marassana (15)
		Thalathuoya (15)
Nuwara Eliya (60)	Nuwara Eliya (30)	Nuwara Eliya (15)
		Kandapola (15)
	Haguranketha (30)	Mandarannuwara (15)
		Mathurata (15)
Badulla (60)	Bandarawela (30)	Bandarawela (10)
		Haldumulla (10)
		Kumbalwela (10)
	Welimada (30)	Keppetipola (15)
		Boralanda (15)
Hambantota (60)	Hambantota (30)	Netolpitiya (15)
		Kattakaduwa (15)
	Sooriyawewa (30)	Mayurapura (15)
		Meegahajadura (15)
Ratnapura (60)	Balangoda (30)	Damana (15)
		Weligepola (15)
	Embilipitiya (30)	Godakawela (10)
		Thibolketiya (10)
		Kolonna (10)
Puttalam (60)	Puttalam (30)	Kalpitiya (20)
		Wanathavilluwa (10)
	Madampe (30)	Mugunuwatawana (15)
		Arachchikattuwa (15)
Anuradhapura (60)	Nochchiyagama (30)	Nochchiyagama (Provincial 10)
		Nochchiyagama (Mahaweli 10)
		Ranorawa (10)
	Medawachchiya (30)	Medawachchiya (15)
		Ethakada (15)

Note: Figures of the parenthesis are sample size.

3.4 Data Analysis

Objective 1: To examine availability and accessibility of required information for decision-making of vegetable growers in Sri Lanka.

Descriptive statistics were used to explicate the data related to the availability and accessibility of existing information-sharing systems. The awareness level of the farmers for current information-sharing tools was measured. After the collected awareness level, inquired them whether tools were used. If used what was them. To measure the accessible capacity for available tools, information gathered about availability of divises, computers and internet facilities for any household member of vegetable producers.

Objective2: To understand factors/information leading to farmers' decision-making process in the vegetable production sector.

Analytical Framework and Empirical Model

The analytical approach that is commonly used in multiple choices is Multinomial Logit (ML) models. This approach is also appropriate for evaluating alternative combinations that are used to analyze the determinants of farmers 'decisions involving multiple choices (Hassan, 2008). The low utilization of irrigation potential has affected farmers 'crop choice and their productivity. Crop choice analysis is found to be very important for increasing farm productivity. However, the empirical studies on factors that affect farmers 'crop choice are scanty therefore the ML model was employed to analyze determinants of crop choices (Ayele, 2015). Ayuya *et al* (2012) employed a ML model using the STATA computer programme and results revealed that extension, farm size, household size, gender, age, education, credit, group membership, land tenure, farm distance and slope of the land significantly influenced the choice of particular techniques.

Multinomial Logistic Regression analysis will be applied to understand the governing factors of farmers 'decision-making process. In estimating individual choice probabilities with a set of mutually exclusive alternatives can be estimated in one model. These models are usually consistent with random utility theory, i.e. individuals are supposed to choose the alternative associated with the maximum utility (Bougette and Turolla, 2006).

Multinomial Logit Model can be specified as;

$$\text{Prob}(Y_i = j \mid \mathbf{x}_i) = \frac{e^{\beta'_j \mathbf{x}_i}}{1 + \sum_{k=1}^{J} e^{\beta'_k \mathbf{x}_i}} \quad \text{---------------- (1)} \quad \text{For } j = 0,2, \ldots, J, \ \beta_0=0$$

The estimated equation provides set of probabilities for the J+1 cho
maker with characteristics xi.
The empirical model for this study can be specified as:

$Y_i = \beta_0 + X_i \beta_i + \varepsilon_i$ ------------- (2)

Where;

Y_i = Selection of the vegetable crops
(1=Beans, 2=Beets, 3=carrot, …,k=$crop_k$)

X_i = Vector of all the explanatory variables (Table 2)

β_i= Parameters/coefficients of the explanatory variables,
And

ε_i = Random/disturbance term.

Dependent variable is of the categorical type which has more than two choices. On the other hand, farmers can select one from different crops while same independent variables are changing. Therefore, ML models apply for estimation. There are n-1 models estimated for each crop. Compression is done with the base outcome in ML estimation.

Table 3. 3: Possible Factors Influencing Crop Choice/Selection

Factor	Variables	Variable Name of the Model
1) Economic Factors	1. The market price of the last season	MKTP
	2. The crop is marketable	WMKT
	3. Cost of production	COP
	4. Seed cost	SCST
2) Physical Factors	1. Suitability of the land/soil	SOIL
	2. Accessibility of the water	WAVL
	3. Favourable weather conditions	FWCN
3) Personal Factors	1. Prior experience of the crop	EXP
	2. Other people influenced your decision	OINF
	3. Crop allowed a lot of free time	FTIM
	4. The crop was easy to grow	EGRW
	5. Taste of the crop	TAST
4) Crop profiles	1. The yield of the crop	YILD
	2. Crop growing time	GTIM

	3. Resistance to pests and disease	RPDIS
5) Availability of inputs	1. Seeds	SAV
	2. Fertilizer	FAV
	3. Pesticides	PAV
	4. Labour	LAV
	5. Water	WAV
	6. Credit-formal	FCRD
	7. Credit-informal	INCRD
	8. Own money	MAV
6) Information	1. The cultivated/expected extent of the particular crop in other areas	EXTO
	2. Expected price/forecasting price	FPR
	3. Market demand	MDEM
	4. Future climatic/weather data	WDATA
	5. New market venture and entrepreneurship information	NMVEN

The choice of the farmers may differ between up-country and low-country vegetables in Sri Lanka; therefore, separate models were estimated for the two types. Factor analysis was applied to identify co-related variables for the ML models.

CHAPTER FOUR

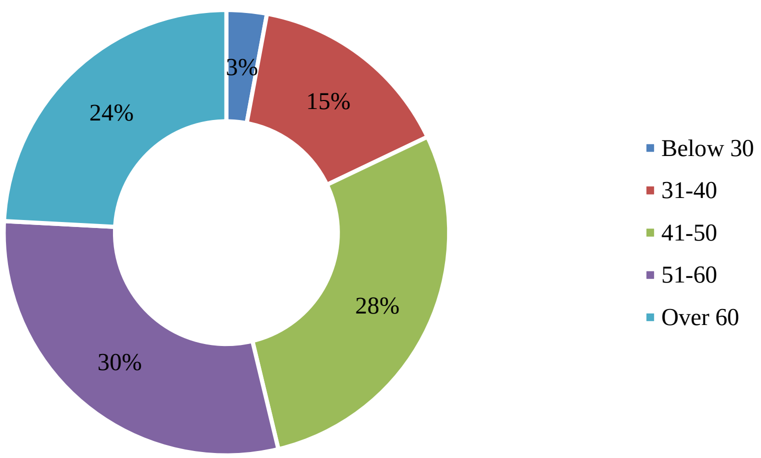
Demographic and Socio-Economic Characteristics of the Sample and Background Information of the Crops

Chapter four discusses the main demographic characteristics of the sample and also the extent of vegetable lands and their distribution across the study locations. Water availability, accessibility and management are also explained in this section. In addition, the chapter describes how major inputs such as seeds, fertilizer, labour, agro-chemicals and other materials are used in vegetable cultivation and the cost incurred. The chapter further illustrates the seasonal patterns of vegetable cultivation of selected up-country and low country vegetables and concludes with the market prices of selected vegetable varieties considering the time of crop establishment.

4.1 Demographic Factors

4.1.1 Age

The majority (30%) of the sample was between the age of 51 and 60 years (Figure 4.1). Those between 41 and 50 years of age made up a similar proportion (28%). Interestingly, 24% of the sample was above 60 years. Thus, the age of more than two-third (82%) of the farmers was above 40 years. In contrast only 15% and 3% were from 31 years to 40 years of age and below 30 years respectively. It is observed that only a limited number of younger people are engaged and remain in vegetable cultivation.

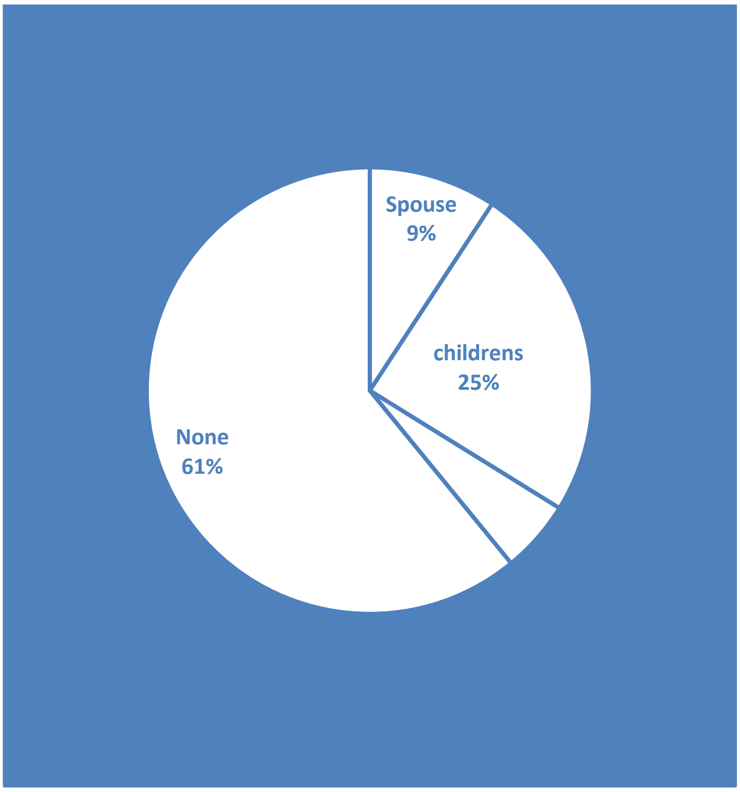


Source: HARTI survey data, 2019

Figure 4. 1: Age Distribution of the Interviewed Vegetable Farmers

4.1.2 Future Prospects of Members of the Households Surveyed on Vegetable Cultivation

From the total family members of the respondents (excluding children below 18 years), more than half (61%) were not interested in vegetable cultivation as an occupation (Figure 4.2). However, 25% of children preferred to engage in vegetable cultivation as an occupation in future (note: family members' interests were obtained from responders while other members were not in the house/farm/*chena*). Furthermore, 9% of the spouses (either husband or wife) preferred to engage in vegetable cultivation in future as did 5%of other family members. This also demonstrates that younger generations do not perceive vegetable cultivation as an attractive venture for their futures. Hence, the most likely outcome would be that less than one-fourth would remain in vegetable cultivation given the option.



Source: HARTI survey data, 2019

Figure 4. 2: Percentage of Members of the Interviewed Households Expecting to Engage in Vegetable Cultivation

4.1.3 Experience of Vegetable Cultivation

Interestingly, the majority (43%) had less than 10 years of experience related to vegetable cultivation (Table 4.1). The age breakdown shows that 30% of them were above 40 years while only 3% were below 30 years. Furthermore, 26% had 11 to 20 years of experience in vegetable cultivation and of them, 13% of farmers who were above 50 years of age. This implies that most of the farmers (70%) had shifted to vegetable cultivation very recently. However, nearly 40% of farmers who had experience of at least 20 years were in the 41 – 60 year category. Only 3% had more than 40 years of experience related to vegetable cultivation. However, it could be concluded that almost all farmers had a fairly adequate experience related to vegetable cultivation. Around 8% of farmers with less than 10 years of experience in cultivation were over 60 years old, indicating that a few persons who worked in the security forces or other organizations of the state sector had taken up vegetable production after their formal retirement.

Table 4. 1: Experience of the Vegetable Cultivation

Age (years)		Experience (years)					Total
		Below 10	11-20	21-30	31-40	Over 40	
Below 30	No	14	0	0	0	0	14
	%	2.92	0	0	0	0	2.92
31-40	No	45	25	2	0	0	72
	%	9.38	5.21	0.42	0	0	15
41-50	No	61	45	27	3	0	136
	%	12.71	9.38	5.63	0.63	0	28.33
51-60	No	50	39	39	11	3	142
	%	10.42	8.13	8.13	2.29	0.63	29.58
Over 60	No	38	18	22	29	9	116
	%	7.92	3.75	4.58	6.04	1.88	24.17
Total	No	208	127	90	43	12	480
	%	43.33	26.46	18.75	8.96	2.5	100

Source: HARTI survey data, 2019

4.1.4 Education Level

Table 4.2 illustrates the education level of the sample respondents. Interestingly, more than a quarter of the respondents (30%) of the sample had completed the Ordinary Level Examination. Furthermore, 21% had a grade 6-9 education level. From the total sample, 16% had studied up to grades 10 or 11 and a similar percentage had passed the Advanced Level Examination. Less than 1% had completed a degree and less than 0.5% had a diploma. Nevertheless, the majority of farmers had education attainment that was adequate to engage in domestic agricultural activities.

Table 4. 2: Education Level of the Respondents

Experience	Frequency	Percent
Not schooling	4	0.83
Grade 1-5	71	14.79
Grade 6-9	102	21.25
Grade 10-11	77	16.04
O/L pass	143	29.79
A/L pass	77	16.04
Graduate	4	0.83
Diploma	2	0.42
Total	480	100

Source: HARTI survey data, 2019

4.2 Distribution of Vegetable Land Size

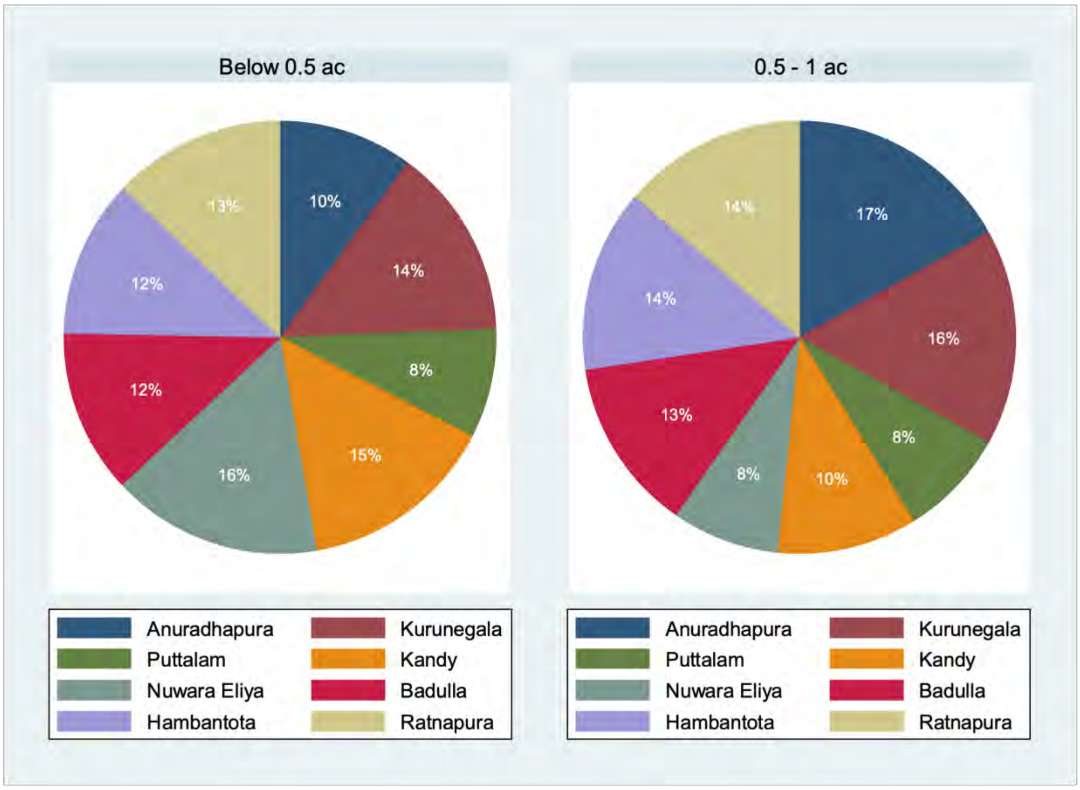
The majority of vegetable, farmers (58%) had less than half an acre of land (Table 4.3). Further, this is categorized as 35% low-country and 23% up-country. In addition, 23% of farmers had land parcels from half to one acre in extent. In total more than 80% of the farmers had one acre or less. Only, 5% had more than two acres of land for vegetable cultivation. Interestingly, this is further divided as 3% in the up-country and 2% in the low-country. This implies that the majority of farmers cultivate vegetables in smaller plots compared to other major food crops in Sri Lanka. In other words, the majority of the vegetable growers are small scale farmers.

Table 4.3: Distribution of the Land Size

Extent of land (ac)		Vegetable category		
		Up-country	Low-country	Total
Below 0.5	No	112	167	279
	%	23	35	58
0.5 - 1	No	49	75	124
	%	10	16	26
1-1.5	No	10	13	23
	%	2	3	5
1.5-2	No	12	20	32
	%	3	4	7
Above 2	No	12	10	22
	%	3	2	5
Total	No	195	285	480
	%	41	59	100

Source: HARTI survey data, 2019

When referring to the lands below half an acre, 16% are located in the Nuwara Eliya District (Figure 4.3) while 15% are in the Kandy District. In general farmers in the Central Province inherited smaller land plots compared to other districts and they cultivate different varieties of vegetables at once. Next is Kurunegala, which accounts for 14% of land parcels less than half an acre in extent while the Puttalam District accounted for 8%.



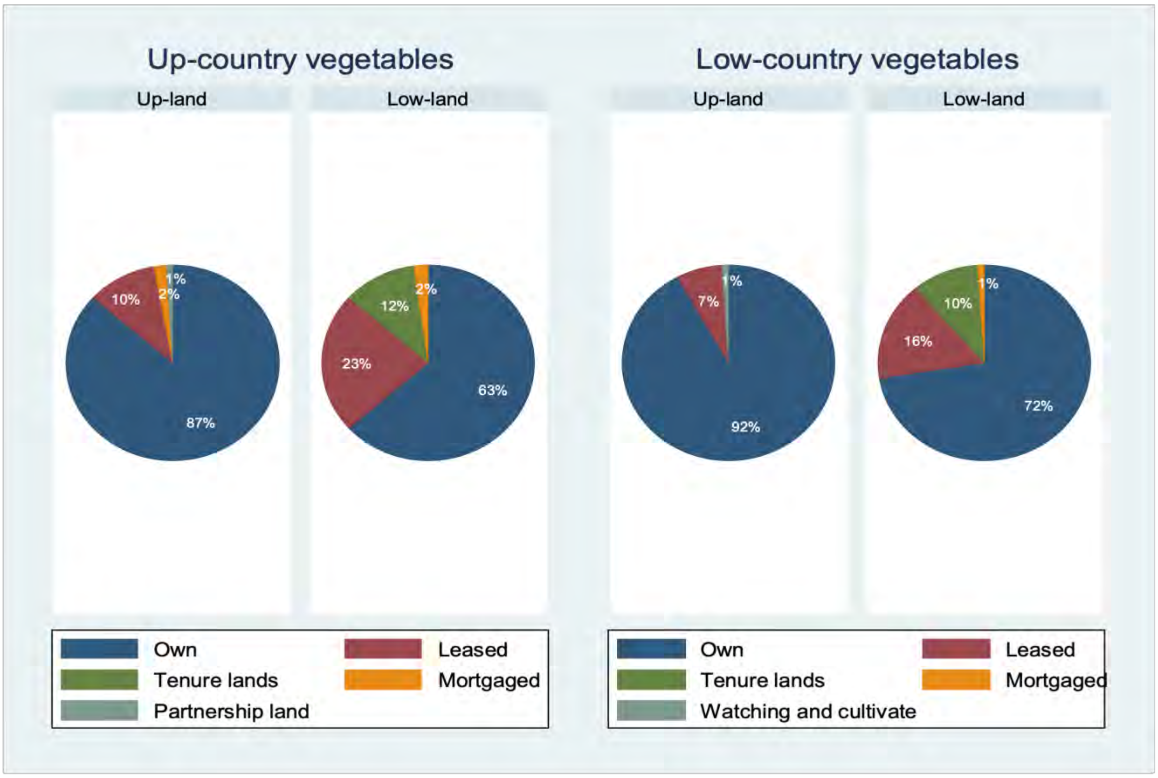
Source: HARTI survey data, 2019

Figure 4. 3 Distribution of the Smallest Lands in Selected Districts

The majority (17%) of land ranging from half an acre to one acre is located in Anuradhapura District (Figure 4.3). The second highest slice (16%) is in Kurunegala followed by Hambantota (14%) and Rathnapura (14%). The least number of land plots in this extent-category (8%) is located in the Puttalam District.

4.2.1 Ownership of Lands

More than 85% of farmers have ownership of the uplands they cultivate in both the up-country (87%) and low-country (92%) (Figure 4.4). In up-country 63% of farmers owned low-lands while the corresponding figure for the low-country was 72 %. Leased land was the second ownership type observed in both up-country and low-country (10% of up-land and 23% of low-land in the up-country while in the low-country the figures were 7%for up-land and 16% for low-land). Tenurial patterns were only reported for low-lands in both up-country and low country. Thus, the most prominent land ownership types were owned, leased and tenure lands. Other ownership types were relatively trivial.



Source: HARTI survey data, 2019

Figure 4. 4: Land Ownership and Its Variability

4.2.2 Ways of Determining Suitable Crops Based on Soil Characteristics

Soil characteristic is an important determinant when selecting a crop. Planting crops without knowing at least the prominent characteristic of the soil may cause various problems. In some cases, this leads to significant reduction or losses in terms of yield-expectation. The study revealed that the majority of farmers (49%) select crops suitable for their lands based on their experience (Table 4.4). As mentioned earlier farmers had adequate experience in farming and therefore drew from this in determining the suitability of soil. Only 15% stated that crops were selected upon the advice of Agriculture Instructors. Around 60% of them (From 15%) had more than 0.5 acres of land while 80% educational attainment of Grade 10 and above.

Table 4. 3 Ways of Determining Suitable Crops for Different Soil Characteristics

Ways of Determining Suitable Crops Based on Soil	Percent	Cumulative Percent
According to advice and information of the AIs'	15	15
Based on long term experience	49	64
Based on recommendations of the soil testing report done by private companies	11	75
Cultivating as a model crop	6	81
Based on recommendations of the soil testing report collected by ASC	15	96
Based on recommendations of the soil testing report done by university	1	97
Based on recommendations of the soil testing report done by the research institute	3	100
Total	100	

Source: HARTI survey data, 2019

Furthermore, 11% of the respondents said that soil suitability was based on recommendations of testing reports done by private companies. Thus, both public and private entities offer soil testing services for the farmer. However, only 3% and 1% of those surveyed determine soil suitability based soil testing conducted by research institutes and universities respectively. This implies a relatively minor contribution from such entities with regard to soil testing and other related services. However, only 30% of farmers have considered the technical suitability of the soil when selecting vegetable crops. Therefore, a two-third information gap related to technical suitability of the soil for crops cultivation could be observed. There is no proper mechanism to test soils and thereby generate recommendations for fertilizer application even this is an important element.

4.3 Water Availability, Accessibility and Water Resource Management

Agricultural production and productivity are highly dependent on water. According to the FAO, the agriculture sector is the largest consumer of water. At the same time the agriculture sector is the major source of water pollution from numerous chemicals inputs. Improving agriculture's water management is therefore essential to sustain the system. Table 4.5 illustrates the water availability and accessibility in the study sample.

Table 4. 4: Sources of Water Application in Vegetable Cultivation

Water sources	Frequency	Percentage
Rain fed	45	9.38
Minor irrigation	219	45.63
Agro-well	85	17.71
Tube-well	61	12.71
Rain fed & Minor irrigation	8	1.67
Rain fed & Agro-well	8	1.67
Rain fed & Tube-well	1	0.21
Minor irrigation & Agro-well	5	1.04
Springs-water	19	3.96
Wells	10	2.08
common water supply system	4	0.83
Rain fed & Springs-water	12	2.5
Minor irrigation & Springs-water	1	0.21
Minor irrigation & Well	1	0.21
Minor irrigation & common water supply system	1	0.21
Total	480	100

Source: HARTI survey data, 2019

The study revealed that there were 15 different water sources and this includes both minor irrigation schemes as well as some combinations (Table 4.5). The majority of the farmers (46%) in the sample mentioned minor irrigation systems as their primary water source. The second (18%) water source was agro-wells. The third (13%) option was tube-wells. The primary water source of another 9% was rainfall. Thus, the most prominent water sources were minor irrigation channels, agro-wells, tube-wells and rainfall.

When accessibility to water is compared with the scale of the vegetable farming, the majority of small scale farmers (land size is below 0.5 acre) have no water issues in vegetable cultivation (Table 4.6). More than 60% of farmers have enough water to cultivate vegetables, but nearly 20% of vegetable growers have struggled with the lack of water for their cultivation. Around 7% of farmers whose land size was above 0.5 acre complained of water issues.

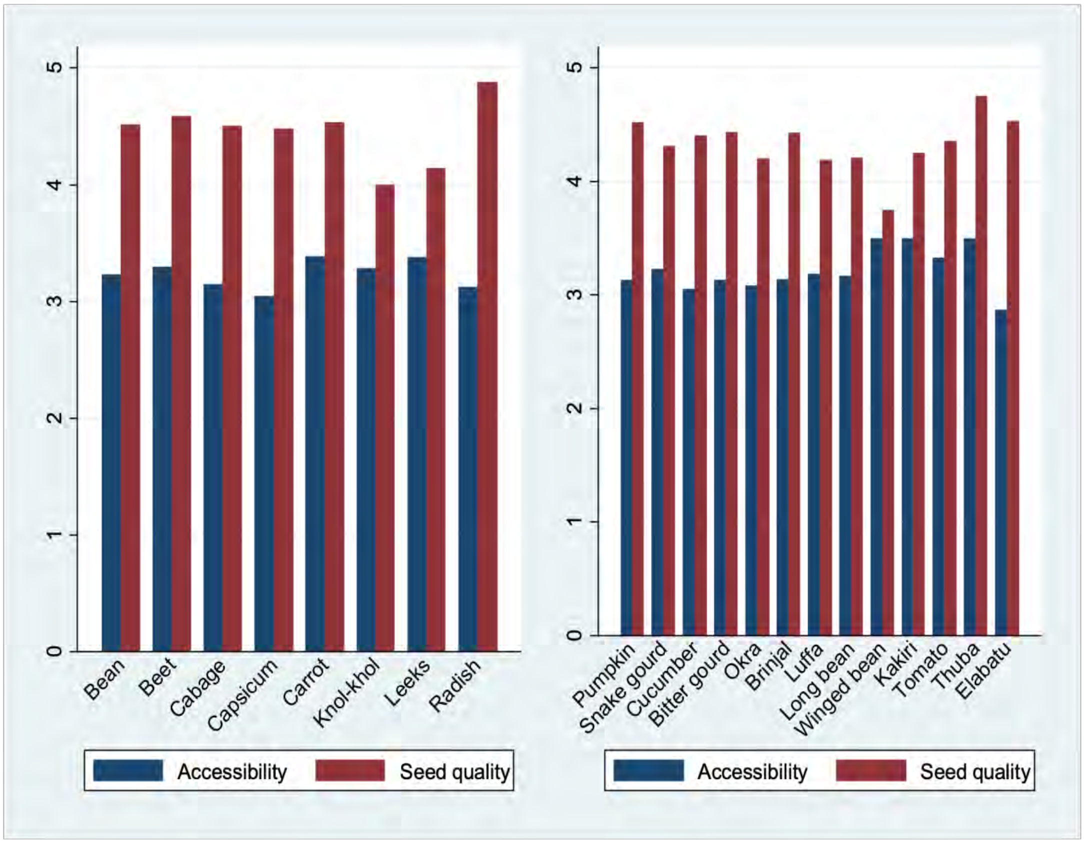
Table 4. 5: Relationship between Land Size and Access to Water

Extent	Water availability (%)				Total
	Enough to cultivate and continuously available	Enough to cultivate	Normally available	Not enough to cultivate	
Below 0.5 ac	12.08	24.58	8.75	12.71	58.13
0.5 - 1 ac	5.83	9.38	5.21	5.42	25.83
1-1.5 ac	0.83	1.88	1.88	0.21	4.79
1.5-2 ac	1.25	2.71	1.67	1.04	6.67
Above 2 ac	0.63	2.29	1.46	0.21	4.58
Total	20.63	40.83	18.96	19.58	100

Source: HARTI survey data, 2019

4.4 Accessibility and Quality of Seeds

We have used Likert Scales to obtain farmers ’perception about accessibility, germination capacity and quality of seeds. Accessibility was valued 4 to 1 (4=very easy, 3=easy, 2=average, 1=not easy). It was found that farmers can easily buy seeds and planting material from the nearest seed selling outlet on cash or credit. On average, the majority of the farmers in the sample stated that the accessibility of seed and planting material has been easy in the cultivated area (Figure 4.5). However, farmers stressed that in certain seasons they have faced some difficulties in finding preferred varieties. In some instances, there had been a vast price variation in seeds. These price variations are greatly dependent on the variety. This was the case in both up-country and low-country vegetable varieties except *Elabatu*.

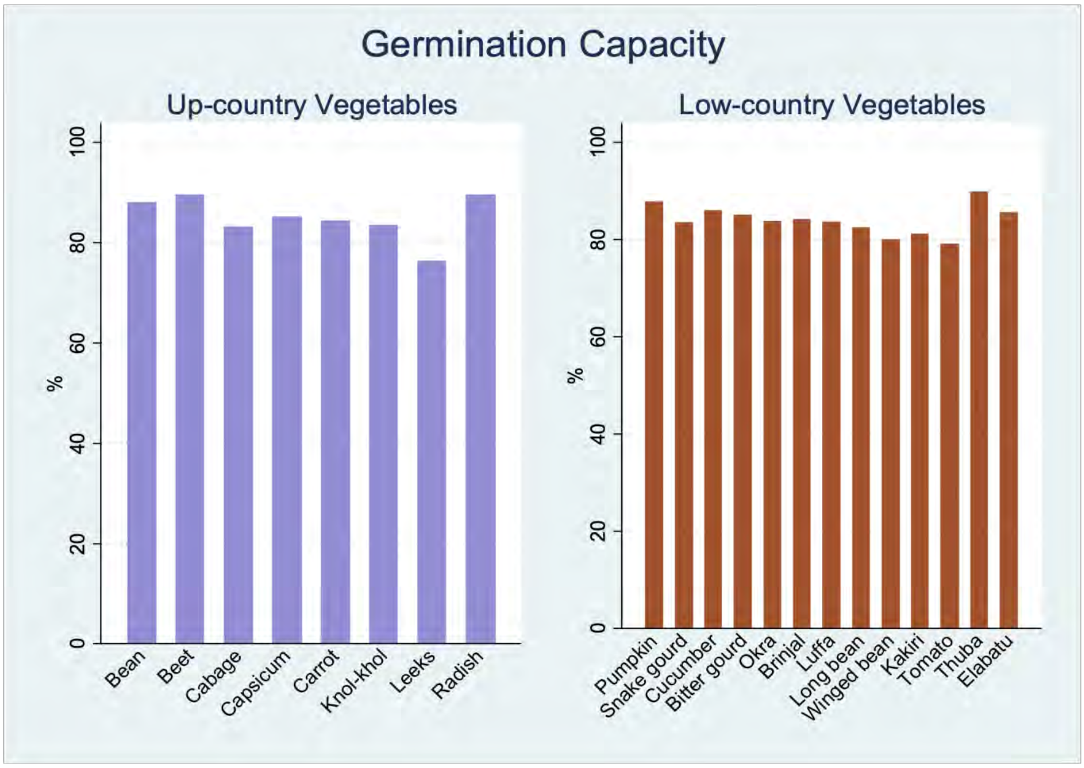


Source: HARTI survey data, 2019

Figure 4. 5: Farmer Perception of Accessibility and Quality of the Available Vegetable Seeds

We have used a 5 to 1 scale for measuring seed quality (5=very good, 4=good, 3=adequate, 2=poor, 1=very poor). Accordingly, farmers were satisfied with the quality of the seeds as well. Most of the farmers ascertained the quality of seeds and planting material through the final harvest. Also, in some cases, farmers considered resistance to pests and diseases as well as germination ability. In general, similar patterns for accessibility and seed quality were observed in the case of both up-country and low-country vegetables.

Germination capacity is the one of the characters used to measure quality of seeds. Here, we obtained the germination capacity as a percentage of germinated quantity from the total seeds. While considering the mean of the percentage values, the majority of all vegetable seeds showed good germination capacity which was more than 80% germinated from the total cultivated seeds (Figure 4.6).



Source: HARTI survey data, 2019

Figure 4. 6: Germination Capacities of the Cultivated Vegetables

The majority of framers (39%) pointed out high seed cost (Table 4.7). This is a common scenario in the vegetable seed sector in Sri Lanka due to the dominance of hybrid varieties. Further, farmers too tend to prefer hybrid seeds with the prospects of higher yields. Accordingly, there is a high market demand for hybrid seeds. The second issue was the low germination capacity in some of the seeds. The third issue is low seed quality (14%) including issues of seed purity.

Table 4. 6: Issues Perceived by the Farmers of Vegetable Seed Sector in Sri Lanka

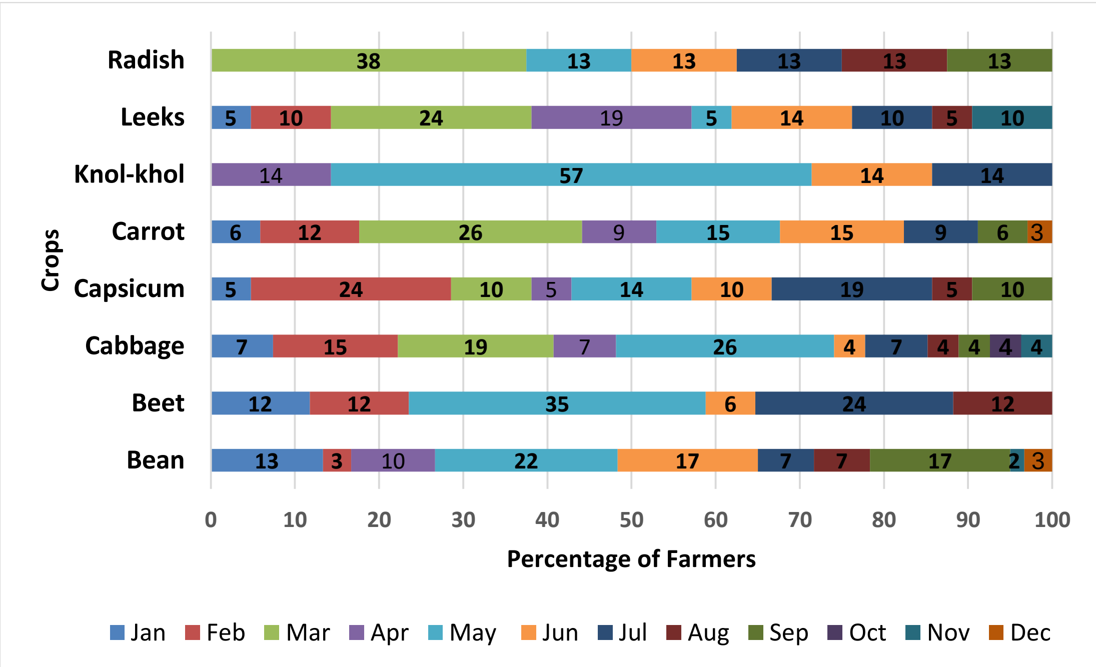
Issues related to seeds	Percentage
Seed cost is high	39.2
Germination capacity is low	15.2
Difficult to find out seeds	12.6
Highly vulnerable for pest and disease	7.9
Low quality seeds	13.5
False seeds selling (mixing, changing exp date)	5.0
Seed price is frequently changed	3.2
Lack of local seeds	0.9
Low productivity	0.9
Low awareness regarding seed varieties	0.6
Unable to find seed plants during the drought	0.6
Varieties are not suitable	0.6
Total	100.0

Source: HARTI survey data, 2019

The fourth issue (13%) was the difficulty in finding seeds and planting material in certain seasons. The farmers mentioned that this problem was associated only for some varieties. For example, one variety could be successful in a particular season but may not be available for the next season. This is also another reason for higher seed prices in some seasons. High vulnerability to pest and diseases was also a problem. As mentioned earlier, most of the farmers prefer hybrid seeds, but which require a high degree of care. Thus, the inability of the farmer to exert such care may cause higher vulnerability to pest and diseases. As a result, this leads to higher yield losses. Next, false seed selling (5%) and frequently changing of the seed price (3%) were raised as issues. These were the prominent issues enumerated during the study.

4.5 Cultivation Pattern of the Vegetables

Figure 4.7 demonstrates the seasonal pattern of up-country vegetable cultivation. It particularly focuses on the initiation stage of selected up-country vegetables by the interviewed farmers. Accordingly, the majority of farmers who cultivated radish (38%), leeks (24%) and carrot (26%) have initiated cultivation in March. Interestingly, more than half of the farmers who cultivated knolkhol (57%) have initiated cultivation in May. The majority of farmers who cultivated cabbage (26%), beet (35%) and bean (22%) have also started their cultivation in May.

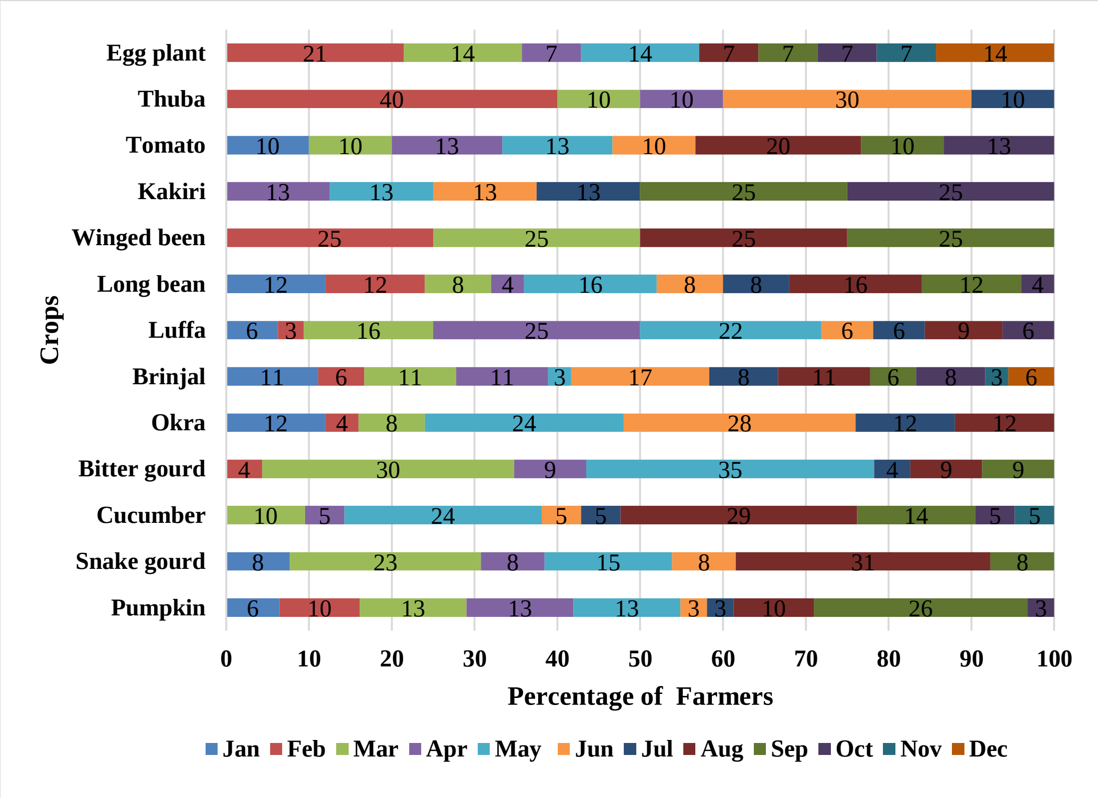


Source: HARTI survey data, 2019

Figure 4.7: Start of the Cultivation – Up-country Vegetables

Interestingly, all selected up-country vegetables have been cultivated in May, June and July. Some of the up-country vegetables have been cultivated in October, November and December as well but by a fewer number of farmers. When analyzing the cultivation initiation patterns it is crystal clear that farmers cultivated vegetables throughout the year. However, the most prominent months were May, June and July.

When considering seasonality, nearly 20% of farmers have cultivated up-country vegetables in the *Maha* and around 40% in the *Yala* season. Thereby, around 60% of total up-country vegetable cultivation happens in both *Maha* and *Yala* seasons.

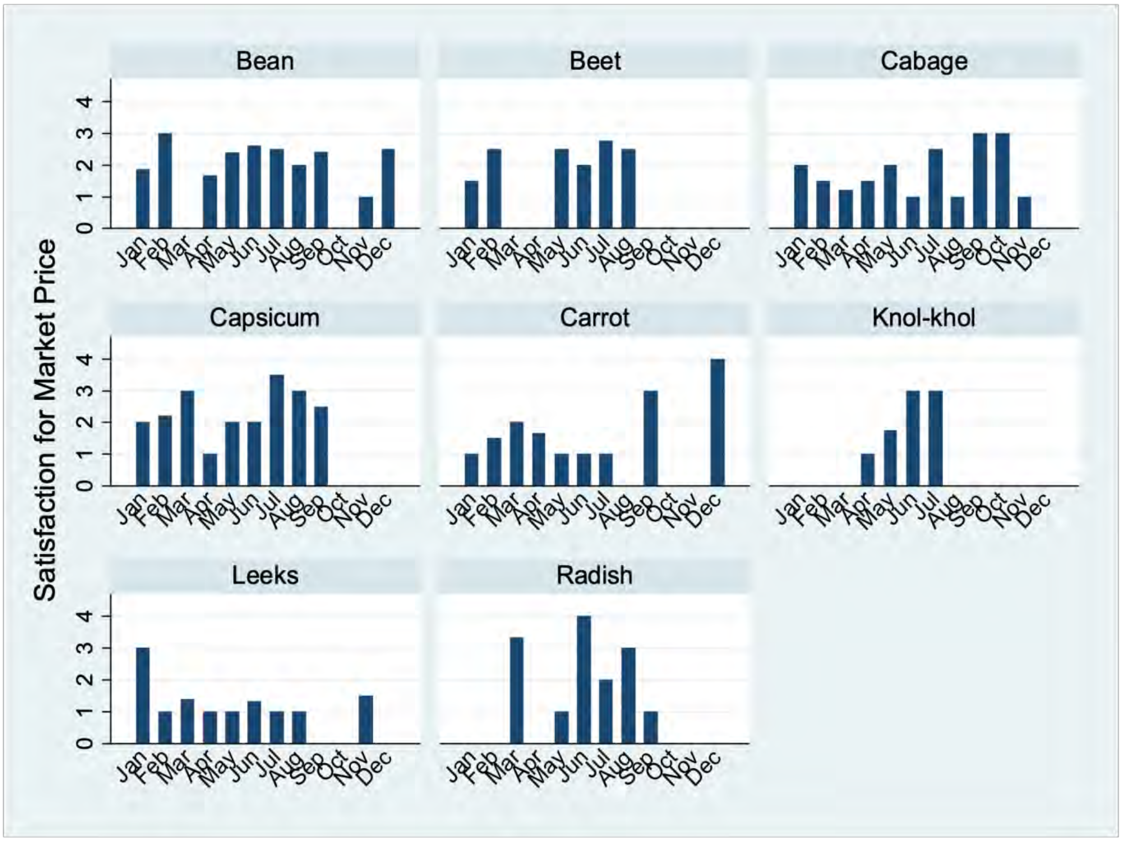


Source: HARTI survey data, 2019

Figure 4.8: Start of the Cultivation – Low-country Vegetables

However, when referring to the low-country vegetables, a highly irregular cultivation initiation pattern was observed (Figure 4.8). In general, farmers have started cultivating all selected low country vegetables except tomato in February. This is prominent in the case of e*labatu* (21%), *thumba* (40%) and winged bean (25%). Furthermore, farmers have also opted the month of August to start their cultivation expect for *thumba* and *kakiri*. Snake gourd (31%), cucumber (29%), winged bean (25%), tomato (20%) and long bean (16%) were prominently cultivated in August. The majority of the farmers have started cultivating okra (28%) and brinjal (17%) in June. Thus, a significant pattern of cultivation-initiation of low country vegetables was not observed. However, around 18% of farmers cultivated in the *Maha* and 34% of farmers cultivated in *Yala.* Nearly half of the low-country vegetable producers (52%) grow vegetables in both seasons.

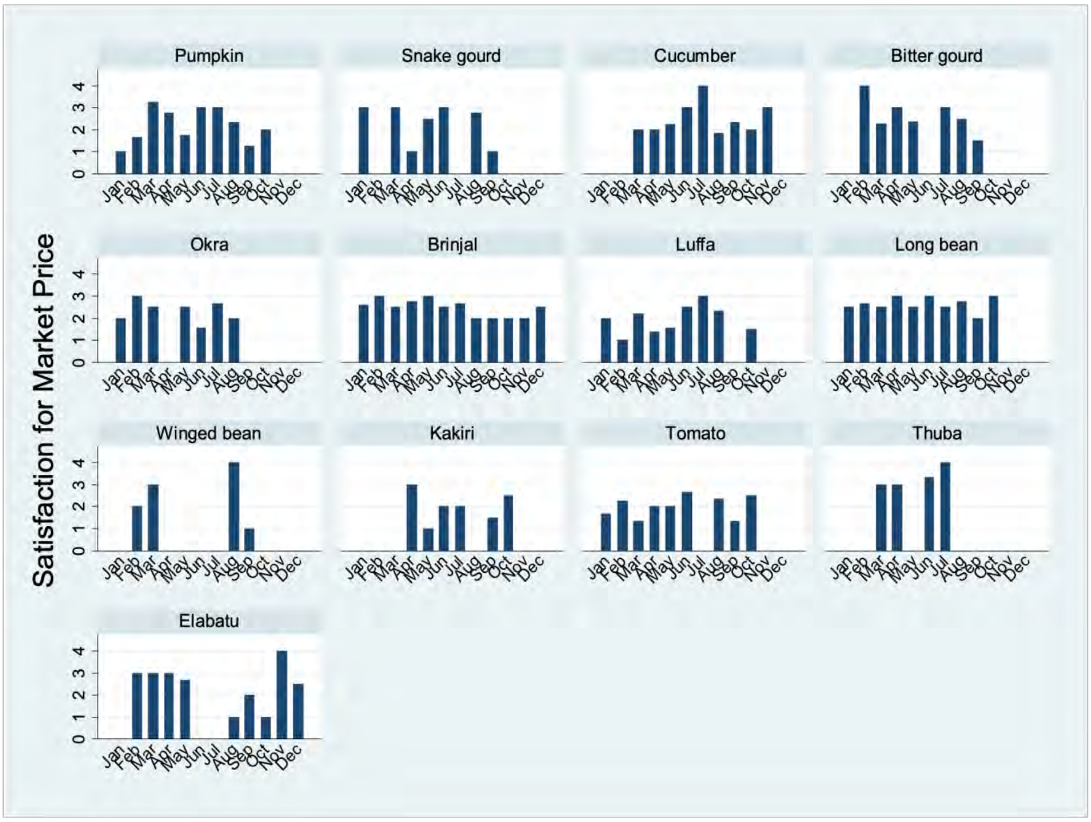
Farmers' satisfaction about received market price of particular crops in relevant time was inquired through a Likert-scale question. When comparing the results of price satisfaction and the time crops were established, we can observe that the average farmers' satisfaction level varied in terms of the month in which cultivation was initiated. On the other hand, if we want to change this pattern, crop establishment time would have to be adjusted. On average a moderate level of satisfaction was observed for selected up-country vegetable market prices throughout the year (Figure 4.9). Farmers who cultivated bean in November, cabbage in June, August and November, capsicum in April, carrot in January, May, June and July, knolkhol in April, leeks in February, April, May, July and August, radish in May and September have not received a satisfactory market price.



Note: 4-Very satisfied, 3-Satisfied, 2-Moderate, 1-Not satisfied
Source: HARTI survey data, 2019

Figure 4.9: Crop Establishment Time and Satisfaction for Market Price – Up-country Vegetables

Bean, beet, cabbage, capsicum, knolkhol and radish growers were generally satisfied with market prices compared with growers of other up-country vegetables except in certain months. Carrot producers who started the crop in March, September and December were satisfied the market price but the majority of leeks growers were worried about the received market prices throughout the year 2019 except for those who cultivated in January.



Note: 4-Very satisfied, 3-Satisfied, 2-Moderate, 1-Not satisfied
Source: HARTI survey data, 2019

Figure 4.10: Crop Establishment Time and Satisfaction for Market Price – Low-country Vegetables

When considering the satisfaction level for market prices of low-country vegetables, the response was positive in the case of most vegetable varieties in most months (Figure 4.9). This was noted in all vegetable varieties except tomato. Accordingly, pumpkin, snake gourd, cucumber, bitter gourd, okra, brinjal, luffa, long bean, winged bean *thumba* and *elabatu* have fetched satisfactory market prices in two or more months in the year. Satisfactory levels of the market prices of snake gourd and long bean were relatively stable throughout the year. However, there were vast differences in satisfaction with regard to the market prices of okra, luffa, tomato and e*labatu*.

CHAPTER FIVE

Effectiveness of Existing Information Sharing Tools for Decision-making of Vegetable Growers in Sri Lanka

The prevailing information sharing tools in Sri Lanka will be discussed in Section 1 of this Chapter. This will be followed by a discussion on awareness, accessibility and usage of existing information sharing tools. Next, the current status of accessing methods and related limitations will be analyzed. This chapter concludes with a consideration of farmers' perception about information that is important for making production decisions.

5.1 Existing Information Sharing Tools in the Agriculture Sector of Sri Lanka

Information and Communication Technology (ICT) has long been viewed as having great potential for generating and disseminating information within a few seconds. Moreover, ICT is one of the best solutions to overcome the time lags pertaining to information sharing. ICT has become an easy and even essential platform for connecting with the world. It also enabled easy access due to the proliferation of smart phones. Simple accessing platforms (tools) have been developed for many purposes in the world. According to the FAO (2017), high levels of adoption and integration of ICTs has reduced transaction costs, improved service delivery, created new jobs, generated new revenue streams and saved resources. ICT has enhanced information transmission through radio, television, computers and mobile phones. The implications are clearly evident in both the public and private sector with several tools being deployed in the agriculture sector of Sri Lanka. A brief description follows.

Govipola app

Released date	-	July 02, 2018
Offered by	-	Govipola

The major objective was to provide a digital marketplace for the farming community. It was envisaged that buyers and sellers would come together in a transparent manner. Buyers can post their needs and farmers can sell their products. This digital market platform provides opportunities for both buyers and sellers in all food categories including vegetables, fruits, spices, rice, processed foods, pulses and grains, tubers and yams, dairy, poultry, fisheries, coconut etc., as well as agro-machinery and other products relevant to the sector.

AgInfo app

Released date	-	April 14, 2016
Offered by	-	Olexto Digital Solutions.

This mobile app can help to find any information about crops grown in Sri Lanka and also find out about pesticides, post-harvest technologies, integrated pest management methods, planting material price etc. This app can be used on a mobile phone without internet. It is easy to reference when working in the field.

SL-GAP

Released date	-	February 06, 2018
Offered by	-	Department of Agriculture

Good Agricultural Practices (GAP) is a project introduced on a crop basis for fruits and vegetables. The app provides information necessary to register with the GAP programme and adopt relevant practices.

Krushi Advisor app

Released date	-	December 4, 2018
Offered by	-	Department of Agriculture

This app provides a lot of information on food crops including suitable locations, available varieties with seed and planting material requirement, field establishment with nursery management, weed management, pest management, disease management, nutrient deficiency and physical disorders, harvesting and post-harvesting and special crop management systems available for selected food crops. In addition the application provides the ability to contact agricultural advisory service through the number 1920 or a data call (070-2201920) via WhatsApp, Viber, IMO or Skype (multimedia messages with text, picture, voice and video email).

Yield price Sri Lanka

Released on	-	January 07, 2019
Offered by	-	Chandana Napagoda

Daily and weekly price information is displayed here. However, this application presents only Colombo Manning market prices including vegetables and a few essential food items. This application supports English, Tamil and Sinhala languages.

1920 Call Centre

Released on	-	February 23, 2006
Offered by	-	Govi Sahana Sarana

Govi Sahana Sarana is an agriculture advisory service contactable with the 1920shortcode from any place over any telephone network in Sri Lanka. Framers can directly contact technical officers in agriculture and obtain advice on issues related to cultivation. All conversations are recorded. This service is provided only on weekdays from 8.30am to 4.15 pm and is not available on weekends and public holidays.

E-SMS service

It is integrated with the 1920 agriculture advisory service. Farmers can register with this service and technical information is shared via SMS.

Krushi FM web radio

The web radio has been broadcasted since December 2013 by Farm Broadcasting Service under the Department of Agriculture. This radio feeds agriculture-related information through conducting various programmes.

Market price information systems

Daily market price information is provided over mobile phones by two mobile networks.

6666 - Mobitel Network

The Hector Kobbekaduwa Agrarian Research and Training Institute (HARTI) provides daily wholesale price information collected from the Pettah, Kandy, Dambulla, Meegoda, Norochcholai, Thabuthegama, Nuwaraeliya and Kappetipola markets. Daily price information of the vegetables can be browsed product wise or market-wise. If consumers need to know product-wise, they have to select one of the 23 product codes, each representing a particular vegetable. This service is provided only for Mobitel network consumers.

977 - Dialog Network

The Dialog Trade Network provides agri-produce price information from three dedicated economic centres — Dambulla, Meegoda and Narahenpita.

Govi Mithuru

Release date - 2015

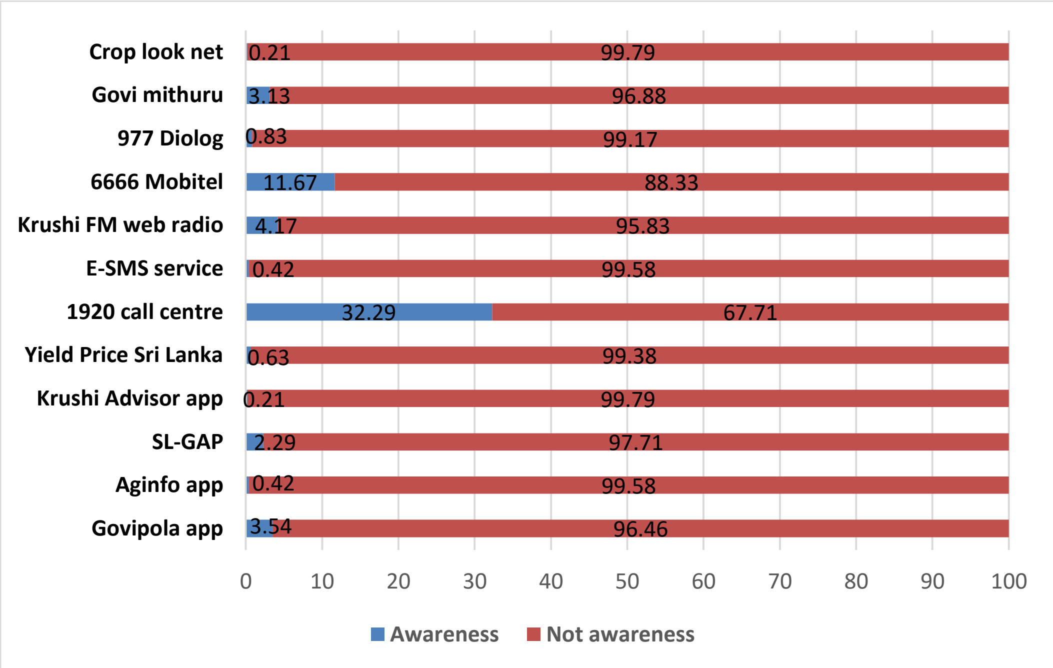
This provides customized and timely advice to farmers regarding land preparation, cultivation, crop protection, harvest and improved family nutrition. This service is especially designed to help farmers by sending the right information at the right time according to each farmers' needs, accurately tailored for crop, location and stage of cultivation. Registered users receive information related to each registered crop as a voice message to their mobile phones. Rs.2+ tax is charged per day for this service and it is a 'data-free 'facility for Dialog users.

Crop Look Net

Crop Look Net is offered by the Department of Agriculture. This provides an early warning system giving price predictions for two weeks. It is an online information system run by the Department of Agriculture and cultivated extent data is used to predict price. Furthermore, the extent and production data of the paddy, OFC, vegetables are provided with a lot of related information.

5.2 Awareness, Accessibility and Usage of Existing Information Sharing Tools

As explained in the above section, eleven information-sharing tools are being operated in Sri Lanka. Both the state and private sectors have identified the importance of sharing information among the farming community and have developed these facilities based on several objectives which have been explicated in the above section. Therefore, the availability of information is not an issue for the farming community in Sri Lanka. The awareness levels about prevailing tools were investigated in terms of whether they were known or not. Figure 5.1 illustrates the real picture of the grass-root level situation.

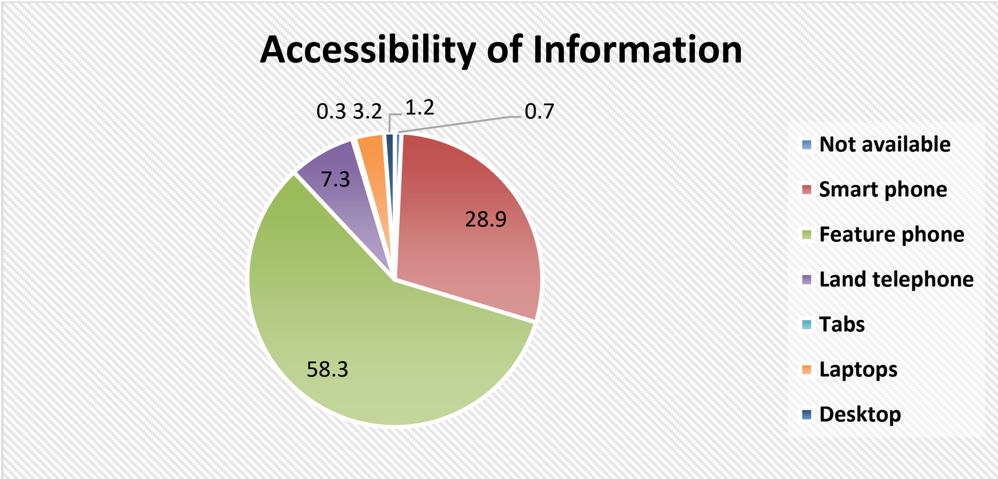


Source: Survey data, 2019

Figure 5.1: Farmers' Awareness about Information Sharing Tools in Sri Lanka

Generally, most of the applications were not well known among the farming community (Figure 5.1). But interestingly, the hotline of the DOA which provides extension services (1920 call centre) was recognized by 33% of the respondents. Around 12% of the farmers stated awareness about the HARTI marketing prices sharing hotline "Govi Mithuru app", "Krushi FM web radio" and "Govipola app" were known only among three to four percent of the farmers. However, awareness of other applications did not exceed one percent of the total farmers surveyed. Therefore, it could be concluded that awareness about information-sharing tools and applications is low among vegetable growers in Sri Lanka.

Internet facilities and suitable equipment are necessary to access and collect information from most of the available information-sharing tools. Most of these instruments have been developed to suit a smart world. According to figure 5.2, around 65% of the vegetable farmers are unable to access most of the information-sharing tools except the 1920 hotline, 6666 hotline and Krushi FM radio even they have good enough knowledge. Nearly 30% of farmers have enough facilities to access information using applications and tools. Therefore, we could observe a mismatch between availability of information-sharing tools and the accessible capacity of the farming community at the grass-root level.



Source: Survey data, 2019

Figure 5. 1 Available Resources to Access Information in Farmers' Household

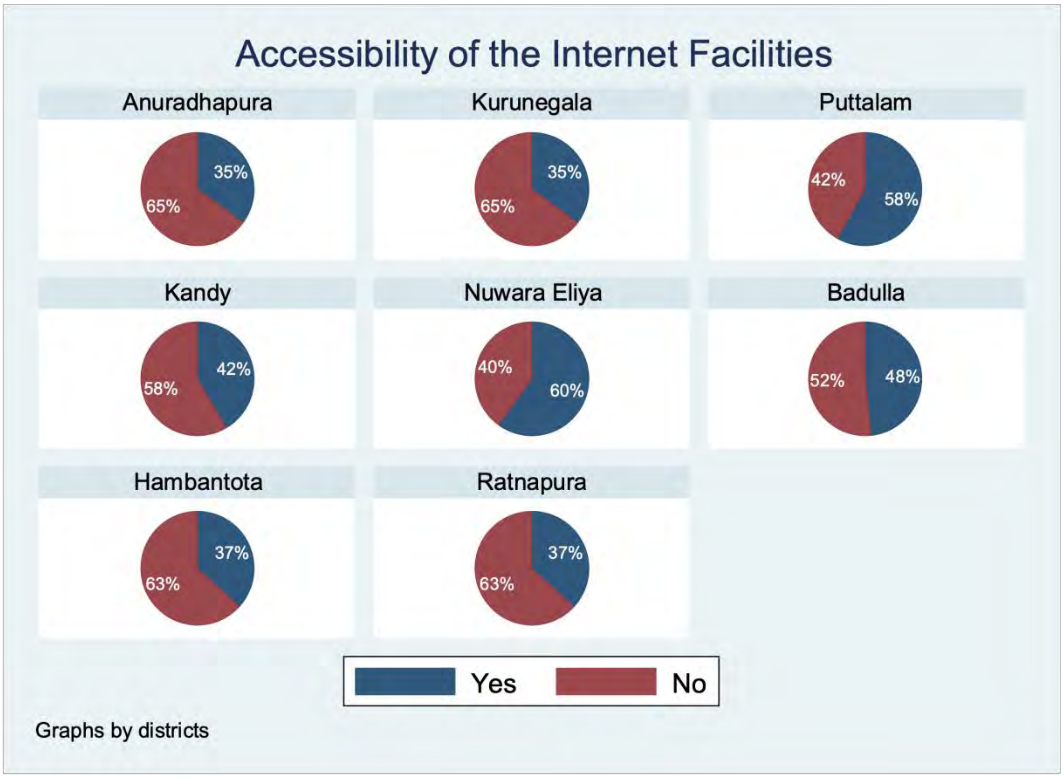
Low usage of the prevailing information sharing tools was evident. Moreover, only a few of the farmers who were aware of available tools actually used them. From the total sample, only around 18% have used at least one or more tools to get information. Around three percent used ICT application and the rest were hotlines and the Krushfm radio. Interestingly, among those farmers who used that tools have made use of hotlines which can be contacted from feature phones and "Kruchi FM web radio" (Table 5.1). Accordingly, most farmers are not interested or not capable of or do not trust following other sources of information.

Table 5.1: Present Usage of Existing Information Sharing Tools

Usage of Existing tools	Frequency	Percent	Cumulative percentage
Govipola app	6	1.25	1.25
Aginfo app	1	0.21	1.46
Yield Price Sri Lanka	2	0.42	1.88
1920 Call Center	33	6.88	8.75
Krushi Fm Web Radio	11	2.29	11.04
6666 Mobitel	18	3.75	14.79
977 Diolog	2	0.42	15.21
Govi Mithuru	1	0.21	15.42
SL GAP & 1920	2	0.42	15.83
1920 & Krushi FM	4	0.83	16.67
1920 & 6666	4	0.83	17.5
1920 & Govi Mithuru	2	0.42	17.92
6666 & Govi Mithuru	1	0.21	18.12
Not used	393	81.88	100
Total	480	100	

Source: Survey data, 2019

Obtaining internet facilities depends on the availability of smart phones, tabs, laptops or desktops. In terms of district-wise variation in accessing internet facilities it was found that nearly two-thirds of vegetable growers in Nuwara Eliya and Puttalam had access while only one-third did in Anuradhapura, Kurunegala, Hambantota and Ratnapura. Around half of the farmers in Badulla and Kandy had internet facilities.



Source: Survey data, 2019

Figure 5.3: Accessibility of Internet Facilities

Therefore, promoting newly introduced applications in Nuwara Eliya and Puttalam district would be more effective as opposed to other districts. Such moves could succeed but to a lesser extend in the Badulla and Kandy districts but in the other districts more effective would be simpler methods such as mainstream media or just phone calls. Anyway, Figure 5.3 reveals that effectiveness of internet-based information-sharing methods fall short of expectations because of the limited access that vegetable farmers have to internet facilities.

5.3 Present Status and Limitations of Using Information for Vegetable Cultivation

Although there are many self-access tools available for farmers in Sri Lanka, they tend to opt for other avenues in accessing relevant information. More than one-third of the farmers avail themselves of extension services to obtain required information and advice while approximately 18% of the farmers depend on agrochemical outlets centers. If farmers have any issues about cultivation, they tend to seek assistance from neighbouring farmers (25%) since this is the easiest way of obtaining information considering that most farmers have enough experience in cultivating particular crops. Around six percent have depended on vegetable sellers for market information such as present market price or price behaviour. According to table 5.2, around 80% have utilized the above-mentioned methods. Therefore, conventional sources have remained the most effective way of disseminating information among vegetable farmers.

Table 5.2: Receiving Information on Vegetable Sector from Different Sources

Source of Information Used	Percentage	Cumulative Percent
Via AIs officers	28.9	28.9
Via nearest farmers	24.7	53.6
Through agrochemical sells centers	18.4	72.0
Through ARPA	6.8	78.8
Through vegetable sellers	6.2	85.0
By TV programmes	4.2	89.2
From officers of private companies	3.3	92.5
Through family members	2.8	95.3
By farmer organizations	2.3	97.6
By handbills	0.5	98.1
Through drivers of vegetable transport vehicle	0.5	98.6
Via radio programmes	0.3	98.9
Through DDA office	0.3	99.2
Via 6666	0.4	99.6
Through participating the training programmes	0.1	99.7
Through research institute	0.1	99.8
Via you tube	0.1	99.9
By digital board of the DECs	0.1	100.0
Total	100.0	

Source: Survey data, 2019

The limitations of farmers in accessing prevailing information sources are highlighted in table 5.3. Accordingly, lack of awareness about information/new technologies was the main concern among farmers. They have no clear idea about how to obtain information necessary for making effective decisions. If demonstration programmes would be conducted to enhance awareness about online source of information it would help to improve success rates since nearly two-third of farmers have the feature phones and land telephones. However, it must be noted that around 70% of farmers were still depending on other farmers to obtain relevant information (Table 5.2).

Table 5.3: Limitation to Accessing Available Information in Vegetable Sector

Limitations	Percent	Cumulative Percent
Not awareness about the information	60.7	60.7
Lack of awareness about the use of new technologies	10.2	70.9
Time is limited to access information sources	8.8	79.7
Given advice not match with practical situation	6.0	85.7
Not a requirement of the information	5.6	91.3
Lack of awareness about the available sources of information	3.5	94.8
Lack of access to new technologies	2.8	97.6
Contacts with government officers are low	2.1	99.7
Low confidence about the information of the sources	0.3	100
Total	100.0	

Source: Survey data, 2019

5.4 Information Required for Making Decisions on Vegetable Production

Decisions based on reliable information have a greater chance of effecting positive outcomes than those based on unreliable information. In vegetable cultivation, decisions have mostly been made without proper direction.

Table 5.4: Required Information for Vegetable Production

Required Information to Success Cultivation	Percentage	Cumulative Percent
New technical knowledge	18.0	18.0
About diseases and controlling methods	17.5	35.5
About new seed varieties and relevant technical knowledge	12.2	47.7
Provide regular information about market price and variations	11.5	59.2
Information about formal methods to correct apply of agrochemicals	9.2	68.4
Information about new market ventures	6.6	75.0
About quality agrochemicals and fertilizer	5.9	80.9
Information about cultivated crops in other areas	5.8	86.7
About correct application of fertilizer	3.6	90.3
Information about quality seeds sellers	3.0	93.3
Cultivated extent of relevant crop in other areas	2.0	95.3
Provide information about suitable crops for relevant areas	1.8	97.1
About seasonal pattern of the crops	1.2	98.2
Information about weather and climatic condition	1.0	99.2
About local seed varieties	0.7	99.9
About value added products	0.2	100.0
Total	100.0	

Source: Survey data, 2019

The surplus/deficit situation of some vegetable crops observed is a result of this situation. When there is a surplus of some crop, farmers receive lower incomes. On the flip side, when there's a deficit, consumers have to pay a higher price for vegetables. Both extremes generate losses to society in general and moreover they indicate that limited resources are being wasted.

The respondents were queried about the information they believe that the results are summarized in table 5.4. Accordingly, it was found that their main interest was in acquiring new technical knowledge for reducing the cost of production, enhancing yields, minimizing labour cost and post-harvest loss, and improving efficiency of water management. Information relating to disease and controlling methods were highlighted by 17% of the farmers while 12% indicated a need for information on new seed varieties and relevant technical knowledge. Only 11% highlighted the importance of having regular information about market prices and their variations. Less than 10% believed it was important to be informed about correct methods of agrochemical application. Around seven percent showed interest in knowing of new market ventures for deviating from conventional marketing channels. Six percent of the farmers thought about the importance of quality agrochemicals and fertilizer. Information about the cultivated crops was sought by nearly six percent of the farmers while only four mentioned that there was a knowledge-gap with regard to the correct application of fertilizer (4%). Doubt about seed quality was mentioned by three as an issue that could be addressed by more information on reliable seed sellers. Less than two percent mentioned other areas of concern. A stand out feature here is the fact that nearly 70% of the farmers have focused on the major five important data sources.

CHAPTER SIX

Cost of Production, Marketing and Returns of Vegetable Cultivation in Sri Lanka

The cost of production is explained in the first section followed by a discussion on returns. This chapter concludes with a consideration of market behaviour and awareness about post-harvest technologies.

6.1 Cost of Production

The production cost for vegetables was calculated in terms of including and excluding the imputed cost for all vegetables. Family labour and own inputs were included in calculating imputed cost while excluding imputed cost disregarded these. The mean values of all up-country vegetables including all the cost components are presented in Table 6.1. The highest seed cost was reported for capsicum while the lowest was for radish. The highest family labour involvement could be observed in the production of capsicum, beans, leeks, carrot, knolkhol and radish. On the other hand, farmers have utilized more hired labour for capsicum and beetroot production. The labour requirement was found to depend on the number of operations for the particular crops. The highest amount expended on controlling pests and diseases, Rs. 37,500 for capsicum. Less than Rs 10,000 was spent to control pest and disease for beet, leeks and knolkhol and around Rs 15,000 – 20,000 for cabbage, carrot and bean while approximately Rs 14,000 was spent on agrochemicals for radish. Leeks, carrot, capsicum and bean cultivation received the most inorganic fertilizers among the up-country vegetables. Application of organic fertilizer was less compared to inorganic fertilizer. However, leeks and carrot producers do apply organic fertilizer. The knolkhol and radish producers did not use organic fertilizer because the same lands had been previously cultivated with leeks and carrot cultivation.

Table 6. 1: Cost of Production of the Up-country Vegetables

Crops	Seed cost (Rs/ac)	Family labour cos (Rs/ac)	Hired labour cost (Rs/ac)	Agro chemical cost (Rs/ac	In-organic fertilizer cost (Rs/ac	Organic fertilizer cost (Rs/ac	Machinery cost (Rs/ac)	Other materials cost (Rs/ac)	Total cost including imputed cost (Rs/ac)	Total cost excluding imputed cost (Rs/ac)	Unit Cost (Rs/kg)		Farm gat price (Rs/kg)
											Including imputed cost	Excluding imputed cost	
	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean
Bean	16,803	146,227	45,862	19,332	12,468	4,564	7,439	33,160	285,856	139,629	97	33	92
Beet	19,139	11,683	73,165	8,975	6,900	4,855	8,391	4,154	137,262	125,579	17	14	44
Cabbage	11,105	51,289	42,170	16,975	8,804	1,741	4,905	2,623	139,613	88,324	35	22	28
Capsicum	22,526	202,705	78,154	37,528	12,470	4,649	10,626	19,614	388,274	185,569	110	24	139
Carrot	18,833	97,433	50,076	17,912	12,687	11,685	4,901	2,127	215,656	118,223	61	29	57
Knol-khol	21,200	99,166	40,419	7,183	9,525	-	10,651	1,821	189,966	90,800	46	22	49
Leeks	18,939	101,884	52,814	8,455	16,455	15,741	7,989	-	222,279	120,394	54	31	29
Radish	5,744	71,399	50,173	13,849	4,705	-	9,714	6,857	162,442	91,043	20	12	29

Source: Survey data, 2019

The highest 'other material costs' was reported for bean cultivation due to expenditure on sticks and cords, with prices for the former varying from Rs. 2.50 to Rs. 6.00. The highest cost of production (COP) including own input cost was reported for capsicum, bean, leeks and carrot, above Rs. 200,000. The lowest COP was noted for beet production. However, when considering the excluding imputed cost, the highest was recorded for capsicum and the lowest for cabbage. According to the unit cost excluding imputed cost, growers of all up-country vegetables except leeks were able to cover their cash cost (Table 6.1).

Table 6.2 provides the COP of low-country vegetables. Accordingly, the highest cost for seed and planting materials was for *thumba* because farmers have to buy one plant for Rs. 50.00 and more than 800 plants are required to cultivate one acre. Next came bitter gourd, luffa, tomato and pumpkin because the majority of farmers used hybrid seeds. *Elabatu*s, brinjal, bitter gourd, luffa and tomato cultivating farmers have spent more than Rs. 20,000 for agrochemicals. Inorganic fertilizer was applied in the largest quantities for *Elabatu*, brinjal, bitter gourd, luffa and tomato. Cultivators have applied more organic fertilizer for tomato as opposed to other low-country vegetables. Farmers cultivating snake gourd, bitter gourd and luffa have used sticks, cords and wires for setting up nets over the plants and therefore have had to bear greater costs than those cultivating other crops. Sticks and cords are also required for tomato cultivation which requires around Rs. 28,000 per/ac to be spent additionally. The cash cost of all crops can be covered except in the case of cucumber and *kekiri* (Table 6.2).

Table 6. 2: Cost of Production of the Low-country Vegetables

Crops	Seed cost (Rs/ac)	Family labour cost (Rs/ac)	Hired labour cost (Rs/ac)	Agro chemical cost (Rs/ac)	In-organic fertilizer cost (Rs/ac)	Organic fertilizer cost (Rs/ac)	Machinery cost (Rs/ac)	Other materials cost (Rs/ac)	Total cost including imputed cost (Rs/ac)	Total cost excluding imputed cost (Rs/ac)	Unit Cost (Rs/kg)		Farm gate price (Rs/kg)
											Including imputed cost	Excluding imputed cost	
	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean
Pumpkin	15,459	41,539	30,472	6,271	8,996	288	7,527	470	111,022	69,483	18	12	36
Snake gourd	7,113	109,182	26,932	13,225	9,211	4,667	4,225	33,657	208,213	98,587	41	22	67
Cucumber	18,545	75,319	21,772	9,501	7,653	1,191	6,002	2,711	142,692	67,374	26	11	25
Bitter gourd	25,858	109,473	85,218	24,889	18,590	2,099	7,903	31,514	305,545	196,072	74	46	112
Okra	9,474	131,130	16,498	14,971	8,751	148	10,819	3,021	194,813	63,683	71	22	51
Brinjal	3,553	165,643	53,249	36,179	30,786	1,486	9,443	5,921	306,259	140,616	30	16	67
Luffa	22,429	160,913	115,268	24,103	17,389	1,864	7,780	34,242	383,990	223,076	113	49	65
Long bean	4,243	158,351	11,510	13,912	5,755	4,226	8,572	8,705	215,273	56,922	65	17	68
Kakiri	2,653	90,821	21,391	9,446	8,158	750	8,670	1,625	143,515	52,694	30	11	17
Tomato	19,938	196,836	91,169	23,943	16,141	14,312	15,779	27,930	406,048	209,212	118	35	46
Thumba	41,250	172,983	70,500	33,794	18,350	5,367	4,500	6,567	353,311	139,077	147	58	193
Elabatu	5,822	129,191	32,001	40,086	31,183	417	8,893	1,104	248,696	114,237	37	10	83

Source: Survey data, 2019

The market price of the vegetables varies across time in accordance with the demand and supply of the vegetables. The demand for the vegetables is the constant over the years except during certain festival seasons. However, the supply of the vegetables has shown variation, with surplus as well as deficit situations being reported. The average producer prices and crop establishment time (months) are provided in Table 6.3. Accordingly, a deviation from the average market price is observed. The farmers who cultivated bean in February, May, June, July, September and December have got a better price which exceeds the unit cost (97 Rs/kg). However, bean produces in April, August and November received a low market price but it was enough to cover the cash cost of the production. Generally, it is observed that bean producers received an economically viable market price over the year. Beetroot producers have obtained a better market price each month. The farmers who cultivated cabbage in July, September and October have received a market price that was higher than the unit cost (35 Rs/kg) while in the other months market prices lower than the unit cost of the cabbage were reported. Capsicum cultivators received a better market price over the year, prices exceeding the unit cost (110 Rs/kg) with the highest recorded in August and the lowest in April according to the crop establishment time. Carrot farmers starting cultivation in January, February, March, April, September and December received a higher market price over the unit cost (61 Rs/kg). Carrot producers who established the crop in May, June and July received a market price below the unit cost. The majority of the knolkhol produces except those who commenced cultivation in June obtained good market prices. Unfortunately, the leeks producing farmers have not received a better market price. However, among them, those who started cultivation in February, March, July and November were able to cover the cash cost of production (31 Rs/kg). Radish farmers who started in March, May and June obtained a better market price whilst the low prices were recorded for crops where cultivation was started in July, August and September, the prices being below the unit cost (20 Rs/kg).

Table 6.3: Producer Price of the Vegetables and Crop Established Time in 2019

Type	Crops	Average Market Price (Rs/kg)											
		Crop Establishment Time (Month)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Up-country Vegetables	Bean	81	118		54	108	101	105	68	124		64	103
	Beet	63	60			44	28	41	38				
	Cabbage	30	27	31	25	28	12	35	10	50	80	20	
	Capsicum	140	161	130	110	125	132	117	200	155			
	Carrot	161	63	66	71	34	50	36		81			80
	Knol-khol				60	49	35	50					
	Leeks	15	38	34	29	25	29	39	15			45	
	Radish			45		33	33	15	14	5			
Low-country Vegetables	Pumpkin	31	22	62	56	40	60	45	38	14	20		
	Snake gourd	65		88	50	59	50		74	25			
	Cucumber			26	30	24	25	25	23	24	35	35	
	Bitter gourd		90	101	133	111		350	170	83			
	Okra	45	63	59		67	45	50	36				
	Brinjal	61	90	78	71	85	60	68	66	58	57	51	75
	Luffa	88	65	67	65	51	102	185	62		51		
	Long bean	68	75	82	60	66	58	55	85	52	63		
	Kakiri				48	20	20	11		21	12		
	Tomato	47	42	55	46	76	28		66	55	81		
	Thumba			203	165		180	250					
	Elabatu		82	70	110	72			117	105	56	100	78

Source: Survey data, 2019

Pumpkin producers who started in September received a low market price which was below the unit cost (18 Rs/kg), but the majority were satisfied with the market price they received. Snake gourd producers who began in January, March, April, May, June and August were able to cover their unit cost (41 Rs/kg) while those who initiated cultivation in September received just Rs 25 per kg. Majority of cucumber growers have obtained good economic prices. Bitter gourd producers received a market price higher than the unit price (74 Rs/kg) with the highest price being recorded for those who established crops in July. Okra producers spent around 71 Rs/kg; they were able to cover cast costs despite low market prices. Brinjal farmers have received an economic benefit regardless of the month in which the crop was established. Farmers who cultivated luffa in July have obtained a market price higher than the unit cost (113 Rs/kg). Long bean producers received better market prices except in the case of cops established in April, June, July, September and October. Farmers who cultivated *kekiri* in April obtained better market price while others received low market prices. All tomato producers obtained low market prices rather than the unit cost (118 Rs/kg) but most of them were able to cover their cash cost except in the case of those who established crops in June. There was no market issue for *thumba* produces in Sri Lanka. The *Elabatu* cultivators have obtained market prices exceeding unit cost (37 Rs/kg) regardless of the time of cultivation.

6.2 Returns of the Vegetable Cultivation

Return on the investment is a very important factor in deciding whether to stay or exit from the business. The return on vegetable cultivation is considered against including imputed cost as well as excluding imputed cost (Table 6.4). Here, we considered returns with respect to the unit cost of all vegetables against received market price. Those who could cover their unit cost (including/excluding imputed cost) in terms of received market price are considered profitable farmers. When looking at the overall picture of vegetable cultivation, around 48% of the vegetable growers were able to get returns while 52% were unable to obtain returns from vegetable cultivation according to unit cost including imputed cost. More than 90% farmers who cultivated leeks, okra, luffa and tomato received incomes insufficient to cover their cost. However, 52% of the leeks, 96% of the okra, 75% of the luffa and 65% of the tomato producers were able to cover their cash costs. More than 50% of the vegetable growers received returns from cultivating capsicum (62%), knolkhol (71%), radish (63%), pumpkin (68%), snake gourd (92%), bitter gourd (87%), brinjal (97%), long bean (50%), *thumba* (100%) and *Elabatu* (100%). Around 65% of carrot, 65% of cucumber and 88% of *kekiri* produces were unable to get returns. However, 88% of the carrot, 100% of the cucumber and 75% of the kakiri producers were able to cover their cash cost from the production cost. Around 86% of vegetable growers in Sri Lanka have received enough income to cover their cash costs. Interestingly, around 14% of the vegetable growers were unable to cover even their cash costs because they had received the lower than average farm gate prices. Around 44% of the cabbage (Rs.16/kg) , 48% of the leeks (Rs.22/kg), 26% of the pumpkin (Rs.8/kg), 25% of the luffa (Rs. 41/kg) and *kekiri* (Rs. 10/kg) and 35% of the tomato (Rs. 28/kg) producing farmers were unable to recover their cash cost by cultivating in 2019. The main reason was that they received the lowest farm gate prices, which were not enough to cover their cash costs.

Table 6.4: Returns of the Vegetable Cultivation

Crop	Return Against Including Imputed Cost		Return Against Excluding Imputed Cost	
	% of not profitable farmers	% of profitable farmers	% of not profitable farmers	% of profitable farmers
Bean	58	42	7	93
Beet	0	100	0	100
Cabbage	70	30	44	56
Capsicum	38	62	0	100
Carrot	65	35	12	88
Knolkhol	29	71	0	100
Leeks	90	10	48	52
Radish	38	63	13	88
Pumpkin	32	68	26	74
Snake gourd	8	92	0	100
Cucumber	65	35	0	100
Bitter gourd	13	87	4	96
Okra	92	8	4	96
Brinjal	3	97	3	97
Luffa	94	6	25	75
Long bean	50	50	0	100
Kakiri	88	13	25	75
Tomato	91	9	35	65
Thumba	0	100	0	100
Elabatu	0	100	0	100
Total	52	48	14	86

Source: Survey data, 2019

The economic viability of vegetable cultivation would help farmers decide whether to stay or not in the cultivation. In the case of vegetables, due to the short-term nature of the crops, there's a tendency to rotate based on previous experience with respect to market behaviour. The rule of thumb employed is the level of profitability in the previous season: good incomes prompt repeat cultivation and if the margins were low the tendency is to shift to a different crop. Therefore, farmers may continue with the same crop choice even if economic viability is unlikely. Indicators such as return per family labour day and return per worker (family and hired labour) have been used to measure economic viability of the vegetable cultivation. If return is greater than the wage rate in the open market, cultivation would be considered economically viable (Table 6.5).

Beetroot, capsicum, cucumber, bitter gourd, brinjal, long bean, winged bean, *kekiri*, *thumba* and *Elabatu* were the economically viable crops with respect to the returns per family labour (Rs/day/ac). According to the return per worker (Rs/day/ac), the same crops except for beetroot, brinjal, long bean and *kekiri* were found to be economically viable for both up-country and low-country vegetables.

Table 6.5: Returns from Vegetable Cultivation in 2019

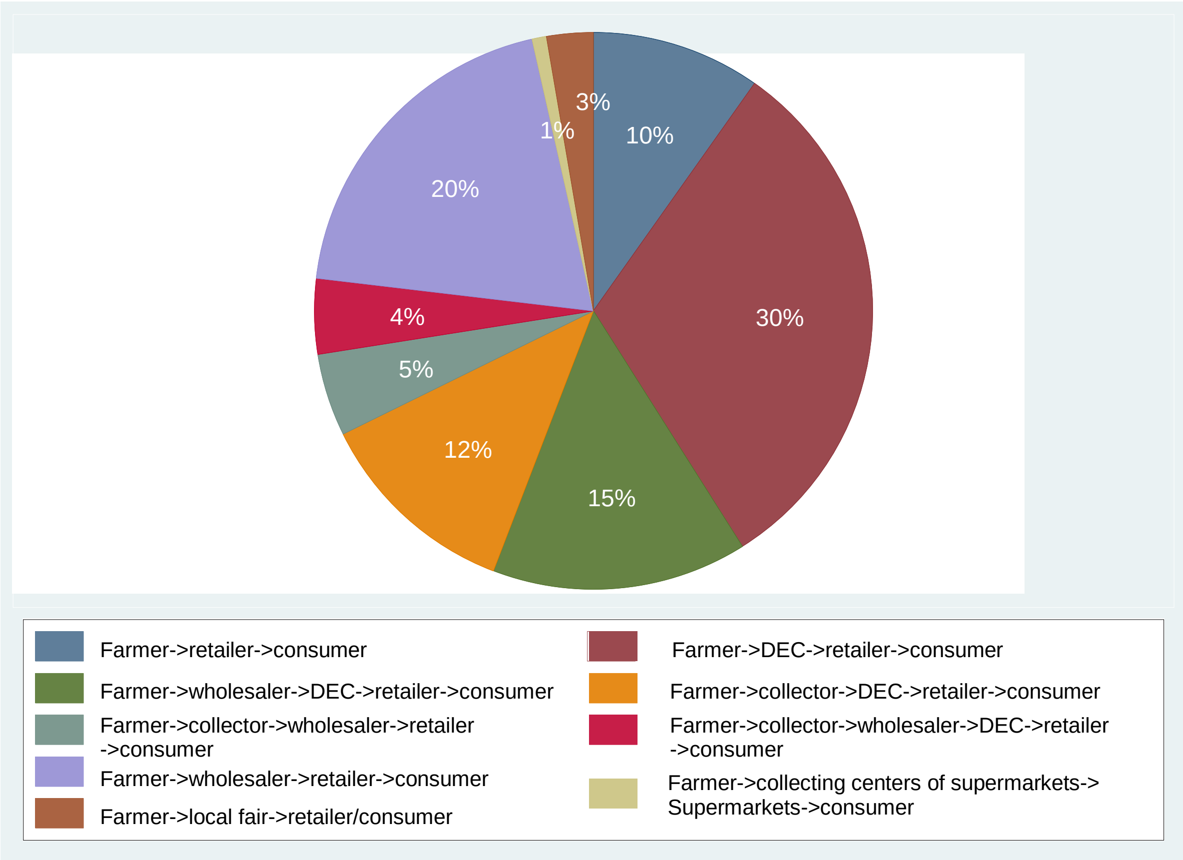
Type	Crops	Return per family labour (Rs/day/ac)	Return per worker (Rs/day/ac)	Wage rate (Rs/day)-Maximum	
		Mean	Mean	Male	Female
Up-country Vegetables	Bean	1,006	1,136	1,500	1,500
	Beet	1,897	1,616	1,800	1,000
	Cabbage	435	456	1,500	1,200
	Capsicum	2,633	2,211	1,500	1,200
	Carrot	245	423	1,800	1,000
	Knolkhol	901	798	1,500	1,000
	Leeks	76	345	1,800	1,000
	Radish	1,380	1,357	1,500	1,000
Low-country Vegetables	Pumpkin	933	1,239	1,500	1,300
	Snake gourd	1,025	706	1,500	1,200
	Cucumber	1,819	1,170	1,700	1,200
	Bitter gourd	4,609	2,197	1,800	1,200
	Okra	550	660	1,500	1,000
	Brinjal	3,895	1,403	1,800	1,300
	Luffa	656	1,139	1,800	1,200
	Long bean	1,628	1,385	1,500	1,000
	Kakiri	1,572	982	1,500	1,000
	Tomato	255	319	1,500	1,200
	Thumba	2,612	3,164	1,500	1,200
	Elabatu	6,226	4,180	1,500	1,000

Source: Survey data, 2019

The return per worker of farmers who cultivated cabbage, carrot, leeks and tomato was less than Rs 500.00 per day. Therefore, farmers who cultivated these crops did not benefit economically compared to those who cultivated other crops. However, knolkhol and okra producers have earned Rs 500 to 1000 per working day. Those who cultivated bean, radish, pumpkin, snake gourd and luffa received returns of Rs. 1000-1500 per working day.

6.3 Marketing and Awareness of Post-harvest Technologies in Vegetable Cultivation

Several actors are involved in the vegetable marketing value chain from producer to retailer in Sri Lanka. We observed nine marketing channels for distributing vegetables from farmer to consumer. More than 60% of total vegetable marketing functions through the dedicated economic centres (DEC).



Source: Survey data, 2019

Figure 6.1: Vegetable Marketing Network in Sri Lanka

One-third of the total vegetable market in Sri Lanka is handled through the farmer-DEC-retailer matrix. Vegetable collectors in the distribution network comprise around 20% of all actors while wholesalers in the vegetable market account for around 40% in. One percent of the vegetable production is transferred via supermarket channels and they obtain a limited quantity of vegetable production while maintaining the quality of the vegetables. Around 10% of the farmers have used the farmer-retailer-consumer marketing channel and three percent of the vegetable production has been directly sold in the local vegetable fair.

Table 6.6: Main Wholesale Market Places in Sri Lanka

Vegetable Producing District	The Endpoint of the DEC/Wholesale Markets	Vegetable Producing District	The Endpoint of the DEC/Wholesale Markets
Anuradhapura	• Dambulla (79%) • Thambuthegama (16%) • Manin market (5%)	Ratnapura	• Manin market (69%) • Godakawela (27%) • Dambulla (4%)
Kurunegala	• Dambulla (47%) • Manin market (14%) • Hettipola (14%) • Kobeigane (5%) • Wariyapola (4%) • Hiripitiya (4%) • Kochchikade (4%) • Veyangoda (4%) • Minuwangoda (2%) • Kurunegala (2%) • Rambe (2%)	Nuwara Eliya	• Dambulla (52%) • Nuwara eliya (14%) • Katugasthota (12%) • Kappetipola (4%) • Kandapola (4%) • Manin market (4%) • Bandarawela (3%) • Megoda (3%) • Hawaeliya (3%)
Puttalam	• Norochchole (40%) • Dambulla (14%) • Manin market (13%) • Arachchikattuwa (7%) • Daluwa (6%) • Chilaw (6%) • Kalpitiya (3%) • Bangadeniya (2%) • Wennappuwa (2%) • Veyangoda (2%) • Thambuttegama (2%)	Hambantota	• Sooriyawewa (40%) • Ranna (29%) • Beliatha (11%) • Manin market (10%) • Nuwara eliya (3%) • Waliara (2%) • Angunakolapalassa (2%) • Thangalla (2%) • Dambulla (2%)
Kandy	• Dambulla (48%) • Katugasthota (38%) • Ududumbara (7%) • Manin market (3%) • Hatharaliyadda (2%) • Theldeniya (2%)	Badulla	• Bandarawela (60%) • Kappetipola (19%) • Manin market (17%) • Godakawela (2%) • Hatharaliyadda (2%)

Source: Survey data, 2019

According to Table 6.6, the Dambulla Dedicated Economic Centre could be identified as a main vegetable wholesale market. Nearly 80% of the vegetables produced in Anuradhapura, 50% in Kurunegala, Nuwara Eliya and Kandy, 14% in Puttalam, four percent in Ratnapura and two percent in Hambantota are distributed via the Dambulla Dedicated Economic Centre. Therefore, Dambulla DEC is the prime price determinant of the vegetable market in Sri Lanka. Around 69% of the vegetables produced in Ratnapura, 17% in Badulla, 14% in Kurunegala, 13% in Puttalam, 10% in Hambantota, five percent in Anuradhapura, four percent in Nuwara Eliya and three percent in Kandy have gone to the Manning Market in Colombo. Around 60% of the vegetable production in the Badulla district has been sold in the Bandarawela wholesale market while 19% of the production has gone to the Kepetipola DEC. The Bandarawela wholesale market is functioning well and it was observed that wholesalers in the Southern province were also moving to the Bandarawela market.

The DECs were established to provide a market for farmers' Products without the interference of middlemen. However, it appears that the current administrative arrangement of DECs is not geared to deliver the envisaged outcomes. Various issues have prompted farmers to not to use the DECs. Vegetable growers in the Anuradhapura, Ratnapura, Nuwara Eliya and Badulla districts have preferred to go to other wholesale markets and not the respective DECs. However, those in the Puttalam District sell their produce at the Norochcholai DEC.

Vegetable growers have stressed several marketing issues they have faced using the market distribution network (Table 6.7). Nearly 40% of the farmers highlighted the unavailability of the stable market price for vegetable crops. Most of the time, demand is constant for vegetables except during certain festival seasons. For example, vegetable demand rises during the Sinhala-Hindu New Year season. The market price is sensitive to variability in supply and therefore what is needed is a proper crop-wise production plan that corresponds to intersect between demand and supply for all vegetable crops. Next, the farmers emphasized middlemen intervention in the value chain and pointed out that they earn considerably higher profits than farmers. The farmers work hard for two to three months but middlemen largely determine farmgate and tend to make a bigger profit than farmers. One-fourth of farmers spoke of this issue. Regardless of the market situation it is the vegetable producers who have to bear the profits or losses of cultivation.

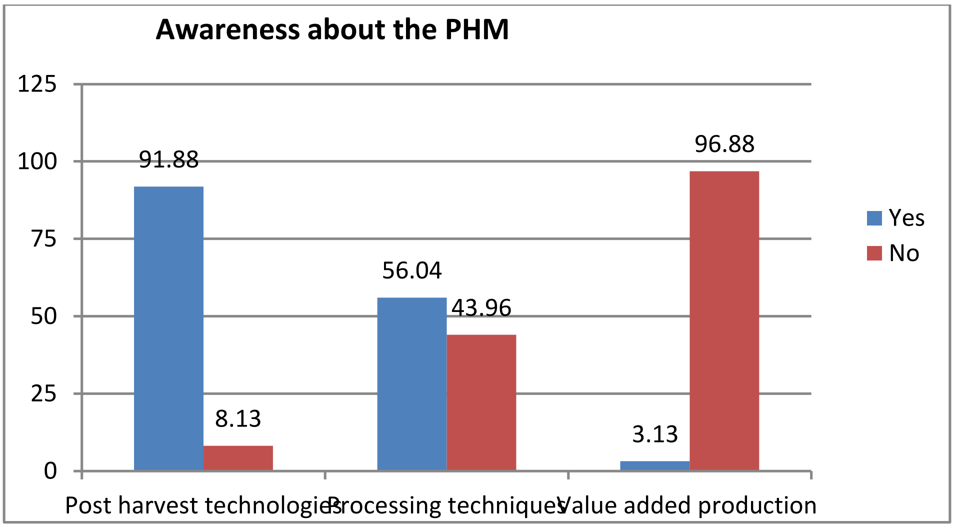
Table 6.7: Issues of the Marketing/Marketing Network

Highlighted Issues of the Vegetable Marketing	**%**
The stable market price for vegetables is not available	37
Middlemen who engage in vegetable marketing earn more profit than farmers	24
Commission fee obtained from the DECs is high	13
Transport cost of the vegetables is high	7
Difficult to sell vegetables when there is an excess supply of the vegetable	6
Farmers have to sell their products under the given price by vegetable collectors	3
The market price has differed from person to person who buys vegetables from farm-gate	2
Difficult to find out wholesalers in vegetable producing areas	2
Farmers are not paid the agreed price by the middlemen	3
Cheating when vegetable weighting by collectors	1
Only high-quality products are bought for supermarkets	1
Transporting losses are high	1
Total	100

Source: Survey data, 2019

Around 13% of the farmers expressed concern about the commission charged by the DECs. The high transport cost (7%) and marketing problems in a surplus situation (6%) were highlighted. Since vegetable growers lack bargaining power, they have to sell at a price determined by collectors (3%). Around 8% raised the problem of the middlemen and their activities in the market. Farmers who are linked with the supermarket channel pointed out that only high quality vegetable are purchased and therefore they have to find other channels to sell the rest of the harvest.

It is very important for policy makers to pay the attention to post-harvest handling in the vegetable production sector in Sri Lanka. Even though there is adequate awareness about post-harvest technologies and the importance of maintaining quality during storage and transportation the processing techniques themselves including those deployed for value-addition are lacking in the vegetable sector (Figure 6.4). Only a few techniques are currently being practiced such as wooden boxes for tomato and plastic crates for other kinds of produce used by only a few farmers, collecter and wholesale.



Source: Survey data, 2019

Figure 6.2: Farmers' Knowledge about Post Harvest Management (PHM)

Vegetable processing is sparse in Sri Lanka except in the case of a few exporters and super market channels. Around 44% of the vegetable producers had not even heard about canning, freezing, pickling or drying. Therefore, the policymakers should pay their attention to enrich farmers with knowledge of processing techniques which could in addition ensure a better supply of high quality vegetables to the consumers. There is also a huge knowledge gap about value addition in the vegetable sector (97%). If the vegetable sector is to be diversified, processing and value addition technologies need to be expanded to minimize post-harvest losses and enhance the farmers' income rather than persisting with bulk sale of produce.

CHAPTER SEVEN

Determinants of farmer's decisions on vegetable production in Sri Lanka

Farmers' perception on selecting different vegetables is explained briefly in the first section of this chapter. Descriptive statistics about the economic and physical factors, personal characteristics, availability and accessibility of resources, and information that directly affects decision making in selecting different crops are presented in the second section. Thereafter the results of the estimated multinomial logit models are interpreted by crop-wise comparisons.

7.1 Major Reasons for Selecting Types of vegetables for Cultivation

Individual farmers select particular types of vegetables for cultivation and apply strategies according to their experiences; their predictions, however, do not always materialize. Each farmer seems to have a particular logic in selecting crops. The reasons offered have been ranked and the summarized results are shown in table 7.1.

Table 7.1: Major Reasons to Select Particular Vegetable Crops

Crops	**Main Five Reasons to Select Crops (rank 1-5)**					**Meaning of the Abbreviations**
	1	**2**	**3**	**4**	**5**	
Bean	HP (15%)	SAE (12%)	HY (10%)	FH (10%)	STY (9%)	**AG -** Not required more agrochemical **EC –** Easy of the cultivation **FFC -** Few farmers are cultivating **FH -** Obtaining a high frequency of harvesting **HD** – High demand for the crop **HP**–High market price **HY -** High yielding capacity **LCP** - Low cost of production **LLR - L**abour requirement is low **LSC -** Low cost of seeds **LTY -** Able to obtain yield in a long-term **LWA -** Low impact of the wild animals' **RPD -** Resistant to pest and disease
Beet	STY (23%)	LCP (20%)	EC (10%)	HP (8%)	SAE (8%)	
Cabbage	SAE (20%)	EC (20%)	HY (9%)	HP(9%)	YAO (7%)	
Capsicum	HP (28%)	HY (24%)	SAE (13%)	FH (7%)	FFC (4%)	
Carrot	LCP (20%)	SAE (17%)	EC (12%)	HY (9%)	HP (6%)	
Knolkhol	STY (25%)	HY (10%)	LCP (10%)	HP (10%)	EC (10%)	
Leeks	HY (20%)	EC (16%)	LLR (13%)	HP (9%)	SAE (9%)	
Radish	HY (17%)	LCP (17%)	STY (13%)	SAE (13%)	EC (13%)	
Pumpkin	LLR (14%)	LCP (14%)	EC (13%)	YAO (10%)	HP (8%)	
Snake gourd	HY (24%)	HP (16%)	RPD (12%)	EC (12%)	STY (4%)	
Cucumber	EC (19%)	HY (15%)	STY (13%)	HP (13%)	HD (6%)	
Bitter gourd	HP (25%)	SAE (14%)	HD (12%)	HY (10%)	TBP (8%)	
Okra	FH (14%)	RPD (14%)	EC (14%)	SAE (10%)	TBP (10%)	

Brinjal	FH (22%)	HY (14%)	LTY (8%)	HP (6%)	EC (6%)	**SAE -** Suitable for agro-ecological conditions and the soil **STY** - Able to obtain yield within a short time **TBP** - Trusting that able to obtain better profit **YAO** - Able to obtain yield at once
Luffa	STY (19%)	HY (13%)	FH (11%)	HP (10%)	LLR (8%)	
Long bean	EC (16%)	STY (13%)	HY (11%)	LCP (11%)	FH (5%)	
Kakiri	LCP (15%)	EC (15%)	HY (15%)	RPD (15%)	LLR (10%)	
Tomato	HY (19%)	FH (14%)	HP (12%)	SAE (8%)	EC (8%)	
Thumba	HP (21%)	TBP (16%)	FFC (11%)	AG (11%)	LSC (11%)	
Elabatu	FH (23%)	RPD (15%)	HP (8%)	LLR (8%)	LWA (8%)	

Note: Values in the parentheses are percentages responding to each crop growers
Source: Survey data, 2019

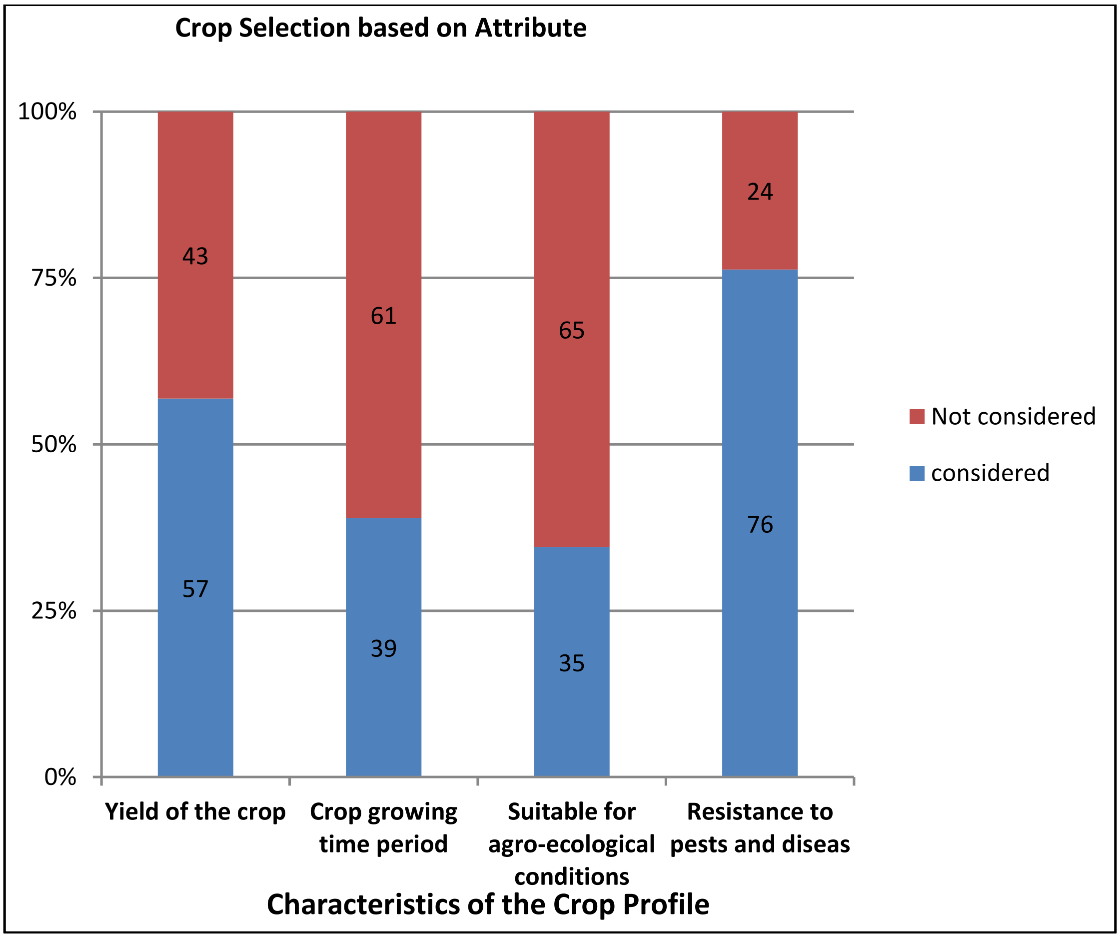
According to the farmers, yield (average 15%) was one of the major factors considered. Farmers considered the obtainable yields since this impacts income. Harvesting frequency (average 13%) is highly correlated with the yield factor. Sensitivity of the market price (average 12%) was observed as a second important factor for many crops. If the market price was high in the previous season/year, they believed that market price was likely to increase in the next season. Cost of production (average 12%) was also considered an important factor because this directly affects profit margins. Ease of cultivating a particular crop (average 13%) also found mention. The high market price (bean, capsicum, bitter-gourd and *thumba*), ability to obtain yields within a short time (beet, luffa and knolkhol), suitability of agro-ecological conditions and soils (cabbage), low cost of production (carrot, winged-bean and *kekiri*), high yields (leeks, radish, snake-gourd and tomato), low labour requirement (pumpkin), ease of cultivation (cucumber and long bean) and high frequency of harvesting (okra, brinjal and *elabatu)* have been highlighted as a main considerations when selecting crops (Table 7.1).

7.2 Factors affecting farmer’s decision making regarding vegetable production

Earning a better income/profit is the premier objective of any economic activity. The rational thinking of the farmers’ is to create competitiveness among farmers. However, factors affecting the farmer’s decision-making process are very complex and it is difficult to isolate the impact of each factor. Decision-making may depend on various socio-economic and technical factors. Sometime farmers may be interested in special characters of the crops. Economic factors, physical factors, personal characteristics, availability and accessibility of the resources, information etc. could be broadly considered affecting factors.

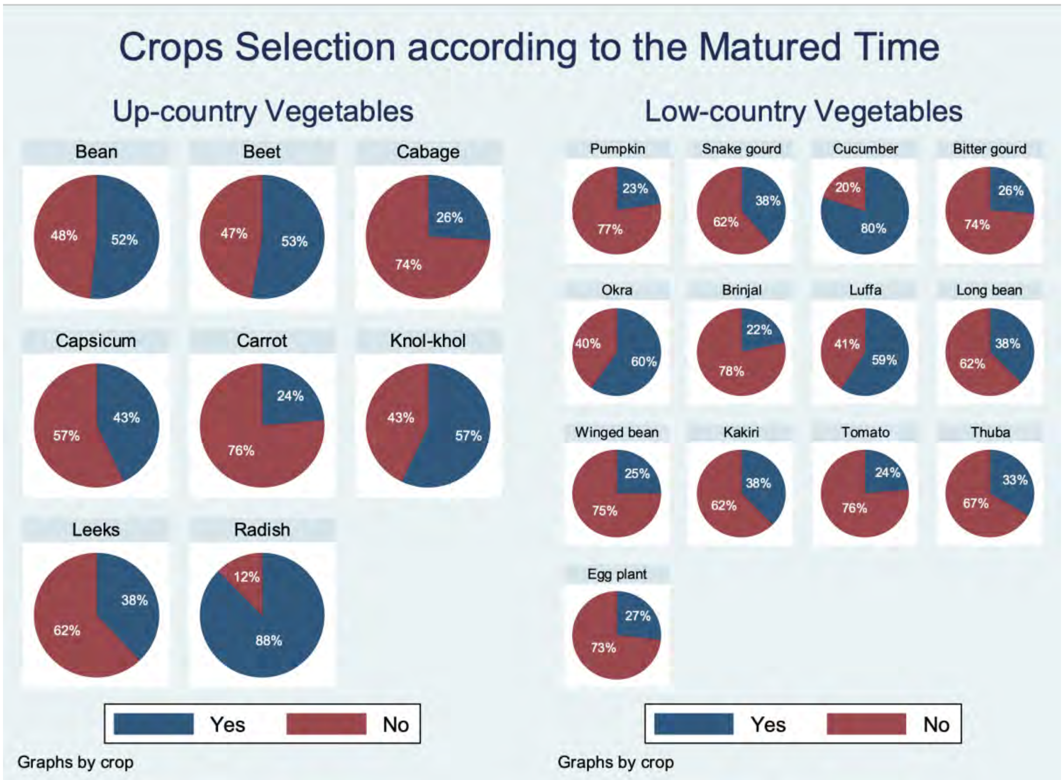
7.2.1 Crop Profiles

The attribute of the crops has played a significant role in decision making. Yield, crop-growing time (maturation time), suitability in terms of agro-ecological conditions and resistance to pest and disease are separately considered in this study under crop attributes. Around two-thirds of the vegetable growers have considered the yield of the crop in making cultivation decisions. Some vegetables like bean, beet, radish, knolkhol, luffa, cucumber and snake-gourd comparatively mature within a short time and around 40% of the farmers have considered this in the decision-making process. Interestingly, more than two-thirds of the farmers have not been concerned about suitability in terms of agro-ecological conditions. Resistance to pest and disease of the crops has significantly influenced the farmers' decision-making process (Figure 7.1). Both short and long maturation periods interest vegetable growers in the up-country and low-country. Decision-making that takes this into consideration varies across crops (Figure 7.2).



Source: Survey data, 2019

Figure 7.1: Decision Making Considering the Attributes of the Crop Profile



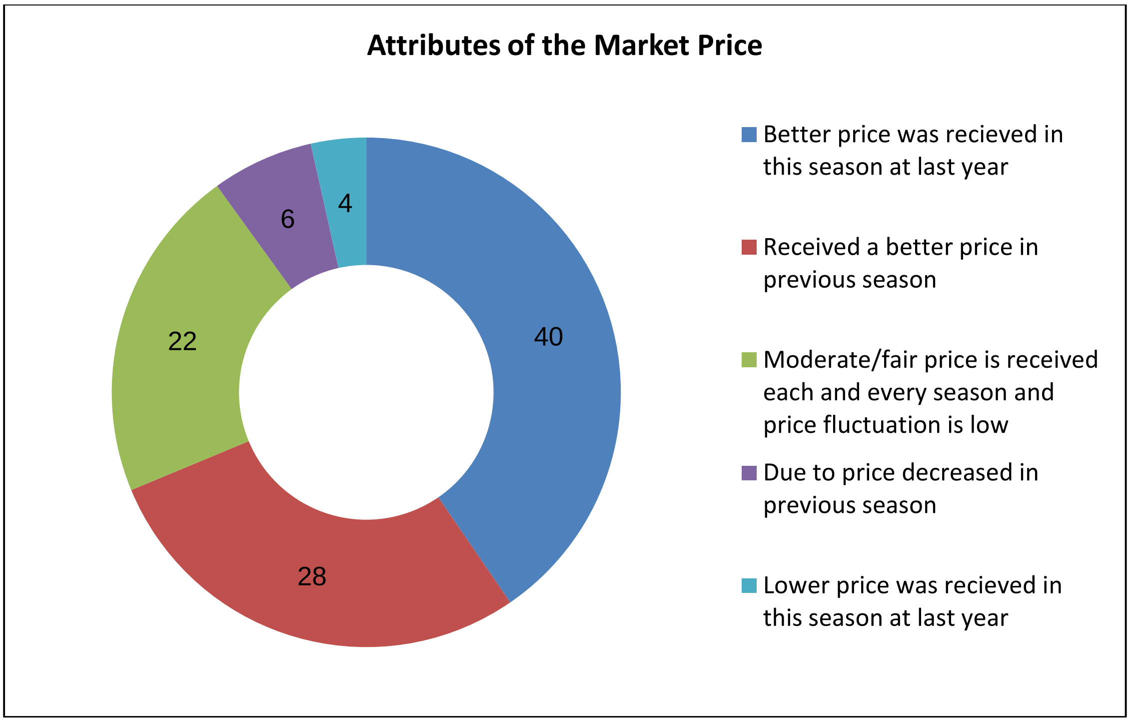
Source: Survey data, 2019

Figure 7. 1 Maturation Times and Decision Making for Selecting Crops

Maturity time of the crop is the starting time of the yield in a crop. It means that farmers are targeting to supply the yield to the markets at a specific time in the future. Therefore, this is one of key determinants when it comes to selecting a crop. This was particular significant in case of radish and cucumber. Nearly 60% out of those who grew bean, beet, knolkhol, okra and luffa based their selection on matured time whether or not it was long term or short term harvesting.

7.2.2 Economic Factors

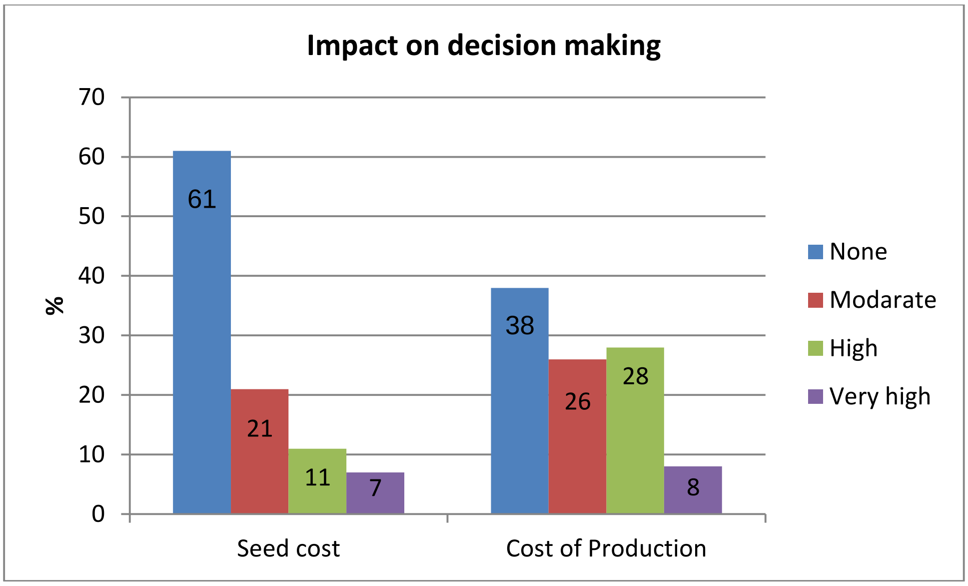
Market price determines the demand and supply of the vegetables. Barring special circumstances, demand seems to remain constant while supply will vary due to many reasons. However, the market price of the vegetables may play as a symbol of market directions. If a particular vegetable was sold at higher price in a particular season, most of the farmers (40%) tend to grow that vegetable in the next season, leading to a glut, and consequently, a price-decrease for that vegetable a situation which of course does not please the farmer. Vegetable growers have noted certain trends in price behaviour in the market and factored these into their decisions.



Source: Survey data, 2019

Figure 7. 2 Crop Selection concerning the Market Price

Around 40% of the farmers decided on the crop by considering previous season's prices. For example, if a farmer received a good price in the 2018 *Yala* season for a particular crop the farmer would select that crop for the 2019 *Yala* season as well. This correlates between equal seasons in different years. Nearly 30% of the farmers have selected crops based on receiving a good market price in the previous season. This is true for different season in a single year as well. For example, if a farmer received a good price in the 2018/2019 *Maha* season for a crop, he will select the same crop for the 2019 *Yala* season as well. Generally, a few vegetable crops have received moderate or fair market prices every season and 22% of the total respondents used selected vegetables such as bean, leeks, bitter gourd, brinjal, e*labatu,* capsicum and carrot based on this. Around 10% of the sample has shown sensitivity to the negative sign of the market price; fewer would cultivate a particular crop if it fetched a poor in the previous season (Figure 7.3).



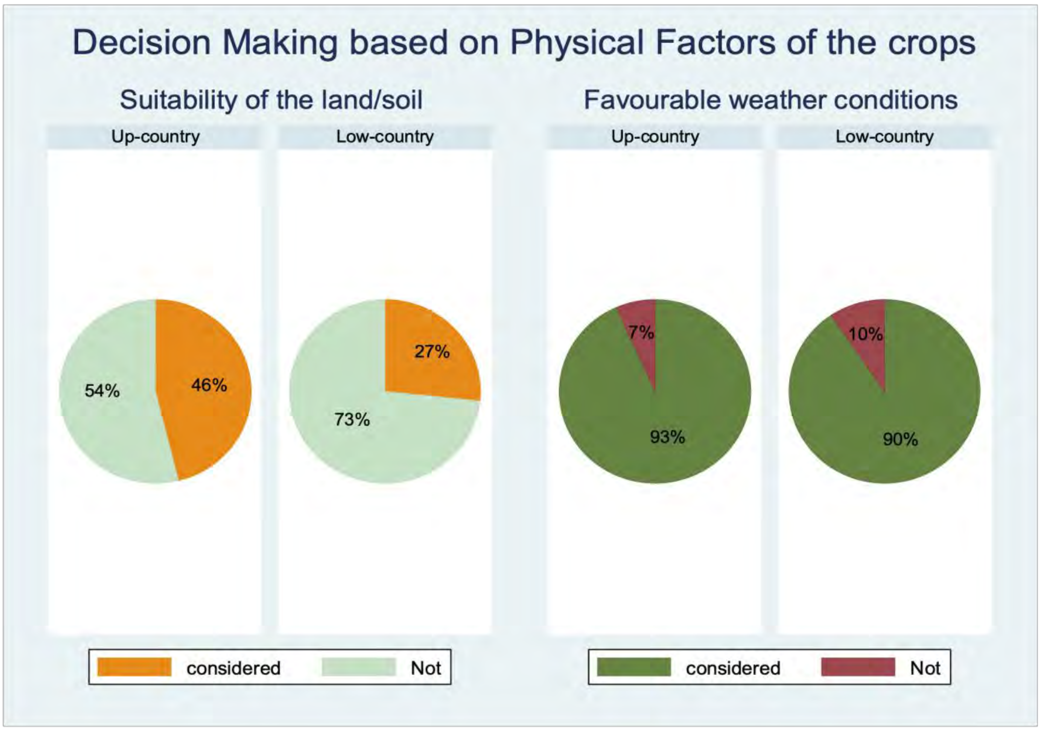
Source: Survey data, 2019

Figure 7.4: Crop Selection through Seed Costs and Other Costs of Production

Seed cost and overall cost of production are also key determinants when it comes to crop selection. A majority of the farmers (more than 60%) have not taken seriously the seed cost when they select crops. Interestingly, one-fifth of the farmers have considered the seed cost of the particular crop. If the seed cost is high the particular crop may not be selected and conversely if seed costs are low there's a greater likelihood of that particular crop being selected. Increasing cost of production and low market prices are the key issues faced by vegetable producers. Nearly 60% of the farmers have thought about the cost of production before selecting the crop for the next season (Figure 7.4).

7.2.3 Physical Factors

Most of the physical factors are relevant to agro ecological conditions such as soil, water, temperature, humidity. These directly influence plant growth. However, knowledge regarding physical factors is low and they've tended to depend on experience alone. More than 90% of both up-country and low country farmers have selected crops after determining that weather conditions would be favorable to cultivate them. Suitability of soil/land was not a critical factor for low-country vegetable growers whilst half of the up-country vegetable growers have considered these factors (Figure 7.5).



Source: Survey data, 2019

Figure 7.5: Crop Selecting based on Physical Factors

7.2.4 Personal Factors

Although collective action among vegetable farmers is hardly evident, they do draw from the experiences of neighboring farmers. Several personal characteristics influence the decision making process. A farmer could be influenced, for example, by a family member, another farmer or an organization where information and sharing of experiences could directly or indirectly guide the thinking. Fascinatingly around 60% out of the farmers indicated that decisions were somewhat guided by information provided by other people. A majority of the growers (85%) have thought about ease of cultivation and maintaining. On the other hand, around 50% of the farmers have taken into account the free time that's possible in cultivating different crops. If cultivation requires a lot of operations/activities it inhibits free time and this has persuaded farmers to select crops that involve fewer operations.

Table 7.2: Decision Making regarding Personal Factors

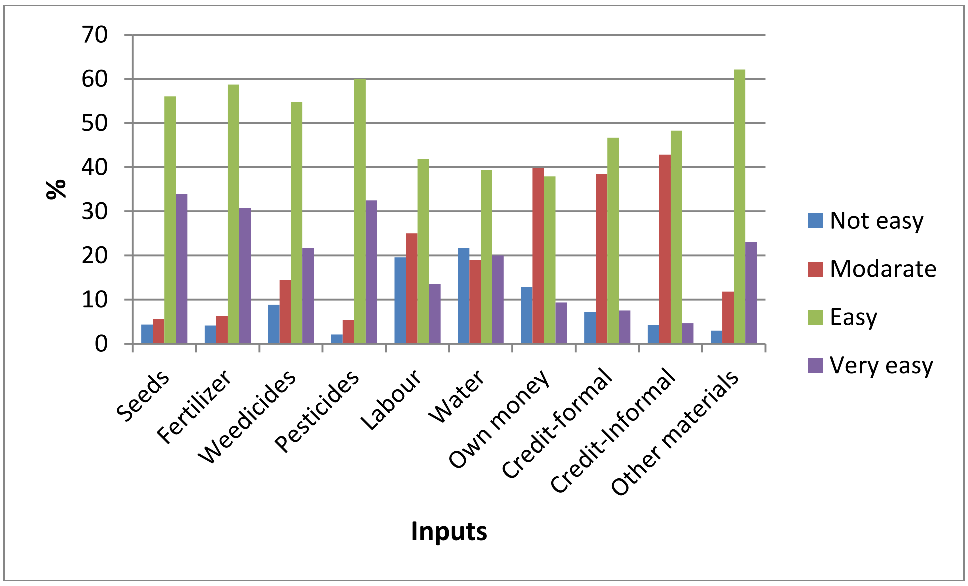
Personal Factors for Selecting Crops	**Yes**	**No**
	%	**%**
Other people's influenced the decision	59	41
Cultivation of the crop is easy	85	15
The crop is allowed a lot of free time	51	49
Taste of the crop/quality/equal appearance of the nuts	72	28

Source: Survey data, 2019

Most of the vegetable growers have factored in the qualities for which there was a demand before selecting crops. For example, tastes, quality output, the equal appearance of the nuts were keenly considered by 72% of the farmers.

7.2.5 Availability of Resources

Availability and accessibility of resources for the cultivation may influence crop selection. The availability of resources is not a critical problem for vegetable growers but there are accessibility issues with respect to some of them. Nearly 20% of the farmers have highlighted that obtaining labour was not easy and more than 20% stressed that water was the major problem. More than 50% of the farmers had difficulty in bearing the initial costs of cultivation. Therefore, farmers have been strained to begin cultivation. The results reveal that 30% depended on agricultural loans and nearly 20% opted to pawning their jewellery.



Source: Survey data, 2019

Figure 7.6: Accessibility to the Resources in Vegetable Cultivation

7.2.6 Information

Information plays a very essential role in making intelligent economic decisions that have a greater chance of being effective. Farmers have used several sources of information to select crops. If farmers have a reasonable idea about the overall area in which the crop is being cultivated, excess cultivation could be avoided. A Likert scale was applied to measure the usefulness of such information. More than 60% of the farmers have noted the importance of extent data while more than 70% of the vegetable growers were interested in forecasted prices of vegetables. The behavioral pattern of the weather/climatic condition in the future (more than 80%) and new market ventures and entrepreneurship information (more than 60%) were highlighted as having a strong impact on decision making (Table 7.3). Farmers are interested to move away from their traditional markets due to issues inherent in the relevant systems. They do not have enough information about new marketing opportunities like links with supermarkets, exporters, processing companies and value-added producers. The vegetable producers are interested in developing entrepreneurship skills and converting their farming activities into a better business model.

Table 7.3: Impact on Production Decision concerning the Information

Information	Impact on the production decision (%)			
	No impact	Moderate	High	Very high
The cultivated/expected extent of the particular crop in other areas	19	14	23	44
Expected price/forecasting price	10	17	29	44
Information relevant to the market demand	9	16	34	41
Future climatic/weather data	7	13	36	45
New market venture and entrepreneurship information	19	13	24	44

Source: Survey data, 2019

7.3 Results and discussion of the Multinomial Logit Model

According to Table 02 of Chapter Three, six major factors correlating with crop selection were identified. There are 28 variables under these major six factors. Factor analysis was done to identify the correlated variables (Annex 1). The results of the factor analysis indicated that prior experience of crop cultivation, possibility or otherwise of free time, crop growing time, resistance to pest and disease were not correlated with any factor, and therefore, those variables have been dropped from the multinomial logit model. We have run two types of multinomial logit models to identify the determinants in selecting vegetable crops. Up-country and low-country are the main distinctions and hence separate models have been run for each.

7.3.1 Multinomial Logit Models for Up-Country Vegetables

There are eight crops in the up-country vegetable category. Thus eight multinomial logit models have been run for each crop by changing the base outcome. The results of all models are presented tables in Annexes 02 to 09. Accordingly, the Chi-square value of the Log-Likelihood ratio test shows that the models are statistically significant at the one percent level which is the overall significance of the models. McFadden’s pseudo-R-squared value is 0.39, indicating that around 40% of the estimating models are fitted with real data.

7.3.1.1 Determinants for Selecting Beans

The multinomial logit estimate for beans relative to the reference group (crops) is presented in annex no 02. Here the reference group is beans. Therefore, results of the base outcome are compared with beans. Cultivated/expected extent of the crop in other areas (EXTO) and seed availability (SAV) have significant and positive relationships with multinomial log-odds values while the availability of pesticides (PAV) is the significant and negative relationship compared with beet-root. Beet-root producers consider pesticide availability to a greater extent that does bean producers. Information relating to the new market venture (NMVEN), decisions influenced by other people (OINF), SAV, PAV, water availability (WAV), the crop is marketable (WMKT) and the yield of the crop (YILD) are significant compared to cabbage. If water is available in a particular season, farmers tend to select beans rather than cabbage because the log-odds ratio is negative. Fertilizer availability (FAV), cost of production (COP), availability of formal credit (FCRD), accessibility of water (WAVL), WAV, favorable weather conditions (FWCN) and 'crop was easy to grow' (EGRW) are the significant determinants compared with capsicum. When decision making is based on the COP with other variables constant, farmers tend to grow beans compared to capsicum. The multinomial log odds ratio of the WAVL and WAV are negative which means that accessibility and availability of water will encourage farmers to select bean over capsicum. With respect to carrot, SAV, PAV, FCRD, the market price of the last season (MKTP) and YILD show a significant relationship. When knol-khol is a base outcome, NMVEN and COP are significant variables. Multinomial logit coefficient of OINF, SAV, COP, WAV and FWCN are statistically significant compared to leeks. When decision making takes into account COP, farmers may select leeks rather than beans due to the negative relationship of the log-odds ratio. Informal credit (INCRD), WAVL, labour availability (LAV), availability of own money (MAV) and WMKT are significant with respect to radish. The log-odds ratio of the WMKT shows a greater positive value which means the marketing capacity of the beans is greater than radish. Therefore, we can conclude that EXTO, NMVEN, OINF, SAV, FAV, PAV, COP, FCRD, INCRD, WAVL, LAV, WAL, MAV, MKTP, YILD, FWCN and EGRW are major determinants when selecting beans compared to other vegetables in the up-country.

7.3.1.2 Determinants for Selecting Beetroot

The results of the multinomial logit model for beet-root relative to base outcome are shown in Annex 03. Accordingly, EXTO, SAV, PAV are significant relative to beans. The multinomial log odds ratio for EXTO relative to beans illustrates a negative relationship which leads to select beans when reducing the extent of beetroot. NMVEN relative to cabbage, PAV, FCRD, WAVL, WAL, FWCN and EGRW are major determinants to select beetroot compared to capsicum. Accessibility and availability of water may lead to choosing beetroot over capsicum. The log-odds ratio of the FWCN and EGRW tends to increase both beetroot and capsicum. MAV, MKTP relative to carrot, EXTO, weather data (WDATA), NMVEN, MAV relative to Knolkhol, EXTO, WDATA relative to leeks and INCRD, LAV, MAV, WMKT relative to radish are significant determinants when choosing beetroot compared with different crops. The market price of the previous season may lead to an increase in the selection of both beetroot and carrot. Informal credit availability would decrease selection of beetroot compared with radish.

7.3.1.3 Determinants for Selecting Cabbage

Table No 4 in the annex provides the output of the multinomial logit model for cabbage relative to other up-country vegetables. According to the results, NMVEN, OINF, SAV, PAV, WAV, WMKT and YILD are the significant determinants for cabbage relative to bean. The log-odds ratio of the WMKT is negative and significant. Accordingly, log-odds ratio changes by one units log-odds of WMKT decreases by 4 units. Therefore with regard to decision making based on the WMKT, there is a high probability of selecting beans rather than cabbage. NMVEN is the main significant variable relative to beet-root. SAV, PAV, FCRD, WAVL, LAV, YILD and EGRW are the key determinants compared with capsicum. When compared with carrot, NMVEN, SAV, FCRD, WAV, MKTP and WMKT are the significant variables. Significant variables compared with the Knolkhol are EXTO, WDATA and COP. WDATA is the key determinant for cabbage relative to leeks. INCRD, LAV and YILD are major determinants relative to radish.

7.3.1.4 Determinants for Selecting Capsicum

The results of the multinomial logit model estimation for capsicum are presented in Annex 05. FAV, COP, FCRD, WAVL, WAV, FWCN and EGRW are significant relative to bean for capsicum selected. When considering the factor of water availability, farmers may tend to select capsicum over beans. Favourable weather conditions may provide a greater likelihood of selecting capsicum than the base outcome (Beans). The log odds ratio of the EGRW variable is negative which means one unit change of EGRW, selection of capsicum reduces by 3 units. The significant variables relative to beet are PAV, FCRD, WAVL, WAV, FWCN and EGRW. However, the log odds ratio of the FWCN and EGRW indicate a negative relationship. Decision making based on both variables indicates that beetroot would be selected rather than capsicum. SAV, FAV, PAV, FCRD, WAVL, LAV, YILD and EGRW show the significant relationship relative to cabbage. A multinomial log-odds value of the LAV is negative which means decisions based on labour availability will be in favour of cabbage when other factors are constant. NMVEN and LAV variables are negative relationships and WAVL, WAV, MAV and YILD variables are positively related compared to carrot. EXTO, WDATA, FAV, MAV, YILD are the major determinants for selecting capsicum relative to knolkhol. When the extent cultivated under capsicum increases, farmers tend to select knolkhol for other areas. WDATA, FAV, WAVL, seed cost (SCST), FWCN, EGRW are the determinants to select capsicum relative to leeks. INCRD, MAV and SCST are the key determinants for selecting capsicum compare to radish. The log-odds ratio of MAV is positive and availability of own money would encourage farmers to select capsicum rather than radish.

7.3.1.5 Determinants for Selecting Carrot

The results of Table No 6 in the annex are determinants of carrot selection compared to the other crops. Accordingly, SAV, PAV, FCRD, MKTP and YILD are significant relative to bean. MAV and MKTP are the key determinants relative to beetroot. The log-odds ratio of the MKTP reveals that decision making to select carrot decreases 3 units compared to beetroot; otherwise probability to choose carrot is less than beetroot. NMVEN, SAV, FCRD, WAV, MKTP and WMKT variables are major determinants in selecting carrot relative to cabbage. Determinants for carrot relative to capsicum are NMVEN, WAVL, LAV, WAV, MAV, and YILD. When farmers decide to select crops concerning the yields of both carrot and capsicum, capsicum will be selected according to the log-odds ratio of the YILD. EXTO and NMVEN are the key determinants for selecting carrot relative to knolkhol. Log-odds ratio of the EXTO is negative and when the extent under carrot increases in other areas, there is a greater chance of selecting knolkhol compared with carrot. Determinants of selecting carrot relative to leeks are MKTP, SCST, YILD and EGRW. The significant variables of the selection of carrot compared with radish are INCRD, WAVL, LAV, MAV, WMKT, SCST and YILD.

7.3.1.6 Determinants for Selecting Knolkhol

Multinomial logit analysis for selecting knolkhol is presented in Annex No 07. Compared to bean, NMVEN and COP are the main determinants. The log-odds ratio of the COP increases from 2 units relative to the bean which reveals that if farmers decide to select crops based on the cost of production, the tendency for selecting knolkhol is high compared to beans when other factors are constant. The significant variables are EXTO, WDATA, NMVEN and MAV relative to beetroot. EXTO, WDATA, COP are significant determinants relative to cabbage. The variables such as EXTO, WDATA, FAV, MAV, and YILD are significant determinants relative to capsicum. The farmers who cultivate up-country vegetables have enough money to invest in their cultivation; according to the log-odds ratio of MAV they would select capsicum rather than knolkhol. Compared with carrot, log-odds ration of the EXTO and NMVEN are significant. Only NMVEN variable shows a significance relative to leeks. INCRD, LAV and YILD are key determinants for selecting knolkhol relative to radish.

7.3.1.7 Determinants for Selecting Leeks

Table No 08 in the annexes illustrates the results of the multinomial logit model estimation for leeks. Accordingly, OINF, SAV, COP, WAV and FWCN are the significant determinants relative to the bean. The log-odds ratio of the SAV is negative and indicates that seed availability of bean encourages farmers to select bean than leeks. Decision making considering FWCN of both leeks and bean would promote bean rather than leeks. EXTO and WDATA are the key determinants for selecting leeks relative to beetroot. Log-odds ratio of EXTO increasing one unit relative to beet, nearly 1.5 units of the log-odds increase leeks selection. If farmers have weather data, they tend to select beetroot rather than leeks. Log-odds ration of WDATA for selecting leeks relative to cabbage is negative which indicates if farmers have weather information cabbage would be selected over leeks. WDATA, FAV, WAVL, SCST, FWCN and EGRW are the main determinants relative to capsicum. When comparing capsicum cultivation with leeks, there is greater chance of choosing leeks than capsicum with reference to easy cultivation. MKTP, SCST, YILD and EGRW are the significant determinants of leeks selection relative to carrot. INCRD, LAV, MAV and WMKT are significant determinants relative to radish.

7.3.1.8 Determinants for Selecting Radish

The results of the multinomial logit model estimation for radish are presented in Annex No 9. INCRD, WAVL, LAV, MAV and WMKT variables are significant relative to bean. Compared to the beetroot, INCRD, LAV, MAV and WMKT are the key determinants. When considering the log-odds ratio of the WMKT is negative and farmers may tend to select beetroot rather than radish. INCRD, LAV, MAV and YILD are the determinants relative to cabbage. If farmers do not have a labour availability problem they would select cabbage over radish. INCRD, MAV and SCST are the variables related to radish selection compared to capsicum. Availability of their own money would encourage farmers to choose capsicum rather than radish. INCRD, WAVL, LAV, MAV, WMKT, SCST and YILD are significant variables relative to carrot. It is revealed that the marketable capacity of radish is less than carrot. INCRD, LAV and YILD are significant relative to knolkhol. INCRD, LAV, MAV, WMKT show a significant relationship relative to leeks. The marketing capacity of radish is greater than leeks.

We have summarized the results of the multinomial logit model in Table 7.4 to help visualize the overall picture of determinants and variability in up-country vegetable selection.

Table 7. 1 Summary of the Determinants for Selecting UP-country Vegetables

Variable	Bean	Beet	Cabbage	Capsicum	Carrot	Knol-khol	Leeks	Radish
EXTO	X	X	X	X	X	X	X	
FPR								
MDEM								
WDATA		X	X	X		X	X	
NMVEN	X	X	X	X	X	X	X	
OINF	X		X				X	
SAV	X	X	X	X	X		X	
FAV	X		X	X		X	X	
PAV	X	X	X	X	X			
COP	X		X	X		X	X	
TAST								
FCRD	X	X	X	X	X			
INCRD	X	X	X	X	X	X	X	X
WAVL	X	X	X	X	X		X	X
LAV	X	X	X	X	X	X	X	X
WAV	X	X	X	X	X		X	
MAV	X	X	X	X	X	X	X	X
MKTP	X	X	X		X		X	
WMKT	X	X	X		X		X	X
SCST				X	X		X	X
YILD	X		X	X	X	X	X	X
FWCN	X	X		X			X	
EGRW	X	X	X	X	X		X	

Note: X – denoted at least one or more time significant at 1%/5%/10% level at the different base outcome

7.3.2 Multinomial Logit Models for Low-Country Vegetables

There are therein crops in the low-country vegetable category. Thus therein multinomial logit models have been run for each crop by changing the base outcome. The results of all models are presented in the tables Annexes 10 to 22. Accordingly, the Chi-square value of the Log-Likelihood ratio test shows that the models are statistically significant at the one percent level which is the overall significance of the models. McFadden's pseudo-R-squared value is 0.26, indicating that around 26% of the estimating models are fitted with real data.

7.3.2.1 Determinants for Selecting Pumpkin

The output of the estimated multinomial logit model has presented Annex No 10. According to the results, there is no significant difference to select pumpkin relative to snake gourd. Forecasting price/expected price (FPR), NMVEN and YILD are key determinants for choosing pumpkin compared to cucumber. WDATA, NMVEN, MAV, SCST and YILD are the significant variables relative to bitter gourd. Sensitivity to future weather data is higher compared with bitter gourd. Log-odds ratio of YILD is negative which means pumpkin selection is less than bitter gourd based on the yield factor when the impact of the other factors are constant. Compared to the okra, WDATA, NMVEN, LAV, SCST and YILD are the significant determinants of pumpkin selection. Availability of the labour may encourage farmers to select okra rather than pumpkin. The negative log-odds ratio of the YILD reveals that the probability of okra selection is greater than pumpkin selection. WAVL, WMKT and YILD are significant relative to brinjal. Accessibility of water may encourage pumpkin selection rather than brinjal. Comparing with luffa, WDATA, NMVEN and YILD are key determinants. Log-odds ratio of the WMKT is a key determinant relative to long bean. Otherwise, marketing issues are not evident for long bean compared with pumpkin. There is no significant difference between the winged bean and pumpkin. SAV and WAV are key determinants to select pumpkin relative to *kekiri*. WMKT, SCST and YILD are significant variables relative to the tomato. Log-odds ratio of the WMKT is 3.2 and highlights those low-country vegetable growers may tend to select tomato rather than pumpkin based on the marketable capacity of the crop. There is no choice difference between pumpkin and *thumba* selection. Determinants of selecting pumpkin are NMVEN, WMKT, SCST and YILD relative to *elabatu*.

7.3.2.2 Determinants for Selecting Snake Gourd

Table No 11 in the annexes provided the output of the multinomial logit model estimation. There is no significant difference in selecting snake gourd relative to the pumpkin. Both FPR and COP are the significant determinants for selecting snake gourd compared to cucumber. Selecting of snake gourd and bitter gourd has not differed with reference to the present explanatory variables in the multinomial logit model. WDATA is a key determinant for selecting snake gourd relative to okra. Compared to brinjal cultivation, there is no significant difference in selecting snake gourd. EXTO and COP are the main determinants relative to the luffa. Determinants of snake gourd and long bean selection have not significantly changed; otherwise equal weights are given for selecting snake gourd and long bean. The same picture has been indicated for winged bean and snake gourd. NMVEN, SAV, SCST and COP have shown a significant relationship while selecting snake gourd relative to the *kekiri*. Seed availability and cost of production may result in *kekiri* being selected rather than snake gourd. EXTO is the key determinant to select snake gourd relative to tomato. When comparing with *thumba*, there is no significant difference in selecting snake gourd. NMVEN is a significant variable relative to *elabatu.*

7.3.2.3 Determinants for Selecting Cucumber

The output of the multinomial logit model estimating for cucumber is presented in Table No 12 in the annexes. FPR, NMVEN and YILD are the significant determinants relative to pumpkin. Log-odd ratio of the FPR and COP are significant determinants. WDATA is the key determinant for selecting cucumber relative to bitter gourd. FPR, WDATA and MKTP have been significant variables relative to okra. Significance of the FPR and MKTP reveals that decision making based on the market price has encouraged growing okra rather than cucumber. WAVL is the key determinant for selecting cucumber relative to brinjal. According to the FPR, farmers would select luffa because expected market price will not decrease more compared with cucumber. EXTO, FPR and NAVEN are the key determinants with regard to long bean. There is no significant difference between the selection of cucumber and winged bean. The log-odds ratios of NMVEN, WAV, MAV and SCST are the significant variables relative to the. Seed availability of the *kekiri* has encouraged its selection rather than the cucumber. Considering WAV, MAV and SCST, if low-country vegetable growers have decided to select a crop they are more likely to choose cucumber rather than *kekiri*. Compared to tomato, NMVEN, COP, WAVL and WMKT are the key determinants. However, according to the log-odds ratio of the WMKT tomato is more marketable than cucumber. There is no significant difference between the selection of *thumba* and cucumber. FPR is the key determinant for selecting cucumber over *elabatu*. However, log-odds of the FPR would suggest *elabatu* is better than cucumber considering FPR.

7.3.2.4 Determinants for Selecting Bitter Gourd

The results of the estimating multinomial logit model for bitter gourd have been presented in Annex No 13. Accordingly, WDATA, NMVEN, MAV, SCST and YILD are the key determinants relative to pumpkin. When SCST and YILD are considered bitter gourd would be selected compared to pumpkin. There is no significant choice difference between bitter gourd and snake gourd. Sensitivity to weather data is less relative to cucumber. EGRW is the only determinant when selecting bitter gourd relative to okra. WDATA, WAVL and MAV are the significant variables for selecting bitter gourd relative to brinjal. Compared to luffa, market demand (MDEM) and EGRW are significant relative to luffa. MDEM, WDATA, NMVEN, PAV, INCRD, YILD and EGRW are the determinants relative to long bean. There is no significant difference between the selection of winged bean and bitter gourd. Compared to the *kekiri*, NMVEN, SAV, FAV, MAV and SCST are the significant variables. WDATA, NMVEN, PAV and WAVL are the significant variables. When selecting *thumba* and bitter gourd, there is no significant difference among those crops. MDEM, WDATA, FCRD and MAV are the key determinants relative to *elabatu.*

7.3.2.5 Determinants for Selecting Okra

Multinomial logit output for selecting okra is presented in Annex No 14. WDATA, NMVEN, LAV, SCST and YILD are the significant determinants relative to pumpkin. Considering WDATA, pumpkin will be selected. Availability of labour will encourage farmers to select okra rather than pumpkin. When considering the yield of the crop, farmers tend to choose okra rather than pumpkin. Comparison with snake gourd, WDATA is the key determinant. FPR, WDATA and MKTP are the significant determinants relative to cucumber. The key determinant of selecting okra compared to bitter gourd is EGRW. WDATA and WAVL are the significant variables relative to brinjal. EXTO is the key determinant relative to luffa. WDATA and YILD are significant determinants compared with long bean. There is no significant difference between okra and winged bean. NMVEN, SAV, FAV, WAV, MAV and SCST are the significant variables relative to the *kekiri*. Availability of water would encourage farmers to choose okra rather than *kekiri*. WDATA, LAV and MKTP are the determinants relative to tomato. EGRW is the key determinant relative to *thumba*. This reveals that okra is easier to cultivate than *thumba*. WDATA and MKTP are the significant variables relative to *elabatu*. Selecting okra is more likely than selecting *elabatu* considering the market price of the last season.

7.3.2.6 Determinants for Selecting Brinjal

The results of the multinomial logit models for brinjal are shown in Table no 15 in the annexes. Accordingly, WAVL, WMKT and YILD are the key variables related to pumpkin. When considering the accessibility of water, there's a greater interest in pumpkin cultivation as opposed to brinjal. However, when potential yields are considered, there’s a better chance of selecting brinjal rather than pumpkin. There is no significant difference between brinjal and snake gourd selection. WAVL is the key determinant when selecting brinjal relative to cucumber. However, the accessibility of water leads cucumber to be chosen rather than brinjal. WDATA, WAVL and MAV are the significant variables relative to bitter gourd. WDATA and WAVL are significant determinants compared to okra. WAVL is the main determinant to select brinjal relative to luffa. WAVL and YILD are the significant variables relative to long bean. There is no significant difference between selecting brinjal and winged bean. When compared with *kekiri*, NMVEN, SAV, WAV and SCST are the key determinants. There is no significant difference between the selection of brinjal and tomato or between *thumba* and brinjal. NMVEN, WAVL and MKTP are the significant determinants relative to *elabatu*.

7.3.2.7 Determinants for Selecting Luffa

The estimated results of the multinomial logit model for luffa are presented in Table 16 of the annexes. WDATA, NMVEN and YILD are the significant determinants for selecting luffa relative to pumpkin. EXTO and COP are the determinants which are significant compared to snake gourd. FPR is a key factor in choosing luffa relative to cucumber cultivation. MDEM and EGRW are the significant variables in selecting luffa compared to bitter gourd. EXTO is the key significant factor relative to okra. Accessibility of water is the key determinant to select luffa as opposed to brinjal. EXTO, WDATA, NMVEN and YILD are the key determinants for selecting luffa compared to long bean. There is no significant difference between the selection of luffa and winged bean. NMVEN, SAV, FAV, MAV and SCST are the significant variables relative to *kekiri*. With compared to tomato, NMVEN, COP and WAVL are significant determinants. EGRW is the key determinant for selecting luffa relative to *thumba*. Ease of cultivation is greater in the case of luffa compared to *thumba*. There is no significant difference between the selection of luffa and *elabatu.*

7.3.2.8 Determinants for Selecting Long Bean

The output of the multinomial logit model estimating is provided in Table 17 of the annexes. WMKT is the key determinant of selecting long bean relative to pumpkin. There is no significant difference between selecting long bean and snake gourd. However, compared to cucumber, EXTO, FPR and NMVEN are significant determinants. MDEM, WDATA, NMVEN, PAV, INCRD, YILD and EGRW are the determinants for selecting long bean relative to bitter gourd. Log odds ration of the YILD shows a negative relationship and it could be interpreted that bitter gourd would be selected rather than long bean considering yield of the crops. Ease of cultivation is positive and long bean would be selected over bitter gourd. WDATA and YILD are significant relative to okra. Compared with brinjal cultivation, WAVL and YILD are the key determinants. EXTO, WDATA, NMVEN and YILD are the main determinants for selecting long bean relative to luffa. There is no significant difference between selecting long bean and winged bean. SAV, the taste of the crop (TAST), WAV and SCST are the significant determinants relative to *kekiri*. Compared to tomato, EXTO, YILD and EGRW are the determinants for selecting long bean. The log odds ratio of the EGRW is positive and it has changed 4 units compared to *thumba*. Otherwise, it reveals further long bean cultivation is easier than *thumba* cultivation. Only NMVEN is significant relative to *elabatu*.

7.3.2.9 Determinants for Selecting Winged Bean

The results of the multinomial logit model for winged bean selection are presented in Table No 18 of the annexes. There is no significant difference among the selection of all crops of the low country vegetables and winged bean selection except *kekiri*. Further, winged bean cultivation is not influencing the decision of selecting other vegetables. On the other hand, winged bean cultivation has not expanded in the country. Therefore only a limited quantity would come into the market and marketing issues have not arisen. Only TAST is a significant variable relative to *kekiri*.

7.3.2.10 Determinants for Selecting Kakiri

The results of the estimating multinomial logit model for *kekiri* are provided in Table No 19 of the annexes. SAV and WAV are the significant determinants for selecting *kekiri* relative to pumpkin. Relative to snake gourd, NMVEN, SAV, COP and SCST are the key determinants. NMVEN, SAV, WAV, MAV and SCST are the significant determinants relative to cucumber. The log odds ratios of the WAV, MAV and SCST are negative and it reveals that the probability of cucumber selection is greater than of *kekiri*. NMVEN, SAV, FAV, MAV and SCST are determinants for choosing *kekiri* relative to bitter gourd. When compared to the okra, the significant variables are NMVEN, SAV, FAV, WAV, MAV and SCST. The availability of water would encourage farmers to cultivate okra rather than *kekiri*. NMVEN, SAV, WAV and SCST are the main determinants relative to brinjal. When compared to luffa, the significant determinants are NMVEN, SAV, FAV, MAV and SCST. SAV, TAST, WAV and SCST are the key determinants compared with long bean. TAST is the only one determinant for selecting *kekiri* relative to winged bean. NMVEN, SAV, WMKT and SCST are the main factors relative to tomato cultivation. With regard to *thumba* cultivation, NMVEN, MAV and SCST are the determinants for selecting *kekiri*. NMVEN, SAV, WAV and SCST are the significant variables relative to *elabatu* cultivation.

7.3.2.11 Determinants for Selecting Tomato

The output of the estimated multinomial logit model for selecting tomato is presented in Table No 20 of the annexes. WMKT, SCST and YILD are the major determinants relative to pumpkin. The log odds ratio of WMKT would increase by 3.2 units compared to pumpkin while other factors are constant. EXTO is significant factor relative to snake gourd. NMVEN, COP, WAVL and WMKT are the determinants for selecting tomato compared to cucumber. WDATA, NMVEN, PAV and WAVL are significant variables relative to bitter gourd. Compared to the okra, WDATA, LAV and MKTP are the key determinants. There is no significant difference between the selection of tomato and brinjal. NMVEN, COP and WAVL are significant variables relative to luffa. EXTO, YILD and EGRW are the key determinants relative to long bean. With respect to ease of cultivation, farmers tend to select long bean rather than tomato according to the log odds ratio of the EGRW. There is no significant difference between the selection of tomato and winged bean. However, with reference to *kekiri* cultivation NMVEN, SAV, WMKT and SCST are significant determinants. There is no significant relationship between tomato and *thumba* cultivation selection. When compared with *elabatu*, NMVEN is the key determinant.

7.3.2.12 Determinants for Selecting Thumba

The multinomial logit output for selecting *thumba* has shown in Table No 21 of the annexes. According to the results depicted in Table No 21, there is no significant difference among determinants in selecting *thumba* and pumpkin, snake gourd, cucumber, bitter gourd, brinjal, winged bean, tomato and *elabatu*. However, the log odds ratio of the EGRW relative to okra, luffa and long bean are significant and negative. This implies that okra, luffa and long bean cultivation are easier to cultivate than *thumba* according to the results. NMVEN, MAV and SCST are significant determinants relative to *kekiri.*

7.3.2.13 Determinants for Selecting *Elabatu*

The estimated results of the multinomial logit model for selecting *elabatu* are presented in Table No 22 of the annexes. NMVEN, MKTP, SCST and YILD are the significant determinants relative to pumpkin. Compared to the snake gourd, NMVEN is the key determinant. FPR is the only determinant for selecting *elabatu* relative to cucumber. MDEM, WDATA, formal credit (FCRD) and MAV are the main determinants relative to the bitter gourd. Compared to okra, WDATA and MKTP are significant variables. NMVEN, WAVL and MKTP are key determinants relative to brinjal. There is no significant difference between *elabatu* and luffa selection. NMVEN is the key variable which is significant relative to long bean. There is no significant difference between selecting the determinants of *elabatu* and winged bean. NMVEN, SAV, WAV and SCST are significant determinants relative to *kekiri*. Compared to the tomato, NMVEN is the key determinant. When comparing *elabatu* and *thumba* selection determinants, no significant difference is observed.

All the results explained in previous section have been summarized in Table 7.5 to understand the variability of determinants in different crops.

Table 7. 2 Summary of the Determinants for Selecting Low-country Vegetables

Variable	Pumpkin	Snake gourd	Cucumber	Bitter gourd	Okra	Brinjal	Luffa	Long bean	Winged bean	Kakiri	Tomato	Thumba	*Elabatu*
EXTO		X	X		X		X	X			X		X
FPR	X	X	X		X		X	X					X
MDEM				X			X	X					X
WDATA	X	X	X	X	X	X	X	X			X		X
NMVEN	X	X	X	X	X	X	X	X		X	X	X	X
OINF													
SAV	X	X	X	X	X	X	X	X		X	X		X
FAV				X	X		X			X			
PAV				X				X			X		
COP		X	X				X			X	X		
TAST								X	X	X			
FCRD				X									X
INCRD				X				X					
WAVL	X		X	X	X	X	X	X			X		X
LAV	X				X						X		
WAV	X		X		X	X		X		X			X
MAV	X		X	X	X	X	X			X		X	X
MKTP	X		X		X	X					X		X
WMKT	X		X			X		X		X	X		
SCST	X	X	X	X	X	X	X	X		X	X	X	X
YILD	X		X	X	X	X	X	X			X		X
EGRW					X		X	X			X	X	

Note: X – denoted at least one or more time significant at 1%/5%/10% level at the different base outcome

CHAPTER EIGHT

Conclusion and Recommendations

8.1 Conclusion

Adoption of new technology is dependent on the demographic characteristics of the farmers. Age, experience and education level provide some background information about the farmers' adoption capacity to new technology. The farmers have enough experience to produce vegetables. The majority of farmers have a reasonable education level to conduct domestic agricultural activities.

Majority of farmers were small scale and most of them have utilized their owned lands to cultivate vegetables in both up-land and low-land. Farmers have depended on long term experience to select crops relevant to the soil. Interestingly, one-third of the farmers have considered recommendations of the soil testing reports. Minor irrigation systems comprised the major water source (46%) of vegetable farmers and nearly one third (31%) of farmers have used agro-wells and tube-wells. However, more than 80% have been satisfied with the availability of the water source whilst the rest struggled without access to water sources. Nearly half of the interviewed farmers have used water-pumps to supply water into their vegetable plots and one-fifth of the farmers use the most efficient water use technologies such as drip irrigation and sprinkler systems.

The accessibility for seed and planting material has been easy but farmers stressed that in some seasons they have faced some difficulties in finding preferred varieties. In some instances, vast price variations of seeds varieties were highlighted.

When considering up-country vegetables, the preferred months to start cultivation were May, June and July although cultivation of some vegetables had been begun in October, November and December by the fewer number of farmers. While referring to low-country vegetables, irregular cultivation initiation pattern was observed. However, most of the low-country vegetable crops have been started in March, April, May, June, August and September rather than other months.

In Sri Lanka, eleven information-sharing tools have been in circulation up to 2019. Therefore, the availability of information is not an issue for the farming community; however, most of the applications were not well known among the farming community. The awareness level about information-sharing tools and applications has been lower than expected among vegetable growers in Sri Lanka.

Most of the applications were developed to suit the smart world hence to access and collect information from most of the available information-sharing tools internet facilities and suitable equipment such as smart phones, tabs, laptops or computers are necessary. The data revealed that information-sharing methods by way of the internet would not be effective because of limited access to the internet facilities for vegetable farmers. Therefore, vegetable farmers do not make accurate decisions due to lack of awareness and access to information but not because information is unavailable.

However, farmers use other avenues to access relevant information. They make use to extension services, communicate with agrochemical sales centers and inquire from neighbouring farmers. Therefore, conventional methods still remain the most effective way to disseminate information among vegetable farmers. The main limiting factor in accessing available information sources is the lack of awareness. Around 70% of farmers still depend on personal contacts and as such information transformation system from the national level to ground level through a third party would be more effective rather than on an individual basis. The majority of farmers do need information relating to disease and controlling methods, new seed varieties and relevant technical knowledge, market prices and variations, new technical knowledge, formal methods for correct application of agrochemical and the quality agrochemicals and fertilizer.

In the broader picture, around 48% of vegetable growers were able to get cost-effective returns. On the other hand, around 86% of the vegetable growers in Sri Lanka have received enough income to cover their cash cost while 14% were unable to cover even their cash cost. Unfortunately, around 44% of the cabbage, 48% of the leeks, 26% of the pumpkin, 25% of the luffa and kakiri and 35% of the tomato producing farmers were unable to cover their cash cost from vegetable cultivation in 2019. The cultivation of beetroot, capsicum, cucumber, bitter gourd, brinjal, long bean, *kakiri, thumba* and *elabatu* were the economically viable crops with respect to the returns per family labour (Rs/day/ac). According to the return per worker (Rs/day/ac), the same crops except for beetroot, brinjal, long bean and *kakiri*, were economically viable among both up-country and low-country vegetables. The return per worker for farmers cultivating cabbage, carrot, leeks and tomato was less than Rs 500.00 per day. However, knolkhol and okra producers have earned incomes between Rs 500 and Rs 100 per day. In the case of bean, radish, pumpkin, snake gourd and luffa returns of Rs. 1000-1500 per working day were recorded.

The nine marketing channels for distributing vegetables from farmer to consumer were considered in this study. Accordingly, more than 60% of the total vegetable distribution was functioning through the dedicated economic centres (DEC) in Sri Lanka. Around one-third of the total vegetable market in Sri Lanka involved the farmer, DEC and the retailer. Vegetable collectors account for 20% of the distribution network. Wholesalers of the vegetable market have engaged to distribute vegetables from farmer to retailer which was around 40% in Sri Lanka. The Dambulla Dedicated Economic Centre could be identified as the main vegetable wholesale market. Nearly 80% of the vegetables produced in the Anuradhapura District, 50% in Kurunegala, Nuwara Eliya and Kandy, 14% in Puttalam, four percent in Ratnapura and two percent in Hambantota have been distributed via the Dambulla Dedicated Economic Centre. Therefore, the Dambulla DEC is the prime price-determining vegetable market in Sri Lanka. Around 69% of vegetables grown in Ratnapura, 17% in Badulla, 14% in Kurunegala, 13% in Puttalam, 10% in Hambantota, five percent in Anuradhapura, four percent in Nuwara Eliya and three percent in Kandy have gone to the Manning Market in Colombo. Around 60% of the vegetable production in Badulla District has been sold in the Bandarawela wholesale market while 19% of the production has gone to the Kepetipola DEC.

Farmers mentioned several key issues in the market distribution network. Nearly 40% of the farmers mentioned the absence of stable market prices for vegetable crops. The intervention of middlemen in the value chain was also mentioned as a serious concern since they earn far greater profits compared to farmers. Around 13% of the farmers mentioned the commission charged by the DECs as a concern. The high transport cost (7%) and marketing problems in the event of a surplus situation (6%) were also highlighted.

There was a relative absence of awareness about the post-harvest technologies, processing techniques and value-added product. There was sufficient awareness about post-harvest technologies but only a few and simple techniques were being used and only by a few farmers, collectors and wholesalers. Processing of vegetables in low except in the case of a few vegetable exporters and super market chains was observed. Around 44% of the vegetable producers had never heard about processing techniques. There was a huge knowledge gap about value addition in the vegetable sector (97%). There is potential however for the expansion of processing and value addition technologies which could reduce the post-harvest losses and enhance the farmers' income.

The yields, harvesting frequency, sensitivity to the market price, cost of production and ease of cultivation were some of the major factors considered when selecting crops. Around two-thirds of the vegetable growers have considered about the yield when selecting crops for cultivation. Some vegetables such as bean, beet, radish, knolkhol, luffa, cucumber and snake gourd comparatively matured within a short time and around 40% of the farmers have considered this when making decisions. Around two-thirds of the farmers have not considered suitability in terms of agro-ecological conditions before crop selection. Resistance to pest and disease of the crops has significantly influenced the farmers' decision-making process.

Around 40% of the farmers have taken into consideration crops which fetched better prices in the same season in the previous year while 30% considered prices from the previous season itself. In general a few vegetable crops have received moderate or fair market prices every season and 22% of the respondents used these criteria when selecting crops to cultivate. Around 10% of the sample has followed the negative sign of the market price and they expect fewer farmers will cultivate due to low prices reported in the previous season. Seed cost and cost of production are also a key determinant in crop selection. A majority of the farmers (more than 60%) have not considered seed costs when selecting crops. Interestingly, one-fifth of the farmers have considered seed cost as an important factor while crop selecting. Nearly 60% of the farmers have thought about the cost of production before selecting the crop for the next season.

Availability and accessibility of resources for cultivation may influence crop selection decisions. The availability of resources is not a critical problem for vegetable growers but accessibility problems do occur with regard to certain resources. Nearly 20% of the farmers have highlighted that labour was not easy to obtain and more than 20% stressed water as the major problem. More than 50% of the farmers expressed difficulty in bearing the initial cost of cultivation. The results reveal that 30% depend on agricultural loans and nearly 20% pawned their jewelry.

Information plays a very important role when making intelligent economic decisions. Farmers have used several sources of information to select crops. However, more than 60% of the farmers have underlined the importance of extent data. More than 70% of the vegetable growers showed interest in forecasted price for vegetables. The behavioural pattern of the weather/climatic conditions (more than 80%), new market ventures and entrepreneurship information (more than 60%) were also highlighted as having a high impact on decision-making.

The results of the multinomial logit model estimated for up-country vegetables revealed that the selected factors influenced farmers' decisionson crop selection. The cultivated/expected extent of the particular crops in other areas was one of the key determinants in the case of bean, beet, cabbage, capsicum, carrot, knolkhol and leeks producers. Beet, cabbage, capsicum, knolkhol and leeks producers were interested to know weather data. New market ventures and entrepreneurship information have been concerns for all up-country vegetable producing farmers except radish producers. Bean, cabbage and leeks producing farmers' decisions have been motivated by the others; influence. The availability of seeds has encouraged farmers to grow bean, beet, cabbage, capsicum, carrot and leeks. Whether fertilizer was available or not in the market has not affected decisions on cultivating beet, carrot and radish. Whether pesticides available in the market or not has not concerned those who grow knolkhol, leeks and radish. Bean, cabbage, capsicum, knolkhol and leeks growers have been very concerned about the production cost of the selected crops. Formal credit availability has not influenced farmers who decided to grow knolkhol, leeks and radish and informal credit availability was mentioned by all up-country vegetable growers. The availability and accessibility of water are factors considered by bean, beet, cabbage, capsicum, carrot and leeks growers while knolkhol and radish producers were not concerned with water availability. The availability of labour and own money was the key determinants for all up-country vegetables. Market prices of the previous season have influenced the selection of bean, beet, cabbage, carrot and leeks for cultivation. Farmers who cultivated bean, beet, cabbage, carrot, leeks and radish had taken into account marketability. Capsicum, carrot, leeks and radish producers have considered the cost of seeds. The yield of the crops has been an important factor for all crops except beet. Expected/forecasting price of the crops, market demand and taste of the crops were not significant for any up-country vegetables.

The output of the estimated multinomial logit model for low-country vegetables demonstrated that selected factors influenced crop selection. Farmers who grew snake gourd, cucumber, okra, luffa, long bean, tomato and *elabatu* have thought about the cultivated/expected extent of the particular crop in other areas. Expected/forecasting price has been considered by pumpkin, snake gourd, cucumber, okra, luffa, long bean and *elabatu* growers. Bitter gourd, luffa, long bean and *elabatu* producers have considered the market demand. All low-country vegetable growers except those who cultivated winged bean and *thumba* have stressed the importance of having in hand future climatic/weather data. All the low-country vegetable growers were interested in information about new market ventures and entrepreneurship. The availability of seeds has been considered by all of the low-country vegetable growers excluding those who grew winged bean and *thumba*. The bitter gourd, okra, luffa and kakiri producing farmers have thought about the availability of fertilizer when they selecting those crops. The bitter gourd, long bean and tomato cultivating farmers have worried about the availability of pesticide. The production cost of the crops had been considered by the snake gourd, cucumber, luffa, *kakiri* and tomato farmers. The taste of crop was not significant for any low-country vegetables but long bean, winged bean and *kakiri* producing farmers had considered these factors. Formal credit availability encouraged bitter gourd and *elabatu* cultivation while the availability of informal credit encouraged the cultivation of bitter gourd and long bean. Water availability and accessibility have been considered by pumpkin, cucumber, okra, brinjal, luffa, long bean, tomato and *elabatu* producers. Farmers who grew pumpkin, okra and tomato have thought about the availability of labour. Having one's own money persuaded farmers to cultivate pumpkin, cucumber, bitter gourd, okra, brinjal, luffa, *kekiri*, *thumba* and *elabatu*. The market price of the previous season influenced the decision to grow pumpkin, cucumber, okra, brinjal, tomato and *elabatu*. Pumpkin, cucumber, brinjal, long bean, kakiri and tomato producing farmers have thought about whether the crop is marketable or not before crop selection. Seed cost was a key determinant for all low-country vegetables except winged bean. Snake gourd, winged bean, *kakiri* and *thumba* producing farmers were not concerned about the yield of the crops but other low-country vegetable growers considered this an important factor.

8.2 Recommendations

The majority of the vegetable growers use conventional agro-technologies because most of them are relatively older (only 3% are below 30 years of age). Therefore, the development of the vegetable production sector requires a greater involvement of youth. Digital information sharing methods have been developed by the public and private sector but capacities to make use of them should be expanded so that strategically meaningful decisions can be made. To develop agro-entrepreneurs among the young generation in most vegetable producing areas knowledge on techniques and value addition should be disseminated while providing financial support and ensuring close monitoring and evaluation.

To increase the efficiency of water usage among water-pumps users, it is necessary to provide financial support or introduce loan schemes to enable the installation of drip irrigation/sprinkler systems or granting drip irrigation/sprinkler systems for those farmers who struggle most to obtain water.

Random quality checks are necessary to resolve seed quality issues such as the sale of inferior seeds (mixing, changing expiry dates). The Seed Certification Service of the Department of Agriculture should ensure the quality of seeds in the market.

Since awareness about information-sharing tools and applications was low among the vegetable growers in Sri Lanka, an awareness programme needs to be implemented at the ground level by the Ministry of Agriculture.

Promoting mobile hotlines is recommended for sharing information because information-sharing methods do not deliver expected results due to limited access to internet facilities.

It is necessary to prepare a systematic mechanism for sharing information from top to bottom and develop a strong network with the field officers empowering them with updated information necessary to support the decision-making process of the farmers.

Reducing the production cost of vegetable cultivation, seeds, agrochemicals and fertilizers is a matter that requires urgent attention. Providing tax relief for selected vegetables with an agreement to the reduce seed price of all private sector seed importers and grant a fertilizer subsidy for vegetable growers as encouragement are recommended.

The Dambulla Dedicated Economic Centre can be used as a main information-sharing hub because it is the prime price-determining vegetable market in Sri Lanka. On the other hand, a lot of farmers engage with the Dambulla wholesale market. Establishing a center for disseminating market information close to the DEC is recommended.
To ensure a stable market price for vegetables with minimum price volatility, it is necessary to prevent oversupply of vegetables. Preparation and implementation of a production plan at zonal levels to stabilize the supply of the vegetables so that demand can be met is recommended.

Encouraging farmers to implement collective marketing strategies through farmer organizations is recommended. All Dedicated Economic Centers in Sri Lanka should reduce the commission.

To minimize post-harvest losses and control over-supply, processing and value addition technologies should be demonstrated through AIs and ASCs.

In order to minimize the risk of vegetable cultivation, farmers should be encouraged to opt for a mixed cropping systems maintaining starting time differences between different crops. On the other hand, introducing an insurance scheme for vegetable farmers with the engagement of the Agricultural and Agrarian Insurance Board is recommended because around 70% of the farmers have depended on credit to manage risks.

The yield of the crops is the prime determinant among vegetable growers, therefore displaying yield information on the seed packet at the seed selling stage is recommended. Providing information about pests and diseases for different crops centers is also recommended.

Since 80% of the farmers have utilized price information pertaining to crops for decision making, sharing a forecasting price, as well as the cost of production among vegetable growers via public media is recommended.

Vegetable producers need to know extent data, forecasting prices and weather data. Therefore, it is recommended that a data gathering and sharing system be developed in collaboration with seed selling centres, both public and private would enable farmers to access the relevant information before purchasing seeds.

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Annexes

Annex 01 Results of the Factor Analysis

variables	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7	Factor8	Factor9	Factor10	Factor11
Mktp								0.76			
Wmkt								0.79			
cop			0.62								
Scst									-0.68		
Soil											0.84
Wavl					0.89		0.88				
Fwcn										0.56	
Exp											
Oinf		-0.54									
Ftim											
Egrw										0.80	
Tast			0.73								
Yild									0.61		
Gtim											
Rpdis											
Sav		0.82									
Fav		0.83									
Pav		0.81									
Lav						0.56					
Wav						0.53	0.52				
Fcrd				0.81							
Incrd				0.76							
Mav						0.74					
Exto	0.84										
Fpr	0.93										
Mdem	0.90										
Wdata	0.85										
nmven	0.76										

Annex 02: Multinomial Logit Model Estimation for Bean

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
exto		1.29**	0.74	0.91	0.62	-1.17	-0.12	0.39
fpr		0.16	0.29	-0.59	0.12	-0.71	0.08	0.60
mdem		0.22	0.16	-0.96	-0.50	-1.22	-0.88	0.03
wdata		-1.05	-0.88	-1.52	0.07	2.10	0.71	-2.79
nmven		-0.57	0.84*	0.52	-0.78	2.51**	0.15	0.75
oinf		0.85	1.70**	0.03	0.47	0.98	1.37*	-4.82
sav		1.97**	2.57**	0.40	1.26*	1.65	1.87**	1.75
fav		0.46	0.02	1.79**	0.40	-6.06	-1.87	0.58
pav		-3.30**	-3.46**	-0.62	-2.43**	2.89	-1.25	-1.64
cop		-0.65	-0.28	-1.16**	-0.46	-1.84**	-0.83*	-0.90
tast		-0.29	0.69	0.29	-0.42	1.92	0.10	-0.96
fcrd		-0.01	-0.10	1.61**	0.93*	1.74	0.47	0.10
incrd		0.50	-0.76	-0.34	-0.61	-0.38	0.18	-7.40*
wavl		-0.35	-0.31	-1.81**	0.08	-1.28	0.13	-3.37*
lav		0.03	-0.39	0.55	-0.44	-0.09	-0.04	3.28*
wav		-0.70	-1.63**	-2.19**	-0.14	-1.96	-1.00**	-2.53
mav		-0.71	0.12	-0.81	0.38	1.84	-0.26	4.61**
mktp		-1.15	-0.22	-0.04	1.33*	0.19	-0.84	3.98
wmkt		0.98	3.88**	-16.82	1.90	-13.93	1.72	10.38**
scst		-0.16	0.06	-0.51	-0.38	0.11	0.50	3.09
yild		0.75	1.66**	-0.82	2.01***	2.76	0.56	-2.58
fwcn		0.75	-16.47	6.38***	-15.46	-11.83	3.51**	2.74
egrw		-1.58	-1.11	2.65**	0.65	-0.76	-1.87	4.96
constant		9.35*	20.95	22.40	16.93	31.86	4.00	5.67
Base outcome	Bean	Beet	Cabbage	Capsicum	Carrot	Knol-khol	Leeks	Radish
Number of observation								195
LR chi2(161)								287.71
Prob.> chi2								0.00
Pseudo R2								0.3916
Log likelihood								-223.542

legend: * p<.1; ** p<.05; ***p<.001

Annex 03: Multinomial Logit Model Estimation for Beetroot

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
exto	-1.29**		-0.56	-0.38	-0.67	-2.47**	-1.41**	-0.9
fpr	-0.16		0.14	-0.75	-0.04	-0.87	-0.08	0.44
mdem	-0.22		-0.06	-1.18	-0.72	-1.44	-1.11	-0.19
wdata	1.05		0.17	-0.47	1.12	3.16**	1.76**	-1.74
nmven	0.57		1.41**	1.09	-0.21	3.08**	0.72	1.32
oinf	-0.85		0.85	-0.82	-0.37	0.13	0.52	-5.67
sav	-1.97**		0.6	-1.57	-0.71	-0.32	-0.10	-0.22
fav	-0.46		-0.44	1.33	-0.07	-6.53	-2.33	0.11
pav	3.30**		-0.15	2.68*	0.87	6.19	2.06	1.66
cop	0.65		0.38	-0.51	0.19	-1.19	-0.17	-0.25
tast	0.29		0.99	0.58	-0.12	2.22	0.40	-0.66
fcrd	0.01		-0.09	1.62**	0.94	1.75	0.48	0.11
incrd	-0.50		-1.27	-0.84	-1.11	-0.89	-0.33	-7.91**
wavl	0.35		0.04	-1.46*	0.43	-0.93	0.48	-3.02
lav	-0.03		-0.41	0.53	-0.47	-0.11	-0.07	3.25*
wav	0.70		-0.93	-1.49*	0.56	-1.26	-0.30	-1.83
mav	0.71		0.83	-0.10	1.09*	2.56*	0.45	5.32**
mktp	1.15		0.93	1.11	2.48**	1.34	0.31	5.13
wmkt	-0.98		2.90	-17.80	0.92	-14.90	0.74	9.41**
scst	0.16		0.21	-0.36	-0.22	0.26	0.66	3.24
yild	-0.75		0.92	-1.56	1.27	2.02	-0.19	-3.33
fwcn	-0.75		-17.22	5.63**	-16.21	-12.58	2.76	1.99
egrw	1.58		0.47	4.23**	2.23	0.82	-0.29	6.55
constant	-9.35*		11.59	13.05	7.58	22.51	-5.35	-3.68
Base outcome	Bean	Beet	Cabbage	Capsicum	Carrot	Knol-khol	Leeks	Radish

Number of observation	195
LR chi2(161)	287.71
Prob.> chi2	0.00
Pseudo R2	0.3916
Log likelihood	-223.542

legend: * p<.1; ** p<.05; *** p<.001

Annex 04: Multinomial Logit Model Estimation for Cabbage

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
exto	-0.74	0.56		0.18	-0.12	-1.91*	-0.85	-0.34
fpr	-0.29	-0.14		-0.88	-0.18	-1.01	-0.21	0.30
mdem	-0.16	0.06		-1.12	-0.66	-1.38	-1.04	-0.13
wdata	0.88	-0.17		-0.65	0.95	2.98**	1.59**	-1.92
nmven	-0.84*	-1.41**		-0.32	-1.62**	1.67	-0.69	-0.09
oinf	-1.70**	-0.85		-1.67	-1.23	-0.72	-0.34	-6.52
sav	-2.57**	-0.60		-2.18**	-1.32*	-0.92	-0.70	-0.82
fav	-0.02	0.44		1.77*	0.37	-6.09	-1.89	0.56
pav	3.46**	0.15		2.84**	1.03	6.34	2.21	1.81
cop	0.28	-0.38		-0.88	-0.18	-1.56*	-0.55	-0.63
tast	-0.69	-0.99		-0.41	-1.11	1.23	-0.59	-1.65
fcrd	0.10	0.09		1.71**	1.03*	1.83	0.57	0.20
incrd	0.76	1.27		0.43	0.16	0.38	0.94	-6.64*
wavl	0.31	-0.04		-1.50**	0.39	-0.97	0.44	-3.06
lav	0.39	0.41		0.94*	-0.06	0.30	0.34	3.67**
wav	1.63**	0.93		-0.56	1.49**	-0.33	0.63	-0.90
mav	-0.12	-0.83		-0.93	0.26	1.72	-0.38	4.49*
mktp	0.22	-0.93		0.18	1.55*	0.41	-0.62	4.20
wmkt	-3.88**	-2.90		-20.70	-1.98*	-17.80	-2.16	6.51
scst	-0.06	-0.21		-0.57	-0.43	0.05	0.44	3.03
yild	-1.66**	-0.92		-2.48**	0.35	1.10	-1.11	-4.25**
fwcn	16.47	17.22		22.86	1.01	4.65	19.98	19.21
egrw	1.11	-0.47		3.76**	1.76	0.34	-0.76	6.07
constant	-20.95	-11.59		1.45	-4.01	10.91	-16.94	-15.28
Base outcome	Bean	Beet	Cabbage	Capsicum	Carrot	Knol-khol	Leeks	Radish
Number of observation								195
LR chi2(161)								287.71
Prob.> chi2								0.00
Pseudo R2								0.3916
Log likelihood								-223.542

legend: * p<.1; ** p<.05; *** p<.001

Annex 05: Multinomial Logit Model Estimation for Capsicum

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
exto	-0.91	0.38	-0.18		-0.3	-2.09*	-1.03	-0.52
fpr	0.59	0.75	0.88		0.71	-0.12	0.67	1.19
mdem	0.96	1.18	1.12		0.46	-0.25	0.08	0.99
wdata	1.52	0.47	0.65		1.60	3.63**	2.23**	-1.27
nmven	-0.52	-1.09	0.32		-1.31*	1.99	-0.37	0.23
oinf	-0.03	0.82	1.67		0.45	0.96	1.34	-4.84
sav	-0.40	1.57	2.18**		0.86	1.26	1.47	1.35
fav	-1.79**	-1.33	-1.77*		-1.4	-7.86*	-3.66**	-1.22
pav	0.62	-2.68*	-2.84**		-1.81	3.50	-0.63	-1.03
cop	1.16**	0.51	0.88		0.70	-0.68	0.33	0.26
tast	-0.29	-0.58	0.41		-0.70	1.64	-0.19	-1.24
fcrd	-1.61**	-1.62**	-1.71**		-0.68	0.12	-1.14	-1.51
incrd	0.34	0.84	-0.43		-0.27	-0.05	0.51	-7.06*
wavl	1.81**	1.46*	1.50**		1.89**	0.53	1.94**	-1.55
lav	-0.55	-0.53	-0.94*		-1.00**	-0.64	-0.60	2.73
wav	2.19**	1.49*	0.56		2.05**	0.23	1.19	-0.34
mav	0.81	0.10	0.93		1.19*	2.65**	0.55	5.42**
mktp	0.04	-1.11	-0.18		1.37	0.23	-0.80	4.03
wmkt	16.82	17.8	20.70		18.72	2.89	18.54	27.2
scst	0.51	0.36	0.57		0.14	0.62	1.01*	3.60*
yild	0.82	1.56	2.48**		2.83**	3.58*	1.37	-1.76
fwcn	-6.38***	-5.63**	-22.86		-21.84	-18.21	-2.88*	-3.64
egrw	-2.65**	-4.23**	-3.76**		-2.00	-3.41	-4.52**	2.32
constant	-22.4	-13.05	-1.45		-5.46	9.46	-18.4	-16.73
Base outcome	Bean	Beet	Cabbage	Capsicum	Carrot	Knol-khol	Leeks	Radish
Number of observation								195
LR chi2(161)								287.71
Prob.> chi2								0.00
Pseudo R2								0.3916
Log likelihood								-223.542

legend: * p<.1; ** p<.05; *** p<.001

Annex 06: Multinomial Logit Model Estimation for Carrot

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
exto	-0.62	0.67	0.12	0.30		-1.79*	-0.73	-0.22
fpr	-0.12	0.04	0.18	-0.71		-0.83	-0.03	0.48
mdem	0.50	0.72	0.66	-0.46		-0.71	-0.38	0.53
wdata	-0.07	-1.12	-0.95	-1.60		2.03	0.64	-2.87
nmven	0.78	0.21	1.62**	1.31*		3.29**	0.94	1.53
oinf	-0.47	0.37	1.23	-0.45		0.51	0.89	-5.29
sav	-1.26*	0.71	1.32*	-0.86		0.40	0.61	0.50
fav	-0.4	0.07	-0.37	1.40		-6.46	-2.26	0.18
pav	2.43**	-0.87	-1.03	1.81		5.32	1.18	0.79
cop	0.46	-0.19	0.18	-0.70		-1.38	-0.37	-0.44
tast	0.42	0.12	1.11	0.70		2.34	0.52	-0.54
fcrd	-0.93*	-0.94	-1.03*	0.68		0.81	-0.46	-0.83
incrd	0.61	1.11	-0.16	0.27		0.22	0.78	-6.80*
wavl	-0.08	-0.43	-0.39	-1.89**		-1.37	0.05	-3.45*
lav	0.44	0.47	0.06	1.00**		0.36	0.40	3.72**
wav	0.14	-0.56	-1.49**	-2.05**		-1.82	-0.86	-2.39
mav	-0.38	-1.09*	-0.26	-1.19*		1.46	-0.64	4.23*
mktp	-1.33*	-2.48**	-1.55*	-1.37		-1.14	-2.17**	2.66
wmkt	-1.90	-0.92	1.98*	-18.72		-15.82	-0.18	8.49**
scst	0.38	0.22	0.43	-0.14		0.48	0.88**	3.46*
yild	-2.01***	-1.27	-0.35	-2.83**		0.75	-1.46**	-4.60**
fwcn	15.46	16.21	-1.01	21.84		3.63	18.97	18.20
egrw	-0.65	-2.23	-1.76	2.00		-1.41	-2.52*	4.31
constant	-16.93	-7.58	4.01	5.46		14.93	-12.93	-11.26
Base outcome	Bean	Beet	Cabbage	Capsicum	Carrot	Knol-khol	Leeks	Radish
Number of observation								195
LR chi2(161)								287.71
Prob.> chi2								0.00
Pseudo R2								0.3916
Log likelihood								-223.542

legend: * p<.1; ** p<.05; *** p<.001

Annex 07: Multinomial Logit Model Estimation for Knolkhol

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
exto	1.17	2.47**	1.91*	2.09*	1.79*		1.06	1.57
fpr	0.71	0.87	1.01	0.12	0.83		0.8	1.31
mdem	1.22	1.44	1.38	0.25	0.71		0.33	1.24
wdata	-2.10	-3.16**	-2.98**	-3.63**	-2.03		-1.39	-4.9
nmven	-2.51**	-3.08**	-1.67	-1.99	-3.29**		-2.36*	-1.76
oinf	-0.98	-0.13	0.72	-0.96	-0.51		0.38	-5.8
sav	-1.65	0.32	0.92	-1.26	-0.40		0.22	0.10
fav	6.06	6.53	6.09	7.86*	6.46		4.2	6.64
pav	-2.89	-6.19	-6.34	-3.50	-5.32		-4.13	-4.53
cop	1.84**	1.19	1.56*	0.68	1.38		1.01	0.94
tast	-1.92	-2.22	-1.23	-1.64	-2.34		-1.82	-2.88
fcrd	-1.74	-1.75	-1.83	-0.12	-0.81		-1.27	-1.64
incrd	0.38	0.89	-0.38	0.05	-0.22		0.56	-7.02*
wavl	1.28	0.93	0.97	-0.53	1.37		1.41	-2.08
lav	0.09	0.11	-0.30	0.64	-0.36		0.04	3.37*
wav	1.96	1.26	0.33	-0.23	1.82		0.96	-0.57
mav	-1.84	-2.56*	-1.72	-2.65**	-1.46		-2.11	2.76
mktp	-0.19	-1.34	-0.41	-0.23	1.14		-1.03	3.80
wmkt	13.93	14.90	17.80	-2.89	15.82		15.65	24.31
scst	-0.11	-0.26	-0.05	-0.62	-0.48		0.39	2.98
yild	-2.76	-2.02	-1.10	-3.58*	-0.75		-2.21	-5.35**
fwcn	11.83	12.58	-4.65	18.21	-3.63		15.33	14.56
egrw	0.76	-0.82	-0.34	3.41	1.41		-1.11	5.73
constant	-31.86	-22.51	-10.91	-9.46	-14.93		-27.86	-26.19
Base outcome	Bean	Beet	Cabbage	Capsicum	Carrot	Knol-khol	Leeks	Radish
Number of observation								195
LR chi2(161)								287.71
Prob.> chi2								0.00
Pseudo R2								0.3916
Log likelihood								-223.542

legend: * p<.1; ** p<.05; *** p<.001

Annex 08: Multinomial Logit Model Estimation for Leeks

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
exto	0.12	1.41**	0.85	1.03	0.73	-1.06		0.51
fpr	-0.08	0.08	0.21	-0.67	0.03	-0.8		0.52
mdem	0.88	1.11	1.04	-0.08	0.38	-0.33		0.91
wdata	-0.71	-1.76**	-1.59**	-2.23**	-0.64	1.39		-3.5
nmven	-0.15	-0.72	0.69	0.37	-0.94	2.36*		0.60
oinf	-1.37*	-0.52	0.34	-1.34	-0.89	-0.38		-6.18
sav	-1.87**	0.10	0.70	-1.47	-0.61	-0.22		-0.12
fav	1.87	2.33	1.89	3.66**	2.26	-4.20		2.45
pav	1.25	-2.06	-2.21	0.63	-1.18	4.13		-0.4
cop	0.83*	0.17	0.55	-0.33	0.37	-1.01		-0.08
tast	-0.10	-0.40	0.59	0.19	-0.52	1.82		-1.06
fcrd	-0.47	-0.48	-0.57	1.14	0.46	1.27		-0.37
incrd	-0.18	0.33	-0.94	-0.51	-0.78	-0.56		-7.58**
wavl	-0.13	-0.48	-0.44	-1.94**	-0.05	-1.41		-3.50*
lav	0.04	0.07	-0.34	0.60	-0.40	-0.04		3.32*
wav	1.00**	0.30	-0.63	-1.19	0.86	-0.96		-1.53
mav	0.26	-0.45	0.38	-0.55	0.64	2.11		4.87**
mktp	0.84	-0.31	0.62	0.80	2.17**	1.03		4.83
wmkt	-1.72	-0.74	2.16	-18.54	0.18	-15.65		8.67**
scst	-0.50	-0.66	-0.44	-1.01*	-0.88**	-0.39		2.59
yild	-0.56	0.19	1.11	-1.37	1.46**	2.21		-3.14
fwcn	-3.51**	-2.76	-19.98	2.88*	-18.97	-15.33		-0.77
egrw	1.87	0.29	0.76	4.52**	2.52*	1.11		6.83
constant	-4.00	5.35	16.94	18.40	12.93	27.86		1.67
Base outcome	Bean	Beet	Cabbage	Capsicum	Carrot	Knol-khol	Leeks	Radish
Number of observation								195
LR chi2(161)								287.71
Prob.> chi2								0.00
Pseudo R2								0.3916
Log likelihood								-223.542

legend: * p<.1; ** p<.05; *** p<.001

Annex 09: Multinomial Logit Model Estimation for Radish

Variable	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
exto	-0.39	0.90	0.34	0.52	0.22	-1.57	-0.51	
fpr	-0.60	-0.44	-0.30	-1.19	-0.48	-1.31	-0.52	
mdem	-0.03	0.19	0.13	-0.99	-0.53	-1.24	-0.91	
wdata	2.79	1.74	1.92	1.27	2.87	4.90	3.50	
nmven	-0.75	-1.32	0.09	-0.23	-1.53	1.76	-0.60	
oinf	4.82	5.67	6.52	4.84	5.29	5.80	6.18	
sav	-1.75	0.22	0.82	-1.35	-0.50	-0.10	0.12	
fav	-0.58	-0.11	-0.56	1.22	-0.18	-6.64	-2.45	
pav	1.64	-1.66	-1.81	1.03	-0.79	4.53	0.40	
cop	0.90	0.25	0.63	-0.26	0.44	-0.94	0.08	
tast	0.96	0.66	1.65	1.24	0.54	2.88	1.06	
fcrd	-0.10	-0.11	-0.20	1.51	0.83	1.64	0.37	
incrd	7.40*	7.91**	6.64*	7.06*	6.80*	7.02*	7.58**	
wavl	3.37*	3.02	3.06	1.55	3.45*	2.08	3.50*	
lav	-3.28*	-3.25*	-3.67**	-2.73	-3.72**	-3.37*	-3.32*	
wav	2.53	1.83	0.90	0.34	2.39	0.57	1.53	
mav	-4.61**	-5.32**	-4.49*	-5.42**	-4.23*	-2.76	-4.87**	
mktp	-3.98	-5.13	-4.20	-4.03	-2.66	-3.80	-4.83	
wmkt	-10.38**	-9.41**	-6.51	-27.20	-8.49**	-24.31	-8.67**	
scst	-3.09	-3.24	-3.03	-3.60*	-3.46*	-2.98	-2.59	
yild	2.58	3.33	4.25**	1.76	4.60**	5.35**	3.14	
fwcn	-2.74	-1.99	-19.21	3.64	-18.20	-14.56	0.77	
egrw	-4.96	-6.55	-6.07	-2.32	-4.31	-5.73	-6.83	
constant	-5.67	3.68	15.28	16.73	11.26	26.19	-1.67	
Base outcome	Bean	Beet	Cabbage	Capsicum	Carrot	Knol-khol	Leeks	Radish
Number of observation								195
LR chi2(161)								287.71
Prob.> chi2								0.00
Pseudo R2								0.3916
Log likelihood								-223.542

legend: * p<.1; ** p<.05; *** p<.001

Annex 10: Multinomial Logit Model Estimation for Pumpkin

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13
exto		0.33	-0.53	-0.15	0.10	-0.25	-0.6	0.22	-1.31	0.61	-0.56	-0.02	0.12
fpr		-0.46	1.37*	0.34	0.21	0.57	0.33	-0.46	-1.72	-0.26	0.54	1.53	-0.41
mdem		0.42	0.02	-0.51	-0.09	0.14	0.72	0.83	2.62	0.51	0.00	0.84	1.46
wdata		0.26	0.49	1.79**	1.82**	0.53	1.20*	-0.08	2.53	1.00	0.57	-0.98	0.18
nmven		-0.26	-0.89**	-0.91**	-0.60*	-0.45	-0.86**	-0.07	-1.54	1.58	-0.15	-1.60	-1.61**
oinf		0.70	-0.11	0.67	0.38	0.09	0.46	-0.01	-3.87	-0.09	-0.21	-0.92	0.05
sav		0.58	0.47	0.48	0.63	0.56	0.44	0.62	-5.21	-4.79*	0.09	-0.41	0.63
fav		0.33	-0.52	-1.29	-0.8	-0.10	-0.84	-0.34	2.8	1.83	-0.07	0.22	-0.24
pav		-0.55	0.96	1.37	0.74	-0.08	0.69	-0.56	3.64	-0.31	-0.35	0.17	0.65
cop		0.75	-0.42	0.22	-0.21	0.02	-0.38	0.03	-3.44	-0.94	0.31	0.96	-0.04
tast		-16.35	-0.19	-0.47	-0.22	-0.12	0.09	0.67	8.69	-5.36	-0.15	-15.65	0.33
fcrd		-0.28	0.62	1.01	0.26	0.49	0.13	0.05	2.7	-1.06	0.34	-0.23	-0.48
incrd		-0.67	-0.21	-0.64	0.68	0.23	-0.5	0.65	-1.07	-0.05	0.41	0.90	0.43
wavl		0.39	-0.43	-0.32	-0.21	0.79**	-0.41	-0.04	2.44	0.71	0.51	1.09	-0.21
lav		-0.66	-0.27	-0.33	-0.79**	-0.38	-0.26	-0.39	-4.14	0.11	-0.1	-0.66	-0.55
wav		0.19	-0.56	0.25	-0.29	0.09	0.24	-0.18	2.27	1.53*	0.20	0.64	-0.05
mav		-0.01	-0.74	-0.85*	-0.29	-0.07	-0.39	-0.22	-2.06	1.28	-0.15	-1.52	0.25
mktp		0.51	0.87	0.06	-0.50	0.11	0.65	0.64	-17.45	1.48	1.04	0.03	1.52*
wmkt		-16.94	-0.96	-19.28	-1.10	-1.51*	-18.98	-1.77*	-29.73	0.39	-3.19**	-15.84	-18.81
scst		-0.54	-0.76	-0.94**	-0.73*	-0.58	-0.59	-0.53	1.26	1.45	-0.84**	-0.95	-1.02**
yild		-1.12	-1.34*	-2.50***	-1.52**	-2.07**	-2.02**	-0.29	0.88	-1.59	-1.43**	-2.14	-1.51*
egrw		17.48	17.22	17.89	16.06	17.17	16.35	15.59	-2.57	-0.03	17.46	19.91	1.05
constant		16.36	-13.81	2.67	-16.83	-19.58	3.78	-13.81	51.73	2.74	-16.74	17.03	18.64
Base outcome	Pumpkin	Snake gourd	Cucumber	Bitter gourd	Okra	Brinjal	Luffa	Long bean	Winged bean	Kakiri	Tomato	Thumba	*Elabatu*
Number of observation													274
LR chi2(264)													341.93
Prob.> chi2													0.00
Pseudo R2													0.2593
Log likelihood													-488.302

legend: * p<.1; ** p<.05; *** p<.001

Annex 11: Multinomial Logit Model Estimation for Snake gourd

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13
exto	-0.33		-0.87	-0.49	-0.24	-0.58	-0.94*	-0.11	-1.64	0.28	-0.89*	-0.36	-0.22
fpr	0.46		1.82*	0.8	0.67	1.03	0.79	-0.01	-1.27	0.2	1.00	1.99	0.05
mdem	-0.42		-0.40	-0.93	-0.51	-0.28	0.3	0.41	2.20	0.09	-0.42	0.42	1.04
wdata	-0.26		0.23	1.54	1.56*	0.27	0.94	-0.34	2.27	0.74	0.31	-1.24	-0.08
nmven	0.26		-0.63	-0.65	-0.34	-0.19	-0.60	0.19	-1.28	1.83*	0.11	-1.35	-1.36*
oinf	-0.70		-0.81	-0.04	-0.32	-0.61	-0.24	-0.71	-4.57	-0.79	-0.91	-1.63	-0.66
sav	-0.58		-0.11	-0.1	0.05	-0.02	-0.14	0.04	-5.79	-5.37*	-0.49	-0.99	0.05
fav	-0.33		-0.85	-1.62	-1.13	-0.43	-1.17	-0.67	2.47	1.50	-0.40	-0.11	-0.57
pav	0.55		1.51	1.91	1.29	0.47	1.24	-0.01	4.19	0.24	0.20	0.72	1.20
cop	-0.75		-1.18*	-0.54	-0.97	-0.74	-1.13*	-0.72	-4.19	-1.69*	-0.45	0.21	-0.80
tast	16.35		16.15	15.88	16.13	16.23	16.44	17.02	25.03	10.99	16.2	0.70	16.68
fcrd	0.28		0.90	1.29	0.54	0.77	0.41	0.33	2.98	-0.78	0.62	0.05	-0.20
incrd	0.67		0.46	0.03	1.36	0.90	0.18	1.32	-0.4	0.62	1.09	1.57	1.10
wavl	-0.39		-0.82	-0.72	-0.60	0.40	-0.80	-0.43	2.05	0.32	0.12	0.70	-0.60
lav	0.66		0.39	0.34	-0.13	0.28	0.41	0.27	-3.47	0.77	0.57	0.00	0.12
wav	-0.19		-0.75	0.06	-0.48	-0.10	0.05	-0.37	2.09	1.34	0.01	0.45	-0.24
mav	0.01		-0.73	-0.84	-0.28	-0.06	-0.38	-0.21	-2.05	1.28	-0.14	-1.51	0.26
mktp	-0.51		0.36	-0.45	-1.01	-0.40	0.14	0.13	-17.96	0.97	0.53	-0.48	1.01
wmkt	16.94		15.98	-2.33	15.85	15.44	-2.04	15.18	-12.78	17.33	13.75	1.11	-1.87
scst	0.54		-0.22	-0.4	-0.19	-0.04	-0.05	0.00	1.80	1.99*	-0.30	-0.41	-0.48
yild	1.12		-0.22	-1.37	-0.39	-0.95	-0.89	0.84	2.00	-0.46	-0.30	-1.01	-0.39
egrw	-17.48		-0.27	0.40	-1.42	-0.32	-1.13	-1.89	-20.06	-17.52	-0.03	2.43	-16.43
constant	-16.36		-30.16	-13.69	-33.19	-35.94	-12.57	-30.16	35.37	-13.62	-33.09	0.67	2.29
Base outcome	Pumpkin	Snake gourd	Cucumber	Bitter gourd	Okra	Brinjal	Luffa	Long bean	Winged bean	Kakiri	Tomato	Thumba	*Elabatu*
Number of observation													274
LR chi2(264)													341.93
Prob.> chi2													0.00
Pseudo R2													0.2593
Log likelihood													-488.302

legend: * p<.1; ** p<.05; *** p<.001

Annex 12: Multinomial Logit Model Estimation for Cucumber

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13
exto	0.53	0.87		0.38	0.63	0.29	-0.07	0.75*	-0.77	1.14	-0.03	0.51	0.65
fpr	-1.37*	-1.82*		-1.02	-1.16*	-0.8	-1.04*	-1.83**	-3.09	-1.63	-0.82	0.16	-1.78*
mdem	-0.02	0.40		-0.53	-0.10	0.12	0.71	0.82	2.61	0.49	-0.02	0.82	1.45
wdata	-0.49	-0.23		1.30**	1.33**	0.04	0.71	-0.57	2.03	0.51	0.08	-1.47	-0.31
nmven	0.89**	0.63		-0.02	0.29	0.44	0.03	0.83*	-0.65	2.47**	0.74*	-0.71	-0.72
oinf	0.11	0.81		0.77	0.49	0.20	0.57	0.10	-3.76	0.02	-0.10	-0.82	0.16
sav	-0.47	0.11		0.01	0.16	0.09	-0.02	0.16	-5.68	-5.26*	-0.37	-0.88	0.17
fav	0.52	0.85		-0.77	-0.28	0.42	-0.32	0.18	3.32	2.35	0.45	0.74	0.28
pav	-0.96	-1.51		0.40	-0.22	-1.04	-0.27	-1.52	2.68	-1.28	-1.31	-0.79	-0.31
cop	0.42	1.18*		0.64	0.21	0.44	0.05	0.45	-3.02	-0.52	0.73*	1.38	0.38
tast	0.19	-16.15		-0.28	-0.02	0.07	0.29	0.86	8.88	-5.17	0.04	-15.46	0.53
fcrd	-0.62	-0.90		0.39	-0.36	-0.13	-0.49	-0.57	2.08	-1.68	-0.28	-0.85	-1.1
incrd	0.21	-0.46		-0.43	0.89	0.44	-0.29	0.86	-0.86	0.16	0.62	1.11	0.64
wavl	0.43	0.82		0.11	0.22	1.22**	0.02	0.39	2.87	1.14	0.94*	1.52	0.23
lav	0.27	-0.39		-0.05	-0.52	-0.11	0.01	-0.12	-3.86	0.38	0.17	-0.39	-0.27
wav	0.56	0.75		0.81	0.26	0.65	0.80	0.38	2.83	2.09**	0.76	1.20	0.51
mav	0.74	0.73		-0.11	0.45	0.67	0.35	0.52	-1.32	2.01**	0.59	-0.78	0.99
mktp	-0.87	-0.36		-0.80	-1.36*	-0.75	-0.22	-0.23	-18.31	0.61	0.17	-0.83	0.65
wmkt	0.96	-15.98		-18.32	-0.13	-0.55	-18.02	-0.81	-28.77	1.35	-2.23*	-14.88	-17.85
scst	0.76	0.22		-0.18	0.03	0.18	0.16	0.22	2.02	2.20**	-0.08	-0.19	-0.26
yild	1.34*	0.22		-1.16	-0.18	-0.73	-0.68	1.05	2.22	-0.24	-0.08	-0.80	-0.17
egrw	-17.22	0.27		0.67	-1.16	-0.05	-0.87	-1.62	-19.79	-17.25	0.24	2.69	-16.17
constant	13.81	30.16		16.47	-3.03	-5.78	17.59	0.00	65.53	16.54	-2.93	30.84	32.45
Base outcome	Pumpkin	Snake gourd	Cucumber	Bitter gourd	Okra	Brinjal	Luffa	Long bean	Winged bean	Kakiri	Tomato	Thumba	*Elabatu*
Number of observation													274
LR chi2(264)													341.93
Prob.> chi2													0.00
Pseudo R2													0.2593
Log likelihood													-488.302

legend: * p<.1; ** p<.05; *** p<.001

Annex 13: Multinomial Logit Model Estimation for Bitter gourd

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13
exto	0.15	0.49	-0.38		0.25	-0.09	-0.45	0.37	-1.15	0.76	-0.41	0.13	0.27
fpr	-0.34	-0.80	1.02		-0.13	0.23	-0.01	-0.81	-2.07	-0.60	0.20	1.19	-0.75
mdem	0.51	0.93	0.53		0.42	0.65	1.23*	1.34*	3.13	1.02	0.51	1.35	1.97*
wdata	-1.79**	-1.54	-1.30**		0.03	-1.26**	-0.59	-1.87**	0.73	-0.79	-1.22*	-2.77	-1.61*
nmven	0.91**	0.65	0.02		0.31	0.46	0.05	0.84*	-0.63	2.49**	0.76*	-0.69	-0.70
oinf	-0.67	0.04	-0.77		-0.29	-0.58	-0.2	-0.67	-4.54	-0.75	-0.87	-1.59	-0.62
sav	-0.48	0.10	-0.01		0.15	0.08	-0.04	0.14	-5.69	-5.27*	-0.39	-0.89	0.15
fav	1.29	1.62	0.77		0.50	1.20	0.45	0.96	4.10	3.12*	1.23	1.51	1.06
pav	-1.37	-1.91	-0.40		-0.63	-1.45	-0.67	-1.92*	2.28	-1.68	-1.72*	-1.19	-0.71
cop	-0.22	0.54	-0.64		-0.43	-0.20	-0.59	-0.19	-3.66	-1.16	0.09	0.74	-0.26
tast	0.47	-15.88	0.28		0.25	0.35	0.56	1.14	9.16	-4.89	0.32	-15.18	0.80
fcrd	-1.01	-1.29	-0.39		-0.75	-0.52	-0.88	-0.96	1.68	-2.07	-0.67	-1.24	-1.49**
incrd	0.64	-0.03	0.43		1.32	0.87	0.14	1.29*	-0.43	0.59	1.05	1.54	1.07
wavl	0.32	0.72	-0.11		0.11	1.11**	-0.09	0.29	2.76	1.04	0.83*	1.41	0.12
lav	0.33	-0.34	0.05		-0.46	-0.05	0.07	-0.06	-3.81	0.44	0.23	-0.34	-0.22
wav	-0.25	-0.06	-0.81		-0.54	-0.15	0.00	-0.43	2.03	1.28	-0.05	0.39	-0.3
mav	0.85*	0.84	0.11		0.56	0.78*	0.46	0.63	-1.22	2.12**	0.69	-0.67	1.10*
mktp	-0.06	0.45	0.8		-0.56	0.05	0.59	0.57	-17.51	1.42	0.98	-0.03	1.46
wmkt	19.28	2.33	18.32		18.18	17.77	0.29	17.51	-10.45	19.67	16.08	3.44	0.46
scst	0.94**	0.40	0.18		0.21	0.36	0.35	0.41	2.20	2.39**	0.11	-0.01	-0.08
yild	2.50***	1.37	1.16		0.98	0.43	0.48	2.21**	3.38	0.91	1.07	0.36	0.98
egrw	-17.89	-0.40	-0.67		-1.83*	-0.72	-1.54*	-2.29**	-20.46	-17.92	-0.43	2.02	-16.84
constant	-2.67	13.69	-16.47		-19.50	-22.25	1.12	-16.47	49.06	0.07	-19.41	14.36	15.97
Base outcome	Pumpkin	Snake gourd	Cucumber	Bitter gourd	Okra	Brinjal	Luffa	Long bean	Winged bean	Kakiri	Tomato	Thumba	*Elabatu*
Number of observation													274
LR chi2(264)													341.93
Prob.> chi2													0.00
Pseudo R2													0.2593
Log likelihood													-488.3018

legend: * p<.1; ** p<.05; *** p<.001

Annex 14: Multinomial Logit Model Estimation for Okra

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13
exto	-0.10	0.24	-0.63	-0.25		-0.34	-0.70*	0.12	-1.4	0.51	-0.66	-0.12	0.02
fpr	-0.21	-0.67	1.16*	0.13		0.36	0.12	-0.67	-1.93	-0.47	0.33	1.32	-0.62
mdem	0.09	0.51	0.10	-0.42		0.22	0.81	0.92	2.71	0.60	0.08	0.92	1.55
wdata	-1.82**	-1.56*	-1.33**	-0.03		-1.29**	-0.62	-1.90**	0.71	-0.82	-1.25**	-2.80	-1.64**
nmven	0.60*	0.34	-0.29	-0.31		0.15	-0.26	0.54	-0.94	2.18**	0.45	-1.00	-1.01
oinf	-0.38	0.32	-0.49	0.29		-0.29	0.08	-0.39	-4.25	-0.46	-0.59	-1.30	-0.33
sav	-0.63	-0.05	-0.16	-0.15		-0.07	-0.19	-0.01	-5.84	-5.42*	-0.54	-1.04	0.00
fav	0.80	1.13	0.28	-0.50		0.70	-0.04	0.46	3.60	2.63*	0.73	1.02	0.56
pav	-0.74	-1.29	0.22	0.63		-0.82	-0.05	-1.30	2.90	-1.05	-1.09	-0.57	-0.09
cop	0.21	0.97	-0.21	0.43		0.23	-0.16	0.24	-3.23	-0.73	0.52	1.17	0.17
tast	0.22	-16.13	0.02	-0.25		0.09	0.31	0.89	8.90	-5.15	0.06	-15.43	0.55
fcrd	-0.26	-0.54	0.36	0.75		0.23	-0.13	-0.21	2.44	-1.32	0.08	-0.49	-0.74
incrd	-0.68	-1.36	-0.89	-1.32		-0.46	-1.18	-0.04	-1.76	-0.74	-0.27	0.21	-0.26
wavl	0.21	0.60	-0.22	-0.11		1.00**	-0.20	0.18	2.65	0.92	0.72	1.30	0.01
lav	0.79**	0.13	0.52	0.46		0.41	0.53	0.40	-3.35	0.90	0.69*	0.13	0.24
wav	0.29	0.48	-0.26	0.54		0.39	0.54	0.11	2.57	1.82**	0.49	0.93	0.24
mav	0.29	0.28	-0.45	-0.56		0.22	-0.10	0.07	-1.77	1.56*	0.13	-1.23	0.54
mktp	0.50	1.01	1.36*	0.56		0.61	1.15	1.13	-16.95	1.98	1.54**	0.53	2.02**
wmkt	1.10	-15.85	0.13	-18.18		-0.41	-17.89	-0.67	-28.63	1.48	-2.10	-14.74	-17.72
scst	0.73*	0.19	-0.03	-0.21		0.15	0.13	0.19	1.99	2.18**	-0.11	-0.22	-0.29
yild	1.52**	0.39	0.18	-0.98		-0.55	-0.50	1.23*	2.40	-0.07	0.09	-0.62	0.01
egrw	-16.06	1.42	1.16	1.83*		1.11	0.29	-0.46	-18.63	-16.09	1.40	3.85**	-15.01
constant	16.83	33.19	3.03	19.5		-2.75	20.62	3.02	68.56	19.57	0.09	33.86	35.47
Base outcome	Pumpkin	Snake gourd	Cucumber	Bitter gourd	Okra	Brinjal	Luffa	Long bean	Winged bean	Kakiri	Tomato	Thumba	*Elabatu*
Number of observation													274
LR chi2(264)													341.93
Prob.> chi2													0.00
Pseudo R2													0.2593
Log likelihood													-488.302

legend: * p<.1; ** p<.05; *** p<.001

Annex 15: Multinomial Logit Model Estimation for Brinjal

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13
exto	0.25	0.58	-0.29	0.09	0.34		-0.36	0.47	-1.06	0.86	-0.31	0.22	0.36
fpr	-0.57	-1.03	0.80	-0.23	-0.36		-0.24	-1.03	-2.30	-0.83	-0.03	0.96	-0.98
mdem	-0.14	0.28	-0.12	-0.65	-0.22		0.59	0.70	2.49	0.37	-0.14	0.70	1.33
wdata	-0.53	-0.27	-0.04	1.26**	1.29**		0.67	-0.61	2.00	0.47	0.04	-1.51	-0.35
nmven	0.45	0.19	-0.44	-0.46	-0.15		-0.41	0.38	-1.09	2.02**	0.30	-1.16	-1.17*
oinf	-0.09	0.61	-0.20	0.58	0.29		0.37	-0.10	-3.96	-0.18	-0.30	-1.01	-0.04
sav	-0.56	0.02	-0.09	-0.08	0.07		-0.11	0.07	-5.77	-5.35*	-0.46	-0.97	0.08
fav	0.10	0.43	-0.42	-1.20	-0.70		-0.75	-0.24	2.90	1.92	0.03	0.31	-0.14
pav	0.08	-0.47	1.04	1.45	0.82		0.77	-0.48	3.72	-0.23	-0.27	0.25	0.73
cop	-0.02	0.74	-0.44	0.20	-0.23		-0.39	0.02	-3.46	-0.95	0.29	0.94	-0.06
tast	0.12	-16.23	-0.07	-0.35	-0.09		0.22	0.79	8.81	-5.24	-0.03	-15.53	0.46
fcrd	-0.49	-0.77	0.13	0.52	-0.23		-0.36	-0.44	2.21	-1.55	-0.15	-0.72	-0.97
incrd	-0.23	-0.90	-0.44	-0.87	0.46		-0.73	0.42	-1.30	-0.28	0.19	0.67	0.20
wavl	-0.79**	-0.40	-1.22**	-1.11**	.00**		-1.20**	-0.83*	1.65	-0.08	-0.28	0.30	-1.00*
lav	0.38	-0.28	0.11	0.05	-0.41		0.12	-0.01	-3.76	0.49	0.28	-0.28	-0.17
wav	-0.09	0.10	-0.65	0.15	-0.39		0.15	-0.27	2.18	1.43*	0.11	0.54	-0.15
mav	0.07	0.06	-0.67	-0.78*	-0.22		-0.32	-0.15	-1.99	1.34	-0.08	-1.45	0.32
mktp	-0.11	0.40	0.75	-0.05	-0.61		0.54	0.52	-17.56	1.37	0.93	-0.08	1.41*
wmkt	1.51*	-15.44	0.55	-17.77	0.41		-17.48	-0.26	-28.22	1.89	-1.69	-14.33	-17.31
scst	0.58	0.04	-0.18	-0.36	-0.15		-0.01	0.05	1.84	2.03*	-0.26	-0.37	-0.44
yild	2.07**	0.95	0.73	-0.43	0.55		0.05	1.78**	2.95	0.48	0.64	-0.07	0.56
egrw	-17.17	0.32	0.05	0.72	-1.11		-0.81	-1.57	-19.74	-17.20	0.29	2.74	-16.12
constant	19.58	35.94	5.78	22.25	2.75		23.37	5.78*	71.31	22.32	2.85	36.61	38.22
Base outcome	Pumpkin	Snake gourd	Cucumber	Bitter gourd	Okra	Brinjal	Luffa	Long bean	Winged bean	Kakiri	Tomato	Thumba	*Elabatu*
Number of observation													274
LR chi2(264)													341.93
Prob.> chi2													0.00
Pseudo R2													0.2593
Log likelihood													-488.302

legend: * p<.1; ** p<.05; *** p<.001

Annex 16: Multinomial Logit Model Estimation for Luffa

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13
exto	0.60	0.94*	0.07	0.45	0.70*	0.36		0.82*	-0.70	1.21	0.04	0.58	0.72
fpr	-0.33	-0.79	1.04*	0.01	-0.12	0.24		-0.79	-2.06	-0.59	0.21	1.20	-0.74
mdem	-0.72	-0.30	-0.71	-1.23*	-0.81	-0.59		0.11	1.90	-0.21	-0.73	0.11	0.74
wdata	-1.20*	-0.94	-0.71	0.59	0.62	-0.67		-1.28**	1.33	-0.20	-0.63	-2.18	-1.02
nmven	0.86**	0.60	-0.03	-0.05	0.26	0.41		0.79**	-0.68	2.43**	0.71*	-0.75	-0.75
oinf	-0.46	0.24	-0.57	0.20	-0.08	-0.37		-0.47	-4.33	-0.55	-0.67	-1.39	-0.42
sav	-0.44	0.14	0.02	0.04	0.19	0.11		0.18	-5.65	-5.23*	-0.35	-0.86	0.19
fav	0.84	1.17	0.32	-0.45	0.04	0.75		0.50	3.64	2.67*	0.77	1.06	0.61
pav	-0.69	-1.24	0.27	0.67	0.05	-0.77		-1.25	2.95	-1.00	-1.04	-0.52	-0.04
cop	0.38	1.13*	-0.05	0.59	0.16	0.39		0.41	-3.06	-0.56	0.68*	1.34	0.33
tast	-0.09	-16.44	-0.29	-0.56	-0.31	-0.22		0.58	8.59	-5.46	-0.25	-15.74	0.24
fcrd	-0.13	-0.41	0.49	0.88	0.13	0.36		-0.08	2.57	-1.19	0.21	-0.36	-0.61
incrd	0.50	-0.18	0.29	-0.14	1.18	0.73		1.14	-0.58	0.44	0.91	1.40	0.92
wavl	0.41	0.80	-0.02	0.09	0.20	1.20**		0.37	2.85	1.12	0.92**	1.50	0.21
lav	0.26	-0.41	-0.01	-0.07	-0.53	-0.12		-0.13	-3.88	0.37	0.16	-0.40	-0.29
wav	-0.24	-0.05	-0.80	0.00	-0.54	-0.15		-0.42	2.03	1.29	-0.04	0.39	-0.29
mav	0.39	0.38	-0.35	-0.46	0.10	0.32		0.17	-1.68	1.66*	0.23	-1.13	0.64
mktp	-0.65	-0.14	0.22	-0.59	-1.15	-0.54		-0.01	-18.09	0.83	0.39	-0.62	0.87
wmkt	18.98	2.04	18.02	-0.29	17.89	17.48		17.21	-10.75	19.37	15.79	3.14	0.17
scst	0.59	0.05	-0.16	-0.35	-0.13	0.01		0.06	1.85	2.04*	-0.24	-0.35	-0.43
yild	2.02**	0.89	0.68	-0.48	0.50	-0.05		1.73**	2.90	0.43	0.59	-0.12	0.51
egrw	-16.35	1.13	0.87	1.54*	-0.29	0.81		-0.76	-18.93	-16.39	1.10	3.56*	-15.30
constant	-3.78	12.57	-17.59	-1.12	-20.62	-23.37		-17.59	47.94	-1.05	-20.52	13.25	14.86
Base outcome	Pumpkin	Snake gourd	Cucumber	Bitter gourd	Okra	Brinjal	Luffa	Long bean	Winged bean	Kakiri	Tomato	Thumba	*Elabatu*
Number of observation													274
LR chi2(264)													341.93
Prob.> chi2													0.00
Pseudo R2													0.2593
Log likelihood													-488.302

legend: * p<.1; ** p<.05; *** p<.001

Annex 17: Multinomial Logit Model Estimation for Long bean

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13
exto	-0.22	0.11	-0.75*	-0.37	-0.12	-0.47	-0.82*		-1.53	0.39	-0.78*	-0.24	-0.10
fpr	0.46	0.01	1.83**	0.81	0.67	1.03	0.79		-1.26	0.20	1.01	1.99	0.05
mdem	-0.83	-0.41	-0.82	-1.34*	-0.92	-0.7	-0.11		1.79	-0.32	-0.84	0.00	0.63
wdata	0.08	0.34	0.57	1.87**	1.90**	0.61	1.28**		2.61	1.08	0.65	-0.90	0.26
nmven	0.07	-0.19	-0.83*	-0.84*	-0.54	-0.38	-0.79**		-1.47	1.64	-0.09	-1.54	-1.55**
oinf	0.01	0.71	-0.10	0.67	0.39	0.10	0.47		-3.86	-0.08	-0.20	-0.92	0.05
sav	-0.62	-0.04	-0.16	-0.14	0.01	-0.07	-0.18		-5.83	-5.41*	-0.53	-1.04	0.01
fav	0.34	0.67	-0.18	-0.96	-0.46	0.24	-0.50		3.14	2.16	0.27	0.56	0.10
pav	0.56	0.01	1.52	1.92*	1.30	0.48	1.25		4.20	0.24	0.21	0.73	1.21
cop	-0.03	0.72	-0.45	0.19	-0.24	-0.02	-0.41		-3.47	-0.97	0.27	0.93	-0.08
tast	-0.67	-17.02	-0.86	-1.14	-0.89	-0.79	-0.58		8.02	-6.03*	-0.82	-16.32	-0.34
fcrd	-0.05	-0.33	0.57	0.96	0.21	0.44	0.08		2.65	-1.11	0.29	-0.28	-0.53
incrd	-0.65	-1.32	-0.86	-1.29*	0.04	-0.42	-1.14		-1.72	-0.70	-0.23	0.25	-0.22
wavl	0.04	0.43	-0.39	-0.29	-0.18	0.83*	-0.37		2.47	0.75	0.54	1.13	-0.17
lav	0.39	-0.27	0.12	0.06	-0.40	0.01	0.13		-3.74	0.50	0.29	-0.27	-0.15
wav	0.18	0.37	-0.38	0.43	-0.11	0.27	0.42		2.45	1.71*	0.38	0.82	0.13
mav	0.22	0.21	-0.52	-0.63	-0.07	0.15	-0.17		-1.85	1.49	0.06	-1.30	0.47
mktp	-0.64	-0.13	0.23	-0.57	-1.13	-0.52	0.01		-18.08	0.84	0.40	-0.60	0.88
wmkt	1.77*	-15.18	0.81	-17.51	0.67	0.26	-17.21		-27.96	2.16	-1.42	-14.07	-17.04
scst	0.53	0.00	-0.22	-0.41	-0.19	-0.05	-0.06		1.79	1.98*	-0.30	-0.41	-0.49
yild	0.29	-0.84	-1.05	-2.21**	-1.23*	-1.78**	-1.73**		1.17	-1.30	-1.14*	-1.85	-1.23
egrw	-15.59	1.89	1.62	2.29**	0.46	1.57	0.76		-18.17	-15.63	1.86**	4.32**	-14.54
constant	13.81	30.16	0.00	16.47	-3.02	-5.78*	17.59		65.53	16.54	-2.93	30.84	32.45
Base outcome	Pumpkin	Snake gourd	Cucumber	Bitter gourd	Okra	Brinjal	Luffa	Long bean	Winged bean	Kakiri	Tomato	Thumba	*Elabatu*
Number of observation													274
LR chi2(264)													341.93
Prob.> chi2													0.00
Pseudo R2													0.2593
Log likelihood													-488.302

legend: * p<.1; ** p<.05; *** p<.001

Annex 18: Multinomial Logit Model Estimation for Winged bean

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13
exto	1.31	1.64	0.77	1.15	1.40	1.06	0.70	1.53		1.92	0.75	1.28	1.42
fpr	1.72	1.27	3.09	2.07	1.93	2.30	2.06	1.26		1.47	2.27	3.26	1.32
mdem	-2.62	-2.20	-2.61	-3.13	-2.71	-2.49	-1.90	-1.79		-2.11	-2.63	-1.79	-1.16
wdata	-2.53	-2.27	-2.03	-0.73	-0.71	-2.00	-1.33	-2.61		-1.53	-1.96	-3.51	-2.35
nmven	1.54	1.28	0.65	0.63	0.94	1.09	0.68	1.47		3.12	1.39	-0.06	-0.07
oinf	3.87	4.57	3.76	4.54	4.25	3.96	4.33	3.86		3.79	3.66	2.95	3.92
sav	5.21	5.79	5.68	5.69	5.84	5.77	5.65	5.83		0.42	5.30	4.80	5.84
fav	-2.8	-2.47	-3.32	-4.10	-3.60	-2.90	-3.64	-3.14		-0.98	-2.87	-2.59	-3.04
pav	-3.64	-4.19	-2.68	-2.28	-2.90	-3.72	-2.95	-4.20		-3.95	-3.99	-3.47	-2.99
cop	3.44	4.19	3.02	3.66	3.23	3.46	3.06	3.47		2.50	3.74	4.40	3.40
tast	-8.69	-25.03	-8.88	-9.16	-8.90	-8.81	-8.59	-8.02		-14.05*	-8.84	-24.34	-8.35
fcrd	-2.70	-2.98	-2.08	-1.68	-2.44	-2.21	-2.57	-2.65		-3.76	-2.35	-2.93	-3.18
incrd	1.07	0.40	0.86	0.43	1.76	1.30	0.58	1.72		1.02	1.49	1.97	1.50
wavl	-2.44	-2.05	-2.87	-2.76	-2.65	-1.65	-2.85	-2.47		-1.73	-1.93	-1.35	-2.64
lav	4.14	3.47	3.86	3.81	3.35	3.76	3.88	3.74		4.25	4.04	3.47	3.59
wav	-2.27	-2.09	-2.83	-2.03	-2.57	-2.18	-2.03	-2.45		-0.75	-2.08	-1.64	-2.33
mav	2.06	2.05	1.32	1.22	1.77	1.99	1.68	1.85		3.34	1.91	0.54	2.31
mktp	17.45	17.96	18.31	17.51	16.95	17.56	18.09	18.08		18.93	18.48	17.48	18.97
wmkt	29.73	12.78	28.77	10.45	28.63	28.22	10.75	27.96		30.12	26.54	13.89	10.92
scst	-1.26	-1.80	-2.02	-2.20	-1.99	-1.84	-1.85	-1.79		0.19	-2.10	-2.21	-2.28
yild	-0.88	-2.00	-2.22	-3.38	-2.40	-2.95	-2.90	-1.17		-2.47	-2.31	-3.02	-2.39
egrw	2.57	20.06	19.79	20.46	18.63	19.74	18.93	18.17		2.54	20.03	22.48	3.63
constant	-51.73	-35.37	-65.53	-49.06	-68.56	-71.31	-47.94	-65.53		-48.99	-68.46	-34.69	-33.08
Base outcome	Pumpkin	Snake gourd	Cucumber	Bitter gourd	Okra	Brinjal	Luffa	Long bean	Winged bean	Kakiri	Tomato	Thumba	*Elabatu*
Number of observation													274
LR chi2(264)													341.93
Prob.> chi2													0.00
Pseudo R2													0.2593
Log likelihood													-488.302

legend: * p<.1; ** p<.05; *** p<.001

Annex 19: Multinomial Logit Model Estimation for Kakiri

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13
exto	-0.61	-0.28	-1.14	-0.76	-0.51	-0.86	-1.21	-0.39	-1.92		-1.17	-0.63	-0.49
fpr	0.26	-0.20	1.63	0.60	0.47	0.83	0.59	-0.20	-1.47		0.80	1.79	-0.15
mdem	-0.51	-0.09	-0.49	-1.02	-0.60	-0.37	0.21	0.32	2.11		-0.51	0.33	0.95
wdata	-1.00	-0.74	-0.51	0.79	0.82	-0.47	0.20	-1.08	1.53		-0.43	-1.98	-0.82
nmven	-1.58	-1.83*	-2.47**	-2.49**	-2.18**	-2.02**	-2.43**	-1.64	-3.12		-1.73*	-3.18**	-3.19**
oinf	0.09	0.79	-0.02	0.75	0.46	0.18	0.55	0.08	-3.79		-0.12	-0.84	0.13
sav	4.79*	5.37*	5.26*	5.27*	5.42*	5.35*	5.23*	5.41*	-0.42		4.88*	4.38	5.42*
fav	-1.83	-1.50	-2.35	-3.12*	-2.63*	-1.92	-2.67*	-2.16	0.98		-1.90	-1.61	-2.06
pav	0.31	-0.24	1.28	1.68	1.05	0.23	1.00	-0.24	3.95		-0.04	0.48	0.96
cop	0.94	1.69*	0.52	1.16	0.73	0.95	0.56	0.97	-2.50		1.24	1.90	0.90
tast	5.36	-10.99	5.17	4.89	5.15	5.24	5.46	6.03*	14.05*		5.21	-10.29	5.70
fcrd	1.06	0.78	1.68	2.07	1.32	1.55	1.19	1.11	3.76		1.40	0.83	0.58
incrd	0.05	-0.62	-0.16	-0.59	0.74	0.28	-0.44	0.70	-1.02		0.47	0.95	0.48
wavl	-0.71	-0.32	-1.14	-1.04	-0.92	0.08	-1.12	-0.75	1.73		-0.20	0.38	-0.92
lav	-0.11	-0.77	-0.38	-0.44	-0.90	-0.49	-0.37	-0.50	-4.25		-0.21	-0.77	-0.66
wav	-1.53*	-1.34	-2.09**	-1.28	-1.82**	-1.43*	-1.29	-1.71*	0.75		-1.33	-0.89	-1.58*
mav	-1.28	-1.28	-2.01**	-2.12**	-1.56*	-1.34	-1.66*	-1.49	-3.34		-1.43	-2.80*	-1.02
mktp	-1.48	-0.97	-0.61	-1.42	-1.98	-1.37	-0.83	-0.84	-18.93		-0.44	-1.45	0.04
wmkt	-0.39	-17.33	-1.35	-19.67	-1.48	-1.89	-19.37	-2.16	-30.12		-3.58*	-16.23	-19.2
scst	-1.45	-1.99*	-2.20**	-2.39**	-2.18**	-2.03*	-2.04*	-1.98*	-0.19		-2.28**	-2.40*	-2.47**
yild	1.59	0.46	0.24	-0.91	0.07	-0.48	-0.43	1.30	2.47		0.16	-0.55	0.07
egrw	0.03	17.52	17.25	17.92	16.09	17.20	16.39	15.63	-2.54		17.49	19.94	1.09
constant	-2.74	13.62	-16.54	-0.07	-19.57	-22.32	1.05	-16.54	48.99		-19.47	14.29	15.91
Base outcome	Pumpkin	Snake gourd	Cucumber	Bitter gourd	Okra	Brinjal	Luffa	Long bean	Winged bean	Kakiri	Tomato	Thumba	*Elabatu*
Number of observation													274
LR chi2(264)													341.93
Prob.> chi2													0.00
Pseudo R2													0.2593
Log likelihood													-488.302

legend: * p<.1; ** p<.05; *** p<.001

Annex 20: Multinomial Logit Model Estimation for Tomato

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13
exto	0.56	0.89*	0.03	0.41	0.66	0.31	-0.04	0.78*	-0.75	1.17		0.54	0.67
fpr	-0.54	-1.00	0.82	-0.20	-0.33	0.03	-0.21	-1.01	-2.27	-0.80		0.99	-0.95
mdem	0.00	0.42	0.02	-0.51	-0.08	0.14	0.73	0.84	2.63	0.51		0.84	1.47
wdata	-0.57	-0.31	-0.08	1.22*	1.25**	-0.04	0.63	-0.65	1.96	0.43		-1.55	-0.39
nmven	0.15	-0.11	-0.74*	-0.76*	-0.45	-0.30	-0.71*	0.09	-1.39	1.73*		-1.45	-1.46**
oinf	0.21	0.91	0.10	0.87	0.59	0.30	0.67	0.20	-3.66	0.12		-0.72	0.25
sav	-0.09	0.49	0.37	0.39	0.54	0.46	0.35	0.53	-5.30	-4.88*		-0.51	0.54
fav	0.07	0.40	-0.45	-1.23	-0.73	-0.03	-0.77	-0.27	2.87	1.90		0.29	-0.17
pav	0.35	-0.20	1.31	1.72*	1.09	0.27	1.04	-0.21	3.99	0.04		0.52	1.00
cop	-0.31	0.45	-0.73*	-0.09	-0.52	-0.29	-0.68*	-0.27	-3.74	-1.24		0.66	-0.35
tast	0.15	-16.20	-0.04	-0.32	-0.06	0.03	0.25	0.82	8.84	-5.21		-15.50	0.49
fcrd	-0.34	-0.62	0.28	0.67	-0.08	0.15	-0.21	-0.29	2.35	-1.40		-0.57	-0.82
incrd	-0.41	-1.09	-0.62	-1.05	0.27	-0.19	-0.91	0.23	-1.49	-0.47		0.48	0.01
wavl	-0.51	-0.12	-0.94*	-0.83*	-0.72	0.28	-0.92**	-0.54	1.93	0.20		0.58	-0.71
lav	0.10	-0.57	-0.17	-0.23	-0.69*	-0.28	-0.16	-0.29	-4.04	0.21		-0.56	-0.45
wav	-0.20	-0.01	-0.76	0.05	-0.49	-0.11	0.04	-0.38	2.08	1.33		0.44	-0.25
mav	0.15	0.14	-0.59	-0.69	-0.13	0.08	-0.23	-0.06	-1.91	1.43		-1.37	0.40
mktp	-1.04	-0.53	-0.17	-0.98	-1.54**	-0.93	-0.39	-0.40	-18.48	0.44		-1.01	0.48
wmkt	3.19**	-13.75	2.23*	-16.08	2.10	1.69	-15.79	1.42	-26.54	3.58*		-12.65	-15.62
scst	0.84**	0.30	0.08	-0.11	0.11	0.26	0.24	0.30	2.10	2.28**		-0.11	-0.18
yild	1.43**	0.30	0.08	-1.07	-0.09	-0.64	-0.59	1.14*	2.31	-0.16		-0.71	-0.09
egrw	-17.46	0.03	-0.24	0.43	-1.40	-0.29	-1.10	-1.86**	-20.03	-17.49		2.45	-16.41
constant	16.74	33.09	2.93	19.41	-0.09	-2.85	20.52	2.93	68.46	19.47		33.77	35.38
Base outcome	Pumpkin	Snake gourd	Cucumber	Bitter gourd	Okra	Brinjal	Luffa	Long bean	Winged bean	Kakiri	Tomato	Thumba	*Elabatu*
Number of observation													274
LR chi2(264)													341.93
Prob.> chi2													0.00
Pseudo R2													0.2593
Log likelihood													-488.302

legend: * p<.1; ** p<.05; *** p<.001

Annex 21: Multinomial Logit Model Estimation for Thumba

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13
exto	0.02	0.36	-0.51	-0.13	0.12	-0.22	-0.58	0.24	-1.28	0.63	-0.54		0.14
fpr	-1.53	-1.99	-0.16	-1.19	-1.32	-0.96	-1.20	-1.99	-3.26	-1.79	-0.99		-1.94
mdem	-0.84	-0.42	-0.82	-1.35	-0.92	-0.70	-0.11	0.00	1.79	-0.33	-0.84		0.63
wdata	0.98	1.24	1.47	2.77	2.80	1.51	2.18	0.90	3.51	1.98	1.55		1.16
nmven	1.60	1.35	0.71	0.69	1.00	1.16	0.75	1.54	0.06	3.18**	1.45		-0.01
oinf	0.92	1.63	0.82	1.59	1.30	1.01	1.39	0.92	-2.95	0.84	0.72		0.97
sav	0.41	0.99	0.88	0.89	1.04	0.97	0.86	1.04	-4.80	-4.38	0.51		1.05
fav	-0.22	0.11	-0.74	-1.51	-1.02	-0.31	-1.06	-0.56	2.59	1.61	-0.29		-0.45
pav	-0.17	-0.72	0.79	1.19	0.57	-0.25	0.52	-0.73	3.47	-0.48	-0.52		0.48
cop	-0.96	-0.21	-1.38	-0.74	-1.17	-0.94	-1.34	-0.93	-4.40	-1.90	-0.66		-1.00
tast	15.65	-0.70	15.46	15.18	15.43	15.53	15.74	16.32	24.34	10.29	15.50		15.98
fcrd	0.23	-0.05	0.85	1.24	0.49	0.72	0.36	0.28	2.93	-0.83	0.57		-0.25
incrd	-0.90	-1.57	-1.11	-1.54	-0.21	-0.67	-1.40	-0.25	-1.97	-0.95	-0.48		-0.47
wavl	-1.09	-0.70	-1.52	-1.41	-1.30	-0.30	-1.50	-1.13	1.35	-0.38	-0.58		-1.30
lav	0.66	0.00	0.39	0.34	-0.13	0.28	0.40	0.27	-3.47	0.77	0.56		0.12
wav	-0.64	-0.45	-1.20	-0.39	-0.93	-0.54	-0.39	-0.82	1.64	0.89	-0.44		-0.69
mav	1.52	1.51	0.78	0.67	1.23	1.45	1.13	1.30	-0.54	2.80*	1.37		1.77
mktp	-0.03	0.48	0.83	0.03	-0.53	0.08	0.62	0.60	-17.48	1.45	1.01		1.49
wmkt	15.84	-1.11	14.88	-3.44	14.74	14.33	-3.14	14.07	-13.89	16.23	12.65		-2.97
scst	0.95	0.41	0.19	0.01	0.22	0.37	0.35	0.41	2.21	2.40*	0.11		-0.07
yild	2.14	1.01	0.80	-0.36	0.62	0.07	0.12	1.85	3.02	0.55	0.71		0.63
egrw	-19.91	-2.43	-2.69	-2.02	-3.85**	-2.74	-3.56*	-4.32**	-22.48	-19.94	-2.45		-18.86
constant	-17.03	-0.67	-30.84	-14.36	-33.86	-36.61	-13.25	-30.84	34.69	-14.29	-33.77		1.61
Base outcome	Pumpkin	Snake gourd	Cucumber	Bitter gourd	Okra	Brinjal	Luffa	Long bean	Winged bean	Kakiri	Tomato	Thumba	*Elabatu*
Number of observation													274
LR chi2(264)													341.93
Prob.> chi2													0.00
Pseudo R2													0.2593
Log likelihood													-488.302

legend: * p<.1; ** p<.05; *** p<.001

Annex 22: Multinomial Logit Model Estimation for *Elabatu*

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13
exto	-0.12	0.22	-0.65	-0.27	-0.02	-0.36	-0.72	0.10	-1.42	0.49	-0.67	-0.14	
fpr	0.41	-0.05	1.78*	0.75	0.62	0.98	0.74	-0.05	-1.32	0.15	0.95	1.94	
mdem	-1.46	-1.04	-1.45	-1.97*	-1.55	-1.33	-0.74	-0.63	1.16	-0.95	-1.47	-0.63	
wdata	-0.18	0.08	0.31	1.61*	1.64**	0.35	1.02	-0.26	2.35	0.82	0.39	-1.16	
nmven	1.61**	1.36*	0.72	0.70	1.01	1.17*	0.75	1.55**	0.07	3.19**	1.46**	0.01	
oinf	-0.05	0.66	-0.16	0.62	0.33	0.04	0.42	-0.05	-3.92	-0.13	-0.25	-0.97	
sav	-0.63	-0.05	-0.17	-0.15	0.00	-0.08	-0.19	-0.01	-5.84	-5.42*	-0.54	-1.05	
fav	0.24	0.57	-0.28	-1.06	-0.56	0.14	-0.61	-0.10	3.04	2.06	0.17	0.45	
pav	-0.65	-1.2	0.31	0.71	0.09	-0.73	0.04	-1.21	2.99	-0.96	-1.00	-0.48	
cop	0.04	0.80	-0.38	0.26	-0.17	0.06	-0.33	0.08	-3.4	-0.90	0.35	1.00	
tast	-0.33	-16.68	-0.53	-0.80	-0.55	-0.46	-0.24	0.34	8.35	-5.70	-0.49	-15.98	
fcrd	0.48	0.20	1.10	1.49**	0.74	0.97	0.61	0.53	3.18	-0.58	0.82	0.25	
incrd	-0.43	-1.10	-0.64	-1.07	0.26	-0.20	-0.92	0.22	-1.50	-0.48	-0.01	0.47	
wavl	0.21	0.60	-0.23	-0.12	-0.01	1.00*	-0.21	0.17	2.64	0.92	0.71	1.30	
lav	0.55	-0.12	0.27	0.22	-0.24	0.17	0.29	0.15	-3.59	0.66	0.45	-0.12	
wav	0.05	0.24	-0.51	0.30	-0.24	0.15	0.29	-0.13	2.33	1.58*	0.25	0.69	
mav	-0.25	-0.26	-0.99	-1.10*	-0.54	-0.32	-0.64	-0.47	-2.31	1.02	-0.40	-1.77	
mktp	-1.52*	-1.01	-0.65	-1.46	-2.02**	-1.41*	-0.87	-0.88	-18.97	-0.04	-0.48	-1.49	
wmkt	18.81	1.87	17.85	-0.46	17.72	17.31	-0.17	17.04	-10.92	19.20	15.62	2.97	
scst	1.02**	0.48	0.26	0.08	0.29	0.44	0.43	0.49	2.28	2.47**	0.18	0.07	
yild	1.51*	0.39	0.17	-0.98	-0.01	-0.56	-0.51	1.23	2.39	-0.07	0.09	-0.63	
egrw	-1.05	16.43	16.17	16.84	15.01	16.12	15.30	14.54	-3.63	-1.09	16.41	18.86	
constant	-18.64	-2.29	-32.45	-15.97	-35.47	-38.22	-14.86	-32.45	33.08	-15.91	-35.38	-1.61	
Base outcome	Pumpkin	Snake gourd	Cucumber	Bitter gourd	Okra	Brinjal	Luffa	Long bean	Winged bean	Kakiri	Tomato	Thumba	*Elabatu*
Number of observation													274
LR chi2(264)													341.93
Prob.> chi2													0.00
Pseudo R2													0.2593
Log likelihood													-488.302