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Review of Coordination and Governance of Agriculture Industry Activities in Sri Lanka and Potential Use of ICT in Value Chain Strategy

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Abstract:

Over last sixty years, Sri Lankan agriculture sector has gone through a downhill resulting a growth drop from thirty percent to seven percent of its contribution to national GDP. There might be multiple factors contributing to this downturn including weak coordination of industry activities and inadequate governance of various functions. Therefore, this case review investigates how the activity coordination and governance of agricultural industry relates to this degrowth and potential use of ICTs to improve the situation. The review brings in value chain concepts and associated theories into the analysis to unpack the coordination and governance issues. In series the available literature and sector performances indicators are also reviewed. The possible use of modern ICTs is assessed to improve the agriculture value chain coordination and governance (AVC C&G) of activities. The government initiatives on e-agriculture adaptation and the existing ICT service platforms deployed at present in supporting agriculture are briefly assessed in the process of propositioning a conceptual approach to design the modules of full-featured agro support system which can integrate industry activities for improved AVC C&G. The review proposes a research based methodical approach to design the artifacts (modules) of the system following the design science research method (DSR). The proposed approach opens up three research areas: 1) Identification of barriers of user adaptation to ICTs into an integrated AVC, 2) Selection of appropriate technology to onboard AVC actors, and provide AVC C&G services, 3) Identification of strategic business model for such digital deployment in Sri Lankan context.

Keywords: agriculture; agriculture value chain; e-agriculture; information exchange; value chain coordination and governance; conceptual model

Background:

The agricultural activities of Sri Lanka have been evolving over decades since form ancient history of the country which is dating back to more than 2500 years. At present there is an organically evolved functioning agro-business system which has been formed around key agricultural activities of farming, harvest collecting, distributing and retailing together with other allied supportive activities. Figure 01 depicts the elements of the operating agro business system and its network which connects the stakeholders. Analysing and understanding of behaviour of agricultural activities are not straight forward since the activities are heterogeneous and fragmented in nature. Despite there is a functioning agro business system and country is with full of agricultural resources, the agricultural industry contribution to the national GDP has dropped down from 30% to 7 % over last 60 years (TheGlobalEconomy.com, 2021). This fact itself implies the existence of obvious efficiency and effectiveness gaps and productivity issues in the agriculture sector of the country. In order to unfold this indication, this review investigates more indicators related to the sector performances in a separate chapter and finds out that there is an obvious downturn in the progress of present-day agriculture in Sri Lanka. There might be multiple reasons causing this degrowth, however the scope of this review is limited to analyse the possible coordination and governance gaps of agriculture industry activities which contributes to the issue. The review brings in value chain (VC) perspectives and other associated theories evolved around VC concepts to investigate coordination and governing (C&G) gaps in agriculture value chain (AVC) and how it contributes to the above mentioned degrowth of agriculture sector. Trienekens, J. H. (2011) uses the VC concepts comprehensively in his study of agriculture value chain of developing countries and the approach is useful is applicable to Sri Lankan context as well. In series with AVC theoretical analysis, the review studies the existing literature and some performances indicators of agriculture industry which can be closely related to the behaviours of AVC C&G activities to reach more informed conclusions on its behaviours. In the latter part, the review analyses the potential uses of ICTs to improve AVC C&G activities and appropriate use of ICTs in the form of decision support system. This includes the review of present government initiatives on e-agriculture strategy and other various ICT service platforms deployed in supporting agriculture industries and including their impact on the AVC C&G at present. Finally, the study proposes theoretical and research-based approach to develop conceptual model for ICT driven decision support system (DSS) in the form business support partner deployed on digital platform for improved activity coordination and governance. This review

believes the study contributes new conceptual model to existing knowledge of systematic review and methodical design approach of industry value chain decision support system in the domain of AVC of Sri lanka.

Use of ICTs in value chain activities is common in every part of the world in enterprise and organization domains generally integrating VC functions into ERP systems. However, ICT use in VC activities in holistic industry such as in agriculture is different to usual ERP integrations since business functions are fragmented into various segments (Figure 01) and ownership of the functions and activities are not defined and managed harmoniously across the segments in integrated manner. Therefore, the study proposes to onboard the AVC actors scattered in the VC segments into a unique platform to process activity coordination and governance as independent entity. The system dilivers the services based on true and transparent intelligence processed by a computer system powered with modern technology.

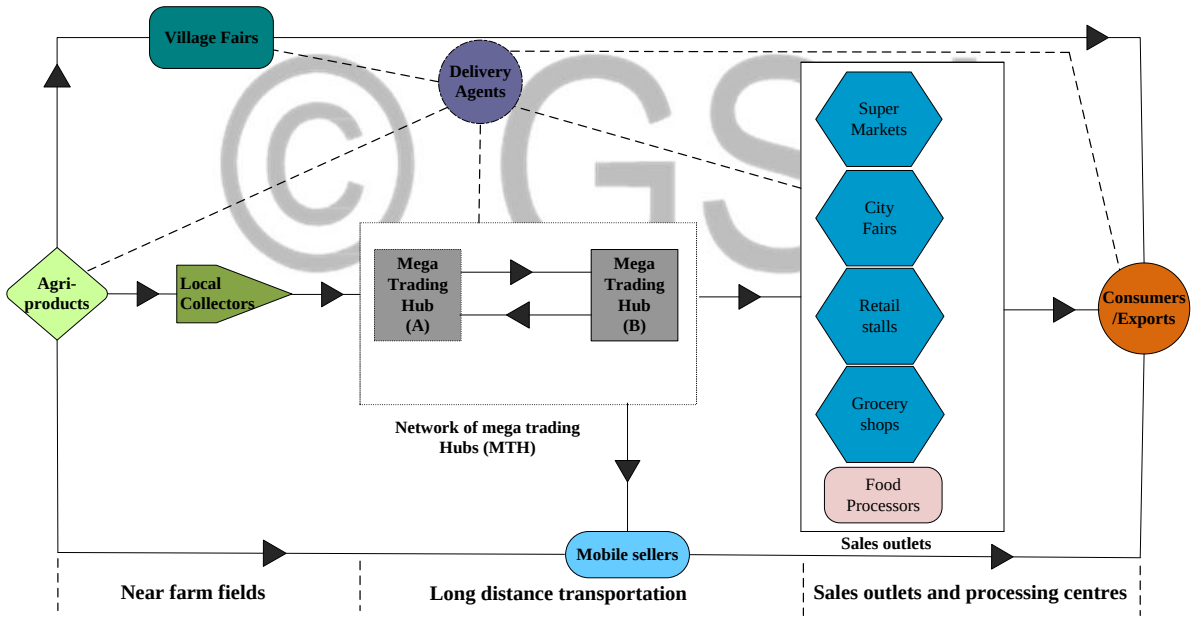


Figure 01: Present agriculture business network in Sri Lanka

Theoretical framework of AVC review:

During past decades extensive theories have been built around the concept of value chain reflecting various definitions and analytical approaches. (Porter, 1985, P. 37-38) defined the primary and the support activities of a generic value chain. According to Kaplinsky (2000) a value chain is the full range of activities which are required to bring a product or service from conception, through the intermediary phases of production, delivery to final consumers, and

final disposal after use. (Trienekens, 2011) groups the value chain theories into four streams with different information exchange perspectives of intercompany relationships. Since the information exchange of intersegment relationships in AVC is analogous to "intercompany" relationship of Trieneken's (2011) explanation, this review adopts those combined theories, definitions and concepts in this AVC analysis in Sri Lankan context. The agriculture industry primary activities and allied value activities are mapped into following information exchange streams indicating inter-segment relationships as shown in the below diagram (Figure 02).

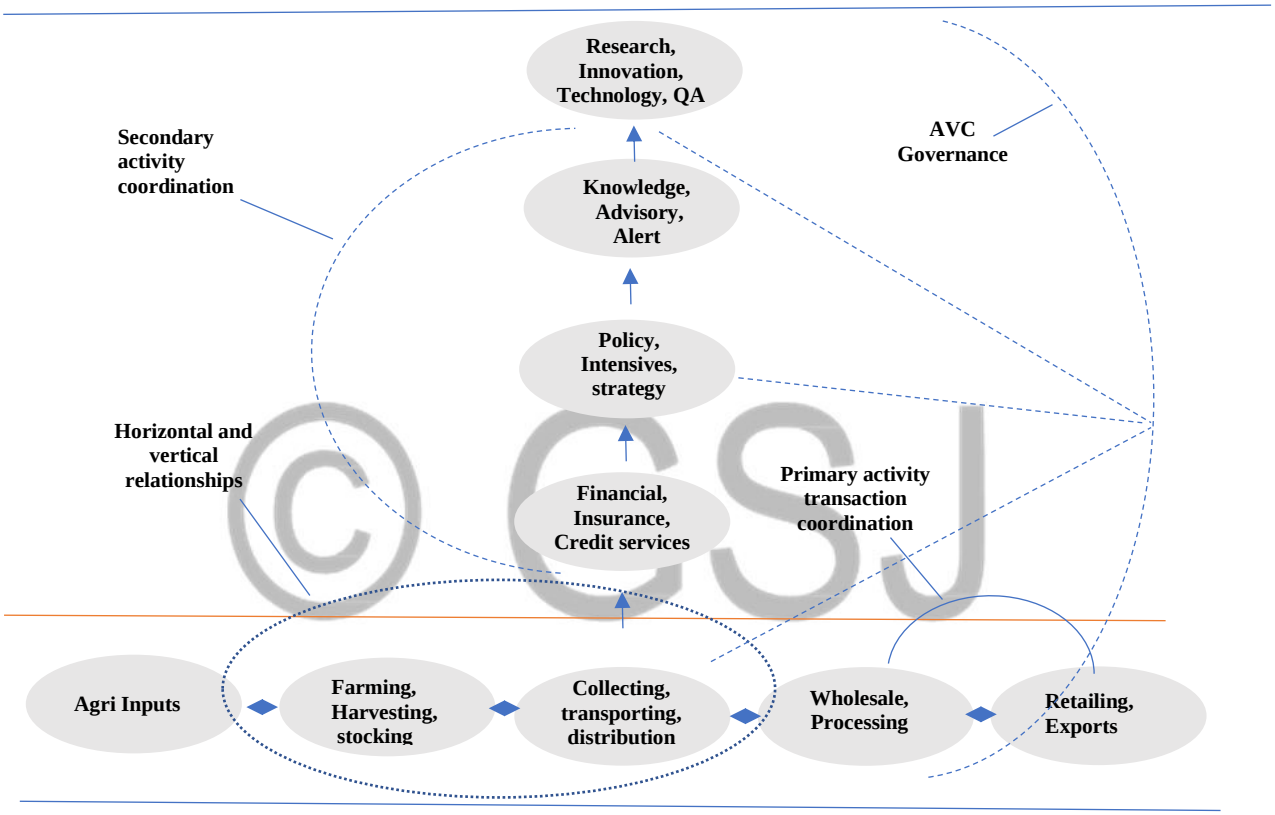


Figure 02: Map of AVC activity relationships into information exchange streams
Source: (Trienekens, 2011, p.56)

AVC information exchange streams:

The information exchange streams are vital in AVC C&G and ICTs can play key role in improving information exchanges. Therefore, this review is structured on four information exchanges streams: 1) AVC governance, 2) Primary activity transaction coordination, 3) Horizontal and vertical relationships, 4) Secondary activity coordination. The theories which can shed light to understand each stream in more scientific ways are considered during the review.

AVC governance:

The concept of global value chain analysis originates from the commodity chain approach. Gereffi, Humphrey, & Sturgeon, (2005) investigated relationships between multi-national companies, the "lead firms", and other participants in international value chains. The key determinants they found on VC governance in different types of VCs are demonstrated in Table 01 below. Later Gereffi, G., Lee, J., & Christian, M. (2009) concluded that the adoption of a GVC framework into their research of US-based food and agricultural value chains and their relevance to healthy diets, advances their understanding of healthy diets. The global governance framework shows applicable characteristics to a local industry value chain such as agriculture. Therefore, framework is selected to apply to AVC analysis in this study.

Table 01: Key determinants of global value chain governance

Governance type	Complexity of transactions	Ability to codify transactions	Capabilities in the supply-base	Degree of explicit coordination and power asymmetry
Market	Low	High	High	Low
Modular	High	High	High	↕
Relational	High	Low	High	
Captive	High	High	Low	
Hierarchy	High	Low	Low	High

Source: (Gereffi, Humphrey, & Sturgeon ,2005, P.87)

Since different agro-products show different VC type characteristic, the analysis groups the crop items which shows similar characteristics such as fruit and vegetables, rice and coconut, and tea and rubber (export-oriented crops) etc.

Horizontal and vertical relationships:

The social network theory views companies as embedded in a complex of horizontal, vertical and business value chain relationships with other companies and other organizations in supporting inputs and services (such as advisory services, credit facilitators, and transportation companies). According to network theory, relationships are not only shaped by economic considerations; other concepts like trust, reputation and power also have a key impact on the structure and duration of inter-company relationships (Uzzi,1997). The theory is useful to understand the inter segment relationships of AVC between horizontal and vertical integrations. Roko, L. P., & Opusunju, M. I. (2016) used this theory in their study of value chain and performance in agro allied small-land medium scale enterprise in Sokoto state,

Nigeria. The study concludes that value chain is significant in achieving performance of agro allied SMEs in Sokoto state and that primary activities of value chain contribute significantly to the performance of agro SMEs in Sokoto State and secondary activities.

Primary activity coordination:

According to governance theory value chains have been a conductor enhancing information flows between various actors in the chain. These governance issues have everything to do with the complexities of power relations within the chain, which determine how financial, material and human resources are allocated and flow within the chain. Schmitz (2004) has outlined four key parameters that define the production process of a product as to what is produced, how it is produced, when it is produced and how much is to be produced. This theory can be applied directly to understand the input outputs coordination and governance in AVC. Girma G.Gebre, E. Rik & A.Kijne (2020) found the theory is useful in analysing market information flow of banana VC which has both vertical and horizontal directions of banana chain interlinking the regions of the country.

Secondary (value) activity coordination:

In Porter's value chain framework (1985) value configuration theory proposes that the value chain is a good representation of one of three basic value creation. The chain represents manufacturing of physical goods with its focus on the transformation and assembly of inputs into finished goods. The other two value configurations are for problem-solving services and mediation services. The theory is useful in integrating various value adding services to ensure expected quality and required standard of the final products including other problem solving and mediation service as explained in the theory itself. Fromm. I. (2007) used this theory to investigate the upgrading opportunities of SMEs participating in agri-food chains. It focused on the local producers analysing how their interaction with local processors or exporters and international retailers opened the possibility to acquire new skills and knowledge. In particular, the type of trust relationship and power dependence was scrutinized to determine how information flows and how firms upgrade.

View of AVC activities through a thermotical lenses

In its nature agro business functions and activities are fragmented and characterised by various other determinants such as type of crop, areas of cultivation, seasonality of cultivation, and other socioeconomic and cultural factors associated with the sector. Therefore, the approach of this review is to consider product in different categories and analyse them within the theoretical framework explained above. Out of the diverse growing crops varieties, vegetable, coconut,

rice, tea and rubber are selected for consideration in this review. The VC activities of vegetable and coconut show close market governance type characteristics with low activity coordination which relates to the common observation of that farmers produce vegetables and fruits with less coordination with the buyers to match the realistic demand. The primary driving force of these markets seems market price which controls the business. (Ranathilak, & Andri, 2014) in their case study from Dambulla wholesale market showed that market prices of vegetables increase and fluctuates often and the cause for this fluctuation is found to be mainly due to market margin added by the middlemen. They also concluded that marketing cost mainly depends on post-harvest losses which is a long prevailing issue in the sector for years. Though there are limited literature on more accurate finding on post-harvest losses, various analytical discussions, mass media news and documentaries estimate the post-harvest loss as 30% in vegetable fruit chains. (Wasala, Dissanayake, Dharmasena, Gunawardane, & Dissanayake, 2014) researched and concluded that total post-harvest loss of banana was 28.5% from farm gate to retailer in their study of postharvest losses in banana supply chain. (Wasala at el, 2014) further propose continuous training and awareness programs to improve the safe handling and transportation of banana to minimize post-harvest losses.

Above findings shows an inelastic characteristic of supply and demand of vegetable and coconut chains which causes frequent losses to farmers particularly in seasons where supply creates surplus exceeding the demands. There are no proven mechanisms put in place of absorbing those surpluses and convert into processed items. On the other hand, in some seasons the prices of these items radically climb up due to low productions resulting deficit in the supply chain. This sudden price hikes results less value for money for consumers purchases. These findings and arguments reveal a coordination and governing gap in the value chain of vegetable coconut and fruits sector in the present operating context in all terms of primary activity coordination, horizontal and vertical relationships.

The food processing sector, which is an essential vertical addition into modern day AVC is slow growing in Sri Lanka. According to Esham & Usami (2006), the conversion of vegetables and fruits into post-harvest processing or exports is less than 4 percent in the industry, the situation might be the same at present too since there is no visible growth in agro product exports in recent years. Esham & Usami (2006) found the reason for low conversion rate as cost constrains in establishing organized linkage between those value adding service providers and farmers (small holder farmers in particular).Organizing of small-scale farmers into collective groups in the form of farmer organizations and farmer companies are proposed as

alternatives to strengthen the above-mentioned linkages in the VC. This implies that problem solving, and mediation support is lacking in the AVC and important to integrate into solutions of value configurations.

These findings implicitly or explicitly imply that there are gaps in correct and timely decision making by farmers and other value chain actors. Accurate information and relevant knowledge on time are vital in making decisions on activities such as volume forecast, transportation, safe handling and ultimate pricing to ensure AVC success.

The rice VC displays different characteristics to vegetables. Most of paddy cultivators are small scale producers who are dependent on buyers such as stocking merchants, rice mill owners and government purchasing facilities. These buying parties often wield a great deal of power and control on VC activities than the farmers and other allied actors of the VC. The powerful buyers in the VC are perceived to be often controll the VC activities. Ethical leadership is important to ensure equitable share of market price being received by farmers and other stakeholders in the value chain which is proportional to their contribution. However, the growing monopolistic controlling behaviour of rice market is a concern brought up by public media repetitively for last several years. Nevertheless, the review proposes this area for further research to draw more realistic conclusion on these concerns and allegations. (Senanayake, & Premaratne ,2016) concluded that in most cases the small producers within value chains work together and form producer groups in rice production. In some cases, large firms take a leading role for such integration and small holder farmers will be able to benefit from such integrations. Rice production VC is closer to captive type behaviours where the supplier is less empowered in decision making therefore VC governance is vital to eliminate this disparity.

The behaver of tea and rubber production including other plantation crops which are mainly produced for export market displays both modular and relational behaviour of the value chain. Typically, suppliers in modular value chains make products or provide services to a customer's specifications. In such market environment, interactions between buyers and sellers are characterized by the transfer of information and embedded services based on mutual reliance regulated through reputation. In order to maintain such relationships, it is essential to have well organized communication links both internal and transnational. Technology, language and literacy barriers are huge concerns for small-scale plantation owners and information poor stake holders in the plantation VC. In addition to above communication gaps and difficulties

(Wekumbura, Mohotti, Frossard, Kudagammana, & Silva, 2017) foresaw an uncertain future of tea because of changing climate and yield declining trends. As a remedy they proposed promotion and development of tea-based home garden as a strong foundation as a sustainable alternative. They also point out that application of proper extension service and introduction of sustainable techniques as a greater investment for smallholder farmers to secure both food and economic status of family. Information exchange, timely coordination of activities and regulations are important functions to make these suggestions to functioning reality. In addition to above theoretical investigations and literature reviews, this review continues to look at some indicators of agriculture sector performances to get more practical insight on the above findings related to AVC performances to compare with indicators.

Application of performances indicators of agriculture sector:

The agriculture industry product mix of Sri Lanka comprises variety of crop items such as cereals, rice, vegetables, fruits, sugar cane, tobacco, and non-perennial crops, oleaginous fruits(coconut, oil palm etc.), tea, rubber ,other beverage crops (coffee, cocoa etc.), perennial crops, spices aromatic drug and pharmaceutical crops, animal productions, marine fishing and aquaculture,freshwater fishing and aquaculture,forestry and logging and plant propagation and support activities to agriculture.(Department of Agriculture, 2019).Despite the industry comprises great biodiversity in crop cultivation across the country, the average agriculture income for national economy is Rs 661,318 million in average over last 6 years and most recent contribution to national GDP is around 7 percent. The export income remains stagnated and it is low as 6% of the country gross export which is unexpectedly low. (Central bank ,2020a). The following diagram in Figure 03 shows the severity of the downturn occurred in the sector during last 60 years.

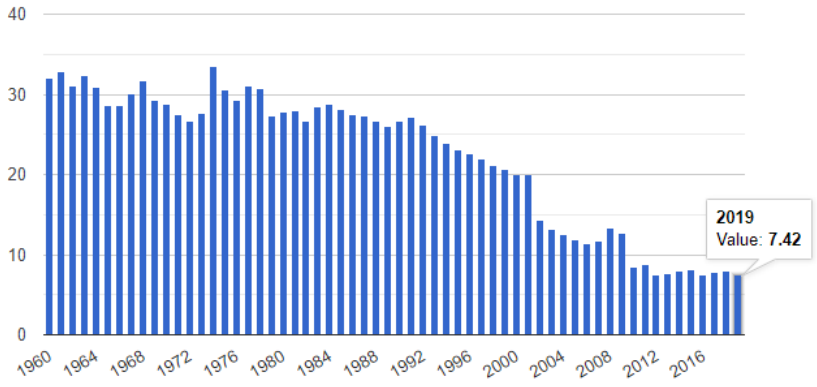


Figure 03: GDP share of agriculture
Source :(TheGlobalEconomy.com, 2021) and (Central bank,2020a)

Comparative growth of Agriculture industry:

The percentages of contribution from agriculture to national agriculture income of the economy is depicted in Figure 04 below. According the details of central bank annual reports major crop product show either negative or slow growth over last 5 years which indicate that there are unresolved issues in Sri Lankan agriculture industry (Central bank ,2020a). These negative performances also can be related to the gaps of AVC C&G to a greater extent.

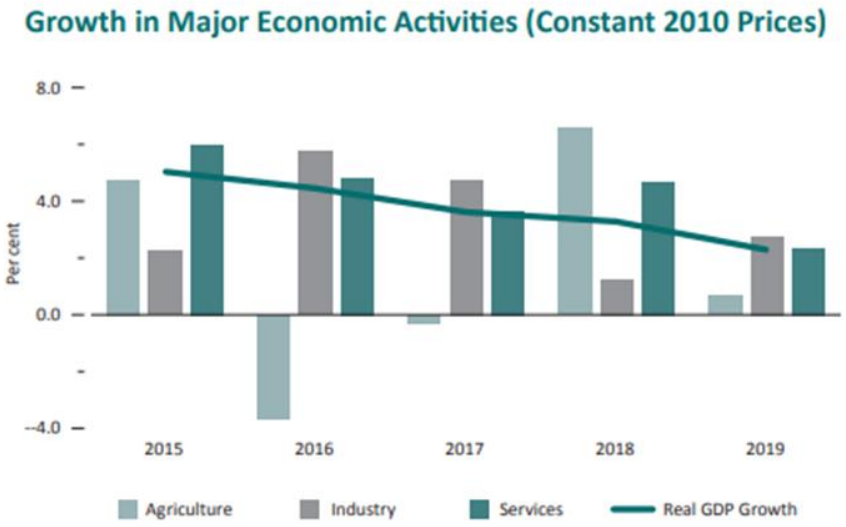


Figure 04: Comparison growth of Agriculture industry
Source: (Central bank,2020b)

Price fluctuation of vegetable, rice and coconut:

The price fluctuations of vegetables, coconut and rice was observed over last twelve month taking some samples from daily price list published in the website of central bank of Sri Lanka. Figure 05 below shows the patterns of price fluctuations of beans, brinjal, tomato and snake guard, coconut, and rice (Central bank, 2021). The prices of vegetable vary dramatically over months and often exceeds100% change with a short period of time (month).This behavior corelates with the theoretical and literature observation of characteristics of market type VC. The unregulated price is the key factor dictates the market terms and causes imbalance in the supply chain.

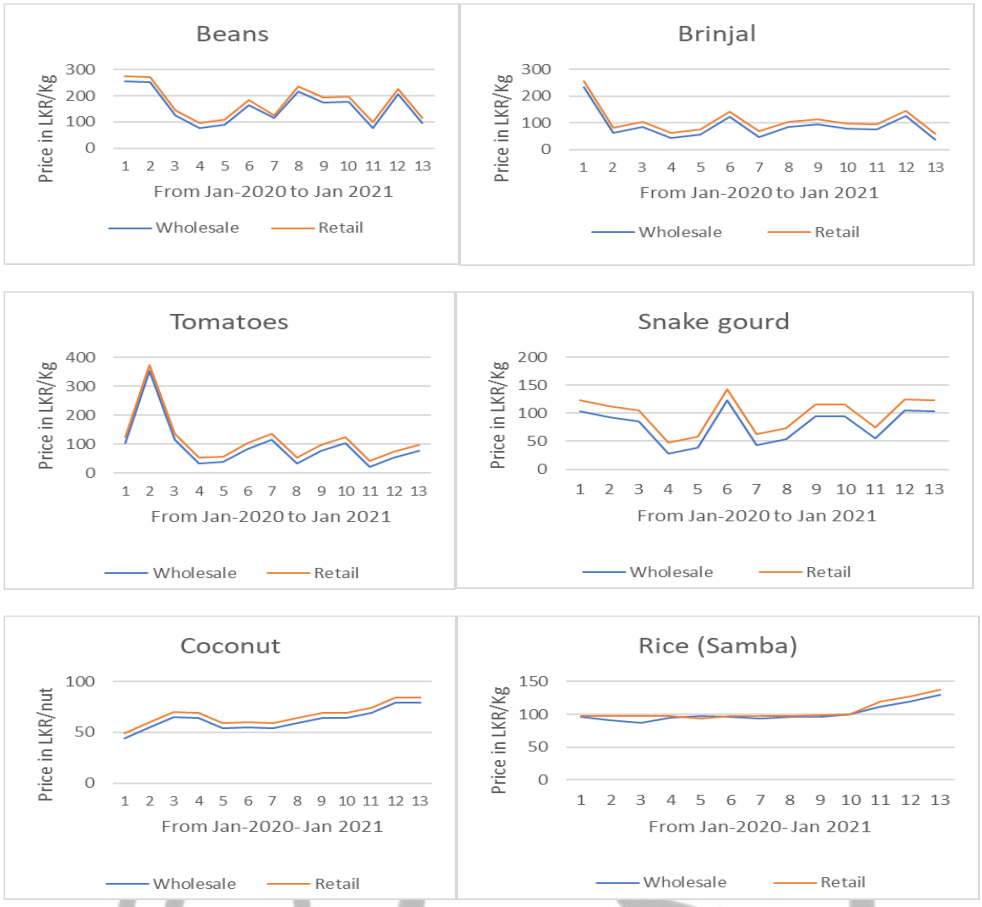
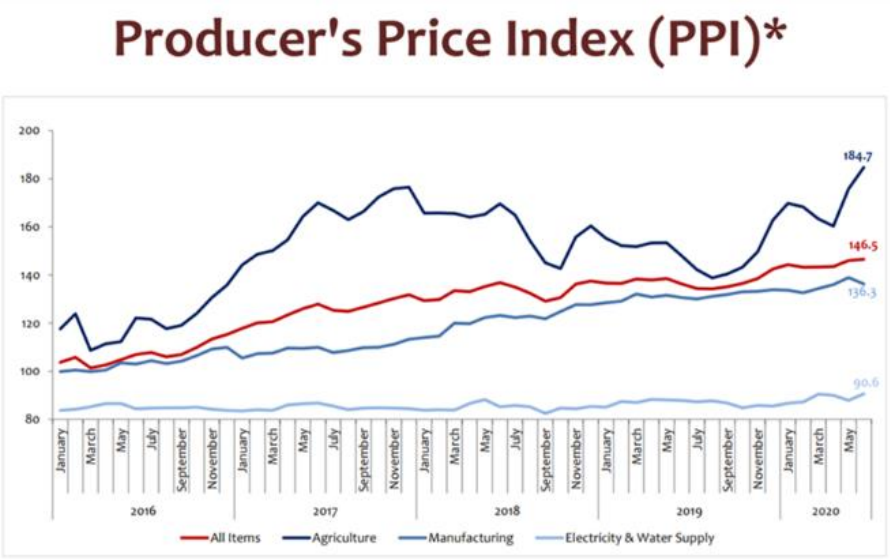


Figure 05: Price Fluctuation of vegetables (From Jan 2020- Jan 2021)
Source:(Central bank, 2021).

Samples of price fluctuation analysis :
(location of the prices: Dambulla market and at Marandagahamula (rice) are considered in plotting the graphs
Dates of the price : 01-Jan-20 ,03-Feb-20.02-Mar-20,01-Apr-20,04-May-20,01-Jun-20,01-Jul-20,04-Aug-20,02-Sep-20,02-Oct-20,02-Nov-20,01-Dec-20,01-Jan-21
Unit of the prices :LKR)

Producer price index (PPI) and Inflation :

In comparison to other sectors, PPI is favorable on agriculture products despite there are regular fluctuations. However, the positive PPI trends trade of with fluctuation of inflations as shown in Figure 07 below. In supporting to this observation, Senanayake, & Premaratne (2016), find that profit margins accruing to actors involved in the rice value chains are not excessive when compared with the bank rate. This indicates PPI is following the cost of production and inflation resulting less profit for farmers. There is space to improve in AVC to leverage the profit margins of AVC actors which could be achieved through enhanced AVC C&G which can help in productivity improvements.



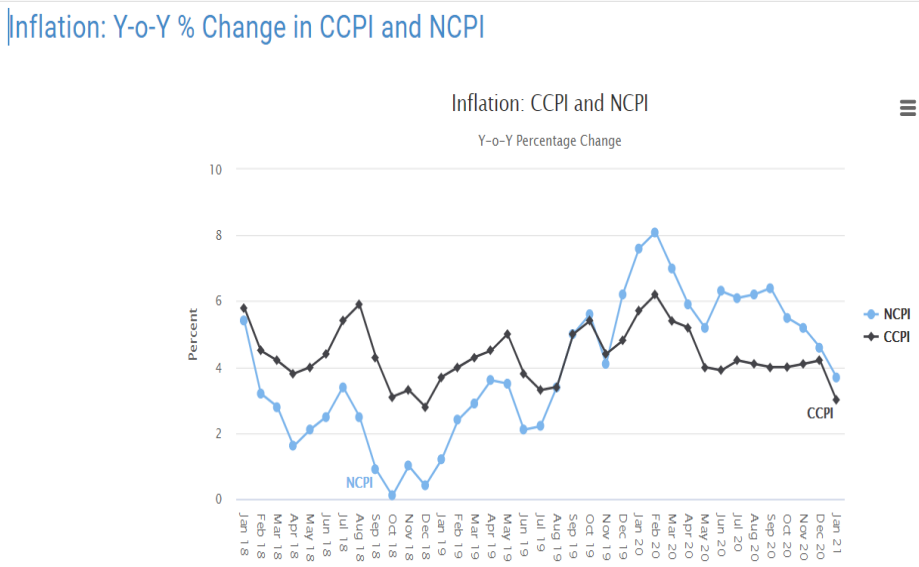


Figure 07: Variation of PPI and Inflation
(*Based on the Producer's Price Index (PPI,2013 Q4=100)
Source: (Central bank,2020b)

E-agriculture strategy:

The Department of Agriculture and Telecommunications Regulatory Commission of Sri lanka has already started looking at the possibilities of use of ICTs to improve the AVC activities. With the same objective above authorities had held an expert workshop in December 2015, in collaboration with the ITU, FAO & CABI in supporting of development of e-agriculture strategy framework for Sri Lanka. In this workshop the expert group had identified 97 unresolved challenges in agriculture sector in Sri Lanka in various areas where ICT can play major role in providing solutions. The areas of the prevailing challenges identified in various categories are shown in below list. (Department of Agriculture, 2016)

(Note: ITU- International Telecommunication Union of United nations, FAO- Food and Agriculture Organization of United Nations, CABI- Centre for Agriculture and Bioscience International)

The categories of challenges identified in the expert workshop:

- Policies, guidelines and regulatory frameworks
- Resource constraints
- Value chain, farm inputs and logistics
- Natural resource management and climate change
- Marketing and financing
- Data availability, accessibility and reliability
- Knowledge, information and awareness
- Lack of services

The outcome of the expert group shows that more than 80% of those challenges identified in the workshop are related to AVC C&G which are potentially could be subdue by adaptation of modern ICTs into AVC as support function

The above theoretical analysis, insights drawn from exiting literature and performance indicators, and outcome of the e-agriculture expert group collectively provide evidence of prevailing coordination and governing gaps across AVC. Use of ICTs for VC coordination and governance are common in integrated ERP platforms (Example: SAP and Oracle EBS). However, implementation of VC coordination and governing system in broad industry perspective such as in agriculture has not been adequately discussed in academic domain and business environments. Therefore, this review attempts to propose conceptual framework to design ICT driven AVC C&G system which will help to derive a business model for practical deployment of such system. This review firmly believes implementation of such system could leverage the achievement of below objectives proposed by (FAO, 2016) for Asia pacific nations which is also adapted into e-agriculture strategy development by Department of Agriculture of Sri Lanka in year 2016.

Main objectives proposed in e-agriculture strategy guide for Asia-pacific region by FAO:

- Higher income for small holders
- Low transaction logistical and distribution cost
- Improve traceability and quality standards for buyers
- New opportunities for financial institutions
- National policy , strategy and regulation implementations

- Empower youth engagement in agriculture

(FAO, 2016)

How ICTs can make a difference in AVC coordination and governance:

Modern day the use of ICTs is common in e-commers space for various objectives such as transaction handling, Knowledge sharing, true and intelligent decision-making, enhancing visibility of activities, activity optimization and collaboration, financial accounting facilitation, policy and strategy implementation, and data hosting and information processing. The following table (Table 2) illustrates possible solutions and the impact of those solutions in the AVC context (FAO, 2016)

Table 02 : Potential ICT Solutions in supporting AVC C&G

Information exchange streams	Solutions	Impact
Supports on AVC governance	Implementation of regulatory and policy frameworks	• Sustainable quality and compliance • Higher degree of resilience on emergencies/calamities • Well informed decisions • Effective and efficient Agri-input management • Regulation of inequalities in income
	Disaster management and early warning	
	More efficient and reliable data for high level strategy decisions	
	Promoting environmentally sustainable farming practices	
Supports horizontal and vertical relationships of AVC	Widen the reach of local communities	• Leverage the wellbeing of AVC actors (Support on Education, health etc.) • Sustainable ties among parties (Ex: Contact farming , retailer /supermarket backward integration etc.) • Credible field researches • Infusion of actionable knowdgeee
	Build social relationship horizontal and vertical actors	
	Bridge the gap between researches and extended agents	
Supports on secondary activity services and coordination	Climate and disease information	• Better disaster and risk management • Higher-yield production • More accurate assessment on soil health, right use of Agri-inputs • Increased efficiency and predictability, Reduced administration cost, reduce frauds • Higher Yields , optimal production , fewer losses
	Good agriculture practices	
	Extension services	
	Better transaction recording, accounting and traceability	
	Credit Insurance Payment methods	
	Market Information	

Support on primary activity coordination and services	Direct links between farmer supplier and buyer networks Direct links to export channels Reach global market	• Higher prices, produce based on demand etc. • Less exploitation by intermediaries, more efficient distribution channels • More exports

Source : (FAO, 2016)

The present ICT initiatives in supporting ICT sector :

Over the past years, there are several novel concepts and initiatives emerged in agriculture sector which have added value to agribusinesses in various means, such as enhancing farmers' knowledge, and disseminating important market information. The following list summarizes some live projects in the sector and the objectives of each respectively.

1. **www.doa.gov.lk:** Ministry of Agriculture web site which provides information for farming community, other stakeholders, and general public on policies, guidance and administrative services.
2. **Wikigoviya web**: Cyber agriculture Wikipedia which provide learning & education materials.
3. **AgMIS**: Short Message Service (SMS) service for market information requests.
4. **Crop forecasting** (*boga purokathanaya***):** Farmer advisory (SMS) on crop selection for better pricing.
5. **SL paddy fertilizer app**: Mobile application (App) which provides fertilizer recommendation.
6. **Govipola app and web site**: Mobile application (App) for market linkage and improve price awareness.
7. **Rice knowledge bank website (IRRI):** Country information system for rice cultivation hosted by International Rice Research Institute (IRRI).
8. **Agriculture videos on the internet:** Documentaries, awareness programs on timely and relevant technologies, including success stories.
9. **Govi Mithuru project:** A project to strengthen the technology transfer in agriculture to farming community using mobile technology.
10. **Market price information systems:** Telephone dial-in service to provide daily market price information over mobile phones by two mobile networks.
11. **www.b4fn.org/countries/sri-lanka:** A web application offering information on healthy food items and preparations together with the respective nutrition values (Information System for Biodiversity of Food and Nutrition System).

12. **doaseed.lk:** Seed and planting material management information system for real-time seed and planting material information to monitor their productions, certifications, distributions, sales and available stocks.
13. **Progress monitoring system for national food production program:** A software solution to monitor the progress of the National Food Production Program (NFPP).
14. **QR code system for GAP certification program:** A program to promote Good Agriculture Practices (GAP) to certify agricultural products to meet international standards for export market

(Department of Agriculture, 2016)

In this preliminary review of the existing ICT platforms the quick findings are those applications are basically developed to support market information services and support on establishing links between supplier and buyer. Also, there are websites including the Department of Agriculture (doa.gov.lk) which provides information, advisory, and knowledge services to agriculture communities. These systems operate in isolation and the impact of the systems on AVC C&G is less visible. Therefore, the following section proposes a conceptual approach to design a harmonized AVC C&G system driven by latest technology on digital platform to harmonize and centralize the AVC C&G.

Discussion on designing ICT system for AVC C&G:

(FAO, 2013) in its publication of "ICT Uses for Inclusive Agricultural Value Chains" highlights the requirement of full understanding the nature of the problems and reasons for problem existence before designing a solution. (FAO, 2013) further proposes to listen to customers and field staff who may have the most innovative and appropriate solution to the problems. Also, the study emphasises on simplicity and user-friendliness of such system and its sustainability for longer term perspectives. All these points are valid and taken into consideration in proposing the conceptual approach for AVC C&G system. In supporting the above conclusions by (FAO,2013), (Jayathilake, Jayaweera, & Waidyasekera, 2010) came up with findings that 62.6% and 42.9% of tea sector and poultry sector users respectively are constrained by cost of technology and prevent use of ICTs. Lack of farmers literacy on use of ICTs, infrastructure, and trust of systems were found as secondary factors for slow user adaptation on ICT system. This review proposes more up to date and widely represented research-based finding to assess the present situation of such barriers in user adaptation to ICT platforms.

Method and Approach to develop the conceptual model (artifacts) :

The review proposes research-based approach to design the modules of AVC C&G system in the form integrated supporting system overarching the entire AVC. The main four building pillars of the systems are for AVC information streams identified in the theory. Onboarding of VC actors who are fragmented geographically in diverse segments in the VC into such system is one of the key identified challenges in the design. Also figuring out exact feature set fitting for the purpose of support system is another obvious design challenge. Selection of appropriate technology which can host the AVC holistically and process true intelligence in coordination and governing activities whilst maintain the user-friendliness, trust and security is equally important challenges need to be overcome.

Design science research (DSR) methodology is proposed in this design since DSR has been used in designing information management systems over years. The methodology is proposed in developing the conceptual model for AVC C&G while mapping concept into local context. The three-way cycle view of DSR explained by Hevner (2007) details the three steps of DSR approach as depicted in Figure 08 below which is mapped to AVC context.

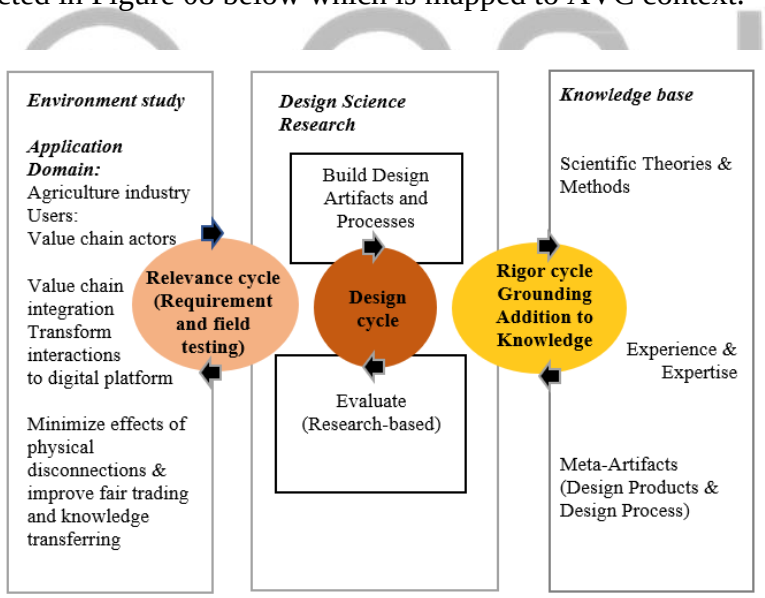


Figure 08: Design Science Research Cycles
Source: (Hevner, 2007, p.2)

Framework for artefact building:

The areas of service portfolio of proposed AVG C&G system have been derived based on the requirements identified in the review. However, identification of barriers related ICT adaptation of AVC users and onboard them into a digital platform is the primary challenge in such deployment. Therefore, a filed research is proposed to find out those barriers and then

incorporate the features to overcome those barriers in the design. Selection of technology and the architect of the business model are proposed to be carried out using desk researches . Figure 09 explains conceptual model for design and implementation of AVC C&G system for better coordination and governance of AVC activities.

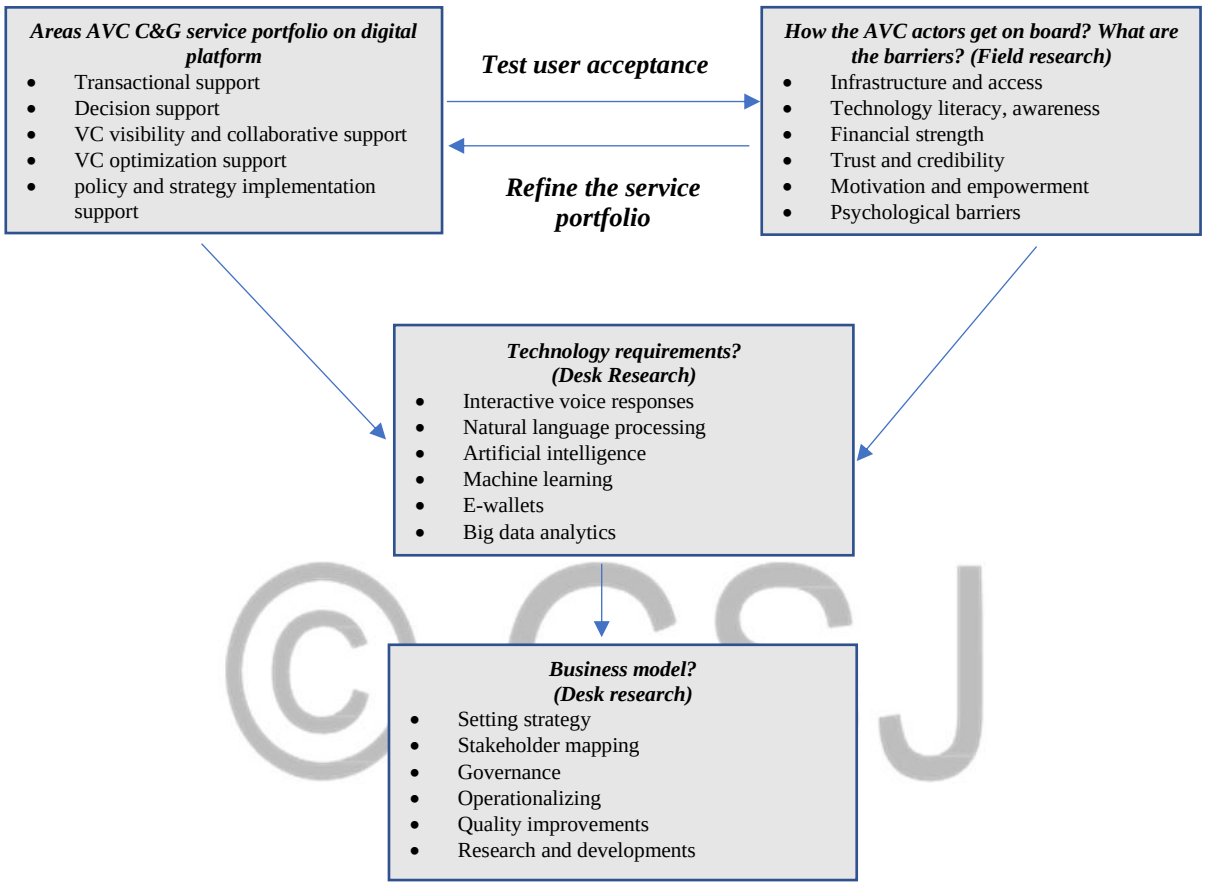


Figure 09. Conceptual framework in designing and implementing AVC C&G system

Discussion and Consultation :

Bringing in of VC perspectives and associated theories into this review is right approach since this theoretical framework helps to map the practical issues into theoretical frame for in-depth understanding of the issue. Understanding of information exchange streams systematically is the key requirement in designing a concept for AVC C&G. This clarity on both theoretical and practical aspects greatly helps in formulating a solid approach to design and implementing the modules in proposed AVC C&G system. Despite the available literature is limited within the scope of the review study , the combination of some agriculture performances indicators and literature helps to corelate the finding with the theoretical explanations for final consolidation of findings.

Sri Lankan agriculture sector growth is obviously in declining trend and Department of Agriculture has realized the need of uplifting the agriculture sector through implementing an e-agriculture strategy in the agriculture industry. Though the strategy was formulated in 2016 the implementations seem have taken a slow path. The outcome of the expert workshop held in 2015 by Department of Agriculture provide justifying evidence on the need of cohesive ICT platform in the key information exchange streams identified as AVC coordination , primary activity transaction coordination, horizontal and vertical activity relationships , and secondary activity coordination which is addressed in this proposed solution.

According to the quick assessments carried out during this review, the existing ICT service platforms are basically information push systems and basically facilitating in linking supplier and buyer for trading. However, it is recommended to carryout detailed review on use of exiting ICT platforms and the impact of those platforms to the industry. Also, the review proposes to explore the opportunities of integrating those platforms into unified system for better information exchanges ,users support and governance.

Use of ICTs obviously can leverage the coordination and governing functions of VC; however, such use of ICTs is not straight forward in the context of holistic industry VCs. Industry VCs are much broader than organizational or enterprise VC and hence the design and governing of such system requires much informed user requirement driven approach than regular ERP systems design. The proposed approach helps to overcome on field barriers of onboarding the AVC actors into the platform and determine the exact feature set required based on the demands required for solutions. Also, the approach will help to choose appropriate technology to host the VC actors , retain them , and serve them with true intelligence driven by a computer system powered with modern ICTs. Identification of strategic business model for such deployment is a key requirement since the ownership, responsibility and accountability should be well defined. Clear governing and operationalizing structure of such system is key requirement for sustainable success of such system. Identification of the factors influencing user adaptation of such system is the major challenge and key element of success .Therefore this review proposes a comprehensive filed research in this area and the outcome of such research will help in featuring the service modules of the proposed AVC C&G system for exact user needs.

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