International Journal of Business and Management 1 (2): 232-237, 2017
e-ISSN: 2590-3721

DOI: 10.26666/rmp.ijbm.2017.2.35

Production Management Model for Demand-Based Tomato Production System

Ida Marina[a)] Tomy Perdana[a)] Trisna Insan Noor[a)] Dety Sukmawati [b)]
[a] Agricultural Science, Faculty of Agriculture, University of Padjadjaran, Jatinangor Campus, West Java 45363, Indonesia.
[b] Faculty of Agriculture, University of Winaya Mukti, Tanjungsari Campus, West Java 45362, Indonesia.

Abstract: Based on the literature review of supply chain management for fresh agricultural products, the problem is differentiated based on strategic issues, technical issues, and operational issues. However, this research is more focused on operational issues. Furthermore, operational issues are examined to find its main cause and a quality of fresh agricultural products. The availability of products at a certain time, changes in agroecosystems, attack of plant-disturbing organisms and the amount of waste produced in post-harvest are the impact of a poor production operating system of fresh agricultural products. All inputs in production operations require a regulatory system to achieve an expected production output. The regulatory system referred to by the author is the supply chain management in the production department to handle the operational issues of fresh agricultural products. In this research, management system and operational problem in fresh agricultural product were developed by system dynamics by using system thinking model, where every management problem and operational of fresh agricultural product was seen as a system, a whole interaction between elements of an object within certain environmental boundaries that work to see and discuss a reality that can help understand phenomena.

Key words: Supply Chain Management, Operational Problem, Fresh Agricultural Products, Tomato Production.

INTRODUCTION

Supply chain management is an increasingly important issue to face the tight business climate, especially in the globalization era [1]. The adoption and implementation of SCM have been widely recognized to improve organizational performance [2], where studies have found a positive relationship between SCM and the increased organizational competitiveness and performance [3]. The implication of SCM on performance depends on a variety of factors, which are generally grouped as demand uncertainty, supply uncertainty, and technological uncertainty [4-5]. In this regard, it takes "responsiveness", the ability of the supply chain to respond to market changes and customer demand quickly [6].

Responsiveness in general sense is defined as "the ability to react purposefully and within an appropriate time-scale to customer demand or changes in the marketplace, to bring about or maintain competitive advantage" [7]. In this case, responsiveness is associated with the ability to act deliberately and on an appropriate time-scale to respond to customer demand or market changes in order to maintain or achieve a competitive advantage through the underlying problem-solving based on current issues.

Related to those developments, it is interesting to see how far the supply chain management can respond to changes in customer demand. In this research, attention is directed specifically to the application of SCM to operational issues in agriculture. More specifically, it deals with the production of fresh agricultural products. Tomato (*Lycopersicum esculentum* Mill) is a fresh agricultural product that has a high economic value and it still requires serious handling, especially in terms of increasing its yield and the fruit's quality [8]. In particular, attention is directed to West Java province, where the allocation of tomato production centers ranks first nationally, as well as the number of tomato production that also ranks first at the national level.

According to Murthy et al. (2007) [9], the operational issues of agricultural products can be solved through several stages: Demand, Production Planning, Inventory Management, and Transportation. One way to handle the operational

issues of agricultural products is through a production planning system. According to Ahumada et al. [10], operational issues on fresh agricultural products can be solved through harvest and transportation planning systems with demand information to help maximize revenue.

In operational activities, fresh agricultural products require SCM involvement to ensure food availability and safety. So, the management system on tomato commodity will be a reference in achieving the goal for improvement in the prevention of agricultural product availability and quality improvement. SCM in agricultural products is widely used through production controls by forecasting demand, planning production, managing inventory, and transportation.

In previous research, solving operational issues in the production control through the management system have often been done. Applying the right management system will result in action or activity to reach the goal in the period to come. The continuity of the production process can save costs and optimize the profits. In addition, the production management system is one of the solutions to meet the targets and also tackle the obstacles that can disrupt the production. Therefore, the management system is one of the most important elements in the operation of agricultural enterprises which will continuously be used in assisting the company's production planning in the period to come [11]. From the results of her study, Alex and Torres, [12] conclude that production planning requires a system that can provide information on production, inventory, and purchases to accelerate the production process. All elements can be well integrated and developed according to the required level of need. According to Heri Utomo [13], a system that can help and optimize all existing resources is needed in meeting the market demand for a product to further serve as the basic capital in meeting diverse needs.

The methods used to solve operational problems for production control through improved management have been widely developed, among others is the approach through Supply Chain Management (SCM) on sequencing of less efficient production schedules through one sequencing technique, EDD (Earliest Due Date), which is seen from three main criteria, namely the average of job delay, the amount of delayed work and the maximum delay [14].

Ai Rosita, et al. [15], use Web-Based Unified Modeling Language on production balance through cropping pattern scheduling system using information technology combined with cellular communication technology. According to Bambang Pramono [16], genetic algorithm (Programming) on production scheduling optimization is done by comparing the three genetic algorithm crossovers to construct the most minimum scheduling model structure and determine the best operator type to obtain a purpose or fitness function. The use of system dynamics can make improvements in the mechanism of production planning in an integrated manner so that the coordination system is effectively established between the agricultural production actors and the processing industry [17]

The model designed in this research is a simulation using system dynamics. This design can represent dynamic situations ranging from describing all the components that will affect the operating effectiveness of the system, input acceptance in the form of viable system alternatives to the completion of the modeling. The model approach to system dynamics is used to abstract actual world phenomena into more explicit models. The phenomena in question include two things: structure and behavior. Structure in this research is the relation between elements: Feedback, there is a causal relationship, for example between the availability of tomatoes with the demand; Stock and flow, which states the condition of the system at any time, in this case, describes a decision made based on the information; Time delay, there is a time delay on the tomato production system; Nonlinearity, which generates signals to be formulated into decision models which will then be the feedback for the dynamics of the system itself.

LITERATURE REVIEWS

This activity was conducted to evaluate the efforts of researchers in researching various disciplines to form a research on the supply chain management of fresh agricultural products with production control to overcome production operational issues that occur in supply chain management operations. This research used research problems as the guidance to improve the understanding. The researcher wondered whether there were works of literature reviewing operational controls on product quality in the supply chain of fresh agricultural products. Ahumade and Villalobos [10] distinguish the main issues of fresh agricultural products supply chain management based on the strategic issues, technical issues, and operational issues:

- Strategic issues include supply network cost planning, capacity selection, and technology
- Technical issues include harvesting plan, planting schedule, selecting manpower, and plant capacity.
- Operational issues include activities during production, harvest, and storage

Although it was difficult to distinguish between strategic issues, technical issues, and operational issues, it can be distinguished on the basis of technical issues and operational issues.

Furthermore, operational issues were examined to find its main cause and a quality of fresh agricultural products

The main operational issues in the supply chain of fresh agricultural products were divided into four categories:

1. Demand
2. Product Planning
3. Inventory Management
4. Transportation

Supply chain management was not easy because it involved a lot of parties from within and outside the company, in addition to the uncertain conditions in the supply chain and the increasingly tight conditions in the market added the complexity of the supply chain management. Uncertainty in the supply chain involved the consumer demand uncertainty, supply uncertainty, and technology uncertainty.

Table 1 shows that studies on agricultural product operational issues focus on demand, production planning, inventory management and transport. To obtain the desired study, the literature search was continued by using the keywords "Production Management System on agricultural products". From the literature results, there was no study that specifically discusses the production management system on agricultural products on demand. Although there were several journals that published research on agricultural production management systems, it was very limited and only studied on irrigation, plant physiology, pests, nutrition, growth, cropping patterns and suppliers.

METHODOLOGY

This research was based on a system thinking foundation, a conceptual framework developed to identify problems fundamentally by identifying holistically all the variables that play an important role [18]. The ground of the system dynamics methodology was the system thinking, a way of thinking in which every problem is viewed as a system, that is, the whole interaction between elements of an object within the boundaries of certain environments that work to see and discuss a reality that can help understand phenomena.

The system thinking approach was used to

Table 1 Reference Matrix of Agricultural Products Journal On Operational Issues

No.	Author	Operational Issues and Their Usefulness	Dependensi			
			DF	PP	IM	Tr
1	- Fan at al. (1994) - Halbrent el al. (1994) - Wu el at. (1995)	*Evaluated the effect of income elasticity on the demand of agri-Fresh Produce*	√			
2	- Ahmadi-Esfahani and Stanmore (1997) - Mutuc et al. (2007)	*Compared the rok of income elasticity, own-price, and cross -price elasticity of agri-fresh produce in the rural an urban areas.*	√			
3.	- Glen (1987) Lucas and Chhajed(2004) Lowe and Preckel (2004) - Ahumada and Villalobos (2009b)	*models for farm location, crop plantation, and harvesting analysis. Several reviews present the status of research from different perspectives.*		√		
4	- Nahmias (1982)	*model the deteriorating characteristic of the agri-fresh produce for inventory management.* *A comprehensive literature survey of inventory models was first given*			√	
5	- Raafat (1991)	*reviewed the literature on continuously deteriorating inventory models.*			√	
6	- Goyal and Giri (2001)	*The latest review of the deteriorating inventory models is given*			√	
7	- Ahumada, O. and Villalobos, J.R. (2011)	*Operational model for planning the harvest and distribution of perishable agricultural products*			√	
8	- Murthy et al.(2009)	*waste in transportation is one of the highest in* *the FSCM*				√
9	- E. Iakovou, D. Vlachos,Ch. Achillas, F. Anastasiadis (2014)	*Design of sustainable supply chains for the agrifood sector:* *a holistic research framework*			√	
10	- Manish Shukla and Sanjay Jharkharia (2012)	*Agri-fresh produce supply chain Management*			√	
11	- Jose Orlando Feriera, Otavio Batalha and Jean Carlos Domingos (2016)	*Integrated planning model for citrus agribusiniess system using systems dynamics*	√	√		

DF= Demand Forecasting, PP= Production Planning, IM= Inventory Managemen, Tr= Transportation.

express a behavioral change brought about by a structure in which there were interdependent elements. This system thinking was the basis of the system dynamics methodology. According to Senge [19], there were two essences of the system thinking:

1. Examined the interdependent relationships (influence and influenced or feedback), instead of direct causal relationships.
2. Examined the processes of change (the ongoing process), instead of momentary portraits.

The dynamic model system was one approach to a system which has several advantages, among others: (a). can simplify a complex problem model, and (b). there was feedback in the model [20]. Furthermore, Davidsen [21] stated that there were two forms of feedback in the dynamic model: (1). Positive feedback, and (2). Negative feedback. The positive feedback has a reinforcing effect meanwhile the negative feedback has a balancing effect on the model.

A qualitative system thinking approach was used to build structures, whereas a quantitative system thinking approach was used to simulate structures into behaviors. The qualitative system thinking approach was used to understand the complexity of the system and to support rational thinking processes in the process of utilizing quantitative - qualitative system thinking approach; these two approaches were used in an integrated manner according to the needs, substance, and context of the analysis.

RESULT ANALYSES AND DISCUSSIONS

Tomato production management in West Java Production Center, Garut District, has not been able to produce tomatoes to meet the demand throughout the year. Tomato production management in Garut District is expected to be a solution to overcome all complex problems, especially on tomato commodity, so it can increase the income of farmers and business actors involved and also able to drive the economic growth.

The general model of tomato production management begins with production planning based on demand information or demand forecasting, proceeds to production, and delivery. Production planning is done from input supply, nursery, land processing, maintenance, harvest, post-harvest, marketing, and the involvement of conventional financial institutions that act as the provider of capital and its involvement in price determinants. Tomato production management in Garut District is a complex network because it involves various actors. However, tomato production management activities will implement an integrated system that connects various actors at each activity.

Nowadays, tomato farmers are facing complex problems, both internal and external problems. Internal problems include: lack of management skills at the farmer level, increasingly narrow land tenure, very limited access to capital, technology, and markets, incompatibility between the quality required with the quality of the product produced, lack of superior tomato varieties availability that have high production and good quality fruit, and are resistant to pests and diseases. The external issues include climate and weather change issues, pests and plant diseases, and sharp price fluctuations. Such problems may pose risks and uncertainties for farmers, both in terms of production risks as well as market and price risks. It demands a change of production strategy which is deemed to be able to regulate the availability of tomatoes based on market information in fulfilling the demand through management improvements.

The benefits of the tomato availability management, among others: efficient in production activities, efficient in harvesting schedule, prices are relatively stable due to product security, encourage farmers to produce quality products, guarantee the quantity of supply throughout the year, and market security. Production strategies should be carried out through a well-arranged production planning process with the arrangement of production activities between nurseries, cultivation, planting, maintenance, harvesting, and marketing as can be seen in Figure 1

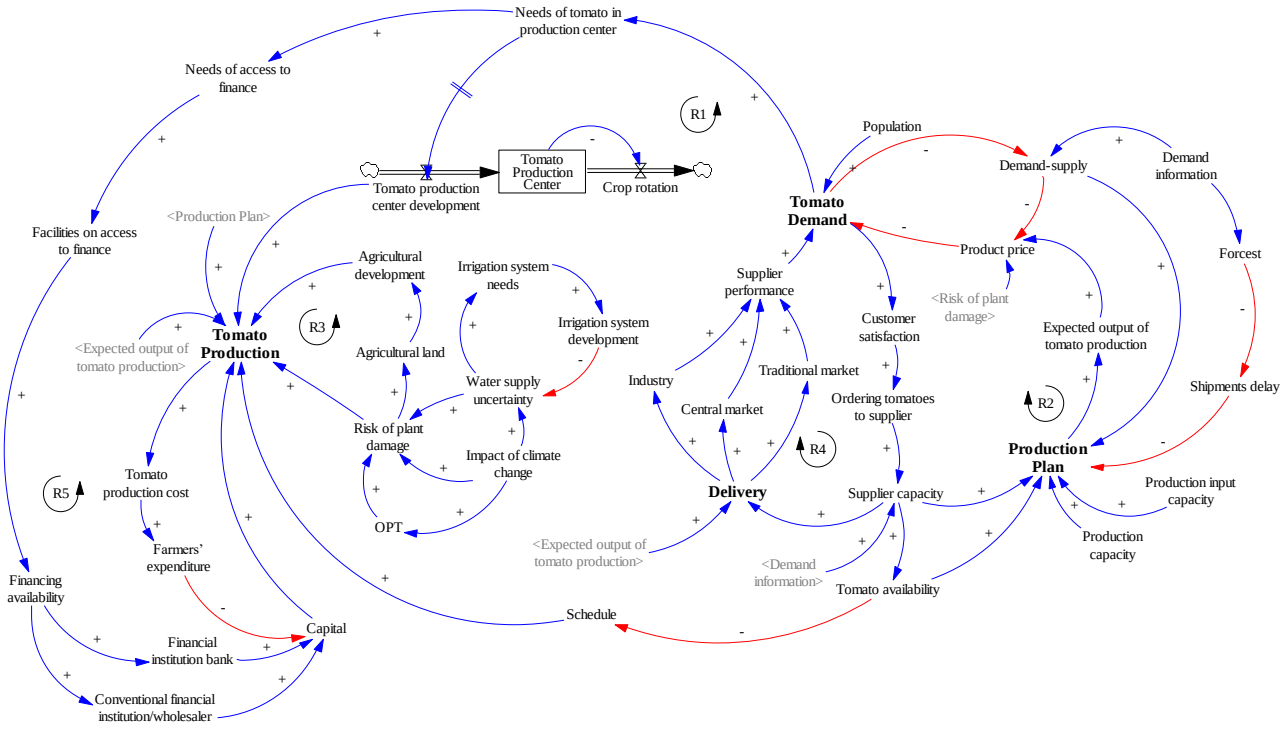

Figure 1. Stock diagram and management flow on the operational issues of tomato production center production system in West Java.

The general model of tomato production management begins with *production planning* based on demand information or d*emand forecasting*, proceeds to *production*, and *delivery*. Production planning is done from input supply, production activities, marketing, and the involvement of financial institutions that act as the provider of capital and its involvement in price determinants. Tomato production management in Garut District is a complex network because it involves various actors. However, tomato production management activities will implement an integrated system that connects various actors at each activity.

Stages of activities in tomato production management to meet the market demand for tomato commodity include: demand forecasting, production planning including input inventory from tomato farm, implementation of tomato production process activities ranging from seed procurement, land preparation, fertilization, pest eradication, harvest, post-harvest, distribution of results and the involvement of financial institutions. Before distributed, tomato sorting process is done to distinguish the quality *grade* of tomato that will be distributed. Furthermore, the tomatoes are packed and delivered to various markets, especially structural or industrial markets in accordance with the quality specifications required by the industry or referred to as *on-grade* products. It is also in accordance with the payments, thus affecting the decision in production management. In the fulfillment of local market needs, the activities performed is the same as the fulfillment of industrial demand process, the only difference is the quality of tomatoes that is referred to as *off-grade*. On the other hand, to meet industrial demand, there must be a relationship between product flow (tomato) and partnership contracts between farmers and industry.

CONCLUSIONS

The implementation of SCM on operational issues with production controls for fresh agricultural products is able to meet the relatively stable demand throughout the year. Tomato farmers can handle product characteristics through control. The role of production control on tomato production system is done by improving the management through demand forecasting, production planning, inventory management, and delivery arrangements. In addition, demand information becomes one of the references to

improve the production management system in the fulfillment of demand. Management systems have an important contribution to improve the farm performance. Improving the management system can solve complex problems. The management system in question is the incorporation of operational issues in previous research by adding agroecosystem, technological, social, and economic elements involvement as well as the involvement of non-formal fund providers as the newness in this study. Methodology Approach used in this research is the system dynamics as an attempt to abstract the phenomena in the real world into more explicit models both in structure and behavior.

REFERENCES

1. Friedman, T. (2006) The word is flat, London: Penguin Books.
2. Gimenez, C. and Ventura, E. (2005), "Logistics Production, Logistics Marketing and External Intergration – Their Impact on Performance", Internasional Journal of Operations & Production Management, Vol 25, No1, pp 20-38.
3. Li, S., Ragu-Nathan, B., Ragu-Nathan, T.S., and Rao, S.Subba (2006),"The Impact of Supply Chain Management Practices on Competitive Advantage and Organizational Performance", Omega, 34 (2), pp.107-124.
4. Fynes, B., de Bu'rca, S. and Marshall, D. (2004)"Environmental Uncertainty, supply chain relationship quality and performance", Journal of Purchasing and supply chain management, vol. 10 Nos 4/5, pp.179-90.
5. Liao, K. and Tu, Q.(2008), Leveraging automation and integration to improve manufacturing Supply Chain performance under uncertainty"Industrial Management and Data System, Vol. 99, pp.11-17.
6. Holweg, M. and Pil, F.K. (2001), "Succesful Build-To-Order Strategis Start with the Customer ",MIT Sloan Management Review,43 (1),pp. 74-84.
7. Kritchanchai, D., and MacCarthy, B.L. (1999) "Responsiveness for order fulfiment process,"Internasional Jurnal of Operations and Production Management, 19(8),pp.812-833.
8. Nisa, H,. 2008. Analisis Ekspor Tomat Segar Indonesia. Bogor: Program Pascasarjana Manajemen Bisnis Institut Pertanian Bogor.
9. Murthy, D.S., Gajanana, T.M., Sudha, M. and Dakshinamoorthy, V. (2007), "Marketing losses and their impact on marketing margins", Agricultural Economics Research Review, Vol. 20 No. 1, pp. 47-60. [Google Scholar] [Infotrieve]
10. Ahumada, O., and Villalobos, R. 2011. Operational model for planning the harvest and distribution of perishable agricultural products.Dalam Int. J. Production Economics. Elsevier. Mexico City, Mexico. Hal 677–687.
11. Agus Ahyari. 2002 " Production Management System Production Planning ", Fourth Editio.Yogyakarta : BPFE.
12. Alex, J and Torres, R. 2014. Production planning of parallel resources considering yields, failures and production costs. Dalam Int. J. Applied Management ScienceVol.6, N0.2. Facultad de Administración de Empresas, Universidad de Puerto Rico – Rio Piedras, San Juan, PR 00931-3332, USA.
13. Heri Utomo, Udisubekti C. M., Nurhadi S.2005. Behavior Analysis of Supply Demand of National Shallots Commodity using System Dynamics Model Approach. Proceedings of National Seminar on Technology Management II ISBN : 979-99735-0-3. MMT-ITS Study Program. Surabaya.
14. Muhamadi, A.E, and Soesilo, B. 2001. Dynamic System Analysis (Environmental, Social, Economic, Management. Jakarta :UMJ Press.
15. Ai Rosita and Yadi Ruslan, 2007. Plant schedular sitem to arrange balance Holticultural plant production using sms technology In district garut.. SNATI 2007 ISSN: 1907-5022. Yogyakarta.
16. Bambang Pramono (2007).Optimization Of Production Scheduling Using Genetic Algorithm. Jurnal Computech & Bisnis. ISSN (Print) : 1978-9629, ISSN (Oline) : 2442-494.
17. Ferreira, A. Moulang, C, and Hendro, B. 2009. "Environmental anagement accounting and innovation: an exploratory analysis".accounting, Auditing & Accountability Journal.Vol. 23 No.7, 2010 pp. 920-948q Emerald Group.
18. Sengge. PM., et al 1990a. The Fifth Disipline. The Art and Practice Of Learning Organization. Daubelday Publ, New York.
19. Sengge. PM., et al 1995b. The Fifth Disipline Fieldbook. Nicholas Brealey Publishing Limited.London
20. Muhamadi, A.E, and Soesilo, B. 2001. Dynamic System Analysis (Environmental, Social, Economic, Management. Jakarta :UMJ Press.
21. Devidsen, PI.1994. User`s Guide and Reference Powersim : The Comlete Software Tool for Dynamic Simulation. Model Data, Norway.