

RESEARCH

Financing System For Technology Application In The Management of High Value Horticultural Supply Chain: Case Study of Paprika Greenhouse Financing System In West Bandung Regency, West Java

Kusnandar* and Tomy Perdana**

*Center for Science and Technology Development Studies, Indonesian Institute of Sciences

**Laboratory of Agribusiness, Faculty of Agriculture, Padjadjaran University

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* Correspondence:

Building A PDII-LIPI
4th Floor, Jl. Jend. Gatot
Subroto No. 10, Jakarta
Selatan 12710
E-mail:
kussrai0779@yahoo.co.id

Abstract

Until now, financing is still a problem for most farmers in developing country including Indonesia, especially for high value commodity such as pepper. Pepper cultivation requires high investment cost due to the necessity of pepper to grow in a greenhouse equipped with drip irrigation installation. Most farmers today utilizes greenhouses with appropriate technology. Even though favourable, the crop cannot reach optimal productivity. Meanwhile, Indonesian Vegetable Research Institute (Balitsa), cooperating with Wageningen University, has conducted a research to study a greenhouse design, optimal for Indonesian climate. However, the resulted greenhouse requires so high investment cost that most farmers cannot afford. Direct loan from banks is difficult to get because it requires guarantee and financing system, inappropriate with characteristics of farming. Due to that reason, it is necessary to have financing system that can help but does not burden farmers in its payment mechanism. This paper aims to analyze the financing system in supply chain management, capable to solve problems about financing access for small-scale business actor in order to apply a technology capable to increase productivity. This paper is written from the result of action research in Pasirlangu Village, Cisarua Subdistrict, West Bandung Regency. The result shows that the availability of partnerships between farmer groups/cooperation and exporters opens an opportunity for farmers to get loan from bank through guarantee from the exporters, with financing system regulated by exporters to fit the characteristic of pepper farming. The system also involves university as the facilitator.

Keywords: financing system, high value commodity, pepper greenhouse technology, supply chain system, partnership

I. Introduction

Background

Agriculture in developing country including Indonesia is characterized by narrow land tenure and small capital owned by farmers that leads to financing problem. The problem is more visible in cultivation of high value commodity. The characteristic of high value commodity is that the increase in productivity and quality highly depends on the availability of technology and capital, as well as competitiveness in global market (Dolan and Sorby, 2003; Lee, *et al.*, 2010). One of the

commodities is pepper (Lee, *et al.*, 2010) that is lately produced considerably in Indonesia. Most peppers are cultivated for export demand; therefore in its cultivation, the quality of the crop is highly prioritized.

The production of pepper in Indonesia is relatively low compared to other vegetables; however in recent years it starts to increase. In 2010, the production of pepper in Indonesia was approximately 5 thousand tons, and the next year it increased to 13 thousand ton, more than twice of the previous year production¹. Pepper cultivation concentrated in West Java is approximately 90% of

Table 1. Data of Pepper Production in Indonesia, West Java and West Bandung Regency from 2010 to 2011

	Production (Tons)	
	2010	2011
Indonesia	5,533	13,068
West Java	4,661	11,661
West Bandung Regency	4,052	10,856

Source: Directorate General of the Ministry of Agriculture Horticulture, RI¹ and Department of Food Crops of West Java²

total national production (Table 1). Most peppers in West Java come from West Bandung Regency².

Economically, pepper cultivation is very profitable but requires high production cost, especially investment cost. It is because the process of pepper cultivation must take into account the intensity of sunlight, temperature, duration of lighting, irrigation and nutrition that highly effect the productivity and quality of the crop (Dorais, 2003). Therefore, pepper will be optimal if it is cultivated in a sheltered production house or greenhouse. Today, pepper farmers are capable of building greenhouses, however the technology applied is simple and not equipped with irrigation installation, so that the productivity is not maximum yet.

Meanwhile, Indonesian Vegetable Research Institute (IVEGRI), an R&D institution under the Ministry of Agriculture of Republic of Indonesia, has cooperated with Wageningen University of Netherlands since 2003 to design the pepper greenhouse, appropriate for Indonesian climate. The activity has produced a greenhouse design capable to increase productivity about twice of the productivity of common greenhouse that farmers use.

After obtaining such result, the next task from IVEGRI is to socialize the technology of the greenhouse to be applied by farmers widely; however, there are several obstacles in doing this. One of the obstacles in expanding the application of IVEGRI's greenhouse is higher investment cost compared to common greenhouse used today. To be able to use the technology of the greenhouse, capital is the biggest obstacle for most farmers, whereas capital is one of the determining factors in technology adoption decision (Noltze, *et al.*, 2012; Mariano, *et al.*, 2012). The second obstacle is the perception of the farmers about the superiority of the greenhouse in increasing productivity. In technology adoption, the perception of the prospective users about the technology's utility to increase profit becomes a significant factor (Aubert, *et al.*, 2012).

Like Indonesian farmers in general, most pepper farmers in Cisarua Subdistrict, Lembang, have limited capital and minimum financing access. To obtain direct loan from Banks is a very difficult thing

due to the collateral and payment system which is not fit with the farming characteristics. Therefore, it is required to have financing system capable to help farmers to apply the new technology in order to gain more crops to gain more profit.

This paper aims to analyse the financing system in supply chain management capable to solve problems about financing access for small-scale business actors, in this case pepper farmers, to apply technology capable to increase productivity. This paper is written from the result of action research in Pasirlangu Village, Cisarua Subdistrict, West Bandung Regency. In the supply chain management, the partnership between involved parties, namely the farmers, farmer groups/cooperation, and exporters, is formed. The partnership is facilitated by academic institution, namely Value Chain Centre (VCC)-Unpad.

In this case, exporter as the downstream actor has a vision to increase export volume because so far there are many unmet demands. Therefore, exporter performs a strategy to the upstream to increase not only the volume of supply from farmers but also the quality of the product that meets the export standard. One of the strategies conducted is by participating in applying the technology of partner farmer through financing scheme. In that activity, exporter involves academicians as producer and facilitator of technology.

Research Position

Several researches have been conducted to review technology application on farming in developing country. Noltze, *et al.* (2012) analyses how characteristics of farmer and agricultural land owned have the effect on technology adoption rate. More broadly, Mariano, *et al.* (2012) conducted a research, examining the institutional and environmental effect. Meanwhile, Wang, *et al.* (2013) has added a social factor, namely social learning. From those researches, it can be concluded that financing and investment become important points in successful technology adoption.

Research about financing system for technology application in society in developing country has

¹http://hortikultura.deptan.go.id/index.php?option=com_content&view=article&id=319&Itemid=920 Accessed: 20 September 2013

²<http://diperta.jabarprov.go.id/index.php/subMenu/924> Accessed: 20 September 2013

been conducted by Monroy and Hernandez (2008), Liming (2009), Mainali and Silveira (2011), and Pote (2013) about financing of technology application for energy source for rural communities. The result of those researches emphasizes more on financing system through government policy, either subsidies, direct financing or through external party. Meanwhile, research about financing on farming is conducted by Bojnec and Latruffe (2011) who states that investment decision of farmers highly depends on market opportunity. Yet, the aforementioned researches are not connected to the supply chain system discussed in this paper.

Research about financing on supply chain system is a theme currently developing; the problem is included in financial theme about supply chain finance (SCF). Most researches nowadays emphasize more on the financing to strengthen operational capital between actors inside the SCF, such as development of mathematical model to determine the period of payment in SCF (Thangam and Uthayakumar, 2009; Haidar, *et al.*, 2014; Chern, *et al.*, 2014), the loan amount (Raghavan and Mishra, 2011), and the calculation of credit risk (Zhang, *et al.*, 2014).

In SCF, the financing source can be obtained from internal actors in SCF as well as external actors, such as bank and other financial institutions. Zang and Yan (2009) as well as Jing and Seidman (2014) analyze the comparison between financing source obtained only from internal actor in SCF and financing source involving external actor. The research shows that financing source from internal actor is very effective for small working capital, while big capital needs to involve external party.

Meanwhile, from company management side, Lainez and Puigianer (2009) examine how financing system in SCF affects money flows that subsequently determine management decision. Kristofik, *et al.* (2012) examines the opportunity of SCF application in small and intermediate industry in Europe in order to increase the working capital.

The aforementioned researches on SCF focus more on the financing for the operation of production, while in this research, the financing concept examined is related to technology application in a supply chain system, to solve problems on the difficulty in financing access for small scale actors. Observed from the financing source, this study case is a combination, by involving external actor but through one of the internal actors in SCF.

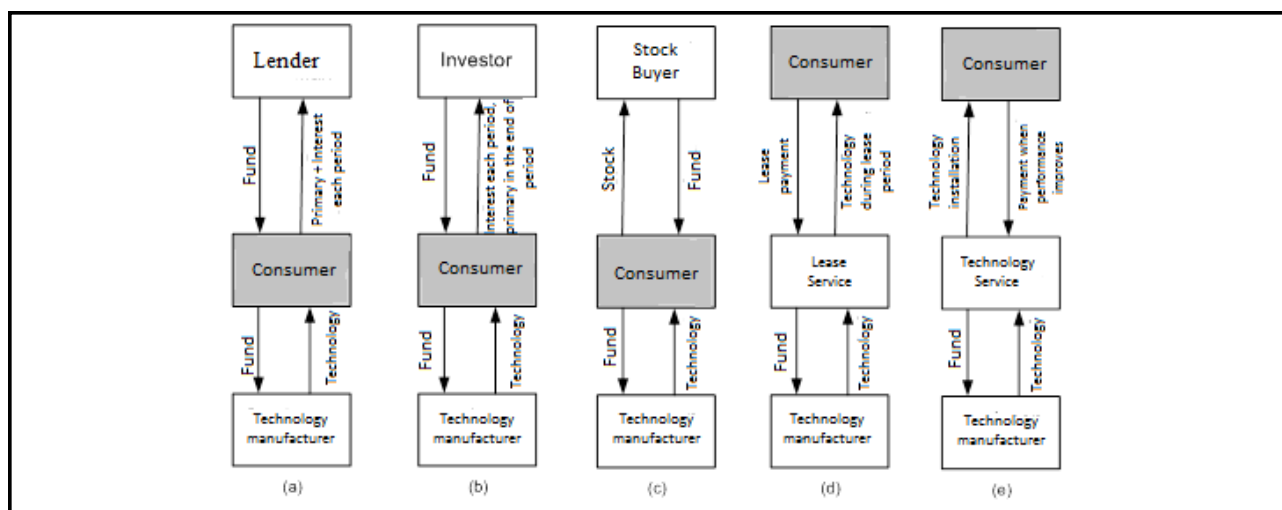
II. Literature Review

Financing system

The adoption of an agricultural technology in developing country commonly encounters a problem, namely the limitation of capital. Therefore, the first factor should be taken into account after benefit is the cost, especially investment cost (Woods, *et al.*, 2006). The limitation of capital for farmers in developing country cannot be separated from the limitation of income that becomes the biggest obstacle in innovation adoption (World Bank, 1989). In order to overcome the problem, a financing scheme becomes one of solutions that needs to be taken into account. Financing is an important factor to guarantee the sustainability of technology adoption (Liming, 2009).

Based on the source of funds, financing is divided into two (Woodroof, 2008; Engle, 2010), 1) Debt Financing, the source of funds comes from a loan, and 2) Equity Financing, the source of funds comes from the company cash or investor. For these two types, creditor obliges to pay interest or often called cost of capital. The amount of the cost of capital is determined by 1) evaluation of the creditor; 2) the risk of the project; and 3) the risk of external factor (i.e. national economic and political condition).

Meanwhile, observed from management side, Woodroof (2008) divides financing scheme into (Figure 1):



Source: Woodroof (2008)

Figure 1. Financing Scheme (a) Loan; (b) Bonds; (c) Selling Stocks; (d) Lease; (e) Contract Performance.

1. Loan, creditor borrows money from a third party, it can be financial institution, other companies/institutions, or individual, then the loan is used to buy the necessary products, and the creditor pays the debt to the third party based on the agreement.
2. Bonds, almost similar to loan system, however the creditor gets the money from the investor and pays only the interest each period, then returns a number of the amount after certain period based on the agreement.
3. Selling Stocks, company sells stocks to obtain fund as a capital for purchasing a product. Even though it is relatively effective, this strategy risks of giving negative understanding for investor toward company.
4. Lease, creditor does not have the required product but can use it by leasing from the owner.
5. Performance Contracting, similar to lease, where there is a third party as the owner of product required by creditor, however the creditor only pays when there is an increase in performance because of the product.

In the case of financing for pepper farmers in developing country, scheme 3 to 5 cannot be applied. Selling stocks (scheme 3) can be applied only by a large company that has gone public. Meanwhile, lease system (scheme 4 and 5) cannot be applied because up to the present there is no company running in greenhouse leasing.

Based on that fact, the possible schemes that can be applied are loan from financial institution (scheme 1) or loan from investor (scheme 2). However, to apply those schemes there are some obstacles. It has been mentioned previously that the characteristic of most farmers in Indonesia is small-scale business tenure; thus it is difficult to get the trust from financial institution or investor. In addition, the characteristic of peppers farming that requires long time in production process makes it impossible for farmers to return the payment each month based on the loan mechanism of the financial

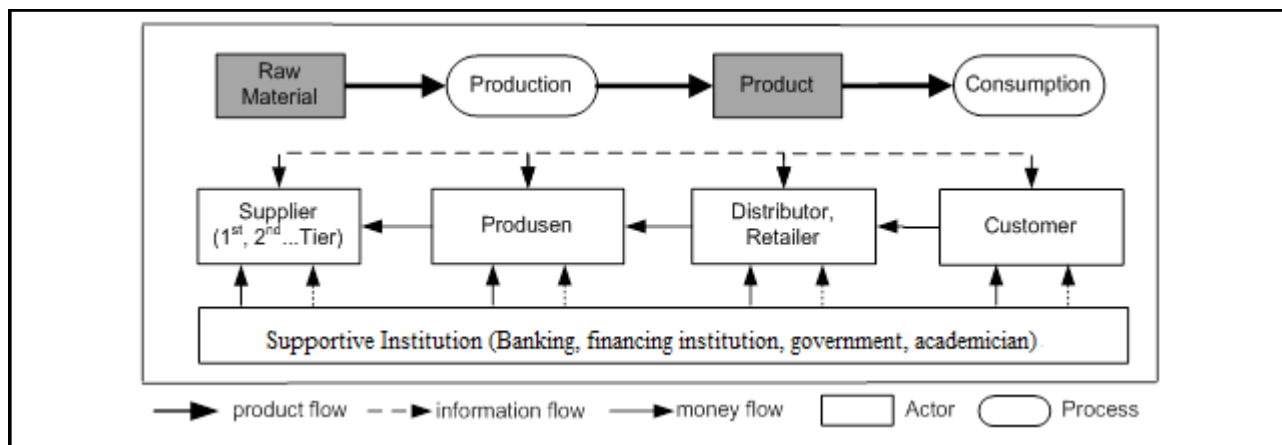
institution. For that matter, it is a necessity to have another financing scheme capable to solve the problem.

Supply Chain Management

The concept of supply chain has been stated in many literatures. Hugos (2003) emphasizes it on a process of product transformation, namely a network functions in supplying and turning raw materials into goods and distribution for consumers. Van Der Vorst, et al. (2007) defines supply chain as sequences of process (decision making and implementation) and flow (material, information, and money) aiming to meet the needs of last consumers. Therefore in a wider definition, supply chain includes product development, marketing, operation, distribution, financing, and service for customers. Based on such definition, it can be concluded that supply chain system consists of actor, process, and flow of product, money, and information.

To achieve its objective, a supply chain system requires a management concept capable to integrate management of several business functions in an inter-organizational relationship or known as supply chain management (SCM). Gimenez and Ventura, (2003) states that supply chain management involves integration, coordination and collaboration of all organizations in the supply chain. Meanwhile, Hugos (2003) states that supply chain management is a coordination from production process, storage, and transportation between actors in supply chain to achieve effectiveness and efficiency in customer service.

In its development, the concept of supply chain management develops not only in the vertical relationship among main actors, but also involves supporting actor participating in achieving the system objective, such as, government as policymaker, financing institution as sponsor of money flow, university as facilitator of knowledge, and other relevant actors (Wolf, 2008). It is because the effectiveness of supply chain management not



Source: Constructed from Hugos (2003); Van Der Vorst, et al., (2007); Wuttke, et al. (2013); Jing and Seidman (2014).

Figure 2. Supply Chain Management.

only depends on business factor but also non-business factors such as government policy, science and technology, and other environmental factors. To put it simpler, the concept of supply chain management is presented in Figure 2.

Financing in Supply Chain Management

Financing is an important factor in supply chain system to guarantee the continuity of product flow activity as the main objective (Gupta and Dutta, 2011). Financing can support availability of cash flow, crucial in production decision (Lainez, 2009). All this time, most studies of supply chain management focus on product and information flow, while money flow is not integrated. Even in reality, product often flows faster than money (Hofmann and Belin, 2011). Since money flow is a very important factor, study of financing in supply chain becomes a developing topic in academia, while the concept becomes an innovation in business world, namely financing and financial innovation (Zhang and Yan, 2009). Financing topic in supply chain is a part of topic in supply chain finance (SCF).

SCF is defined as an optimal planning, management and control of cash flow in supply chain to facilitate the continuity of product flow (Wuttke, et al., 2013). Hofmann (2005) states that there are three elements in SCF as follow:

1. Institutional of actor, it can be only a business actor in supply chain and/or involve financial institution, private investor and government.
2. Characteristic of supply chain management, regarding regulations in cooperation in supply chain system such as contract regulation, financing system, pricing policy, etc.
3. Financing function, types of utilization of financing such as for investment, operational capital, goods supplying, marketing, etc.

Financing source in SCF can flow not only among main actors, but also among supporting actors, such as banking and other financing institution (Wuttke, et al., 2013; Jing and Seidman, 2014). Furthermore, Wuttke, et al., (2013) states that financing in supply chain involves interaction between companies in the system or through outside party, involving financing institution as banking. For that reason, based on financing source, SCF can be divided into: 1) internal financing source; 2) external financing source.

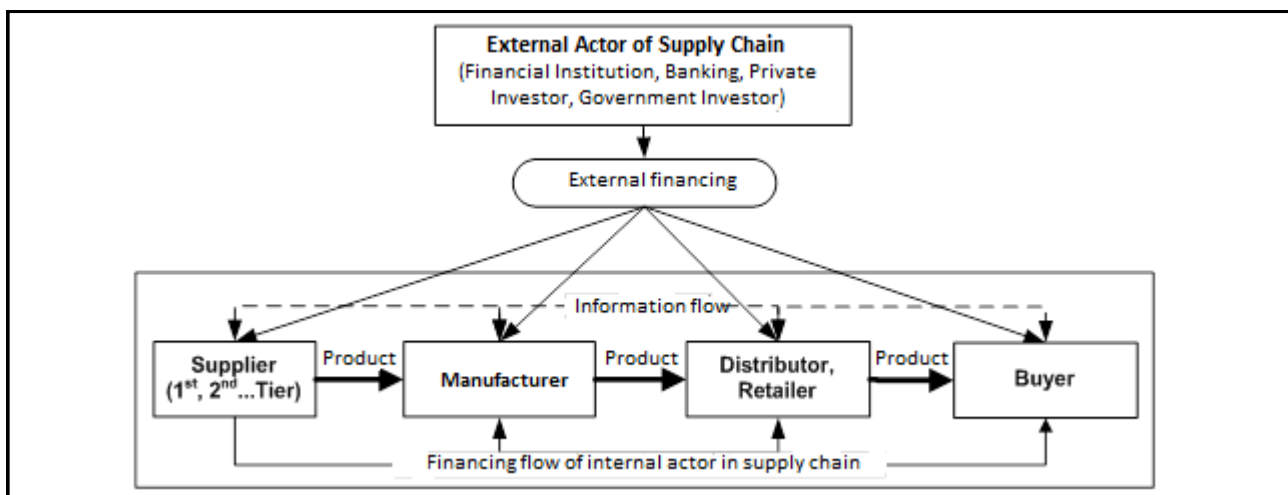
SCF is a complex system in financial system since it involves various actors (Zhang and Yan, 2009), either actor integrated vertically in the supply chain or financial supporting actor (Wuttke, et al., 2013), all aim to increase profit. Generally, financing system in supply chain is presented in Figure 3.

Financing coming from internal actor in supply chain system can be divided into (Wuttke, et al., 2013):

1. Pre-shipment, financing flows from downstream actor to upstream actor in order to strengthen production capital of upstream actor, generally to guarantee that raw materials meet the demands.
2. Post-shipment, financing flows from upstream actor to downstream actor, generally in order to improve marketing.

SCF concept is often integrated with Financial Supply Chain concept even though both are different concepts. Financial Supply Chain is related to a transaction between actors in supply chain, purchase, payment, ordering, etc. However, SCF focuses on things related to liquidity ability of each actor either through pre-shipment or post shipment system (Pezza, 2011).

Financing system in supply chain is important especially for a system involving small-scale business actors with limited capital source (Zhang and Yang, 2009; Kristofik, et al., 2012; Lan and Hua, 2013).



Source: Modified from Zang and Yan, 2009)

Figure 3. Financing System in Supply Chain.

Therefore, SCF application is relevant to be applied in Indonesia especially for small and average industry and agricultural industry whose most upstream actors own small-scale business.

III. Method

Data and Information Collection

This paper is written based on the result of action research conducted by the authors in one of the cases, namely development of pepper supply chain management in Pasirlangu Village, Cisarua Sub-district, West Bandung Regency conducted in 2009 to 2010. In this program, the authors are involved as team of facilitator from Value Chain Centre of Padjadjaran University, cooperating with PT Alamanda as the exporter to assist farmers in order to increase productivity, quality and continuity for trading in export market. For pepper commodity, cooperation is expanded by involving Indonesian Vegetable Research Institute as the provider of technology and banking party as the provider of loan.

Action research is a field work utilizing various techniques as well as experience and knowledge of all involved actors, not only to solve a problem directly but also produce knowledge for scientific benefit (Greenwood and Levin, 2007). By being involved directly, the authors obtain information accurately by observing the object directly so that what can be observed is not a perception from the second party (Yin, 2011).

Activity conducted in action research is non-linear, unlike research methods in the form of observation. Each activity becomes the feedback for the next activity decision. Activities in action research in this research are as follow:

1. Discussions between VCC-Unpad and Exporter

Discussions between VCC-Unpad and exporter were conducted many times during the ongoing program. In initial stage, the discussion was intended to reach an agreement on cooperating to increase the meet of export demands of several fresh agricultural commodities. Pepper program in Cisarua Subdistrict, Bandung Regency is one of them. Even though according to the agreement a meeting to evaluate and planning was supposed to be held once a month minimally, due to many problems encountered, the discussion schedule was made flexible.

2. Discussions between Exporter, Farmer Group and VCC-Unpad

When an agreement had been reached between VCC-Unpad and exporter, a further discussion was conducted with the representation of farmer groups and pepper cooperation, in this case is the group leaders. In the initial discussion, it had been agreed that to increase productivity, exporter would give loan in the form of greenhouse investment of IVEGRI's technology. Furthermore, payment

system from farmers had been agreed, including the right and obligation of both parties. A meeting between exporter, farmer group and VCC-Unpad was held every time a problem occurred, either production problem from farmers or marketing problem from exporter. The schedule for the three actors to hold a meeting was flexible.

3. FGD (Focus Group Discussion) with members of farmer group and cooperation.

The FGDs involving the members of farmer groups and pepper cooperation were conducted by VCC - Unpad. The FGD aims to explore wider and deeper the problems of pepper production encountered by farmers. The information will be the basic for VCC-Unpad to conduct the technical plan of training and mentoring activity.

4. Technical training on the cultivation and management of agribusiness for farmers.

Technical trainings on the cultivation and management of agribusiness were conducted by VCC-Unpad with the support from exporter. Materials given in the training were basic and adjusted to the problems encountered by farmers. Those materials are expected to be initial knowledge for farmers. In the practical realization of those materials, there would be mentoring from VCC-Unpad.

5. Direct mentoring in farmer group and cooperation.

Direct mentoring in farmer group and cooperation was the main role of VCC-Unpad. The mentoring was held by locating minimal one person from VCC-Unpad as an assistant in each production-based area that was a partner in the cooperative program with exporter, including for pepper farmers. The assistant had a duty to give technical guidance for each member of farmer groups and cooperation, starting from cultivation technique, post-harvest, to financial management. The assistant was not required to master each aspect; however, if there were a difficult problem that could not be solved directly in the field, the assistant was expected to report the problem to VCC-Unpad. The problem would be solved by an expert, since VCC-Unpad consisted of many lecturers from various departments. The assistant was also obliged to report every week to VCC-Unpad.

By living there, participating and assisting the process of production every day, the information obtained can be more profound technically and socially and can be utilized; one of the examples is in the writing of this paper.

Analysis

This study applies system thinking approach, described by Causal Loop Diagram (CLD). CLD can be used to identify, analyze and communicate complex structure and interaction from various variables in the model. In modeling system, CLD is

an excellent way to explain dynamic cause and mental model of human individually or in group to communicate feedback, believed to be the important problem in the system (Stermann, 2000). Systematic consideration through CLD can communicate a complex system into a simple feedback structure (Richardson in Haraldsson, *et al.*, (2006).

The model resulted from this research is a reality-based conceptual model constructed with system thinking approach in the form of CLD. Since analysis in CLD model is a qualitative one, the validation technique conducted is the validation system structure by comparing several findings with literature or previous researches (Stermann, 2000). Comparing findings with literature is a way to deduct a qualitative research (Yin, 2011).

IV. Result

Pepper Supply Chain in West Bandung Regency

Pepper supply chain from Pasirlangu Village, Cisarua Subdistrict, West Bandung Regency consists of several actors, either inside or outside the production center. The upstream actors are the producers of seeds and agro input acting as suppliers of production input for farmers such as seeds, nutrition, pesticide, material and equipment for greenhouse construction, and other materials. The second actor is the farmer acting as pepper producer, starting from planting preparation including constructing greenhouse and equipment to harvest time.

In marketing, most farmers sell the crops to middleman while the others sell the crops to cooperation and farmer groups. In that marketing, farmers sell the crops with one price for all grades without sorting and grading. Middleman is the main actor in pepper distribution in production center. About 70% peppers from farmers are controlled by middleman. Mostly the marketing of middleman is done to exporter (60%), and the rest to traditional market, supplier supermarket, and food processing.

Generally, illustration of pepper supply chain in Pasirlangu Village, Cisarua Subdistrict, West Bandung Regency is presented in Figure 4.

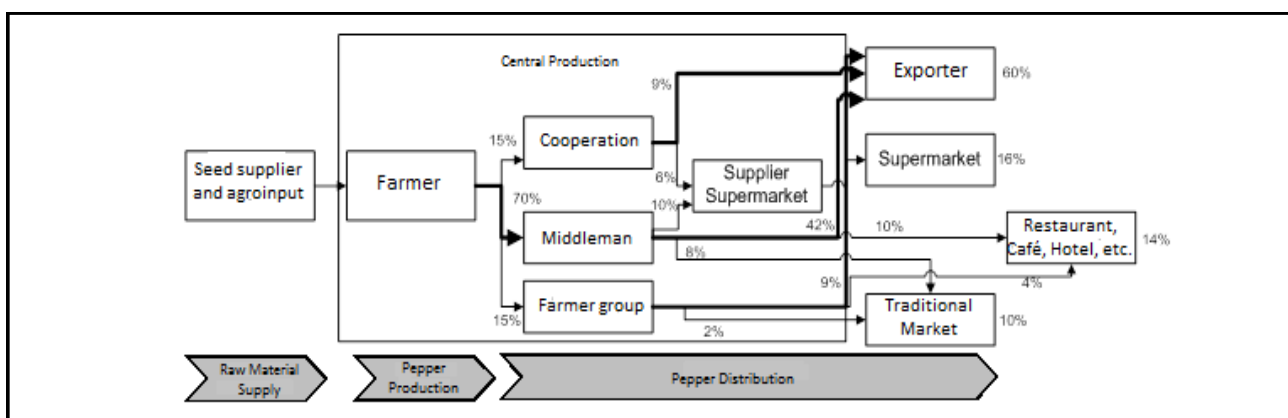
Besides middleman, other actors involved in marketing at production centers are cooperation and farmer groups established by and consisting of farmers. Transaction system of cooperation and farmer group is different from the transaction system of middleman, where there is no purchasing transaction, but each member hands over their peppers to cooperation/farmer groups. Then the peppers are sorted and graded and sold mostly to exporter and the rest to supplier supermarket. The money from the trading is given to the members after the cooperation/farmer group takes the service fee according to the agreement with all members.

From Figure 4, it can be seen that on the end point in marketing, most peppers enter export market (60%). Therefore, exporter has an important role in the sustainability of pepper farming in Lembang Subdistrict. One of exporters purchasing many peppers from Lembang Subdistrict is PT Alamanda, located in Bandung Regency. The exporter not only purchases pepper with outright sale system, but also develops partnership with several farmers in technology introduction and application. It is done to guarantee the continuity of good-quality pepper supply for export market.

Greenhouse Technology for Pepper in Lembang Regency

The Green house constructed by pepper farmers in Pasirlangu Regency today still utilizes simple technology. They build the frames from wood and bamboo and do not consider the direction of sun and wind that affect productivity. Water and nutrient are given manually. These treatments will affect the accuracy of the dose of nutrients and the effectiveness of the nutrients to reach the roots. Pepper productivity with this system is approximately 2 kg for each tree.

Meanwhile, technology for pepper cultivation



Source: Structure and data are constructed by the writer based on the result of FGD in production center.

Figure 4. Pepper Supply Chain in Pasirlangu Village, Cisarua Subdistrict, West Bandung Regency



Source: Setiawati (2007)

Figure 5. Common greenhouse utilized by farmers
(a) Greenhouse of IVEGRI (b).

has received the government's attention. It can be seen from the cooperation established between IVEGRI and Applied Plant Research (APR) and Plant Research Institute (PRI) of Wageningen University and Research Centre through Horticultural Research Cooperation between Indonesia and the Netherlands (HORTIN) program started in 2003. The cooperation aims to study proper greenhouse design for Indonesian climate by considering the material types, irrigation system, and the direction of sun and wind.

The study has produced a pepper greenhouse design to be examined in IVEGRI of Lembang. Examination is also applied on common greenhouse used by farmers as a basis of comparison. The examination shows that the greenhouse of IVEGRI produces 3.5 to 4 kg each tree, about twice of common greenhouse production.

The first difference between both greenhouses lies on the material used to construct the frames. The frames of greenhouse of IVEGRI are made of iron; therefore the roof can be modified into a semi-circle, while the roof of common greenhouse is normally in triangular shape. The shape of the roof affects the intensity of sunlight entering the greenhouse that subsequently affects the productivity. The triangular roof reduces the intensity of sunlight for about 40.3% while semi-circle roof reduces only 27.7% (Setiawati, 2007). The shape of greenhouse of IVEGRI and common greenhouse can be seen in Figure 5.

The second difference between both greenhouses lies on irrigation system and nutrients distribution. Irrigation system highly affects productivity and quality of the pepper since pepper is highly affected by the humidity of growing media (Shongwe, *et al.*, 2010; Gonzalez-Dugo, *et al.*, 2007). Therefore, greenhouse of IVEGRI is equipped with irrigation installation to distribute proper water and nutrient to the roots. Water and nutrient should be given in the same time with proper dose and frequency to get optimal productivity. Therefore, irrigation installation system of greenhouse of IVEGRI is equipped with timer to control the frequency of water and nutrients delivery. The pipe's measurement of this automatic irrigation system is

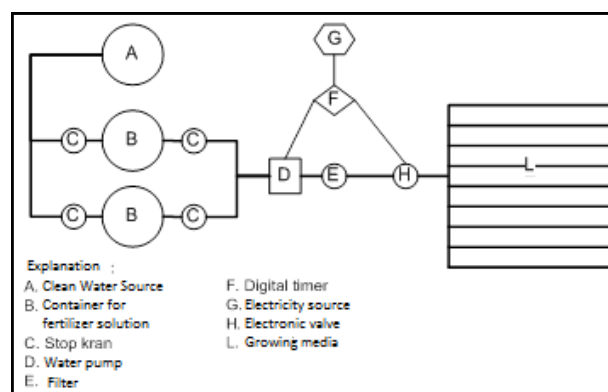
adjusted to water and nutrient dose necessity. The system also makes an efficient nutrient distribution, since wasted nutrient solution is far less than of manual watering system.

The differences in the construction of greenhouse of IVEGRI implicate the price. Compared to common greenhouse used by farmers, the greenhouse of IVEGRI requires higher investment cost. The price for the construction of greenhouse of IVEGRI is about 220,000 rupiahs per square meter including irrigation installation, while the price for common greenhouse is only about 75,000 rupiahs per square meter. However, the lifespan of greenhouse of IVEGRI is about 10 years or 15 times of pepper planting season, while the lifespan of common greenhouse is only about 4 years or 6 times of planting seasons.

Based on the research conducted by Grismeisanti (2013), the cost of pepper production variable in Pasirlangu Village is about 9,082 rupiahs per tree. By considering the greenhouse depreciation, the price per tree for common greenhouse is about 12,207 rupiahs while for greenhouse of IVEGRI, it is about 14,082 rupiahs. However, since the productivity of common greenhouse is only about 2 kg per tree while greenhouse of IVEGRI is about 3.5 to 4 kg per tree, with the average price for pepper of 10.000 rupiahs per kg, the profit earned from common greenhouse is about 3,897 per kg while the profit earned from greenhouse of IVEGRI is about 5,977 to 6,480 rupiahs per kg. It can be concluded that the greenhouse of IVEGRI can increase profit for farmers about 53 to 66%.

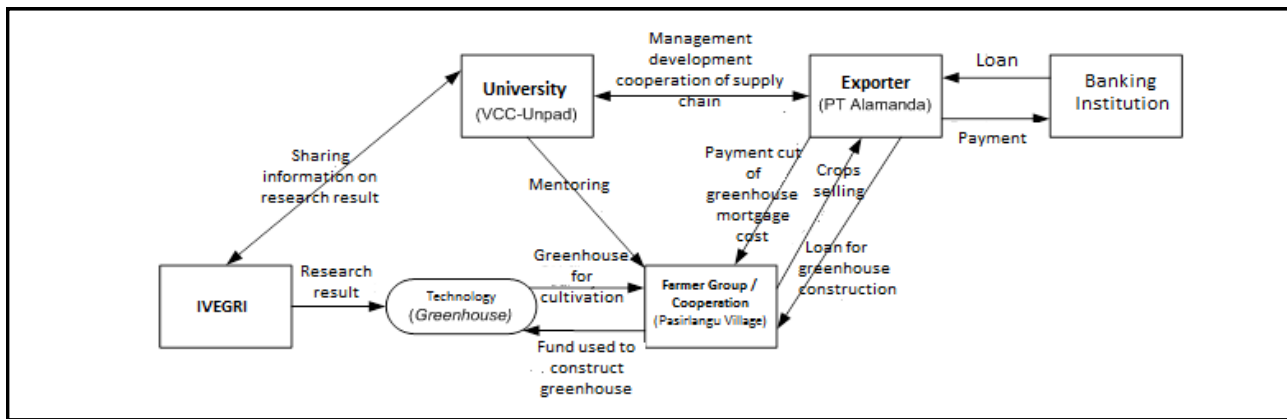
Financing System in Pepper Supply Chain for Export

Based on the analysis, greenhouse of IVEGRI is very profitable economically. The profit is not only owned by the farmers but also by actors in supply chain. For example, for exporter, the increase of productivity leads to the increase of fulfillment of export demand that until today still have not been met maximally due to the limitation of production.



Source: Setiawati (2007)

Figure 6. Irrigation Installation System of Greenhouse of IVEGRI.



Source: Constructed by the writer

Figure 7. Financing Scheme for Greenhouse on Pepper Supply Chain in Pasirlangu Village, West Bandung Regency.

However, farmers cannot utilize such technology due to notably high investment cost.

One of the exporters, namely PT Alamanda, has a program intended to increase the fulfillment of export by conducting partnership strategy with farmer group and cooperation, particularly those cultivating pepper. The partnership is not only about marketing problem but also about technology, management and financing. In that program, PT Alamanda cooperates with one of university units studying supply chain for agricultural products, namely Value Chain Centre –Padjadjaran University (VCC-Unpad).

Once the greenhouse technology capable to improve pepper productivity is known and the financial problem hampering the application is found, PT Alamanda and VCC-Unpad cooperates to apply financing scheme for farmer group and cooperation that have already been their partner. Constructing the financing scheme is initiated by the conversation between exporter and VCC-Unpad. The first choice is by charging the financing source to the farmers, but the possibility is low because of limited capital and difficulty in obtaining trust from financial institution such as bank. The next choice is by involving the government to aid, however, since to build even a greenhouse requires large fund, while the aid from the government should be distributed evenly, this choice is impossible. The next choice is loan from exporter for farmer group; however, this choice is hampered by the limitation of exporter capital. Gradually, it is determined to involve financial institution, namely bank that has become exporter partner. A financing scheme for farmer group and cooperation is arranged afterward and is discussed with the administrators of the farmer group and cooperation. After holding several meetings between exporter and farmer group and cooperation facilitated by VCC-Unpad, an arrangement has been made.

In that agreed scheme, exporter side will borrow the fund from Bank with its collateral asset. The fund is utilized for construction cost of greenhouse

of IVEGRI for farmer group and cooperation. The greenhouse will be owned by the farmer group/cooperation, while the fund used is a debt of farmer group/cooperation to PT Alamanda. By doing this, one of the problems on the difficulty for farmers to borrow fund from bank because of guarantee requirement can be solved.

In payment mechanism, PT Alamanda will pay the installment to the bank according to bank procedure. Meanwhile, farmer group and cooperation pay to PT Alamanda during crops selling. Since there has been a marketing partnership between PT Alamanda and farmer group and cooperation, the schedule of pepper delivery and crops payment has been agreed. During crops payment from PT Alamanda to farmer group and cooperation, the price is cut at the amount of agreed installment. With that mechanism, the problem of loan payment procedure from bank that requires payment is done each month and is started from the first month, since in this mechanism, farmer group and cooperation pays the installment during harvest time. To put it simple, financing scheme for greenhouse on pepper supply chain in Pasirlangu Village, West Bandung Regency is presented in Figure 7.

The financing scheme also applies transparency system that is one of the concepts from supply chain management. Transparency is done either from exporter to farmer group or cooperation and vice versa, similarly from farmer group and cooperation to their members. The transparency concept is an important thing to build trust as a basic of partnership. For that reason, VCC-Unpad as the facilitator does not only help in technology and organization management aspect but also liaise between exporter and farmer group or cooperation in transparency aspect.

On its progress, this financing scheme cannot be applied for other farmers because of the limitation of exporter capacity. Until now, there is only one exporter having this program, namely PT Alamanda. However, this cooperative program

affects other farmers in Pasirlangu. If initially other farmers do not completely trust that utilizing of IVEGRI greenhouse will be more profitable, after they see the examples done by the farmer group and cooperation, they begin to believe on the greenhouse design. The evidence will encourage farmers' interest to adopt the technology; however, the very high cost of the technology will be a problem.

After some observations in the field and calculations of the price and existing economic capability, some farmers try to adopt some of the technology of IVEGRI, especially the irrigation installation system to circulate the solution of water and nutrient to the roots of the tree. The result of the experiment is quite satisfying. Even though it still cannot achieve the productivity as high as the whole technology of IVEGRI, the productivity improves up to 35 to 50%. Eventually, more and more farmers in Pasirlangu Village adopt the irrigation installation system. Nowadays, most farmers do not give water and nutrients manually.

V. Discussion

Solving the problem of payment access for the new technology application, in this case, greenhouse of IVEGRI can be described through the system thinking approach as shown in Figure 8. The greenhouse of IVEGRI can increase pepper productivity and profit, thus encouraging farmers to adopt the technology. Such connection produces positive feedback (R1), meaning that the adoption will increase continuously.

However, in the other side, the technology needs high investment cost. High investment cost results in two matters. Firstly, it will decrease the profit that will decrease the farmers' interest (negative feedback B2). However, the problem will be solved

when the increase of productivity give higher profit margin rather than the increase in investment expenditure.

Secondly, it will result in the decrease of opportunity for farmers to apply the greenhouse technology, leading to decrease of farmers' interest to apply the technology (B1).

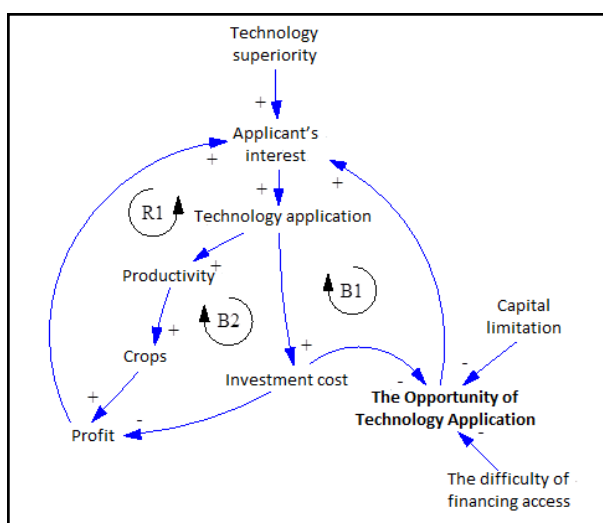
Low opportunity to apply greenhouse application is the result of capital limitation and the difficulty of payment access such as from bank or other financial institutions. To determine the success of the technology to be applied depends on the availability of resources owned and innovation capacity of the users. (Aubert, *et al.*, 2012).

From Figure 8, it can be seen that thing encouraging farmers to use greenhouse of IVEGRI is their opportunity i.e. a function of capital and financing access. Therefore, a financing system to solve the problem is required. Financing scheme with partnership system between exporter and farmer group/cooperation is constructed to solve the problem.

Financing system of supply chain, in this case between exporter as downstream actor with farmer group and cooperation as upstream actor, can solve the problem of difficulty of financing access for farmers (Figure 9). Farmer group and cooperation dare to invest through credit scheme from exporter because there is a guarantee from the market, thus increasing farmers' interest to follow the financing scheme (R3). Bojnec and Latruffe (2011) state that market opportunity is determinant factor for business investment.

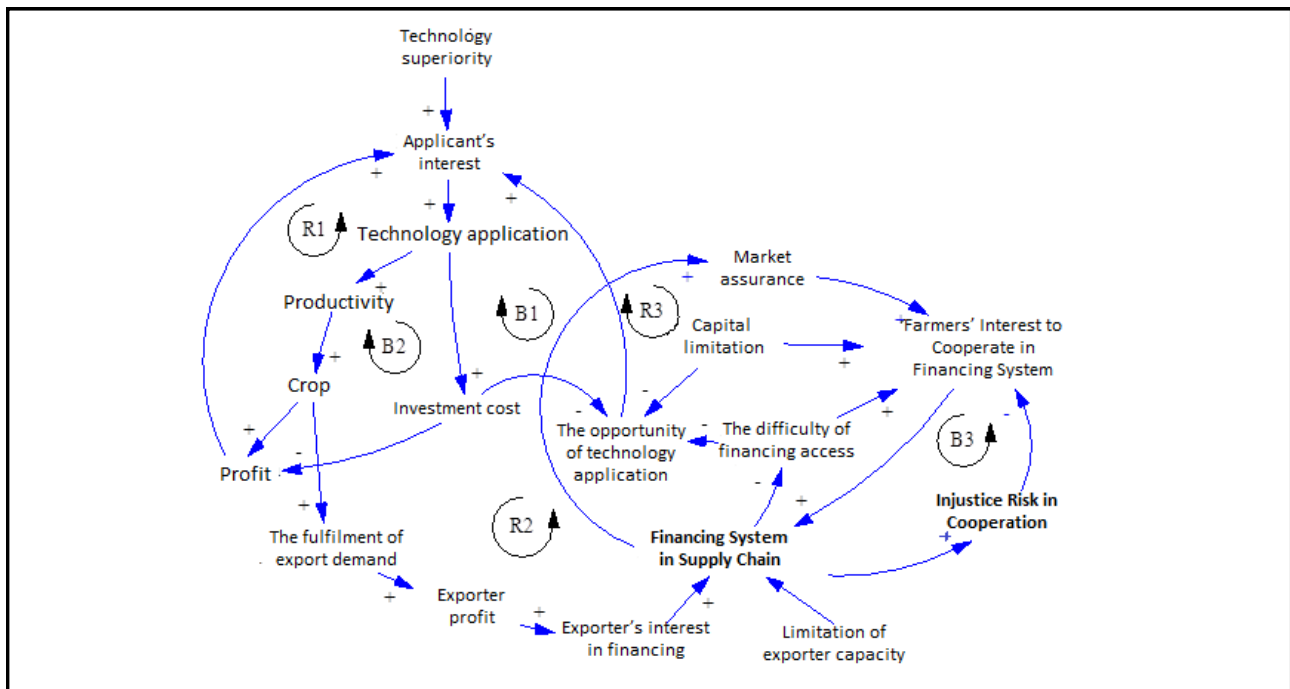
Meanwhile, exporter is interested in applying financing scheme because the technology can increase the productivity to increase the fulfillment of currently low export demand to eventually increase the profit of exporter. Exporter applies pre-shipment financing system in order to increase capital capacity of supplier, most of whom are actors with small-scale business to guarantee the fluency of product flow (Wuttke, *et al.*, 2013). The connection forms positive feedback (R2) that in turn increases the application of greenhouse of IVEGRI.

Based on its source, the financing concept on supply chain in this case is a combination concept, namely from external actor (banking), meanwhile the mechanism is conducted through an agreement among actors inside the chain. The involvement of Bank as funding financial is required since investment need high cost. However, since banking access is impossible to be obtained by farmers, the one borrowing the fund is exporter. Exporter then provides investment financing for farmers with mechanism appropriate to characteristic of pepper business to guarantee the fluency of cash flow to support production activity. It is in accordance with what Jing and Seidman (2014) state that financing model by involving banking is highly appropriate for high investment; meanwhile for financing with



Source: Constructed by the Writer

Figure 8. Causal Loop Diagram of Pepper Greenhouse Application of IVEGRI's Technology



Source: Constructed by the writer

Figure 9. Causal Loop of Financing System for Greenhouse of IVERGI on Pepper Supply Chain System in Pasirlangu Village, West Bandung Regency.

not-too-high value, financing model among actors inside the system is the best option.

Financing scheme with partnership system between exporter and farmer group/cooperation will produce a risk, namely injustice risk such as balance position among cooperated parties and technical problem such as payment, commitment and others (B3).

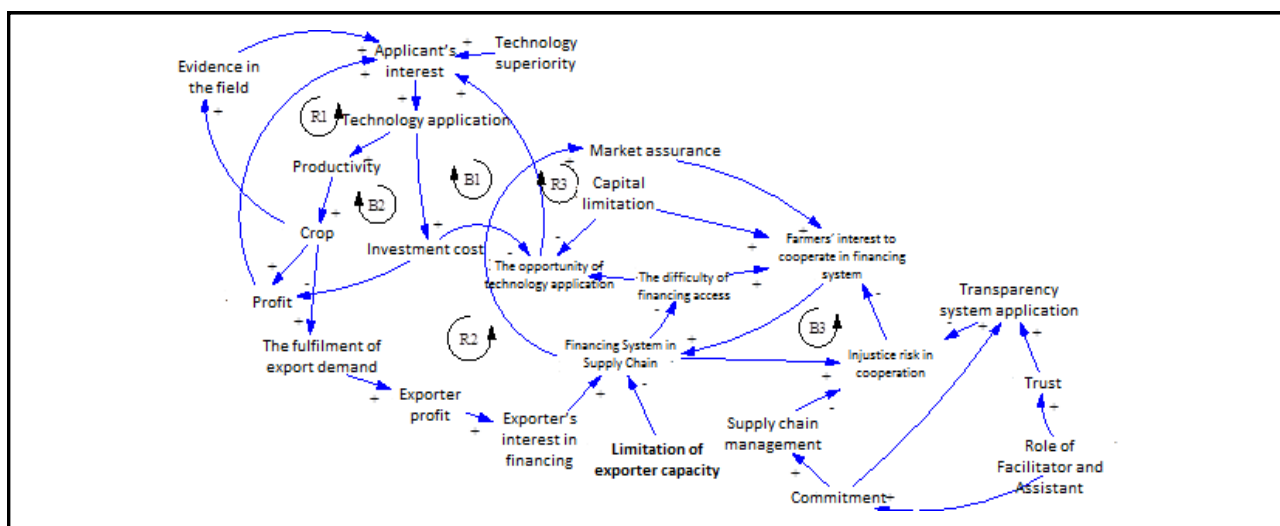
To solve the risk of injustice, transparency is required in that partnership management, as well as proper supply chain management to guarantee the increase of crops for fulfillment of export demand. Transparency system application highly depends on the commitment of both parties. Another crucial matter is trust. Therefore, it is required to have a third party liaising between upstream actor and downstream actor. The third party in this case is academican as facilitator. The role of facilitator or assistant in agricultural innovation system is very important in financing access and information facilitation in addition to technical role such as planning and management (Pascucci and Magistris, 2011). If information flows smoothly between downstream actor and upstream actor, the trust between both parties will be formed. As a whole, CLD model of financing system and the role of facilitator for pepper greenhouse of IVEGRI's technology is presented in Figure 10.

Financing scheme between exporter and farmer group/cooperation enables the initiation of construction of greenhouse of IVEGRI in production center of Pasirlangu Village. It enables farmers in that area to observe directly its superiority and evidence that the technology is profitable

economically. It can increase the trust of farmers in the surrounding area to adopt it. In about a year after greenhouse of IVEGRI applied in farmer group and cooperation, there are changes in pepper greenhouse technology applied by most farmers in Pasirlangu Village, Cisarua Subdistrict, West Bandung Regency. This research does not conduct census to record the information, however, the information is valid since it is sourced from direct observation of facilitator in the field and information from actors in production centers. Even though the program has ended, there is still cooperation between actors in production center and VCC-Unpad for the next programs.

The change in greenhouse technology adopted by farmers is not in thorough elements of the greenhouse, but only in irrigation system. It is due to the limited financing. Partial adoption of greenhouse technology is done due to the fact that there is direct evidence and information about the superiority of the technology from the farmer group that has applied the technology. It is a learning process through social network and one of key factors in technology adoption in rural areas (Wang, *et al.*, 2013).

Nowadays, only few farmers can apply the technology of greenhouse of IVEGRI, because of the limitation of exporter capacity to cooperate with other farmers in production center widely (Figure 10). It alludes to government policy i.e. technology diffusion program to improve productivity that supposedly involve downstream actors such as industry or exporter who has already had supply chain management to the upstream actors. It is due



Source: Constructed by the writer

Figure 10. Causal Loop of Financing System and Role of Facilitator in Technology Application of greenhouse of IVEGRI in Pepper Supply Chain System in Pasirlangu Village, West Bandung Regency.

to the fact that technology application requires high investment cost. In addition, productivity improvement requires market assurance, especially for vegetable commodity with fluctuated price.

VI. Conclusion

1. Low opportunity caused by capital limitation and financing access is the main factor hindering the technology application of greenhouse of IVEGRI to increase pepper production.
2. Financing scheme through partnership system between exporter and farmer group/cooperation can solve the problem of high investment cost and the difficulty of financing access. The financing mechanism does not burden the farmers since it is adjusted to the characteristic of farming.
3. The risk of encountering problem in the cooperation between exporter and farmer group/cooperation can be solved by applying transparency system and supply chain management with the aid of academicians as assistant and facilitator.
4. The construction initiation of greenhouse of IVEGRI from financing scheme of exporter and farmer group/cooperation earns the trust of farmers in the surrounding area on the superiority of the technology, so that even with their limitation, farmers can adopt the technology partially, namely the irrigation installation system for pepper cultivation.

VII. Policy Implication

The government program for technology diffusion activity in order to increase the productivity should involve industry or exporter as the downstream

actors, capable to play a role in financing for investment and market assurance through the constructed management scheme of supply chain.

Research Limitation

This research only focuses on financing system in pepper supply chain system in order to apply the technology of greenhouse capable to increase the productivity. In the discussion about financing of supply chain system, it is also important to notice the payment time (money flow) from one actor to other actors that will determine the continuity of production activity (Lainez, 2009). In further research, it is expected to study the optimal financing model development related to the financing for technology investment.

Financing concept in supply chain for technology application in this research is taken from a case study. The disadvantage of studying a single case is there is a possibility that the context is not well noticed, so that the resulted model may not be able to directly applied for different case.

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