Lean management in the rice industry; case study at Widasari, Indramayu district

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Abstract. Rice is a strategic product in Indonesia development because it becomes an essential aspect of economic growth. The inefficiency of food agribusiness system becomes a crucial aspect of developing the sustainable industry. Those affected by the lack of using technology that impacts the high amount of waste and losses, the inefficiency of time, etc. It could impact the competitiveness, equity of value-added, unstable price and poverty. Some amount of rice grade materials rejected from the production line due to the unsatisfactory quality. This article aimed to analyze efficiency in the food industry as a preparation in the development of agricultural digital supply chain. The analysis shows that inefficiency in the rice industry due to a lot of manual activities that impact the time and expense efficiency (labor intensive rather than the use of technologies). Improving efficiency in the food industry is not only about time and cost management, but it becomes complex issues which are involved in several barrier factors. It should be anticipated with appropriate technology, improving skills, and also develop an integrated logistics system. Importantly, improving efficiency in rice industry needs to develop soft skill as the key success factors to improve efficiency in the digital supply chain for the rice industry.

Keywords: rice industry, lean management, efficiency

1. Introduction

Understanding how agricultural business grow is a key endeavor in this digitalization era. The economy will continue to grow and develop and today, we face the digitalization era as a revolution economic worldwide (hereinafter called the fourth industry revolution). The agricultural sector is one of the strategical sectors in the developing country likely in Indonesia. Agriculture is seen as a potential economic sector as well as challenges sector include with tons of risk from the production process until the products delivered to the end customers. Perishable, short of the live-time period, socio barrier and lack of technology adoption are an image of the agricultural sector in developing country [1]. Moreover, logistics and supply chain management become one of the major challenges due to the several factors such as product characteristics, handling process, distribution, market as well as socio characteristics. Those factors could impact to the availability and continuity of products ([13]; [14]; [15]; [19]).

Rice is a staple food and automatically as an essential and strategic commodity in Indonesian economic growth. The average of rice consumption expenditure in the fifth years (2013-2017) is about IDR 58,248 per capita per month or around 29.39 percent of total food expenditure of Indonesian is
allocated for rice [15]. Food expenditure can be illustrated how the government develops food sovereignty to develop economic independence is the control of local resources and major strategic products as an effort to develop community wealth (hereinafter called Nawa Cita program). Meanwhile, the food industry has a complex and dynamic logistics system. The inefficiency of production becomes one of the barriers to develop the value of product [6]. This day, efficiency in logistics is an important aspect to develop food economics growth and advantage of products in the global competitiveness. Efficiency and effectiveness of production system have continued serious addresses in the food industry due to the competitiveness, consumer awareness, and economic revolution. Recently, a whole food supply chain actors have witnessed the dynamic form of competitiveness in the agricultural markets. It should have an understanding of this situation as an effort to develop competitiveness and find alternative food networks [17].

Misconception and high fragmented in the food industry could affect in several aspects of food logistics. The food industry in Indonesia dominated by small-scale farmers that witnessed the emerging problems such as uncertainty of production volume, the inadequacy of hard and soft technology, nothingness of production planning and conceptual [4]. Those issues caused by several factors such as food actor is dominated by smallholders which are not business oriented, lack of knowledge because they only doing business for generations, and also lack funding due to it has no network and information access coupled with no conceptual alignment with the banking system. Ironically, farmers are not a price maker anymore but become price taker because farmers do not have power and competitiveness in the food industry, thus resulting price fluctuation and limited information access about consumers need ([11]; [8]).

West Java Province is the second main production of rice in Indonesia after East Java Province with a total contribution of around 16% of total production with the consumption need is an amount of 98.39 Kg per capita per year [16]. Indramayu district is one of the main production centers in West Java Province with a total contribution of around 12.66% of total production in West Java Province. Even though Indramayu district is the point of the production area, the actors are witnessed competitiveness and helpless to increase the advantage. In addition, rice has a tendency to influence inflation both the regional and national economic situation. That is how rice becomes a sensitive commodity in the economic growth this day. Furthermore, the inefficiency of rice logistics system becomes a crucial aspect in the global competitiveness. Improper post-harvest handling, the inadequacy of plan production, technology, food logistics infrastructure (as an example less of grain storage warehouse, transportation mode, the absence of rural logistics service, etc.), and limited of farmers knowledge are the obstacle to improve price competitiveness. Price stability is an issue to increase farmer wealthy outright competitiveness. Price stability also contributed to inflation as an indicator of economic stability. Effectiveness in rice logistics could develop business process outright develop advantage and competitiveness and value of products with the result that producer could gain stable price [11]. Efficiency in the whole logistics process could reduce waste (both from production until the post-harvest process) and any kind of factors that contributed to the production cost [19]. Other problems in the rice logistics are about continuity of production, lack of funding becomes an obstacle for farmers to adopt new technology. In order to fill the current issues, it needs an appropriate approach to develop efficiency and effectiveness of rice logistics and supply chain management.

Lean production (known as lean manufacturing) is a stimulus to understanding a study problem about efficiency. Lean production is a key tool to find a new foundation for the improvement of the rice production process and had several impacts in the globalization competitiveness. A comprehensive design of industrial production that stressed on continuing improvement, system efficiency, and value-adding action had truly based on lean production concept [24]. Designing the production process as an effort to minimize waste in the whole supply chain process and gain the value of products is the aim of lean production. Improving competitiveness and value of products in the industrial process need the integral concept of the rice manufacturing landscape ([25]; [4]). In order to develop rice optimization production with the efficiency concept, lean production could be a starting point to develop the model. Different principles in lean production theory could create detailed of the conceptual model and it is a
suitable strategy for rice logistics process [23]. Lean production concern in the development of production, procurement and process improvement in the distribution process [9]. The ultimate aimed of implementation of lean production for rice logistics and supply chain industry is to enhance the productivity of products, improve quality of products, shorten lead times, reduce waste of time and cost, etc. In line with the issues, lean manufacturing had been developing food chain as an effort to delivering beneficiaries along food logistics actor in the United Kingdom [4].

In this study, value stream mapping was used to analyze the general idea of the production process, improving efficiency and reducing waste in the production system. Lean production has used an effort to enhance the capacity of production, develop a model with the robust, effective and efficient concept that could implement for the whole actors. Value stream mapping could illustrate the logic of production process, post-harvest flow and how the actors delivering the products to the end consumers. Improving efficiency for rice industry is considering involve some element in the lean production such as bottleneck removing, cellular manufacturing, competitive benchmarking, cycle time reductions, cross-functional workforce, pull system, planning and scheduling strategy, self-directed work programs, process capacity measurement, quality management, and operation management system [12]. Lean production has a key success factor that could gain value of products and advantageous to develop a concept based on production improvement, institutional framework, service provider and logistics actors. A multi-dimensional combination approach is a foundation concept to merging individual practice in a multiplicative function (16; 7).

Based on the explanation above, the goals of this study is to explore the potential factor in the rice industry with using lean production concept as an effort to reduce waste, develop efficiency and effectiveness of rice industry. The novelty of this study is development efficiency of lean production management for rice industry involving the whole actors in the rice logistics and supply chain in Widasaari sub-district, Indramayu, West Java. Our role in this study is a chance to analyze the conceptual lean production for rice commodity and introduction a new concept for the rice industry as a preventive study to tackling the fourth industrial revolution.

2. Material and Method
The study is based on rice supply chain cases at Widasaari, Indramayu District, West Java Province, Indonesia. In this paper, value stream mapping was used as an instrument to develop the model of efficiency with the concept of lean production management. The case study was applied as a research method to gain the information and data as well as exploring the complex issues of rice logistics and supply chain system. Moreover, an in-depth interview, field observation, literature studies, and document analysis were used to gain in-depth understanding of the rice industry in Indramayu District. About 35 informants were an interview to obtain the actual data of the rice industry.

Value stream mapping is a tool to develop production planning with exploring production operations planning, materials management and control, process improvement, database/system design and development and develop project activity in support of the industrial process, reducing waste all along the process of the factory [18]. The value stream is a set of action involve value added and non-value added that are required to take a product through the main flows, starting the procurement of agro-inputs, production process, post-harvest process until the products deliver to the end user [19; 20]. The concept of understanding considers the flow of both information and materials within the overall supply chain.

This model concern about production optimization process, harvest and post-harvest process and distribution process in rice supply chain and also identify all of the kind the of waste in the value stream and take an action how to eliminate these. All of the conceptualization is linking and visualizing the actual material and information entire rice supply chain as a means to develop value stream [10]. Value stream mapping is a predefined toolset of standardized icons and divides into a two-step, the first step is drawing current state map consist of current data and information on the shop floor. The data and information is basic information to develop ideal future state map. Data and information should recognize in the current step mapping is customer demand, cycle time (C/T), process time (P/T), change
over time (C/O), number of operations (Op.), capital (cap.), available time, uptime or downtime, quality or defect rate (Q), number of product variations, batch size and inventory level.

Furthermore, the second step is drawing future state ideas as a point of key step to deliver the information about analysis. Future state map is redesigning the process of current state map based on lean principles [20]. Future state map should observe several principles i.e., rebalancing process, move toward continuous flow, changing the batch size, leveling out production, reducing changeover time, improve quality and linking all the stage in the illustration map as a visual of future state analysis ([18; [19]].

3. Result and Discussion
3.1. Rice Supply Chain
Understanding the rice supply chain is an important aspect to analyze current state as well as future state map. The study is underpinning the current process all over the rice supply chain as an understanding of the manufacturing process of a rice commodity. Figure 1 illustrates the process mapping of the rice supply chain in Indramayu district.

![Figure 1. Current rice supply chain map at Widasari, Indramayu district.](image)

Rice supply chain in Widasari, Indramayu was involved multiple actors, i.e., farmers as a producer, intermediaries (known as bandar) as an intermediaries between farmers and RMU (rice milling unit), and in this picture, RMU is divided into two type, i.e., RMU I is only do processing process from grain into broken skin and RMU II is an actor who does post-harvest from broken skin until marketing rice. In this figure shows that the rice supply chain develops based on distribution roles to produce rice. It is mean that rice supply chain has been linkage and it is an opportunity to develop efficiency more effective to develop the system. Meanwhile, 80% of grain is supplied directly by farmers to RMU I without going through a dealer or other intermediary. This indicates that farmers have an alternative market to sell grain produced to get a better price and competitive bargaining position. Meanwhile, intermediaries contribute to supply grain around 20% and in general, the intermediary is the partner of each RMU I or RMU II. However, it does not influence the price fluctuation and farmers still do not have a bargaining position. All actors in Indramayu (farmers, intermediaries, and RMU) are still as price taker and market act as price maker.
Figure 2. SIPOC mapping on production process of the rice industry.

Figure 2 illustrates the current situation of rice production flow. The SIPOC mapping consists of the supplier (means actors entire rice supply chain), input, process (starting from procurement until distribution), output and customers (means shop or market). Supplier consists of agro-input shop, farmers, intermediaries, and RMU. Meanwhile, local government acts as a policymaker and does several supports for the production process. The output of this supply chain is rice that divided into two grade; medium and premium quality. Meanwhile, RMU I is only produce broken rice to fulfill RMU 2 needs. Business process of rice value stream is described in the schematic picture.

Figure 3. Schematic picture of rice industry.

According to figure 3, the business process of the rice supply chain is having some process from production until the distribution process. Farmers do production process and after harvest, product delivered to the intermediary and/or directly distributes to RMU I. It seen that farmers do not have the
competitiveness and less value-adding process. RMU II do a lot of value adding and have a chance to get more some value of products as a strategy to build the value of products. According to the capacity of production, from 1 Ha field could produce 7-8 ton grain with the conversion from grain to rice is about 62.77%. RMU I only can process 3 ton grain per day and RMU II can be handling 10 ton broken skin per day.

3.2. Current State Mapping
Following table 1, all the activities depend on estimations process. PERT (Program Evaluation and Review Technique) analysis is used to describe the spend time on each process activities. Rice value stream is seen that the production (cultivation) process is lack of technology. It was difficult to maintain the quality of products. Meanwhile, the drying process is still using the traditional method rather than using new technology. Value stream should show non-value adding activities and maintain a pull-off process as well as lead time. It is seen that rice value stream mapping has a lot of losses and uncertainty of quality and time effectiveness.

| No | Activities                  | Activity Type | Expected Time (t_e) (Hour) | Activity Value |
|----|-----------------------------|---------------|----------------------------|----------------|
| 1  | Agro-input Procurement      | Operation     | 2.00                       | NVA            |
| 2  | Land Processing             | Operation     | 20.33                      | NNVA           |
| 3  | Basic Fertilization         | Inspection    | 2.67                       | VA             |
| 4  | Planting                    | Operation     | 5.33                       | VA             |
| 5  | Cultivation                 | Operation     | 19.920                     | VA             |
| 6  | Pest and Diseases Protection| Inspection    | 96.67                      | VA             |
| 7  | Harvest                     | Operation     | 4.67                       | VA             |
| 8  | Drying                      | Operation     | 48.00                      | VA             |
| 9  | Grinding                    | Operation     | 3.00                       | VA             |
| 10 | Packing                     | Operation     | 1.00                       | NNVA           |
| 11 | Weighting                   | Operation     | 1.51                       | VA             |
| 12 | Finishing                   | Operation     | 3.58                       | VA             |
| 13 | Milling I                   | Operation     | 4.42                       | VA             |
| 14 | Milling II                  | Operation     | 4.08                       | VA             |
| 15 | Packing                     | Operation     | 1.14                       | VA             |
| 16 | Distribution                | Transportation| 9.33                       | NNVA           |

Regarding information flow in figure 4, the current state mapping or an overview of the state is the performance of the rice supply chain in Indramayu District. In the picture, it is clear that in each post-harvest process of rice there is a waiting time before the rice moves from process one to the next process. This is an obstacle to waste management, especially waste at the time of processing. The length of time wasted on each process will indirectly affect the quality of rice produced, the speed performance of the production time to affect the costs used during the post-harvest process [3].
Figure 4. Current state mapping of rice industry.

The communication in the business process is divided into a 2-way system, first direct and indirect communication using the telephone. This communication is about negotiation, determination of quality and price. The drying of rice is still done manually, which is still using solar energy so that the process of drying rice is still relatively long and affects the subsequent post-harvest process. The average farmer can produce 10 tons of grain, with an estimated conversion of grain to rice by 62.74%. RMU is an important factor in marketing and plays a role in increasing the value of rice produced by farmers. TCT in the current state around 67 hours, with TLT long 68 hours and 41 minutes which means that there is a more time-consuming activity. Therefore, time management is important to improve the performance of the rice supply chain in Indramayu District [9].

### Table 2. Classification analysis of activities and average time of current state rice production.

| Activities | Time (hour) | Percentage |
|------------|-------------|------------|
| VA         | 20.095      | 99.84%     |
| NVA        | 2.00        | 0.01%      |
| NNVA       | 30.66       | 0.15%      |
| TOTAL      | 20,127.73   | 100.00%    |

Most of the activities in the rice production are adding the value of any activities that add value to the consumer. Value adding process in rice production is an effort to provide the best customer service. Meanwhile, any kind of activities which do not add value is waste. That would decrease TCT of the production to set approaches for tracking the progress in the entire supply chain.

3.3. Future State Mapping

Future state map is a step to create an idea as an effort to improve and plan to achieve the efficiency of the rice production process. The implementation of rice daily production is reducing waste. TAKT
time of rice supply chain is about 120.7 minutes per Kg. It is mean that every 120.7 minutes of rice has completed in whole processing. In the current state map sight that the roughing process consumes about 28 minutes more than TAKT time.

According to current state case scenario, there is some waste in the post-harvest process and it should be reduced in order to improve the efficiency of the value chain, cost, processing time and some activities. Furthermore, rice value stream should develop a contract between RMU II, RMU I and farmers as well as RMU II and market. It is a guarantee to do forecasting (continuity of products) and get a stable price. Moreover, maintaining the relationship with market or customer, RMU II should collaborate with logistics services which are help RMU II to do forecasting, negotiation and other business administration process, as well as logistics services should play a role as the center of rural and city logistics and supply chain. In this scenario, most of the communication will be done by an electronic system which could decrease waste of time in order to fulfill the efficiency of customer services and production. Moreover, in the downstream part should develop production controls that play a role to control continuity of production, production services for farmers (sharing knowledge and actual information related production problems), improvement of cultivation scheduling, and social engineer. This collaboration is adopting distributed government in order to distribution process for each actor and for sharing value as an effort to improve wealthy. Furthermore, the production control services should visit farmers more often and all the information should obtain based on direct communication. It is an endeavor to apply socio engineering process. As the preventive way for continuity of production, basis production should build from several farmers or farmers group.

Regarding rice future state map, networking between farmers, RMU I and RMU II must be strengthened. Thus, the intermediary is not required; therefrom decrease Non Value Added activities. Decreasing Non-Value Added activities is reminding the parties to obtain the highest profit in global competitiveness. Furthermore, in the production process, a farmer who from an individual or are grouped is under the same contract, term and right. The production control unit also will be able to manage farmers need such as agro-input procurement (such as fertilizer, pesticide, and seed) and also

Figure 5. Future state map of rice industry.
funding as to support cultivation process. The goal of the production control unit is to maintain the quality and quantity of products before delivered to the RMU (Rice Milling Unit) I. Accordingly, the time spent at this process can be minimized. This scenario shows that rice production should calculate of stock as a strategy to maintain price, availability of product and controlling the quality of the product. Quality control must be applied to start from drying process until the packaging process. In this scenario, 6s (Seiri (sort), Seiton (Set in Order), Seiso (Shine or sweeping), Seiketsu (Standardize), Shitsuke (Sustain), and Safety) system was used to eliminated waste within the post-harvest process. In addition, the packaging process is one of the important aspects to increase market strategy. Branding and packaging become an essential aspect in the global competitiveness. Branding and packaging is a part to increase the value of products and enhance agribusiness industry in the globalization era [20]. Lead time on post-harvest process was decreased gradually from 68.41 hours to 65.65 hours. Moreover, the estimation of the efficiency is about 99.87% of the total lead time is adding the value of production and only 0.13% of the time is wasted on the loading process.

4. Conclusion
This paper has studied the efficiency of the rice supply chain in Indramayu District through value stream mapping in order to analyze the performance of the rice supply chain. The result was illustrated into several processes, supply chain mapping, SIPOC diagram, Schematic Picture, and current state map was used to the understanding of actual information about rice industry. Moreover, future state map was illustrated the optimum scenario to improve the performance of rice supply chain. In order to improve efficiency, the rice industry should improve socio engineering between farmers, RMU I and RMU II and also involving logistics services and production control to maintain quality, continuity and market guarantee. Furthermore, quality control, stockiest system, and technology engineering should involve as an effort to increase the value of products. In addition, branding and packaging of products must be added as a strategy in the marketing process as an effort to increase the value of products as well as enhance the competitiveness of rice industry in the global competitiveness.

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