

Integrating Risk Management into Business Process Models for Small-scale Shrimp Industry in East Java, Indonesia

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Abstract The complexity and dynamism in shrimp industry have increase uncertainties and subjectivities in the risk analysis process. Identifying the business process in shrimp farming, and the sources risk that may arise in each process is the critical factor in maintaining the sustainability of shrimp industry. This study presents a risk analysis based on the business process modeling, which is a useful tool to identify the sources of risk and management strategies along the shrimp business process. The results revealed that there are three primary business processes in small-scale shrimp farming, consist of pond preparation and inputs for production, production, and harvesting and marketing. From the total of 32 sources of risk identified, the process of production accounted for 20 risk sources. This fact represents that the shrimp farmers more concerns on preventive actions to avoid unexpected event occur during process of production stage compare with other stages. Regarding management strategies, the results showed that the shrimp farmers develop a wide variety of and conversely, a risk management strategy can apply to mitigate diverse types of risk source along the business process of shrimp production.

Keywords: risk management, shrimp farming, small-scale, business process

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1. Introduction

Over the past decades, shrimp farming plays a significant role to Indonesian aquaculture. FAO mentions that Indonesia has become the second biggest aquaculture producer in the world [1]. The total Indonesian aquaculture production reached 4.253 thousand metric tons, which constituted 5.77 % of the world's total production in 2015 [2]. Among aquaculture commodities, shrimp was the leading fisheries export in terms of value for a couple of years ago. The increasing Indonesian shrimp production was triggered by the rapid growth of demand in both international and domestic markets. The shrimp farmers responded to those conditions by applying a recent technology in shrimp cultivation, particularly an intensive system. The intensive system allows them to cultivate shrimp with higher stocking density thus increasing productivity. However, it also brings more risks and changes activities along the business process in their shrimp farms. Zott, Amit & Massa defined a business process as a set of activities a cross the time and place, and clearly identified the inputs that designed to produce a specified output [3].

Nowadays, identifying the stages of the business process, and the sources risk that may arise in each process is the key factor to maintaining the sustainability of shrimp industry. The business process has played a significant role in many quality control methods for

assessing the risks or product failure [4]. Rosemann & Muehlen revealed that there is a tight relationship between risk and business process [5]. They mention that risk is important business phenomena, which increasingly should be considered in the design and redesign of the business process. Moreover, Lhannaoui, et al., described that the aims of the business process are to create and develop value inside the organization or enterprise [6]. Though, business processes are exposed to various sources of risk that may cause failure in the implementation.

To enable the successful implementation of the business process, it is important to understand and manage the risks that associated with each stage of the process and with the overall process. However, issues of risk in organization or enterprise are separated from business process that focused on operational matters [5,7,8]. Therefore, this paper aims to identify the sources of risk and risk management strategies and integrated risk and risk management strategies into business process model of small-scale shrimp industry in East Java, Indonesia.

2. Conceptual Framework

2.1. Understanding the Risk

The risk is defined in many ways. Based on the International Risk Management Principles and Guidelines standard (AS/NZS ISO 31000:2009), the risk is defined as

the result of uncertainty on objectives [9]. Moreover, several scholars defined risk as reflecting variation in the distribution of possible outcomes, their likelihood, and their subjective values [8,10,11,12,13,14].

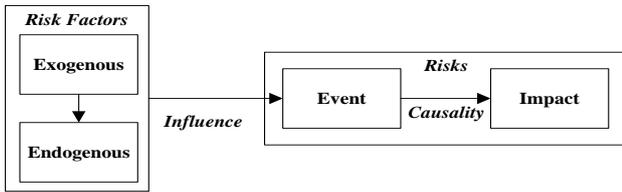


Figure 1. Relationship of Risk Factor and Risk (adopted from Karduck, Sienau, Lamine & Pingaud, 2007)

As represented in Figure 1, the uncertainty, in both exogenous and endogenous, is inherent to the activity in the form of risk factors [15,16,17]. Exogenous and endogenous risk factors are a potential cause that could favor the occurrence of the risk event. An exogenous risk factor refers to the sources of risk from an unexpected or unpredictable event that are generated within the system. On the contrary, exogenous risk relates to an unexpected or unpredictable event that arrives from outside the system [17]. The risk factors may trigger the occurrence of any undesirable events that ultimately affect the activity progress towards enterprises objective.

2.2. Business Process Model

In general, business could define as a collection of activities or structure for action [3,19,20]. In a business process, activities are the fundamental of the process. Karduck, Sienou, Lamine & Pingaud mention that each activity in the business process is performed with the idea to fulfill a particular transformation [22].

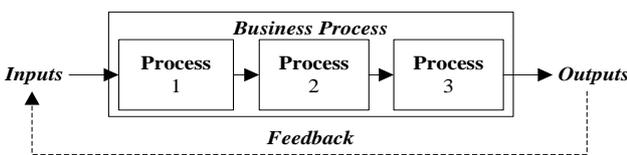


Figure 2. A Business Process Management

As represented in Figure 2, a process could be described as a structure of enterprise activities that organized in time and space, which uses a mechanism to control and manage the resources in orders to transform input into the output for given of purpose [20,22,23].

2.3. Understanding the Process Risk

The business process model transforms with a certain degree of performance for a given enterprise purpose. In changing the resources, each activity along the business process contain uncertainty and risk. Based on Karduck, Sienou, Lamine & Pingaud [23], there are two kinds of risks at the business process, which are:

- *The risk of the business process.* In this case, the risk defined as the possibility that the business process does not achieve the expected of enterprise’s goals.
- *The risk in the business process.* In this term, the risk described as the probable events to which the

activities of the business process are exposed. These events were preventing the transformation of the resources from achieving their goals (outputs).

With regard to business process, risk in small-scale shrimp industry defined as any probable event in each activity that able to cause the deviation from the expected enterprise’s goals. By definition, it is possible to set the following structure of process risks for the small-scale shrimp industry in the research area.

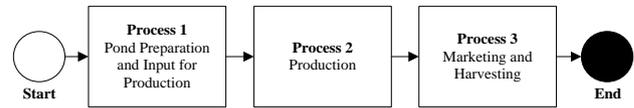


Figure 3. Structure of Process Risks for Small-scale Shrimp Industry

The structure of process risk above represents each a sub process along the shrimp production. The sub process 1 “shrimp pond preparation” risk defined as the risks associated with activities before the production process begins including maintenance and preparation of shrimp pond. The risk in the sub process 2 (preparation of inputs for production) is a risk that associated with the preparation of all inputs for growing out of shrimp. Then, “production” risks in sub process 3 described as the risks which interrupted production cycles, such as finance and credit access, weather and environment, business environment, and change of government policies and regulations in shrimp farming. The sub process 4 “harvesting” risks are the risk that associated with loss of product quality and lack of knowledge of harvesting methods. Last, risk the sub process 5 “marketing” defined as the risk that related to the variability of shrimp size and price in the harvesting time.

3. Materials and Methods

The data used for this research originated from a field survey in the southern and northern coasts of East Java, Indonesia. Two districts, Banyuwangi and Lamongan, which were selected purposively due to the main shrimp producing areas in East Java. The sample includes 79 and 87 small-scale shrimp farms in South (Banyuwangi) and North (Lamongan) coast, respectively. A semi-structured questionnaire used for data collection from small-scale shrimp farms in the study areas. Prior to the start of the survey, in-depth interviews with experts in shrimp farming were conducted to avoid missing any important information. The questioners consisted of 1) degree of consequences and the likelihood of sources of risk, and 2) degree of efficacy of risk management strategies.

The business process modeling was used to identify the sources of risk and risk management strategies associated with each sub process (include activities inside the sub process) in small-scale shrimp farming. The shrimp farming process is broken into five stages (called sub process), which are shrimp pond preparation, preparation of inputs for production, production, harvesting and marketing. In each sub process, we described the activities and identified the possibility of risks and risk management strategies.

4. Results and Discussions

In this research, the business process modeling was used to identify the risk and risk management strategies in small-scale shrimp farming. The business process of general shrimp farming is shown in Figure 4. The overview of this process starts with the process preparation of shrimp pond and input for production.

The second process is production. Production is the most important among all processes in shrimp farming. The process of production takes 110 to 130 days to complete, starting from stocking shrimp fries to harvesting. Shrimp farmers should simultaneously take care of many managerial activities, such as finance and credit access, growing out of shrimp, personal risk, managing weather and environment. Moreover, the shrimp farmers deal with business process risks related to changes in government policies and business environment. Then, the last process consists of two sub-processes, which are; harvesting and marketing

4.1. The First Process: Pond Preparation and Inputs for Production

Preparation of shrimp pond and inputs for production is the first step in the entire process of shrimp farming. This process consists of two sub-processes as follows;

- *Sub Process 1a: Shrimp Pond Preparation*

The shrimp pond preparation is an activity that regularly conducted before starting a new crop. To provide a healthy and suitable environment for rearing the shrimp, carefully preparation the brackish water pond is a significant activity.

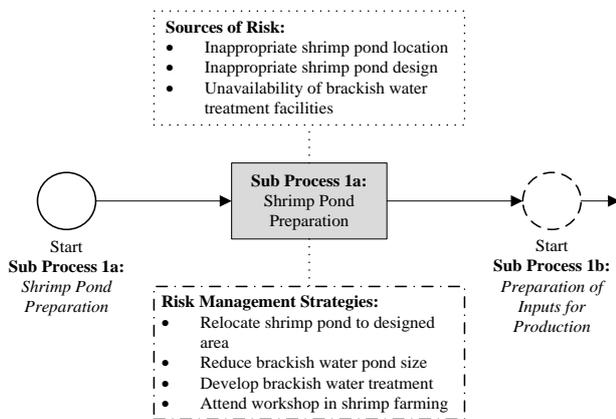


Figure 4. Sub Process 1a: Shrimp Pond Preparation

As shown in Figure 5, the risk involved in the sub-process of *shrimp pond preparation* consists of (1) inappropriate shrimp pond location, (2) inappropriate shrimp pond design, and (3) unavailability of brackish water treatment facilities. Several risk management strategies are available for these risks, include (1) relocate the shrimp pond to suitable areas for shrimp farming, (2) reduce brackish water pond size, (3) develop brackish water treatment, and (4) attend a workshop in shrimp farming to improve their knowledge and skill in managing water quality.

- *Sub Process 1b: Preparation of Inputs for Production*

The second sub-process is the preparation of inputs for production. The purpose of this sub-process is to ensure all inputs for production, such as shrimp fries, formulated feed, capital, and labor, ready for production cycle. In the study areas, the farmers used shrimp fries at size PL (post-larvae) 8 – 10 that produced artificially at hatcheries. The shrimp fries should be healthy and good quality, not infected by any diseases. However, the supply of shrimp fries does not fulfill the demand due to the fast-growing of the shrimp industry. As the results, the farmers used low quality of shrimp fries for production. Therefore, the risks involved in the preparation of inputs for production consist of (1) low quality of shrimp fry, and (2) inappropriate shrimp fries size. To reduce impact from these risks, the farmers applied several strategies, include; (1) only buy shrimp fries from the trusted hatchery and (2) only buy shrimp fries from a hatchery that have Specific Pathogen Free (SPF) for their broodstocks.

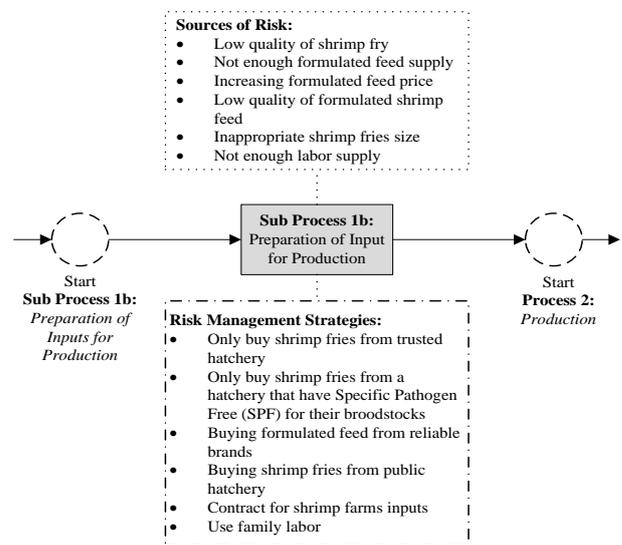


Figure 5. Sub Process 1b: Preparation of Input for Production

Most of the shrimp farmers apply the intensive system in their cultivation. This system highly depends on formulated feed for growing out the shrimp fries. The shrimp requires good quality of feed and nutritionally balanced for healthy growth. The formulated feed should be contained nutrient like fat, protein, fiber, vitamins, and mineral for faster growth. However, the price of formulated feed is often high and not stable. Thus, some of the shrimp farmers used low quality of formulated feed in their shrimp cultivation to reduce production cost. They often face the risks as follows: (1) Lack of supply of formulated feed from the factory, (2) a rise of feed price, and (3) low quality of formulated shrimp feed. To manage these risks, shrimp farmers conducted risk management strategies, such as; (1) buying formulated feed from trusted brands, and (2) contract for shrimp farm inputs.

4.2. The Second Process: Production

The next step is the process of production of shrimp. Regarding time required to complete, the process of production is the longest step. This process requires 110 to 130 days to complete. The process of production can be broken into six sub-process and happen simultaneously

throughout the whole crop duration, namely; managing finance and credit access, managing growing out, managing personal aspect related with shrimp farmers, managing weather and environment, managing policy and institutional, and managing the business environment. Moreover, the following section will describe these sub-processes and identify the risks and management strategies in each sub-process.

• *Sub Process 2a: Managing Finance and Credit Access*

Shrimp farming, especially intensive system, requires a significant amount of capital for pre-production activities and during operation of shrimp farms. In the normal condition, the shrimp farming duration could last up to four months (from preparation until harvesting), during which operation expenses for formulated feed, labor, medicines, electricity, and fuel take place throughout the shrimp cultivation. Lacking capital for operation can damage sustainability of their shrimp farm, which can affect the farmer’s income and their livelihood. Moreover, limited access to credit from the formal financial institution (i.e., bank or cooperation) is the main risk to shrimp farmers. Hence, the shrimp farmers need to give more attention about financial arrangement for their farms. Financial risks that shrimp farmer's face is (1) increasing formulated feed price, (2) lack of capital to operate shrimp farms, (3) lack of collateral for loan, (4) high-interest rate for loan, and (5) high wages for hired labor. The following financial risk management strategies are effective to mitigate impact of lacking capital for shrimp farm: (1) contract for shrimp farm inputs, (2) use informal loan, (3) make production arrangement before production cycle, (4) dissaving, (5) use family labor, (6) sharing machinery and paddle wheels, and (7) off-farm work. **Figure 6** summarizes the risk and management strategies related to finance and credit access of shrimp farms.

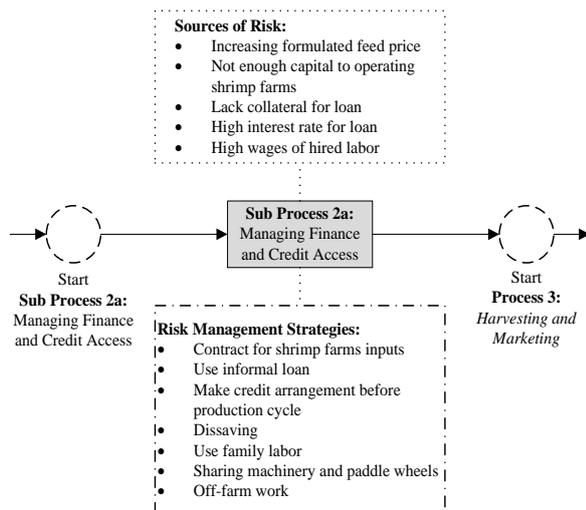


Figure 6. Sub Process 2a: Managing Finance and Credit Access

• *Sub Process 2b: Managing Growing Out of Shrimp*

Managing growing out of shrimp is the most significant activity in the process of production. Diseases infection, feed and feeding preparation, and managing brackish water quality are the main farmer’s concern in this step. In the recent years, Indonesian shrimp farming has had

problems with several shrimp diseases. These diseases reduce shrimp growth hence decrease both output and quality of the harvest.

Moreover, shrimp diseases cause from both inside and outside brackish water pond. First, inside sources are incriminated as brackish water quality in shrimp pond and quality of shrimp fries’ problems. Second, outside sources of shrimp diseases come from environmental issue around the shrimp pond. Hence, in the growing out process, the shrimp farmers may face the risks as follow: (1) high mortality due to diseases, (2) water pollution due to excessive formulated feed, (3) feeding management failure, (4) excessive stocking density, and (5) brackish water quality. To manage these sources of risk, the shrimp farmers conduct several risk management strategies, such as (1) strictly managing water quality, (2) strictly feeding management, (3) conducting partial harvest, (4) reducing stocking density, (5) reducing brackish water pond size, (6) preventing shrimp disease by regular checking, (7) developing brackish water treatment, (8) attending workshop in shrimp farming, (9) applying new technology in shrimp production, (10) applying better management practices, and (11) requesting government support for technical assistant.

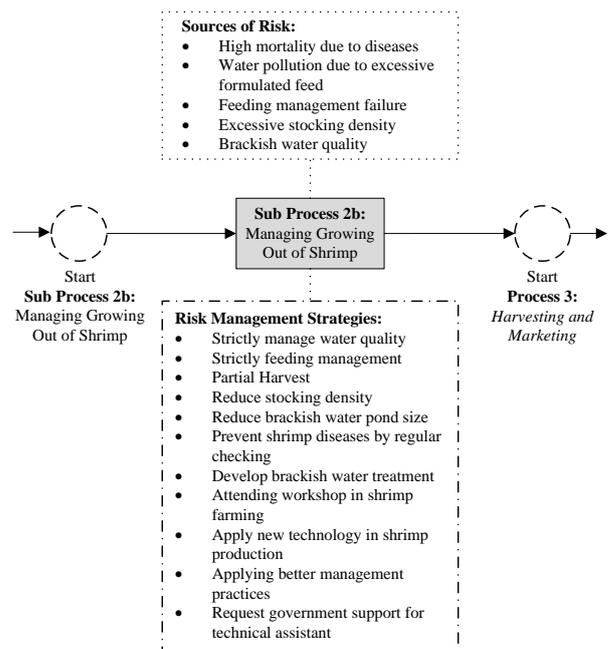


Figure 7. Sub Process 2b: Managing Growing Out of Shrimp

• *Sub Process 2c: Managing Personal Risk*

Figure 9 summarizes the risk and risk management strategies related to personal risk in shrimp farming. Besides technical aspect that is directly related to shrimp farming, the farmers also need to consider their personal risks that are associated with farmers’ capabilities (knowledge, experience, infrastructure, management, etc.). In general, the shrimp farmer's face two groups of risk. The first group related to the shortage of facility such as; (1) shrimp farmers don’t have brackish water treatment facility and (2) lack of labor knowledge about shrimp farming. Then, the second group consists of risks related to the lack of facilities, such as (3) lack of knowledge to prevent shrimp diseases, (4) lack of information about

shrimp fries origin, (5) lack of knowledge for pond preparation.

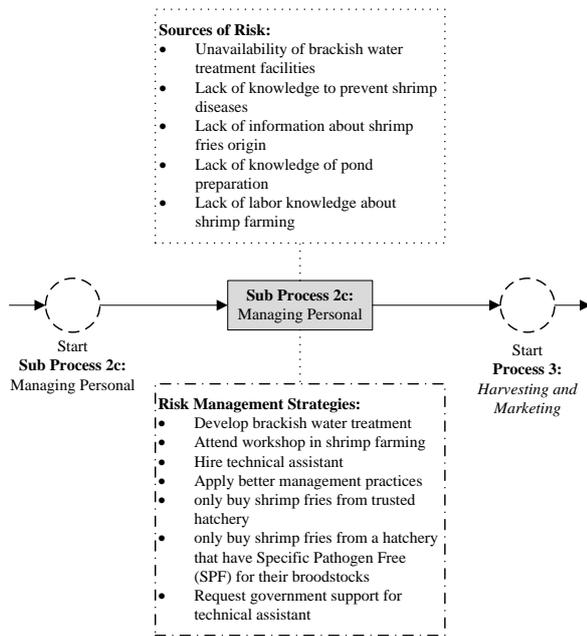


Figure 8. Sub Process 2c: Managing Personal Risk

In order to manage personal risk, the shrimp farmers adopted certain strategies, such as (1) to develop brackish water treatment facility, (2) attend workshop in shrimp farming, (3) to hire technical assistants, (4) to apply better management practices, (5) buy shrimp fries only from trusted hatchery and (6) only buy shrimp fries only from a hatchery that have Specific Pathogen Free (SPF) for their broodstocks, and (7) to request government support for technical assistant.

• Sub Process 2d: Managing Weather and Environment

Shrimp farming is a biological process that highly depends on environmental condition. This condition should maintain shrimp pond environment, hence affect the shrimp growth. In the research area, some of the shrimp ponds were located near the river and close to the coast. Therefore, the flood is one of the primary risks during the rainy season. Water overflows or breaks the shrimp pond dyke. As a result, the shrimp may freely escape to the environment and thus makes a loss of income for the shrimp farmers.

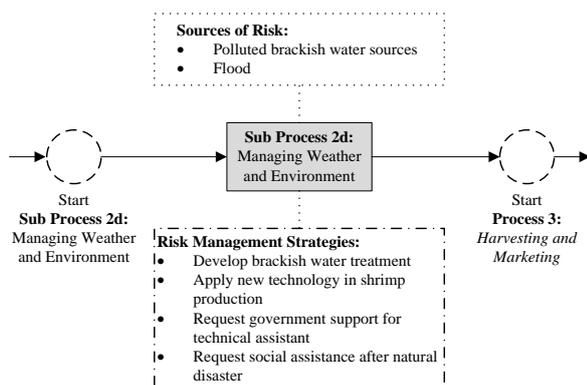


Figure 9. Sub Process 2d: Managing Weather and Environment

In this sub-process, the risks involved in the managing weather and environment are (1) polluted brackish water sources and (2) flood. To reduce impact of these risks, the farmers applied the following strategies: (1) developing brackish water treatment, (2) applying new technology in shrimp production, (3) requesting government support for technical assistant, (4) enforcing the shrimp pond dyke, and (5) requesting social assistant after natural disaster.

• Sub Process 2e: Managing Policy and Institutional

Changing the government policies related to environmental protection and standard for food safety and hygiene are also faced the shrimp farmers in the study area. Figure 10 presents the policy and institutional risks in shrimp farming and the risk management strategies to mitigate the impact of those risks. Recently, strict requirements derive from customers, not only in domestic market but also in the foreign markets in developed countries. For the small-scale farmers, strict regulations for food safety and environmental protection can be big challenges that should be managed.

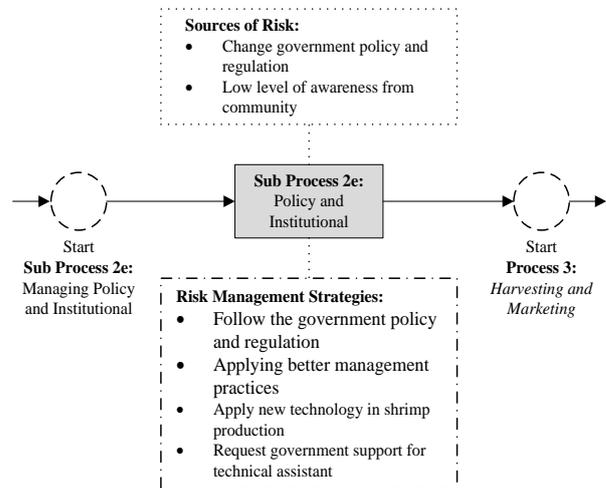


Figure 10. Sub Process 2e: Managing Policy and Institutional

Moreover, the intensive system in shrimp farming releases a significant amount of brackish water waste from the shrimp pond into water bodies around the ponds. Waste water could affect other shrimp pond and other users, such as agriculture and domestic uses. However, not all shrimp farmers concern to these issues and make shrimp farming riskier. Hence, in the managing policy and institutional activity, the shrimp farmers faced the risk as follows: (1) changeable government policy and regulation, and (2) low level of awareness from the community about the environmental condition. Furthermore, the following risk management strategies are effective to mitigate the impact of policy and institutional risks: (1) following the government policy and regulation, (2) applying better management practices, (3) applying new technology in shrimp farming, and (4) requesting government support regarding technical assistant.

• Sub Process 2f: Managing Business Environment

Shrimp farming is a dynamic business, which depends on not only biology aspect but also economic aspects. Regarding economic aspect, two main factors are affecting the shrimp industry. First, market power in both input and output sides strongly influences the business stability of shrimp industry. Secondly, the number of actors along the

supply chain in both input and output is enormous. Hence, asymmetric information between buyer and seller becomes the main obstacle while managing the business environment in the shrimp industry. To overcome this risk, the possibility of risk management strategies are (1) vertical integration, (2) contract-based production (3) marketing contract with the processor and (4) informal marketing contract with the wholesaler.

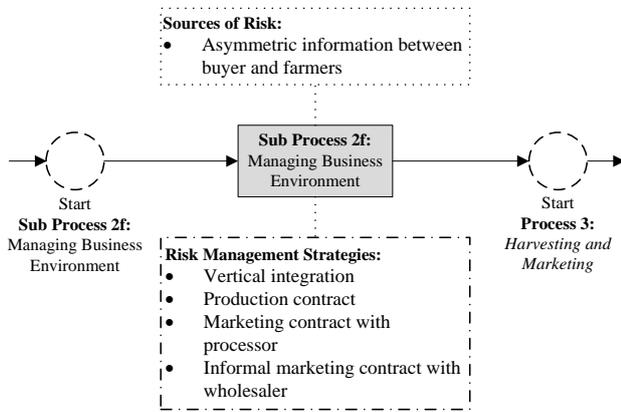


Figure 11. Sub Process 2f: Managing Business Environment

4.3. The Third Process: Harvesting and Marketing

Harvesting and marketing are the most important sub-process in the entire shrimp farming business process. The outcome, such as income or profit, of the whole process is realized at this stage.

• *Sub Process 3a: Harvesting*

Shrimp can reach marketable size after 110 to 130 days of rearing in a brackish water pond. However, harvesting time and size of shrimp can be harvested mainly depend on two factors, that is, stocking density and feeding management. In the intensive system, the farmers can cultivate shrimp with stocking density more than 100 shrimp fries per meter². Nevertheless, to get optimum growth rate, they should conduct partial harvest after 60 or 90 days of rearing the shrimp.

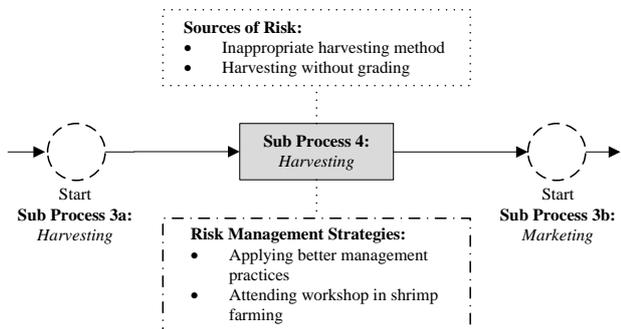


Figure 12. Sub Process 3a: Harvesting

Figure 12 depicts the risks and risk management strategies in the harvesting activity of shrimp farming. There are two sources of risk involved in this sub-process, consist of inappropriate harvesting method and harvesting without grading. To reduce the impact of these risks, the shrimp farmers applied the following strategies, which are (1) applying better management practices and (2) attending a workshop in shrimp farming.

• *Sub Process 3b: Marketing*

The last sub-process in the whole shrimp farming business process is marketing. All activities in the previous stage result in this sub-process. Moreover, the outcome (i.e., income or profit) of the whole shrimp farming process is realized in sub-process of marketing.

Two sources of risk were identified in marketing, which is (1) shrimp price volatility and (2) shrimp size variability. The first source of risk, shrimp price volatility, is the most important for Indonesian shrimp farming. The shrimp farmers do not know market price for their product. Usually, the buyers set a price at harvesting time, and the farmers have little bargaining power in setting the shrimp price. Even if they have a contract, there is no guarantee for them to get a high price for their product. The farmers only got a market guarantee from the contractor. To minimize impact of marketing risk, they could apply the following strategies; (1) production contract, (2) sharecropping, in which the owner of the brackish water pond allows a tenant to use the pond in return for a share of the crops produced on their portion of pond, (3) informal marketing contract with wholesaler, (4) vertical integration, in which the shrimp farmers tried to link their business with the shrimp feed supplier and processors, (5) marketing contract with processor, (6) conduct partial harvest to reduce biomass at the shrimp pond in the middle of production cycle, (7) reduce brackish water pond size, and (8) reduce stocking density.

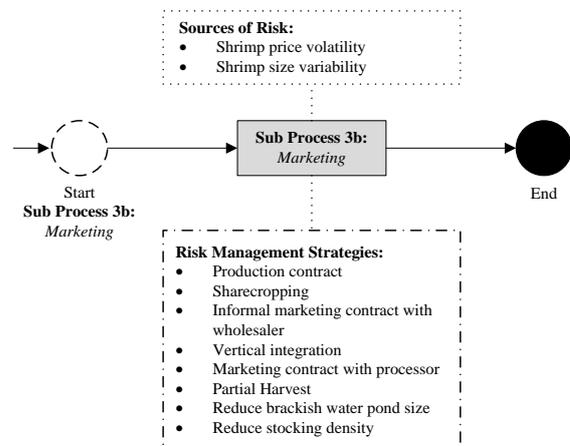


Figure 13. Sub Process 3b: Marketing

5. Conclusion

Integrating risk management strategies into business process modeling shall be able to anticipate the uncertainties outcome. Through this paper, we propose risk management analysis in each activity which is illustrated through business process modeling for small-scale shrimp farming. A business process model for shrimp farming in research areas consists of three main business processes, which are pond preparation and inputs for production, production, and harvesting and marketing.

Among three processes, the second process, which is production, was the riskiest stage. From the total of 32 sources of risk identified, the process of production accounted for 20 risk sources. At the sub-process level, the preparation of inputs for production was the most

significant in the shrimp business process model. Six sources of risk were included in this sub-process. This fact represents that the shrimp farmers more concerns on preventive actions to avoid unexpected event occur during sub-process of production compare with others sub process. Regarding management strategies, we conclude that there are no particular risk management strategies for the specific risk sources. Our results showed that the shrimp farmers develop a wide variety of and conversely, a risk management strategy can apply to mitigate different types of risk source along the business process of shrimp production.

References

- [1] FAO. (2016). *The State of World Fisheries and Aquaculture: Opportunities and Challenges*. Rome: Food and Agriculture Organization of the United Nations.
- [2] Ministry of Marine and Fisheries. 2015. www.djpb.kkp.go.id/produksi. Retrieved January 05, 2016, from www.djpb.kkp.go.id:ww.djpb.kkp.go.id/index.php/arsip/c/246/Udang-Vaname-dan-Udang-Windu-Masih-Andalan-Ekspor-Indonesia/?category_id=13.
- [3] Zott, C., Amit, R., & Massa, L. (2011). The Business Model: Recent Developments and Future Research. *Journal of Management*, 1019-1042.
- [4] Cope, E. W., Kuster, J. M., Etzweiler, D., Deleris, L. A., & Ray, B. (2010). Incorporating risk into business process models. *IBM Journal of Research and Development*, 54(3), 4-1.
- [5] Rosemann, M., & Zur Muehlen, M. (2005). Integrating risks in business process models. *ACIS 2005 Proceedings*, 50.
- [6] Lhannaoui, H., Kabbaj, M. I., & Bakkoury, Z. (2013, May). Towards an approach to improve business process models using risk management techniques. In *Intelligent Systems: Theories and Applications (SITA), 2013 8th International Conference on* (pp. 1-8). IEEE.
- [7] Conforti, R., De Leoni, M., La Rosa, M., & Van Der Aalst, W. M. (2013, June). Supporting risk-informed decisions during business process execution. In *International Conference on Advanced Information Systems Engineering* (pp. 116-132). Springer, Berlin, Heidelberg.
- [8] Conforti, R., Fortino, G., La Rosa, M., & Ter Hofstede, A. H. (2011, October). History-aware, real-time risk detection in business processes. In *OTM Confederated International Conferences" On the Move to Meaningful Internet Systems"* (pp. 100-118). Springer, Berlin, Heidelberg.
- [9] SAI Global (2009). AS/NZS ISO 31000 : 2009, Risk management : principles and guidelines. Standards Australia, Sydney, N.S.W
- [10] Verbano, C., Venturini, K. (2011). Development Paths of Risk Management: Approaches, Methods and Fields of Application. *Journal of Risk Research*, 14(5-6), 519-550
- [11] Nieto-Morote, A., & Ruz-Vila, F. (2011). A fuzzy approach to construction project risk assessment. *International Journal of Project Management*, 29(2), 220-231.
- [12] Muehlen, M., & Ho, D. T. Y. (2006). Business Process Management Workshops, LNCS 3812.
- [13] Jaafari, A. (2001). Management of risks, uncertainties and opportunities on projects: time for a fundamental shift. *International journal of project management*, 19(2), 89-101.
- [14] Campbell P. L. and J. E. Stamp (2004) *A classification scheme for risk assessment methods*. Sandia National Laboratories, Oak Ridge
- [15] Shah, L. A., Etienne, A., Siadat, A., & Vernadat, F. (2016). Decision-making in the manufacturing environment using a value-risk graph. *Journal of Intelligent Manufacturing*, 27(3), 617-630.
- [16] Vernadat, F., Shah, L., Etienne, A., & Siadat, A. (2013). VR-PMS: a new approach for performance measurement and management of industrial systems. *International Journal of Production Research*, 51(23-24), 7420-7438.
- [17] Shah, L. A., Etienne, A., Siadat, A., & Vernadat, F. (2016). Decision-making in the manufacturing environment using a value-risk graph. *Journal of Intelligent Manufacturing*, 27(3), 617-630.
- [18] Danielsson, J., & Shin, H. S. (2003). Endogenous risk. Risk Books.
- [19] Wirtz, B. W. (2011). Business Model Management. Speyer: German University of Administrative Sciences Speyer.
- [20] Sienou, A., Karduck, A., & Pingaud, H. (2006). Towards A Framework for Integrating Risk and Business Process Management. *Information Control Problems in Manufacturing* (pp. 647-652). Saint-Etienne, France: IFAC.
- [21] Sienou, A., Lamine, E., Karduck, A., & Pingaud, H. (2007). Conceptual model of risk: Towards a risk modelling language. In *Web Information Systems Engineering–WISE 2007 Workshops* (pp. 118-129). Springer Berlin/Heidelberg.
- [22] Segatto, M., Padua, S. I., & Martinelli, D. P. (2013). Business Process Management: A Systemic Approach? *Business Process Management Journal*, 698-714.
- [23] Karduck, A. P., Sienou, A., Lamine, E., & Pingaud, H. (2007). Collaborative Process Driven Risk Management for Enterprise Agility. *IEEE International Conference on Digital Ecosystems and Technologies* (hal. 535-540). Cairns, Australia: Institute of Electrical and Electronics Engineers (IEEE).