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Research Article

Challenges of Small Scale Fish Farmers for Fish Product Sustainability

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ABSTRACT

The aquaculture industry is growing tremendously over the past two decades following the significant decline of the world's fish catch. Nevertheless, small scale fish farmers are still one of the most vulnerable communities in Indonesia, with low income and limitation in carrying out their fish farming business. In their attempt to carry out successful aquaculture business, small scale fish farmers encounter several challenges that inhibit the fish farmers in ensuring the sustainability of fish products. This research aims to explore challenges and identify internal and external challenges that affect fish farmers' activities in ensuring fish product sustainability. This research used a quantitative approach by collecting data through questionnaire distribution to small scale fish farmers in Central Java and data was analyzed using statistical analysis package. The findings of this research showed that challenges consist of nine internal and seven external challenges. Result of statistical analysis indicated that internal challenges influenced product sustainability through water quality examination, whereas external challenges influenced product sustainability through two activities, such as giving feed at the right quantity and time, and maintain fish seed quality and availability.

Keywords: *aquaculture; challenges; product sustainability; small-scale fish farmers*

1. Introduction

Indonesian aquaculture is still under maximum potential yield. Although the number of fish farmers in Indonesia exceed 2.5 million but the industry is still dominated by small-scale fish farmers which most of them in vulnerable condition (KKP, 2013). Previous studies have found that the small-scale fish farmers are lacking access to high quality fish seed and still use poor farming systems which restrain the growth of the industry. Environmental degradation and pollution also increases vulnerability of fish farmers (ADB, 2015). Fish farmers' business expansion are also hold back since they have to encounter barriers like limitations in finance, lack of marketing strategies, and other constraints.

Product sustainability is an important indicator for successful fish farming. Despite aquaculture activities should be a reliable action in providing fish supply, it has also created new problems such as environmental destruction and is using large quantity of wild fish catch for "fish food" (Huntington, 2009). Pauly *et al.* (2002) has also claimed similar opinion that the environment degradation which adversely results in pollution and fish disease outbreak, was a result of the current unsustainable aquaculture practice.

The Indonesian government is making an effort to implement sustainable aquaculture practice by introducing an "eco-friendly production process" (Sukadi, 2006). One of the major examples of unsustainable aquaculture activity in Indonesia was shrimp production in Central Java in the 1970s which increased rapidly due to high export demand. Unfortunately, this was not accompanied by sustainable fish farming management. There were many mangrove forests removed in order to provide space for the shrimp culture production which eventually resulted in deterioration of ecosystem (Elfitasari, 2006). The key factors that hinder the success of activities to ensure product sustainability may lay in the challenges encountered by small scale fish farmers. Therefore, it is important to identify main challenges encountered by small scale fish farmers and its influences to ensure product sustainability. Activities which ensure product sustainability and influenced by these challenges will also be discussed.

Activities to ensure aquaculture product sustainability

There are many perspectives on sustainability. Pezzey and Toman (2005) defined sustainability as "the ability to maintain the needs of human beings over a long period of time by using various interdisciplinary ideas to sustain industrial civilization". World Commission on Environment and Development—WCED—defined sustainability as the ability to meet the current generation's needs without disturbing the needs of future generations (Be, 1994).

Based on former research, product sustainability can be defined as the ability to continuously provide a product over prolonged period of time. Small scale fish farmers, which mostly have low education, encounter many obstructions in their attempt to sustain their product. These obstacles may come internally within the fish farmers or externally uncontrollable as an effect from other people or event.

Aquaculture have shown a significant increase in global production, nevertheless, a negative view of aquaculture have emerged as an effect of unsustainable aquaculture practice. Instead of resolving problems, the fish farming practices of some fish species were causing problems (Huntington, 2009). Salmon and shrimp farming have caused fish depletion, environmental disruption because of excess fish feed and pesticides and consuming more fish for fish feed. Furthermore, it may lead to the occurrence of fish disease, an outbreak and total mortality. This example will damage the image of aquaculture as "the solution of overfishing". Therefore, it is crucially important that fish farmers adopt sustainable aquaculture practices.

Many steps have been taken to implement aquaculture product sustainability in Indonesia, however there was still a long way to go before achieving sustainability since the aquaculture industry was dominated by small scale fish farmers. Therefore, strong action is needed to empower small scale fish farmers to use sustainable aquaculture practices (Sukadi, 2006).

This research has identified four activities carried out by small scale fish farmers in Central Java. . Central Java was chosen as a location for this research because this province is on the top five province of aquaculture producers (FAO, 2017).

Table 1. Frequency of product sustainability activities

Activities for product sustainability	Frequency	Percentage
Check water quality	210	52.5
Give feed at the right quantity and time	213	53.2
Maintain fish feed quality and availability	156	39
Maintain fish seed quality and availability	110	27.5

Table 1 shows that out of the four activities, giving feed at the right quantity and time was the most common activity carried out by small scale fish farmers in Central Java to sustain their product. The second most common activity implemented by the fish farmers was water quality examination, followed by maintaining fish feed quality and availability, and then maintaining fish seed quality and availability.

Challenges encounter by small scale fish farmers

In performing their fish farming practices, small scale fish farmers in Indonesia face many and harsh challenges. In this research, these obstacles are divided into internal and external challenges. Business directory (2017) defined that internal challenges are "inner strengths and weaknesses that strongly effect how a business can achieve its target. And external chellenges were defined as "an outside influence that can impact business which effect the ability to acheve its objective/target. It can be competition, social, legal, technological changes or political environment"

The above definition shows that internal challenges is characterized as a person's limits and is viewed as an internal restriction. On the other hand, external challenge is viewed as an external obstruction that creates difficult conditions for a person with which to deal. Therefore, in this research constraint is associated with internal matters and problems to external issues. Research has identified some challenges faced by fish farmers, as described in Table 2.

Table 2. Challenges encountered by small scale fish farmers

Challenges
Lack of start up capital (Awulachew et al, 2008; Das, 2006)
Lack of technical abilities (Mkoka, 2007)
Lack of family support Loscocco et al, 1991; Verheul and Thurik, 2006)
Lack of government support (Kristiansen, 2002; Das, 2006)
Lack of training provided by local government (De La Cotera, 2001)
Lack of fish farming experiences and knowledge (Das, 2006)
Lack of potential market (Sukadi, 2006)
Low selling price (Kinseng, 2005; Effendi, 2008)
Low profits (Zainal, 1998)
Low quality and quantity of fish seed (Mantau, Rawung dan Sudarty, 2004)
Low quality and quantity of fish feed (Bueno, 1999)
Poor financial management skills (Theng and Boon, 1996)
Poor quality control (Sukadi, 2006)
Low ability to handle fish disease and parasite (Sukadi, 2006)
Poor water quality (ADB, 2015)
Inability to secure suffecient loans (Nam and Thuk, 1999)

There are sixteen challenges identified based on previous studies. Internal and external challenges were grouped based on theoretical conceptualisation. According to the definition of internal challenges given previously, internal challenges include aspects within the fish farmer business and are controllable, whereas external challenges are aspects outside the fish farmers and therefore, uncontrollable.

Based on definition of internal challenges from Business dictionary, the internal challenges were identified as follows:

- Poor financial management skills
- Low ability to handle fish diseases and parasites
- Poor water quality
- Low quality of fish feed
- Low quality of fish seed
- Poor quality control
- Lack of fish farming experience
- Lack of start up capital
- Lack of technical abilities

Similarly, based on the definition of external challenges, the following are grouped into uncontrollable external challenges:

- Lack of family support
- Lack of potential market
- Lack of government support
- Lack of training provided by the government
- Lack of profit
- Low selling price
- Cannot secure a sufficient loan

2. Materials and Methods

This study used a quantitative research approach, which involved development and distribution of questionnaire. Questionnaire was carefully constructed and customized to ease understanding and suitable for small scale fish farmers. Questionnaire was then distributed to fish farmers from various district in Central Java. Samples of fish farmer groups were chosen purposively according to list of fish farmer groups with constant fish production record from the Central Java Fisheries and Marine Affairs.

Data collected was analyzed with descriptive analysis and binary logistic regression. Descriptive statistics was used in this research analysis to describe the characteristics of the sample used in a research. The binary logistic regression was used to carry out the analysis where the dependent variables used a Likert scale and the independent variables were categorical (Pallant, 2013). In this research the dependant variables were the activities that influence product sustainability, which was acknowledged as water quality examination, giving feed at the right quantity and time, maintain fish feed quantity and availability and maintain fish seed quality and availability. Whereas the independant variables were the internal and external challenges encountered by fish farmers. The omnibus test of model coefficients is part of the logistic regression analysis in SPSS. This model is useful to check the new model as an improvement over the baseline model, and chi square test are used to see if there is significant differences between the new model and the baseline model.

3. Results and Discussion

The effect of internal and external challenges on product sustainability activities

Water quality examination

Water quality examination is one of the activities that may be influenced by internal and external challenges. The result of statistical analysis is shown in Table 3.

Table 3. Omnibus tests of model coefficients for internal and external challenges which influenced product sustainability through checking water quality

		Chi-square	df	Sig.
Step 1	Step	18.282	2	.000
	Block	18.282	2	.000
	Model	18.282	2	.000

The Omnibus test of model coefficients for challenges influencing product sustainability is shown in Table 3. The result was significant with p-value of .000. This suggests that both internal and external challenges associated with product sustainability affect water quality examination.

Table 4. Variables in the equation for internal and external challenges which influenced product sustainability through water quality examination

		B	S.E.	Wald	df	Sig.	Exp[B]
Step 1	Internal	-.037	.013	7.443	1	.006	.964
	External	-.004	.017	.050	1	.822	.996
	Constant	1.298	.317	16.776	1	.000	3.660

Table 4 shows that internal challenges contributed to the product sustainability through water quality examination. This is shown by the p-value of 0.006. Conversely, external challenges did not have a significant correlation with water quality [p = 0.822]. The odds ratio shows that the odds to influence product sustainability through water quality examination were decreased by a factor of 0.996 for a one unit increase in the problems scale while the internal challenges scale was statistically controlled.

Proper feeding amount and time

Feeding fish with the accurate quantity and proper time have been affected by internal and external challenges as shown in Table 5. Table 5 shows the Omnibus test of the model coefficients for using internal and external challenges influencing product sustainability to predict giving feed at the right quantity was significant [p = 0.000].

Table 5. Omnibus tests of model coefficients for internal and external challenges which influenced product sustainability through proper feeding amount and time.

		Chi-square	df	Sig.
Step 1	Step	49.875	2	.000
	Block	49.875	2	.000
	Model	49.875	2	.000

Table 6.Variables in the equation for challenges which influenced product sustainability through giving feed at the right quantity and time

	B	S.E.	Wald	df	Sig.	Exp[B]
Internal	.000	.014	.001	1	.979	1.000
External	.084	.018	21.372	1	.000	1.088
Constant	-1.783	.335	28.372	1	.000	.168

Table 6 confirms that the external challenges which influenced product sustainability impacted significantly on feeding amount and time [p = 0.000]. On the other hand, internal challenges which influenced product sustainability did not have significant influence [p = 0.979] on feeding amount and time. The odds ratio shows that the odds of influencing product sustainability by proper feeding amount and time was increased by a factor of 1.088 for one unit increased in the external challenges scale while the internal challenges scale was statistically controlled.

Maintain fish feed quality and availability

The third activity influenced by challenges is assuring to provide good quality of fish feed and maintain its availability.

Table 7. Omnibus Tests of Model Coefficients for challenges which influenced product sustainability through managing fish feed quality and availability

		Chi-square	df	Sig.
Step 1	Step	12.688	2	.002
	Block	12.688	2	.002
	Model	12.688	2	.002

Table 7 shows the Omnibus test of model coefficients where a significant result indicates a useful model. In this case, the model relating challenges which influenced product sustainability to maintaining fish feed quality and availability was significant with a p value of 0.002.

Table 8. Variables in the Equation for challenges which influenced product sustainability through managing fish feed quality and availability

	B	S.E.	Wald	df	Sig.	Exp[B]
Internal	-.017	.013	1.746	1	.186	.983
External	-.023	.016	1.922	1	.166	.978
Constant	.578	.307	3.557	1	.059	1.783

Table 8 shows internal and external challenges variables which influenced product sustainability through maintaining fish feed quality and availability. The result for both variables shows that constraints [p = 0.186] and problems [p = 0.166] did not contribute significantly to product sustainability. The odds of influencing product sustainability by maintaining fish feed quality and availability was decreased for a one unit increase in the external challenges scale while the internal challenges scale was statistically controlled.

Fish seed quality and availability management

The following table provides statistical result of fish seed quality and availability management as product sustainability activity influenced by constraints and problems. Table 9 shows that the model coefficients for challenges which influenced product sustainability through fish seed quality and availability management, was highly significant with result of 0.000 which indicated that this was a useful model.

Table 9. Omnibus tests of model coefficients for challenges which influenced product sustainability through fish seed quality and availability management

		Chi-square	df	Sig.
Step 1	Step	42.668	2	.000
	Block	42.668	2	.000
	Model	42.668	2	.000

Table 10 presents a significant result that external challenges influenced product sustainability [0.000] by managing fish seed quality and availability. Conversely, internal challenges that influenced product sustainability significantly influenced fish seed quality and quantity management [p = 0.957]. The odds of influencing product sustainability by fish seed quality and availability management were increased by a factor of 1.095 for one unit increase in the problem scale while the external challenges scale was statistically controlled.

Table 10. Variables in the equation for challenges which influenced product sustainability by fish seed quality and availability management

	B	S.E.	Wald	df	Sig.	Exp[B]
Internal	.001	.014	.003	1	.957	1.001
External	.091	.019	23.709	1	.000	1.095
Constant	-3.227	.454	50.584	1	.000	.040

Table 11 summarizes the significant effects of internal and external challenges on product sustainability. It indicates that internal challenges showed a significant relation to product sustainability by water quality examination, but no relationships to other product sustainability activities. On the other hand, external challenges showed significant effect on two of the product sustainability activities: proper feeding amount and time, and fish seed quality and availability management.

Table 11. Significant effect of challenges to product sustainability

Influencing	Internal [p-value]	External [p-value]
Water quality examination	0.006*	0.822
Proper feeding amount and time	0.979	0.000*
Fish feed quality and availability management	0.186	0.166
Fish seed quality and availability management	0.957	0.000*

The results of the binary logistic regression analysis for internal and external challenges that influenced product sustainability shows that nine internal challenges had positive correlation with the activity of water quality examination, while seven external challenges were positively correlated with the activities of proper feeding amount and time, and fish seed quality and availability management.

There are nine internal and seven external challenges originate in this research. The nine internal challenges are identified as: poor financial management skills, low ability to handle fish diseases and parasites, poor water quality, low quality of fish feed, low quality of fish seed, poor quality control, lack of fish farming experience, lack of start up capital and lack of technical abilities. These internal challenges can be grouped into technical and managerial challenges. Coversely, the external challenges are: lack of family support, lack of potential market, lack of government support, lack of training provided by the government, lack of profit, low selling price and cannot secure a sufficient loan.

Technical challenges

Six technical constraints directly impacted product sustainability through the activity of water quality examination, namely :

a. low ability to handle fish diseases and parasites,
b. poor water quality,
c. low quality of fish feed,
d. low quality of fish seed,
e. poor quality control and
f. lack of technical abilities.

The combination of low quality fish feed, low quality fish seed, poor water quality and a low ability to handle fish disease and parasite were signs of a lack of sustainable aquaculture practices. The poor-quality control which also includes environmental quality control, also indicated the absence of sustainable fish farming practices.

Managerial constraints

Two managerial constraints influenced product sustainability through the activity of water quality examination, namely poor financial management skills and inability to secure sufficient loans. These managerial constraints had no direct impact on product sustainability. Nevertheless, they had significant indirect impact on product sustainability. Without access to sufficient loans and without adequate financial management skills already makes it difficult for small scale fish farmers to manage their fish farming businesses. Obtaining low sales prices and lacking profits could disturb business situation and make it even harder to implement sustainable fish farming.

Lack of family support

Family members were the closest people to fish farmers in their ability to influence how the fish farmers conduct their business. Without a supportive family, fish farmers may be discouraged in developing their businesses. This includes their ability to develop and implement sustainable aquaculture in order to achieve product sustainability.

In addition, many small-scale fish farmers received direct assistance from family members in running their businesses. Many family members help out in managing the fish ponds, which includes managing fish feed and fish seeds, and hence their direct assistance influenced product sustainability.

Lack of Potential Market

The lack of potential market had considerable influence on achieving product sustainability. Without fish markets, fish farmers were unable to sell their products. Fish products have limited shelf life and the longer it takes to sell the products, the greater the deterioration and decomposition of the fish which influenced the quality of environment.

Lack of support and training provided by the government

Government has the power to develop policies to support small scale fish farmers. As it pertains to the implementation of sustainable aquaculture practices by small scale fish farmers, the Indonesian government developed the Indonesian Fisheries Act No. 31 which requires that environmental sustainability practices be included in all fish farming practices. Small scale fish farmers were also dependent on the government to provide them with training on sustainable aquaculture and other subsidies.

Lack of fish farming experience and knowledge

Small scale fish farmers cannot implement sustainable aquaculture if they do not have sufficient experience and knowledge of the practices. Prior fish farming experience and knowledge was important in equipping fish farmers with technical and managerial skills needed in conducting sustainable aquaculture, practices such as how to prepare and manage their pond as well as how to combine fish in poly-culture system.

Lack of capital

Financial capital was an ongoing problem faced by small scale fish farmers. A lack of adequate funds makes it difficult for small scale fish farmers to run their business. This includes their ability to implement sustainable aquaculture as means to achieve product sustainability.

Lack of technical abilities

Lack of technical skills was a rising problem as some of these fish farmers did not receive adequate fish farming education. Some fish farmers started their fish farming business simply because they witnessed their neighbours or relatives successful in fish farming. They tried to copy the activities but they did not have proper knowledge to undertake this type of business. The catfish village in Boyolali region is a good example. Previously they started off with one successful fish farmer managing his pond that inspired his neighbor to follow suit by fortuitously being willing to share his fish farming secrets. Unfortunately, this situation is rare and competition often exceeded the willingness to share and help each other. A lack of technical abilities includes a lack of technical skills to implement sustainable aquaculture. Limited technical abilities in implementing sustainable aquaculture may result in failure to obtain product sustainability and even total fish harvest failure. This technical inability is incorporated in fish feed and fish seed management.

4. Conclusion

Internal challenges consisted of all the internal weaknesses of fish farmers that affected their income. On the other hand, external challenges arose as the result of uncontrollable negative support from people or institutions surrounding the fish farmers. Results showed that one product sustainability activity, which was water quality examination, was influenced by internal challenges. Also, two product sustainability activities, i.e. proper feeding amount and time, and fish seed quality and availability management, were found to be influenced by external challenges. This result indicates that in order to sustain products, small scale fish farmers need to encounter their internal and external challenges. Furthermore, considering that small scale fish farmers are still vulnerable in many aspects, government should therefore give full support for the small scale aquaculture industry.

It is also recommended that Indonesian government encourages small scale fish farmers to proactively implement sustainable aquaculture practice. The implementation of sustainable aquaculture has been developed as the vision and mission for aquaculture development in Indonesia. The vision was to “shape Indonesian aquaculture as a competitive and sustainable mainstay of economic growth”, and the third mission was to “develop an aquaculture sector which is responsible and environmentally friendly” (Nurdjana, 2006). The results of this research strongly support the government’s mission and vision for sustainable aquaculture development. The findings have shown that product sustainability was positively correlated with internal and external challenges. Therefore, future programs to encourage sustainable aquaculture implementation can be developed and based on the findings of this research.

To support the small scale fish farmers, it is also recommended that government should provide training and continuous monitoring of sustainable aquaculture in order to achieve product sustainability. Indonesia is still facing challenges in implementing sustainable aquaculture and therefore it is crucial for the government to provide trainings, continuous monitoring and support for the development of sustainable aquaculture. In order to achieve sustainable aquaculture the recommendation is for the Regional Fisheries and Marine Affairs Office to provide information on the importance of sustainable aquaculture implementation to fish farmers, provide training on the implementation of sustainable aquaculture in fish farmers’ businesses, perform continuous monitoring of fish farmers that carry out sustainable aquaculture and provide technical support for fish farmers that need assistance in implementing sustainable aquaculture.

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