

Original article

Where do risk in shrimp farming come from? Empirical result from small-scale farmers in East Java, Indonesia

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Introduction

Two factors that characterized of small-scale shrimp farming are high-risk and uncertainty. FAO [1] reported that risk in aquaculture is greater due to intensified transboundary movement of aquaculture products as part of increasing market liberalization. Nowadays, risk environment has been changing [2]. In aquaculture, production aspects such as diseases become the primary sources of risk during the last several years. The costs of diseases outbreak to the global aquaculture industry reached tens of billions of US\$ over the last 20 years [3]. Aquaculture also faces risks from other human activities such as contamination of waterways by agriculture and industrial activities [1]. Moreover, the shrimp industry alone has suffered losses around US\$ 10 billion since 1990, with new diseases appearing almost every year [4].

In exploring risk environment, there are several types of analysis of risk sources and their impact on farm level. One of these types is factor analysis. Factor analysis is an effective tool for examining the underlying structure of a relatively large set of risk sources and risk management strategies. The present study aimed to investigate the risk behavior of the small-scale shrimp farmers in East Java, Indonesia. This study is expected to provide essential information to policy makers that will further understand risk management in small-scale shrimp farming.

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 regencies were selected: (1) Banyuwangi Regency in the south, and (2) Lamongan Regency in the north. The sample included 79 and 87 shrimp farms in the south and north, respectively.

As the first step analysis, shrimp farmers' perception on sources of risk and risk management strategies were studied using descriptive statistical analysis. Afterward, the shrimp farmers' perception on

sources of risk and risk management strategies was analyzed using exploratory factor analysis. The variables that were highly correlated (represented by high loading factor, either positive or negative) are likely influenced by the same factor, vice versa. Moreover, the eigenvalues express the degree of variation among variables in each factor. As a guideline, the eigenvalue score > 1 was used to determine how many factors to extract [2,5-7].

Results

The total 32 risk sources were reduced into eight risk factors using varimax rotation factor. The factors 1 to 8 could be best denoted as (1) Input and pond preparation, (2) Finance and credit access (3) Production, (4) Personal, (5) Harvesting and marketing, (6) Weather and environment, (7) Policy and institutional, and (8) Business environment. These factors explained 73.1% of the total variance that was observed.

For the factor extracted, the result revealed that factor 1, namely 'input and pond preparation', explained 12.74% of the observed variation. Several risk sources, such as *low quality of shrimp fries, not enough formulated feed supply, and low quality of formulated shrimp feed*, were high loading factors among the risk sources in this group. Factor 2, 'finance and credit access', had a relatively high loading of *increasing formulated feed price and not enough capital to operating shrimp farms*. This finding showed that formulated feed price could have a major impact on shrimp farmers' income.

High mortality due to diseases, water pollution due to excessive formulated feed, and feeding management failure were loaded strongly on factor 3 of the 'production' risks. This factor explained 11.79% of the observed variation. The small-scale shrimp farmers are also affected by risks that were associated with 'personal' risk factor. This factor explained 11.41% of the observed variation. *Lack of knowledge to prevent shrimp diseases, lack of information about shrimp fries' origin, and lack of knowledge of pond preparation* were

the highest loading factor in personal risk. Majority, ‘harvesting and marketing’ risk in factor 5 was affected by *shrimp price volatility* and *shrimp size variability*. Harvesting and marketing risk sources were associated with an oversupply of shrimp in the market and inappropriate harvesting method.

The sixth factor, ‘weather and environment’ risk include *polluted brackish water source* and *flood*. This factor explained 6.24% of the observed variation. Furthermore, *change government policy* and *low level of awareness from the community about environmental protection* loaded strongly on factor 7 of the ‘policy and institutional’ risk. Last, ‘business environment’ risk on factor 8, which explained 4.94% of the observed variation, is associated with *asymmetric information between buyer and farmers*.

Moreover, the factor analysis with varimax rotation was applied to reduce many risk management strategies. Thus, nine factors loadings were obtained for risk management strategies in study areas. These nine factors explained 83.61% of the total cumulative variance. The factors 1 to 9 were identified as (1) Diseases prevention, (2) Education and technology improvement; (3) Input of production; (4) Farm management; (5) Government support; (6) Risk sharing and insurance; (7) Financial; (8) Household adjustment; and (9) Alternative income sources.

Factor 1, which was named ‘diseases prevention’, explained 17.33% of the observed variation. *Strictly managed water quality, strict feeding management, and partial harvest* were the top three strategies in this group. Factor 2 represented ‘education and technology improvement’ by *attending a workshop in shrimp farming* and *applying new technology in shrimp production*. These strategies were perceived as an effective strategy in small-scale shrimp farming in East Java to manage their risk. Factor 3 identified as ‘input of production’. This factor includes high loading of risk management strategies that were associated with management of input in shrimp farms, such as *only buy shrimp fries from the reliable place* and *buying formulated feed from reliable brands*. Factor 4 (farm management) comprised the strategies concerning the internal management of shrimp farms. High loading in this factor was: *applying better management practices, hire a technical assistant, enforcing the shrimp pond dike, and follow the government policy and regulation*.

Two risk management strategies, which are *request government support for technical assistance* and *request social assistance after the natural disaster*, were grouped into factor 5 (government support). Factor 6, ‘risk sharing and insurance’, includes high loading risk management strategies that were associated with the efforts of shrimp farmers to share with third parties. Seven strategies are listed in this factor. These strategies include *production contract, sharecropping, contract for farm inputs, informal marketing contract,*

vertical integration, and marketing contract with the wholesaler. Three strategies were grouped into factor 7, which is identified as ‘financial’ strategies. This group had high loadings for the items of *use informal loan, make credit arrangement before production cycle, and dissaving*. Factor 8 was named ‘household adjustment’ due to the dominant strategies for this factor which are *change consumption pattern* and *use family labor*, which explained 6% of the observed variation. Finally, two risk management strategies, such as *farm diversification* and *off-farm work*, were classified into factor 9 (alternative income sources).

Conclusions

The results found 32 sources of risk. Shrimp price volatility and high mortality due to shrimp diseases were the most important risk sources of small-scale shrimp farming in East Java, Indonesia. The result also showed that small-scale shrimp farmers’ have practiced 34 strategies to cope with the risk in their farms.

The exploratory factor analysis showed that the risks in small-scale shrimp farming derived from 8 factors. These factors explained 73.1% of the observed variation. Furthermore, nine factors sorted for risk management strategies which included diseases prevention; education and technology improvement; the input of production; farm management; government support; risk sharing and insurance; financial; household adjustment; and alternative income sources. To conclude, identifying such risk sources and risk management strategies could contribute to a better understanding of the nature of risk and uncertainty in small-scale shrimp farming. This could be followed by suggesting effective strategies manage the risk at the farm level.

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