Prospective Strategy for the Development of Grouper Fish (*Ephinepelus spp*) Aquaculture in Sub-district of Brondong, Lamongan Regency

Agung Pamuji Rahayu*, Mohammad Fadjar, Muhammad Musa

Faculty of Fisheries and Marine Sciences, Universitas Brawijaya, Jl. Veteran, Malang 65145, Jawa Timur Province, Indonesia

Abstract : One of prominent farming activities in coastal areas in Lamongan, East Java, is grouper fish (*Epinephelus spp*) aquaculture. The grouper fish aquaculture activities mostly employ simple technology, but this has been experiencing some problems such as several diseases, limited-yielding of superior seeds, limited trash fish feeds, and limited to the decrease the carrying capacity of the land. There should be maximum efforts to support the potential of grouper fish aquaculture rationally and sustainably. The objective of this research was to determine the carrying capacity of the land for the grouper fish aquaculture in the fishponds and formulate strategies for the development of grouper fish aquaculture in Sub-district of Brondong in Lamongan based on some scenarios that may occur in the future. The weighting and prospective analysis method was employed in this study. According to the land carrying capacity analysis showed that the grouper fish aquaculture in the Labuhan Village, Sub-district of Brondong, was categorized into moderate to high of land carrying capacity with the limiting factors of fishpond including high value of water pH ranging from 9.8 ± 8.2, Ammonia >0.1 ppm, BOD 5.41 ± 3.71, and $33.2 \pm 5.69\%$ for land organic substances. Results of prospective analysis, optimistic scenario is determined for the development of grouper fish aquaculture in the regional fishponds completed with facilities and infrastructure which can support the farming activities, improve the technology for the aquaculture, improve the marketing results of the operations, increase the counseling activities, increase human resources (HR), increase business capital, improve business management and increase business competiveness.

Keywords : Grouper Fish, Land Carrying Capacity, Development Strategy.

Introduction

Lamongan Regency has an area of approximately 1,812.80 km^2, equivalent of 181,280 hectares, or $\pm$ 3.78% of total area of Province of East Java Province with the length of the coastline of 47 Km. Lamongan is strategic area including as the center for aquaculture and capturing fisheries production in Province of East Java. The land area for fish farming in Lamongan in 2011 amounted to 25,313 hectares, in specific for the development of fisheries aquaculture (aquatic brackish water fishponds) with total area of approximately 1,745.4 hectares[1]. The aquaculture area in the form of fishpond is stretched in the coastline area which is divided into two areas namely Sub-District of Paciran and Brondong. One of prominent fish farming activities in the Sub-District Brondong is grouper fish aquaculture in the fishponds, which specifically develop grouper fish hybrids namely Beautiful Grouper hybridized between female tiger grouper (*Epinephelus fuscoguttatus*) and batik grouper (*Epinephelus Microdon*); another grouper fish hybrid *Cantang Grouper* hybridized between

female tiger groupers and male giant grouper (*Epinephelus lanceolatus*)[2] and mud grouper fish (*Epinephelus coioides*).

Mostly, grouper fish aquaculture activities have employed simple technology, and there have been several problems ranging from several cases of the diseases, limited-yielding seeds, limited trash fish feeds to the decrease the carrying capacity of the land. There should be rational and sustainable strategies to maximize the potential of grouper fish aquaculture. The development of grouper fish aquaculture in Lamongan is needed, and the formulation of development strategies is formulated based on scenarios that may occur in the future (prospective strategic).

Materials and Method

The study was conducted from June to August 2016 in the grouper fish aquaculture area in Labuhan village, Sub-district of Brondong, Lamongan. The analysis of water quality was conducted at the Mobile Laboratory of Environmental and Fish Health, Department of Fisheries and Marine Sources, Lamongan. The analysis of soil quality was conducted at the Laboratory of Soil Physics and Chemistry, Faculty of Agriculture, University of Brawijaya and Research Institute for Crops, Beans and Tubers (Balitkabi) Malang.

Some tools and equipment used in this research to find the prospective strategy of development of grouper fish aquaculture in Sub-district Brondong, Lamongan, were one water quality measurement tool (DO meter; pH pen; refract meter; *sechi disc*, and spectrophotometer); soil quality (soil tester) and questionnaires for the informants. The data processing in this study was performed through Microsoft Excel and Microsoft Excel-based Prospective Software. The materials used were primary data obtained from interviews and test results of laboratory or field testing (water and soil quality) and secondary data obtained from the literature review and data on the relevant departments.

This research was conducted through the systematic, logical and structured stages, consisting of two phases, namely:

1. Analysis of carrying capacity of the fishpond for grouper fish
2. Prospective Analysis for the strategy to develop grouper fish aquaculture

Analysis of carrying capacity of the land with through weighing system refers to the adapted idea by Poernomo[3], that the carrying capacity of the environment is the value of the quality of the environment posed by the interaction of all elements or components in the ecosystem. The method for carrying capacity analysis of the environment is actually a quantification of land suitability classes by way of assigning weights to the land suitability classes. The value of weighting qualities / characteristics of the land is between 1 and 3; that land with high suitability class is given the highest weight of 3, moderate suitability classes of 2, and low land suitability classes were weighted 1. From the simulation data to know the carrying capacity of the fishpond environment, it was obtained a range of values as follows:

1. Score 0-39 = Low carrying capacity
2. Score 40-79= Moderate carrying capacity
3. Score 80-100= High carrying capacity

Prospective analysis can be used to predict the possibilities that may occur in the future[4]. This prospective analysis is not the same as the forecast as the results of the prospective analysis can be used to determine the unpredictable alternatives that may occur in the future, both positive (desirable) or negative (undesirable) alternatives.

According to Hardjomidjojo[4], the stages for prospective analysis in this study are as follows:

1. Determining the objective of the system that will be examined
2. Identifying the influential factors
3. Assessing the direct influence among the factors
4. Listing the conditions (states) that may happen to the factors
5. Generating and choosing the scenario

6.   Analyzing the scenario and arranging strategies.

Table 1 . Guideline for Assessing Prospective Analysis

No.	Score	Influence
1.	0	Not influential
2.	1	Small influence
3.	2	Moderate influence
4.	3	Strong influence

Source: Hardjomidjojo (2002)

      The results of combined matrix from the opinion then were processed by using prospective analysis software. The calculation result is visualized or illustrated in the diagram of influence and interdependence of the factors as in Figure 1.
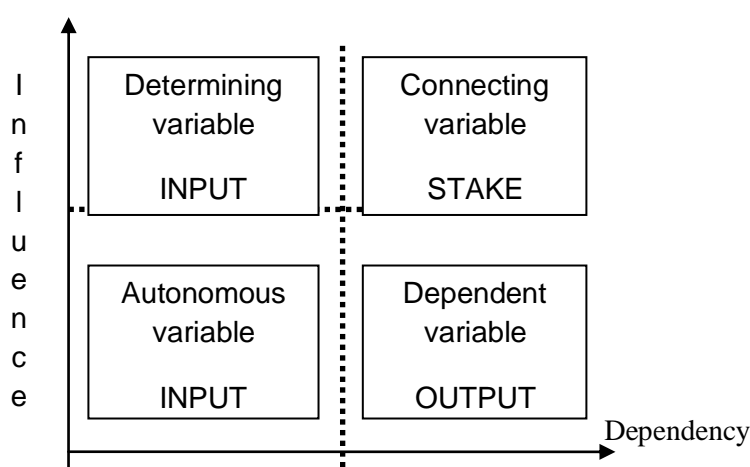

Figure 1. Diagram of the influence and dependency of the system

Findings and Discussion

Carrying Capacity of Grouper Fish Aquaculture in the Fishponds in Sub-district of Brondong

      The results of calculation of carrying capacity of the land classes of grouper fish aquaculture ponds in Labuhan village, Sub-district Brondong, Lamongan generally indicated the carrying capacity of the land was classified as moderate to high class. The limiting factor for the quality of the soil was organic substances in which the range of values of 33.2 ± 5.69%. Soil organic substances are typical to the fishponds content. Soil organic substances that can be tolerated by grouper fishes are 5 to 10%[5]. Such efforts should be taken to overcome the high soil organic substances by doing the drying the ponds and bottom land reversal of the ponds during land preparation, which may result in the oxidation process. In addition, the inhibiting factor of water quality includes pH of the water, that the range of pH values obtained at each observation station was 8.2 ± 9.8. From the results of measurement of ammonia at each station research showed that the value of ammonia ranged between 0.155 ± <0.05 ppm, this means that the value of ammonia is still in the stage that can be tolerable for the groupers in ponds. He also stated (1992) that the ammonia tolerance limits for aquaculture is 0-0.25 ppm, of which the ammonia is safe and tolerable for grouper aquaculture in fishponds which is less than 0.01 ppm[5]. The results of the analysis of water quality at observation stations showed that the pond water had BOD value of 5.41 ± 3.71 ppm. In order to minimize the content of BOD, such method should be done such as by circulating the water mill (aeration) as an enhancer of dissolved oxygen in the water. Alternatively, i reclamation or basic soil tillage and longer drying through the process of oxidation can also be done to minimize the BOD.

Prospective Analysis of Developing Grouper Fish Aquaculture in Fishponds Sub-district of Brondong
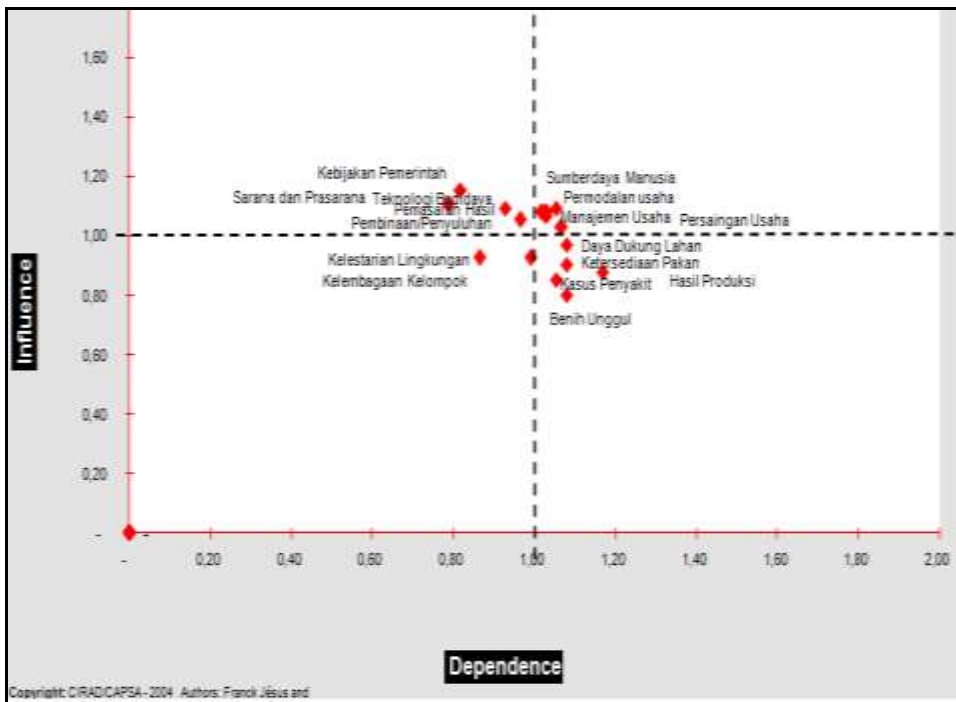
Figure 2. Factors Affecting the Grouper Fish Aquaculture in Fishponds

The results of analysis of influence among the factors that may influence the development of groupers aquaculture activities in fishponds in Sub-District Brondong were based on stakeholder analysis is presented in graphical form in the cross axis Kartesien[6,7] and can be seen in Figure 1.

Determinant variable (input) in the first quadrant consists of governmental policy factors, aquaculture facilities and infrastructure, marketing the cultivation, the use of technology for the cultivation and guidance or counseling from relevant agencies. These five factors have strong influence on the development of grouper fish aquaculture in fishponds. These factors are not overly influenced by other factors in the system (independent variables). The results suggest that in order to develop the activities of grouper fish aquaculture in fishponds in the area, the five factors should be very carefully calculated and concerned anytime actions take place. The government's policy is one factor related to the development of grouper fish aquaculture in fishponds which by nature cannot be controlled internally (uncontrollable factor). Therefore, the other main factors that may affect dominantly the development of grouper fish in fishponds and can be controlled internally are the facilities and infrastructure of the aquaculture and fishponds, marketing the cultivation, the use of cultivation technology, and guidance or counseling from relevant agencies. These four factors need to be improved as they will affect each other related to the development of the grouper fish aquaculture.

As for the stake variables (linking variables) are located in quadrant II, covering human resources, venture capital, business management and business competition. The variables besides have a very strong influence in the system, these four factors as determinants are dependent each other on the system. The variables located in quadrant I and quadrant II are key variables that are the most influential in the development of grouper fish aquaculture in fishponds. The variables categorized into the dependent variable are in quadrant III, namely the carrying capacity of the land, availability of food, products, cases of diseases and superior seeds. Variables in quadrant IV include environmental sustainability and institutional variables as autonomous variable groups. The development of grouper fish aquaculture in the fishpond in the area is actually not directly related to the environmental sustainability and institutional groups.

Listing Development Scenario

The development scenario is listed based on the key factors that influence the development of grouper fish aquaculture in the fishponds. Based on these key factors further, they will be described on various circumstances (states) which will probably happen in the future.

Table 2. Mapping the States of the Determinant Factors of the Development Grouper Fish Aquaculture in Sub-district Brondong, Lamongan Regency

No.	Factors	Conditions (states)		
		1A	1B	1C
1.	Government policy	Becoming more positive (developed) area for grouper fish aquaculture region	Static as low enforcement and it may inhibits the establishment of grouper fish aquaculture region	
		2A	2B	2C
2.	Facilities and infrastructures of grouper aquaculture	Increasing more with the support of facilities and infrastructure for the aquaculture activities	Stagnant as the facilities and infrastructures are not available nor well-supported	
		3A	3B	3C
3.	Cultivation technology	Become more advanced as the impact of the introduction and implementation of the newest technology to support the cultivation activities	Tend to be stagnant or slowed down in line with the capital and supervision or guidance	
		4A	4B	4C
4.	Marketing the cultivation	It is better as the demand is bigger even for export; it is better as support from the government as well	Fair increase along with the access provision for export market	Tend to decline because the limited consumption of grouper fish in importing countries
		5A	5B	5C
5.	Guidance and counseling	Guidance and counseling are more intensive with the addition of the personnel or the number of counselors and supervision from the related agencies	It is stagnant in line with the limited number of supervisors and counselors from related agencies	
		6A	6B	6C

6.	Human resources	The quality is better supported with more productive and qualified human resources	Stagnant as the productivity level is static and there are not any update changes	Declining as the land is converted into industrial area
		7A	7B	7C
7.	Business capital	It is higher as the results of better and more efficient financial management	It is fair increase in line with the number of demand from local and foreign market	Fluctuated as cash-flow is directly influenced by the price of commodity
		8A	8B	8C
8.	Business management	It is better with the increase of productivity, profit, and growing business	Stagnant like in the past the number of productivity is stagnant and there is no significant increase	Declining as the management is not efficient
		9A	9B	9C
9.	Business competitiveness	It is more competitive as supported with facilities and infrastructure, and also with better quality of productivity	Stagnant as the limited supporting facilities and infrastructure of cultivation to the productivity	Decline as the limited number of productivity of grouper fish

Scenario for the development of grouper fish aquaculture based on the stakeholder analysis is as follows:

Table 3. Scenario for development of grouper fish aquaculture in the fishponds in Sub-district of Brondong, Lamongan Regency

No.	Scenario	Conditions / States	Ranks
1.	Optimistic	1A-2A-3A-4A-5A-6A-7A-8A-9A	I
2.	Pessimistic	1B-2B-3B-4C-5B-6C-7C-8C-9C	III
3.	Moderate	1A-2A-3A-4B/C-5A-6B/C-7B/C-8B/C-9B/C	II

The optimistic scenario was determined for the development of grouper fish aquaculture area (scenario 1). This scenario is based on the condition of the existence of synergy between local government policy and internal capabilities of the grouper fish aquaculture region. The optimistic scenario for the development grouper fish aquaculture is through more complete facilities and infrastructures to support the farming activities (2A), the increased use of technology for the cultivation a result of the introduction of newest technology in the grouper fish aquaculture activities (3A), the increasing marketing of cultivation through the operation access for high number export demand and it is supported with government participation (4A), supervising or counseling activities are intensified with the increase in personnel and number of supervisors from the relevant agencies (5A), human resources (HR) increased and supported with more qualified and productive personnel (6A),

business capital is increasing as the impact of increasingly efficient financing management (7A), business management is getting better by increasing the amount of production, profit and growing businesses (8A), business competitiveness is getting higher as supported by infrastructure and better production quality (9A).

The pessimistic scenario (scenario 2) would occur if the facilities and infrastructures for the aquaculture remain as yet provided (2B), the use of technology for the cultivation activities tends to be slowly and stagnant in accordance with the capital and the intensity of mentoring / supervision (3B), marketing the aquaculture tends to decrease because of restrictions on the consumption of grouper fish in some country importers (4C), supervising or counseling remains as limited number from the relevant agencies (5B), human resource has declined due to the impact converting the fish farming land into industrial areas (6C), Capital venture is unpredictable (fluctuated) because the cash flow is strongly influenced by the price of commodity (7C), business management declined because it is managed inefficiently (8C), business competitiveness declined due to reduced productivity of grouper fish (9C). The pessimistic scenario is a scenario that is not expected to happen, so it needs likely to be avoided. Moderate scenario (Scenario 3) is motivated by the circumstances in which although internally management capability of grouper fish aquaculture in the future still has not shown any significant changes towards improvement, as it happens in scenario 2; the future government policy will be more conducive to developing the area of fish farming including the grouper fish which are able to develop and remain intense in the future.

Based on the listed scenario, for the development of grouper fish aquaculture in the future, the scenario 1 should be chosen and as the main concern, which is an optimistic scenario. The optimistic scenario should be implemented for the regional development of grouper fish aquaculture, therefore grouper fish farmers need to encourage this optimistic scenario may occur in the future.

a.   Operational Recommendations

Operational recommendations for the development of grouper fish aquaculture in the fishpond area in the Sub-District of Brondong, Lamongan Regency, are arranged based on the chosen scenario, the optimistic scenario. The optimistic scenario should be enforced in order to develop the grouper fish aquaculture happen in the region, namely by improving the internal factors, especially the factors which influence the development of the aquaculture area namely the government policies, infrastructure to support the cultivation activities, technology related to cultivation process, marketing for the cultivation results, supervision or counseling, human resources (HR), business capital, business management, and business competitiveness.

The operational recommendations for the chosen strategy is that the local government as the stakeholder is required to enact a policy that is conducive to realizing the cultivated area for grouper fish and operationally conduct monitoring and evaluation to the internal factors.

Conclusions and Suggestions

Based on the prospective analysis for the development of grouper fish aquaculture in in the fishponds in the area, there are some conclusions as follows:

1.   The analysis of carrying capacity of the land showed that grouper fish aquaculture in Labuhan village, Sub-District of Brondong, was included in medium to high category in terms of the carrying capacity. The limiting factor for the carrying capacity of the ponds include high value of water pH in the range of 8.2 $\pm$ 9.8; Ammonia > 0.1 ppm, BOD 3.71 $\pm$ 5.41 ppm and soil organic substances of 5.69 $\pm$ 33.2.
2.   The results of the prospective analysis suggested that the optimistic scenario should become the strategy for the development of grouper fish aquaculture in the regional fishponds in Sub-district Brondong, Lamongan Regency.

Based on the conclusions, the following are suggestions:

1.   There should be alternative solution for the existing problems as well as some of the limiting factors such as water pH, Ammonia, BOD and soil organic substances for the grouper fish aquaculture in the fishponds. Such intensification is needed for the grouper fish aquaculture in the fishponds through improved farming technology.

2. There should be further studies on the development of grouper fish aquaculture in the coastal area and marine areas in Lamongan Regency for the conservation and protection and supported by the policies.

References

1. Department of Fisheries and Marine Resources. Data Potensi Perikanan Budidaya Kabupaten Lamongan. 2014. Laporan Tahunan 2014.
2. Ismi, S., Y.N. Asih. Pengamatan perkembangan benih kerapu hybrid persilangan antara kerapu macan (*Epinephelus fuscoguttatus*), kertang (*Epinephelus lanceolatus*). 2011. Prosiding Seminar Nasional Kelautan VII. Universitas Hang Tuah. Surabaya.
3. Poernomo, A. Pemilihan Lokasi Tambak Udang Berwawasan Lingkungan. Seri Pengembangan Hasil Penelitian No. PHP/KAN/PATEK/004/1992. 1992. Badan Penelitian dan Pengembangan Pertanian, Pusat Penelitian dan Pengembangan Perikanan bekerjasama dengan USAID/FRDP. Jakarta.
4. Hardjomidjojo, H. Metode Analisis Prospektif. 2002. Departemen Teknologi Industri Pertanian Fakultas Teknologi Pertanian. Bogor.
5. Supratno, K.P.T., Kasnadi. Peluang usaha Budidaya Alternatif dengan Pembesaran Kerapu di Tambak Melalui Sistem Modular. 2003. Pelatihan Budidaya Udang Windu Sistem Tertutup bagi Petani Kab. Tegal dan Jepara- Jateng di BBPBAP. Jepara.
6. Bourgeois, R. Expert Meeting Methodology for Prospective Analysis. 2002. CIRAD Amis Ecopol.
7. Hartrisari, H. Bahan Kuliah Anlisis Sistem dan Permodelan dalam Pengelolaan Sumberdaya Pesisir dan Lautan (unpublished). 2002. Program Pascasarjana SPL-IPB. Bogor.

*****