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Strategy of blood cockle aquaculture development for conservation and welfare in Sub-district of Central Kupang, West Timor, Indonesia

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Abstract

Blood cockle (*Anadara granosa*) is the one commodity that has driven the economy of coastal communities in Sub-District of Central Kupang, West Timor, Indonesia. Uncontrolled fishing activities have led to over-fishing of blood cockle, which have degraded its conservation and livelihood of coastal communities. Conservation efforts should be done to conserve blood cockle resources and improve the income of fishermen. Potential management strategies for conservation are through development of blood cockle aquaculture business. This study aims were determine the type of strategy and formulate alternative strategies to blood cockle aquaculture development for conservation and welfare. This study has applied survey method with population are the blood cockle fishermen community. Data collection was done by observations, deep interviews and focus group discussions (FGD), while data analysis has been used SWOT (strengths, weaknesses, opportunities, and threats) analysis. Results of SWOT analysis recommended the aggressive strategy type. Alternative strategies that support the aggressive strategy are development of blood cockle aquaculture business integrated with its fishery business; development of blood cockle aquaculture with participatory approaches; and building partnerships for development of blood cockle aquaculture.

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Introduction

Blood cockle (*Anadara granosa* L.) is the one of fishery commodity in Indonesia, which is the income source of partly coastal communities since 1979. Production of Indonesia blood cockles in the last decade has achieved the highest production volume of 47,437 tons in 2007, then dropped to 31,163 tons in 2008 and increased to 43,177 tons in 2012 (Ministry of Maritime Affairs and Fisheries-Indonesia, 2015). One area with major producing blood cockle in Indonesia is Sub-District of Central Kupang, West Timor. Blood cockle production in this area continued to decline in the last decade. Drastic decline in the production of blood cockles occurred in 2013 for 0.79 tons, or down 75.16% (Fig. 1) from production in 2010 (Statistics Central Bureau of Kupang Regency, 2014). Decreased production of blood cockles has also led to exploitation of blood cockle juveniles that threaten the sustainability of blood cockle resources in the area. Preliminary study found the composition of blood cockle juveniles in the catch reaches 48%.

Sustainable management strategy needs to be designed to rehabilitate blood cockle resources in Sub-District of Central Kupang. The strategy should be able to support the conservation of blood cockle resources and providing economic benefits for fishermen, thus it will able to encourage the participation of fishermen. Management strategies that ignore the economic aspects of fishermen community, such as catch size restrictions or limitations catchment blood cockles, is often resisted or ignored, because they are more concerned with short-term economic benefits or necessities demand of daily needs. Consequently, sustainable management strategies proposed in this study is the development of blood cockle aquaculture (rearing) for restocking of blood cockle population and providing economic benefits for fishermen.

Blood cockle aquaculture is beneficial for rearing blood cockle juveniles, which was caught by fishermen, thereby allowing blood cockle breed in the wild before it is marketed. Since the blood cockle

juveniles reared until it reach market size (>3.2 cm), it is certain that the blood cockles have spawned more than once, because the first spawning of male occurs in size 24.6 mm and female 24.3 mm (Gimin *et al.*, 2014). Thus aquaculture of blood cockle can provide an opportunity for regeneration of blood cockles in wild for restocking blood cockle population; in addition the fishermen community will obtain economic advantage both of catching and aquaculture production. This study was conducted to determine the type of strategy and formulate alternative strategies to develop bloodcockle aquaculture for conservation and welfare.

Materials and methods

Study site and data collection

The research located in Sub-District of Central Kupang, Kupang Regency, East Nusa Tenggara Province, Indonesia, it conducted from September to December 2014. The respondents are blood cockle fishermen communities who live in Sub-District of Central Kupang. Total population is 49 fishermen, while the number of fishermen involved as respondents was 35 fishermen. Purposive sampling method was used for data collection.

SWOT, IFE and EFE analysis

This study has been initiated with the identification of internal and external factors related to the development of blood cockle aquaculture for the conservation and welfare. The identification was done using the method of observation and focus group discussions. Internal and external factors which have been identified analyzed using the SWOT matrix. These factors were grouped according to its character, i.e. strengths, weaknesses, opportunities and threats.

The next step was an internal factor evaluation (IFE) and external factor evaluation (EFE), each using a matrix of IFE and EFE (David, 2012). Both of evaluations were begun by collecting perception data of weight and rating of each factor, which is obtained from respondents through deep interviews with a guide questionnaire. Total score of weighted obtained

from IFE and EFE matrix matched to strategy matrix. The matching total score of SWOT factors will lead to point position in quadrants of strategy matrix, which indicates type of strategy to the development of blood cockle aquaculture for conservation and welfare (Fig. 2). SWOT analysis was performed using software of Microsoft office excel 2013. According to Rangkuti (2011) interpretations of the quadrant position in matrix strategy are:

Quadrant I (aggressive strategy): Condition is very favorable for development of blood cockle aquaculture. Fishermen have an opportunity and strength that can be utilized in the management. Direction of management strategy is a strategy that supports aggressive growth (growth-oriented strategy).

Quadrant II (diversification strategy): There is a threat, but fishermen have strength to overcome the threat. Direction of management strategy is a strategy that supports the improvement of competitiveness.

Quadrant III (turnaround strategy): There is opportunity, but fishermen have a weakness. Direction of management strategy is a strategy that overcomes the weakness to seize the opportunity.

Quadrant IV (defensive strategy): The condition is very unfavorable; fishermen have weakness and at the same time face threat. Direction of management strategy is a defensive strategy to minimize the weakness while avoiding threat.

SWOT matrix

The next step is building of alternative strategies using SWOT matrix, that conducted by researchers together with the fishermen by focus group discussions. SWOT matrix has four different combinations of strategies, namely strategies of SO (strength-opportunity), WO (Weakness-opportunity), ST (strength-threat) and WT (Weakness-threat) (Table 1). This strategy combination is synergies with the type of strategy in the strategy matrix, i.e. SO

strategy synergic with the aggressive strategy; WO strategy synergic with the turnaround strategy; ST strategy synergic with the diversification strategy; and WT strategy synergistically with the defensive strategy. According to Rangkuti (2011) interpretations of four combinations of these strategies are:

SO Strategy: This strategy utilizes the strength factors to seize opportunity factors. This strategy was chosen in the event of dominance of strength and opportunity factors.

WO Strategy: This strategy utilizes the opportunity factors to overcome the weakness factors. This strategy was chosen in the event of dominance of opportunity and weakness factors.

ST Strategy: This strategy utilizes the strength factor to overcome the threats. This strategy was chosen in case the dominance of strength and threat factors.

WT Strategy: This strategy minimizes the weakness factors while avoiding the threat factors. This strategy was chosen in the event of the dominance of weakness and threat factors.

Results

Identification of internal and external factors

Internal and external factors have been identified using the methods of observation and focus group discussion. Internal factors were grouped in component strength and weakness, while external factors are grouped into opportunity and threat components. Strength component consists of seven factors, while weakness component consists of six factors (Table 2). Otherwise, opportunity component consists of six factors, and threat component consists of five factors (Table 3).

Internal and external factor evaluation

Data of respondent perception on the internal and external factors is input for evaluation. The evaluation was done using a matrix of IFE and EFE. These

matrices provide important information for building and choosing strategies effectively (David, 2012). The result of the evaluation of internal factors indicate

that the main factor of strength affecting the strategy was the suitability of intertidal waters for blood cockle aquaculture with a score of 0.2792.

Table 1. SWOTmatrix.

	Internal Strengths (S)	Weaknesses (W)
External Opportunities (O)	SO: Strategies that use strengths to maximize opportunities	WO: Strategies that minimize weaknesses by taking advantage of opportunities
Threats (T)	ST: Strategies that use strengths to minimize threats	WT: Strategies that minimize weaknesses and avoid threats

Adapted from Rangkuti (2011).

Table 2. Internal factors in blood cockle aquaculture development.

No	Internal Components	
	Strength Factors	Weakness Factors
1	Suitability of intertidal waters for blood cockle aquaculture	There has been no effort to empower fishermen
2	Infrastructure for blood cockle aquaculture is available in local market	Fishermen is less innovative
3	Technique of blood cockle aquaculture is easy and inexpensive	Fishermen have not had experience in blood cockle aquaculture
4	Local labor is available	There are no participatory planning in management of blood cockles
5	Motivation to conduct sustainable management	Role of fishermen in sustainable management is still less
6	Motivation to improve income and welfare	There are no formal institution for fishermen
7	Support of public infrastructure	

Table 3. External factors in blood cockle aquaculture development.

No	External Components	
	Opportunity Factors	Threat Factors
1	Product requirements is convenient	Blood cockle fishing is not selective
2	Local market demand is still widespread	Decreased of natural blood cockle production
3	Access to information and technology	Conflicts of land use for blood cockle aquaculture
4	Support of government policy	Living cost is high
5	Employment recruitment	Degradation of coastal ecosystems
6	Motivation to increase local-generated revenue	

The main factor of weakness that influences the strategy was no participatory planning in the management of blood cockles, with a score of 0.2394 (Table 4). Otherwise, the result of the evaluation on external factors indicate that major factor of opportunity affecting the strategy was motivation to increase local-generated revenue, with a score of 0.3338. The main factor of threat that influences the strategy was decreased of blood cockle production in the wild, with a score of 0.2922 (Table 5).

Strategy for blood cockle aquaculture development

Matrix of strategy was used to determine the type of strategy for blood cockle aquaculture development. Inputs in the positioning strategy in the matrix were the total score of IFE 0.75 and EFE 0.65 (Fig. 3).

Quadrants position in the matrix strategy determines the type of strategy that are important for building of alternative strategies (David, 2012).

Table 4. Internal factor evaluation for blood cockle aquaculture development.

Components	Indikator	Weight	Rating	Score
Strength	Suitability of intertidal waters for blood cockle aquaculture	0.0814	3.4286	0.2792
	Infrastructure for blood cockle aquaculture is available in local market	0.0857	3.1143	0.2669
	Technique of blood cockle aquaculture is easy and inexpensive	0.0881	3.1429	0.2768
	Local labor is available	0.0821	3.2000	0.2626
	Motivation to sustainable management	0.0793	3.2286	0.2559
	Motivation to improve the incomes and welfare	0.0883	3.1429	0.2774
	Support of public infrastructure	0.0815	3.1714	0.2583
	Weakness	There has been no effort to empower fishermen	0.0630	2.6571
Fishermen less innovative		0.0670	2.7143	-0.1819
Fishermen have not had experience blood cockle aquaculture		0.0616	2.4000	-0.1478
There are no participatory planning in management of blood cockles		0.0838	2.8571	-0.2394
role of fishermen in sustainable management is still less		0.0715	3.0000	-0.2145
There are no institutional of fishermen		0.0668	2.6000	-0.1737
Total (X)				0.7523

Table 5. External factor evaluation for blood cockle aquaculture development.

Components	Indikator	Weight	Rating	Score
Opportunity	Product requirements is convenient	0.0954	3.1714	0.3024
	Local market demand is still widespread	0.0983	3.3143	0.3257
	Access to information and technology	0.0972	2.9714	0.2889
	Support of government policy	0.0885	2.9429	0.2604
	Employment recruitment	0.1026	3.1143	0.3194
	Motivation to increase local-generated revenue	0.1007	3.3143	0.3338
Threat	Blood cockle fishing is not selective	0.0785	2.5714	-0.2019
	Decreased of natural blood cockle production	0.0938	3.1143	-0.2922
	Conflicts of land use for blood cockle aquaculture	0.0807	2.6000	-0.2098
	Living cost is high	0.0806	2.6857	-0.2165
	Degradation of coastal ecosystems	0.0838	3.0571	-0.2562
Total (Y)				0.6541

The result of strategy matrix analysis indicates that the position of the strategy for the development of blood cockle aquaculture was located in the first quadrant (Fig. 3), so a type of strategy suitable implemented was aggressive strategy, namely strategies supporting aggressive growth (growth-oriented strategy).

This was a favorable condition because the fishermen community have the opportunities and strengths supporting the strategy of blood cockle aquaculture development (Rangkuti, 2011).

Building of strategies has been done by focus group discussions using SWOT matrix, and it has produced a number of alternative strategies of SO, WO, ST, and WT (Table 6).

Therefore SO strategy synergistically with the aggressive strategy, so the alternative strategies chosen, i.e. development of blood cockle aquaculture business integrated with its fishery business; development of blood cockle aquaculture with participatory approaches; and building partnerships for development of blood cockle aquaculture.

Table 6. Building Strategies in SWOT matrix.

		Internal	Strengths (S)	Weaknesses (W)
		External		
Opportunities (O)		SO strategies:		WO strategies:
		<ol style="list-style-type: none"> 1. Development of blood cockle aquaculture business integrated with its fishery business. 2. Development of cockle aquaculture blood with a participatory approach. 3. Building partnerships for the development of cockle aquaculture blood. 		<ol style="list-style-type: none"> 1. Development of blood cockle fishermen Institutional. 2. Empowerment of blood cockle fishermen. 3. Educating fishermen about cockle development of cockle aquaculture blood.
Threats (T)		ST strategies:		WT strategies:
		<ol style="list-style-type: none"> 1. The establishment of regulations preventing the exploitation of blood cockle juveniles. 2. Determination of zonation for the blood cockles sustainable management. 3. Increased awareness and role of fishermen in the conservation of blood cockles. 		<ol style="list-style-type: none"> 1. Education on fishing on the sustainable management of coastal resources. 2. Implementation of laws and regulations in the sustainable management of coastal resources. 3. Improved coordination among stakeholders in the sustainable management of coastal resources.

Discussion

Development of blood cockle aquaculture business integrated with its fishery business is one of strategy more adaptive and effective for fishermen. Aquaculture blood cockle is beneficial for rearing the catches of juvenile blood cockle until reach market size, thus it will provide opportunities to a large amount of blood cockles spawning in the wild. Rao and Somayajulu (2006) state that blood cockle market size is 3.2 to 4.0 cm. Thus the blood cockles

reached the market size predicted have been spawned in the wild more than once, because according to Giminet *al.* (2014) first spawning of blood cockles occurs in a size of 24.6 mm in male and 24.3 mm in females, in Sub-District of Central Kupang. Implementation of this strategy is useful for restocking blood cockles and simultaneously increase revenue obtained from the production of fishery and aquaculture.

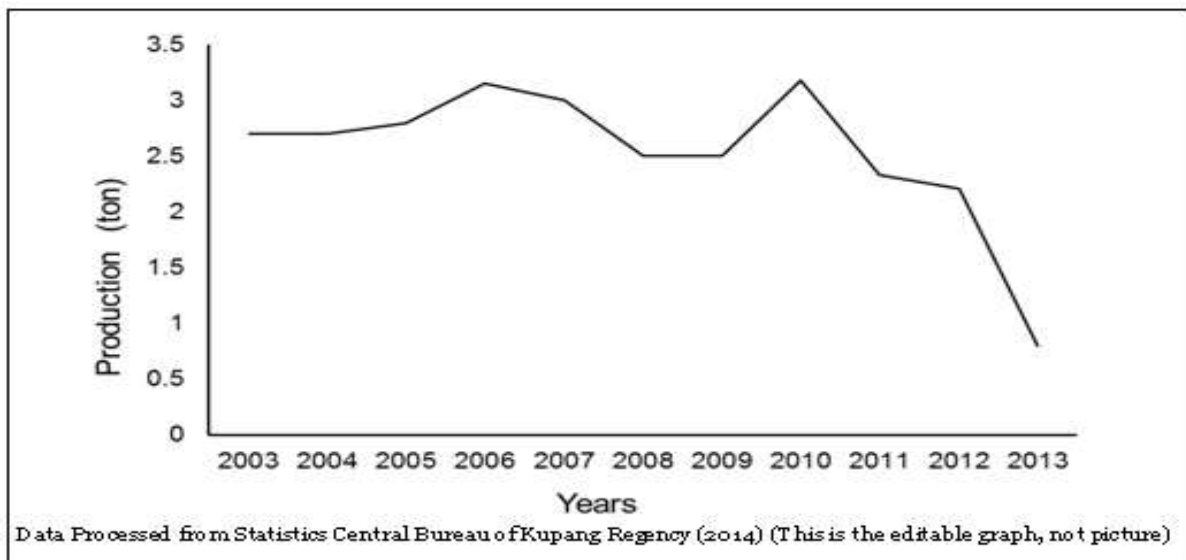


Fig. 1. Trend of blood cockle production in Sub-District of Central Kupang.

Sustainable management of fisheries resources devoted to the conservation of fisheries resources, so it can be used in a sustainable manner as the livelihood of fishermen community to improve their economic and social welfare (Murdiyanto, 2004). Management of fisheries resources must consider the balance between the welfare of fishermen community

to the conservation of ecosystems (Mussadunet *al.*, 2011). Implementation of conservation that benefit for community livelihood is an adaptive approach that can accommodate the interests of the community and cooperation among stakeholders (Frey and Berkes, 2014).



Fig. 2. Matrix of Strategy.

Development of blood cockle sustainable management with a participatory approach is a strategy consistent with the concept of sustainability. A sustainable development must prioritize elements of participation in society. Participatory development can foster a sense of belonging and positive motivation on fishermen community. Mallawaet *al.*(2006) states that ecological concerns can be achieved through participatory activities in planning and implementation of the management of fisheries resources. The involvement of fishermen community is vital for success of the sustainable management of fisheries resources.

A development strategy that is positioning community as objects is cause of lack of active participation of fishermen community in managing their potency and environment (Retnowati, 2011). Community participation is a complex process and pose challenges for all involved. However, participatory initiatives also generate benefits, i.e.

cutting apathy and psychological burden of society, community development, and dissemination of information (Chifamb, 2013). Community participation can be optimized if people understand and feel the benefit of the development program for improvement of their welfare (Syahra, 2012).

Partnership development is a strategy that can improve the ability of fishermen in sustainable management of blood cockles. Soselisa (2006) states that an integrated partnership and mutual benefit with various stakeholders such as local government, finance institutions, employers, educational institutions and non-governmental organizations may provide reinforcement to the fishermen community for better capitalization, marketing and expertise. Shofwan *et al.* (2008) states that the partnership could also open up public access to technology, markets, knowledge, capital, better management, and broader business relationships.

Sustainable management more effective when implemented through synergy and partnerships among community, governments and other stakeholders (Agboola and Braimoh, 2009; Tamba and Cipta, 2011). Partnership in sustainable development is an interactive process, a number of stakeholders who realize their interdependence and establish joint action to building a new management strategy (Glasbergen, 2011). Good partnership can encourage regional economic growth and the creation of new livelihoods (Oktaviani and Sarjito, 2012). An

equal partnership between the public and the government in the management of fisheries resources can be realized in collaboration management scheme (co-management). Co-Management is a collaboration with centralized resources management by government (government-based management) with community-based resource management (community based management). In co-management or distribution of authority and responsibility in all phases of the management of fishery resources (Syahra, 2012).

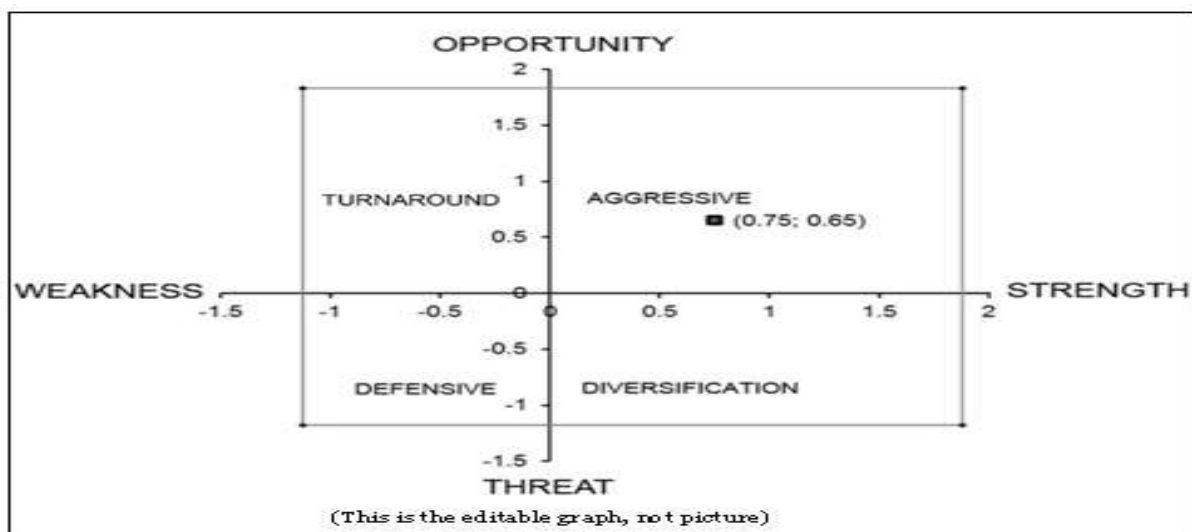


Fig. 3. Strategy position in strategy matrix.

The alternative strategies recommended in this study are novelty ideas that can be applied in development of the blood cockle aquaculture to conservation and welfare in this region. Furthermore, the alternative strategies are expected to be useful in the preparation of the policy of sustainable management of blood cockles, and it can be applied globally as alternative strategies in blood cockle sustainable management for conservation and welfare.

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