

TECHNOPRENEUR DESIGN OF MARINE AQUACULTURE BASED ON MULTI-TROPHIC AQUACULTURE AND TFD-BAKAR BATU FOR MILLENNIALS IN THE ERA OF DIGITAL SOCIETY IN TABLOLONG KUPANG NTT

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ABSTRACT

Integrated multi-trophic aquaculture (IMTA) is an innovation from conventional cultivation methods or focusing on one species to integrated cultivation of several species together. This study aims to design an entrepreneurial model for technology-based millennials by combining Integrated Multi-trophic Aquaculture (IMTA) and downstream "TFD-Bakar Batu" as a technology for handling agricultural products with a collaboration system through partnership efforts in Tablolong waters, Kupang Regency, East Nusa Tenggara Province. Stakeholder perceptions of the model design are centered on several issues such as risk, impact on the use of marine space, and the level of acceptance of fishermen, millennials so that this model can be socially accepted with the level of stakeholder satisfaction. The method used in this study uses questionnaires conducted on provincial governments, district governments, the private sector, communities and fishermen to identify potential and stakeholder concerns and perceived benefits at the commercial production level, with research questions on the level of understanding of IMTA, spatial location problems, food safety and disease, waste utilization and the emergence of new economic sectors. Data was analyzed using qualitative data analysis with NVivo14 QSR International software. The results showed that there are several problems including risks to the environment, risks arising from governance and risks to the industry itself however, stakeholders feel that the source of risk can be overcome with agricultural product handling technology "TFD Bakar Batu" and policies. Stakeholders also believe that this model can contribute to improving the aquaculture industry so that this model can develop from pilot scale to industrial scale through studies by forming entrepreneurs using technology.

Keywords: *mariculture, design, integrated multi-trophic aquaculture (IMTA), technopreneur*

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INTRODUCTION

Integrated multi-trophic aquaculture (IMTA) is an innovation from conventional cultivation methods or focusing on one species to integrated cultivation of several species together (Alexander *et al.* 2016). This method is considered to be able to solve environmental problems by utilizing commodity cultivation waste towards zero waste where feed input is only given to target commodities with high economic value while the remaining feed nutrients will be utilized by the next-level commodities so that there are no feed costs for non-target commodities other than their function. can act as a cleaner for aquaculture waste so that it will increase environmental sustainability (Zulham *et al.* 2013). IMTA methods and aquaculture in general must be aware of the potential for socially acceptable use of the marine environment to cause social conflict. In the process of catching fish, fishermen often have the potential for conflict over the use of resource areas that apply cultivation, which among other things causes conflict (Alexander *et al.* 2016). Several previous studies on stakeholder attitudes towards conventions have focused on the topics of industry risk perception, environmental impact and

consumer factors (Ahsan dan Roth 2010; Bergfjord 2009). According to Ahsan dan Roth (2010) risks in production include bad weather, harmful algae, oxygen depletion, and *Escherichia coli*. Furthermore, market risks such as price and demand as well as the value of equity. Apart from that, other factors are institutional factors and market prices, environment and commodity health. Currently fishermen in the study area run a marine cultivation business using conventional methods, namely seaweed cultivation. For this reason, researchers will design a technopreneur model for marine cultivation based on multi-trophic aquaculture in collaboration with stone-fired TFD as a technology for handling agricultural products.

METHOD

The first stage

Designing a technology-based entrepreneurship system by combining Integrated Multi-trophic Aquaculture (IMTA) and downstream "TFD-Bakar Batu" as a technology for handling agricultural products with a collaboration system through a partnership business.

Second stage

Data collection: in-depth interviews as a suitable method in qualitative research methods to obtain information or information in answering research objectives through face-to-face debriefing between the interviewer and the person being interviewed or the respondent with or without using an interview questionnaire where the interviewer and respondents were involved in social life for a relatively long time (Mayssara A. Abo Supervised 2019). Interviews in research are used to: 1) fill knowledge gaps that cannot be answered by other methods, 2) to investigate complex behaviors and motivations, 3) to gather a variety of meanings, opinions, and experiences (Winchester dan Rofe 2010). Interviews were conducted with the provincial government, district government, private sector, communities and fishers who had been previously identified using the guide which was divided into four parts with two sub-sections. First, identify the awareness and understanding of respondents who do not know about IMTA, then the interviewer will explain by showing an explanatory picture. Second, knowing the perceptions of respondents in terms of negative and positive perceptions. Third, opinions about risks for industrial development and ways that can be done to reduce risks and finally asking about the image of the industry and IMTA's impact on this model. Information obtained from the respondents was recorded using an audio recorder and field notes regarding the time, location and message of the respondents' impressions in general were also written during the interview.

Data were analyzed using qualitative analysis which consisted of three stages: data reduction, data display, and conclusion (Miles dan Huberman 2014). The first stage in the data reduction process in this study is for the key points of each interview as well as direct quotations. Then using the NVivo14 QSR International software to analyze the coding so that the analysis process is more efficient. Coding is a form of analysis for assigning code placement using letters or numbers or a combination of both that represent data components so that a number of qualitative data are reduced to smaller pieces in texts related to behavior, events, meanings, strategies, relationships, constraints and consequences with shorter term, then data is entered in metadata sequentially according to the case (Miles dan Huberman 2016).

RESULTS AND DISCUSSION

Design of a collaboration model to form Integrated Multi-trophic Aquaculture (IMTA) and downstream "TFD-Bakar Batu" as a technology for handling agricultural products with a partnership business system from upstream to downstream between universities, partners/investors and fishermen by building IMTA using the system planting cages measuring 7m X 14m x 2m at sea depth at low tide as deep as 2m, with types of commodities such as seaweed, grouper, sea cucumbers, abalone and pearls.

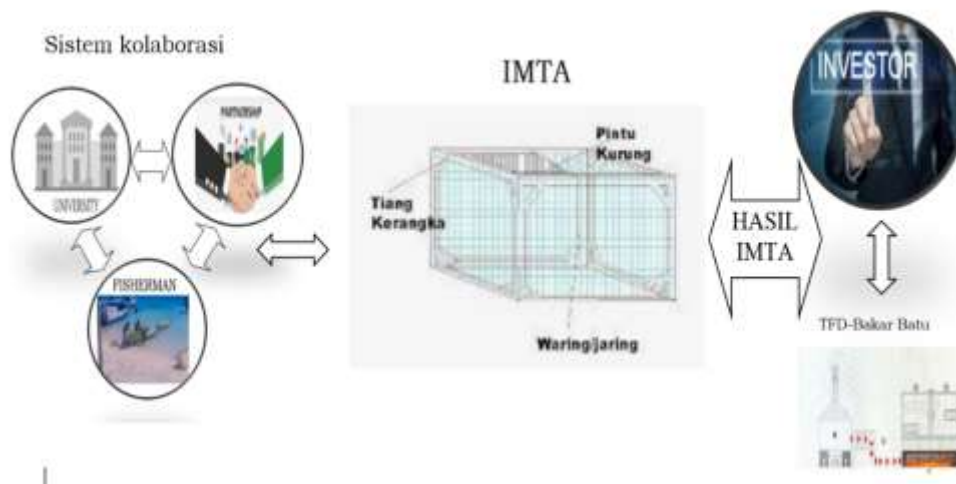


Figure 1. Collaborative model between Integrated Multi-trophic Aquaculture (IMTA) and downstream "TFD-Bakar Batu" as a technology for handling agricultural products with a partnership business system.

Understanding level

Interviews were conducted in this study as many as 30 respondents (Table 1). The largest number of respondents are fishermen. The results of the interview will be presented as follows: Respondents' answers are in the form of descriptions or quotations from respondents. At the level of understanding, the respondents showed various results (Figure 1). Respondents who are directly related to the marine and fisheries industry, such as industry representatives from the marine and fisheries service, who are related to aquaculture research, understand and are more familiar with IMTA, while respondents who are not directly related to aquacultures, such as community organizations, fishermen and tourism, are generally not familiar with IMTA because fishermen in the research area carry out conventional cultivation but there are several fishermen respondents who understand the concept because IMTA has already been implemented in the research area on a trial scale.

Table 1. Number of respondents

Respondents	Sum
Community organizations	1
Milieu	1
Fisherman	16
Industry representative	1
Planners	4
Word processing	1
Manufacturer	1
Provincial government (Marine and Fisheries Service)	1
Researchers	1
Retailers	1
Supplier	1
Tourism	1
Total	30

Most of the respondents interviewed were able to explain briefly about the meaning of IMTA:

"Innovation for mariculture by combining several commodities in one cage so as to save energy, cost and food given to core commodities can be utilized in other commodities so that there is less pollution and there is potential for added value of products and increased income".

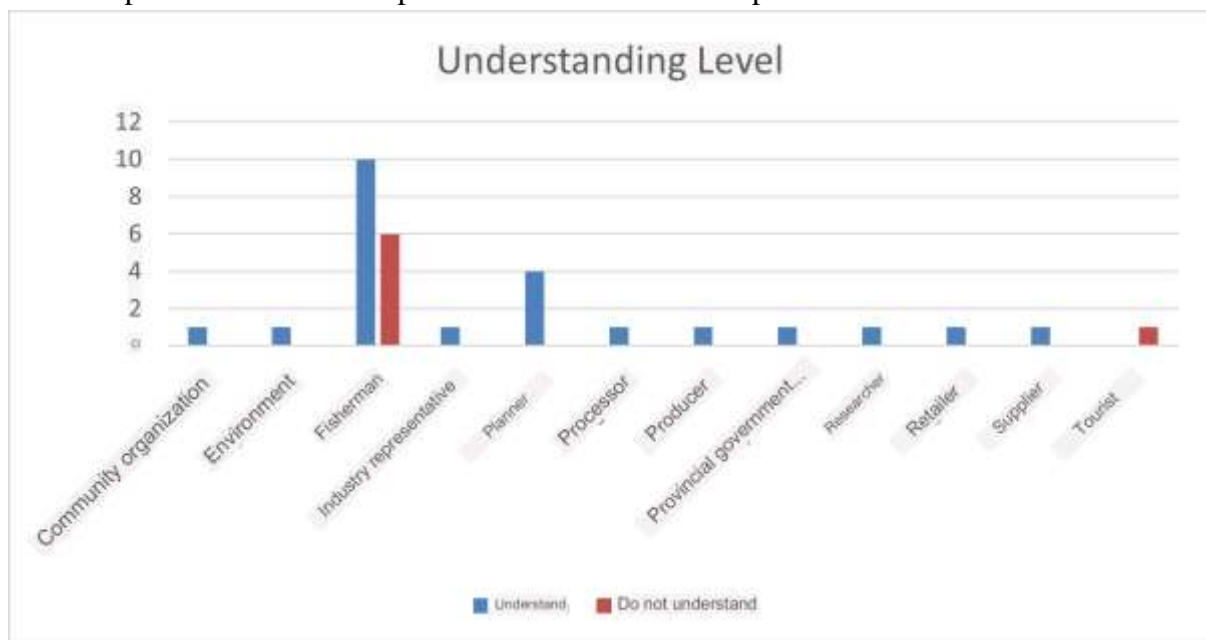


Figure 2. Respondent's level of understanding

'I know what IMTA is. Leftover food from one cultivated species can be used as food for seafloor species, this is the same as organic fertilizer from animal manure can be used to fertilize fields.'

Perception of positive and negative impact

Various perceptions of IMTA from the positive and negative sides of the respondents because the number of respondents was small so that in some cases there was only one respondent so the researcher did not state which problem was most in the interests of each group even though some spatial problems, location factors were raised from the respondents (Table 2). The discussion in this study is related to the IMTA system including the additional space that will be used, especially in relation to seaweed cultivation, which will have an impact on interactions with other sea users. Respondents also asked which commodities were superior in cultivation considering the suitability of the available space for aquaculture in the study area.

"There is a conflict in the use of space among fishermen groups"



Figure 2 Interviews with fishermen groups

Provincial Government Maritime Affairs and Fisheries Service

Food safety is an issue that is discussed. Several respondents were worried about the safety and cleanliness of the commodity. The concern arose because they had experienced an oil spill that caused death and damage to the seaweed which is the livelihood of the farmers. In addition, respondents were worried about the type of feed that could damage the bottom sediments. However, several contrasting opinions occurred during the interview where other respondents suggested that cultivation could be tightly controlled so that it would prevent food and feed safety problems.

"I feel there will be higher risk on this model. However, there will be rules to guarantee its sustainability."

Fisherman

Concerns about disease and transmission problems between different commodities were debated among respondents. However, this was explained by stakeholders that the types of commodities that are cultivated do not occur cannibalism but can act as containers that provide mutual benefits. Other respondents responded that disease transfer was unlikely but at this stage

little was known so that further information could be obtained regarding the potential of this model to be able to cultivate commodities that can reduce and act as disease vectors.

“The possibility of disease transfer between different species is very unlikely but it should still be noted if something appears to be 'stay alert'. In addition, it must be assessed if this system will introduce other species to the area that may harbor parasites or act as a source of disease that could affect the fish species being cultured.”

Fisherman

IMTA's positive impact on the environment is one of the most interesting. Some of the benefits discussed include minimizing the impact on the benthos, water cleanliness, being able to filter sea flea larvae, being able to increase oxygen levels in bottom sediments, and using coral as an indicator of pollution. The environmental impact that was most suggested by the respondents was the utilization of waste in which the waste was reduced by the number of species at the basic commodity level, so that overall, IMTA can be seen as a method capable of reducing the negative impacts of aquaculture.

"In our opinion, disposal of waste from the city can enter the fishermen's environment or even waste from fishermen's settlements which can be contaminated in terms of input to the cultivation system, so it needs attention.

Planner

Another positive impact mentioned by respondents is the emergence of new economic sectors with significant income. This is due to cost savings and increased revenue so that this method can be used for various purposes other than food security, feed supply, medicines, cosmetics and so on. Several respondents argued that this system is the key to developing the IMTA system by creating various additional products so that investors can invest in this system.

“There are new revenue streams from the IMTA method, otherwise it is unlikely that the industry will invest large capital in running this system. This system can convince various parties that through this system money can be generated.”

Fisherman

The results show that several important issues in certain issues including spatial planning, business location are a matter of interest on the part of fishermen (Table 2). The concept of environmental benefits, especially waste, is the focus for all respondents as well as new economic sectors and the importance of innovation in the IMTA aspect.

“IMTA can also contribute to innovation and research in the aquaculture sector, and develop ecosystems in the education and service system.”

Community organization

Sourcing and risk mitigation

The source of risk is related to three main aspects, namely the first is the risk to the environment, the risk arising from governance and the risk to the industry. There are several sources of risk that overlap with negative perceptions of IMTA, in cases of disease and food safety, the majority of respondents feel worried about cages and their impact on native species. This is related to the spawning process and risks to the environment, for example climate change and oil spills in the waters.

Producer

Other concerns were also raised related to what would happen if the types of commodities being cultivated were not successful in the event of climate change or extraordinary events or

disasters. This problem is greatest among farmer groups (Table 3). In addition, governance issues are also one of the focus areas of problems that arise in potential risks.

“Next, we have to anticipate climate change and governance issues because this is related to the agreement document. Various agreements must be made in the agreement so as to create trust between stakeholders in this system so that it will be the right choice next in managing various business permits in the study location to produce more types of products.

Supplier

Another risk raised by the majority of respondents (fishermen) is related to the business potential that will buy commodities from IMTA with the intention of disrupting market prices or for other purposes, so it is suggested that in this system the industry directly handles the nursery process to the marketing process and continues increased investment in other types of species.

“This system provides theoretical benefits to be patented with existing planning and permits as well as necessary operational requirements related to supply chain regulation of all types of commodities.”

Provincial Government of the Marine and Fisheries Service

In addition, it is also recommended that universities can use this system as a means to obtain grants. Lease facilities in implementing this system to ensure that the area of space use is not used for other aquaculture so that it needs to be resolved related to spatial regulations and marine permits. Spatial planning related to location is an important part of risk reduction. It is proposed that further research be carried out on the impact of IMTA in reducing risks, especially in cultivation projects, so that future research must relate to the environmental risks of IMTA. For issues related to governance, it is argued that policies may be able to reduce the source of risk. Higher education is recommended as a risk reduction strategy by respondents because universities connect all components of this system ranging from industry, government and society.

"For the local general public, I think information about this system will be a way to: First, they must be made aware that aquaculture is needed to address efforts to reduce unsustainable fishing, and second, IMTA's products consist of seaweed, grouper, abalone, sea cucumber, lobster and pearls because these commodities are currently imported by various countries and sold in national and international markets."

Provincial Government Investment Office

The influence of IMTA on the aquaculture industry

Most respondents suggested that IMTA could potentially improve the progress of the aquaculture industry with the blue economy concept of figure (Table 4). This is found in various national and international studies. Respondents suggested that negative attitudes towards cultivation are due to lack of knowledge base and people's perceptions that it becomes difficult to develop. A number of respondents proposed that this system can open people's thinking insights, especially millennials, that aquaculture is becoming more developed and environmentally friendly. In some countries many people do not want to eat seafood derived from aquaculture, so with the aquaculture system with this system can change perceptions while introducing a blue economy aquaculture system which makes the environment greener and more sustainable.

Milieu

In addition, there are some concerns related to marketing in this system "marketing is left to investors as capital owners to be marketed so that fishermen do not need to worry about cultivation results.

Researchers

Some respondents said that there is a need for information about this system to be disseminated not only to the public but also to governments and policymakers. Furthermore, this design must be carried out through scientific dissemination so that the slogan of fish-eating culture can be socialized.

"Marketing must begin before the product is ready and must be socialized to the public through advertising/billboards. Associations of farmers and government institutions must provide support so that government programs such as eating fish can be achieved and doing in the international market".

Fisherman supplier

One respondent suggested that promotion be carried out by a multidisciplinary group.

"Promotion should be carried out by a multidisciplinary group that includes governments, aquaculture companies, investors and marketing experts."

Researchers.

There are limitations to the use of in-depth interview methods including the interviewer's potential to unintentionally influence outcomes through verbal and nonverbal cues. To reduce this bias only one interviewer will be used, but in this study it is not possible to use one interviewer due to time constraints. In addition, unintentional bias is difficult to identify in this study because interviews are not written verbatim. Furthermore, limitations relate to the number of respondents in each component and respondents' experience in describing opinions. In some groups of respondents only one or two interviews were conducted, making it more difficult to investigate similarities and differences across populations. The main findings of this study in general from all respondents suggested that the results of this study should be immediately transferred to the community. The level of understanding of this system varies, the understanding of respondents who are in the aquaculture industry group and the marine and fisheries service is most aware of production methods using this system, but some fishermen and tourists do not know about IMTA.



Figure 3. Interviewers and respondents

Furthermore, respondents stated a number of positive impacts from this system including benefits for the environment such as the economic benefits of waste utilization. Respondents also know the potential negative impacts of IMTA including spatial planning, location, outbreaks, and food safety issues as well as management risks. However, this source of risk can be overcome through studies and policy studies. Respondents also felt that this system would contribute to improving the aquaculture industry but there were still many problems such as species interactions that needed to be studied and classified. Respondents who know about this system are more than those who do not know. There is a gap in a study conducted in Canada that 78% of the participants who attended the FGD had never heard of the term IMTA (Barrington et al. 2009). Respondents who are directly involved in aquaculture understand more because of interest, cultivation progress and cultivation technology.

Several negative impacts were stated by respondents in a study on perceptions of monoculture cultivation and not specifically for IMTA, particularly spatial and locational issues (Gerwing dan McDaniels 2006; Katranidis et al. 2003; Nimmo et al. 2011) besides food safety issues (Amberg dan Hall 2008; Batzios et al. 2004). In this study it was not attempted to inform respondents about the potential benefits but it can be noted that this system can reduce management concerns expressed by respondents about combining two or more species. species may serve to reduce monitoring due to geographic reach issues such as visual and environmental impacts and economic impacts. In addition, there are other concerns about the potential for disease transmission, and whether shellfish species may act as a disease "reservoir" for finfish. However, it has been suggested that additional species carefully selected in IMTA so that under good management have the potential for some disease control, for example mussels can act as bio-filters for disease reduction or prevention. This requires further research to develop a meaningful framework.

Until now there is still a lack of research on ecology as a socio-economic function, the goods and services provided in the production of this system. Several respondents felt that the theoretical aspect of waste utilization would be an environmental benefit. However, there are

studies showing that integrated fish-shellfish aquaculture in open water can only reduce a fraction of a particular waste from the fish it feeds (Cranford et al. 2013). In the end, this research also shows that respondents believe that this system can increase the overall negative image of sustainable aquaculture production.

CONCLUSION

The level of respondents' acceptance of model design or novelty related to aquaculture development tends to be related to local social, economic and cultural factors that are not easily applied to other regions with different conditions. However, a number of environmental, social and economic issues are critical to address in order for the model to succeed and move forward from pilot scale to development in other areas. Key to this model are collaborative partnerships and the environmental benefits accrued to local communities and producers. In this study, it has not been studied about government policy issues that are priorities for action reform, be it changes in government policy on spatial planning as the basis for policy initiatives in this model.

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