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Re-Thinking Indonesian Fisheries Policy: Empowerment of a Hidden Asset for Sustainable Fisheries in West Pasaman District, West Sumatra, Indonesia

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ABSTRACT

This study investigates the influence of culture on the utilization of natural resources with particular attention to the fisheries industry. The fisheries sector is significantly affected by externalities resulting from unsustainable fishing practices. In order to overcome this, the fishing environment needs to be preserved and protected. This study explores the role of Indonesian local wisdom in achieving sustainable fisheries. The role of local wisdom, encompassing cultural capabilities, technological and knowledge systems, religion, traditions, social capital including ethics, environmental wisdom, norms, and legal institutions, is crucial in resource utilization, this mainly explains that farmers' lifestyles cannot be completely replaced. Local wisdom has both direct and indirect economic effects and it has contributed to the conservation of the environment and the prevention of environmental degradation. This cultural practice is used to balance exploitation and capture with potential for processing, making it a vital factor for local communities striving for fisheries sustainability. The aim of this study is to assess sustainability in the presence of local wisdom and to develop scenarios for the achievement of sustainability. "We employed Multidimensional Scaling (MDS) with the RAPFISH application and Participatory Prospective Analysis (PPA) to assess the sustainability status and identify the main attributes that have a dominant contribution to the economic, technological, social, ethical and governance dimensions. This research has identified and measured the sustainability status of the fisheries sector, which has not been done in previous studies. The sustainability score resulting from this analysis is 49.67, indicating poor sustainability performance, highlighting the importance of local knowledge and mitigation of ecosystem damage. Empowering customary rules and local wisdom, alongside mitigating ecosystem damage, is crucial; therefore, a deeper analysis is required to formulate effective fisheries mitigation strategies. This research shows that West Pasaman Regency in West Sumatra Province is a highly suitable location for the development of a Minapolitan area. Its distinctiveness arises from the local wisdom, which satisfies the criteria for being designated as a Minapolitan zone according to the guidelines set out in Regulation No. 12 of 2010, as articulated by the Minister of Marine Affairs and Fisheries. Minapolitan incorporates region-specific fisheries development principles that combine economic and social elements to provide a practical, long-term solution to achieving sustainable fisheries.

1. INTRODUCTION

While the fisheries sector in Indonesia has become a commercial enterprise, the fact remains that its progress has not been fully relied upon to lift the national economy. Indonesia still lags behind other countries that have achieved economic progress through the development of their fisheries sectors. This condition should motivate all parties to immediately arrange concrete steps to manage and empower the fisheries sector to obtain optimal results. One of the dilemmas in the fisheries sector is the existence of externalities. Economically, the primary challenge facing the development of aquaculture fisheries is the need to minimize externalities. There are two distinct types of externalities to consider: those arising from actions that generate unfavorable conditions for others, such as pollution or the destructive impact of human activities, and those brought on by competition for limited resources, both of which can cause economic inefficiencies if uncompensated. Since fishery resources are public goods, they are freely accessible to everyone. This dilemma arises because, on the one hand, people are faced with problems of economic needs and demands, but on the other hand, they still have to pay attention to the continuity of the natural resources that support these economic activities. Externalities are a major contributor to overfishing due to efforts to optimize the satisfaction of increased demand [1, 2]. Although fishery resources are highly profitable, they are associated with environmental [3] and socio-economic issues [4, 5], damage

to fishery biota due to long-term overexploitation will lead to a decline in the populations of these fish species. The fishing industry faces significant challenges, including decreasing catches, rising environmental degradation, and overcapacity. As a result, an integrated management approach is necessary. To address these challenges effectively, it is essential to maintain and conserve the fishing environment. Furthermore, fisheries communities' welfare can be enhanced by taking an approach that goes beyond the economic aspect. One possible way of achieving this is by utilizing resources that these communities already possess but have yet to harness.

Local knowledge pertains to local concepts, beliefs, and opinions that possess an intelligent and sagacious character, along with positive significance that adhere to. Similarly, local wisdom denotes a wise and sagacious idea that is embedded within and supports its members, local wisdom can be uncovered in Indonesia, particularly in West Pasaman Regency, West Sumatra Province. This is the main reason why the farmers' way of life cannot be completely replaced.

Local wisdom, comprising values and norms adopted by a community for the management of natural resources and the environment within the context of the local economy, has the potential to be leveraged for enhancement. The implementation of local wisdom serves as a means of cultural preservation while also functioning as a means of funding community activities for the betterment of society. Local wisdom patterns value cultural capacities, knowledge, and technological systems, religion, traditions and social capital (ethical and ecological wisdom, norms and legal institutions) as important in the context of resource use. This cultural capacity is used to balance exploitation and capture, the potential that is expected to be processed, and as an important consideration for local communities in using resources to achieve fisheries sustainability.

Cultural assets through local wisdom can encourage community welfare, to understand the impact of culture on the economy, it is important to know the values and cultural norms that exist and have been applied by individuals in their economic activities. Economic progress shows the economic productivity of a region and cultural development as the identity of a region, both must complement each other in order to achieve economic prosperity through the empowerment of cultural assets through local wisdom, including one of them in the fisheries sector.

Local knowledge patterns and cultural empowerment, knowledge and technology systems, religion, traditions and social capital which include ethics and environmental wisdom, norms and legal institutions, are important in the context of the use of resources. These cultural capacities are used to balance harvesting and exploitation, the potential expected to be processed, and as an important consideration for local communities in resource use to achieve fisheries sustainability. Previous research has examined the role of culture as a social dimension in natural resource utilization [6]. The local wisdom that has been practiced for generations in West Pasaman Regency, West Sumatra Province, contributes to the protection and conservation of fishery resources. This wisdom embodies principles that are valuable and deserve to be strengthened. Those in West Pasaman Regency, West Sumatra Province, are still valued only as something unique that should be preserved, which tends to be used as a cultural tourism object. The concept of local wisdom has been present in society for a long time and has had an economic impact. It contributes directly and indirectly to environmental conservation and the prevention of environmental degradation, ultimately aiming for sustainable fisheries. Fisheries management based on local wisdom has been studied in Indonesia. A previous study has examined the impact of culture on the use of natural resources. The results of the research show that local wisdom plays a role in the formation of individual, and group behavior in relation to the environment and efforts to manage natural resources. In addition, local wisdom helps us to develop socio-political systems that are environmentally friendly, and to make decisions and policies that have an impact on the environment or natural resources. From a cultural perspective, the use of local wisdom is a form of cultural preservation that has been passed down from generation to generation. The results indicate that local wisdom plays a role in the development of behaviour towards the environment and attempts to manage natural resources, both individually and as a group. Furthermore, local wisdom helps us to develop environmentally friendly socio-political systems and to formulate decisions and policies that affect the environment or natural resources [7-11].

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Sustainable development is oriented towards meeting the needs of the current generation without compromising future generations' abilities to meet their own needs. This concept, also applied to the fisheries sector, ensures that current practices do not hinder future generations. The theory of the triple bottom line (TBL) focuses on the economic and social aspects, technology, and governance [12-14]. The sustainable paradigm is based on a balance between dimensions. It also takes into account social values. Previous research has shown that a history of fisheries management and an analysis of successful fisheries management, such as in Canada with the Sustainable Fisheries Framework (SFF) [15] and the Sustainable Fisheries Development Indicator System (SFDIS) in India [16]. The results of this study show that a focus on resource conditions alone is not enough to achieve sustainable fisheries.

Ensuring productive and sustainable fisheries involves complex interactions between ecosystems, the environment, policy, human and the management and governance of fisheries. Fisheries face many challenges, and without strong and careful management, the fisheries sector will not be sustainable, this view places humans and their environment in a functional or holistic relationship [17]. Environmental issues are becoming increasingly important as people become more aware of the environment and the importance of protecting it.

The multi-dimensional status of sustainable fisheries is a very important source of information because it will be known important attributes that affect the sustainability of aquaculture, especially in West Pasaman Regency, West Sumatra Province. There has never been a measurement of the sustainability status, fisheries activities also have various other attributes that have never been studied to be empowered in achieving sustainable fisheries. Some research findings regarding inefficient fisheries management and resulting failure to achieve sustainability principles are due to the unavailability of data on the status of fisheries sustainability. Empirically, not all dimensions have been investigated in previous research studies to assess sustainable fisheries. Only the environmental dimension of sustainable fisheries has been studied. Previous research has been carried out by Garibaldi et al. [18, 19] have examined sustainability and sustainable growth and found that

sustainability and sustainable growth are complex things that can be achieved through a social-ecological system by taking into account the pillars, namely social, including culture, economy, institutions, or governance, as well as ecology and growth, these social dimensions must be integrated to achieve sustainability. This cultural capacity is used to balance the potential for use, capture and processing, and is an important aspect for local populations in the exploitation of resources to create sustainable fisheries.

Based on the above points, it is evident that an approach beyond economic perspectives is necessary to improve the welfare of communities. One potential aspect yet to be utilised is the use of indigenous knowledge, commonly known as 'local wisdom'. From a cultural perspective utilizing indigenous knowledge constitutes a means of safeguarding a society's cultural heritage. Local knowledge, which has been passed down by the community as a cultural heritage can be harnessed to achieve sustainable development, notably in the fisheries sector. Invented traditions instil specific values and behavioural norms, which automatically imply continuity with the past and are linked to the growth of sustainable development. The community of Pasaman Barat possesses a local wisdom based on long-standing practices within their society [20].

Furthermore, no assessment has been conducted on the sustainability status in various dimensions in West Pasaman, Regency, West Sumatra Province, Indonesia. Fisheries also have various other attributes that have not been studied for utilization. However, the sustainability of fisheries in this region has not been evaluated, a gap this study aims to bridge. Considering the novelty of this research is that it will be an assessment of the sustainability of fisheries through the empowerment of local wisdom. This study aims to examine the current sustainability status of fisheries by applying local wisdom Identify the main attributes that make a dominant contribution to the status of sustainable fisheries and formulate scenarios that can be applied to achieve sustainable fisheries based on the implementation of local wisdom in West Pasaman Regency, West Sumatra Province, Indonesia. With the implementation of this scenario, once its sustainability status has been determined, it will be possible to apply local wisdom values, as a culture of the local community, in the management of natural resources, specifically while simultaneously preserving their continuity.

The objective of this study is to assist policymakers and development agencies in their efforts to establish sustainable fishing practices in West Pasaman Regency, West Sumatra Province, Indonesia. This study employs a mixed-method approach to address the research problem. Multidimensional Scaling (MDS) was utilised to assess sustainability and identify the key factors dominating the economic, technological, social, ethical, and governance dimensions. Sustainability assessment is conducted by examining the outcomes of interviews with participants, subsequently analysed via the RAPFISH tool. A leverage analysis was conducted to determine the factors that can be leveraged in each dimension of sustainability, relying on the RAPFISH analysis. The purpose of the prospective analysis is to explore different options for sustainable management that may be in place in the future. As a result of this research, academics and other stakeholders will be able to outline scenarios that can be implemented to achieve sustainable fisheries development based on the application of local wisdom values.

2. LITERATURE REVIEW

One approach to promoting sustainability in the fishing industry is to gain a comprehensive understanding of the sustainability status of fisheries. Although a number of studies [21-27] have been carried out to assess the sustainability of the fishery, including research in Indonesia, no one has yet examined the sustainability of fisheries from a multi-dimensional perspective. To achieve sustainability, social dimensions such as culture, economy, institutions, governance, ecology, and growth must be integrated. This integration is crucial for achieving long-term sustainability goals. Research findings from previous studies are crucial for the growth of financially, ecologically and socially sustainable fisheries in the nation.

The identification of important attributes that influence sustainability, such as social dimensions and local wisdom, has also not been identified in previous research. The main challenge to the economic development of fisheries is the necessity to reduce these externalities. Research on environmental conservation efforts has been conducted. The results show that restoring or recovering shared resources will be particularly challenging when conservation efforts among stakeholders are carried out sequentially. The results suggest that decision-makers will consider various attributes before undertaking environmental conservation [28]. Further research found that sufficient information will make it easier for decision makers to formulate policies related to the preservation of open access resources [29]. Other research shows that common goals need to be defined and accepted by all stakeholders. It is very difficult to determine who is responsible for the sustainable management of resources and to set up appropriate monitoring and control systems [30]. Cultural assets, stemming from local knowledge, have the potential to enhance community welfare. Understanding the impact of culture on the economy requires knowledge of existing values and cultural norms that guide individuals' economic activities. This mainly explains that fisheries lifestyles cannot be completely replaced.

It is crucial to explain that if the sustainability of natural resources is determined, then utilising them in line with local wisdom values and cultural practices of the community can improve the community's welfare while ensuring ecological sustainability. Previous research has also found that governments should explore ways to develop fisheries in ways that create livelihoods for the most vulnerable [31]. Subsequent research also found that there are still challenges in developing the social-ecological systems framework as a diagnostic tool for knowledge accumulation [32]. Approach beyond economic perspectives is necessary to improve the welfare of communities not only ecological perspective, the community has a pre-existing capital but has not been utilised optimally to improve welfare. The research found that territorial-based fisheries management rights is a promising tool for fisheries management in Indonesia that can help address the current major problem of overfishing [33].

3. MATERIAL AND METHOD

3.1 Sampling location

The geographical location of this study is West Pasaman Regency, West Sumatra, Indonesia (Figure 1).

Figure 1. Study area of West Pasaman Regency, West Sumatra Province, Indonesia

West Pasaman Regency, West Sumatra, Indonesia is located between 00° 33' north latitude and 00° 11' south latitude and 99° 10' to 100° 04' east longitude. West Pasaman is one of the regencies in the province of West Sumatra, Indonesia. This area was formed from the division of Pasaman Regency based on Law No. 38 of 2003 concerning the establishment of Dharmasraya, South Solok and West Pasaman Regencies dated 18 December 2003, with the capital of Simpang Ampek District. West Pasaman Regency of West Sumatra Province has an area of 3,864.02 Km² with a distribution of 110 people/Km², a population of 436,298 people (2021) with government administration covering 11 (eleven) sub-districts.

3.2 Methodology and key participants

This research uses a mixed method approach to answer the research question. Data collection uses a concurrent embedded strategy model where quantitative research methods are used to analyse attributes for determining sustainability status. After collection of quantitative data, qualitative research methods are carried out to conduct a deeper exploration of the sustainability attributes and formulate of sustainability scenarios. This research uses the snowball sampling technique in order to obtain sufficient information to be analysed and draw conclusions in accordance with the formulation and objectives of the research.

Therefore, key participants were identified using non-probability sampling with purposive sampling method. This was done by deliberately selecting certain samples in view of their special characteristics, including, an adequate number of at least 30 (thirty) community respondents or 3 (three) to 6 (six) or 7 (seven) experts and their combinations. Community experts amounted to as many as 100 respondents on the basis of their knowledge about the subject matter under study [34]. The key participants included community leaders, religious scholars and resource persons from the Office of Maritime Affairs and Fisheries, West Pasaman Regency, West Sumatra Province. A total of 100 respondents originating from 11 (eleven) sub-districts in West Pasaman Regency, West Sumatra Province were involved in the study.

Collection of qualitative data was conducted by means of face-to-face interviews, observations, researching documents and Focus Group Discussions (FGDs) by preparing relevant interview guidelines. This research used guided interviews with a set of interview guidelines. This included the duration of interview sessions. FGDs were conducted to increase the depth of related information to address the objectives of this study.

3.3 Sustainability status

Multidimensional Scaling (MDS) was used to determine the status of sustainability and to identify the main attributes that dominate the economic, technological, social, ethical and governance dimensions [35]. Such a scaling method is a useful tool for objective analysis of various fields of study. MDS is a statistical technique that allows for the determination of an objects position based on its similarity or dissimilarity to multiple variables [36] and has been used to measure the sustainability status of fisheries [37-39]. Scores were determined based on the results of interviews with respondents and then analysed using the RAPFISH program. The results of the analysis are then interpreted in 4 groups describing the state of sustainability, where an interval of 0-25 means bad (not sustainable), 25.01-50 means less (less sustainable), 51-75 means sufficient (fairly sustainable) and 76-100 means good (very sustainable) [40, 41].

To determine the sustainability status in West Pasaman Regency, West Sumatra Province, Indonesia, the RAPFISH analysis was conducted based on five aspects or dimensions, including economic, social, technological, ethical and governance dimensions. RAPFISH uses simple and easily assessable attributes to provide a rapid, cost-effective, and multidisciplinary assessment of fisheries status, in terms of comparative levels of sustainability of freshwater aquaculture fisheries [42, 43], RAPFISH has been used to measure the sustainability status of fisheries [44-47].

The leverage analysis was then performed to identify the leverage factors in each sustainability dimension, based on the RAPFISH analysis. The leverage analysis is presented as a bar chart, where the aspect with the greatest value is the aspect that has the greatest leverage on the sustainability status of a dimension [48-51].

To minimize analytical errors, Monte Carlo analysis was employed to examine the magnitude of the error in the sustainability analysis due to differences in respondents' ratings of attributes, errors in data entry, and incomplete or missing data. Monte Carlo analysis has already been used to measure the sustainability status of fisheries. In this research, Monte Carlo analysis was used to test the results of the ordinate analysis carried out, as the RAPFISH method is very likely to have variations in scoring due to differences in judgement, or errors in data entry.

To find out whether the attributes of the sustainability dimensions examined in the MDS analysis are sufficiently accurate, the magnitude of the stress value and the value of the coefficient of determination (R-Squared) were noted. For stress values of less than 0.25 or 25% and a coefficient of determination (R2) close to 1.0 or 100% were analysed. Kite diagrams were used to describe the status of sustainability in multiple dimensions by comparing the performance of each dimension. The obtained accuracy test of the MDS was between 93.86% - 95.18% and it can therefore be categorized as being of good fit.

Sustainability assessment was determined on the basis of the results of the interviews and then analysed with RAPFISH. The value of the analysis results was then interpreted in 4 groups that describe the condition of sustainability, namely: 0-25 means poor (unsustainable), 25.01-50 means poor (less sustainable), 51-75 means fair (moderately sustainable) and 76-100 means good (highly sustainable). The sustainability index value for each dimension was plotted using the kite diagram, to reflect the sustainability index of each dimension

(ecological, economic, social, institutional and technology) [52, 53].

3.4 Sustainability scenarios

In order to formulate a sustainability scenario, a situation analysis is carried out using a prospective analysis (Participatory Prospective Analysis). The cognitive nature of the method is in the form of a typology focus on interactions and consensus building, which is capable of generating a consensus from interactions between stakeholders, which can then be used for planning purposes [54-56]. This method aims to explore different options for sustainable management that can be applied in the future. In this research, the prospective analysis was conducted with stakeholder involvement through representatives of key informants such as community leaders and religious scholars who are experts and knowledgeable about aquaculture and indigenous knowledge in determining key planning variables, defining variable conditions in the future, developing planning scenarios, and preparing strategic implications and anticipatory actions in fisheries management [57, 58].

In order to achieve a focused discussion, the boundaries of the problem being discussed were first established for West Pasaman Regency, West Sumatra Province, Indonesia, for the next 20 years while making reference to Law No. 26 of 2007 on spatial planning. The identification of system variables was done through brainstorming that began with the identification of variables that have an influence on the composition and evolution of the system from the perspective of the participants. The definition of key variables was done through structured discussions that addressed the relevance of each of the previously agreed variables. From this stage a final list of all system variables is established, then variables are defined. All variables that have been determined and defined are directly entered into the software for further analysis.

Interpretation of influence/dependence links was done based on the results of software processing with output in the form of tables and graphs. The direct and indirect effect graphs showed the level of strength of the variables. Quadrant I (top left) is the area of driving variables (drivers). Quadrant II (top right) is the area of control variables (leverage); Quadrant III (bottom right) is the area of output variables which are highly dependent and has little influence, and Quadrant IV (bottom left) is the area of marginal variables. Variables in Quadrants I and II are considered to be strong variables and were selected as determining variables in the next analysis [59].

The scenario building stage was carried out through the preparation of a combination of variables with different conditions and on the scenarios that have been built. The resulting information was a roadmap for stakeholders to deal with developments and threats that may occur in the future.

4. RESULTS

4.1 Sustainability status

4.1.1 Leverage analysis

(1) Economic Dimension

An analysis was conducted to determine the leverage factors for each dimension of sustainability by using RAPFISH (Figures 2-5).

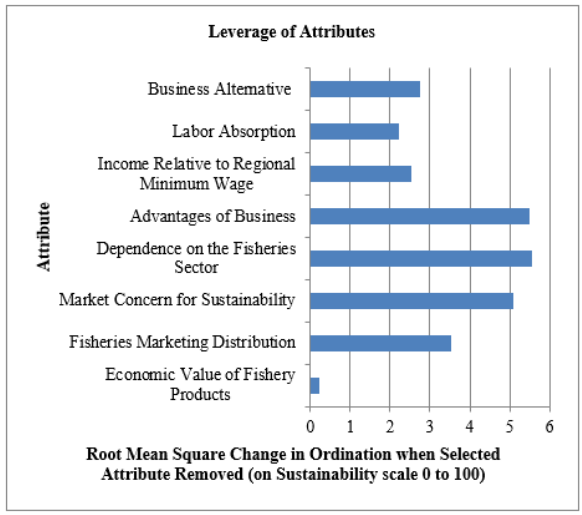

Figure 2. Leverage analysis: Economic dimension

Figure 2 shows that the community in West Pasaman Regency, West Sumatra Province, is still very dependent on the fisheries sector as a source of household economy. As a vital component of the economy, the community has acknowledged the importance of sustaining the fisheries sector through successful marketing of products at the local area. Small-scale fishermen continue to hold a significant place in the cultural and social heritage of the fisheries sector in Pasaman Barat District, which constitutes the primary source of income for the majority of the nation's fishermen, but the economic value of fisheries products is still markedly low and has yet to uplift the livelihoods of the fishing communities.

The study suggests that, on a macroeconomic scale, the fisheries industry has not made a noteworthy contribution to the regional economy. Additionally, the employment rate within the industry remains at a moderate level. An interesting finding is that the community cares about the sustainability of the fisheries sector, it appears that the principles of sustainability actually exist and are known because the principles have been taught from generation to generation but are still not maximally utilised. The community of West Pasaman Regency in West Sumatra Province has implemented local wisdom values particularly in freshwater aquaculture sector, specifically in the preservation of protected fish species which has been passed down for generations. Freshwater fish farming activities in Pasaman Barat district, West Sumatra province, have been widely supported by the government. However, the sustainable growth of this sector has not yet been achieved due to the lack of local wisdom values despite their economic, social, cultural, and environmental benefits to the fisheries industry.

(2) Social Dimension

The leverage analysis for the social dimension is shown in Figure 3.

It can be seen that the community already has knowledge about environmental sustainability, one of which is sourced from inter-generational traditional culture and local wisdom. It is interesting to note that the socialization for environmental conservation attribute has been obtained from parents and families in a traditional way. The research findings demonstrate that the government has established various regulations to govern the fishing sector and has also provided socialization to the public regarding these regulations so as to

ensure the sustainability of the sector. It is also evident that there is very low conflict over fishing among communities due to the cultural factor of strong bonds within families, as well as the presence of adequate regulations that make it comfortable for people to engage in the fisheries sector.

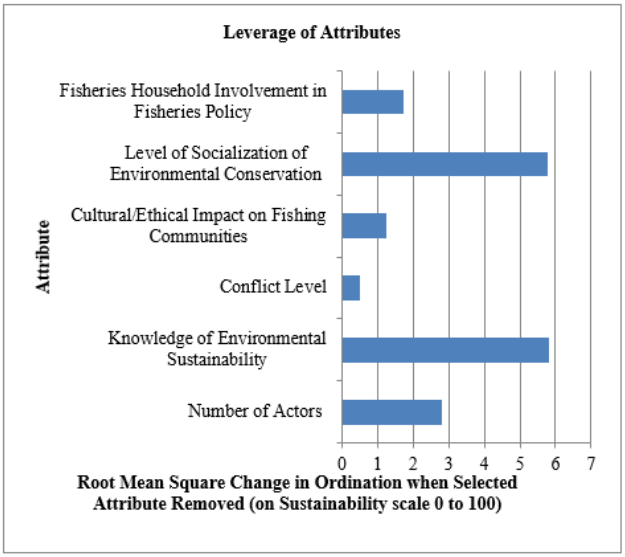

Figure 3. Leverage analysis: Social dimension

An interesting finding is the need for wider community involvement, particularly in the refinement and creation of regulations. It appears that the actors involved in this are currently very limited. Therefore, efforts are needed to involve the wider community, particularly those with a vested interest in the fisheries sector.

After conducting observations in Pasaman Barat Regency, West Sumatra Province, it was found that there are three components governing the management of prohibited fishing: myths, customary law regulations, and customary institutions. This community-based approach to managing fishery resources involves closing specific areas or seasons once a year, coinciding with the Islamic holy day of Eid al-Fitr, to promote resource sustainability. The principles and local wisdom of the prohibited fishing culture involve a sense of communal responsibility, which has been the cornerstone of local wisdom in fish farming from ancient times. This practice is applied from clearing and preparing the land to the harvesting stage, where it is essential to ensure that fish farming activities do not disrupt the environmental conditions.

(3) Technology Dimension

Figure 4 shows the leverage analysis for the technology dimension.

Results show that the technological advancements, particularly in the field of fisheries, have been adopted by the fishing community to enhance their production processes. An interesting finding is that the community has been using oxygen during the harvesting process to maintain the freshness of fish products for transportation outside the region. The use of simple tools for harvesting involves equipment commonly used by traditional communities such as lukah or bubu, nets, fishing lines, bamboo rods, and bamboo traps. These tools are made from natural or organic materials, such as wood, rattan, and roots, and do not contain any hazardous materials like iron, nails, wire, or other dangerous substances. These tools rely solely on human power, and some may either be used by an individual or require assistance from others.

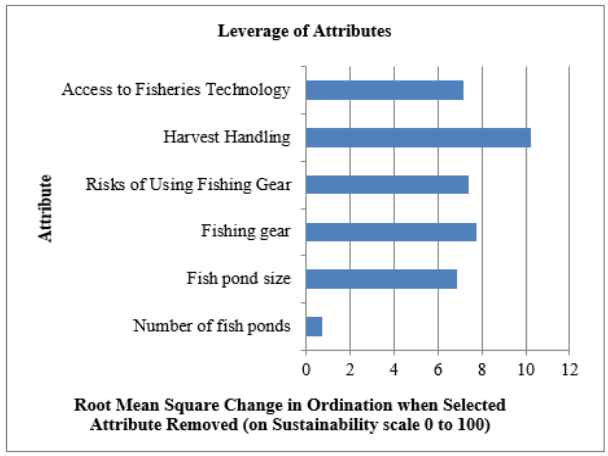

Figure 4. Leverage analysis: Technology dimension

Another interesting finding is that the community has demonstrated technological literacy, evidenced by their knowledge of the internet. This has allowed them to gain access to the latest fishing techniques, equipment, and other related information that they apply to their daily fishing activities. Using the latest environmentally friendly equipment, combined with the application of local wisdom, has proven to be effective in maintaining the sustainability of the fishing environment.

The findings of this study further support the economic dimension shown by Figure 2, which highlights the lack of modernization in the fishing community. Consequently, policies are needed to develop more sustainable and environmentally friendly management techniques. There is a need for policies to develop environmentally friendly management techniques that have a better impact on production outcomes, resulting in greater welfare for the fishing community.

(4) Ethical and Governance Dimension

Figure 5 shows the leverage analysis for the ethical and governance dimension.

It shows that traditional rules and local wisdom are important in maintaining the sustainability of fisheries resources. Local wisdom in a community can be observed from the rules and norms that are still valid and continue to be maintained and applied to community life. The application of customary values and local wisdom, especially in conserving freshwater aquaculture resources in West Pasaman Regency, West Sumatra Province, namely prohibited fishing continues to develop in everyday life through direct teaching by parents to children, Ninik mamak to children and grandchildren and nephews and penghulu to the community. This custom is one of the manifestations of the principle of conservation of natural resources carried out by the community to preserve fishery resources, especially river waters.

Traditional communities in conserving aquatic resources have certain rules to prevent overexploitation such as the harvesting process which is strictly controlled by the community. Figure 5 also shows that the number of regulations set by the government to maintain the sustainability of resources is sufficiently available, but there are still violations that result in not maximising the

implementation of these regulations in maintaining the sustainability of fisheries resources.

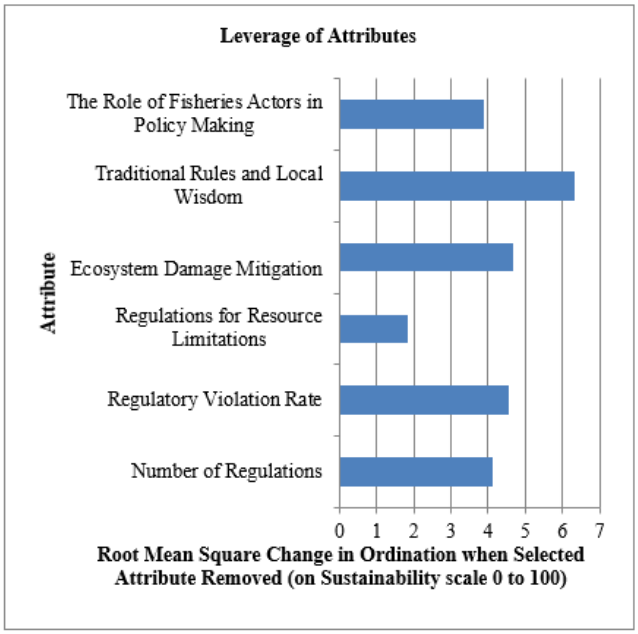

Figure 5. Leverage analysis: Ethical and governance dimensions

From a regulatory perspective, this finding reinforces the previous dimension shown in Figure 3 where fishing resource exploitation needs to be limited. Sufficient regulations have been implemented by the government and related agencies, but there is still inadequacy in limiting exploitation. The supervision of implementation of regulations pertaining to the restriction of exploitation is also ineffective, as seen by the high levels of regulation violations in the field.

An interesting and important finding of the study emphasizes the crucial role of government-led measures in controlling environmental harm. Preserving the sustainability of water environments is an essential objective for both regional regulators and communities. This can be achieved by implementing standardized guidelines and regulations because they provide direction to regulators and the community on sustaining fisheries. The guidelines have been customised to accomplish specific objectives, guaranteeing they are precise and succinct.

Based on the analysis of each dimension, it can be concluded that there are key components that can be leveraged for each dimension. The aspects with the highest leverage in each dimension are presented in Table 1.

Several studies have shown that traditional rules and local wisdom are important in maintaining the sustainability of fisheries at West Pasaman Regency, West Sumatra Province, Indonesia. A recent study emphasizes the importance of decentralising fisheries policy and involving local communities in decision-making processes. This approach has been seen as a viable solution to address the issue of resource depletion in fisheries. The study supports previous research that has highlighted the negative impact of centralised fisheries management practices on the depletion of resources [60]. In Indonesia, the evolution of fisheries management policy has progressed towards decentralisation, transitioning from deconcentration and delegation to devolution. This transition has been facilitated by the implementation of Law 22/1999, also known as the Local Autonomy Law, which grants local governments new authorities in managing fisheries. This move towards devolution aims to empower local governments and integrate local wisdom into fisheries management, ultimately promoting more sustainable practices and mitigating resource depletion.

Table 1. Leverage analysis on each dimension of sustainability in West Pasaman Regency, West Sumatra, Indonesia

No	Dimension	Attribute	Value
1	Economy	Dependence on Fishing Sectors	5.55
2	Social	Knowledge of Environmental Sustainability	5.80
3	Technology	Harvest Handling	10.26
4	Ethical and Governance	Customary Rules and Local Wisdom	6.33

Source: RAPFISH

The findings of this study also strengthen the results of previous research [61], where decentralisation has emerged as the most appropriate form of fisheries governance, enabling local governments to fundamentally control local fisheries through a community-based management system. Decentralisation has also been justified as a means to increase the efficiency and equity of development activities and service delivery, and local participation and democracy. The efficiency and equity benefits of decentralisation come from the existence of democratic processes that encourage local authorities to serve the needs and desires of their constituents.

The aspect that has the most decisive leverage value for the sustainability of West Pasaman Regency, West Sumatra Province, Indonesia on the economic dimension is dependence on the fisheries sector. The aspect that has the most decisive leverage value for the sustainability of aquaculture on the technological dimension in the studied region is harvest handling.

The results showed that the community has knowledge about environmental sustainability and in the applied harvesting process.

4.1.2 Monte Carlo analysis

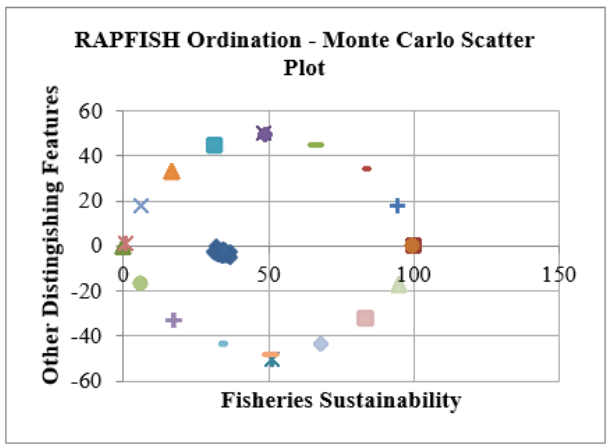

Figure 6. Monte Carlo: Economic dimension

Monte Carlo simulations offer valuable insights as they allow analysts to explore multiple possible outcomes and their associated probabilities. They facilitate the identification of

potential risks, optimization of strategies, and making of informed decisions based on statistical analysis of the simulated data. Monte Carlo analysis enhances decision-making processes by providing project managers with a spectrum of potential outcomes based on different risk scenarios. This enables them to make more informed decisions regarding project planning, resource allocation, and risk mitigation strategies. Monte Carlo analysis has been incorporated in this study to determine the appropriate strategy based on a preset statistical analysis. This is to enable the identification of relevant indicators, which will subsequently serve as the foundation for developing sustainable fisheries scenarios and strategies in the following stage. The Monte Carlo analysis for each dimension is shown in Figures 6, 7, 8 and 9.

(1) Economic dimension

The Monto Carlo analysis for the economic dimension is shown in Figure 6.

It shows a converging sustainability index value to a single point. Therefore, after 25 repetitions, some uncertainties from the RAPFISH analysis can be seen, where errors may have been caused by scoring mistakes, scoring variation due to different assessments, or errors in inputting minimum data occur. According to the results of the analysis, the determination of sustainable scenario analysis in the economic dimension can be continued.

(2) Social dimension

The Monto Carlo analysis for the social dimension is shown in Figure 7.

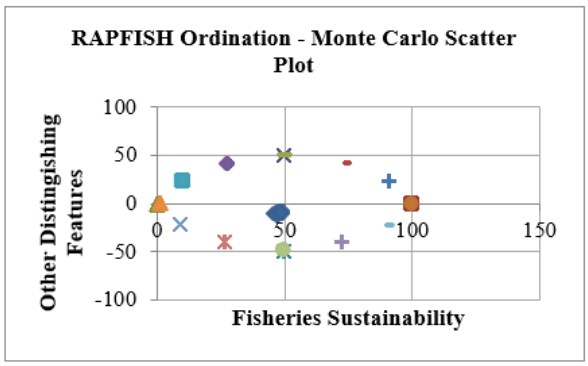

Figure 7. Monte Carlo: Social dimension

The analysis for the social dimension shows a converging sustainability index value to a single point.

(3) Technology dimension

The Monto Carlo analysis for the technology dimension is shown in Figure 8.

(4) Ethical and governance dimension

The Monto Carlo analysis for the ethical and governance dimension is shown in Figure 9.

Based on the Figure 6, it can be seen that the analysis results for the ethical and governance dimensions dimension show a converging sustainability index value to a single point. Therefore, after 25 repetitions, some uncertainties from the RAPFISH analysis, such as errors caused by scoring mistakes, scoring variation due to different assessments, or errors in inputting minimum data occur. According to the results of the analysis, the determination of sustainable scenario analysis in the economic dimension can be continued.

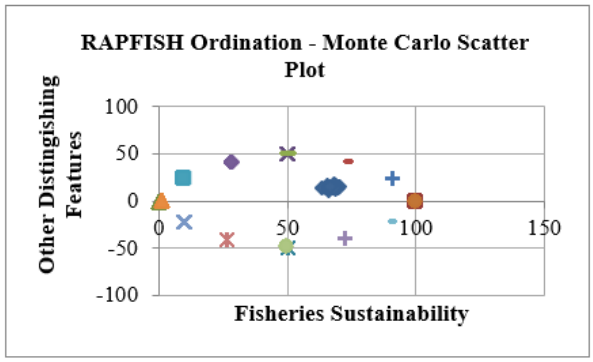

Figure 8. Monte Carlo: Technology dimension

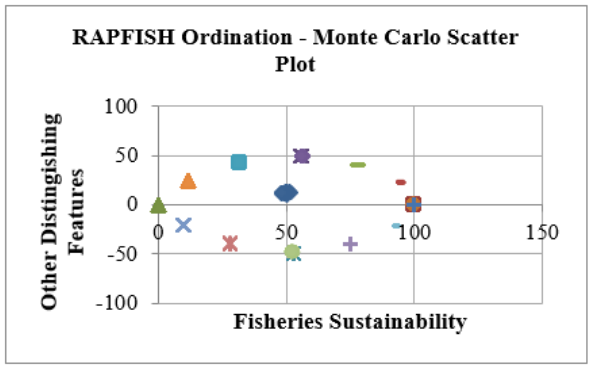

Figure 9. Monte Carlo: Ethical and governance dimensions

Table 2. Multidimensional value of aquaculture fisheries in West Pasaman Regency, West Sumatra, Indonesia

No	Dimension	Stress	r-Squared	MDS	Monte Carlo	Diff
1	Economy	0.140	94.64	32.61	31.72	0.89
2	Social	0.151	94.02	47.69	49.51	1.82
3	Technology	0.143	94.01	69.16	72.24	3.08
4	Ethical and Governance	0.149	94.02	49.20	52.56	3.36

Source: RAPFISH

After conducting our analysis, it becomes clear that the sustainability index values converge to a single point. However, in spite of the above-mentioned limitations, the results of the analysis can still be used to determine the status of sustainability according to Multidimensional Scaling (MDS) principles on all dimensions. The fisheries in West Pasaman Regency, West Sumatra Province, Indonesia are ordinated based on an assessment of their attributes, and the accuracy of this assessment is enhanced by a Monte Carlo simulation, which produces a sensitivity value for each attribute as shown in Table 2.

Based on Table 2, it is evident that the Monte Carlo analysis outcome is fundamental in this study. It permits the evaluation of any inaccuracies or misjudgements made by participants while assessing attributes. Due to differences in expertise among our key informants, including community leaders, religious scholars and resource persons, there is a possibility of errors. Monte Carlo analysis can also be used as a simulation method to evaluate the impact of random errors in statistical analyses conducted on the entire scale.

From Table 2 it can be seen that based on the results of the Monte Carlo analysis, based on 25 replicates with a 95% confidence level, the stress values in each dimension range from 0.140 (14%) to 0.151 (15.1%), all of which are less than 0.25, or 25%. Additionally, the coefficient of determination (R2) ranges between 94.01% and 94.64%, which is close to 1.0, or 100%. The results of this analysis show that analysis results can still be used to determine sustainability status, and it appears that the ordination model that has been carried out is good because the errors that occur in the ordination determination process are very small ranges. This is also reflected in the comparison of MDS and the Monte Carlo scores, which have only a small or insignificant difference between 0.89-3.36. These findings lead to the conclusion that the analysis results are accurate and reliable, and can be considered a good and fit representation. This analysis demonstrates that the obtained data is valid and can be used to formulate sustainable fishery scenarios in the next analysis.

4.1.3 Sustainability status

The sustainability status of fisheries in West Pasaman Regency, West Sumatra Province, Indonesia is determined using RAPFISH analysis, by considering four dimensions: economic, social, technological, ethical and governance (Table 3).

Table 3. Analysis of Sustainability in Every Dimension in West Pasaman Regency, West Sumatra, Indonesia

No	Dimension	Sustainability Status	Value
1	Economy	Poor (Less Sustainable)	32.61
2	Social	Poor (Less Sustainable)	47.69
3	Technology	Fair (Moderately Sustainable)	69.16
4	Ethical and Governance	Poor (Less Sustainable)	49.20

Source: RAPFISH

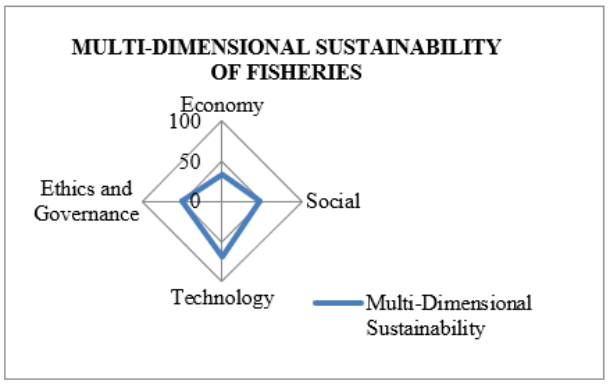

Figure 10. Kite diagram multi: Dimensional sustainability of fisheries in West Pasaman Regency, West Sumatra, Indonesia

The kite diagram approach was used to analyse the value of the sustainability index for each dimension of sustainability of terrestrial or freshwater fisheries in the study region (Figure 10).

From Table 3 and Figure 10, it can be seen that the results of the multidimensional analysis show that the highest index is on the environmental dimension with 69.16. This is in the fair (moderately sustainable) category. The economic dimension follows with a value of 32.61, which is the lowest sustainability index in the poor (less sustainable) category. This is followed by the social dimension with a Sustainability Index value of 47.69, which is in the poor (less sustainable) category. The technological dimension has a Sustainability Index value of 69.16 in the fair (moderately sustainable) category. The Ethics and Governance dimension, with a score of 49.20, is categorised as poor (less sustainable). Therefore, from a multi-dimensionally point of view, the sustainability index in West Pasaman Regency, West Sumatra Province, is 53.68, or in a fair (moderately sustainable).

5. DISCUSSION

5.1 Sustainability status

Based on the results of the RAPFISH analysis, it can be seen that each dimension has a sustainability category, which is then presented in Table 4.

Table 4. Sustainability analysis on each dimension

No	Dimension	Value	Sustainability Status
1	Economy	32.61	Less Sustainable
2	Social	47.69	Less Sustainable
3	Technology	69.16	Sufficiently Sustainable
4	Ethics and Governance	49.20	Less Sustainable

Source: RAPFISH

Based on the results shown in Table 4, observation and interviews related to the economic dimensions, it is evident that in West Pasaman Regency, West Sumatra, fish farming activities have become a commercial business and a source of community economy; however, progress made so far has not been fully sufficient to lift the community economy that has a low sustainable status. What is interesting about this research is that the community was aware of the efforts to preserve the environment and applied them to the handling of the harvest, but did not apply them to the maximum extent in maintaining the sustainability of the fishing environment, which was rated as less sustainable in the social dimension, but as sufficiently sustainable in the technological dimension.

In addition, in terms of ethics and governance this research shows that successful development must go hand in hand with the preservation of the environment. For this reason, the government must empower the community to carry out various activities in the fisheries sector, including cultural empowerment in the form of local wisdom. On this basis, by strengthening the cultural assets in the form of local wisdom that have existed in the community for a long time, while still prioritizing the conservation of the natural environment, the people's economy can strive to survive and continue to contribute to the economy as one of the main sources of income for households. Because local wisdom is generally expressed in the form of taboos and prohibitions that must be followed by the community, and restricted areas for fishing, these results support the investigation [62], which examines how restrictions imposed on the Sundarbans to protect its biodiversity have affected fishermen's access to fish resources. It also looks at how local people have responded to these restrictions in order to maintain their way of life. They found that the adoption of conservation as a global ideology without consideration of the local context has created new complexities that have alienated local communities and made

the unknown future even more frightening. The integration of development programmes, the development of fishing communities, the participation of the whole community and the strengthening of local wisdom are crucial to the success of development, especially in the fisheries sector.

5.2 Sustainability scenarios

The results of the analysis show that each dimension has the aspect with the highest value, and the greatest leverage, so it strongly influences the sustainability of fisheries in West Pasaman Regency, West Sumatra Province (Table 5).

Table 5. Key Components in developing a sustainable fishery scenario in West Pasaman Regency, West Sumatra, Indonesia

No	Scale	Scenarios	State Arrangement
1	0	Existing	1(H)-2(L)-3(L)-4(L)-5(L)-6(L)-7(H)-8(L)-9(L)-10(L)
2	1	Conservative-Pessimistic	1(M)-2(M)-3(M)-4(M)-5(M)-6(M)-7(H)-8(M)-9(H)-10(H)
3	2	Moderate-Optimistic	1(M)-2(M)-3(M)-4(M)-5(H)-6(H)-7(H)-8(M)-9(H)-10(H)
4	3	Progressive-Optimistic	1(L)-2(H)-3(H)-4(H)-5(H)-6(H)-7(H)-8(H)-9(H)-10(H)

Source: PPA Software

The state arrangement of each key component and prospects for sustainable fisheries management in West Pasaman Regency, West Sumatra Province is also shown in Table 5.

Table 6. Condition of key components of sustainable fisheries in West Pasaman Regency, West Sumatra, Indonesia

No	Key Component	Value
1	Dependence on the Fisheries Sector	1.01
2	Profit of Aquaculture Business	0.13
3	Market Concern for Sustainability	-
4	Fisheries Marketing and Distribution	-
5	Knowledge of Environmental Sustainability	-
6	Level of Socialization of Environmental Conservation Efforts	-
7	Harvest Handling	-
8	Pool Size	-
9	Customary rules and local wisdom	1.95
10	Ecosystem Damage Mitigation	0.91

Source: PPA Software

Based on Table 6, results of sustainability analysis using RAPFISH software show that there are 10 (ten) key components that have a strong influence on the freshwater aquaculture management scenarios that can be carried out to achieve sustainable freshwater aquaculture management in in the study region. These are formulated as shown in Figure 11.

Based on Figure 11, there are indications that the conditions are mutually incompatible or can occur but the chances are very small. Scenarios that can be offered for the sustainability of freshwater aquaculture are as follows:

1. The current condition can be described as 1(H)-2(L)-3(L)-4(L)-5(L)-6(L)-7(H)-8(L)-9(L)-10(L), namely high dependence on the fisheries sector, low profitability of aquaculture business, low market concern for sustainability, low distribution of fisheries marketing, low knowledge of environmental sustainability, low level of socialisation of environmental conservation efforts, high harvest handling, low/small pond size, low application of customary rules and local wisdom, low mitigation of environmental damage.

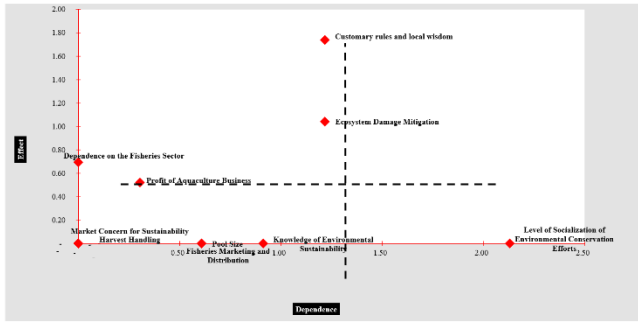

Figure 11. Result of Prospective Analysis of Sustainable Scenarios in West Pasaman Regency, West Sumatra, Indonesia
Source: PPA Software

2. The conservative-pessimistic scenario is one that involves repairs to key components at a minimum level. The cost-efficiency of improvements is taken into consideration in the improvement efforts, namely 1(M)-2(M)-3(M)-4(M)-5(M)-6(M)-7(H)-8(M)-9(H)-10(H), namely moderate dependence on the fisheries sector, moderate profitability of aquaculture business, moderate market concern for sustainability, moderate distribution of fisheries marketing, moderate knowledge of environmental sustainability, moderate level of socialisation of environmental conservation efforts, high harvest handling, moderate pond size, high application of customary rules and local wisdom and high mitigation of ecosystem damage.
3. The moderate-optimistic scenario is one that involves improving about half (50%) of all key components (sensitive components) i.e., 1(M)-2(M)-3(M)-4(M)-5(H)-6(H)-7(H)-8(M)-9(H)-10(H) i.e. moderate dependence on the fisheries sector, moderate profitability of aquaculture, moderate market concern for sustainability, medium distribution of fisheries marketing, high knowledge of environmental sustainability, high level of socialisation of environmental conservation efforts, high harvest handling, medium pond size, high application of customary rules and local wisdom and high mitigation of ecosystem damage.
4. An optimistic progressive scenario is one in which all components are strived for in adequate conditions. This scenario is long-term and requires adequate financial support. Therefore, the implementation scheme is carried out in three stages, namely short term, medium term and long term. Implementation in the short term is emphasised on improving key components that must be done immediately. Meanwhile, the medium and long term prioritises problem solving on the supporting components of coastal area management. The success of the progressive-optimistic scenario is highly dependent on the strong commitment and seriousness of the local government, namely 1(L)-2(H)-3(H)-4(H)-5(H)-6(H)-7(H)-8(H)-9(H)-10(H), that is, low dependence on the fisheries sector, high profitability of aquaculture business, high market concern for sustainability, high/wide distribution of fisheries marketing, high knowledge of

environmental sustainability, high level of socialisation of environmental conservation efforts, modern harvest handling, adequate/wide pond size, good application of customary rules and local wisdom and good mitigation of ecosystem damage.

The results of identifying the key components, as shown in Table 4, are then used as a basis for developing scenarios for the future. Scenarios are developed using Focus Group Discussion (FGD). Stakeholders are asked for their opinion to estimate the future state of each determinant. Predictions of the future state of these variables can be used to develop scenarios that may occur in relation to fisheries management in West Pasaman Regency, West Sumatra, Indonesia, Participatory Prospective Analysis (PPA) is used to formulate scenarios.

Table 7. Condition of key components of sustainable fisheries in West Pasaman Regency, West Sumatra, Indonesia

No	Key Component	State Category		
		Low (L)	Middle (M)	High (H)
1	Dependence on the Fisheries Sector	1(L)	1(M)	1(H)
2	Profit of Aquaculture Business	2(L)	2(M)	2(H)
3	Market Concern for Sustainability	3(L)	3(M)	3(H)
4	Fisheries Marketing and Distribution	4(L)	4(M)	4(H)
5	Knowledge of Environmental Sustainability	5(L)	5(M)	5(H)
6	Level of Socialization of Environmental Conservation Efforts	6(L)	6(M)	6(H)
7	Harvest Handling	7(L)	7(M)	7(H)
8	Pool Size	8(L)	8(M)	8(H)
9	A Customary rules and local wisdom	9(L)	9(M)	9(H)
10	Ecosystem Damage Mitigation	10(L)	10(M)	10(H)

Using PPA, we found that customary rules and local wisdom, as well as mitigation of ecosystem damage, are key components in achieving sustainability in freshwater aquaculture fisheries. The sustainability analysis results, obtained using the RAPFISH software and presented in Table 2, demonstrate that customary rules and local wisdom are important factors in this analysis, as shown in Table 7.

Table 7 indicates that the values of local wisdom, implemented by the community so far, are embodiments of the conservation principles applied to preserve fishery resources. Traditional resource-conserving communities enforce specific rules to prevent over-exploitation; for example, they strictly control the harvesting process and prohibit hunting or harvesting in designated areas. Violations of these rules result in established customary sanctions. Table 7 indicates that the three scenarios analyzed are mostly unlikely to be implemented.

Table 8. Prospective analysis: Scenarios for the sustainability of fisheries in West Pasaman Regency, West Sumatra, Indonesia

No	Scenarios	Rank
1	Conservative-Pessimistic	1
2	Moderate-Optimistic	2
3	Progressive-Optimistic	3

Based on Table 8, the conservative-optimistic scenario is ranked 1, the moderate-optimistic is ranked 2, and the progressive-optimistic scenario is ranked 3. Therefore, the conservative-optimistic scenario is considered the most likely scheme to be implemented in the management of fisheries in West Pasaman Regency, West Sumatra Province. This is because the scenario involves improvements to key components at the minimum level with the efficiency of repair costs being considered in the improvement effort. The results of the sustainability analysis in each dimension with the RAPFISH application in Tables 2, 3, 4 and 5, and Figure 11 show an economic dimension sustainability index value with a value of 32.61, which is considered to be the lowest sustainability index found in the less sustainable category. Next comes the social dimension with a sustainability index value of 47.69 in the less sustainable category. The technological dimension of the sustainability index value is 69.16 in the moderately sustainable category. The ethics and governance dimension with a value of 49.20 is categorised as less sustainable. The multidimensional sustainability index value of freshwater aquaculture in West Pasaman Regency, West Sumatra Province is 49.67, found in a less sustainable status, and therefore the sustainability value of management needs to be improved through improvement efforts on the key components involved.

The main assets of local wisdom that are kept and managed collectively concern the different species of fish that live there. Obviously, the management of fisheries systems cannot be separated from the three dimensions that are inseparable from each other. These are related to fisheries resources and their ecosystems, those relating to the exploitation of fisheries resources for the socio-economic interests of the community, and those relating to fisheries policy itself. These results support the study [63] that found that managing fisheries to meet social, economic, and environmental objectives is a fundamental problem in fisheries management worldwide, involving a complex set of national and sub-national policy arrangements. The shift in societal objectives from maximizing yield to a greater emphasis on ecosystem protection has led to major conflicts in the courts and in policy-making. While continued conflict seems inevitable, there is a growing convergence in a number of areas between those advocating greater ecosystem protection and consumptive users seeking profitability and stability.

The values and norms in the form of local wisdom held by a community, which constitute the wisdom of the community in the management of natural resources and the environment, can be empowered. Fisheries activities with community-based economic empowerment are very important and strategic for economic progress in the form of fisheries systems management in improving people's welfare. According to observations and interviews in West Pasaman Regency, West Sumatra Province, local knowledge is usually well integrated with the norms, culture, and belief systems expressed in traditions and myths. Local wisdom is generally expressed in the form of taboos and prohibitions that must be followed by

the community in the management of fishery resources. Both taboos and prohibitions have different philosophical underpinnings. The taboos have a religion-magical pattern, while the prohibitions are closely related to the rules of customary law in that society. Although they have different foundations, both taboos and prohibitions are in favor of the balance of nature as a guarantee of life for community members. In West Pasaman Regency, there are several elements that apply to the management of prohibited fishing, namely customary institutions, customary law provisions and myths, and community-based forms of fisheries resource management. These include the closing of seasons or areas at certain times of the year to ensure that harvesting or catching fish in these areas is limited to sustainable periods, such as coinciding with the religious holiday of Eid al-Fitri.

From an ecological point of view, fishing according to local wisdom values allows fish to grow and reproduce properly, and fish can be harvested when they reach a certain size, thus protecting them from extinction. The local wisdom management system implemented by the community is a participatory, adaptive, and sustainable community wisdom system to conserve fishery resources, especially local fish. Forbidden fishing refers to areas where fish are strictly protected and prohibited from being caught. These areas serve as habitats for fish species that cannot be harvested or taken in any manner. The selection of fish species kept in these areas is usually based on their economic value. In West Pasaman Regency, West Sumatra Province, Indonesia, the species of local freshwater fish that are prohibited to be fished, which are mostly cultivated in rivers, are Gabus (C*hanna striata*) and Baung (M*ystus nemurus*), which are local fish that have economic value. In West Pasaman Regency, West Sumatra Province, there are several species of local fish that are farmed in each subdistrict. These are fish species that have economic value and, if developed, will have an impact not only on the community in terms of the surrounding economy, but also on nature in terms of economic, social and socio-cultural impacts. These results support a study [64] that highlights the importance of the local government's goal in the management of the fishery to provide a source of income and food for community members. There are two broad approaches to achieving this: helping fishers to become more effective harvesters and improving the quality of the fishery. This approach could also be adopted in West Pasaman Regency, West Sumatra Province, to enhance economic outcomes through socio-cultural empowerment.

This culture has been adopted by the people of West Pasaman Regency, West Sumatra Province, Indonesia. The habit of conserving water, especially for fishing, is deeply ingrained among the people of West Pasaman Regency. The community highly values the use of water because water is the source of life for the community. These results support research [65] that shows how people consider drinking water, groundwater, mountain snow, water for power generation and rivers/lakes (surface water) to be very important issues because they are essential human needs. Because water resources are important for human life, these resources must be managed as much as possible. in the future, if management and preservation are not carried out, it is possible that these water resources will be destroyed and cause drought. These results support research [66] showing that the best strategy for dealing with drought should start with a vulnerability assessment, which will have several purposes, namely to prioritize the implementation of prevention and mitigation measures, to understand where and how to improve adaptive capacity, to identify where and how exposure and vulnerability should be reduced, to optimise resource allocation and, more generally, to support better water management as was done in this study.

The results of this paper support other research [67], aimed at helping the government to make policies regarding the preservation of water resources in places where the community poorly participates in environmental activities (20.1% and 30.3%). Additional research [68] also corroborates with the findings. It suggests that in order to generate public interest in environmental programs, it is imperative to increase awareness about the diverse interests of social groups, shift focus from economic pressures to economic benefits, and promote ecological lifestyles through media and additional public education.

The inclusion of local culture in development programs is supposedly crucial for managing natural resources across different sectors. It is believed that drawing from community culture can offer valuable insights and solutions to address the challenges brought about by environmental changes. The values and norms of a community, particularly in terms of managing natural resources and the environment, can be enhanced through community-based economic empowerment initiatives focused on fishing activities. These initiatives play a crucial role in promoting economic progress through fisheries management cultivation, ultimately aiming to improve the overall welfare of society. From an economic and cultural point of view, this will have an impact on improving the welfare of the community, where participatory, adaptive, and sustainable culture, in the form of local wisdom values, has the potential to improve the local economy.

6. CONCLUSIONS

Previous studies have failed to address the sustainability status of the fisheries sector in West Pasaman Regency, West Sumatra Province, Indonesia. However, this research has taken the initiative to reveal and measure this crucial aspect. This research has also offered scenarios that can be carried out by stakeholders to achieve the sustainability of the fisheries sector in the future. The sustainability index in West Pasaman Regency, West Sumatra Province, is calculated to be 46.97, which is considered to be of a fairly sustainable status highlighting the importance of local knowledge and mitigation of ecosystem damage. The research identifies the primary factors to attain sustainable fisheries. The economic dimension is dependent on fishing sectors, whereas the social dimension necessitates knowledge of environmental sustainability. Furthermore, the technology dimension involves efficient harvest handling. Lastly, ethical and governance dimensions emphasise customary rules and local wisdom.

The probable strategy for managing fisheries in West Pasaman Regency, West Sumatra Province is deemed to be the conservative-optimistic scenario. Analysis via RAPFISH indicates that the conservative-pessimistic scenario is most likely to be implemented immediately as it involves minimum level enhancements of essential components with efficient repair cost consideration. Therefore, these key components require improvements to enhance management sustainability.

This research proves that local knowledge, a concept that has been around for ages, has an economic impact - whether direct or indirect. It is also claimed to contribute to

environmental conservation and the prevention of degradation. The ultimate goal is achieving sustainable fisheries, but despite the abundance of resources, it seems that this has not improved the welfare of the community. There is a strong need for further community empowerment. The studies also demonstrate the significance of adhering to traditional regulations and local knowledge in upholding the long-term sustainability of fisheries in the study area. Furthermore, a recent study underscores the significance of decentralising fisheries policy and involving native communities in the decision-making procedures. This method is viewed as a practical remedy for tackling the concern of resource depletion in fisheries.

Forbidden fishing is an example of conservation practices based on local knowledge of the community in their environment. Communities have the knowledge capacity to utilize natural resources, which indirectly has positive consequences in terms of conservation efforts. The principle of conservation is a conscious effort made by the community to preserve the resources they have for an indefinite period of time. Local knowledge is a potential factor in supporting the sustainability of resource management. However, this local knowledge must be continuously updated and enriched.

7. RECOMMENDATIONS

In this study, we demonstrate that the reinforcement of traditional regulations and indigenous knowledge, as well as the reduction of harm to ecosystems, is a crucial element in attaining sustainable fisheries. To ensure the sustainability of fisheries resource management, it is necessary that authorities conduct an ecosystem-based approach (conservation), as defined by the Law No. 32 of 2009 by involving all stakeholders and by establishing the 2 regional management zones namely: regional zone and conservation regional zone.

It has been found in this study that local knowledge plays a crucial role as an existing but untapped resource in the community. It is hoped that the government will develop policies regarding environmental mitigation in the fishing industry that counteracts current Indonesian fisheries law and policy which are seen as being dominated by hierarchical and centralised governance models, with numerous shortcomings compared to participatory governance. For the future, implementing participatory governance in policy-making could be beneficial.

The results of this study show that the West Pasaman Regency of West Sumatra Province is one of the districts that has a uniqueness in applying the culture of prohibited fishing and thus can be considered as a Minapolitan area according to the Regulation of the Minister of Marine Affairs and Fisheries No. 12 of 2010. This approach would be intended to utilise existing land and its potential to overcome problems faced in managing and structuring space for activities that utilise abundant fishery products.

Further research is needed to analyse the condition of the fisheries sector in West Pasaman Regency, West Sumatra Province, Indonesia with the aim of analysing the strengths, weaknesses, opportunities and challenges of the fisheries sector, especially from an ecological perspective so that appropriate risk mitigation can be determined. Furthermore, although it is beyond the scope of this article, it may be valuable to build on this study by conducting further research with additional dimensions and comparing the results with findings from similar research in other provinces in Indonesia and other countries.

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