Miangas, the Outermost Small Island of Indonesia

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Abstract

This study was aimed at producing a management strategy of Miangas island as an outermost small island of Indonesia adjacent to Phillippine based on ecological, economic, social, legal and institutional, and political sustainability. Data analyses used multidimensional scaling (MDS) using RAPFISH (Rapid Appraisal for Fisheries Status) with Eucliden Distances. Results showed that education level was relatively low to the education level of North Sulawesi Province, market was still traditional, and mean income relative to regional minimum wage was still too far below the community's income. For future sustainability, people of Miangas island should strengthen the education development of the local communities, the market, and the strengthen the future economic capacity of the local communities. In addition, government subsidy needs to be provided to strengthen the economic condition in order for future self-support.

Keywords: Management; Miangas island; sustainability; MDS; Rapfish.

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1. Introduction

In general, the sustainability aspects of Miangas island development are defined as ecological, economic, social, legal and institutional, and political sustainability. Resource management pattern of Miangas Island is conditioned and added political dimension aspects [1]**.** Appropriate political and dimenaionl sustainability approaches are considered as indicators. These are data aggregates possessing important interests, so that there are augmentable measures, political sustainability and their attributes.

Multi-dimensional scaling is a technique of visual determination of point positions to ease the point plots in Rapfish method. Nevertheless, socio-cultural and political aspects so far neglected need serious attention in order to manage the resources of Miangas island, so that attemps to distribute proportional income among various resources user groups of Miangas island, such as fishermen and non-fishermen, large-scaled fishermen and small-scaled fishermen, and labor fishermen and owners could be achieved. Marine resources utilization should be limited to control of number of fishing efforts and or catches that excessive efforts, investment or labors could be avoided [2].

Sustainable development is a development strategy that gives thresholds on the utilization rate of natural ecosystem and its resources. The threshold is not absolute but flexible one depending upon the technological and socio-economic conditions of the natural resources utilization and the carrying capacity to receive the impact of human activities. This study added political aspect to obtain the management strategy of Miangas island since it is one of the outermost island that possibly face high political importance.

2. Method

2.1 Sustainability of Miangas island

Data analyses used multidimensional scaling (MDS) using RAPFISH (*Rapid Appraisal for Fisheries Status*) with Eucliden Distances. MDS was based on Euclidien Distance that can be written in n-dimensional space as follows [3]:

$$d = \sqrt{\left(\left[x_1 - x_2\right]^2 + \left[y_1 - y_2\right]^2 + \left[z_1 - z_2\right]^2 + ...\right)} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (1)$$

In 5 dimensions of Miangas island, it was expressed as

$$d = \sqrt{\left(\left[Ek_1 - Ek_2\right]^2 + \left[En_1 - En_2\right]^2 + \left[Hk_1 - Hk_2\right]^2 + \left[Pk_1 - Pk_2\right]^2 + \left[Ss_1 - Ss_2\right]^2\right)} \dots\dots (2)$$

Where : Ek = ecological dimension

En = economic dimension

Hk = legal and institutional dimension

Pk = Political dimension

Ss = Social dimension

The configuration or ordination of the point was then approximated through regressing the Euclidien distance (d_{12}) and point 1 to point 2 with original point (σ_{12}) as shown in the following equation :

$$d_a = n + \beta\delta_{12} + e \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots(3)$$

ALSCAL method optimizes the squared distance (d_{ijklm}) against quadratic data (original point = 0_{ijklm}), in which the formula called S-stress is written in 5 dimensions ($_{12345}$) as follows:

$$S = \sqrt{\frac{1}{m}\sum_{k=1}^{m}\left[\frac{\sum_1\sum_2\sum_3\sum_4\left(d_{12345}^2 - O_{12345}^2\right)^2}{\sum_1\sum_2\sum_3\sum_4 O_{12345}^4}\right]} \quad \dots\dots\dots\dots\dots\dots\dots(4)$$

Sum of squares is loaded Euclidian distance or expressed as $\quad d_{12345}^2 = \sum_{a=1}^{r} W_{ka}\left(x_{1a} - x_{5a}\right)^2 \quad \dots(5)$

Each measurement of fitness condition (goodness of fit), i.e distance of estimated point and original point, is very important. *Goodnest of fit* in MDS was intended to see how well the measurement was. In Rapfish, good model will be indicated by the stress value lower than 0.25 (S ≤ 0.25).

Rapfish analysis of Miangas island was done through scoring the number of 5 dimensions consisting of ecological, economic, social, legal and institutional, political dimensions, then *multidimensional scalling* (MDS) and ordination method were used to relatively evaluate the sensitivity of Miangas island. This study deliberately applied political dimension, since Miangas island needed the sustainability of political dimension in relation with its outermost position and existence.

There are several superiorities of Rapfish under 5 dimensions: RAPFISH can measure and simply and entirely describe all aspects of a condition or area [3]. Multivariate can also handle non-metric data [4]. To implement RAPFISH in Indonesia with characteristics of tropical fisheries, multispecies, open access and as developing country, it remains actual to measure and describe the sustainable condition of Indonesia marine and fisheries. The use of RAPFISH analysis is still relevant because the actual data describing the condition of aquatic area management in Indonseia still very limited. The attributes used to valuate the development sustainability of each dimension were as follows:

• **Ecological dimension :**

Ecological dimension is a reflection of aquatic environmental and resources stresses with their natural processes.

Table 1: Ecological dimension and attribute of sustainability in Miangas island.

Dimension and Attribute	Score	Good	Bad	Remarks
Ecological dimension				
Exploitation pressures from fishing	0,1,2,3,4	0	4	According to FAO and Rapfish : (0) low; (1) full; (2) Very severe; (3) overfished; (4) collapsed
Pressure from Aquatic utilization	0,1,2	0	2	(0) low; (1) moderate; (2) high
Marine ecotourism condition	0,1,2	2	0	Environmental damage: (0) do not care; (1) sufficient; (2) highly concern
Utilization level of	0,1,2,3	3	0	(0) Overcapacity; (1) low;
Marine tourism object				(2) moderate; (3) optimal
Percent cover of live corals	0,1,2,3	3	0	Based on Gomez and Yap (1978) : (0) 0 - 25 %; (1) 26 - 50 %; (2) 51 - 75 %; (3) > 76 %
Seagrass cover condition	0,1,2,3	3	0	Analog to coral reefs: (0) < 25 %; (1) 26 - 50 %; (2) 51 - 75 %; dan (3) > 76 %
Ratio of vegetation cover over terrestrial	0,1,2	2	0	Based on Dahuri et al. (1996) : (0) < 30 %; (1) 30 - 50 %; (2) > 50 %
Groundwater utilization condition	0,1,2	0	2	(0) low; (1) moderate; (3) high
Waste disposal on the sea bottom	0,1	0	1	(0) absent; (1) present
Landfills availability	0,1,2	2	0	(0) none; (1) not all islands are occupied; (2) occurs in all inhabited islands
Change in island area	0,1,2	2	0	(0) smaller and smaller; (1) bigger and bigger; (2) constant
Change in fish individual size of catch (last 5 years)	0,1,2	0	2	Referring to Rapfish : (0) no change; (1) slightly reduce; (2) highly decline

• Economic dimension :

`Economic dimension describing management degree of human economic activities in in Miangas island has 7 attributes of this dimension (Table 2).

Table 2: Sustainable economic dimension and attributes in Miangas island.

Dimension and Attribute	Score	Good	Bad	Remarks
Economic				
Profit	0,1,2,3,4	0	4	Refer to Rapfish : (0) highly profitable; (1) marginally profitable; (2) break even; (3) slightly lost; (4) severely lost
Contribution to Gross Domestic Product(GDP)	0,1,2	2	0	Refer to Rapfish: (0) low; (1) moderate; (2) high
Mean relative income on minimum regional wage	0,1,2,3,4	4	0	Refer to Rapfish : (0) too low; (1) low; (2) avarage; (3) higher; (4) much higher
Profit transfer	0,1,2	0	2	Refer to Rapfish : (0) particularly in local community; (1) equal between local people and outsider; (2) more profitable in domestic foreigners
Market size	0,1,2	0	2	Refer to Rapfish : (0) local market; (1) national market; (2) internasional market
Subsidy	0,1,2,3,4	0	4	Refer to Rapfish : (0) absent; (1) low; (2) high; (3) highly dependent; (4) absolute necessity
Change in number of economic infrastructures (last 10 years)	0,1,2	2	0	(0) decline; (1) constant; (2) increase

• **Legal and institutional dimension**:

This dimension describes legal and institutional degrees in Miangas island as shown in Table 3.

• **Political dimension :**

Political dimension describes degree of human political acitivity management. It is based upon 9 attributes used to obtain sustainability contribution (Table 4).

• **Social dimension**:

Social dimension is measures of social level in Miangas island reflected from 11 attributes (Table 5).

2.2 Sustainability Analysis of Miangas Island

a. Scoring each attribute. Each attribute of management dimension was scored from 1-5 reflecting bad to good conditions, and 1-2 as unsuitable and suitable. The higher the value is, the higher the contribution to the management sustainability of Miangas Island.

b. Ordination determination with Multidimensional Scaling (MDS) Analysis. The use of the sustainability status position of Miangas island management included 4 categories shown in Table 6.

Table 3: Legal and Institutional Dimension in Miangas island.

Dimension and Attribute	Score	Good	Bad	Remarks
Legal and Institution				
presence of formal management regulations	0,1,2	2	0	(0) low; (1) moderate; (2) high
presence of traditional and belief/religious rules	0,1,2	2	0	(0) Absent; (1) moderate; (2) many
Socialization of natural resources and environmental management regulations	0,1,2	2	0	(0) never; (1) rare; (2) often
Presence of respected role Models	0,1,2	2	rendah (1) 0	(0) absent; (1) few; (2) many
Presence of law enforcement personeels on site	0,1,2	2	0	(0) absent; (1) few or rare; (2) many or often on site
Justice in law	0,1,2	2	0	(0) not fair**;** (1) sometimes fair; (2) fair
Transparency in policy	0,1,2	2	0	(0) not transparent ; (1) sometimes transparent or unclear; (2) highly transparent
Democracy in policy establishment	0,1,2	2	0	(0) none ; (1) sometimes democratic; (2)democratic
Water zonation establishment	0,1,2	2	0	(0) none; (1) present but violated; (2) present and obeyed
presence of "Limited entry"	0,1,2,3,4	4	0	Refer to Rapfish : (0) open access; (1) nearly none; (2) few; (3) mederate, (4) very high number
Legal violation in exploitation intensity	0,1,2	0	2	(0) absent; (1) few; (2) not many

c.   Leverage Analysis. This analysis was applied to determine the attributes holding the most sensitive role in ecological dimensions. The most sensitive attribute is indicated with high root mean square (RMS) using the pareto 70/30 calculation [5].

d.   Monte Carlo Analysis. This analysis was applied to evaluate the merits at the ordinace process. It was

used as a validity and fitness test in order to show the effect of error in indicator scoring, the effect of scoring variations from difference of values given by the researcher, the stability of repeated MDS analytical processes, the error of data input o/missing data, and the extent of stress value of MDS analysis [6].

Table 4: Sustainable political dimension and attributes Miangas island.

Dimension and Attributes	Miangas	Good	Bad	Remarks
Politics				
Number of regulations obeyed	0,1,2	2	0	(0) poor; (1) enough; (2) many
No. Complaints	0,1,2	2	0	(0) none; (1) few; (2) many
No. Political cadres	0,1,2	2	0	(0) never; (1) rare; (2) many
No. Political Organization leaders	0,1,2	2	0	(0) none; (1) few; (2) many
Already following national vigilance training	0,1,2	2	0	(0) none; (1) few or rare; (2) many or often on site
Power of political party	0,1,2	2	0	(0) none; (1) low or rare; (2) many or often on site
No. Protest rally in the last 5 years	0,1,2	2	0	(0) not transparent; (1) sometimes transparent or unclear; (2) very transparent
Political right utilization	0,1,2	2	0	(0) none; (1) sometimes; (2) democratic
Politic-impacted ethnics	0,1,2	2	0	(0) not transparent; (1) sometimes transparent or unclear; (2) very transparent

3. Results and Discussion

This study used 5 sustainability dimensions with attributes used [1] with modification of several attributes and addition of political dimension and its attributes in association with Miangas island. The use of political dimension in relation with the position of Miangas island as susceptible and isolated outermost Indonesia island. Looking this condition, the sustainability values need to be strengthened due to its political integration to Indonesia. Therefore, the political attributes of its existence need to be strengthened with other outermost island, Marampit island, as comparison.

Table 5: Sustainable social dimension and attributes in Miangas island.

Dimension and Attributes	Score	Good	Bad	Remarks
Social				
Job Socialization (individual atau group)	0,1,2	2	0	Refer to Rapfish : (0) work done individually; (1) work together in one family; (2) working in group
No. Families exploiting resources	0,1,2	0	2	Refer to Rapfish : (0) < 1/3; (1) 1/3 - 2/3; (2) > 2/3; of total family numbers in the community
No. Families doing marine tourism services	0,1,2	0	2	(0) < 1/3; (1) 1/3 - 2/3; (2) > 2/3; of total family numers in the community
Growth of exploitation work (last 10 years)	0,1,2,3	0	3	Refer to Rapfish : (0) < 10 %; (1) 10 - 20 %; (2) 20 - 30 %; (3) > 30 %
Knowledge of environment	0,1,2	2	0	(0) very low; (1) enough; (2) a lot
Education level relative to provincial level	0,1,2	2	0	(0) low; (1) average; (2) above
Conflict frequency	0,1,2	0	2	(0) absent; (1) few; (2) high
Income from exploitation relative to total revenue	0,1,2	2	0	Refer to Rapfish : (0) < 50 %; (1) 50 - 80 %; (2) > 80 %
Family partisipation in resource use	0,1,2,3,4	4	0	Modified from Rapfish : (0) absent; (1) 1 - 2 family members; (2) 3 - 4 family members; (3) 5 - 6 family members; (4) more than 6 family members are helping the main worker including processing and marketing
Community roles in management	0,1,2,3,4	4	0	(0) very negative; (1) negative; (2) neutral; (3) positive; (4) very positive
Information distribution and training frequency	0,1,2,3,4	4	0	(0) never exist; (1) once in 5 years; (2) once a year; (3) twice a year; (4) minimum 3 times a year

Table 6: Ordination determination with Multidimensional   Scaling (MDS) analysis.

Table of sustainability status category. No	Index Value	Category
1	X < 25	Unsustainable
2	$25 \leq x \leq 50$	Less sustainable
3	$50 \leq x \leq 75$	Sufficiently sustainable
4	$75 \leq x \leq 100$	Sustainable

Several sustainability development considerations of Miangas island are as follows:

(1) The use of sustainable fisheries resources and its processing activities should be based on certai maritimal ecosystem and well identified.

(2) Maintaining the resources carrying capacity against long-term exploitation activities.

(3) developing labors in fisheries in broader communities.

(4) Maintaining the health and the integration of marine ecosystem for other usages, including living diversity, science, intrinsic value, tropical structure, and other economic benefits, such as tourism and recreation.

The objective of sustainable development is in line with the goals of Miangas island development, for instance, fisheries resources stock preservation and their habitat protection. Nevertheless, managing fisheries resources for sustainable development is multi-dimensional and multilevel activities that should consider more aspects than sustainability of fish and itsown fisheries [7].

The knowledge of fisheries system dynamics can be used to address the changes and variations in components and the interactions between components with time in fisheries system. Time factor becomes very important since it becomes determining factor in the dynamic of fisheries system. Time could be distinguished [8] into (1) daily to weekly, (2) monthly to seasonal, (3)yearly, (4) interannual, and (5) decade or longer. Fishing operation can be done in several hours, daily, or weekly (small-scaled fishermen) or monthly or yearly (large scale), depending upon technological capacity, fishing ground distance, and fishing target.

1). Ecological dimension

Exploitation pressures from fishing was low (0), pressure from water use was low (0), marine ecotourism condition was concern enough (1), utilization level for marine tourism object was moderate (2), percent cover of

live corals (1) was good enough), seagrass cover condition (1) was good enough, ratio of vegetation cover over the land (1) was good enough), groundwater use condition (1) was moderate, waste disposal on sea bottom (0) was absent, presence of landfills (0) was absent, change in island area (2) was constant, and change in individual size of fish caught in the last 5 years (0) does not occur. These means that Miangas island ecologically reflects sufficient;ly good condition.

2). Economic dimension

Economic dimension was indicated with 7 attributes that profit was marginal (1), contribution to Gross Domestic Product (0) was low, mean income relative to regional minimum wage (0) was too low, profit transfer (2) gave more profit to the outsiders, market size (2) was international, number of subsidies (3) was highly dependent, change in number of economic infrastructures in the last 5 years (2) increased. These conditions indicates that government needs to strengthen the development of economic infrastructures in order to raise other attribute performance.

3). Legal and institutional dimension

In this dimension, there were many formal management regulations (2), many presence of traditional and belief/religious rules (2), few information distribution of resource and environmental management law (1), many respected role models (2), and high presence of law enforcement personeels on site (2). Fairness sometimes occurs (1), policy was sometimes transparent (1), democracy in policy establishment sometimes occurred (1), land and/water zonation was present but violated), limited entry was open access (0), violation in exploitation intensity were high (0). These conditions reflect that Miangas island is dominantly traditionally managed and has low control of formal regulations.

4). Political Dimension

Political dimension describes degree of human political activity management. Number of regulations implemented were high (2), number of complaints were also high (2), number of political cadres was low (1), number of political organization leaders was low (2), presence of national awareness upgrading was few or rarely present (1), power of political party was also few or rarely present (1), number of protest rally in the last 5 years was sometimes transparent (1), the use of political right was democratic (2), and politic-impacted ethnic was sometimes transparent or unclear (1). These conditions put Miangas island in weak position, but this aspect could be internationally important due to its position in the border cross area. Therefore, more attention should be given by Indonesia Government in order to increase the national awareness of the local communities.

5). Social Dimension

Job socialization was done in group collaboration (2), number of families doing resource exploitation was more than 2/3 (2) and tourism service less than 1/3 (0). Growth of exploitation work in the last 10 years was less than 10% (0), environmental knowledge was enough (1), education level relative to provincial level was low (0), and conflict frequency was absent (0). Income from exploitation relative to total revenue ranged from 50% - 80%

(1), family's participation in resource utilization was 2 persons (1), community's role in management was positive (3), and information distribution and training frequency was at least 3 times a year (4). These conditions demonstrate that social aspects work well through family participation. Low education does not inhibit the community to manage the resources due to high contribution of information distribution and training frequency in the island.

3.1 Sustainability Analysis of Miangas Island

1.   Multidimension
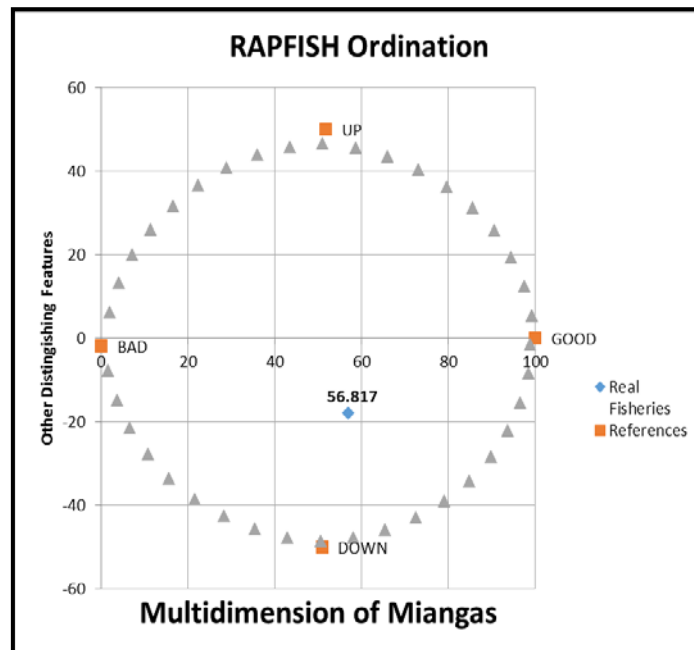
Stress =	0.1285691
Squared Correlation (RSQ) =	0.9540066
Number of iterations =	2

Figure 1

4. Conclusion

Based on the sustainability analyses, this study concluded that

1. Based on sustainability analysis on 5 dimensions of Miangas island, 3 largest main issues were found in order for sustainability:

    a. Education level was relatively low to the education level of North Sulawesi Province
    b. Market of Miangas island was still traditional
    c. Mean income relative to regional minimum wage was still too far below the community's income.

2. For future sustainability management, people of Miangas island should:

1) Strengthen the education development of the local communities

2) Strengthen the market in Miangas island

3) Strengthen the future economic capacity of the local communities

4) Ordination determination with Multidimensional Scaling (MDS) Analysis. The use of the sustainability status position of Miangas island management included 4 categories shown in Table 10.

5) MDS found the economic value of 18.416 (X<25) meaning unsustainable, so that central and local governments should provide subsidies to support the economy of Miangas island to be self-support.
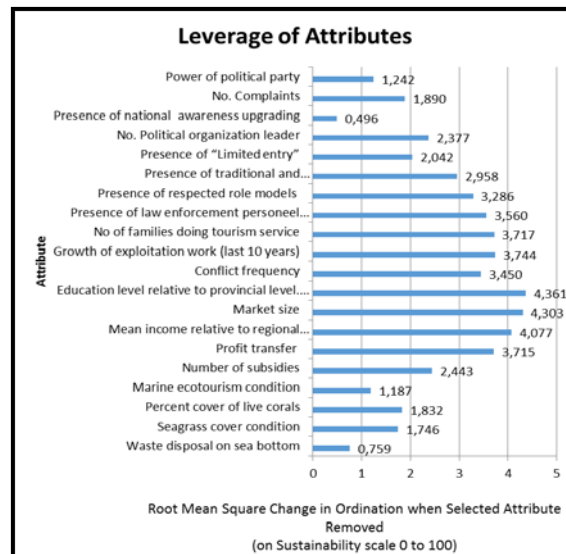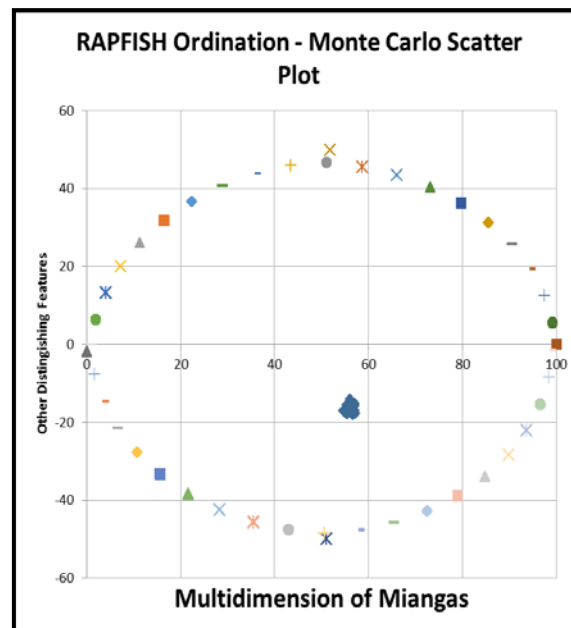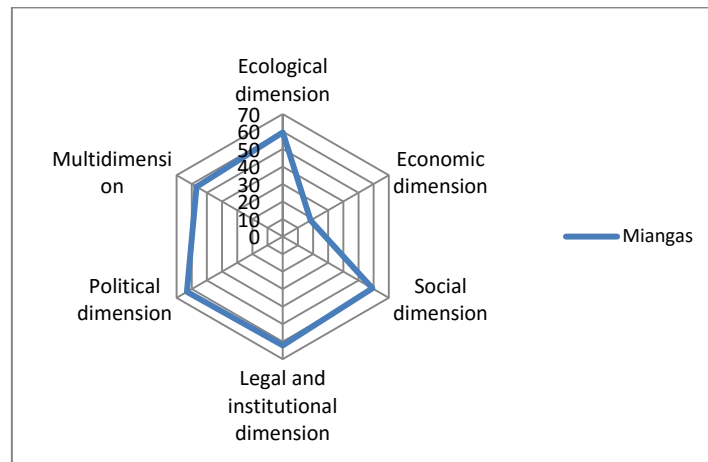

Figure 2

Figure 3

2' Kite Diagram

	Miangas
Ecological Dimension	59.497
Economic Dimension	18.416
Social dimension	59.196
Legal and institutional dimension	62.192
Political dimension	63.1850
Multidimension	56.817

Figure 4

Poverty and education are as 2 sides of coin, difficult to separate, and difficult to determine which are affecting, whether because the fishermen are poor and therefore cannnot get good education opportunity, or their low education has caused them difficult to remove the poverty? However, we believed that better education level could change their thinking pattern and way to easily adapt to the development.

Acknowledgement

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