Journal of
Oceanography and Marine Research

Multi Dimension Scale Analysis Approach to Evaluate Sustainability in the Management of Ambon City Coastal Area

Berhitu PT*, Hutabarat S, Supriharyono and Suprapto D

Faculty of Fishery and Oceanography, University of Diponegoro, Semarang, Indonesia

Abstract

The development process of coastal zone in Ambon city has been confronted with various problems such as the imbalance between development and carrying capacity, unsustainable resource utilization, lack of synergy in management amongst stakeholders, poor legal framework in management and population growth. These issues must be evaluated in order to realize an integrated and sustainable management of the coastal area. The research aimed at understanding the sustainability level of coastal zone management of Ambon City by using multi dimension approach. Research data were obtained from primary and secondary data source. Five dimensions analyzed were: legal and institutional, ecology, technology and infrastructure, economy, and sociocultural. Analysis was done by using Multidimensional Scale (MDS). Research result of 51 attributes of the five dimensions showed multidimensional sustainability index of 50.13% categorized as unlikely to be sustainable. Ecology dimension is 42.74% categorized as unlikely to be sustainable, economic dimension is 50.50% categorized as relatively sustainable, sociocultural dimension is 52.12%, categorized as relatively sustainable. Technology and infrastructure dimension is 51.29%, legal and institutional dimension is 56.88%, categorized as relatively sustainable. Of the 51 attributes analyzed, there are 12 sensitive attributes which affects the sustainability of the coastal area management. Evaluations and interventions on these 12 attributes must be done proportionally by considering the correlation amongst these attributes on coastal zone management of Ambon City in an integrated way.

Keywords: Ambon city; Sustainability; Multi dimension; Coastal zone

Introduction

Integrated and sustainable management of coastal resource is an iterative and evolutionary process to realize an optimal and sustainable development of a coastal area. The goal of Integrated Coastal Zone Management is not only to pursue short term economic growth but also to ensure that the economic growth can be enjoyed equally and proportionately by all stakeholders involved. It also preserves the carrying capacity and the quality of coastal environment which leads to a lasting development [1-6].

There are four aspects related to integration in planning and management of coastal zone, they are: (a) Ecological area integration, (b) Sectoral integration, (c) Knowledge discipline integration, and (d) Stakeholder integration [3,5,7,8]. Ambon is one of 26 coastal cities in Indonesia. These coastal cities are very sensitive to environmental degradation especially when development is over-exploited. Therefore, planning and management of coastal city is crucial as an effort to create integrated and sustainable coastal area development. City development can be categorized as sustainable when three criteria of sustainable are fulfilled; they are ecology, economy and social [3,5,7,9,10]. Sustainable development concept doesn't only emphasize on economic aspect, but also social and ecological [4,5,11].

Ambon city, the capital of Maluku province, has a total area of 786 km^2, its land size is approximately 377 km^2 around the beach in Outer and Inner Ambon Bay with sea size of 409.0 km^2 (52.0%) and coastal line of 102.7 km. It has large sea and coastal resource [12,13]. As laid out in regional and spatial plan of Ambon city 2011-2031, medium term development plan of the city is aligned towards waterfront city concept [14-16]. In its development as a waterfront city in the last 15 years, the coastal area around Ambon has grown and expanded rapidly because its coastal area has high economic and ecological value. This coastal area is the vein of economic activities of the people, because almost all of their daily activities are concentrated at the coastal area.

There are various sea and coastal resource potency in Ambon city; for example, fishery, tourism, and large environmental service. To illustrate, fishery potency such as pelagic fish has sustainable potency of 1.045 tonne/month, demersal fish has sustainable potency of 240 tonne/month, and consumed coral fish has sustainable potency of 11.36 tonne/hectare. Sustainable potency of ornamental coral fish is up to 38.564 individual/hectare, the utilization of all kinds of fish in 2013 on average was still below the sustainable potency [12,13]. Coral reef potency in the water of Outer Ambon Bay is approximately 394.71 hectares. In 2012, fishery sub-sector contributed 14.93% to the total Gross Domestic Regional Product (GDRP) of Ambon city [17].

Tourism potency in Ambon is dominated by beach tourism with the total of 71 sites, natural marine tourism with 34 locations, land tourism has 13 objects, 1 local customary attraction and 1 cultural attraction in its 5 sub-districts [18,19].

As development intensify in coastal area, activities such as settlement, agriculture, cold storage, harbor, government administration, sea transportation, market, capture fish, aquaculture fishery, fish landing sites, conservation of mangrove forest, industrial sites, tourist spots and navy base took place in the area [20,21]. This activities has created issues and problem at the coastal area such as imbalance of development and carrying capacity, customary land tenure, unsustainable land usage, demographic issue (population growth), lack of synergy in managing coastal area amongst stakeholders, overlapping interests in coastal area,

weak legal framework, lack of participation from community to manage coastal resource, physical damage to coastal environment, as shown by high level of abrasion, erosion and sedimentation, pollution, damage to mangrove ecosystem, sea grass, and coral. There are also other issues such as discrepancies between spatial utilization of the area and regional and spatial plan, as well as weak rule of law and institutions [11,21-38]. The management of coastal zone resource is complex, dynamic and vulnerable to conflict of interests. Therefore "*sustainomic*" paradigm is needed to interact between bases of knowledge disciplines and to comprehensively create synergy between them and to exist among economic, social and environmental ecology dimension of a sustainable development [39]. This paradigm must be followed by policy instruments that is complementary and integrative between sectors, systematically impacted on economy, economically and institutionally effective, and is able to build economic independence of the people [40].

Based on the experiences that occurred in the coastal area of Ambon city that is almost as long as 15-20 years overcoming the various problems in arranging and managing coastal areas with the resources that are inside, causing various problems as has been said before. Supply constraints memberiakan outlines that during this coastal area management and its resources have yet to implement integrated management and sustainable. Domination conflict dianatar various intansi in the utilization of coastal areas, conflicts of interest, and various other issues resulted in the undertakings of the integrated and sustainable management in the city of Ambon still cannot be done optimally. In the city of Ambon during coastal management efforts undertaken by the city government with relevant agencies and refers to the city of Ambon 2010-2016 strategic plan and the regional spatial plan of Ambon city but within each-masing pelaksananannya intansi implement their own plans in the utilization of coastal areas with reference to the programs and plans of each of these institutions so as to avoid overlapping in pemanafaatan coastal areas. With so pesiisr regional management efforts and resources that are inside should be done in an integrated and sustainable. Generally in Indonesia there are many areas that have implemented pengelolaaaan coast using siatwm integrated in an integrated and sustainable, this situation may occur because there is a shared commitment anatara government, stakeholders and the entire intansi and the swsata and the community together to make various efforts sosialiasai, evalausi, as well as the implementation of the program ddemi creation in a sustainable management of a variety of dimensions, ecological, social, cultural and economic.

A research on evaluation of sustainable coastal zone management based on multi dimensional approach and review of land allocation based on zones is needed to find solution to these problems and to observe the role of various sectors in the development of coastal area in Ambon city.

Research objective on the evaluation of coastal zone management aims to determine the level of sustainability of coastal zone management Ambon city through the 5 dimensions of both the ecological, economic, social, cultural, technological and infrastructure as well as legal and institutional, as input and evaluation management efforts coastal area of Ambon by the government the current city is not based on principles of integrity and sustainability so that at the end of this study can be input in policy efforts pengembanagn integrated and sustainable development in the future

Material and Methods

The research was done in coastal zone of Ambon city in four sub-districts; Nusaniwe, Sirimau, Teluk Ambon, and Teluk Ambon Baguala

(Figure 1). Selection of 4 out of 5 sub-districts was done using purposive method by considering that these 4 sub-districts are priorized in regional development unit of Ambon city as stipulated in Regional and Spatial Plan. The research was conducted over 10 month period (September 2010–June 2015). Primary data collection was done directly in the field through surveys, discussions and questionnaires with experts, policy makers, government institutions, coastal communities, NGOs, academics and business practitioners. Additionally, secondary data were also collected from various official sources such as Regional Planning and Development Agency (Bappeda), relevant departments, Indonesia Science Institution (LIPI), Ambon Statistics Agency, Head of Sub-districts, Village Chiefs and community institutions.

Method used in conducting the analysis of sustainable coastal management in Ambon is Multidimensional Scaling (MDS) with Ra-Coastal Ambon (Rapid Appraisal Coastal Ambon) approach, where MDS is a multidimensional transformation analysis technique [41]. The result is expressed in an index of sustainability management of coastal zone of Ambon city. MDS is also a statistical analysis to understand similarity and dissimilarity of variables described in geometry space [42].

There are some steps that must be followed when using Multidimensional Scaling (MDS), first is to determine the dimensions and attributes through discussion with experts, assessment and ordinal scoring ranging from 0 (bad) to 3 (good) based on character attributes by selected respondents or based on collected data (primary or secondary) and evaluated based on sustainability status criteria of all dimensions between 0-100 (Table 1). Next step is to arrange MDS ordinance against the dimension of leverage factor of the attributes based on Root Mean Square (RMS) on x axis. The last step is to conduct Monte Carlo Simulation to understand the effect of errors in scoring. To determine precision in the analysis, Goodness of fit in MDS is determined based on S-Stress value which is calculated from S and R^2 value. Iteration process can be stopped when R^2 value is close to 1. This MDS method was selected because it allow to present result in comprehensive, quick, and objective way related to aspects that influence the management coastal area in sustainable way. Calculation of Euclidean distance and stress value in MDS is done as follows:

$$d^2 i = \frac{1}{n} \sum_j d^2 ij \tag{1}$$

$$d^2 j = \frac{1}{n} \sum_i d^2 ij \tag{2}$$

$$d^2 = \frac{1}{n^2} \sum_{ij} d^2 ij \tag{3}$$

Sustainablity analysis procedure with MDS is completed based on Figure 2.

MDS (Multi Dimension Scale) data analysis

In order to perform data analysis by using MDS method, primary and secondary data were collected from expert respondents, relevant government institutions, community, and community institutions according to the 5 dimensions studied; i.e., technology and infrastructure, ecology, legal and institutional, sociocultural, and economy. Next, the data were used to analyze the level of sustainability with MDS. Tables 2 and 3 shows data on results in economy and ecology to represent other dimensions.

Result and Discussion

Index value and sustainability status of ecological dimension:

Sustainability index value based on MDS analysis of ecological dimension is 42.74%. This value sits between poor and good, but the
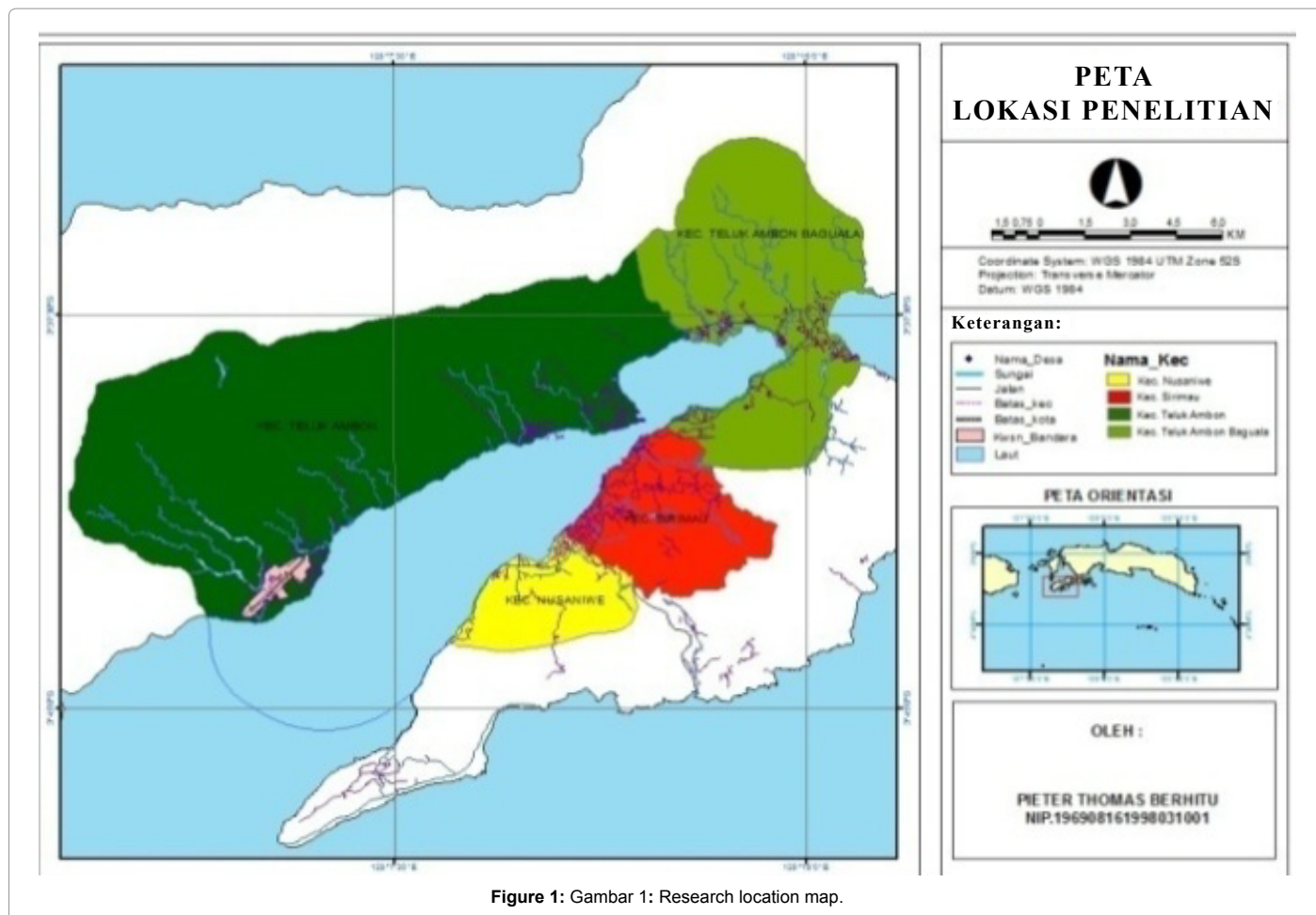
Figure 1: Gambar 1: Research location map.

Index Value	Catagory
0 .00 – 25.00	Bad (Unsustainable)
25.01 – 50.00	Poor (Unlikely to be Sustainable)
50.01 – 75.00	Fair (Relatively Sustainable)
75.01 – 100.00	Good (Very Sustainable)

Source: Hartisari, 2006

Table 1: Index value and sustainability status.

result skewed towards poor (unlikely to be sustainable) as presented in Figure 3. Some very sensitive attributes affected this dimension based on leverage factor analysis of the 10 attributes. As can be seen from the Root Mean Square (RMS), 3 attributes were considered as very sensitive and contributes to this dimension; those are level of coastal physical damage (erosion, abrasion, sedimentation and pollution), level of land conformity, and the level of coastal ecosystem damage (mangrove, coral reef, sea grass, and fishery).

Analysis result in Figure 3 shows that the most sensitive attribute based on RMS value is the level of physical damage (3.12), land conformity (1.27), and level of coastal ecosystem damage.

This means that in order to increase the sustainability value in ecology dimension, it should be done through comprehensive and sustainable policy decision and efforts by Municipal government with related departments, NGOs and community to control the damage in the coastal area of Ambon from physical damage as a result of erosion, abrasion, sedimentation and beach pollution. Furthermore, efforts to

control damage to coastal ecosystem such as mangrove ecosystem, coral reef and sea grass; including regulating coastal land and hinterland allocation for settlements and other usage.

Should be made by government by imposing stricter development permission for new settlement; areas for trade, industry, fishery and tourism on hither land and coastal land to both business actors and community because it could cause erosion and flooding because rain catchment area, forest and farmland have been converted into settlement. Similarly, conservation land such as mangrove ecosystem at coastal area could become diminished and would have direct impact on the disruption of biological water resource and increase the risk of abrasion. Strict rules which limited garbage and waste water being thrown into the river and sea must be applied. Drainage channel from residents, businesses and market activities lead toward the sea can directly increase marine and coastal pollution.

Separate regulation is needed for businesses such as hotel, café, state electric company and private fishery companies, industry and other type of business service providers that don't have their own waste treatment facilities. They are also dumping their waste into the sea and disrupt biological resource of the sea. Restrictions on settlement near the river basin and spring which violate land usage management plan and disrupt water usage management plan could cause erosion, sedimentation, and could reduce water source for resident. Densely populated slum area near the coast and sea which would directly lead to environmental quality and water condition. C type material extraction

Figure 2: MIDS analysis procedure and zone analysis.
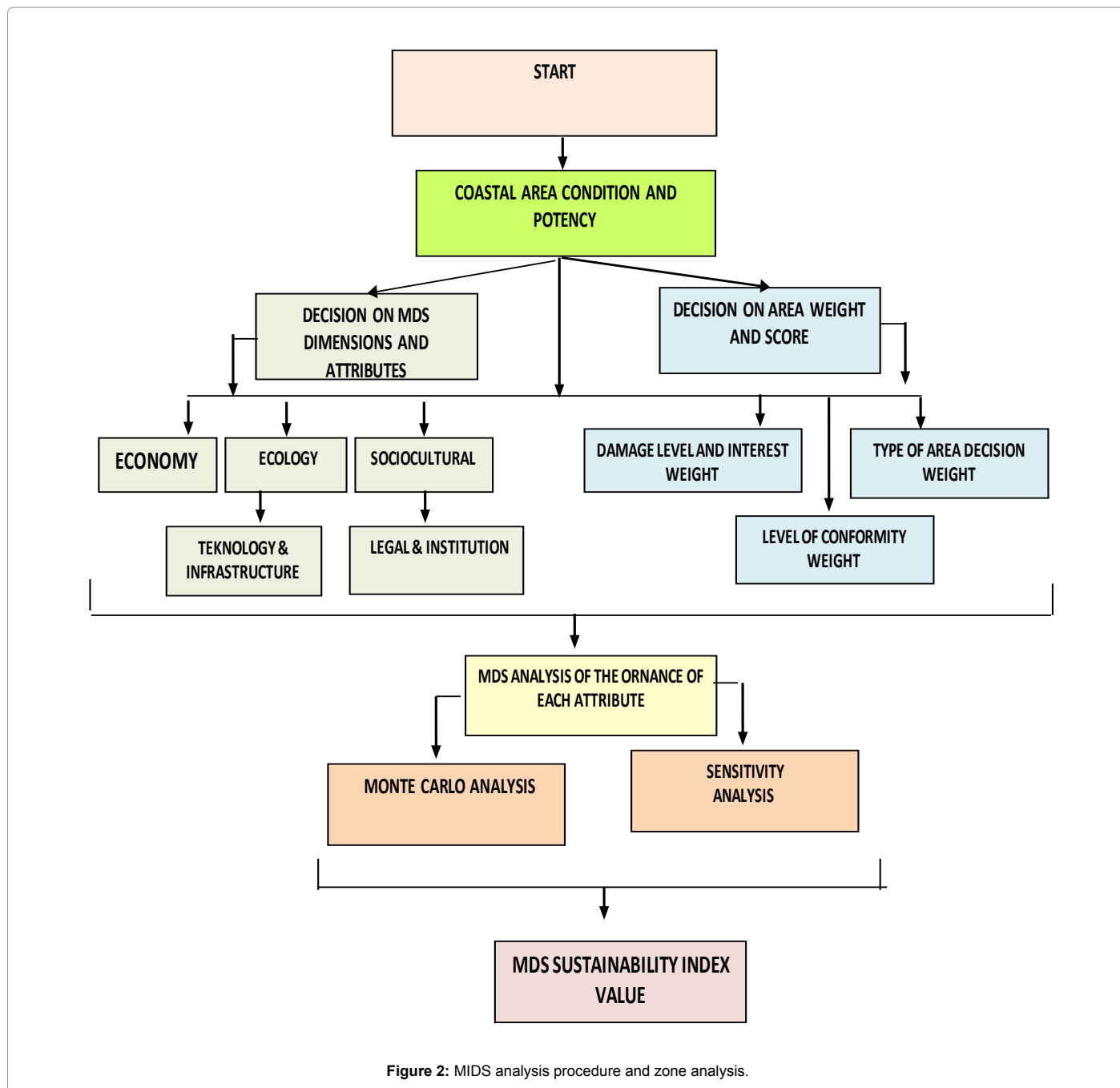
activity to collect sand, stones and coral rock by people and businesses should be restricted and regulated, because it could damage biological resource such as coral reef, sea grass and other ecosystem. Additionally, it could cause abrasion and beach erosion.

Sanction and strict law enforcement must be applied to trespassers who capture the fish by using bomb and damage coral reef and other ecosystem [24,25,28].

Synchronized and shared view in coastal management between relevant institutions and businesses should be improved so that programs that are implemented would not heightened conflicts of interest that might lead to gaps in management because certain institution has greater authority than others. Evaluation of Ambon city regional and

spatial planning needs to be made because land conversion has increased during the expansion of urban development and land conformity, and carrying capacity of the existing land has been neglected. Training and extension related to the importance of maintaining the sustainability of marine and coastal biological resources must be done continuously in order to improve the knowledge and increase public awareness about the importance of marine and coastal damage control. Program such as coral, mangrove replant and mangrove reforestation in watershed areas need to be intensified [20,29,30].

Index value and sustainablity status of economic dimension

MDS analysis of economic dimension showed the sustainability index of 50.50%. This is categorized as fair (relatively sustainable) as

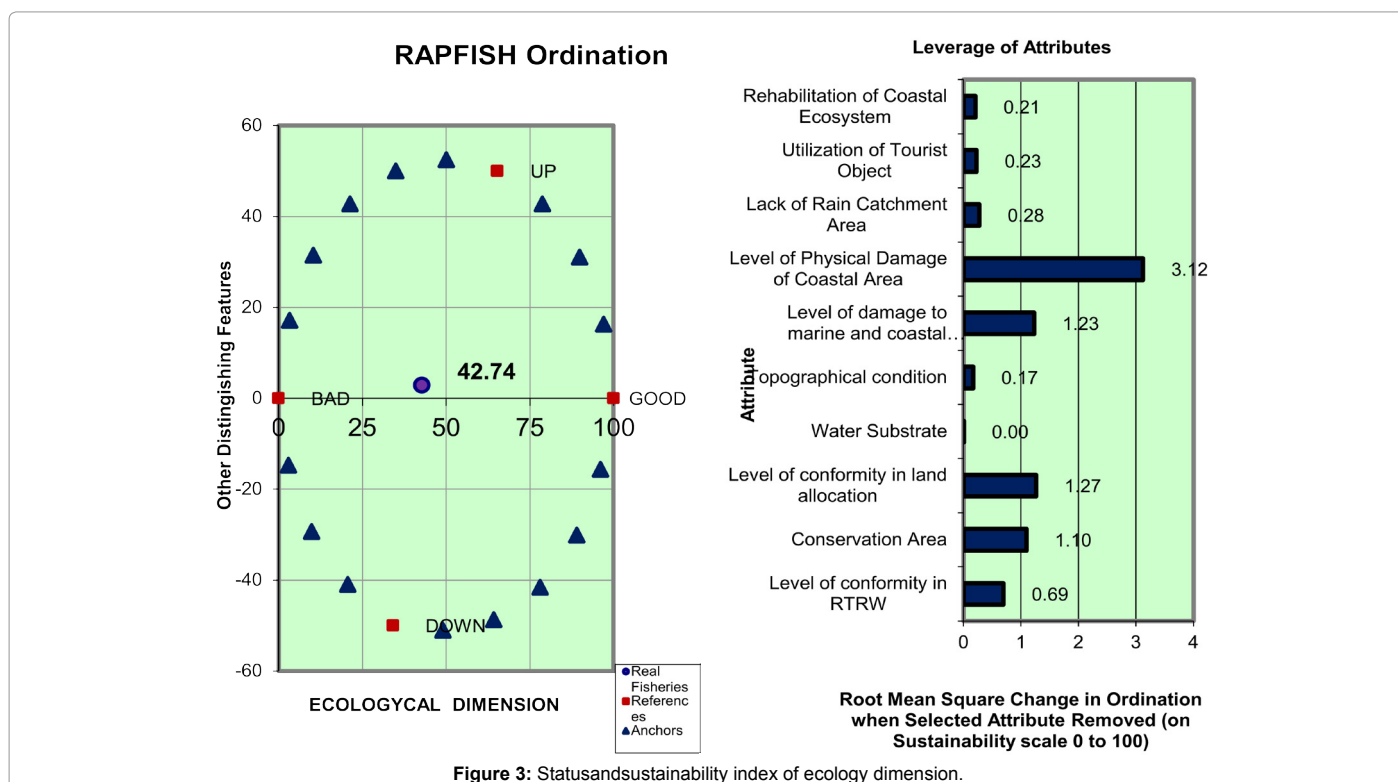| No	Ecology Attributes	Scale	Poor	Good	Value
1	Level of land conformity (Shift in land allocation due to alteration of land function which doesn't conform to regional and spatial plan) ≥50%, Poorly conform -25-49%, Adequately Conform -5-25%, Conform ≤5%, Extremaly Conform	0 = Poorly Conform 1= Adequately Conform 2 = Conform 3 = Extremely Conform	0	3	1
2	The alteration of Conservation area and Protected Forest land (Protected Forest according to Sirimau 3.449 Ha, G. Nona 877.78 Ha. The size of mangrove conservation forest in Ambon is insufficient)	0 = Rapid Alteration (>2, 5 Ha./year) 1 = Moderate Alteration (1,0- 2,5 Ha./year) 2 = Slow Alteration <1 Ha./year	0	2	0
3	Level of reforestation (Percentage of reforestation activities around river basin)	0 = Low, (0-25%) 1 = Moderate (25 – 50 %) 2 = High (>50%)	0	2	0
4	Water substrate (Substrate composition of the seabed at coastal area)	0 = Sediment 1 = Sand and sediment 2 = Fine Sand 3 = Coarse Sand	0	3	1
6	Topographical condition of the city 0-10% (slope) 10-30% (slope) >30% (steep)	0 = Steep 1 = Slope 2 = Flat	0	2	0
7	Level of physical damage of the coastal area 0.5-2.0 m/year (slight-moderate)	0 = Slight-moderate 1 = Moderate-heavy 2 = Severe	0	2	2
8	Damage level of coastal ecosystem - Severe Damage >50% - Heavy Damage (25-49%) - Moderate Damage (10- 24%) - Slight Damage (<10%)	0 = High 1 = Considerably high 2 = Moderate 3 = Low	0	3	1
9	Lack of rain catchment area	0 = Less available 1 = Sufficiently available 2 = Highly available	0	1	1
10	Coastal ecosystem rehabilitation	0 = Never Implemented 1 = Sufficiently Implemented 2 = Often Implemented	0	1	1

Table 2: Ecology attributes assessment data for MDS.

Figure 3: Statusandsustainability index of ecology dimension.

No	Economic Attribute	Scale	Poor	Good	Value
1	Labor Absorbtion	0 = Low 1= Moderate 2 = High	0	2	2
2	Fisherman Income based on municipality poverty line (Rp. 305.651/capita/month)	0 = Low: Income ≤ Rp. 305.651/capita/month 1 = Moderate: Income >Rp. 305.651-Rp. 500.000/capita/month 2 = Considerably high: Income >Rp. 500.000/kapita/bulan	0	2	2
3	Needs fulfilment of decent living	0 = Unfulfilled 1 = Fulfilled 2 = Very Fulfilled	0	2	1
4	Marketing of fishery products based on main market of fishery product (RAPFISH)	0 = International Market 1 = National Market 2 = Local Market	0	2	2
5	Investment climate	0 = Low 1 = Moderate 2 = High	0	2	1
6	Private sector contribution	0 = Low 1 = Medium 2 = High	0	2	0
7	Trade sector contribution	0 = Low 1 = Moderate 2 = High	0	2	2
8	Fishery sector contribution	0 = Low 1 = Moderate 2 = High	0	2	1
9	Local Revenue	0 = Low 1 = Moderate 2 = High	0	2	1
10	Community income per capita	0 = Low 1 = Moderate 2 = High	0	2	1
11	Visit to tourism object	0 = Low 1 = Moderate 2 = High	0	2	1

Table 3: Economic attribute assesment data for MDS.

shown in Figure 4. Analysis result of 11 attributes based on their RMS value showed that the leverage factor in this dimension comes from 3 contributing attributes; they are tourism sector (3.83), local revenue (2.21) and sale from fishery products (1.07).

The result means that in order to increase the sustainability value of economic dimension, it is necessary to evaluate and improve these three attributes. Government commitment, business actors and relevant department should collaborate to improve tourism in Ambon. Compare with other sectors, in 2014 tourism sector only made insignificant contribution on municipality's Gross Domestic Regional Product (GDRP). Primarily, tourism focus in Ambon is Marine Tourism, and art and culture these have become the main attraction for local and international tourists.

In 2014, there were 71 tourist objects in Ambon municipality in 5 (five) sub-districts. Number of local and international tourist visit in 2014 is 4.931 people. Each year, this number continues to rise. Of the 71 tourist objects, 43.38% haven't been developed, 1.45% hasn't been restored while 10.14% is in damaged condition [18]. There are 34 marine tourism objects but only 8 of them are managed by government, private sector or community. Reflecting on the increase of visit every year, and the number underdeveloped objects, government attention need to be focused toward the development tourism sector to increase GDRP. Efforts should be made in improving the standard of facilities and infrastructure in all of tourist spots, repair damaged tourist objects, develop featured tourism product i.e., marine tourism, improve the capacity of human resource, and increase promotion on tourism agenda. For that reason, tourism management should sustainably involve community and stakeholders [43].

Efforts to increase local revenue by optimizing various development sectors must be intensified by city government. According to the evaluation of GDRP in 2014, sectors that contributed less than 3% were mining, industry and tourism; while other sectors contributed over 15%. [17]. Therefore, much improvement must be made to these three sectors by government by collaborating with private sector and business actors to strengthen small, medium and large scale industry, tourism and mining. Other sectors which contributed to >15% of GDRP must also be improved so as to optimize their contribution toward municipality's GDRP. Market strategies to sell fisheries products from capture fishery, fish farm and featured products of processed fish should be evaluated by government and relevant institutions. Production of featured fish commodity in 2013 reached 6,542.05 tonne of cakalang fish, and 2,106.78 tuna fish and 10,412.42 tonne of mackerel fish (float fish). The production increase each year [39]. However, field condition revealed market constrains, because the products sold to companies, collectors and fish processing industry are purchased with low price at about Rp. 25.000/kg. The other constrain is sale to local traditional market and fish auction must go through intermediaries such as wholesaler who collect 10% of the sale for arranging the mechanism to ensure that the product is sold [44].

Other type of marketing system allows fishermen to sell to traders who then sell it to the consumer with 2-3 times the price. On the one hand, this type is beneficial to the trader, on the other hand, it cost both fishermen and consumers. These kind of constrains must be evaluated by government and relevant institutions so that the marketing system could guarantee the welfare of the people.

Index value and sustainability status of sociocultural dimension

MDS analysis of this dimension scored sustainability index at 52.12%. As Figure 5 shows, this is considered as fair or relatively
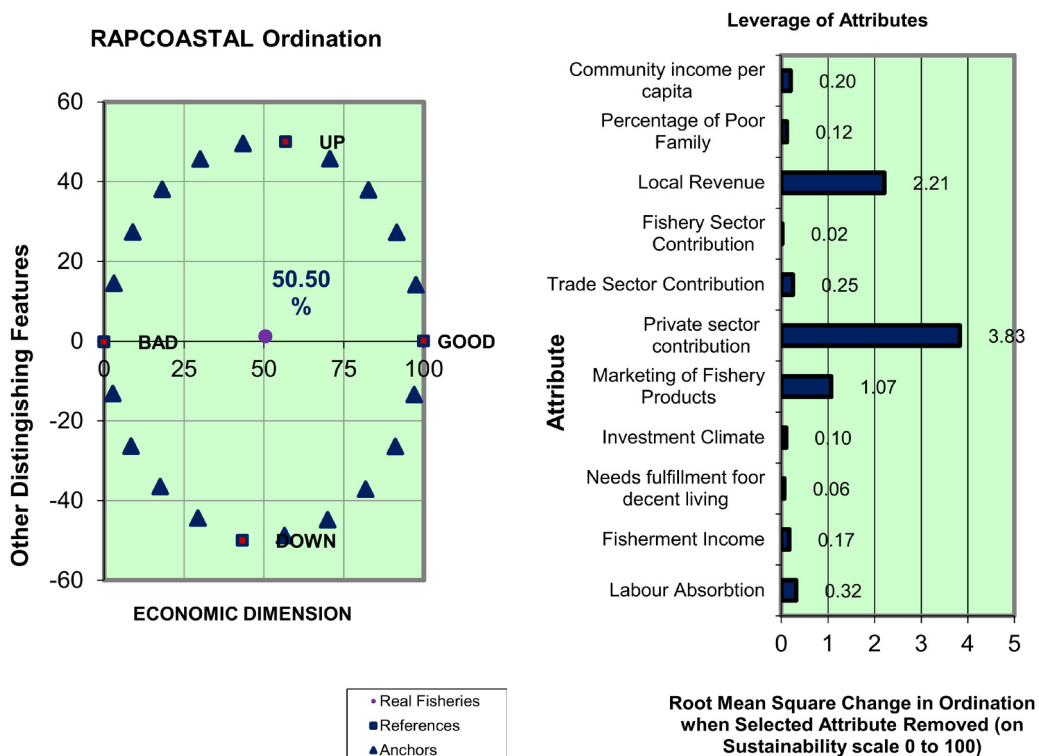
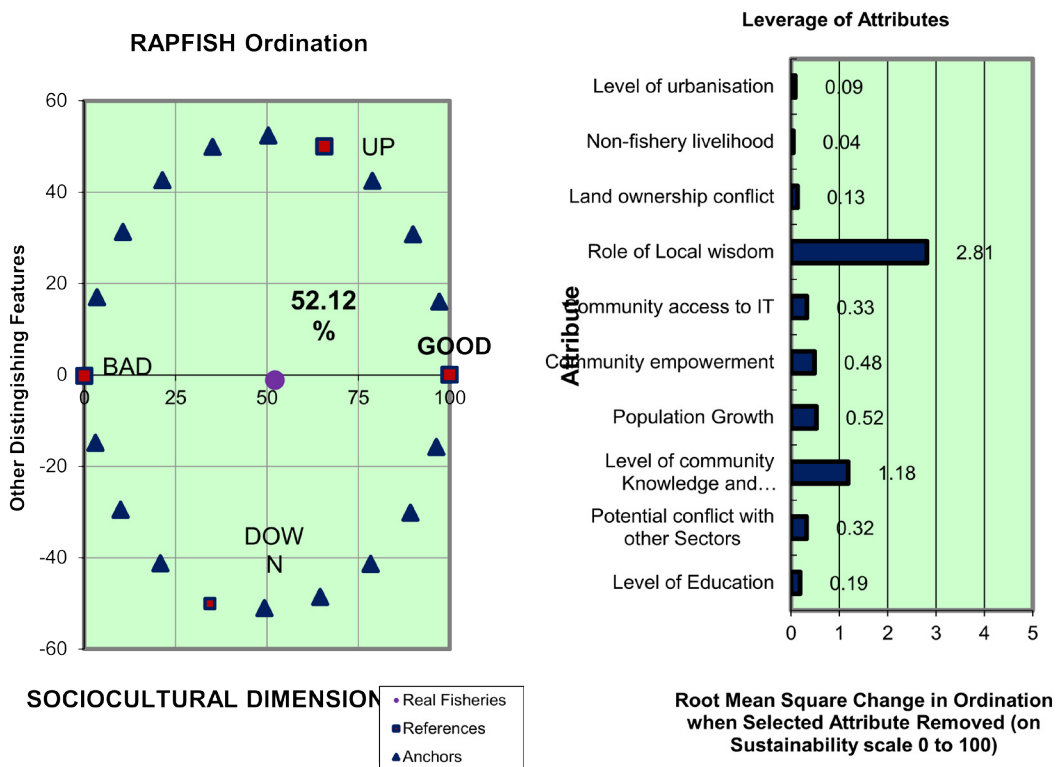**Figure 4:** Status and sustainability index of economic dimension.

Figure 5: Index and sustainability status of sociocultural dimension.

sustainable. There are 10 attributes in this dimension; two of them are considered as sensitive. Those are local wisdom (2.81), and level of knowledge and community participation in managing natural resource (1.18). Local wisdom of the people in Ambon city such as tradition and culture related to the management of natural resource like SASI must be encouraged as it has started to fade away. In natural resource management context, SASI held an important role in regulating how much harvest and catch in fishery, agriculture and plantation at a certain time. This regulation provides space for sustainability of natural resource. SASI is also applied to people who have economic activities near the sea and coastal area who could potentially harm the ecosystem such as mangrove, corals and fish resource. The application of this customary value has begun to disappear and almost completely gone. There are only 13 villages listed from 4 sub-districts which still have this SASI culture, albeit various complexities in its implementation. Actions from government and village institutions are required in order to revive and strengthen this local custom. This could be done by establishing coastal management institutions at village level, so as to ensure efforts to manage the resources at the coastal and marine area could be done in sustainable way.

In the last 10 years the potency of physical damage of coastal area, ecosystem and marine resource in Ambon city has increased. Facts found in the field shows that the level of physical damage such as pollution, sedimentation, abrasion and damage to mangrove ecosystem, coral reef and sea grass has correlation to community role. Community became less aware of the importance of this resource to life. Activities such as clearing out mangrove forest, extraction of C mining materials at the beach, fish catch method by using bomb, waste water from household and industrial activities, hotel, market,

agricultural activities, coral extraction, construction of settlement at the hill, operational activities of anchored ship which empty their oil waste to the sea, and state electricity company which dumped their waste to the sea; shipyard docking and other coastal related business activities has largely contributed to the damage of natural resource at the marine and coastal area around Ambon. This condition existsinspite of direct community involvement in the activities. Therefore, community must be encouraged to increase their awareness and to play role in preserving marine and coastal natural resources. Activities such as training and extension to increase knowledge about the importance of community role in preserving natural resource should be implemented by government, NGOs and relevant institutions. Actions such as replanting mangrove trees, regular beach and sea cleanup should be done by actively involving community in the process. Other efforts that can be done by government and relevant institutions to involve community are by having them participate in planning, implementation and evaluation of the coastal management programs.

Index value and sustainability status of technology and infrastructure dimension

MDS analysis of technology and infrastructure put Sustainability Index Value at 51.29% this is regarded as fair or relatively sustainable. From the 10 attributes analyzed in the dimension, 2 of them are sensitive; i.e., infrastructure support to small and medium scale industry (2.97) and infrastructure support to tourism sector (1.47), as presented in Figure 6.

Infrastructure of small and medium scale industry must be improved to develop community based economy through small scale industry to support the economy of Ambon city. Number of small and medium
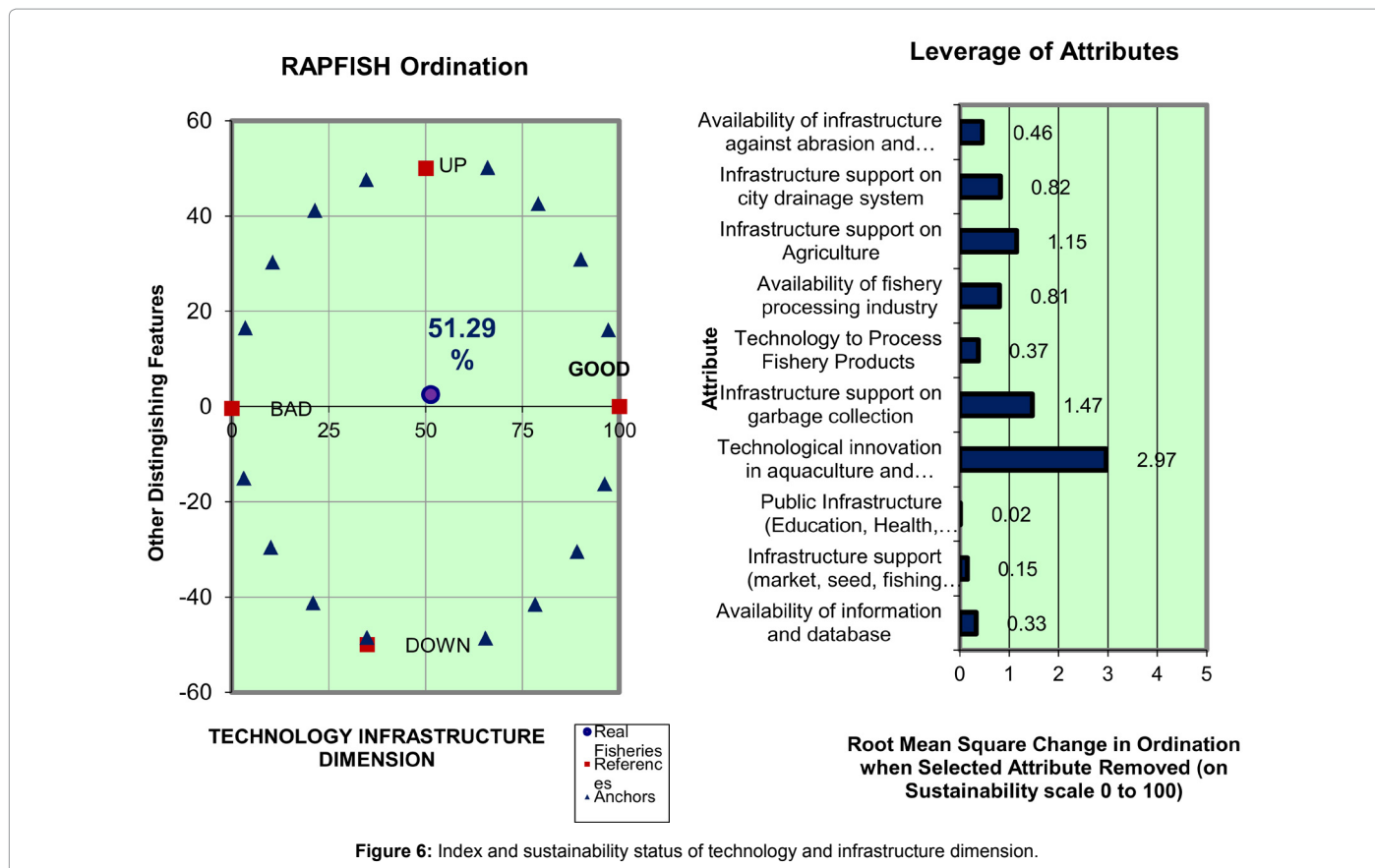

Figure 6: Index and sustainability status of technology and infrastructure dimension.

size businesses in Ambon in 2015 is recorded at 1.218 business units. There are 551 industry type business, and the trend continues to grow each year. Issues in the field related to the processing of fishery products are: low technology used in smoked fish, lack of fish vacuum packer, and other supporting devices such as portable hot print, insufficient freezer to store the catch before processing, and low capacity of human resource to process the catch. Common obstacles faced by small and medium industries Ambon City among others are: The difficulty to get financial credit facilities (capital) to develop their businesses, limited industrial equipment, poor quality of human resources (HR), the lack of business networks and ability to penetrate the market, limited access to market, implication of regional autonomy and the implications of free trade. These obstacles should be concerns of government and relevant institutions to pay more attention to small and medium industries with concrete programs and assistance to improve the production of small and medium industries in the city of Ambon.

In addition to the proposed improvements to be made by the government related to the dimensions of technology and infrastructure to Real program and the government's attention to fix the small and medium industries that should be done by the government: 1) The government in collaboration with national and private banks and other microfinance institutions provide credit facilities to the public interest ketch to small businesses to raise capital so that it can help people to develop their business; 2) The Government is also requested to cooperate with various agencies such as the institution of higher education in relation to the improvement of the fishery management system especially the smoked fish is a small industry in the city of Ambon, so the fish curing industry into industry potential and benefit the people of Ambon kiuta; 3). With related government agencies and academia must program disseminate to the public in carrying connection with bagaimanan upgrading small business, management model must be improved, the management system should be evaluated; 4) The government should also provide a good marketing distribution for small business marketing products, due to the availability of good marketing, the production can be channeled properly community so that the community can mengembagkan operations from time to time; 5) Improvement of community resources should also be made by the government and related agencies, it is highly related to the provision of facilities and how infrastructure new for small businesses. So that human resources from the community businesses become energy professionals in the business; 6) The government must also protect the sustainability of small businesses and mengah with the rules and paying legal tentan how the standards and quality of production and quality standards that benefit the community haraga businesses, so that the public is assured; 7) The government should also provide a guarantee facility for community health workers who work as labor in various small and medium enterprises; 8) In relation with infrastructures to ensure the quality of production can last as long as fishery and marine then the government should provide the fish or cold store refrigeration equipment with sufficient capacity, so that efforts to shelter the catch before it is produced can be guaranteed quality and quality.

To develop the tourism sector in Ambon city and increase the contribution of tourism sector to the GDRP of Ambon city, efforts should be made is the improvement of facilities and infrastructure that support the sector to develop, especially featured tourism. There are 34 marine tourist attractions; only 8 of them are developed. More serious attention from all stakeholders including government, private sector and other stakeholders is required to these improve this.

Efforts should be made to improve infrastructure such as restoring damaged tourist attraction, improving underdeveloped maritime tourist attraction, constructing roads and provide transportation to support the site, formulating regulations that accelerate investment on tourism, build the capacity of human resources when developing of tourist destinations, establishing and improve the quality of accommodation, hotel, improving the quality of the restaurant, improving services like electricity, clean water, and telecommunications in tourist destinations.

Marketing and promotion of featured marine tourism is a very important factor because promotion and various tourist events conducted in Ambon of tourist activities such as Darwin-Ambon yacht race, clean the village, snapper fishing competition, Ambon bay festival, Ambon music festival, opening ceremonies of SASI laor (palolo sea worm), broom beating ceremony, and underwater photography competition. Increased promotion and various events to attract people to come to Ambon will have very positive impact at increasing local revenues, as well as businesses and people.

In addition the government and related agencies should provide guidance, counseling or socialization to masayarakt tourism business operators in the city of Ambon related to how, management, and evaluation of the work done so far with the aim to keep the existing tourism services is down at least. The government should make the process of evaluation of the tourist objects that are managed by the government for this because almost all tourist attraction run by the government tidsak shooting went well, suggestions infrastructures inside relah damaged, manajemenya also suffered losses, the facilities available do not guarantee the needs of tourism good, Attraction conditions do not develop according tutntutan times. The government should also revise the budget terhadpa seluruha naggaran that diperuntyuhakan for management efforts and the local tourism potential to promote tourism in the city of Ambon, because the budget is adequate and skilled manpower to the effort to increase tourism in the city of Ambon to do well and the insured liable

Index value and sustainability status of legal and institutional dimensions

Index value of sustainability based on the analysis of MDS in the legal and institutional dimensions is 56.88% this is considered as fair or relatively sustainable. from the 10 attributes analyzed in this dimension there are two (2) attributes that are very influential, namely regulations on coastal management and resources (3.37), and support to the implementation SASI in natural resource management as presented in Figure 7.

Legal framework is important in the management of marine and coastal resources. This should be a government priority in order to maintain the sustainability of marine and coastal resources, and to prevent damage caused by the various activities of the people such as socio-economic activities and land usage which had caused physical damage or destruction of coastal ecosystems and marine resources. Regulatory instrument or legal framework is very important because it becomes an implementation reference and evaluation guidelines of all utilization activities of coastal and marine areas of Ambon city from various interests, including ecological, economic, sociocultural, technology and infrastructure as well as the legal and institutional. The presence of regulatory instrument or legal framework related to the management of resources coastal and marine areas in Ambon city will provide a safeguard the preservation of coastal and marine resources in a sustainable way.

SASI is one of the local wisdom from Maluku. Implementation or application of the rules of SASI in Ambon city to preserve the natural resources of coastal and marine requires attention from the city government in order to revive its practice as this local wisdom is starting
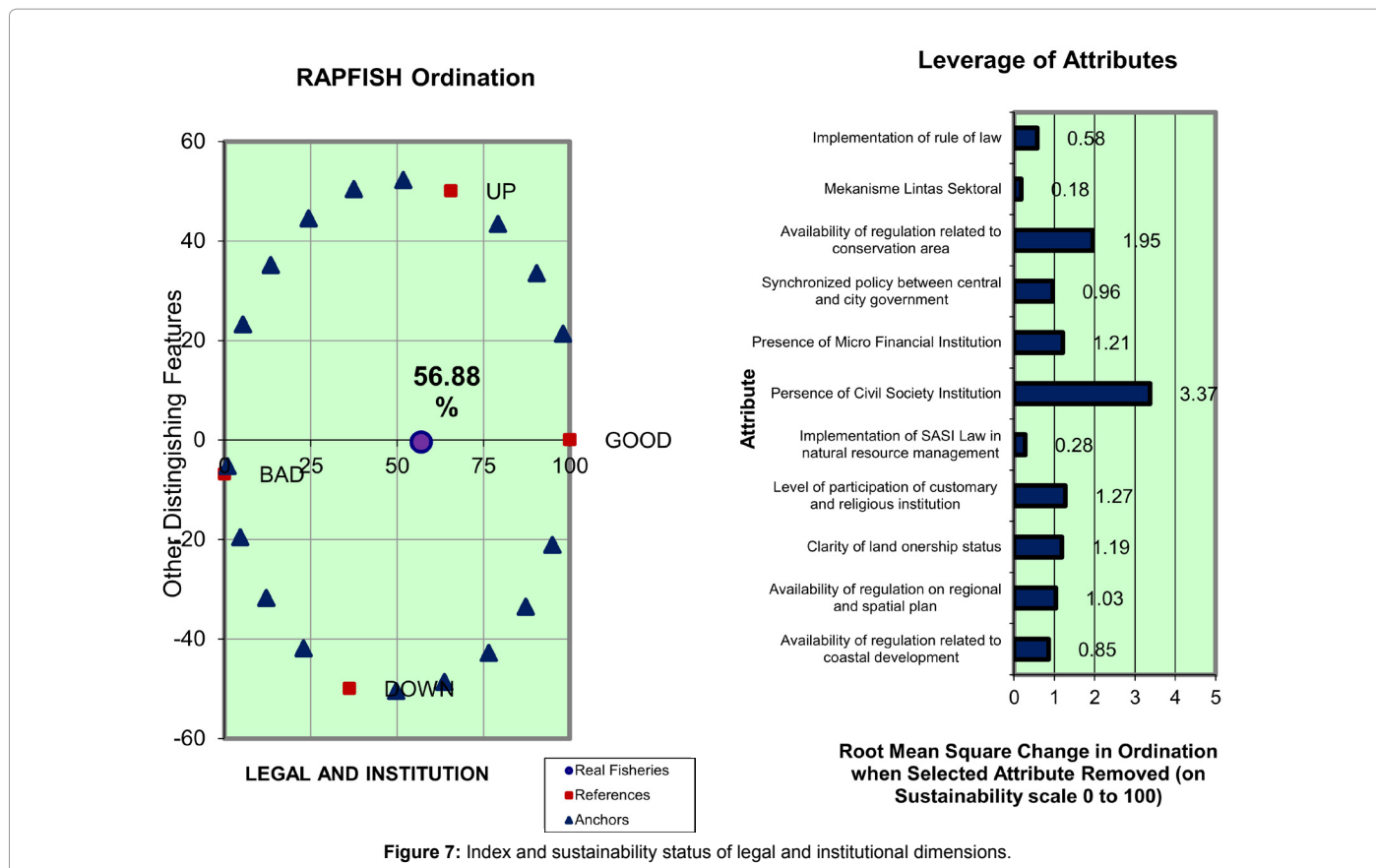
Figure 7: Index and sustainability status of legal and institutional dimensions.

to fade and almost disappear. SASI is one of the social institutions of indigenous peoples from Maluku to regulate how produce such fishery, plantation and agriculture can be taken (harvest) at a certain time with a certain amount as well as to ensure the sustainability of these resources.

MDS analysis of the whole five dimensions of sustainability management of coastal areas of Ambon city produced the value of sustainability index of each dimension as shown in Table 4. Furthermore, sensitive attribute of each dimension based on the leverage factor analysis with reference to the RMS value, can be seen in Table 5.

Multi-Dimensional (MDS) analysis and Monte Carlo analysis are able to show the influence of error with the error rate at confidence level of 95 percent while stress values ranging from 0.14 to 0.15 (stress value <0.25). The value of determination (R^2) ranges from 0.94 to 0.95 (R^2 is close to 1.0). It can be concluded that the results of the analysis can be used to evaluate the level of sustainability of coastal management Ambon

Comparison of the results of Monte Carlo analysis with MDS are very small, as shown in Tables 6 and 7. The difference between the results of MDS and Monte Carlo analysis showed a small mistake and create a difference in the sustainability index dimensions analyzed. Based on the analysis of five of these dimensions, the overall sustainability indices can be seen in the radar chart in Figure 8.

Conclusion

Based on the analysis and discussion it can be concluded that the multi-dimensional approach to coastal zone management evalausi Ambon city in a sustainable manner, said that a multi-dimensional

sustainability index for the 51 attributes of the fifth dimension is equal to 50.13% with less sustainable status. Each -masing ecological dimension of 42,74% less sustainable status, the economic dimension of 50.50% is quite sustainable status, socio-cultural dimensions of 52.12% is quite sustainable status, the dimensions of technology and infrastructure 51.29%, the legal dimensions and overhauls 56, 88% is quite sustainable status. There are 12 attributes from 51 attributes that are very sensitive influence the management of coastal areas of Ambon city in a sustainable manner. The emergence of 12 attributes this effect suggests that the status of coastal zone management Ambon city still needs to be improved in a multi-dimensional. Because the status of ecological dimension is less sustainable, and four other dimensions are in fairly sustainable status. To increase the sustainability of the status to the evaluation and intervention against 12 attributes this effect needs to be done proportionally to consider the relevance of these attributes to coastal zone management in an integrated Ambon city.

Based on the evaluation result of the sustainability of Ambon city coastal zone management, the sustainability index development which reflects on existing conditions against the five dimensions of sustainability has the following results: The level of physical damage to the environment on the coastal area (abrasion, erosion and sedimentation), the level of damage on coastal environmental ecosystems (mangroves, coral reefs, seagrass and fishery resources) and the degree of land allocation conformity are the dominant factors which contribute and cause ecological dimension to become less sustainable. Damage to physical environment and ecosystems that occur is in the form of the destruction (erosion) of beach area due to erosion or beach erosion and overexploitation of coastal biological and marine resources.

Dimension	Sustainability Index Value	Remark
Ecology	42.74	Unlikely to be sustainable
Economy	50.50	Relatively sustainable
Sociocultural	52.12	Relatively sustainable
Technology and infrastructure	51.29	Relatively sustainable
Legal and Institutional	56.88	Relatively sustainable

Table 4: Sustainability index value for multi dimension.

Dimension				
Ecology	Economy	Sociocultural	Technology and Infrastructure	Legal and Institution
a) Level of physical damage of the coast b) Conformity of land allocation c) Level of damage to coastal ecosystem	a) Private sector contribution b) Local revenue c) Marketing of Fishery Product	a) Role of local wisdom b) Level of knowledge and participation of community in natural resource management	a) Infrastructure support to small and medium scale industry b) Infrastructure support to tourism	a) Regulation on coastal area natural resource management b) Implementation of SASI law in natural resource management

Source: Analysis result 2015

Table 5: Sensitive atributte which contribute to sustainability of coastal area management in Ambon city.

Sustainability Dimension	Index Value Variation		Variation
	MDS	Monte Carlo	
Ecology	42.74	42.69	0.05
Economy	50.50	50.43	0.07
Sociocultural	52.12	51.84	0.28
Technology and Infrastructure	51.29	50.99	0.30
Legal and Institutional	56.88	56.50	0.38
Multi-dimension	**50.13**	**50.02**	**0.11**

Source: Analysis result 2015

Table 6: Result of Monte Carlo analysis and MDS in coastal area management in Ambon city.

Parameter	Dimension				
	Ecology	Economy	Sociocultural	Technology Infrastructure	Legal and Institution
Sterss	0.15	0.14	0.15	0.15	0.14
R^2	0.95	0.95	0.95	0.95	0.95

*: Number of iteration only 2, because R^2 value is close to 1

Table 7: Stress value and R^2 multi dimension (number of iteration 2)*.
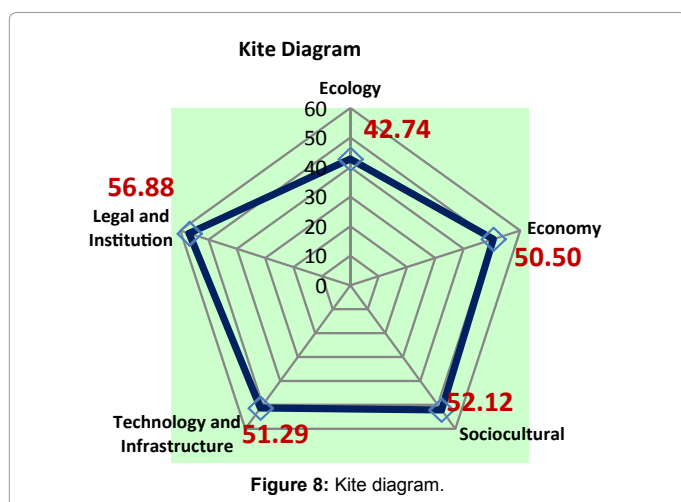

Figure 8: Kite diagram.

Severe damage to the physical environment is when the loss of beach line along with its beauty and ecological potential. Damage to coral reefs and sea grass beds caused by the physical influence of the sea (waves and turbidity), domestic waste and human settlements, as well as the siltation process such as erosion and sedimentation. In addition to natural cause, erosion is also a result of human activities, for example excessive excavation of type C materials such as stone and gravel on the beach, clearing of mangrove trees or coconut on most beaches and land clearing in upstream areas. Forest clearance of the upstream areas (land use conversion) for various purposes such as settlement, residence or farms that are not backed by complementary efforts to conserve water and soil for buffer vegetation in rain catchment area will eventually lead to higher chance of erosion and landslides during rainy season. This, in turn will affect the turbidity of waters. Furthermore, sedimentation on the shore could disrupt marine biological resources

Forest clearing activities and excavation of materials in the river basin has caused serious sedimentation in some estuaries and coastal waters. Land clearing at the upstream area for agricultural activities, have increased chance of solid and liquid agricultural waste goes into the river then carry to coastal waters and the sea. Liquid waste containing nitrogen and phosphorus potentially caused eutrophication (over-fertility) that harm coastal ecosystems. Difference in point of view and the overlapping interests in the coastal area from various agencies has also caused difficulties in coastal zone management.

Based on the conclusions of the results obtained in this study, in order to increase ecology dimension to sustainable level and support coastal zone management of the city of Ambon, it is necessary to do a variety of concrete steps by the government to control the physical environment and the environmental damage coastal ecosystems and conformity in land allocation.

City authority must have regulations to control the management of coastal and marine areas. In addition, the city of Ambon should have management concept which consider the suitability of land allocation and the establishment of area zoning. Therefore, land usage for various purposes can be evaluated through zoning that has been set. For example type Cmateralextraction, pollution control, slums relocation, regulation related to the conversion of coastal land, control of public activities that could damage coral reefs, sea grass and mangrove, regulate clearance upstream and watershed area for various purposes, the regulation against the abuse of land usage which are not conform with regional and spatial plan. In order to achieve that, in addition to regulation, it is important to ensure that community are involved in education programs and activities to rehabilitate coastal area in order to increase the awareness and concern of the community to actively conserve coastal and marine resources.

With knowing the sustainability index is multi-dimensional and the sustainability index of each dimension as well as a variety of attributes

that membengaruhi status sustainability of coastal zone management in the city of Ambon will be input or input means for city government in attempts policies and management of coastal areas of Ambon city in a sustainable manner. So pembnangunan directed to coastal areas can work well and provide assurance that public kesejahtraanbagi Ambon city development goals stated in the vision and misisnya can be achieved

Acknowledgement

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