The development of infrastructure in small islands based on environmental carrying capacity (Case study: Ndao Island, East Nusa Tenggara, Indonesia)

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Abstract. Small islands with an area of 2000 km$^2$ or less are vulnerable to sea level rising and accessibility. The availability of infrastructure plays essential roles in socio-economic activities and regional development. However, not all small islands can have the infrastructure needed, except those that have been selected and included in the regional/local government program on the priority of infrastructure provision. The small island of Ndao that locates in the Eastern Region of Indonesia has been developing after being formed into a sub-district in 2011. This paper discusses the possibility of Ndao Island for further development based on the criteria of environmental carrying capacity and vulnerability. The primary data obtained in 2017 and analysed with the Analytical Hierarchical Process (AHP) method, indicates that Ndao Island is recognised of having low carrying capacity and a deficit of clean water. Ndao has potential natural resources. Therefore, the Local Government has to include this island in the program of priority development by prioritizing the provision of clean water as its supply is limited and low quality due to seawater intrusion. Expectantly these findings become input in determining the priority development and estimating the future population following the carrying capacity of the environment.

1. Introduction

Indonesia is the largest archipelagic country in the world, with a total of 17,477 islands and around 99.8% are small islands. Of all the small islands, about 6,000 islands are inhabited. A small island is an island with an area lower or equal to 2,000 km$^2$ along with its ecosystem unity, with the number of residents ranging from less than or equal to 200,000 people [1,2]. The small islands consist of potential beauty in the form of natural resources such as coral reefs, seaweed, mangrove forests, fisheries and conservation areas. These extensive environmental services can drive the maritime tourism industry [3]. Behind the potencies, they are vulnerable to a disaster such as a sea-level rise that can cause severe impacts on their existence, because most of the small islands in Indonesia are in the form of lowlands and have a height of only a few meters above sea level. With a sea-level rise of several cms, it will significantly reduce the land area of small islands. Ultimate constraints of small islands are a limitation on land area, clean water resources, and water catchment area. Access to small islands is also difficult because their location is far and spreading out over the main island. For some islands, electricity is also a relatively new facility.

The island's assets, however, have not been able to encourage the development due to the following constraints: the orientation of growth in the past was focused more on the mainland area rather than on
coastal areas, and small islands, a small island with an area between 10-500 km² with a low administrative level had not been included in the priority program of the local government [4, 5]. Small islands seem to deal with uncertainty. On one side some islands have been intensively developed and become the local or even regional centre of economic activities. On the other hand, there are still many small islands that are developing not optimal or not also developed at all. As a result, many small islands that classified as rural areas are categorized as underdeveloped areas because the necessary infrastructure does not meet needs and does not support economic activities changes have been made significantly since 2014 after the government declares nine priority agendas on development programs so-called Nawa Cita. The third agenda that states "Building Indonesia from the periphery by strengthening regions and villages within the framework of a unitary state" implies the development of small and outer islands should become concerned of the central and local government. The central government has implemented this agenda through infrastructure development on the small and outer islands under the responsibility of the Directorate General of Coastal Area Management.

Ndao is one of the small islands locates in Ndao Nuse Sub-district, Rote Ndao District, East Nusa Tenggara Province-Indonesia and was designated as a new sub-district on December 14, 2011. As the implementation of the third statement of Nawa Cita, the development has been carried out, including the construction of a pier and assist with the fishermen to support their livelihood. Since August 14, 2015, the residents are gradually served by electricity. But problems remain such as limited necessary facilities and private toilet, lack of clean water, low-quality sanitation, low-quality houses, deep knowledge on large-scale fishing and processing, and lack of knowledge and ability to manage natural resources. Ndao Island is identical to a vulnerable island. In fact, the new administrative status is not able to significantly increase the living standards of the people and the overall island. Accordingly, it tends to be more vulnerable when the provision of infrastructure is not under the capability and capacity of the environment.

This paper aims to describe the potency for developing Ndao Island through the simulation of the 'environmental carrying capacity' assessment of Ndao Island. The results are expected to be input for the Central Government and Regional Governments in developing small islands, including the 111 (hundred and eleven) outer islands [6]. The outer islands on the sea border must be managed well because of their high economic and environmental value, and some of them are used as entry gateways from other countries.

2. Infrastructure provision in sustainable development

The basic concept of sustainable development is the link between the concept of the need to improve the quality of human life and the limitations. Sustainable development is defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" [7]. The development is basically an integrated process of changes of three pillars of sustainability: environment, economy and society where people, habitats and economic systems are inter-related [8]. Correlation between the three pillars that put into the form so-called "triangular framework" is described in Figure 1 [9]. This illustrates a balanced relationship between human activities and the natural world, which does not diminish the prospects for future generations to enjoy a quality of life at least as good as current condition.

The overall sustainable development's goal is the long-term stability of the economy and environment, and its target is social progress and equality, environmental protection, conservation of natural resources and stable economic growth [8]. One that must be considered to achieve the targets is through land allocation that matches the environmental carrying capacity, the resources, and land should be functioned not to exceed its characteristic and regulations. Small islands generally have a large potential of marine resources but have very limited potential natural resources on the land. Analysis of the potential and limitations of the island, including the study on environmental carrying capacity and vulnerability must be carried out to support the island's land-use planning while socio-cultural aspect will be further needed on management of island development [10].
The environmental carrying capacity is the ability of the environment to support the lives of humans and other living things [11]. While the vulnerability is the tendency of an entity to be damaged, and referring the definition that "vulnerability is the tendency of an entity to be damaged" [7]. The vulnerability of small islands than can define as the tendency of an island's system to be damaged, and the higher the level of vulnerability of an island, the easier it will be damaged. The small island ecosystems are very vulnerable because small changes in the landscape can affect the physical and biological functions of the island.

Available sufficient and quality infrastructure is important to improve the welfare of the residents, and to facilitate tourism activities as it will able to invite many investors [12]. In the standard of minimum services, infrastructure in small islands should cover five facilities, i.e. housing, clean water; wastewater treatment, waste management, drainage and accessibility [13]. However, the residents also have rights to deserve a good education, health, welfare and information that can be obtained through facilities such as roads, ports, schools, hospitals, markets, electricity, information, and communication media. All facilities should be comprehensively and integrated carried out with different management approaches because all development will greatly affect its ecosystem. The higher the optimally natural resources utilization, the higher the intensity of the environmental utilization of the island as a whole. The existence of infrastructure that meets the needs and rules will also increase the resilience of the island, and reduce welfare inequality between small islands and large islands. The responsible actors of infrastructure development differ by the island's location. The Central Government and the Local Government in an integrated manner are responsible in the outer islands. The Provincial Government is responsible in the provinces characterized by islands while the Local Government should concern in the provinces that have small islands and outer islands.

3. Ndao Island as part of Rote Islands
The Rote Ndao District consists of 96 small islands, and only six islands are inhabited. Apart from being the largest island, Rote is the capital of the Regency as well as an island on the southern border of Indonesia with the Australian territory. The infrastructure has been developed, and currently, Rote is inhabited by many residents who come from the surrounding islands. Population in Rote Island is increasing, then the provision of infrastructure must take precedence and be included in the development plan of the East Nusa Tenggara Provincial Government.
Ndao Island is one of the six small inhabited islands. In the Rote Islands and the territory of Indonesia, the location of Ndao shows in figure 2. In the structure of Rote Ndao District, Ndao Island is a rural area. Having a land area of about 8.65 km², Ndao is categorized as a very small island. In 2017, the total population was 3,473 residents, and the population growth rate is 4.17% [14]. The growth is relatively high and becomes a warning to Ndao Island, because of the availability of limited land areas.

Rainfall in Ndao is low. In 2014 it only reached 1849.3 mm with the number of rainy days was 126 days per year. In 2015 it dropped to 1600.3 mm per year with the number of rainy days was only 102 days per year. Thus, during the period 2014-2015, rainfall and the duration of rain fell significantly. The decline can be a serious threat to the lives of the residents in conducting plantation and livestock activities. There are no rice fields in Ndao Island but dry agriculture such as coconut, palm, sweet potato, cassava, corn and peanuts [14]. All yields are mostly for local people need of food, and partly such as palm tree sap that processed into brown sugar and liquid sugar and corn are sold to Rote Island. Some residents are fishermen, but in Ndao there is no place to dock fishing boats and fish auctions because the catches are directly sold to Rote Island which has many consumers and they usually catch near capital Rote Island. Fishermen only bring home some fish for family consumption.

Weaving traditional cloth called socket is a hereditary skill of the indigenous people of Ndao Island. Women in almost all households do this local culture. Weaving products are marketed by men to the capital Rote or other islands during the dry season when they cannot do farming or fishing. So, making traditional cloth is not a side activity but also the main source of family income. The District Government plans Ndao Island to be a tourist destination for the potency of songket nice beach and the very clean sea water (see figure 3). The cleanliness of sea water remains because of the continuous application of customary law. The law applies customary sanctions that anyone who pollutes the sea or cuts one tree in a conservation area will be subject to obliged to pay a fine of 10 pigs. It is proven that this customary law has directly preserved the environment of Ndao Island. The tourism activities can hopefully improve the economy of the local community.
According to the Regulation of Minister of Tourism, a small island with an area of less than 10 Km², the maximum land area that can be developed is about 30%. So only about 2.59 Km² of land in Ndao Island can be developed. The rest is conservation land for life support and human habitat. It means that for the sake of Ndao Island's future development, the rate of population growth should be controlled and match its carrying capacity. Therefore, knowing the ability of the island's carrying capacity is very important. This is in line with the statement that in the district spatial plan must provide data on "carrying capacity" and "environmental capacity" [15].

Ndao is around 25 km² away from the Capital District (Rote). Fortunately, regular shipping that routes between the two islands is less than five times a week since the intensity of the ship trips very much depends on the weather condition. There will be no shipping during bad weather. Problems that also persist in Ndao Island are [5,16,17]: a) very vulnerable water resources against rainfall and sea-level rise; b) vulnerable area to extreme weather and global warming which results in flooding from the sea through rivers to higher ground; c) limited land; d) far from the centre of growth areas; e) small population; f) uneven population. Figure 4 and Figure 5 show some facilities in Ndao Island that still have to be developed. Ndao Island is characterised by a very small area (<10 km²), small population, vulnerable transportation, and rural housing. Then these conditions underlie the selection of Ndao Island to be studied.

**Figure 4.** a. Collect water from the pipeline of the Pamsimas program, b. Rainfed pond for a source of clean water, c. Shallow wells with no drainage.
*Source: Field observation, 2017*

**Figure 5.** a. Hole in the ground to burn trash, b. Pier for large ships, while the pier for fishing boats is not yet available, c. Fishermen's house that is not habitable.
*Source: Field observation, 2017*

### 4. Methods

In this study, the way that is considered appropriate to determine the priority of the island that needs to be developed is seen from the capacity of the island's environmental carrying capacity which is assessed by weighting and scoring using the AHP method. The AHP describes complex multi-criteria problems into a hierarchy so that a complexed problem can be broken down into groups which are then arranged into a hierarchical form so that problems will appear more structured and systematic.

The analysis is done by determining criteria through experts' opinion through the Network Hierarchical Process (AHP) method. The collected data consists of primary data (field observations and interviews), and secondary data (related literature, documents and information from government
agencies, and spatial superimpose map, debit and quality of clean water; and vulnerability against pollution, coastal disaster and weather).

AHP is a functional hierarchy with input being mainly human perception. With hierarchy, a complex and unstructured problem is solved into its groups. Then these groups are arranged into a hierarchical form [18]. The AHP model is an individual decision model using a collective approach to the decision-making process. In this study, the AHP method is used because there is more than one criterion/element that needs to be considered in determining the priority for the provision and development of infrastructure. Basically, AHP works by giving priority to alternatives that are important to follow established criteria [19].

AHP gives a ranking of the hierarchical structure based on the goals, criteria, sub-criteria, and choices or alternatives. In a group of islands having more than one inhabited islands, the determination of islands that should be priority developed needs to be selected, one of which is by "weighting" through determining the "rating value". The weight is measured from 2 criteria - "environmental carrying capacity" and "vulnerability". "Environmental carrying capacity" consists of 4 sub-criteria (land capability, land capacity, water capacity and water quality), and "vulnerability" consists of 3 sub-criteria (vulnerability of water resources to pollution, the vulnerability of coastal areas against disaster, the vulnerability of sea transportation against weather). Each weight value is determined by the Analytical Hierarchical Process (AHP) method.

The first stage was conducted by interviewing 22 (twenty-two) respondents who are experts, researchers, academics and practitioners with various fields of expertise related to the environment. The respondent’s opinions are analyzed, and the results are delivered into a focus group discussion to gain additional explanation and agreements. Final results are described in table 1.

Table 1. Value of criteria and sub-criteria.

| Criteria                  | Weight of criteria | Sub-criteria | Weight of sub-criteria |
|---------------------------|--------------------|--------------|------------------------|
| A. Environmental carrying capacity | 70                 | 1. Land capability | 10                     |
|                           |                    | 2. Land capacity | 15                     |
|                           |                    | 3. Water capacity | 35                     |
|                           |                    | 4. Water quality | 10                     |
| B. Vulnerability          | 30                 | 1. Vulnerability of water resources against pollution | 15                     |
|                           |                    | 2. Vulnerability of coastal areas against disaster | 10                     |
|                           |                    | 3. Vulnerability of sea transportation against weather | 5                      |
| Total                     | 100               |              | 100                    |

It is reasonable that "environmental carrying capacity" has a value of 70 out of 100, as the main key to land development is that the land must be able to support all the activities on it. The value of sub-criteria of "water capacity" is 35, which is a very significant value compared to the others. The significance indicates that "water capacity" is the most priority that must be taken into account. The criteria of "land capacity" and "vulnerability of natural resources against pollution" are the second priority with the value of 15. The similar value, however, implies contradict meaning due to "land capacity" belong to positive criterion while "vulnerability of natural resources against pollution" belong to negative criterion. It means that ideally, small islands have large values on positive criteria and small values on negative criteria.

Geometry means analysis and focus group discussion shows the value weight of "criteria" and "sub-criteria". Then the rating is determined by the significance influent of each sub-criteria. The value of the "sub-criteria" is multiplied by the value "rating", and the result is put in to score. The sum of all score indicates the value of the cut-off level, which describes the best or ideal value of "environmental carrying capacity" of a small island. The cut-off level obtained is 87.5 of 100. The score then becomes the benchmark in determining the scale of the environmental carrying capacity of Ndao Island. All value and score of criteria and sub-criteria are revealed in table 2. In this table, rows
that are highlighted are sub-criteria that are assumed to be positive enough for an environment and have an insignificant negative impact on the environment.

**Table 2.** Assessment on carrying capacity of small island to determine priority small islands for infrastructure development.

| Criteria, Sub-criteria, Parameter | Criteria weight | Sub-criteria weight | Rating | Description | Reference | Score |
|-----------------------------------|----------------|---------------------|--------|-------------|-----------|-------|
| A. Environmental carrying capacity | 70             |                     |        |             |           |       |
| 1. Land capability                | 10             |                     |        |             |           |       |
|   - High                           | 1              | Land class III up to VI: suitable for residential use | - Regulation of Minister of Environment No. 17/2009 on Guidelines for Determining Environmental Carrying Capacity in Regional Spatial Planning - Experts agreement - Team discussion | 5 |
|   - Medium                         | 0.5            | Land classes I and II: considered for agricultural and settlement development | | | |
|   - Low                            | 0              | Land classes VII and VIII: must be protected or for conservation | | | |
| 2. Land capacity                  | 15             |                     | 7.5    |             |           |       |
|   - Surplus                        | 1              | Land availability > land needs | Regulation of Minister of Environment No. 17/2009 on Guidelines for Determining Environmental Carrying Capacity in Regional Spatial Planning | |
|   - Intermediate                  | 0.5            | Land availability = land needs | | | |
|   - Deficit                        | 0              | Land availability < land needs | | | |
| 3. Water capacity                 | 35             |                     |       |             |           | 35    |
|   - Surplus                        | 1              | Water availability > Water needs | Regulation of Minister of Environment No. 17/2009 on Guidelines for Determining Environmental Carrying Capacity in Regional Spatial Planning | |
|   - Intermediate                  | 0.5            | Water availability = Water needs | | | |
|   - Deficit                        | 0              | Water availability < Water needs | | | |
| Planning |
|----------|
| 4. Quality of surface water | 10 |
| - Meet the standards | 1 |
| | Water quality standards based on physical parameters (color, taste & smell) |
| - Not meet the standards | 0 |
| | - Regulation of Minister of Health No.416 / 1990 on Clean Water Quality Requirements. |
| | - Experts agreement |
| | - Team discussion |

B. Vulnerability 30

1. Vulnerability of water resources against pollution 15

- Waste water treatment meets standards 1

- Wastewater treatment does not meet standards.

2. Vulnerability of coastal areas against disaster 10

- Low 1

- Medium 0.5

- High 0

3. Vulnerability of sea transportation against weather 5

- Low 1

- Medium 0.5

- High 0

| Planning |
|----------|
| 1. Vulnerability of water resources against pollution |
| - Waste water treatment meets standards | 1 |
| | The existence of wastewater treatment facilities |
| - Wastewater treatment does not meet standards. | 0 |
| | - Experts agreement |
| | - Team discussion |

| Planning |
|----------|
| 2. Vulnerability of coastal areas against disaster |
| - Low | 1 |
| | Population density in tsunami risk areas < 500 people/km² |
| - Medium | 0.5 |
| | Population density in tsunami risk areas 500 -1000 people/km² |
| - High | 0 |
| | Population density in tsunami risk areas > 1000 people /km² |

| Planning |
|----------|
| 3. Vulnerability of sea transportation against weather |
| - Low | 1 |
| | Wave height < 1m |
| - Medium | 0.5 |
| | Wave height 1-2.5 m |
| - High | 0 |
| | Wave height > 2.5 m |

| Planning |
|----------|
| 4. Quality of surface water |
| - Meet the standards | 1 |
| | Water quality standards based on physical parameters (color, taste & smell) |
| - Not meet the standards | 0 |
| | - Regulation of Minister of Health No.416 / 1990 on Clean Water Quality Requirements. |
| | - Experts agreement |
| | - Team discussion |
5. Discussion and results
The ability of Ndao Island is calculated based on the criteria of "environmental carrying capacity" derived from 4 sub-criteria. Then it is compared with the criteria of "vulnerability" derived from 3 sub-criteria. The characteristics of Ndao Island is described in table 3. Information on this table is the secondary data calculated using the formulas explained in [20]. To find out the value Environmental Carrying Capacity is done by entering this parameter status into table 2. Then the description is mentioned in table 4.

Table 3. Characteristics of Ndao Island.

| No. | Sub-criteria                        | Status of parameter                                                                 |
|-----|-------------------------------------|--------------------------------------------------------------------------------------|
| 1.  | Land capability                     | Class III-class VI is land suitable for residential usage                             |
| 2.  | Land capacity                       | In 2016 land availability (1,476.41 Ha) > land requirements (1,370.92 Ha) → surplus. In 2026 land availability (1,476.41 Ha) < land requirement (2,048.68 Ha) → deficit, due to inhabitant increase and need more area for agriculture. |
| 3.  | Water capacity                      | Water availability (98,548 m³/year) < water needs (108,505 m³/year) → deficit         |
| 4.  | Quality of surface water            | Water samples were taken from                                                       |
|     |                                     | - Dusun Fatula wells: colorless, smelling of soil and salty taste.                   |
|     |                                     | - Mbali Lendeki pond: smell fishy, tasteless and colorless                           |
|     |                                     | - Aemame spring: colorless, smelling of soil and salty taste                        |
|     |                                     | Results of physical and chemical parameters test:                                   |
|     |                                     | - Water quality that exceeds quality standards,                                      |
|     |                                     | - high TDS value,                                                                   |
|     |                                     | - hardness and fluoride,                                                            |
|     |                                     | - smells fishy,                                                                    |
|     |                                     | - contains a little sulfate, ammonia, nitrate and fluoride                          |
|     |                                     | Results of biological parameter test results:                                      |
|     |                                     | - some of the water contaminated with e.coli bacteria                               |
| 5.  | The vulnerability of water resources against pollution | Not all domestic wastewater is processed according to standard                       |
| 6.  | The vulnerability of coastal areas against disaster | Of the total population divided by the area of land affected by the tsunami disaster, in 2016 the density of the population affected by the tsunami disaster was 364 people/km², by 2026 it would reach 544 people / km² because the population increased |
| 7.  | The vulnerability of sea transportation against weather | Based on data from the Zoning Plan for Coastal Areas and Small Islands, the height of the east season wave is 3.4 m, so sea transportation is very weather-prone. |
### Table 4. The Score of Environmental Carrying Capacity of Ndao Island.

| Criteria, Sub-criteria, Parameter | Criteria weight | Sub-criteria weight | Rating | Description | Reference | Score |
|---------------------------------|----------------|---------------------|--------|-------------|-----------|-------|
| A. Environmental carrying capacity | 70             |                     |        |             |           |       |
| 1. Land capability               | 10             |                     | 1      | Land class III up to VI: suitable for residential use | - Regulation of Minister of Environment No. 17/2009 concerning Guidelines for Determining Environmental Carrying Capacity in Regional Spatial Planning - Experts agreement - Team discussion | 10 |
| - High                           |               |                     |       |             |           |       |
| - Medium                         | 0.5           |                     | 1      | Land classes I and II: considered for agricultural and settlement development |           |       |
| - Low                            | 0             |                     | 0      | Land classes VII and VIII: must be protected or for conservation |           |       |
| 2. Land capacity                 | 15             |                     | 1      | Land availability > land needs | Regulation of Minister of Environment No. 17/2009 on Guidelines for Determining Environmental Carrying Capacity in Regional Spatial Planning | 0 |
| - Surplus                        |               |                     | 0.5    | Land availability = land needs |           |       |
| - Intermediate                   |               |                     | 0      | Land availability < land needs |           |       |
| 3. Water capacity                | 35             |                     | 1      | Water availability > Water needs | Regulation of Minister of Environment No. 17/2009 on Guidelines for Determining Environmental Carrying Capacity in Regional Spatial Planning | 0 |
| - Surplus                        |               |                     | 0.5    | Water availability = Water needs |           |       |
| - Deficit                        |               |                     | 0      | Water availability < Water needs |           |       |
| 4. Quality of surface water      | 10             |                     | 1      | Standards of water quality based on physical parameters (color, taste & smell) | - Regulation of Minister of Health No.416 / 1990 on Clean Water Quality Requirements. - Experts agreement - Team discussion | 0 |
| - Meet the standards             |               |                     |       |             |           |       |
| - Not meet the standards         | 0             |                     |       |             |           |       |
| B. Vulnerability                 | 30             |                     | 1      | Vulnerability of water resources against pollution |           |       |
| 1. Vulnerability of water resources against pollution | 15 |                     | 0      |             |           |       |
1. Wastewater treatment meets standards
- 1 The existence of wastewater treatment facilities
- 0 Wastewater treatment does not meet standards.

2. Vulnerability of coastal area against disaster
- Low Population density in tsunami risk areas < 500 people/km² 1 Regulation of the Head of BNPB No 02/2012 on General Guidelines for Disaster Risk Assessment
- Medium Population density in tsunami risk areas 500 -1000 people/km² 0.5
- High Population density in tsunami risk areas > 1000 people /km² 0

3. Vulnerability of sea transportation against weather
- Low Wave height < 1m 1
- Medium Wave height 1-2.5 m 0.5
- High Wave height > 2.5 m 0

Total score of Ndao Island 15

From the calculation of basic data year 2016, the total score of Ndao Island is 15. Referring to the cut-off level in table 3, the "environmental carrying capacity" is "low" (0 ≤ X< 43.75), and its position is of "priority 1". The results explain that in 2016 Ndao Island had a low environmental carrying capacity, and needs to be given the first priority in the development of infrastructure. The availability of clean water is deemed a deficit. So Ndao Island should be developed with priority in handling the clean water sector. Water is a major requirement on a small island, but the supply is very limited due to few catchment areas [21]. The availability of clean water is absolute even though it is vulnerable to seawater intrusion. Ensuring the availability of clean water means maintaining island resilience [22].

In 2026, with a projection of the population to be 5,190 people, the needs on land to meet basic daily activities will increase. From the calculation of the carrying capacity of the land, the carrying capacity of Ndao will not meet the needs. For Ndao Island to remain a comfortable place to live, the efforts taken are mitigation and adaptation. For people on small islands, adaption is an instinct action to respond to any changes that they have already done for life. As evidence that they can survive through every occurrence episodes in their habitation [23]. The population that allows living on the island can be used as an indicator of the feasibility of the island, whether investment for mitigating the island is of high economic value [12].

6. Conclusion
As part of the country territory, many of the small islands are difficult to get priority in infrastructure development because of the remote location and few residents while some facilities can be built for a certain population only. Through the calculation of environmental carrying capacity and vulnerability,
the priority level can be identified and included in the regional government program. Small islands that have been included in the program priorities must be followed up by the local government, both the Regional Government and the Central Government with the construction of infrastructure covering the housing, clean water; wastewater treatment, waste management, drainage and accessibility. The priority of facility development will depend on the needs of the island.

Generally, this study can describe the existing conditions of a very small Island of Ndao and its possibility of development in 2026. This can also give a picture of the conditions of dominant islands in Indonesia which are very small in size. From discussions with the government apparatus of Rote Ndao District and Ndao sub-District the findings has been accepted for consideration in "planning indications of island infrastructure provision programs", but need further study for elaborating each facility in detail under the growing needs of the community.

Until now, not all the small islands have been optimally managed because of no integrative and nationally agreed references as the basis for policies and strategies for managing small islands. At present, the Regional Government and the Central Government develop small islands based on the number of population, so the development of infrastructure will be postponed when the population does not meet the requirements. This policy may have to be evaluated, otherwise many small islands will continue to be underdeveloped areas with unequal welfare towards large islands. All small islands should have an equal opportunity of development that regard to community needs and the environmental capability.

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