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Towards sustainable marine and coastal planning for Taka Bonerate Kepulauan Selayar Biosphere Reserve: Indonesian case study to The Global Challenge Research Fund Blue Communities Project

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Abstract. Global Challenge Research Fund (GCRF) Blue Communities is a 4 year research and capacity building project for sustainable interactions with marine ecosystems for the benefit of the health, wellbeing, food security and livelihoods of coastal communities in East and South East Asia. Kepulauan Selayar (Selayar Islands), including Taka Bonerate as a Biosphere Reserve and part of the UNESCO's Man and Biosphere (MAB) Network has been selected as a case study site for the GCRF Blue Communities project in Indonesia. A single case study approach with mixed methods are used to generate knowledge, identify knowledge gap, and triangulate findings. The ongoing research has collated up-to-date knowledge on: (1) current natural resources management strategy in place and what should be adopted in the future and (2) current and projected profile of energy demand-supply. In the next phases of delivery it will inform policy makers and implementers of the mechanisms to optimise sustainable livelihood strategies by: (1) accelerating positive contributions toward sustainable livelihood and (2) mitigating and preventing threats and pressures to sustainable livelihood. Finally it puts forwards strategic recommendations for decision making points which are evidenced-based and holistic, encompassing: (1) best practice policy for sustainable livelihood and (2) community empowerment and programme sustainability.

1. Research project scope

1.1. Background

Taka Bonerate, located in Selayar Island Regency, was first announced as National Park in 1989 based on the Decree of the Minister of Forestry Number: 100/KPTS-II/1989, which is followed by decree No. 280/KPTS-11/1992 dated on 26 February 1992. Regarding its potential values, Taka Bonerate National Park is one of the world biodiversity centres with its wealth of fisheries and coral reefs. It is



part of the one of the UNESCO designated 14 Man and Biosphere (MAB) sites in Indonesia. Taka Bonerate- Kepulauan Selayar MAB was designated in 2015, the second to last to be designated in the country. With the exception of one, they each have a core area that is a designated national park, but the governance arrangements for each differ, reflecting that some sit within a single regency while others transcend the boundaries of two or more regencies or provinces.

Global Challenge Research Fund (GCRF) Blue Communities in Taka Bonerate Kepulauan Selayar biosphere reserve has broad goal and aspirations as follows:

- a. Improvement of local products quality and quantity without jeopardizing natural ecosystems;
- b. Sustainable income generation schemes for local communities established to promote their well-beings;
- c. Community awareness and participatory engagement in environmental protection, sustainable livelihood and climate change adaptation;
- d. Improved hygienic living and equal access to basic resources;
- e. Transferrable lesson learnt for other sites in developing blue communities programme.

1.2. Research question

The main research questions that need to be addressed from this project at the first stage are to identify the current conditions and potentials of natural and human resources, to capture the current and projected energy demand-supply profile, and to find the relationships between sustainable sustainable fisheries and tourism to sustainable livelihood in Taka Bonerate - Kepulauan Selayar biosphere reserve.

2. Research methodology

A case study approach is used to answer the identified research questions. An action research such as this project benefits from utilization of one case study because they emphasize the real-world context where the phenomena occur [1], thus providing a way to address the lived experience [2].

A single case study is most appropriate for broadening understandings, not for proving previous concepts [3]. There are several reasons for the criticism surrounding the use of a single case study in a research design. It has criticized been for being non-representative and lacking statistical generalizability due to different interpretations and researcher bias of its data complexity and richness [4]. However, supported by Yin [5], Denzin and Lincoln [6] argue that case studies do in fact enhance generalizability by looking at multiple actors in multiple settings. The advantages of using a case study includes the level of details that can be derived from the unique perceptions and concerns of individuals in a real-world situation which would otherwise would have been lost in controlled, experimental strategies

The research methods and techniques are therefore designed to acquire the necessary information about various aspects of a situation, issue, problem or phenomenon so that it can be used for purposes such as identifying needs, advising policy, and developing strategies [7]. This prescribes the need for a mixed method to be employed to ensure that the research questions are answered [8]. This study is designed to gain valuable insights of available resources, technology, and policy through quantitative methods, while at the same time it is designed to understand the society members' realities and meanings through qualitative methods.

Data is collected from both secondary and primary sources utilizing several methods i.e., desk studies, surveys and interviews, focus group discussions (FGDs) and workshops, direct measurements, remote sensing, and participatory mapping.

3. Intermediary findings

3.1. Current natural and human resources

Taka Bonerate-Kepulauan Selayar BR is an archipelago covering an area of 4,410,736 ha and encompassing 126 small islands, with a combined coastline of over 670 km. It is located in the south

of Sulawesi between the Flores Sea, Java Sea and Banda Sea. The MAB lies in the administrative jurisdiction of the Selayar Regency in the southern most point of the Province of South Sulawesi [9]. Taka Bonerate is the largest atoll in Southeast Asia and the third largest atoll in the world, with an area 530,775 ha.

The area has an equatorial wet climate with west monsoon (January-April) and east monsoon (August-September) and transition seasons (December and May-July). The area is remote (16 hours by boat to the nearest major city of Makassar) and can become isolated during the monsoon seasons when seafaring becomes dangerous.

The MAB is ecologically important. The main habitats found in the MAB are coral reefs, mangroves, lagoons, sand dunes and sea grasses. There are 22-26 species of mangrove, with mangrove forests providing a barrier to waves and thus a sanctuary for spawning fish and other fauna. Coral reefs – atoll, fringing, barrier and patch reefs – occupy 91,382 ha of the reserve; the Taka Bonerate atoll hosts 261 species of coral and 295 species of reef fish. In the biosphere region there is estimated to be over 900 species [9,10]. The reserve also contains protected species such as hawksbill turtle (*Eretmochelys imbricate*), green turtle (*Chelonia mydas*), dolphin (*Delphinus delphis*), napoleon fish (*Cheilinus undulates*), sperm whale (*Physeter microcephalus*) and fin whale (*Globicephala macrorhynchus*) [9,10].

About 125,000 people live in the reserve, of which 6,700 live in the core area of the MAB having inhabited the islands prior to its designation as Taka Bonerate National Park. The inhabitants comprise a variety of ethnic groups. On Selayar Island, for example, the Selayar are the largest ethnic group, but other groups include Bugis, Bajo, Buton and ethnic Chinese [9]. The natives of Taka Bonerate atoll are known as Bonerate people, who have their own Bonerate language. Selayar society is Muslim, except for ethnic Chinese, who are almost all Christian [10].

Livelihoods in the reserve are dominated by the fisheries, including small-scale fishing and trading. The Bonerates trade freshwater and goods from the land with the Bajou, a sea gypsy ethnic group, for sea products. Beyond the national park, in the wider reserve, the presence of live reef fish cages and fishing vessels from outside the area indicate that groupers are exported from the area [10]. Land-based livelihood activities include crop farming, horticulture (vegetables and fruits), animal husbandry and some limited forestry. Other livelihood activities include village government officials, teachers, medical personal, police and soldiers.

In terms of wellbeing indicators, life expectancy in the Selayar regency is 67 years (compared to 69 in the whole South Sulawesi Province) and poverty incidence is fairly high, with 6,029 poor households [10]. The education attainment of children is relatively low. Data in 2016 showed that the majority of inhabitants in Selayar regency had 6 or less years of education [12].

3.2. Existing energy profile

Small-scale (e.g., island) electricity is mostly generated by communal diesel power plants or individual (usually petrol-driven) portable generators, most of which only operate at night (typically 6 p.m. to 11 or 12 p.m., sometimes to 6a.m.) [11].

The electrification ratio in Selayar Regency almost reached 70% in 2017 and it has the tendency to continue to increase in the next few years [12]. The electrification ratio in Selayar regency will continue to rise per year as the number of state electricity's customer increases. Based on the Figure 1, it is found that the number of state electricity's customer has a dynamic trend each year but it tends to increase, even though the access of electricity is not the same for different subdistricts. Benteng subdistrict has the highest number of customer among the others, followed by Bontomatene and Bontosikuyu subdistricts.

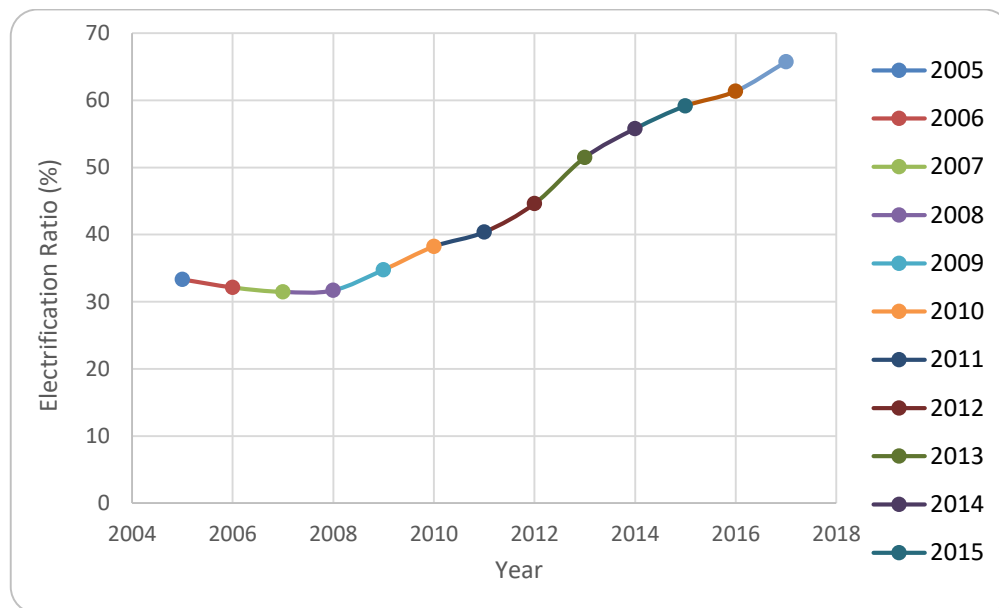


Figure 1. Profile of electrification ratio in Selayar Regency from 2005 to 2017 [12].

It is clear that Benteng subdistrict has the highest number of state electricity's customer due to the highest number of household living in this subdistrict. Based on the statistics data, Bontosikuyu and Bontomatene subdistricts are placed at the second and third place as shown in Figure 2.

Table 1. Number of business unit and its employee per sub district [12].

Sub district	Number of Business Unit	Number of employees
Pasimarannu	69	109
Pasilambena	-	-
Pasimassunggu	86	89
Takabonerate	139	139
Pasimasunggu timur	111	191
Bontosikuyu	26	81
Bontoharu	19	118
Benteng	99	413
Bontomanai	9	42
Bontomatene	14	48
Buki	9	56
Kepulauan Selayar	581	1286

Interestingly, based on the number of business unit located in each subdistrict as shown in Table 1, Takabonerate is found as the highest one. Around 139 business units with 139 employees are placed in Takabonerate subdistrict. On the other hand, Benteng subdistrict has 99 business units with 413 employees and Bontosikuyu has 26 business units with 81 employees. Based on this comparison, it

can be concluded that the scale of business units running in Benteng and Bontosikuyu are bigger compared to Takabonerate. The higher number and the bigger scale of business units will demand a higher energy provision, either from state electricity or other sources.

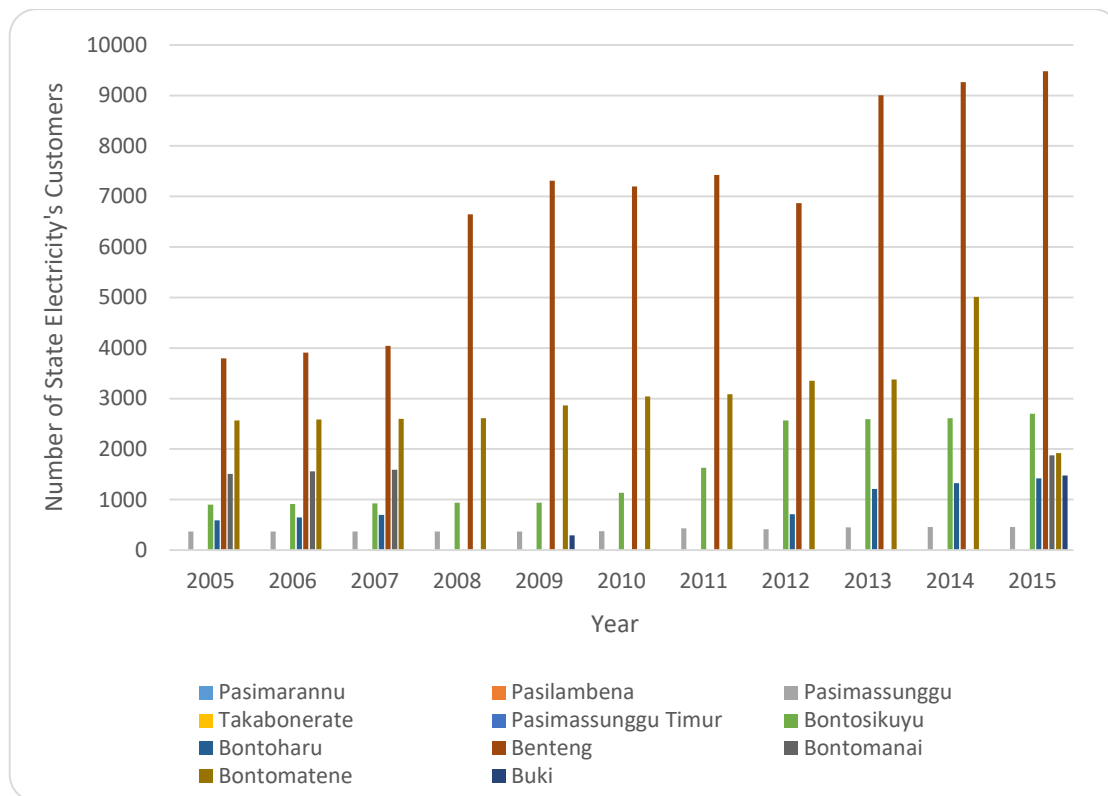


Figure 2. Number of state electricity's customer in Taka Bonerate in comparison with other districts in Selayar Islands Regency [12].

Polassi and Tambolongan Islands are two sites which have been chosen as case study sites for Blue Communities project in Indonesia. Eventhough located in Bontosikuyu subdistrict, these two islands are separated with the main island i.e. Selayar Island and its locations are more remote than other villages in the same subdistrict. Based on the field observation, the provision or supply of energy in these Islands mostly is not coming from state electricity but by using generator. Polassi, located further away from Selayar Island, relies on its energy needs mostly to the use of generator. Tambolongan, on the other hand, since the location is closer to Selayar Island, received governmental aids in installing solar power energy to supply its energy needs. Eventhough a few of local residents in Tambolongan are also still using generator.

In addition to that, Polassi and Tambolongan Islands as a coastal area have an opportunity in developing marine renewable energy to increase energy provision locally. An abundant marine renewable energy potential in Indonesia could become one of sustainable solutions in increasing energy supply at the remote and small islands and also promoting coastal community development [13].

One major limitation to the use of renewables, especially in small and/or remote communities, is that the major demand is at night, whereas the potential for generation is greatest during the day. Thus, appropriate power storage technologies are crucial to the provision of renewable, "clean" electricity to the island and coastal communities of the Sulawesi Sea.

3.3. Sustainable livelihoods drivers and pressures

3.3.1. Drivers. One of the most potential alternative livelihood creation for the local communities is Sustainable Tourism. Visitors to the Sulawesi Seas are few compared to other Indonesian islands, despite their diverse potential. Resorts are scattered around Sulawesi, including Taka Bone Rate/Selayar in South Sulawesi and Selat Lembeh a diving destination with some near pristine coral reefs and whale-shark watching as key attractions.

There are many potentials that could be developed as ecotourism attractions. Visitors can experience a number of activities such as swimming, snorkelling, and diving and walking or cycling around the island. In addition, visitors can also enjoy a tropical beach atmosphere that always displays different scenes and phenomena every time. Interacting with the locals is also a very interesting activity to do, so that visitors can feel the hospitality and learn from their daily way of life.

The locals on both islands have high awareness of cleanliness, so their homes are sufficiently clean and comfortable to be utilised as homestays. The friendliness of the residents is also an advantage on both islands, thus providing comfort for visitors. There is a welcoming atmosphere for visitors who come to the village to stay in their homes.

Polassi Island has a beautiful savannah hill. Visitors can enjoy a breath-taking view from the peak of the island. Sunset panorama is another beautiful view from the top of the hill which visitors can experience. Towards the west of the island, the beautiful underwater scenery is a very unique site to be developed into a tourist attraction and has the potential of attracting tourists who enjoy diving. Well maintained beaches, with rows of palm trees, gentle waves and breeze create a peaceful atmosphere that can be enjoyed by visitors.

Tambolongan Island is endowed by the existence of mangrove forests that is still well preserved. If it is supported by the provision of good tourist facilities the mangrove forest can be developed into various tourist attractions, such as educational and fishery tours. Visitors can learn about the functions of mangrove forests and ecosystem.

Both Polassi and Tambolongan have the potential of ecotourism. Polassi and Tambolongan have relatively closer location to the main island, thereby they are more accessible and more economical in terms of actual travel costs. If it is developed, marketed and promoted well and creatively, these two islands can serve as a window to the Biosphere Reserve and the National. Therefore, visitors with limited funds and time can still enjoy the marine beauty of the region through Polassi and Tambolongan. Planning ecotourism development in both islands, including creating site plans and designing capacity building schemes for the local community, would significantly contributes to the development of tourism.

Another potential drivers for alternative livelihoods for local communities is aquaculture. The data for this sector is currently being collected and will be reported in the next stage of the programme.

3.3.2. Pressures. One of the main pressures to creation of sustainable livelihoods for the local community is over extraction of water supplies and increasing waste generation. Due to economic activities in Selayar and outwith the regency, plastic debris has been found to be stranded around Selayar island shore during the west monsoon due to its position which is directly faced Java Sea. The plastic debris found consists of plastic bottle, plastic cup, rope and fish net, gas matches, plastic box, buoy, food packaging, toothbrush and syringe. The average of plastic debris about 9.5 ± 2.7 item/m² and weight about 229.2 ± 109.9 g/m²

While tourism can bring economic benefits, it also has many (often overlooked) implications for sustainability, inter alia for water resources (e.g., limited freshwater lenses) and water quality. The disposal of both liquid (e.g., sewage) and solid (e.g., plastics) waste, is of particular concern. While tourists may contribute to this problem, there is also the possibility that market forces related to visitor demand may drive actions to address the huge and often complex challenges associated with waste management, especially in small island environments

Another main pressure identified is destructive and over fishing practices. Lampe et al. [14] identified the following destructive methods in use in the region:

Blast fishing on shallow reefs where dead fish can be easily collected

- Cyanide to catch live fish and lobster for international export,
- Iron hammer to break coral to access hiding places of lobster,
- Use of crowbar to access hiding place of seven eyes snail (*Abaloma*) and sea eels,
- Danish seine (cantrang) trawls to capture bottom and surface organisms at once, which can destroy coral habitats.

The social survey by WCS asked respondents about what they would do if there was a 50% decline in the fisheries. 80% said they would fish as usual by changing location, 27% would change gear, 22% would reduce fishing frequency, and 9% would increase the frequency. Only 1.4% said they would exit the fishery. This indicates a high dependence on the fishery and potential lack of capacity to adapt to negative trends in the fishery.

4. Conclusion – pathway creation

In the efforts of delivering its goals and ambitions, the following knowledge gaps currently exists:

Many stakeholders are involved in the governance of the marine environment. These stakeholders are tied together by formal institutions, such as laws, management bodies and agreements to work in partnership, but also by customary (informal) institutions, such as kinship, family and other bonds. Understanding the significance and the direction of influence of this relationships is a significant challenge, but is therefore of great importance as they can have a profound effect on the design, implementation and outcomes of marine planning approaches.

There is also a further need to systematically diagnosing some of the governance questions which came into discussions, such as: understanding how the many departments, ministries and often overlapping laws and policies influenced the history of management in the MAB; and why different communities and islands have developed different capacities and wisdoms for fisheries practice and management over time, including the role of laws, policies and past projects.

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