Collaborative and sustainable management strategy of the Wallacea Key biodiversity area (KBA) in Kasa Island

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Abstract. Kasa island, with an area of 52.80 Ha, was declared a KBA in the Wallacea region with the status of wildlife sanctuary and Ocean Tourist Reserve because of its particular biodiversity and its service to the environment. This research aimed to determine the social, biophysical potential and the threats to the region, as well as to explore a collaborative management. The methods used included survey, spatial analysis of the vegetation and Focus Discussion Groups (FDG). The results showed a variety index level of 1.37%. The dominant tree species were belo hitam, salamuli daun besar and kayu besi pantai. The belo hitam species had the highest INP. The wildlife sanctuary is the habitat of the Gosong Maluku bird (Eulipoa and Megapodis), an endemic species called Gosong Maluku (Eulipoa wallacei). Other species include Gosong Kelam (megapodius freycinet). The coastline with its white sand and natural ocean is a tourist attraction with development potential. The strategy which needs to be developed is by using strengths to take advantage of opportunities so they can overcome weaknesses and threats. The strategies developed are as follows: Collaborative Management; Strengthening The Capacity of Local Community and Formulation of regional policy regarding Kasa Island management.

1. Introduction

Nature Reserve is an area with certain characteristics, both on land and in waters which functions mainly as a preservation area for the reservation of wild plants and animals diversity as well as their ecosystem which also functions as life support system area. In contrast, Wildlife Reserve is a part of nature reserve area which characteristics are in the form of diversity and or uniqueness of animals which for their survival in which their habitat must be maintained (Anonymous, 1990 [1]).

Kasa Island was designated as a conservation area according to Decree of the Minister of Agriculture Number: 653/Kpts/Um/10/1978 dated 25 October 1978 as a Nature Reserve which functions as a Wildlife Reserve in 900 Ha area and a Marine Park in 1,100 Ha area. The designation of Kasa Island forest and the surrounding sea as a conservation area was due to the existence of the island as a habitat for Maluku Gosong bird (Eulipoa wallacei), Gosong Kelam bird (Megapodius freycinet), Soa-soa or Ambon monitor lizard (Hidrosaurus amboinensis). On the other hand, it has a natural beauty with the presence of coral reefs and aquatic animals which need to be maintained for its sustainability for the benefit of science, education, culture, recreation, and tourism. (Anonymous,2016 [2]); (Anonymous, 2016.[3]).

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The management of Kasa Island conservation area face various threats from ecological aspects like the decrease of environmental quality, such as the destruction of coral reef ecosystems due to illegal fishing or overfishing, damage to the habitat of Gosong birds, as well as from local aspects like a lack of elders community involvement in its management. Thus, the management of Kasa island must be done comprehensively and integrated to anticipate and overcome the changes and threats.

Besides designated as Wildlife Reserve and Marine Park, Kasa Island is also one of the hotspots or key biodiversity area of Wallacea region. Considering the important role of the Kasa island area, a scientific study has been carried out to determine the bio-ecological potential of the conservation area so that the direction of its management can be designed. This study aimed to: (1) identify the biophysical potential of Kasa Island conservation area; (2) identify the social potential of Kasa island; and (3) design the direction of Kasa Island management as one of the conservation areas in Maluku.

2. Methods
2.1. Research Location
This study was carried out on the conservation are of Kasa Island, which is located on West Seram regency, Maluku.

![Image](image_url)

**Figure 1.** Map of Kasa Island reservation area

2.2. Analysis of the Vegetation
Data collection of the potential of vegetation in Kasa Island conservation area was done by making observation track and measurement plot on the filed. The observation tracks was made with the width of 20 m, and with some criteria of vegetation observations on the field as follows:

a) Three category (with diameter above 20 cm), the size of measurement plot was 20 m x 20 m.

b) Pole category (with diameter 10 cm to 20 cm), the size of measurement plot was 10 m x 10 m.

c) Sapling category (diameter < 10 cm and height > 1,5 cm), the size of measurement plot was 5 m x 5 m.

d) Seedling category (height < 1,5 cm), the size of measurement plot was 2 m x 2 m.
Measurement plots which were made to measure the density, frequency and vegetation dominance were as follows:

**Explanation:**
- **T**: Trees
- **P**: Poles
- **Sp**: Sapling
- **Sd**: Seedling

![Measurement Plot of Vegetation Sampling](image)

**Figure 2. Measurement Plot of Vegetation Sampling**

From the data of vegetation, it was used to find INP which was then analyzed descriptively. To find INP, the following formulas were used:

- **Density**
  \[ K = \frac{\text{Number of Individual}}{\text{Total Sample}} \]

- **Relative Density**
  \[ KR = \frac{\text{Density of A Variety}}{\text{Density of All Varieties}} \times 100 \]

- **Frequency**
  \[ F = \frac{\text{Total Plot Where A Variety Is Found}}{\text{Total Plot}} \]

- **Relative Frequency**
  \[ FR = \frac{\text{Frequency of A Variety}}{\text{Frequency of All Varieties}} \times 100 \]

- **Dominance**
  \[ D = \frac{\text{Number of Basic Area}}{\text{Width of the Sample}} \]

- **Relative Dominance**
  \[ DR = \frac{\text{Dominance of A Variety}}{\text{Dominance of All Varieties}} \]

**Index of Significance Value**
\[ \text{INP} = KR + FR + DR \]

### 2.3. Analysis of Diversity Index

Diversity index is used to estimate the variety of species in the community analysis, which is (Sugianto, 1994 [9]).

Shannon index of general diversity (H)

\[ H = - \sum_i \left( \left( \frac{n_i}{N} \right) \log \left( \frac{n_i}{N} \right) \right) \]

**Explanation:**
- **H**: Shannon index of general diversity
- **n.i**: Significant value of each species
- **N**: Total of significant value
2.4. Analysis of the Wildlife

The collected data of the wildlife potential covered mammals, aves, reptile, and amphibian. The data collection of wildlife in the inventory and identification of wildlife potential in Kasa Island was carried out by rapid assessment. The observations did not have to be done in a special lane or location. Observations were made directly in the field to the footprints, dirt, traces in plants, feathers or other body parts which left behind, sounds, and nest marks. Other clues were also used such as guidelines for introduction of species, habitat, animals active period and morphological forms.

Additional data of the animal presence were also obtained by finding information from the community who have seen the presence of animals in the area. Information from the community was then verified or reviewed to ensure its validity.

2.5. Descriptive Analysis

Data of environmental service potential were obtained based on the direct observation on the field, which then analyzed by descriptive analysis. Later, the data of social community was also analyzed by using descriptive analysis. The management model of Kasa Island was done based on the result of Focus Group Discussion (FGD) as well as expert judgment regarding their expertise.

2.6. SWOT Analysis

Data analysis in this study was focused on the strategic environment analysis based on the SWOT matrix at the macro level, both on internal and external environments which involved community, Non-Government Organizations (NGO), and related agencies. The SWOT Analysis Approach (Strengths, Weaknesses, Opportunities and Threats) was used to obtain strategic priorities of Kasa Island Area Management (Rangkuty, 2014 [7]).

3. Results and discussion

3.1. Vegetation Potential Condition

Kasa Island conservation area has high vegetation potential, in which some of them are endemic to this area. Tree-category forest vegetation on Kasa Island is dominated by various types of wood. The overall potential inventory which has been done on Kasa Island showed that the category of trees found on Kasa Island consists of forty two species; forty-five species of pole category; forty species of sapling and seedling category. The tree category is dominated by black belo wood species (black ebony or charcoal wood: *Diospyros celebica*), ironwood (ironwood: *Eusideroxylon zwageri*), large leaf Salamuli wood (Kendal Wood: *Cordia spp*), and beach ironwood (ironwood: *Eusideroxylon zwageri*). The pole category is dominated by black belo wood (black ebony or charcoal wood: *Diospyros celebica*), hanet wood (puspa wood: *Schima wallichii*), sea guava (Malapari pods: *Pongamia pinnata*), and ironwood (ulin wood: *Eusideroxylon zwageri*). The sapling category is dominated by black belo wood (black ebony or charcoal wood: *Diospyros celebica*), key lime wood (Citrus aurantifolia), airal wood and totrain wood. Whereas, the seedling category is dominated by black belo wood, sea guava, hanet wood and airal wood.

The density of tree category was 26.34, the pole category was 130.68, the sapling category was 823.14 and seedling category was 17603.71. Black belo wood (black ebony or charcoal: *Diospyros celebica*) dominated the Kasa Island area with the highest density for all categories of vegetation.

The role of one tree species against another can be seen from the Importance Value Index (INP). If a species shows a high INP, the role of the species is very large towards other tree species in the ecosystem. Based on the analysis result, black belo wood showed a fairly high INP of around 48.96% for the tree category; 122.23% for the pole category; 62.21% for the sapling category and 98.41% for seedling category. Black Belo wood also showed a significant Index Value for all types of categories.

The diversity level of natural resources in Kasa Island was quite diverse based on the results from Shannon diversity index analysis. Based on the results of the analysis, the highest diversity index value was 1.37%. It means that the diversity of vegetation on Kasa Island in the West Seram Regency...
was moderate. This result was consistent with the classification of Odum diversity index (1971) which stated that the diversity index value between 1-3 has moderate diversity, and the diversity index value of more than 3 is high diversity. Based on the data above, it can be stated that Kasa Island has received ecological pressure.

Flora biodiversity in this area is a biotic resource which functions as genetic bank that is very potential to be developed. The high biodiversity needs serious effort to maintain its sustainable management, although this are is vulnerable to a higher extinction.

3.2. Wildlife Potential Condition
Kasa Island Wildlife Reserve is a habitat for Gosong Maluku bird (Eulipoa and Megapodis) known as endemic fauna. Gosong/ maleo bird is a type of bird found in Maluku, known as Gosong Maluku (Eulipoa wallacei). The result showed that there were two types of Gosong/ maleo bird that belongs to the genus of Eulipoa and Megapodius. Another type of Gosong bird found was a Gosong kelam bird (Megapodius freycinet). Resence the bird is the environmental balance in the ecosystem components, (Maya Adelina, Sugeng P. Harianto, dan Nuning Nurcahyani. 2016 [6]). The results showed that both types of Gosong birds were threatened by population decline due to habitat degradation and irresponsible hunt of maleo egg. This degradation occurred due to natural factors and human activities. The natural factor caused high abrasion, while human activity which created new paths by not paying attention to maleo nest would eventually threat maleo habitat. The hunting of maleo eggs and sea turtles by the community also greatly threatened the availability of these biological resources. Besides, that there was also the destruction of coral reefs due to illegal fishing done by the people outside Kasa island, especially from several village nearby such as from Telaga, Ketapang and its surroundings.

Various other types of aves were also found on Kasa Island such as Pombo (Ducula bicolor), Sea eagle (Haliastur indus), Trinil pantai (Actitis hipoleucus), Seagull (Stercorarius pomarinus), Dara laut (Sternula hirundo), Pekaka (Halcyon spp), Walet (Collocalia infuscata), and types of sea eagles (Haliaeetus leucogaster).

On the other hands, there are some types of reptiles found on Kasa Island, such as snakes, monitor lizards (Varanus sp), Soa (Hydrosaurus sp), chameleon and gecko. Monitor lizards found were with the average length of 60-100 cm. These lizards are also predators of Gosong/ maleo bird eggs and predators of these birds. Green turtles were also found, in which according to the community, this species has begun to decrease.

3.3. Environmental Services Potential
Kassa Island has various tourism objects which are potential to be developed, especially on the sea both on the surface and under water. Some attractions which are worth developing are in the form of beautiful natural panorama, biodiversity of flora and fauna, animal attractions and distinctive ecosystem characteristics. There are other ecotourism potentials in the form of beaches filled with white sand, coral reefs and various other marine life. By considering Kasa Island based on its function as a nature reserve, the type of tourism that can be done is special interest tourism. However, the development of ecotourism must prioritize the principles of sustainable ecotourism that are ecologically still maintaining the supporting and carrying capacity of the region, and can economically improve the welfare of the community (Scheyvens, 2000 [8]).

3.4. Social Condition of the Village Community
There were 75 people (100%) of Kaibobu villagers who became the respondents of this study. The age distribution were dominantly came from age group of 36-55 years old (45%), 17-35 years old (25%), and the rest from above 56 years old (30%). Age had an effect to the participation level. Generally, when people reach certain age, there is a possibility of deeper involvement in community activities due to the awareness towards environmental issue.

Their education level was primary school graduates (49%), secondary school graduates (27%), senior high school graduates (23%), and university graduates (1%). Regarding the low education level,
the people were given understanding of the importance to maintain the environment especially in Kasa Island.

The profession of the people were mostly farmer (40%), fishermen and farmer (37%), fishermen (9%), private worker and builder (4%) and others such as civil servant and speed boat driver by 1% for each. These types of work were related to the level of education of the respondents that mostly worked as farmers and fishermen.

The people of Kaibobu Village in general were very supportive to the management plan of the Kasa Island area as a Nature Reserve as well as its development as a special interest tourism object. The village community expected that collaborative management of the Kasa island by involving the community, both directly and indirectly, would mean that the community also participated in maintaining the existence of the Kasa Island area so that it would not be degraded. The degradation will possibly threaten Maluku endemic of Gosong bird. It will also protects the area from the outsiders whose activities will possibly damage the area, so that the management of the Kasa Island can be sustained.

3.5. Management Strategy of Kasa Island

In formulating the management strategy of Kasa Island in West Seram regency, SWOT analysis was conducted by selecting the relations or interactions between internal elements (strengths and weaknesses) against external elements (opportunities and threats) based on natural factors and characteristics of the community and other facts at the research setting. The SWOT components of the Kasa Island Management Strategy were as follows:

| Strengths                                                                 | Weaknesses                                                                 |
|--------------------------------------------------------------------------|---------------------------------------------------------------------------|
| High potential of biodiversity in Kasa Island                            | Institutional management of Kasa Island which was not optimum              |
| High diversity of vegetation                                             | Low supervision from relevant agencies                                    |
| The existence of Maleo as endemic bird                                   | Limited knowledge of the people in the community about the management of Kasa Island |
| Has a potential environmental service                                    | No local government regulation of Kasa Island management                  |
|                                                                           | Limited capital of local community to access Kasa Island                  |

| Opportunities                                                             | Threats                                                                    |
|--------------------------------------------------------------------------|---------------------------------------------------------------------------|
| Increase of the economy level of coastal community                       | Maleo bird extinction                                                     |
| Potential of special natural destination                                 | Construction of cottage                                                    |
| Allocation of government’s budget to accelerate the management of Kasa Island | Coral reefs damage                                                        |
| Presence of RPJP in Kasa Island                                           | Weak law enforcement to illegal fishing                                   |
| Increase of fishery products commodity                                   |                                                                           |
Table 1. Weighing of Strategy Factor

| Internal Factor | Weight | Rate | Score |
|-----------------|--------|------|-------|
| Strengths (S)   |        |      |       |
| • High potential of biodiversity in Kasa Island | 0.20   | 3.50 | 0.70  |
| • High diversity of vegetation | 0.10   | 3.40 | 0.34  |
| • The existence of Maleo as endemic bird | 0.15   | 3.65 | 0.54  |
| • Has a potential environmental service | 0.09   | 3.50 | 0.32  |
| Total           | 1.90   |      |       |
| Weaknesses (W)  |        |      |       |
| • Institutional management of Kasa Island which was not optimum | 0.05   | 2.10 | 0.10  |
| • Low supervision from relevant agencies | 0.10   | 2.15 | 0.22  |
| • Limited knowledge of the people in the community about the management of Kasa Island | 0.05   | 2.15 | 0.11  |
| • No local government regulation of Kasa Island management | 0.05   | 1.15 | 0.06  |
| • Limited capital of local community to access Kasa Island | 0.10   | 1.18 | 0.11  |
| Total           | 0.60   |      |       |

| External Factor | Weight | Rate | Score |
|-----------------|--------|------|-------|
| Opportunities (O) |        |      |       |
| • Increase of the economy level of coastal community | 0.17   | 3.30 | 0.56  |
| • Potential of special natural destination | 0.17   | 3.25 | 0.55  |
| • Allocation of government’s budget to accelerate the management of Kasa Island | 0.15   | 3.30 | 0.46  |
| • Presence of RPJP in Kasa Island | 0.10   | 3.40 | 0.34  |
| • Increase of fishery products commodity | 0.10   | 2.50 | 0.25  |
| Total           | 1.91   |      |       |
| Threat (T)      |        |      |       |
| • Maleo bird extinction | 0.17   | 2.20 | 0.38  |
| • Construction of cottage | 0.12   | 2.10 | 0.25  |
| • Coral reefs damage | 0.09   | 2.10 | 0.19  |
| • Weak law enforcement to illegal fishing | 0.12   | 1.10 | 0.13  |
| Total           | 0.95   |      |       |

From table of SWOT above, it can be illustrated that the management strategy of Kasa Island is located in Quadrant I as follows:
Based on Figure 3, the management position of Kasa Island was located in Quadrant I. It showed that the management of Kasa Island had strengths that must be optimized by utilizing the opportunities existed to maintain its sustainability. The strategy which needs to be developed is by using strengths to take advantage of opportunities so they can overcome weaknesses and threats.

The management of the Kasa Island in the quadrant above showed a favorable situation. The strategy which must be applied in this condition is to support growth oriented strategy (Rangkuty, 2014 [7]). Based on quadrant I, the strategies developed are as follows:

1. Collaborative Management

   The legal basis for collaborative management of Kasa Island and its implications is Law No. 5 of 1990 about Conservation of Biological Resources and Its Ecosystems, as a legal basis which allows Kasa Island to be managed together and accommodate various interests for research, science, education, support cultivation and recreation. Besides that, it is also strengthened by Permenhut No. P.19 of 2004 about Management of Nature Reserves and Nature Conservation Areas, which included guidelines for preparation, implementation, monitoring and evaluation in collaborative management of conservation areas, which involves various stakeholders. The implication is that collaborative institution of multi parties needs to be made for the management of Kasa Island with clear guideline from planning to evaluation (Falah F,2013 [5]).

   Collaborative management can be done by promoting integrated environmental sustainability. Coordination among stakeholders needs to be improved to solve various fundamental problems in the management of Kasa Island, especially in infrastructure and socio-economic issues. (Carlsson L, Berkes F. 2005 [4]). Besides that, DKP stakeholder authority through the enactment of Law No. 23 of 2013 which was transferred to the province level also greatly influenced the management of Kasa Island, so that collaborative management needs to be implemented in various forms of innovative programs and activities. Several collaborative management can be effective in achieving sustainability of the functions and benefits of conservation areas, including: (1) Holistic principles, which is the management of the area which must consider all ecological, economic and social functions in the ecosystem; (2) Integrative principles, which includes management based on cooperation between all parties.

2. Strengthening The Capacity of Local Community

   Strengthening the capacity of local community needs to be increased through training. Types of training that can be provided to local communities to support Kasa Island management starts with the
formation of a guided group (increasing the sense of group) based on the social and cultural conditions of the local communities around Kasa Island.

3. Formulation of regional policy regarding Kasa Island management

The existence of regional policy in the form of regional or domestic regulation will be the basis for the legality of Kasa Island management.

4. Conclusion

1. Vegetation potential on Kasa Island is more dominated by black belo wood species, with the highest density level at all vegetation category. The density of the tree category was 26.34, the pole category was 130.68, the sapling category was 823.14 and the seedling category was 17603.71.

2. Kasa island has fairly diverse natural resources, with the highest diversity index value of 1.37%, which includes in the medium category.

3. The wildlife potential is more dominated by two types of Gosong/ maleo birds from the genus of Eulipoa and Megapodius. Another type of Gosong bird found was Gosong kelam (Megapodius freycinet).

4. Based on its function, Kasa Island is a nature reserve, so that the type of tourism that can be done is special interest tourism for research and education purposes.

5. Kasa Island management strategies which can be followed up in collaborative and sustainable management are as follows: (1) Collaborative management; (2) Strengthening the capacity of local communities; (3) Formulation of regional policies regarding the management of Kasa Island.

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