Management and sustainability of the Kupang Bay coastal zone resources, East Nusa Tenggara Province, Indonesia

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Abstract. The sustainability of coastal zone resources could be improved if the management involve the community and stakeholders. The present study aimed to: (a) analyze the correlations between the sustainability of coastal resources at Kupang bay and the ecology, economy, social and spatial arrangement, and management of the area; (b) analyze the management for the sustainability of coastal resources at Kupang bay. A survey method was applied, using a participatory approach. The collected data were analyzed using the generalized structured component analysis (GSCA) method. We found positive correlations between ecology, economic, social, spatial arrangement, and institutional (insignificant) factors and tended to increase the management and the sustainability of the resources on the coastal zone. Thus, better management improves the sustainability of resources. The sustainability targets at Kupang Bay could be achieved by limiting the exploitation of resources and restoring the ecosystem. The major income of the Kupang community was obtained through the skill improvement, the lost local wisdom priority "Songo Songo", the fisheries sector priority as the basis of area development, the improvement priority on the government role, the regulation priority on the management of Kupang Bay, and the management continuity on preserving the area.
Key Words: appreciation, priority, local community, sustainable management, Kupang Bay Area.

Introduction. As a large archipelago, Indonesia is rich in marine resources and has a large, economically important fisheries sector (Dirhamsyah 2004; Tajerin 2009). It has been proposed that a collaborative management strategy, incorporating top-down and bottom-up approaches, could help protect Indonesian coastal marine resources (Ballinger et al 2010). Community-based resource management systems rely heavily on the coastal community, but often require institutional assistance (e.g., economic and management actions) (Shukla & Sinclair 2010). Government and local communities have many common interests in the development of coastal areas (Celliers et al 2012). It is, therefore, important to apply a sustainable management on the various marine resources (Agardy et al 2011; Indar 2013). Good coastal development should consider environmental, socioeconomic, and governmental impacts, but this can be complicated when applying an integrated approach (Belfiore 2003). Although local jurisdictions are responsible for the management of coastal zones and public access, this must being in line with the priorities of local government (Blizzard & Mangun 2008). The indicator system could be developed by means of gradual conceptual approach (Cotanza & Voinov 2001), restricted with the management cycle, linked causally with various aspects, such as socioeconomic and government (Belfiore 2003).

Development activities (total population and socioeconomic activity) are mostly concentrated in the coastal zone (Abel et al 2011; Aiello et al 2013) more than 80% of

the Indonesian population lives within the coastal zone (Solihin et al 2013). Therefore, the management of coastal resources must consider spatial, ecology, and socio-economic factors (Farhan & Lim 2012; Lloyd et al 2013; Teh et al 2012; Hughes et al 2005), while balancing conservation efforts against benefits to the local population. The degradation of the marine ecosystem and the decline of the coastal zone in Indonesia have forced the government to develop strategies that utilize, manage, and conserve the marine ecosystem (Abecasis et al 2013).

The environmental changes and sustainability issues have been demanding our consciousness to intervene the recovery process of the environmental services (Hobs et al 2011). An effective and sustainable management strategy is needed to conserve Kupang Bay (Clifton 2003; Henley 2007; Al Bakri 1996; Belfiore 2003). Therefore, the society and stakeholders take an important role in order to conform the Kupang bay conservation. Some factors are needed to be prioritized in order to create a suitable management for the development and conservation of Kupang Bay.

The management of Kupang Bay coastal areas requires synergy between various management factors by involving local communities as stakeholders. The purpose of this study is to analyze the relationship between ecological, economic, social, spatial and institutional factors in the management of the sustainability of coastal resources of Kupang Bay and analyze the direction of management policy for the sustainability of coastal resources of Kupang Bay.

Material and Method. This study was performed in Kupang Bay, East Nusa Tenggara Province, Indonesia. The survey was conducted using a participatory approach (Soehartono 2011), through questionnaires and interviews (Moleong 2012). First, the determination of the data sampling was conducted by purposive sampling (Nasution 2012). The study population included those living in the region around Kupang Bay, especially fishermen and public figures. The population was calculated according to the method described by Isaac & Michael (1983). Second, the assessment of economic, social, ecological, spatial arrangement and institutional value was conducted by generalized structured component analysis (GSCA) (Hwang & Takane 2004; Hwang et al 2010a), applying an alternating least square algorithm (Hwang et al 2007; Hwang 2009; Hwang et al 2010b). The hypotheses of this study were: (a) the management of Kupang Bay is affected by ecological, economic, social, spatial arrangement, and institutional factors; (b) the sustainability of Kupang Bay's resources is affected by the management model. Variable dimensions were measured by the following indicators presented in Table 1.

Table 1

Variable dimension and indicators of the Management of Kupang Bay

Variable	Indicators
Ecology factor	(1) Exploitation rate, (2) Wide area, (3) Ecology diversity, (4) Community activities, (5) Space utilization
Economic factor	(1) Income levels, (2) Job availability, (3) Occupation levels, (4) Venture capital, (5) Employment, (6) Investor, (7) Alternative income
Social factor	(1) Education level, (2) Status conflict, (3) Community growth, (4) Culture, (5) Impact on society, (6) Participation
Spatial arrangement factor	(1) Management authority, (2) Region potential, (3) The level of conformity, (4) Participatory, (5) Public welfare orientation, (6) Structural form
Institutional factor	(1) Local wisdom, (2) The participation of non-governmental organization, (3) Government, (4) Law regulation
Management	(1) Government role, (2) Regulation, (3) Zonation, (4) Management agencies
The sustainability of natural resources	(1) Public awareness (2) Continuity

Next, we analyzed the Kupang Bay management, according to the management dimension and the resources sustainability. The management approach of coastal zone at Kupang bay is presented in Figure 1.
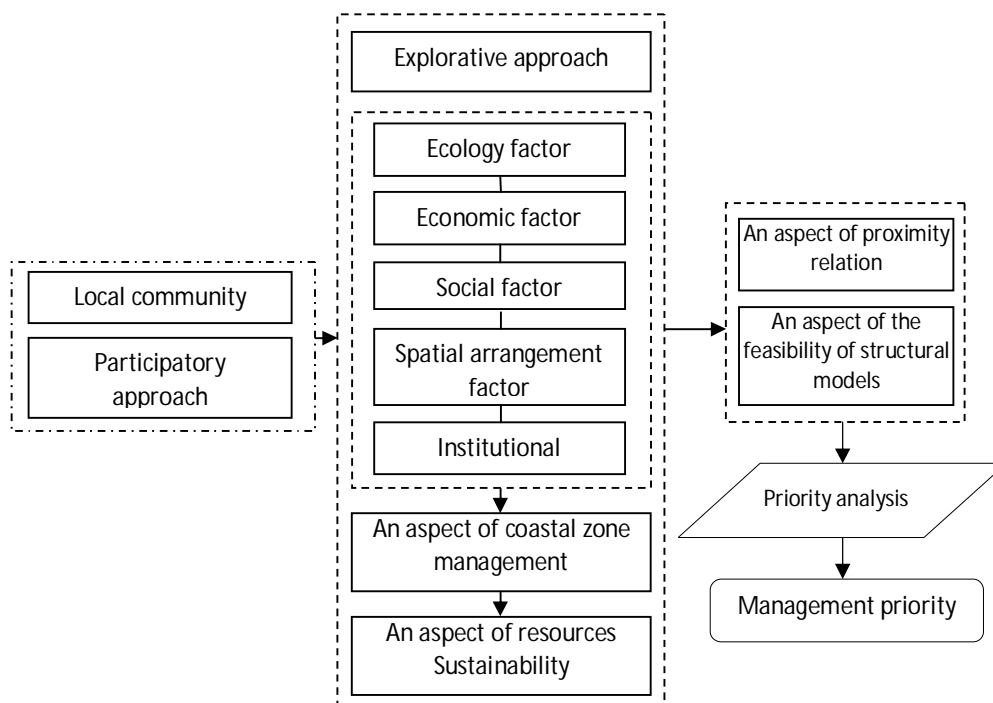

Figure 1. The management of the coastal zone at Kupang Bay.

Results and Discussion. Historically, the coastal zone around Kupang Bay was inhabited by various tribes or ethnicities, creating a heterogeneous community. The Kupang Bay natives are referred to as Timor Dawan, while the migrant ethnicities were comprised of Bugis, Makasar, Bajo, and Solor. The majority of migrants settled at Kupang Bay and lived together with the natives, working as fishermen. There are approximately 10,000 people full-time at Kupang Bay, mostly male (78.9%). The women (21.1%) working at Kupang Bay mostly managed the fishes and sold the catch. We noted two peculiar characteristics of this fishing settlement: (i) a house is typically inhabited by four to five of the head of the family; and (ii) there is a low level of education (68.1% completing elementary school).

We found that the data gathering instruments used in this study were valid and reliable (correlation coefficient, p<0.05; Cronbach's Alpha ≥0.6) for all items. The Convergent Validity 1st and 2nd order tests returned a loading factor *(λ)* >0.6, which is considered valid. Figure 2 shows the pathway model between the ecological, economic, social, spatial arrangement, and institutional dimensions.
We found a significant relationship between the ecological factor and Kupang bay management (correlation, 0.148; Critical Ratio [CR], 4.38*) (Figure 2). The same trend was found for the economic (correlation, 0.264; CR, 9.96) and social (correlation, 0.129; CR, 394*) factors, as well as spatial arrangement (correlation, 0.154; CR, 2.65*). However, we found no significant relationship between the institutional factor and Kupang Bay management (correlation, 0.016; CR, 0.55). The mathematical equation is shown below:

$$CZM = 0.148\ EF + 0.264\ EcF + 0.129\ ScF + 0.154\ SAF + 0.016IF \qquad (1)$$
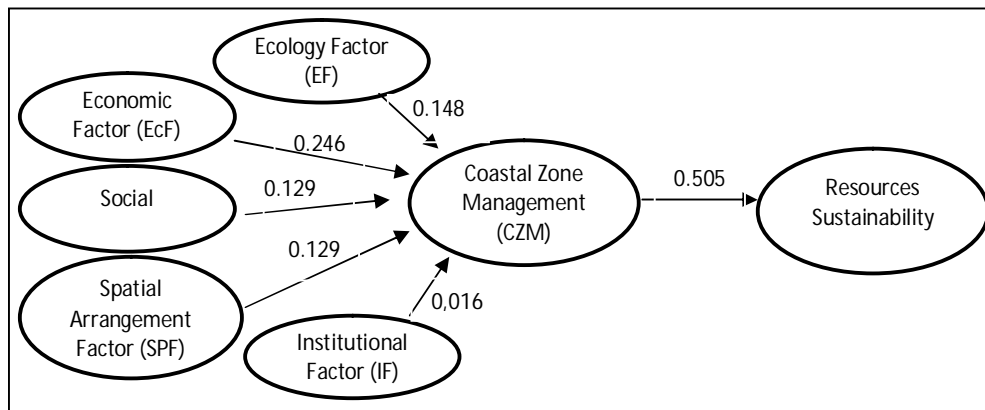
Figure 2. Analysis of the management and resources sustainability track on Kupang Bay.

The test result of management variables showed a significant result towards the resources sustainability (correlation, 0.505; CR, 46.02*; t = 2; α = 0.05). The mathematical equation is shown below:

$$RS = 0.05 \ CZM \quad (2)$$

Testing for indirect effects on resource sustainability (via management intervention), detected a significant contribution (t-stat>t-tab) from the ecological (4.334), economic (9.563), and social (3.893) factors, and spatial arrangement (2.651). No such effect was detected for the institutional factor (0.533). Economic, ecological, social, spatial arrangement and institutional factors could establish the management and resources sustainability on the coastal area of Kupang Bay, although it showed no significant result. The global optimization index of 0.995 suggests a good fit for our structural model. The goodness-of-fit value for our structural model was 0.595, which suggest that there sources sustainability at Kupang Bay could be explained by ecological, economic, social, spatial arrangement, and institutional factors by means of management towards the entire resources sustainability.

Based on a research summary from McClanahan et al (2008), the community perception of the coastal area was strongly correlated with their life. The importance of Kupang Bay management could be evidenced by the involvement of the community, government, and stakeholders, who were all aiming to achieve sustainability of the resources (Gunaisah et al 2016). The development and management of this area should be done using modern, holistic coastal management approach (Wu et al 2012).

The management of Kupang Bay should optimize various factors, such as ecological, social, economic, spatial arrangement, and institutional factors so that the resources sustainability could be conserved. Bengen (2002) stated that the development could be persisted if it involving ecological, socio-economic, culture, and institutional dimensions. Moreover, the management of coastal area is important due to its ecological role between upland, coastal zone, and high seas. The availability of resources, environmental services, community potential, economic sole utilization is basically susceptible to the external and internal changes.

Ecological factors, such as exploitation rate, wide area, diversity, community activities, and space utilization, evidently contribute to the improvement of area management. One of the important management for the coastal area is the linkage of vital habitat ecologically (Dahuri et al 2004). Damage to coastal areas is mainly caused by inappropriate management techniques (Supriharyono 2000).

Kupang Bay has long been utilized as an economic center by the local inhibinants (e.g., for transport, trade, fisheries, hotels, and restaurants) (Handayani et al 2016). Therefore, management should consider some important indicators, including income levels, job availability, occupation, venture capital, employment, investor, and alternative income. Kupang Bay is a dense settlement area. Furthermore, it caused a cultural mix, the economic needs increase, conflict, a low participation rate, and a low public education. Social problems in the area have led to exploitation of the natural resources

by the local community, as noted by Dangeubun & Tetelepta (2013). The recent study shows that social factor also gives a positive contribution. Therefore, the characteristic of the coastal community that is heterogeneous is an important key to the management effort of the coastal area.

The creation of an utilization area is supposed to comply the indicator in order to measure the resources sustainability through a suitable management. The spatial arrangement is a general development planning that aimed to achieve a certain spatial model in the future. The orientation of spatial is related to the arrangement, utilization, and control. It also should consider the authority variable, area potential, area capability, welfare orientation, and structural form. So that the paradigm of sustainability of a region could be compiled.

The Conservation and Natural Resources (NTT) department are responsible for managing the waters of Kupang Bay, whereas the land is under the authority of either Kupang Regency or Kupang City. The administrative jurisdiction is expected could be synergized and integrated a positive decision toward the formation of marine policies. The Ministry of Marine Affairs and Fisheries (2004) stated that the legal framework of the plan, utilization, the community rights and access, conflict management, conservation, mitigation, rehabilitation of coastal damage, and elaboration of relevant international conventions that has not been arranged yet in our legislation. Cooperation between the central and local government is now needed for effective management of this coastal area. This would minimize the conflict (e.g., between the authorities and local fishermen). Other steps that could be taken include providing certainty and legal protection, improving the welfare of coastal communities through policies that ensure the access and rights of the coastal community.

Kupang Bay coastal development policies are aimed at increasing production and needed the management orientation and resources sustainability as one of its concepts. Therefore, the sustainability of Kupang Bay is run through a chain of main priority (Figure 3).

Figure 3 shows that the highest loading factor value was chosen as the priority that was needed in the management and resources sustainability at Kupang Bay. The management priority including (i) control of the exploitation rate and restore the ecosystem of Kupang Bay; (ii) prioritize the income rate through the skill improvement; (iii) prioritize the lost local wisdom "Songo Songo"; (iv) prioritize the fishery as the basis sector and the great potential; (v) prioritize the improvement of the governmental role; (vi) prioritize the regulation form of the Kupang Bay management; (vii) the continuity of management area.

The management strategies may be an alternative that effective with the plurality of the conflict and the threats that must be solved. The major problems in the coastal areas are related to the ecological, social, economic, spatial planning, and institutional aspects. Wu et al (2012) found that those sectoral efforts have caused multiple conflicts within the coastal zone, including conflicts between government agencies and private fishermen, which threaten both the environment and the local community.
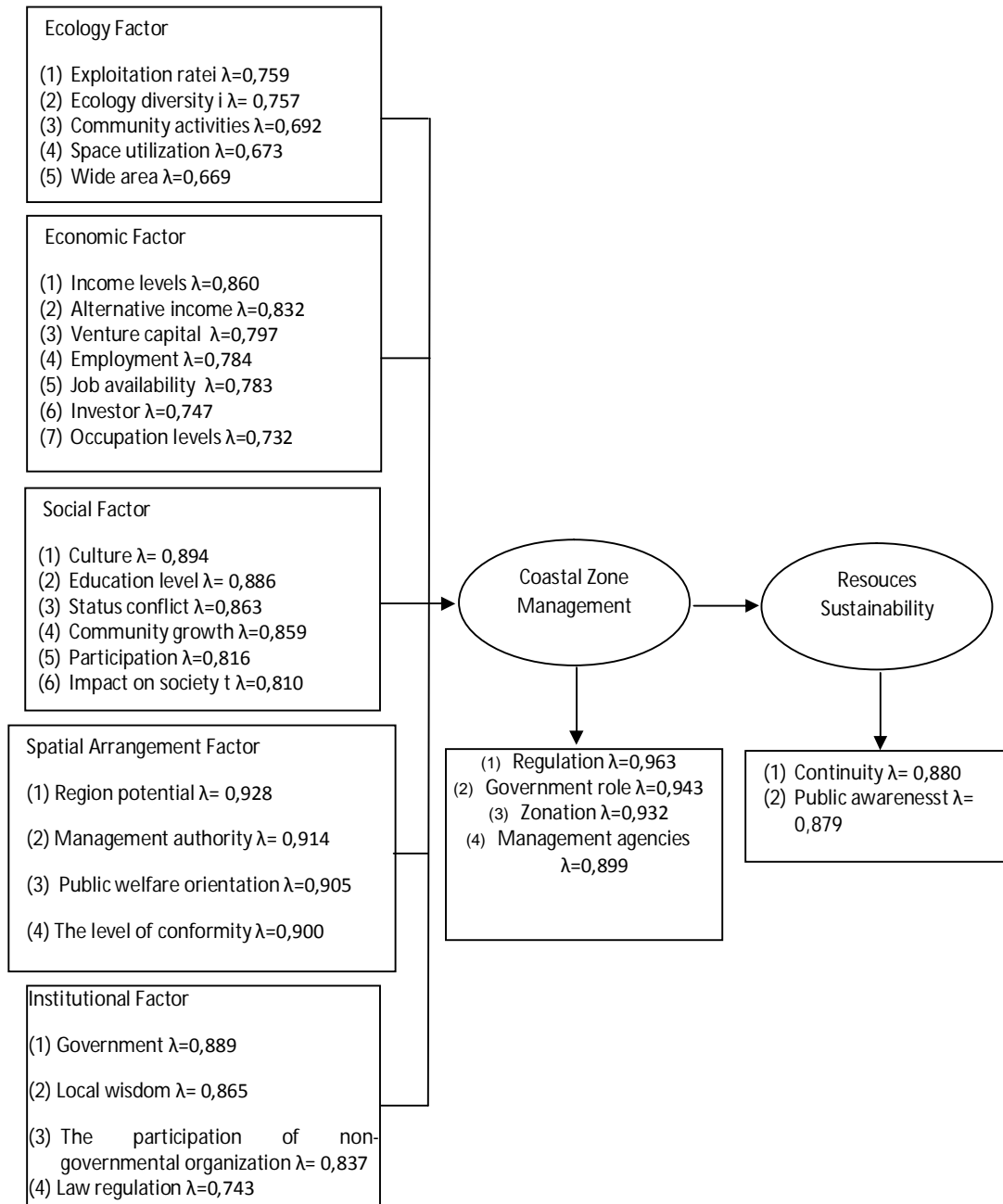
Figure 3. Management priorities for achieving resource sustainability at Kupang Bay.

Conclusions. This research concluded that the relation among various factors toward the management of Kupang Bay was: (a) ecological, economic, social, spatial arrangement and institutional factors demonstrated a positive correlation and tended to increase the management of Kupang Bay, although institutional factor demonstrate an insignificant result; (b) ecological, economic, social, spatial planning and institutional factors demonstrated a positive correlation by means of management and tended to increase the resources sustainability of Kupang Bay, although institutional factor still showed an insignificant result; (c) good management (as indicated by ecological, economic, social, social planning, and institutional scores) was associated with the sustainability of the resources; (d) the structural model considered as proper with a contribution toward the sustainability was 59.5%. The following management priorities for improving

sustainability were identified: (i) control of the exploitation rate and restoration of the Kupang Bay ecosystem; (ii) improve income rate through skill improvement; (iii) protect local wisdom (Songo Songo); (iv) give priority to the fishery sector and develop its potential; (v) improve governmental contributions; (vi) prioritize the regulation form of the Kupang Bay management; (vii) achieve continuity of management.

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