MANAGEMENT PLAN FOR COASTAL RESOURCES IN THE NORTH COAST OF CENTRAL JAVA, INDONESIA

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ABSTRACT

An integrated coastal management plan has become an increasingly important tool to accommodate coastal resource utilization that is multisectoral in nature. The idea of adopting this strategy comes from the fact that coastal resources consist of various valuable assets that should be utilized in a sustainable fashion. This paper emphasizes on some key issues related to coastal resource utilization in the north coast of Central Java, Indonesia, and presents an integrated management plan to achieve the objective of sustainable development. Some key issues include urban development, industrial growth, agriculture and aquaculture. The management plan was devised through the following framework: (1) Intersectoral integration, which involves coordinated management of the various sectors of coastal activity, such as fisheries, aquaculture, shipping, ports, tourism, etc; (2) Intergovernmental integration, which involves various levels of government, from local/municipal to provincial to national; (3) Spatial integration, which include in particular many connections between land-based and sea-based activities and institutions; (4) Science-management integration deals with multiple disciplines required to understand coastal issues, and linkages between science and management itself;

Keywords: integrated coastal management, coastal resources, sustainable development

1. Introduction

The utilization of coastal resources has increased markedly in the recent years. This is mainly due to the depletion and degradation of upland resources and rapid growth of population which is followed by rapid exploitation of coastal resources. Wide ranges of activities associated with this include the development of fishing fleets, ports and related industries, aquaculture, tourism and housing. Moreover, coastal area is also the site for effluent disposal from industrial and domestic sources.

The north coast of Central Java is one of the most populated areas in Indonesia (919 people per square kilometer in 1998). This area is under increasing pressure as a result of rapid socio-economic growth and the expanding use of coastal resources. The coastal waters have changed physically over time. Furthermore, coastal system degradation has been driven not only by physical and economic forces, but also by inadequate planning and management.

The north coast of Central Java has experienced a range of environmental impact arising from the rapid development of shrimp ponds, compounded by the clearing of mangrove areas. Many development programs have been attempted in the area and yet not all are compatible with sound resources utilization. It is suspected that the environment is being severely damaged by pollution and some other forms of environmental deterioration which affect several coastal habitats such as mangrove forest, coral reefs, and estuaries.

Some researches have been undertaken on the coastal ecosystem of the north coast of Central Java and its natural resources as well as the problems associated with their use and exploitation. However, the scope and the approach of the research are still uni-sectoral and therefore it is difficult for government planning agencies to use the results in an integrated development program (Hutabarat *et al*., 1993). The need for integrated development planning for the coastal area of the north coast of Central Java is becoming crucial to address numerous problems such as conflict by groups of resources users and beneficiaries. An appropriate model for integrated resources utilization and management is thus very critical not only to avoid conflicts among the development projects, but also to prevent overexploitation of resources and degradation of the environment. One of the objectives of the Second National Long Term Development Program is to protect and preserve the environment which respects the environmental concerns of the government and all the Indonesian people (Puslitbang Perikanan, 1991).

2. Objective and Scope

The major objectives of this paper are to present, analyze and synthesize data and information on the nature, significance utilization and management of the coastal resources of north coast of Central Java and to develop an integrated coastal resources management plan (ICRMP) for the study area. To understand the scope of the project, terms used in this paper are defined as follows.

Coastal Resources. The term refers to a kind of resources found in or around the coastal area. These resources can be classified into three types: biological, mineral and energy. Biological resources include the flora and fauna found in the area such as mangrove, fish, mollusk and other planktonic and benthic fauna. Mineral resources include minerals, oils, sand and gravel, water. Energy resources include thermal, wave and tidal energy. In this paper due to limitations of space and data, emphasis is placed more on coastal resources of biological nature and to some extent minerals, land and water.

Coastal Area. This may be broadly defined as an area on either side of the coast of any land mass where land, sea water and air interact. The seaward limit of the coastal zone includes the coastal sea influenced by natural or man-made activities on land. A definition of landward limit of the coastal zone may be based on the influence of marine processes such as tidal movement and salt water intrusion towards the land (Carter, 1988). This definition indicates that coastal area boundaries are not particularly obvious because they are highly dependent upon the prevailing local conditions. In a flat area the boundary of coastal region will be further landward from the coastline; in the contrary the land boundary of the coastal area in a steep region will be closer to the coastline.

Coastal resources utilization can be defined as any economic activity within the coastal area that affects directly or indirectly, the socio-economic status of the people or the government and also on the condition of the environment (Paw *et al*., 1988).

3. Materials and Methods

The data were collected from some research reports in the study area, particularly in the identification of biophysical data and some of the biological characteristics of the coastal habitat. These data were supplemented with secondary data collected from related agencies, such as The Ministry of Marine Affairs and Fisheries, the district planning board, and local government of Central Java. Based on this information major issues were determined and studied in order to obtain a general picture of coastal resources and the environmental conditions. The integrated management plan for the study area was devised by taking into account of major issues and their impact on the coastal ecosystem. This management plan is still in a preliminary stage and serves as an umbrella program for the more detailed and elaborated ones.

4. Results

4.1. Major development programs

This section briefly describes some major development programs as the sources of anthropogenic impact on the north coast of Central Java.

4.1.1. Urban development

Rapid population growth has resulted in the problem of human settlement. This exerts more pressure on the local government to provide proper housing for the burgeoning population. In order to address the problem, the government has established a master plan for urban and residential development as documented in their urban development plan scheme (UDPS). In some major cities like Semarang and Pekalongan, coastal areas have been used to develop housing and their infrastructure during the past ten years. Many of the newly-developed housing consist of luxurious and expensive buildings which are aimed at the middle-classes. However, during the past two years some of the areas have been abandoned due to the rise of sea levels.

Raised beaches and sand deposit areas are found extensively in Rembang, Pati and Jepara. These were considered suitable for the development of housing, recreational ground or other facilities related to tourism program. However, the emerging land has created a unique and notoriously difficult problem related to property rights since there are many people attempting to claim the land as their property.

The flat peat swamps such as those along Demak and some areas in Pati and Jepara regency are not suitable for urban development because of their characteristically soft and unsettled nature, and consequently the potential for flooding hazards. The reduction of mangrove areas was also resulted from the development of housing and settlements along the coastal area. Rapid population growth has exacerbated the problem, which become more apparent during the last decade as population pressure and associated economic activities increased considerably. In Rembang, the rapid population growth has posed serious problem on human settlement. According to the calculation and prediction of the government in the year of 2010, the need for housing in rural area will reach 6,000 ha, whilst in the urban area it will be 2,097,013 ha. This situation will lead to changes in land use and designation. Considerable pressure will be placed on the tree crops and rice field areas since they will be converted gradually to housings and other infrastructural needs

4.1.2. Industrial growth

Development is currently being undertaken in Central Java on a massive scale. There is a huge warehouse complex proposed for Tanjung Mas Port in Semarang. Also, residential, industrial and tourism developments are proposed in most of the cities and towns along the North Coast. ln Juwana, sub-district of Pati, local government has planned to develop a fishing port despite the lack of land for the development of the fishing industry and other infrastructure. According to the local government, the reason of this development is to allow larger fishing vessels landing their catches in Juwana which currently has only a small fish landing site. This plan, however, needs a thorough feasibility study and EIA (Environmental Impact Assessment) so as to assure that it will not bring about adverse impacts on the environment.

4.1.3. Agriculture

Almost the whole northern coast of Central Java consists of volcanic soils. These soils are suitable for agricultural uses. The fertility of volcanic soils is derived from the abundance of minerals, phosphorus and other plant nutrients released from the andesitic mud now and volcanic ash. The formation of granular soils results in excellent properties of water retention, aeration and erosion resistance (Furukawa, 1994). Cereal, especially rice farming is the most common agricultural practice in the North Coast of Central Java. Agriculture sites are most predominant in the study area, especially in small districts such as Jepara, Batang and Brebes. However, current development of urban and industrial areas has replaced sizeable areas of agricultural land. The extent of this replacement is growing very rapidly from year to year, thus making it difficult to be quantified. Considerable pressure is placed on the tree crops and rice fields areas which are being converted to housing and other infrastructural needs.

The coastal beaches in general have no agricultural value but this does not exclude the small holder's cultivation of crops and trees scattered irregularly throughout the coastal belt, (e.g. Sendang Sikucing in Kendal Regency is suitable for mango cultivation).

4.1.4. Aquaculture

The number and size of shrimp ponds is growing rapidly in the coastal areas of Central Java. Local tidal conditions with limited diurnal and seasonal range are favorable for shrimp farming. In general these coastal areas have a large potential for aquaculture, especially from Pekalongan to Batang and Jepara to Rembang. This is sustained by the soil condition with a wide expanse of relatively well consolidated into tidal alluvium with tidal or brackishwater culture potential.

The shrimp ponds are found mainly in Brebes, Jepara and Rembang coastal areas. As the number of shrimp ponds increased in the area, expansion also occurred in adjacent coastal areas. Most of the shrimp ponds have been changed from extensive or semi intensive into intensive farming systems, which use a high stocking density along with a full supply of artificial feeds and high-tech equipment to support high-level production. The main species cultivated are tiger shrimp (*Penaeus monodon*) and banana shrimp (*P. merguiensis*) since they are highly demanded in the international food market and also because the technology and systems for the culture of both species are already available. In Brebes and Rembang shrimp culture projects are growing very rapidly. This has been particularly obvious during the past five years when the government began to encourage the development of tiger prawn *(Penaeus monodon*) culture as a major export commodity apart from gas and natural oil. The increased growth of shrimp culture projects is enhanced by the evidence that there is also considerable increase in international market demand for shrimp and prawns.

The development of shrimp culture has brought about some marked changes in the ecological balance. Large areas of mangrove forest have been cleared and converted into shrimp ponds. In Brebes, only 5 km out of its 32 km coastline remains covered by mangroves. The remaining area of mangrove is only about 50 ha. In several of Pati regency some sizeable areas of rice field have been converted into shrimp and fish ponds. Some cases indicated that the conversion did not yield a significant profit since the shrimp and fish production were poor. In contrast, the agricultural activities yielded a better production of crops and thus it was more profitable under the previous use.

4.2. Coastal resources receiving major impact

4.2.1. Mangrove

The mangrove communities in most of the coastal area of Central Java can be classified into 2 different community compositions, namely *Avicennia marina* and *Rhizophora mucronata* communities.

1. *Avicennia marina* community

This community occurs in the outer area directly bordering the sea. It covers an area of 20-30 m wide consisting of young trees (10 years old on average). In several sampling locations *A. marina* was identified with the average height of 3 m. In a deposit lowland *A. marina* was found in seedling form. This fact indicates that this species has a specific pioneer characteristic which enables them to survive in harsh conditions.

2. *Rhizophora mucronata* community

This community has been planted by humans as dike protection. *R. mucronata* mainly occurs in dikes and primary channels of fish pond systems. The community can achieve 1 km in length with the average diameter of 1-10 cm and height of 0.5-3.5 m. In Rembang, out of its 60 km coastline, mangrove forest covers only 3 km or only 5 % of the total area with an area of around 7 ha. Mangrove communities in the coastal area of Rembang did not grow naturally. They were planted by humans and referred to as a secondary community despite a small number of original species growing in the same area. The most common mangrove in Rembang is *Rhizophora mucronata* which grows both in pond channels and along the coastline in which the daily salinity is 31‰ on average. At the coastline *R. mucronata* was found mostly in the form of seedlings which indicate that people have replanted them in order to protect pond form erosion. Young trees have an average diameter of 5-15 cm with the average height of 1-4 m. In Rembang mangrove is not indigenous to the area. Attempt had been made to replant mangrove trees in Mangkang, Semarang in order to protect shrimp ponds from erosion. It was reported by local people that some areas of shrimp ponds had been eroded by erosion occurred in the area concerned. Unfortunately, this attempt was unsuccessful due to the lack of knowledge on the nature and characteristic of the erosion. This suggests that a relevant study needs to be undertaken by experts prior to conducting any replanting programs.

Current development of aquaculture projects in Rembang, Pati and some other areas is deemed responsible for the reduction of the mangrove communities. Based on the 1987 data concerning the shrimp pond ownership by local fishermen, it has been revealed that on average, each fisherman owns approximately 0.12 ha of shrimp pond. Competition among fishers has led to the expansion of aquaculture area which is usually achieved by clearing the nearest mangrove area. This might result in some severe impacts on the environment if there is no attempt to restore mangrove vegetation alongside the newly established aquaculture ponds. This vegetation is important to provide buffer zone in order to maintain biodiversity in the coastal habitat. Direct observation of the study area revealed that only a few fishermen were willing to replant mangrove around their ponds. Once the mangroves were planted not all the people were willing or able to maintain their growth.

The absences of a replanting program by government and the lack of natural regeneration of mangrove have exacerbated the problem. Natural regeneration of some species, e.g. *Avicennia* sp. and *Rhizopora* sp. appears to be inadequate in most of the coastal area in which aquaculture operations exist. Replanting of *A. mucronata* by local communities is considered insufficient to replace the natural regeneration. Insufficient numbers of seedlings of the above species were unable to colonize the area. There are a number of serious problem concerning the conversion of mangrove areas into aquaculture sites, one of which is the formation of acid sulphate soils which occur when previously submerged soils are exposed to the air (Pillay, 1992). Even though such soils are also found in the freshwater swamps, the

problem is more pronounced in brackishwater areas such as mangrove forest. Acid sulphate soil is generated from the formation of pyrite which is fixed and accumulated by the reduction of sulphate from salt water. The process includes reduction of sulphate to sulphide by bacterial action and partial oxidation of sulphide to elemental sulphur followed by interaction between ferrous or ferric iron with sulphide and elemental sulphur. High concentrations of organic matter and sulphate-reducing bacteria in an anaerobic environment are the main factor contributing to the occurrence of sulphate soils (Pillay. 1992).

Although it is clear that mangroves are very important some pressures of development towards the mangrove areas in the North Coast of Central Java are inevitable. For example in Bulukamba (Brebes district) 20 year-old mangrove plants have been identified within residential areas, suggesting that human settlement has eroded into previously mangrove areas. "Coastal squeeze" is occurring as the landward boundary of the mangrove area is pushed seaward.

4.2.2. Capture Fisheries

The amount of fish caught in local waters reached a maximum of about 240.729 tons in 1992. A number of fishing gears were used i.e. gill net, trammel net, beach seine, purse seine, and long line. Most of the fish caught was *Decapterus russeli* which made up about 40% of the total catch. The total catch increased in 1990, 1991 and 1992 but decreased in 1993 and 1994 and increased in 1995 and 1996.

Despite the increase of total catch in 1990, 1991 and 1992, pelagic species which account for 70% of all species caught decreased significantly. The pelagic species include those having near the sea surface or slightly below it, and in general consist of relatively small fish. One of the predominant characteristics of these species is schooling which render stock distribution patterns indiscriminate. In general, the density of pelagic fish in the surface area is higher than that of the deeper areas except in the up-welling zone which is very fertile owing to the enrichment of nutrient by vertical movement of the water (Amin et al., 1991). They also found that the Java Sea has a relatively high density of pelagic species. It was noted that there are four different fishing seasons in the area i.e. the first season (January-March), second or transition (April-June), third (July-September), and the fourth (October-December).

The prominent issue concerning fish stocks is related to the depletion of pelagic species. As mentioned previously, the overall total catch of fish in the study area has increased, but the opposite trend has been identified for the pelagic fish. The catch of pelagic fish decreased in 1990 and 1991 increased in 1992 and decreased again in 1993, and in the last three years (1994-1996) it decreased quite markedly. Production of capture fisheries, in particular pelagic fish in the study area has declined during the past five years. The data obtained show an appreciable reduction of the species particularly from 1990 to 1991, and between 1992 and 1996. The commercially important pelagic fish belong to the Clupeids. Carangids and Scombrids, and consist of a variety of species, i.e. *Decapterus* spp., *Rastrelliger* spp., *Scomberomous* spp., *Euthynnus* spp., *Caranx* spp., *Sardinella* spp., *Stolephorus* spp., *Dussumieara acuta*, and some clupeid fish.

4.2.3. Coral reefs

The extraction of sand and coral reef from coastal areas occurs in many regions along the north coast, the main purpose is to obtain high quality material for building. The government has started to regulate, and even ban these activities which are considered to have a significant negative impact on the environment.

Tourism development has also created a particular problem for the coral reefs and their habitat. Collection of coral and shells of commercial value by souvenir hunters or by the local population are the

most prominent issues which need to be addressed. This situation mainly occurs in Jepara and Rembang regency where there are vast areas of coral reefs.

The extraction of coral reefs also happened along with sand mining to provide material for building construction. However, there are no quantitative data on the volume of materials that has been extracted from particular areas. Even without such information, the fact that there is indeed a serious problem of coral reefs and their habitat is very obvious and this can be seen by direct observation on the affected areas. The extraction of coral reefs and sand are deemed to be major issues of coastal erosion in the area concerned and the adjacent coastline. This activity is suspected to contribute to the lowering of the shore level, resulting in increased frequency and severity of tidal flooding in the area concerned.

4.3. Integrated coastal management

The World Bank (2002) views Integrated Coastal Management (ICM) as seeking to "maximize the benefits provided by the coastal zone and to minimize conflicts and harmful effects of activities on social, cultural and environmental resources" through"…an interdisciplinary and intersectoral approach to problem definition and solutions" involving "a process of governance that consists of the legal and institutional framework necessary to ensure that development and management plans for coastal zones are integrated with environmental and social goals, and are developed with the participation of those affected."

Cicin-Sain and Knecht (1998) focus on ICM as "a continuous process by which decisions are made within a suitable coastal management system", one that involves " blending together science, social science and technological studies, on the one hand, with development of suitable policies, planning and programs, on the other hand." This emphasizes that ICM incorporates an information and analytical process with a policy-oriented stage which provide the required factual and analytical foundation for evaluating implications of alternative decisions.

The concept of integration in this paper follows a methodological framework based on Cicin-Sain and Knecht's conception of the practice of ICM, which includes:

- Intersectoral integration, which involves coordinated management of the various sectors of coastal activity, such as fisheries, aquaculture, shipping, ports, tourism, etc.;
- Intergovernmental integration, which involves various levels of government, from local/municipal to provincial to national;
- Spatial integration, which include in particular many connections between land-based and sea-based activities and institutions;
- Science-management integration deals with multiple disciplines required to understand coastal issues, and linkages between science and management itself;

Within the above framework, we will determine the inter-relationship between major issues and ICM. Incorporation of major issues and ICM will provide critical input by identifying and quantifying major impacts to be taken into account in the management plan. The paper examines these inter-relationships in the context of the coastal areas of northern Central Java, Indonesia. In addition, we examine the manner by which the existence of major issues has influenced ICM planning, as well as the role of an ICM process in actually preventing or mitigating those major issues. Some key components of the ICM framework, contributing to the prevention and mitigation of adverse impacts, are described below.

4.3.1. Mechanism for ICM co-ordination

The provincial government should establish an inter-agency, multi-sectoral coordinating mechanism for integrated coastal management, as well as operational offices to implement ICM programs. The integrated management framework is illustrated in Fig. 1. Committee members include the heads of bureaus for city construction, science, environment protection, fisheries, etc. Within this framework, government has to established priorities, undertaken capacity building to strengthen planning and management capabilities, developed a sustained environmental quality monitoring program and financial mechanism to mobilize public and private financial resources and established the needed local ordinances to legitimize institutional arrangements. This intersectoral integration provides a means for coordinated management of the various sectors of coastal activity.

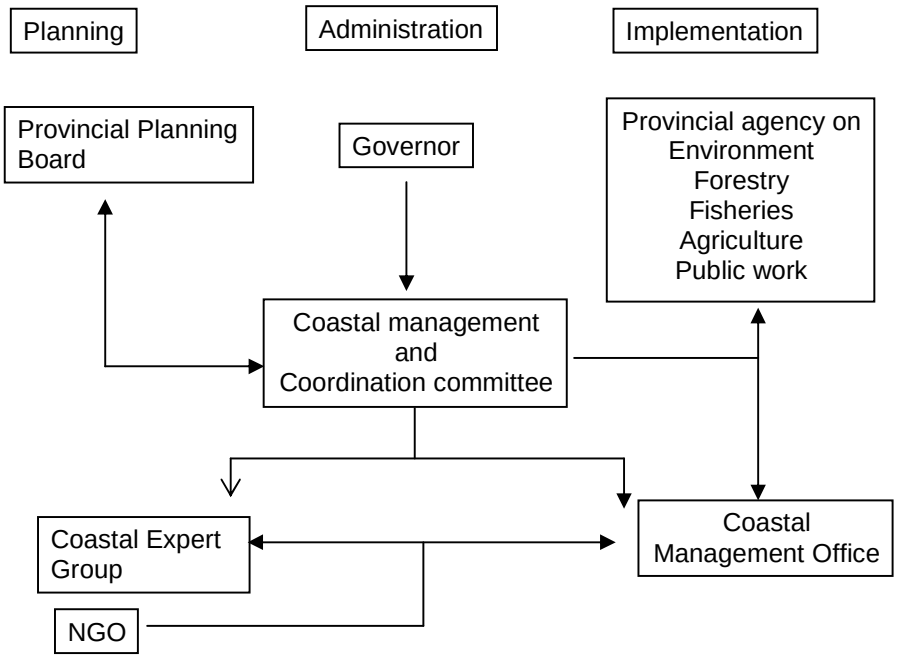

Fig. 1. Legislative framework and enforcement for coastal management

The provincial government should devise a special coastal legislation as the legal framework to address the issues. The legal framework should meet the following objectives: (1) establishing a mechanism to coordinate the management program, (2) redefining the authorities of some government agencies involved in coastal management, (3) establishing an effective law enforcement mechanism. A supervisory force should be formed to strengthen integrated law which includes relevant agencies organized into an integrated law enforcement group.

1. Involvement of scientific group

Scientists in relevant subject (fisheries, agriculture, expert in legal and social, economists, etc.) should be involved in the planning process. An independent expert group should be established to integrate science into policy-making and management. The group will be responsible for providing

essential ecological, socio-economic and technical advice to policymakers and to provide the best available information to address the issue of coastal management. This reflect "science-management integration" concept providing interdisciplinary studies and linkages between science and management.

2. Zonation

Zonation is a crucial means for the effective mitigation of adverse impacts. This provides a framework of zoning of natural resource uses through an integrated approach to considering ecosystem and socio-economic factors. This approach is used to determine multi-use priorities, reduce use conflicts and increase socio-economic benefits to local people while maintaining the sustainability of the resources and environment. Coastal zonation is an important strategy in the management process, providing a starting point for managing multiple use prioritization and coordination, and for effectively minimizing adverse environmental impact through allocation of water-based and land-based zone in a given area.

The zonation scheme will be formulated by the scientific group. Prioritization of use function is the key to the zoning, with priorities depending on the level of socio-economics effect and associated environmental impacts of uses. In addition, zonation plan should be supplemented with GIS data that allow classification and production of habitat and resource map using satellite imagery imported into the GIS. This will provide fundamental information to allow prioritization of target zonation areas.

Conclusion

The particular point of this paper is that the north coast of Central Java represents a challenging situation of very rapid population, economic growth and coastal change. The major issues include urban development, industrial growth, agriculture and aquaculture. Analysis of these issues was used to develop coastal zoning scheme and to provide guidelines for the ICM planning process.

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