

OVERVIEW OF THE SUCCESSFUL CORAL REEF MANAGEMENT IN INDONESIA

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ABSTRACT

Indonesia is the largest archipelagic country in the world, composed of 18,110 islands with a coastline of 108,900 km long, extending some 5000 km long and 2000 km wide located between Asia and Australia. Coral reefs have important meaning and value for the coastal communities in term of economic, social, and cultural conditions. About 1.5 million people are traditional fishermen who live in subsistence level and depend on their lives fully on coral reefs' resources. The Indonesian coral reef contributed 14% of the world, distributed unevenly from Sabang to Merauke with the highest concentration around Sulawesi and Maluku. The species richness and the biodiversity of the Indonesian corals amounted to 590 species belonging to 82 genera or about 80% of the currently existing coral species in the world. Monitoring program has been done from 1993 to 2010 and it shows the trend of improvement in the term of live coral cover. The condition of coral reefs in Indonesia taken from 84 locations and 1048 sites were 50.54% in excellent condition, 26.72% in good condition, 37.21% in fair condition, and 30.82% in bad condition. Improving trends in live coral cover across all project sites shows that the live coral covers has increased in all monitored sites across all project districts with average yearly live coral coverage increase is about 2-5%. The National Policy, Strategy, and Action Plan was established, with its main objective of managing the coral reef ecosystems based on the balance between conservation and utilization, and it was reflected in the Law No. 27 of 2007 concerning coastal management and small islands. The most remarkable result of the program is community awareness, namely the decrease of fishing activities using destructive device such as explosive having extensive range of audience. The result of the activities shows that the destructive fishing activities in all project district are now non-existent or at a minimal level. A special text books on marine lives for elementary, secondary, and high school is the most widely adopted by local education service as a book of local content. Whereas institutional strengthening program constitutes the most difficult, energy and time consuming activities. It is due to the rivalry between the local institutions and the lack of officials' and the communities' knowledge on the conservation based management principle.

Keywords: Coral reef management, National policy, Public awareness, Institutional strengthening

INTRODUCTION

Indonesia is the largest archipelagic country in the world, composed of 18,110 islands with a coastline of 108,900 km long, extending some 5000 km long and 2000 km wide located between Asia and Australia. Ancient formation of island state showed the unique geological appearance and the physiographic condition of sea bottom as such that we have two of the greatest shallow seas in the world separated by a deep sea in between. Indonesian position in the tropical region with water current continuously flowing throughout the

year and the occurrence of deep and shallow seas provide the richest marine ecosystems variation in the world. Apart from that, the occurrence of warm water current with higher salinity from the Pacific Ocean to the Indian Ocean has a very important role in forming the monsoon in Asia and Australia.

Past geological history reveals that since the past million years, the deep sea around Sulawesi Island has community to evolve continuously. Evolution is a continuing adaptation process of animals and plants on their living environment. The

occurrence of various unique and complex ecosystems and existing external factors that provides the support make it possible for the marine biota to grow and develop optimally and the evolution process can be proceed maximally and resulted high species diversity. Therefore, it is not surprising that the sea around Sulawesi and Maluku becomes the center of high biodiversity in the world and is also known as one of the origins of various marine organisms (Veron, 1995; Spalding *et al.*, 2001)

Coral reefs have an important meaning to the Indonesian coastal community for its function and role, either ecologically, socio-economically or culturally. About 1.5 million people are traditional fishermen who live in subsistence level and depend their lives fully on coral reef resources. Whereas the ecological role and function of coral reefs are among others as temporary or permanent living places, a feeding ground, a place for spawning and to grow the offspring of other species that live in association with the reefs. Coral reefs also function to clean sea waters, stock of germ plasm, protecting the shoreline from strong wave, record ancient climate and muffle global warming (Bruke *et al.* 2005, Fabricus *et al.* 2007)

Coral reef forms the great wealth, beauty, and unique and is owned only by a number of countries in the tropic, hence it is appropriate to provide a proper management in order to give the greatest benefit for the community. To be able to manage marine resources properly, it needs proper human resources in and adequate funding, so the coral reefs may be sustained and the coastal communities become wiser.

Composition of coral genera in Indonesia seas does not change much since 25 million years ago and up to now the community structure of coral is relatively the same (Bockshoten *et al.*, 1989; Jackson, 1992) despite that currently the coral reef is undergoing serious threat due to environmentally unfriendly fishing, bleaching event, and pollution.

Several studies have shown that the utilization of coral reef resources caused the degradation. Human activities causing the degradation of coral reef are catching fish using tool and destructive method, over fishing, land based pollution, coral mining and taking and coastal development. While the degradation of coral reef through natural causes includes bleaching event during El-Nino and earthquake or Tsunami.

Aware of the very important coral reef role and function for marine resources and have an important meaning for coastal communities, the Indonesian government introduces a policy, strategy, and action plan to manage the coral reefs ecosystem. This action plan is called Coral Reef Rehabilitation and Management Program began in 2000. This paper is to share information concerning the status condition and state of the art of coral reef management in Indonesia.

Coral Reef Rehabilitation and Management Program

A basic knowledge behind the coral reef rehabilitation and management program is principally managing human activity in utilizing the coral reefs. One important thing to manage human activities is to understand the socio-economic and cultural conditions of the coastal community, and other coral reefs users. By understanding the socio-economic and cultural condition of the community it is expected that an exact step can be adopted in carrying out awareness program for the community. A good understanding on the utilization of coral reef, establish positive attitude and behavior will enhance the awareness and participation in managing coral reefs of which the community can optimally utilize it to enhance the welfare of their lives.

The second step to be taken into account is to regulate human activities. It will need various law instruments, low enforcement, and surveillance. It is by law obliged to control human activities continuously so that the use of coral reef resources can be optimally utilized. Control can be done by community and government apparatus.

The third step to be able to manage marine resources properly particularly coral reefs is to monitor coral reef condition. Accuracy of data and information on the condition of coral reefs and other marine resources must be simultaneously considered. Data resulting from monitoring are kept, analyzed, and disseminated in basic data system which are easy to be assessed and understood by the public, policy, and decision makers to facilitate the planning of the upcoming strategic program.

The coral reef rehabilitation and management program are 15 year program and divided into three phases, namely initiation, acceleration, and institutional phase. The goal of this program is to protect, rehabilitate, and achieve sustainable use

of coral reefs and associated ecosystems which will in turn enhance the prosperity of coastal communities.

The initiation phase is to develop a viable coral reef management system in Indonesia. It was commenced in 2000 and designed to last for three years. The present is acceleration phase and designed to last for six years and will be completed by 2009. One objective of this second is more emphasized to establish positive attitude of fishermen in the management and preservation of the coral reef. The third institutionalization phase of all program activities (institutional, administrative, economic and financial) will be taken by local government in sustainable manner.

Indonesian Coral Reefs

Coral reefs in Indonesia can typically be divided in four types, namely fringing reef, patch reef, barrier reef, and atoll. The largest proportion of Indonesian coral reef is fringing reefs and the atoll of Takabonerate in South Sulawesi constituting the third biggest atoll in the world.

In Indonesia, coral reefs are distributed from west to east, Sabang up to Merauke, and south to north, between Rote Island and Miangas Island (Sameromi) Figure 1.

The extent coral reefs in the world are estimated to be 617,000 km² (Smith, 1978). Out of that, 14% belongs to Indonesia (Tomascik *et al.*, 1997). Coral reefs are not evenly distributed due

to a variety of environmental factors which support and hinder their growth and development. Coral reefs in Indonesia have been adequately mapped in digital map as well as hard copy at the scale of 1 : 200.000, consisting of 360 sheet of maps. The bathymetrical maps of Indonesian seas have also been available in digital form.

The existing data on the extent of coral reef in Indonesia varies from 5000 ha (KLH, 1992), 85,000 km² (Tomascik *et al.*, 1997), 51,000 km² (Burke *et al.*, 2002), and 75,000 km² (Cesar, 1996). All those figures are based only on estimated hence the figures vary depending on the applied estimated. The Research Center of Oceanography-LIPI in cooperation with LAPAN using data satellite (Landsat TM) have calculated the extent of Indonesian coral reefs to be 19,500 km². This extent of coral reefs represents the area of corals, not that true coral reefs due to the sensor limitation of the satellite image which can only penetrate the sea water not more than 10 meters. As a matter of facts, many coral reefs can be found deeper than 30 m. In addition, this calculation does not take into consideration the declivity of the coral reef which varies from slanting in low angle to dropping down vertically. This calculation is very important since for the first time the calculation is based on real data, not on estimation.

Apart from data on the extent of coral reefs which out of the same image, the number of island in Indonesia is also calculated and gives result to

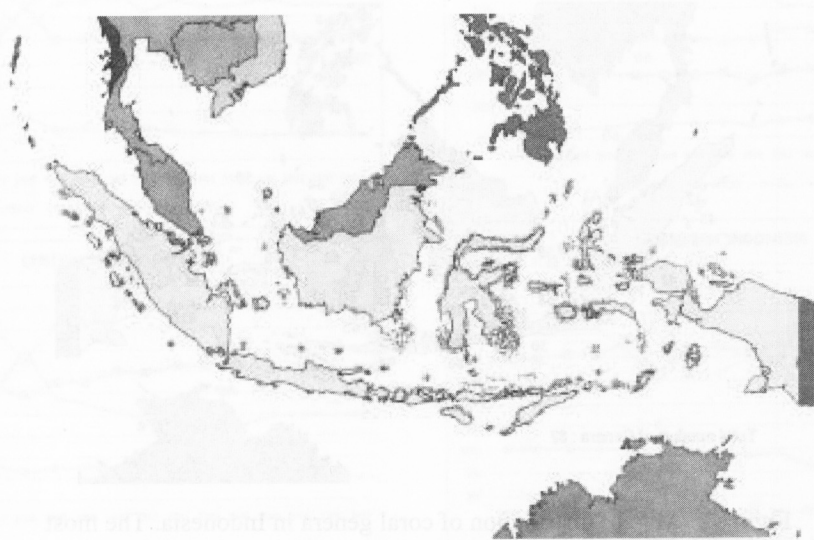


Figure 1. Coral distribution in Indonesia. Coral reefs (dots) are more widely distributed in the central and eastern Indonesia.

18,110 islands with coastal length of 108,820 km. The scale of the map that is used to calculate the coastal line is 1 : 200,000. Calculation of the length of coastal line will increase if a map of bigger scale is used since the calculation accuracy will be better. In the mean time, there is an additional number of 300 islands than was calculated previously which was 17,805. By island here is defined as all polygon objects which are visible from remote satellite data and identified directly as islands regardless of the tidal condition.

Distribution, Diversity, and Status of Coral Reef Condition in Indonesia

Coral reefs grow better in location which is quite far from Sumatera mainland or around small islands in the west coast and is characterized by relatively low species diversity, constituting a typical character of coral reefs in the Indian Ocean. Coral reefs in the east coast of Sumatera do not develop properly due to many big rivers mouth along that coast. Corals grow and develop in small island located sufficiently far from the mainland of Sumatera such as Natuna Island and Anambas Island.

Along the coast of west, south, and east Kalimantan, there is hardly any growth of coral reefs since many large rivers emptied their water along this coast. Despite that, in the place relatively far from mainland along the east coast, corals properly grow and develop in some chain of islands stretching in the north-south direction.

Coral distribution along the north coast of Java did not develop properly due to the high sedimentation and land base pollution. They grow quite well in places where a bit far from the north coast of Java, such as the Seribu Islands, Karimunjawa Islands, and Bawean Islands. In the south coast of Java, coral reefs grow in certain place only, in the relatively protected area from the big wave such as Carita, Pangadaran, Watu ulo, and Blambangan.

The best coral growth is found in Sulawesi waters, Maluku, Bali, east and west Nusa Tenggara, Raja Ampat Islands, north of Papua, Aru, and Kei Islands. Coral growth in these areas are evenly distributed around the islands. Coral did not grow along the south coast of Papua due to the occurrence of many big rivers which dislodge their waters along the coast with muddy bottom. In eastern part of Indonesia, corals grow and develop well vertically as well horizontally up to a depth of more than 30 meters whereas corals in western part grow at less than 20 meters. Current pattern that flows continuously from the Pacific Ocean to the Indian Ocean which is guarantee on the availability of food for the corals, clean waters, hard substrate, deep coastal depression, few large rivers, ruggedness of the coast, is a suitable place for an ideal growth of corals. In this area, corals grow and develop maximally since million years ago so it makes this place a center for species diversity and the origin of presently existing coral species.

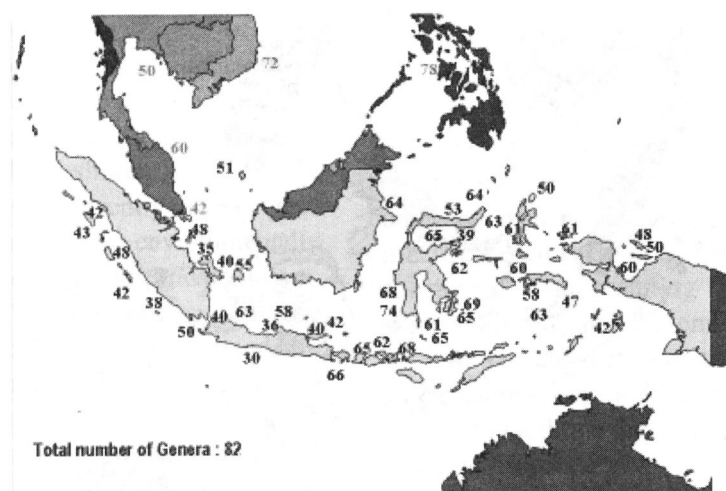


Figure 2. Map of distribution of coral genera in Indonesia. The most numerous coral genera are found in Sulawesi Island. Figure show the number of coral genera. The total number of coral genera in Indonesia is about 82.

Table 1. Status of coral reefs condition in 2010. Data were taken from 1048 stations of 84 sites distributed all over Indonesia.

Location	Σ Loc.	Σ Sites	Excellent	Good	Fair	Bad
West	38	474	5.86	27.48	34.01	32.66
Central	28	277	5.11	30.29	44.89	19.71
East	18	297	5.52	19.31	34.48	40.69
Indonesia	84	1048	5.56	25.89	37.10	31.45

Coral species that dominate in nearly all coral reefs in Indonesia are *Acropora spp*, *Montipora spp*, and *Porites spp*. Number of species found in Indonesia up to the present are 590 belonging to 82 genera (Veron, 2002). The distribution of coral genera in Indonesia is presented in Figure 2. Coral species numbers of the genera *Acropora* in the world are 114 species. Out of that number, 91 species are found in Indonesia and the highest distribution of *Acropora* is found in Tomini Bay (Wallace et al., 2001). There are five *Acropora* species that are native to Indonesia and out the five species, two constitute endemic species, namely *Acropora togianensis* and *Acropora suharsonoi*.

Monitoring activities have been conducted from 1993 to 2010 in 84 locations, consisting of

1048 site all over Indonesia. The results indicate that coral reefs in Indonesia at the end of 2010 were 5.44 % in excellence condition, 26.72% in good condition, 37.21% in moderate condition, and 30.82% in bad condition (Table 1).

Evaluation of coral reef condition from 1993 to 2010 indicated that there was the tendency of coral reefs improvement in Indonesia. The bad condition of coral reef appeared to decline, the condition of moderate coral reefs appeared to increase, while that of the good condition experienced a bit improvement whereas that of the very good coral remains unchanged. In 1998 a drastic change occurred due to bleaching event which caused a mass mortality of corals, but following year the coral reef started to recover as shown by increase of coral reefs in good condition.

Coral Degradation

The principal cause of coral destruction in Indonesia is fishing using bombing and cyanide, bleaching event, land based pollution, coral mining for development material and sedimentation. Bombings have been done in nearly all over Indonesian waters. Damage caused by bombing takes a long time to recover or never at all. Observation done in 1995 at one location purpose

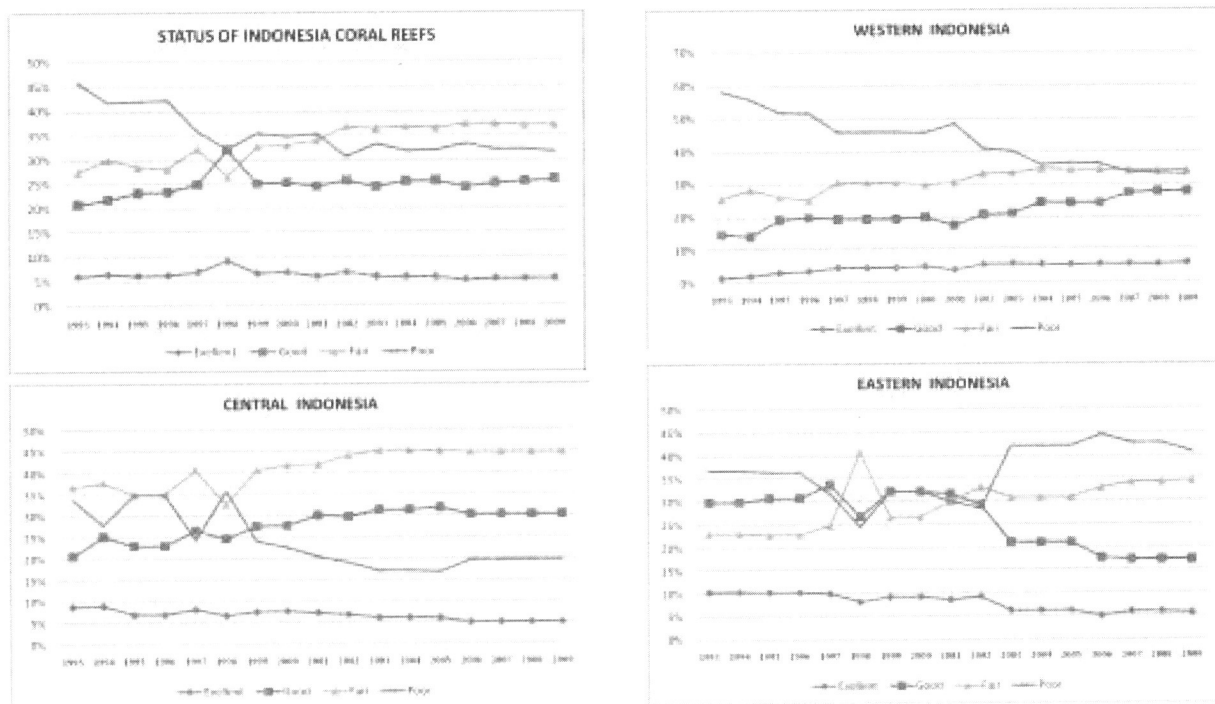


Figure 3. Graphs of the tendency of the condition status of coral reefs in Indonesia during 1993–2009. a) Whole country; b) Western Indonesia; c) Central Indonesia; d) Eastern Indonesia

fully destroyed by bombing which was currently practiced by fishermen, revealed that almost all coral within the radius 3 m were totally destroyed. Monitoring done to measure the level of recovery indicates that up to now it has not recovered to the original condition.

Currently, there has been an interesting phenomenon to the fact that 15 years ago the heavily destroyed coral reefs due to bombing were always found close to people habitation. Whereas coral reefs that were far from human habitation were still in good condition. In the last few years, however the situation was turned the other way around, that is the coral reefs close to human settlement are in a better condition than before and those far away from human population suffer from degradation due to bombing. This phenomenon has been shown by the result of monitoring of coral condition in several places which are far away from human settlement in eastern Indonesia indicated increased damage by bombing. In recent years, fishing using bombing has been significantly reduced across all project sites. The survey to the respondent said that use of explosives has decreased by 58% and 51%, said that use of cyanide has decreased while 70–95% of illegal and destructive fishing has been reduced across all project sites. Currently, community awareness program to manage and guard their coral reef have been growing properly well. Fishermen are afraid to do fish bombing openly despite the fact that some of them are currently still do the bombing stealthily at the remote area which is far away from human settlement. The success of reduced destructive fishing is not only due to public awareness, but also correlated with increased income related to higher quantity fish catch per unit effort and incomes through alternate livelihood activities. Report from socio-economic across various projects 2007–2009 sites shows that the income per capita trend to increase. Income per capita increase vary from 5.6–44.9% across project site (Hidayati *et al.*, 2009; Bandiyono *et al.*, 2009). This project has made a significant increase.

Coral reefs in Indonesia were experiencing mass mortality of corals and various marine organisms due to bleaching event. The El Nino 1983 was followed by bleaching event which was repeated again in 1998 (Suharsono, 1990; 1999). Local bleaching event quite often happens in certain location, such as the case in May 2005, for

example bleaching of coral reefs around Pantai Kuta Bali occurring from reef flat down to 15 meters depth and water temperature increased between 2–3° C. In the same month, bleaching was also reported to occur in Menjangan Island, west of Bali. During May and June 2010, the bleaching event has been reported from several areas of Indonesia such as Pasir putih (East Java), Banyuwangi (East Java), Kuta (Bali), Benete and Maluk (West Sumbawa), Gili air and Sengigi (Lombok), Wakatobi (South East Sulawesi), Makassar (South Sulawesi), Aceh, Pulau-pulau Banyak (Aceh), and in Padang (West Sumatera). The monitoring is still in progress to observe the development of the bleaching event. Coral bleaching in Wakatobi by the end of May has been attained 50%. The distribution of warm water depends on the current pattern. Nonetheless, from some occurrences that we noted bleaching can also locally occur depending on the existing current pattern. The role of current and a good understanding of current pattern in Indonesia to understand bleaching occurrences are very much needed.

Our experiences indicate that coral reefs in a good condition with high species diversity have a higher resilient compared to that which are lesser condition. To face the bleaching event, the thing to be prepared in managing coral reef is to take care of the coral reef in good condition so that the plasticity of the population will be better maintained.

1. User and the Use of Marine Resources

Coral reefs have very important meaning for the coastal community from economic and cultural point of view. One third of the Indonesian population living in the coastal areas depend their lives on shallow water fisheries. From generation to generation they depend their lives on fisheries, resources, seagrasses, mollusks, and crustaceans. The largest proportion of them is traditional fishermen still using simple fishing gears. The use of simple gears and in the location which is close to their home may be used as indicator that the existing resources are still abundant.

Fishermen have a good knowledge regarding of where, when, on what season, and what species to be caught. This knowledge is usually handed over from generation to generation from their parents. Despite that, with the existing request from the market with the appealing offer, they will try to do the best for their abilities to supply the request,

ignoring of the effect to the environment and their living resource. Why do they act arbitrarily to their living resources and will not contemplate in what way the resources can be continuously productive. This attitude is related to their standard of living, which is in the average belongs to poor community. This would mean that apart from being poor of material they are also poor structurally as they have no opportunity to study, minimal means and infrastructure, dense population, limitation to health, and market access.

In Indonesia, the use pattern of the living resources by the coastal community who lives close to and depend on coral resources can be divided in three main groups. First, the utilization pattern that is periodically moved out is intended to follow the movement of resources. The second pattern of utilization is applied for sedentary biota. The fishermen catch the resources in fixed areas around their settlement area. The third pattern is done by some tribes who live roaming to look for fish. The third types of fishermen are the most destructive to coral reefs and marine resources. While the other is consider as a traditional and subsistence fishermen.

There are at least three tribes of fishermen who live roaming to look for fish. They wonder periodically from one island to the other islands. The tribes that have the expertise to wonder are Bajo, Bugis, and Maduranese. They catch anything they come across and sell the catch in the nearest market. They are usually together in one fleet consisting of 5–10 boats. The locations they exploit usually becomes degraded and nothing is left behind, everything is taken, the big as well as the smaller ones, provided they are saleable. They get back home some months after the roaming and they do not bring back the catch, but they bring home money. These wondering fishermen have the highest share of destroying the ecosystem and the marine resources. This is because this kind of fishermen do not have the feeling of ownership, no emotional attachment to the areas visited, and have not the feeling to take good care of them. They have no emotional attachment with the exploited location, therefore they will take the existing resources as they like and even innocently by destroying the ecosystem. They will return to the same location within three or six monthly cycles in one year (Suharsono, 2007).

The cycle of marine environment destruction involves various human activities and one of is are

fishermen who utilize marine resources. Therefore, managing human activity is required in utilizing marine resources, namely by preparing regulation which is consistently applied. In order to develop a regulation that is acceptable to the users, it requires their participation in preparing the regulation so that it will be acceptable and implemented consistently. It is more appropriate if the regulation makers consist of those people who know and understand of the socio-cultural condition of the community as well as being familiar with the population dynamic and ecological characteristic of the marine resources concerned.

2. National Policy, Strategy, and Action Plan

Coral rehabilitation and management program were started by setting up a national policy, strategy, and action plan for managing coral reef. In 1998 there is no direct act, constitution, regulation deal with management of coral reefs. The activity began with constructing the draft for which it involved various stakeholders at national level consisting several academicians, government officials, and non-government organizations. There were variable conceptions and the discussion took quite sometimes, requiring a lot of energy and time consuming since it was the first program in Indonesia to manage the marine resources.

A national policy, strategy, and action plan were finally agreed upon, with the main objective managing the coral reef ecosystems based on the balance between conservation and utilization, designed, and implemented in an integrated and synergistic manner by central government and regional government, civil societies, private sector, education institution, and non-government organization.

Many socialization and advocacy were conducted at various levels from the communities up to member of parliaments and the president. The most difficult course was advocating and socializing to convince the member of parliaments on the importance of including coral reef in the constitution. The result was issuance of a decree of the state Minister of Marine affair and Fisheries, adopting the national policy, strategy and action plan and a Constitution No. 27 of 2007 concerning the management of coastal area and small islands. Article 35 discloses that it is forbidden to destroy the coral reef directly or indirectly. Meanwhile, article 73 determines the criminal punishment in

on how to teach and utilize different teaching materials existing at local level to implement the lessons.

These book is user friendly and contains comprehensive understanding how to manage coastal areas and seas, such as introduction to marine ecosystem and habitats, socio-economic and cultural aspects, coastal community adaptation, resilience and school based disaster preparedness. The book also encourages life skill learning and adaptation considering climate change and due to economic challenges faced by students inhabiting coastal and remote islands.

The book was designed to be handed over to the Ministry of Education for upscale its production in order to widen access to public. The development of this books is was always in partner with the center for curriculum, the Ministry of Education, and follow the latest curriculum system. The books were already validated by this center to be endorsed its use to schools particularly in coastal areas. The Minister of Education agreed to reproduce to enable a better learning access to schools and community in coastal areas. COREMAP program had produced 12,000 sets of elementary book, 8000 sets of junior high school book and 4000 sets of senior high school book, and distributed to COREMAP project site, seven provinces, and 15 districts. Some progressive initiatives were made by the north Maluku Province which does not belong to COREMAP project site. The province decides to self support the need for marine education as their prioritized local content curriculum by reproducing and distributing the books to schools through the coastal areas within the province.

4. Database, Monitoring, Evaluation, and Information System

To manage coral reefs ecosystem properly and to be able to use it in sustainable manner in order to enhance coastal community welfare is not an easy matter. To that end, it is necessary to gather data covering the extend of coral reefs and its potency, how extensive is our marine resources and condition status, identification of users, and the way they utilize the resource and the rule of the game in utilizing the coral reefs as well as monitoring the tendencies whether the resource is getting better or getting worse.

To know the extent of coral reef, a mapping of coral reefs throughout Indonesia has been done. In the mean time, it is done to know the potency of the Indonesian coral reefs, the valuation condition of coral reefs in Indonesia species abundance, species richness, and species diversity of coral reefs. To be able to valuate coral condition, one must have a method agreed upon by all and to train human resources that are capable of doing it either physical skill or scientific skill. The most important is to make a long term monitoring program so that we can properly know the tendency of the Indonesian coral reefs, whether it is getting better or worse. Prediction based on accurate data will facilitate decision making process. To do all that we have selected locations that are considered representing coral reefs in Indonesia.

Results of monitoring, valuation, and evaluation of biotic resources must be documented properly so that data and information can be easily accessed by decision makers as well as by the community at large. For that purpose, it is necessary to have personnels that have expertise on taking, collecting, analyzing, processing, keeping, and presenting the data into formation and indicators that are easily understood by the community and decision makers. At the moment, it has been developed an information system and information network system nationally as well as internationally in coral reef management and other resources.

The developed monitoring system covers the one that can be done by the community as well those to be handled by trained personnel. Community monitoring method was developed in a simplified manner, but can be utilized as a base line information. The most important thing is to involve the community in monitoring the condition status of the biological resources so that they will know and understand easily whether or not their efforts in managing the resources are successful. Meanwhile, the scientific base monitoring is developed according to the international standard of procedure and method that is scientifically acceptable.

A guide book on how to do the monitoring, to collect data following the international standard, data format, analytical method and to input the program in the basic data system is already available. This program will go on forever and it is expected that in the upcoming year, data and information on other marine biota will be collected.

the case of doing coral destruction. Apart from that, there are regulations which indirectly or related to various regulation that are characteristically sector which can be related to coral reef management.

Presently some districts have issued local regulations which regulate coral reefs management. By learning from the field condition concerning the right to manage marine resources, various problems come up among others. At that moment there has been done various efforts to manage coral reefs by local fishermen. The effort has become in vain when the management that have been well carried out was utilization by fishermen that came up from other places. These fishermen that came from other part of the country even utilized the resources haphazardly and with destructive technology. Conflict between local fishermen versus those from other areas is currently common place and become a home work for the local government which needs immediate solution. The thing that needs attention is the claim of right to manage and gift of management to the local community by providing incentive and disincentive for those who succeeded or failed in managing the marine resources through procedure mechanism of provision and cancellation of management right.

3. Public Communication, Education, and Community Awareness Program

Public communications become an important in the management of marine resources. As a matter of fact, the communities in general and coastal community in particular have not understand yet the important meaning and usefulness of coral reefs for their lives. In front of coastal community, we must endlessly inform them to stand aside with them and always provide factual examples that are easy to understand.

Planning and developing the material to be used in the public communication are uneasy since the language used must be simple, easy to remember, easy to understand as well as touching the grid of the live of coastal communities. The results indicate that more they are exposed to communication activities, the easier for them to know and understand the meaning of coral reef management.

The most effective media for communication with the general public are television and radio

(JHU, 2002). While for the coastal communities the most effective media is the event of campaign. Involvement of the minister, governor, and head of district and coverage by electronic and mass media resulted in tremendous impact upon awareness of the community on the important of marine resources in general and coral reefs in particular. The coming of minister in one area will surely be welcomed by the governor and his staff starting of the head of the district, head of the village, and the communities. The appeal from the minister, governor up to head of village will reverberate everywhere and will always be remembered by the communities that have visited. This activity is planned in line with the community habit which is paternalistic.

The basic principle of the community based management is from the community, by the community, and for the community. The community as the main actor is actively involved in the planning and implementing the management of coral reefs so as to obtain the highest profit for their welfare. In previous years, the government interference was too dominant in controlling, managing, and directing what the communities have to do. In the coming year, management of marine resources shall be given to the community as the primary executor and the government will serve only as motivator and facilitator. Therefore, the time has come for the community to form institutional bodies which match their needs to protect their natural resources. Of course, this is not a simple thing to do since they are not used to critically fight for their self interest. Therefore, it is the duty of government to facilitate the institutional strengthening of the coastal community institution to enhance the capacity and capability of the personal so as to make them capable of managing marine resources continuously and to fight for their interest of the coastal community.

Coral reefs rehabilitation and management program had also developed school book series with the title of "Pesisir dan laut kita" or "Our coastal and Sea". These book series cover multi-discipline and cross cutting issues addressed and challenging to Indonesian coastal management efforts including coral reefs management. The wide range of sciences are introduced in fun and joyful learning approach, adjusted to different level of formal school, namely elementary school, junior high school, and senior high school. Each set of book has a guide or manual book for the teacher

The reef health monitoring component is essential for informed management as well as evaluating the success of this project. This component was designed to provide information on key groups of reef organisms particularly live coral cover, reef fishes and large conspicuous reefs benthos. The evaluation of the status of reef health and analysis of change is based on field data that is collected yearly from selected reefs sites. Reef health monitoring is done by a team of trained staff from the provincial and central coral reef information and training center with the participation of other technical institutions as the need arises and as part of the national training program to elevate the skill and experience of research in Indonesia. Some 800 personnels from all over Indonesia have been trained to do monitoring and documenting the data on the condition status of coral reefs.

To facilitate management of data and information that have been collected, the Indonesian sea is divided into eleven marine areas. The first area covers the sea north of Aceh up to the Malaka Strait; the second area consists of the Natuna Sea; the third area consists of the Java Sea, the fourth area covers the Flores Sea and Makasar Strait; the fifth area is the Banda Sea; the sixth area is Ceram Sea; the seventh area consist of Sulawesi Sea and Pacific Sea in the north of Papua. The eighth area consists of the Arafuru Sea; and the ninth area covers the sea in the west of Sumatera. The tenth area covers waters south of Java; and the eleventh area covers the seas south of West Nusa Tenggara (NTB) and East Nusa Tenggara (NTT). This is done in line with the extensive marine areas of Indonesia as well as to avoid problem of administration border between the provinces and to simplify coding in the data base system that is being developed.

CONCLUSION

The program of coral reef management that has been going on to date should be continued and upgraded since it has proven to be able to enhance community awareness and concern so that coral reef condition is improving. A good condition coral reefs turn out to be resilient to environmental change and natural disturbance.

Sustainable development and management of coral reef need some actions to be taken, namely:

1. The existence of national constitution that is translated into local regulation (Perda) and

village regulation (Perdes) in the district and village level with control and law enforcement in sustain and consistence manner.

2. Surveillance in district level should be done by and for the community which is fully supported by government apparatus and the community.
3. The law enforcement process must be accompanied by community awareness and education programs which are conducted continuously.
4. The change in the behavior of fishermen community is immediately needed from fish catching into fish culturing fishermen considering some of the biological resources becoming scarce and difficult to quickly recover without human involvement in providing the seeds.
5. Destruction of marine resources is always started and in connection with human activity in exploiting the resources. Therefore, management of marine resources is basically managing human activities.
6. Community awareness program must always be accompanied with making the efficient use of the by way of giving various selections of works suited to the condition and the existing potency which are in mutual accord with the knowledge of the local community so that they can enhance their loves.
7. There is the need to specifically handle the sea wandering fishermen, for example by executing community awareness program at their original place or their houses.
8. In order that the community can determine the selection that suit with their condition, it needs a continued assistantship and training programs.
9. It is absolutely necessary that the monitoring programs are executed using a uniform monitoring program which can be easily followed by the community.
10. Result of monitoring programs should be kept in an accurate of data storage system which can be easily and quickly assessed to facilitate the process of taking further action.
11. Results of monitoring should be periodically analyzed, packed up, and disseminated to various community groups and decision makers.

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