

Evaluation of the rehabilitation implementation for addressing coastal erosion in the coastal area of Karawang Regency, Indonesia

^{1,2}Medi Nopiana, ³Fredinan Yulianda, ³Sulistiono, ^{3,4}Achmad Fahrudin, ³Gatot Yulianto

¹ Study Program for Coastal and Marine Resources Management, Graduate School, IPB University, Dramaga Campus, Bogor, Indonesia; ² Faculty of Economics, University of Singaperbangsa Karawang, Karawang, Indonesia; ³ Department of Aquatic Resources Management, IPB University, Dramaga Campus, Bogor, Indonesia; ⁴ Center for Coastal and Marine Resources Studies, IPB University, Baranangsiang Campus, Bogor, Indonesia.
Corresponding author: M. Nopiana, medinopiana@yahoo.co.id

Abstract. The level of beach damage in some coastal areas of the Karawang Regency has been at a high rate. However, implemented coastal rehabilitation efforts are still not proceeding optimally, as indicated by the occurrence of coastal erosion until nowadays. Evaluation of the implementation of coastal rehabilitation efforts for controlling coastal erosion is needed to determine the effectiveness of these activities. The research purposed to evaluate efforts to implement coastal rehabilitation in coastal erosion control in the coastal area. The analytical method used the Context-input-process-product (CIPP) evaluation method. The results showed that there were several problems in the implementation of coastal rehabilitation efforts that have occurred to date, including low community awareness to conserve coastal ecosystems, weak law enforcement efforts, low awareness to resolve land ownership status for coastal rehabilitation, and lack of synchronization of coastal management policies in the level of local government itself. Several recommendations to increase the success of coastal rehabilitation efforts in the coastal area were the synchronization of government policies, social reconciliation, and law enforcement, as well as community education.

Key Words: CIPP evaluation methods, coastal management, beach environmental damage.

Introduction. Coastal resource damage needs to be minimized and repaired through rehabilitation efforts to maintain the balance of the coastal resource system. Rehabilitation of coastal areas can be interpreted as an effort to restore, maintain, and improve ecosystems function, so that its carrying capacity, productivity, and role can be maintained to support life cantilever systems (Wibisono 2016). Coastal rehabilitation efforts are one form of implementing coastal function improvement activities in coastal areas. Rehabilitation efforts must be enforced if coastal areas use causes damage to ecosystems or populations have exceeded damage criteria of them. Rehabilitation efforts are carried out by the central and regional governments, and people who directly or indirectly utilize coastal areas (KKP 2013).

One of the coastal areas in Indonesia that was severely affected by coastal erosion is Karawang Regency. The level of damage to beaches in some of the areas was at a high level. Based on observations from 1988 to 2015, the total shoreline affected reached more than 32 km or around 44 percent of the total shoreline length in the coastal areas. The area of coastal land lost due to coastal erosion reached more than 404 ha, or coastal land lost annually between 1.31 to 6.23 ha (Fauzie 2016, 2017; Nopiana et al 2020b).

Coastal rehabilitation efforts were one form of coastal erosion control, including social adaptation activities through relocation of settlements (Nopiana et al 2020a). However, implemented coastal rehabilitation efforts were still not proceeding optimally, as indicated by the ongoing coastal erosion to date and a chronic problem. For the above

reason, it needs the research to discuss the evaluation of the implementation of coastal rehabilitation comprehensively, hence obtains some recommendations to support the success of coastal erosion control in the coastal area of Karawang Regency.

Research on evaluating programs or efforts to conserve and rehabilitate natural resources had been carried out by several researchers beforehand. However, research on evaluating coastal rehabilitation programs for coastal erosion control, so far, had not been found. Jatmiko et al (2012) and Surtiani & Budiati (2015) conducted an evaluation of forest and land rehabilitation activities in the upstream watershed area of Serayu (Wonosobo Regency) and Juwana of Mount Muria area (Pati Regency). Chen et al (2017) evaluated grassland vegetation conservation programs. Fikriyani & Mussadun (2014), Yasin (2013), KIARA (2013), and Munfarida (2018) discussed the evaluation of programs/policies on conservation and rehabilitation of mangrove forests, coral reefs, and seagrass beds. The research aimed to evaluate efforts to implement coastal rehabilitation in coastal erosion control in the coastal area of Karawang Regency.

Material and Method

Time and location. The research was conducted for three months from December 2019 to February 2020. The research location was in the coastal area of Karawang Regency, West Java Province, Indonesia (Figure 1). The research location was the most severely affected coastal erosion area, according to DLHPE Kab. Karawang (2008), which covered three regions and sub-districts as well as five villages (Table 1).

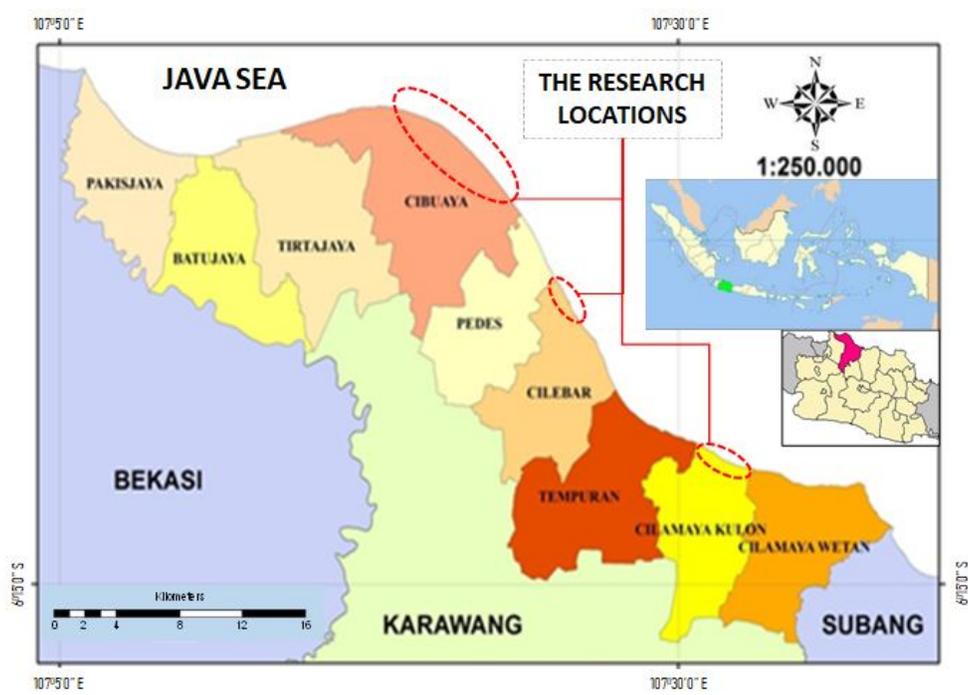


Figure 1. The research locations in coastal area of Karawang Regency, Indonesia.

Table 1

Coverage of coastal areas affected by coastal erosion

No.	Research locations	Coastal areas affected by coastal erosion	
		Sub-districts	Villages
1	Cibuaya Beach	Cibuaya Sub-district	Cemarajaya and Sedari Village
2	Cilebar Beach	Cilebar Sub-district	Pusakajaya Utara Village
3	Cilamaya Kulon Beach	Cilamaya Kulon Sub-district	Pasirjaya and Sukajaya Village

Source: DLHPE Kab. Karawang (2008).

The coastal area consists of 9 sub-districts, with an area of 681.47 square kilometers or 38.87 percent of the total area of Karawang Regency. The length of the coastline reaches 73.65 kilometers, while almost the entire area is characterized by sloping land with flatlands (0-2 percent). The population of the coastal area was 577,231 in 2018, which was 24.71 percent of the entire population of 2,336,009 recorded for the whole of Karawang Regency (Komarudin 2013; Fauzie 2017; BPS 2019).

Data collection. Secondary data were obtained through desk study, that was sourced from several previous studies and literature of coastal erosion control efforts, among other studies from the Environmental and Hygiene Office of Karawang Regency. Besides, primary data were collected through observations and in-depth discussions with interviewees in the field who were competent and understood the problem of coastal erosion in their area. The method of determining the interviewees used one kind of nonprobability sampling, namely judgment sampling.

Analysis. The analytical method used the context-input-process-product (CIPP) evaluation method based on Stufflebeam (2003). The method is commonly used to conduct evaluations in the field of education. The application of the method related to evaluating the conservation of coastal resources was still very rarely used so far. CIPP evaluated four dimensions, namely the context, input, process, and product dimension. The method was unique because each type of evaluation was related to the decision-making tool that involves planning and operating a program. CIPP had the advantage that it provided a comprehensive evaluation format at each of the evaluation stages above (Mahmudi 2011).

Results and Discussion. Evaluation of the implementation of coastal rehabilitation efforts was carried out based on variables (indicators) of context, input, process, and product. Each variable had a role in the success of coastal rehabilitation efforts. The stages of evaluation of the application of rehabilitation efforts in addressing coastal erosion in the coastal area of Karawang Regency explained as follows.

Context evaluation. The context evaluation stage considered the assessment of two indicators. Firstly, assess the suitability of the results of the implementation of coastal rehabilitation to handle the impact of coastal erosion. Secondly, assess coastal rehabilitation efforts list in the strategic plans of the regency and provincial governments. Both indicators were closely related to the essence of public policy, which sought to solve problems faced by the community (Refita 2017).

In context, coastal rehabilitation efforts in some places had shown success in several areas in addressing the impact of coastal erosion. It is indicated by the growth of well-planted mangroves (reaching the tree category), high density, and ecosystem services as a shoreline stabilizer. However, the success was still on short-term, meaning that coastal rehabilitation efforts carried out so far had not guaranteed success in the long term (sustainable). That was because there are still various threats:

- lack of community knowledge and awareness of the importance of the existence and benefits of mangrove ecosystems. Aside from being a barrier to coastal erosion, the mangrove ecosystem had not provided tangible benefits;
- the high economic pressure faced by the community, due to the low standard of living, had led to the exploitation of coastal natural resources, including converting mangrove land to aquaculture land;
- weak law enforcement against violations of exploitation of coastal natural resources. If this continued to happen, it was feared that it would encourage other people to flock to commit the same violations (herding behavior);
- lack of awareness from stakeholders, especially those implementing coastal rehabilitation efforts, to the status of land ownership. Occasionally the landowning community would claim their land back and reused it for commercial purposes.

Following the results of observations and interviews with informants, coastal rehabilitation efforts had succeeded in addressing coastal erosion in most of the areas of Pusakajaya Utara Village, Cilebar Sub-district, and Sukajaya Village, Cilamaya Kulon Sub-district. Applied coastal rehabilitation efforts in some areas through mangrove planting had formed land or new shore border between 100 and more than 500 meters wide. Nonetheless, coastal rehabilitation efforts had also been quite successful in mitigating coastal erosion in parts of Cemarajaya Village, the Cibuaya Sub-district, however, the impact of coastal erosion had not been fully solved, especially when the tidal wave exceeded the height of the coastal protective structure. This condition did not happen routinely but only occurred a few times a year, especially in western monsoon. Otherwise, coastal rehabilitation efforts in several other areas had not succeeded in addressing the impact of coastal erosion, especially in Sedari Village and parts of Cemarajaya Village, Cibuaya Sub-district, a small part of Pusakajaya Utara Village, Cilebar Sub-district, and Pasirjaya Village, Cilamaya Kulon Sub-district.

Another context evaluation indicator was the existence of a strategic plan for coastal rehabilitation efforts for five years of implementation, including a work plan for the coastal rehabilitation program each year. The regency government had accommodated coastal rehabilitation efforts in the 2016-2021 strategic plan, among other the Public Works and Spatial Planning Office inserted a superior program for handling coastal erosion and estuary (PUPR Kab. Karawang 2016). Besides, the Environment and Hygiene Office put a management and rehabilitation program for coastal and marine ecosystems, as well as a program for the protection and conservation of natural resources and the environment (DLHK Kab. Karawang 2018). However, based on literature research, the provincial government had not explicitly included coastal rehabilitation efforts in the coastal area of Karawang Regency in the strategic plans of the relevant agencies. Furthermore, the regency and provincial governments had not yet constructed a coastal rehabilitation plan to address the impact of coastal erosion in the coastal area of Karawang Regency for the long term.

Input evaluation. The input evaluation phase covered an assessment of the institutions and parties involved in coastal rehabilitation efforts. Management and rehabilitation of coastal, according to Law Number 23 of 2014 concerning Regional Government, separates the two areas of coastal zone, namely land and sea areas, as well as two regency and provincial management institutions. The regency government owns the authority to manage coastal land areas. In contrast, the management of the sea section from the baseline towards the high seas for 12 miles is under the authority of the province (Nopiana et al 2020a).

The separation of governmental authority in coastal areas raised several problems, including cooperation and the suboptimal role of regency and provincial governments for synchronizing coastal rehabilitation policies. This problem showed from the lack of supervision and monitoring of coastal conditions, and rarely the coordination meeting activities that discussed management and rehabilitation of the coastal area. It was compounded by the lack of commitment of various stakeholders, including the legislative body. It was suspected that the issue of handling coastal erosion impacts was not a significant concern and urgent to be resolved.

Process evaluation. The process evaluation phase covered the evaluation of management problems, the components involved, and the technical implementation of coastal rehabilitation. In general, the intensity of severe coastal erosion occurred on beaches that have sandy substrates and strong wave characteristics. In contrast, the beaches in areas with muddy substrates and the characteristics of waves and ocean currents that are not too strong showed that coastal rehabilitation efforts were relatively more successful (such as in Cilebar Beach and parts of Cilamaya Kulon Beach). However, there was a threat to the sustainability of coastal rehabilitation results, as happened in Cilebar Beach. Some of the results of mangrove planting had tampered with back by the community surrounding to be converted into aquaculture land.

Private parties who were donors in planting mangroves, community groups, and communities did not have the availability of mangrove seeds that are tolerant and grow on sandy substrates (*Bruguiera* sp., *Sonneratia* sp., and *Xylocarpus* sp.). They also did not have adequate knowledge about the natural formation of mangrove ecosystems. Conditions in the field were often seen seedlings of *Rhizophora* sp. planted facing the sea, while *Avicennia* sp. precisely planted on the back. Mangrove seedlings which should be planted at the front facing the sea are *Avicennia* sp., then followed by *Sonneratia* sp., *Rhizophora* sp., *Bruguiera* sp., and *Xylocarpus* sp. (Bengen 2001).

Each community group in the coastal area worked coastal rehabilitation efforts independently. They did not share knowledge and collaborate reciprocally, even between groups within one village (case in Pasirjaya Village, Cilamaya Kulon Sub-district). Although they worked coastal rehabilitation efforts and implemented in the same coastal area, each group tended not to know each other. The factors often involved coastal rehabilitation efforts had failed, so that the efforts became unavailing. It was suspected due to various things, among others, the problem of access to connectivity, absence of a forum for meeting and communication between groups, the low trust of each group, and community life was still subsistence. The low trust of each group towards other groups even tended to caused sharp friction (case in Pasirjaya Village, Cilamaya Kulon Sub-district). The government should be attended to accomplish the problems by including the solving programs, which supported through the budget from the Regional Budget.

Law socialization and enforcement in some areas had been quite effective, one of which was through the involvement and presence of community groups who actively participate in monitoring coastal and marine resources, namely Pokmaswas. Nevertheless, in other areas, the role and assertiveness of Pokmaswas precisely were not visible, such as a case of the Pusakajaya Utara Village Cilebar Sub-district occurred mangrove conversion in coastal rehabilitation land to aquaculture ponds. Besides, some of the landowners affected by coastal erosion did not allow their land used for the location for implemented coastal rehabilitation. It was compounded by the low leadership of the local government in law enforcement in the region because they did not have the courage to put in order converted mangrove lands.

Before coastal erosion occurred, the land was arable land with low legality of rights, namely a Village Certificate (SKD). When the land was affected by coastal erosion, it resulted in the loss of community aquaculture land. The success of coastal rehabilitation efforts through mangrove planting had led to sedimentation and forming land with a width of approximately 500 meters to the sea. This fact had encouraged the SKD holders to reclaim the land that was previously theirs. However, because the SKD did not include a time limit for land utilization, the community converted back mangrove's land of coastal rehabilitation results to previous use as aquaculture ponds of approximately 10 hectares. Law enforcement efforts ever consisted of by Pokmaswas, but it had made some of the community not chary and heed the existing regulations. They had even expanded their ponds on mangrove lands, but Pokmaswas and other community groups were powerless to prohibit it.

Another problem in coastal rehabilitation efforts was that the land status for coastal rehabilitation was not clear beforehand. Although it had regulated in Presidential Regulation Number 51 of 2016 concerning Shore Border Limit, the regulations below had not been followed it yet (the case in the rehabilitation land was still in the SKD status). The land status should be revoked first with or without compensation to the SKD owner.

Moreover, socialization of the regulation of the shore border limit was still very lacking, so that there are still many communities who did not understand the rules. The community did not clearly understand the rule, especially whether the land that was reformed from the results of coastal rehabilitation and still had SKD status could be claimed as a conservation land? If the land was determined as conservation land, of course, the community found loss due to the regulation. It caused them could not recultivate their land while they obtained it by the trading of arable rights.

Product evaluation. The product evaluation phase consists of various achievements based on institutional, technical, social, economic, and ecological indicators.

Achievement of institutional indicators. Awakening of community cognition to create groups to participate in coastal rehabilitation efforts, such as Pokwasmas, Tourism Awareness Groups, and other community groups. Moreover, to awaken partnerships between community groups with the private sector to obtain the funds for coastal rehabilitation activities through the Corporate Social Responsibility (CSR) program. Private parties that had been involved consisted of the company of Pertamina Hulu Energi Offshore North West Java, Toyota Motor Manufacturing Indonesia, and so on, as occurred in Pusakajaya Utara Village, Cilebar Sub-district, and Sukajaya Village, Cilamaya Kulon Sub-district.

Achievement of technical indicators. There were community groups who had applied some innovations, both in planting mangroves and constructing wave barrier tools, such as in Pasirjaya village, Cilamaya Kulon Sub-district. They planted mangrove seedlings in the middle of the PVC pipe filled with mud, and then the pipe drove it into the ground around the shoreline. It aimed to protect mangroves' seedlings from the waves and seawater immersion at high tide. The construction of protection from ocean wave energy for the planted mangrove vegetation was also carried out through the use of used tires, which were assembled such that as a wave barrier.

Based on interviews with the community, the results of coastal rehabilitation efforts through the coastal belt program in the area of the Cemarajaya Village Cibuaya Sub-district were not effective in addressing coastal erosion. It was suspected that there were construction problems during the construction of coastal protection. The beach building construction was not visible in the area, even at low tide. Different from that area, the beach protector in the Sukajaya Village Cilamaya Kulon Sub-district appeared to arise at low tide and effectively dampened the wave energy when it reached the shoreline.

Achievement of social indicators. The emergence of initiative and awareness of some coastal communities and community groups voluntarily conducted coastal rehabilitation efforts in coastal areas affected by coastal erosion. It occurred in Pusakajaya Utara Village Cilebar Sub-district as well as Sukajaya and Pasirjaya Villages Cilamaya Kulon Sub-district. Furthermore, mangrove areas in Pusakajaya Utara, Cilebar Sub-district, and Sukajaya Village, Cilamaya Kulon Sub-district, were places of education and research related to mangrove ecosystems.

Achievement of economic indicators. The establishment of a mangrove ecotourism area had brought income to the surrounding community. Some managers did not charge entry tickets for visitors, but only charge parking fees. A large number of visitors, especially during holidays, impacted the increased income of traders, as happened in the Pusakajaya Utara Village, Cilebar Sub-district, and Sukajaya Village, Cilamaya Kulon Sub-district. Besides, the skills of the surrounding community also formed in processing material derived from mangrove vegetation into processed food products, including crackers and mangrove syrup, as occurred in Pusakajaya Utara Village, Cilebar Sub-district.

Achievement of ecological indicators. Mangrove ecosystems had worked in maintaining shoreline stability, as occurred in Pusakajaya Utara Village, Cilebar Sub-district, and Sukajaya Village, Cilamaya Kulon Sub-district. The ecosystems had also provided services in the form of habitat for aquatic and terrestrial biota. The mangrove area in Pusakajaya Utara Village, Cilebar District, had been home to thousands of birds. Another thing that is felt by the community from the function of mangrove ecosystems was to hold or absorb strong winds from sea to land. But unconsciously, the community also benefited the function of the mangrove ecosystem in the form of a buffer zone for seawater intrusion processes, producing oxygen and absorbing carbon dioxide, processing waste materials, and producing fish seeds and other biotas. However, based on interviews with the community, the majority of them still had a low comprehension of the function and role of the mangrove ecosystem.

Supporting and inhibiting factors of coastal rehabilitation efforts. The factors that could be supporting and inhibiting for coastal rehabilitation efforts could be grouped into four variables (context, input, process, and product). Furthermore, they could be used as a basis for management recommendations to improve the effectiveness of coastal rehabilitation efforts (Table 2).

Table 2

Factors supporting and inhibiting coastal rehabilitation efforts

<i>Aspects</i>	<i>Supporting factors</i>	<i>Inhibiting factor</i>
Context	Coastal rehabilitation efforts had successfully addressed the effects of coastal erosion in several areas.	Coastal rehabilitation efforts did not have long-term planning, both within the regency and provincial governments.
Input	Coastal rehabilitation efforts would more focus carried out by each level of government as well as obtained budget support from the provincial government.	<ul style="list-style-type: none"> - Separation of governmental authority in coastal areas had the potential to create unequal coastal management and rehabilitation policies; - Lack of supervision and monitoring of coastal conditions by the government.
Process	<ul style="list-style-type: none"> - Some community groups participating in the coastal rehabilitation effort had implemented some innovations, such as in planting mangroves and assemble wave barrier devices (case in Sukajaya Village, Cilamaya Kulon Sub-district); - Socialization and law enforcement, in general, were quite effectively implemented through the efforts and presence of Pokmaswas. 	<ul style="list-style-type: none"> - Owners of land affected by coastal erosion did not allow their land to be used as a location for the implementation of coastal rehabilitation (case in Pusakajaya Utara Village, Cilebar Sub-district); - The threat of mangrove conversion on the land of coastal rehabilitation results by landowners (case in Pusakajaya Utara Village, Cilebar Sub-district); - Community groups did not have yet knowledge of the natural formation of mangrove ecosystems; - Coastal rehabilitation efforts were still carried out partially by each community group, among others that due to the low trust; - In certain areas, Pokmaswas were not effective in carrying out socialization and law enforcement (case in Pusakajaya Utara Village, Cilebar Sub-district), where occurred mangroves conversion in coastal rehabilitation land to aquaculture land; - Low leadership of the local government for law enforcement in coastal areas (the case of Pusakajaya Utara Village, Cilebar Sub-district), who did not have the courage and firmness to put in order converted mangrove lands; - Lack of socialization on Presidential Regulation Number 51 of 2016 concerning Shore Border Limit, so that there were still many communities who did not understand the regulation; - Lack of awareness of stakeholders on the status of coastal rehabilitation land.
Product	<ul style="list-style-type: none"> - Awake community cognition to created groups and partnerships with the private sector; - Creating innovations from community groups in implementing coastal rehabilitation efforts; - Emergence community cognition to carry out coastal rehabilitation efforts voluntarily. 	<ul style="list-style-type: none"> - Lack of community knowledge and awareness of the importance of the roles and benefits of mangrove ecosystems; - There were results of coastal rehabilitation efforts through the beach belt program that were not effective in addressing coastal erosion in the area of Cemarajaya Village, Cibuaya Sub-district.

Recommendations for coastal rehabilitation management. Increasing the success of coastal rehabilitation efforts required synchronizing policies at various levels of government (particularly provinces and regencies), thus created harmonization of development programs and activities in coastal areas, including coastal rehabilitation. The application of agrarian policies and law enforcement consistently was also important in resolving the status of coastal land for the implementation of coastal rehabilitation. Besides, it needed social reconciliation through facilitation, and mediation to increase cooperation between community groups, both within one village and across villages, sub-districts, and regencies. The activities were carried out so that there was a transfer of knowledge in the implementation of coastal rehabilitation, including knowledge about mangrove management for conservation and ecotourism purposes.

The community education program was one of the most important programs to support the success of coastal rehabilitation. Without the support of community understanding and awareness to maintain the results of coastal rehabilitation efforts and the sustainability of coastal ecosystems, the objectives of implementing coastal rehabilitation would never be achieved. Implementation of the program could be in the form of environmental awareness promotion activities and socialization of mangrove ecosystem conservation. To strengthen community cognition and awareness from an early age in the preservation of coastal ecosystems, especially mangroves, it was necessary for the inserting of conservation principles into local content of the lesson in elementary and high schools. The implementation of community education programs could involve related agencies, universities, and other stakeholders, including through the use of social media as well as the lecturer and student community service.

Conclusions. Although it had shown indications of success in some areas, the implementation of coastal rehabilitation in the coastal area of Karawang Regency still did not guarantee long-term sustainable success. There are several problems originating from the community itself and the government at various levels (village, regency, and province). Problems from the community side were mainly related to the low level of community awareness of the importance of the preservation of coastal ecosystems and the low standard of living in coastal communities. Both factors encouraged the exploitation of coastal natural resources. Furthermore, there was a lack of cooperation among community groups in implementing coastal rehabilitation. In contrast, the government side's problems were mainly related to the weak law enforcement efforts against violations of exploitation of coastal natural resources (particularly mangroves), low awareness to resolve land ownership status for coastal rehabilitation, and lack of synchronization of coastal management policies between the provincial and regional governments. Some management recommendations to increase the effectiveness or success of coastal rehabilitation efforts were the implementation of synchronization of government policies, social reconciliation, and law enforcement, as well as community education.

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Authors:

Medi Nopiana, IPB University, Study Program for Coastal and Marine Resources Management, Graduate School, 16680 Dramaga Bogor, Indonesia; University of Singaperbangsa Karawang, Faculty of Economics, 41361 Karawang, Indonesia, e-mail: medinopiana@yahoo.co.id

Fredinan Yulianda, IPB University, Department of Aquatic Resources Management, 16680 Dramaga Bogor, Indonesia, e-mail: fredinan@apps.ipb.ac.id

Sulistiono, IPB University, Department of Aquatic Resources Management, 16680 Dramaga Bogor, Indonesia, e-mail: onosulistiono@gmail.com

Achmad Fahrudin, IPB University, Department of Aquatic Resources Management, 16680 Dramaga Bogor, Indonesia; Center for Coastal and Marine Resources Studies, 16127 Baranangsiang Bogor, Indonesia, e-mail: fahrudina@yahoo.com

Gatot Yulianto, Department of Aquatic Resources Management, 16680 Dramaga Bogor, Indonesia, e-mail: gyo_65@yahoo.com

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