Resource management in the Karimunjawa Islands, Central Java of Indonesia, through DPSIR approach

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Abstract. Karimunjawa Islands is a group of small islands located in the conservation area of Karimunjawa National Park, Jepara Regency of Central Java, Indonesia. The island has a variety of coastal and marine resources that bring benefit for the community. On the other hand, the island is also vulnerable to environmental changes, so that appropriate coastal and marine resource management is needed. The approach of Driver-Pressure-State-Impact-Responce (DPSIR) has been used for the problem identification in this location. Based on interviews and studies, the main problems in this island consisted of fish production decrease, zoning violations of national park, destructive fishing practices (potassium use), coral reef damage due to tourism activities (snorkeling and anchoring), and the property right by private sector ownership. Conflicts of interest between utilization and conservation are unavoidable. Therefore, the strategy of coastal and marine resource management in Karimunjawa Islands should be an integrated and systemic way in order to maintain the sustainability and longterm utilization of biodiversity of the Karimunjawa Islands.
Key words: DPSIR, management small islands, Karimunjawa National Islands.

Introduction. Karimunjawa Islands are located in Jepara Regency of Central Java, Indonesia. As a cluster of small islands, Karimunjawa Islands has an important role for the region's development, especially in natural resources. Hence, the island has been established as Karimunjawa National Park, which comprises 22 islands. According to previous researches (since 2000 until present time), in spite of the fact that it is a part of a National Park, Karimunjawa Islands still has continuing problems e.g. ecosystem degradation, marine resources exploitation, decreasing number in the fisheries production, destructive fishing practice, low level of prosperity and education, conflict of interests, and uncontrolled tourism activities (Suryanto 2000; Yusuf 2007; Purwanti 2008; Irnawati 2011; Taruc 2011; Mussadun et al 2011; Yuliana et al 2016a).

The problems occur due to the characteristics of small islands that are prone to environmental changes such as environmental degradation, water pollution, overfishing, limited land use, coral depletion (for construction materials) and maritime transports (Sulistyowati 2003; Susilo 2003), water scarcity (Hafsaridewi 2004; Kaldellis & Kondili 2007; Máñez et al 2012), limited land for housing (Hafsaridewi 2004), and coastal erosion (Farhan & Lim 2012). Those problems are anthropogenic or due to human activities. Beside the anthropogenic environmental changes, small islands are also prone to nature-caused environmental change, such as tsunami, tidal waves, rise of sea level, and the impacts of climate change. The features and vulnerabilities of small islands as

well as socio-economic pressures create a need of special treatment for managing sustainable resources in small islands. In the concept of sustainable development, the traditional concept cannot be applied to small islands, and a special approach is needed in order to integrate sustainable development in small islands (Polido et al 2014; Fernandes & Pinho 2017).

The problems in Karimunjawa Islandss become interesting to assess further, starting with the standpoint toward the problems that are not systemic. The complexity of the problems in small islands is being inadequately seen and segmented, where the sense of ego sectoral is profound. This caused ineffective and inefficient resources management. This also happens in Karimunjawa Islands. This study attempts to understand deeper the problems within natural resources management, either land-based or water-based in Karimunjawa Islands. The natural resources management on land and water in the area of small islands cannot be separated. The land development will affect the aquatic ecosystem, considering that Karimunjawa Islandss is a small island. The assessment of these problems is conducted using the framework named Driver, Pressure, State, Impact, and Response (DPSIR).

DPSIR has been used by the European Environment Agency (EEA) to analyze pressure and impacts of policy that is made or going to be implemented (Kristensen 2004). The DPSIR approach can be applied to assess indicators of environmental degradation (Agyemang et al 2007), explore the causes and consequences of vulnerabilities (Newton & Weichselgartner 2014). The DPSIR framework provides the relation between the driving force factors that caused pressure which results in a certain state and creates impacts to the ecosystem. Finally, the response is needed in the policy-making. The DPSIR framework is able to simplify the complexity of marine resources management (Mangi et al 2007). This study attempts to understand the problems within land-based and water-based natural resources management which occur in Karimunjawa Islands using the DPSIR framework. The purpose of this study is to identify the problems with the natural resources management in Karimunjawa Islands. The study is then hoped to help to understand the problems and provide suggestions for the natural resources management policy in Karimunjawa Islands.

Material and Method

Description of the study sites. This research was conducted in January to August 2016, in Karimunjawa Islands, which is divided into 3 villages which are Karimunjawa village, Kemujan village, and Parang village. Karimunjawa Islands is geographically located at 5°49′09″S and 110°27′32″E or about 45 nautical miles (83 km) from Jepara regency. Administratively, Karimunjawa Islands is a region of Karimunjawan sub-district, in Jepara regency, Central Java province, Indonesia.

Method. The method used is desk study and survey. Desk study was conducted to gather facts from the researches that have been done before. Meanwhile, survey was conducted to clarify the data that have been retrieved. The data that were used in this research are secondary and primary data. The data collection is conducted through in-depth interview with key informants, such as the head of the fishermen community, head of the association of Indonesian tour guides, Karimunjawa National Park (BTNKJ), Marine and Fisheries Office (DKP) of Jepara regency, and Pelabuhan Perikanan Pantai Karimunjawa.

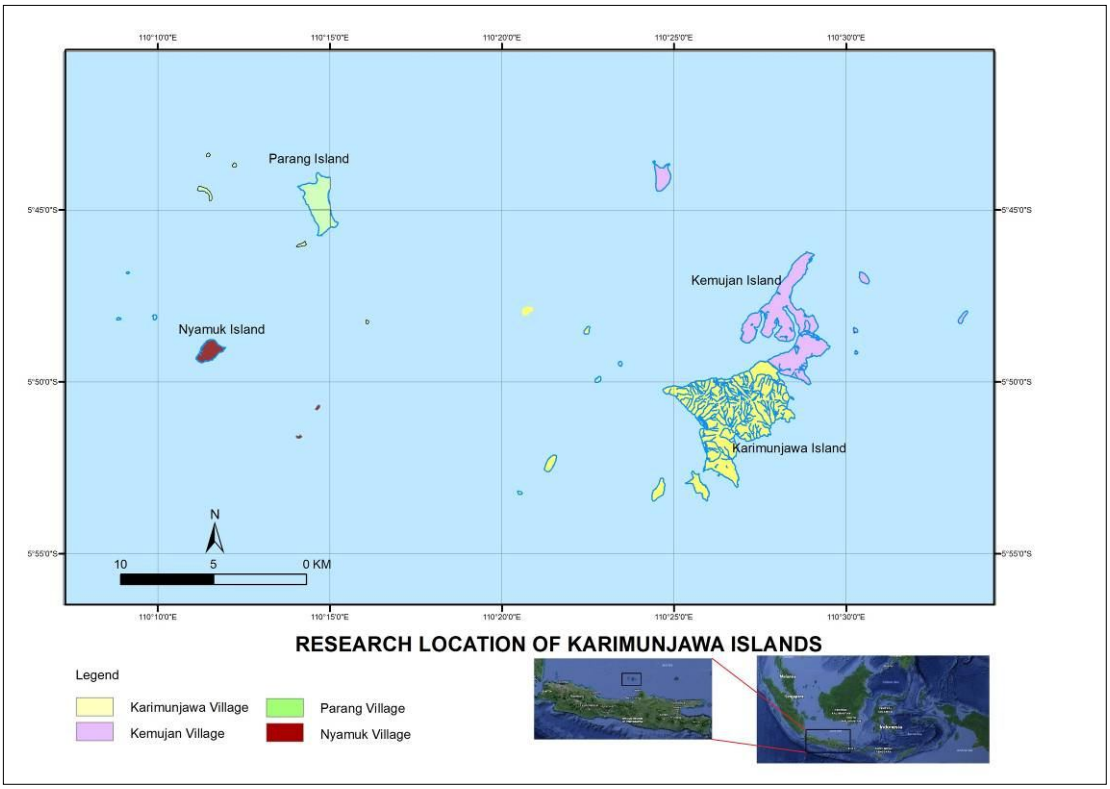

Figure 1. Location of Karimunjawa Islands, Central Java, Indonesia.

Analysis. The data analysis used in this study is descriptive analysis, using the DPSIR framework (Figure 2). The DPSIR framework is an approach toward a system that draws the connection between people and the environment (Atkins et al 2011) which can also be used to create a management strategy framework (Pirrone et al 2005) and serves to inform policy makers, scientists and general public about the indicators to monitor changes in the status of environment (Mangi et al 2007).

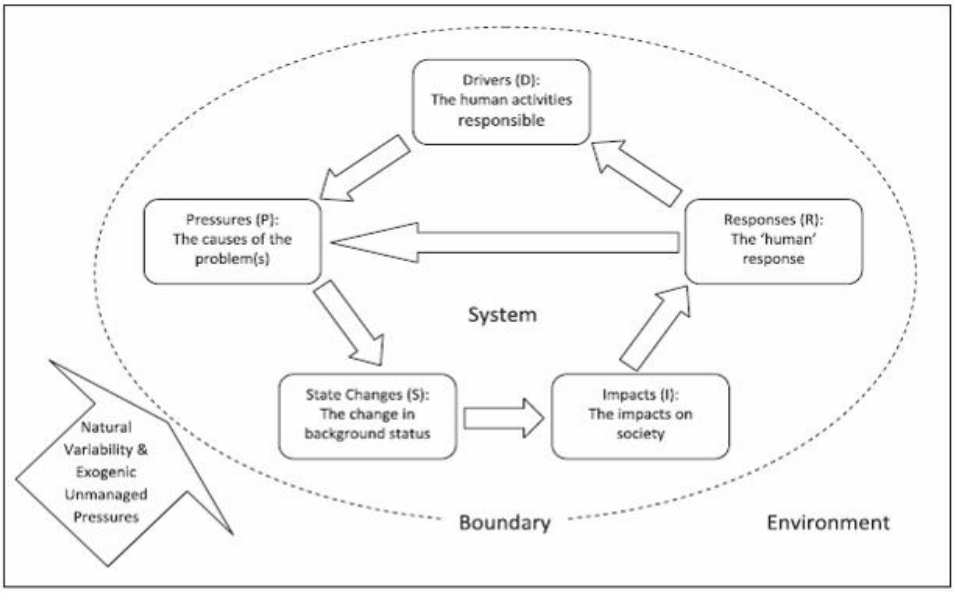

Figure 2. The general framework of DPSIR (Source: Gregory et al 2013).

The components of DPSIR consist of:

- drivers/driving force/trigger factor is a socio-economic factor and its activities that provide pressure against the environment (Agyemang et al 2007) or the need or

urgency to take an act or activity. The activity that is intented to fulfill the need creates pressure against the environment;

- pressure is the activity that is done to meet the needs. There are three types of activities, those are (a) the utilization of natural resources, (b) changes of land use, and (c) emission or pollutant that is resulted from the activities (Kristensen 2004);
- state is the change of circumstances/conditions that is the result from the pressure. The result is the change in the state, for instance, the exploitation of natural resources, the change in land function;
- impact is the effect that comes from the change in the environment, such as environmental degradation;
- response is the act that is taken or could be a policy implication of natural resources management.

Results. Prior to crafting the policy recommendation for resources management, there is identification of the problems from the resources management. There needs a clear identification on the state of the problems that occur and the impacts of its triggers. If driver, pressure, and impact can be identified more properly, then the policy recommendation that comes as the response can be formulized so it can ameliorate the pressure that resulted from the causal factor and its impact on the socio-economy of the people.

Natural resources (coral reef, mangrove, seagrass). Karimunjawa Islands has five intrinsic ecosystems which are lowland forest, mangrove, beach forest, seagrass and coral reefs. The variety of marine biota consists of coral biota (90 genera), coral reef fish (242 genera), several genera of prawns and lobsters, sea turtle (2 genera), algae (10 genera), seagrass (10 genera), mangrove vegetation (11 genera) and other marine biota (Martoyo 1998 in Yusuf 2007). According to BTNKJ (2016), Karimunjawa Islands has a coral reefs ecosystem (±7.487,55 ha with the percentage of coral reefs closure is 54%). The ecosystem contains 72 genera from 14 family of hard corals (scleractinian) and 3 genera of non-scleractinian (Millepora, Heliopora, and Tubipora).

Within the mangrove ecosystem of Karimunjawa, there are 45 genera of mangrove floras. In this area there are also 2 genera of rare plants which are *Schyphiphora hydrophyllacea* and *Sonneratia ovata.* The mangrove are almost spread over the entire island with the size up to 400 ha. The seagrass ecosystem has 9 genera of seagrass from the total of 12 genera which exist in Indonesia. In the island, *Cymodocea rotundata* and *Thalassia hemprichii* are types of common seagrass. In 2005, the seagrass bed in Karimunjawa covered 33.03% (moderate category) and in 2010 the coverage of the seagrass bed reached up to 59.94% which belongs to good category (Wicaksono et al 2012). However, the construction process in Karimunjawa has caused the disclosure of mangrove land for hotel construction.

Fisheries resources. The conservatory area of Karimunjawa National Park has a great marine potential, not only of the demersal fish but also pelagic fish. According to Marnane (2003) in Syaifudin et al (2013), the coral reef fish in Karimunjawa have unique characteristics such as the variety of the coral reef fish is affected by the transition between the fish types in the Thousand islands and Bali Sea (Syaifudin et al 2013). Based on the catch results, pelagic fish are the most dominant type (70%), meanwhile demersal/coral fish made 30% of the total catch (Ramadhan et al 2016). The types of demersal fish which have economic value come from the Serranidae (Grouper) and Labridae (Napoleon). Types of pelagic fish that become Karimunjawan fishermen's target are skipjack tuna and bonito fish. The catching tools that are mostly used are hand line, arrow, *bubu* and net. However, the use is adjusted according to the season and the availability of marine resources (Ramadhan et al 2016). The catch results can be seen in the Figure 3. Based on it, it can be seen that the fisheries production in the Karimunjawa Islands has dropped.

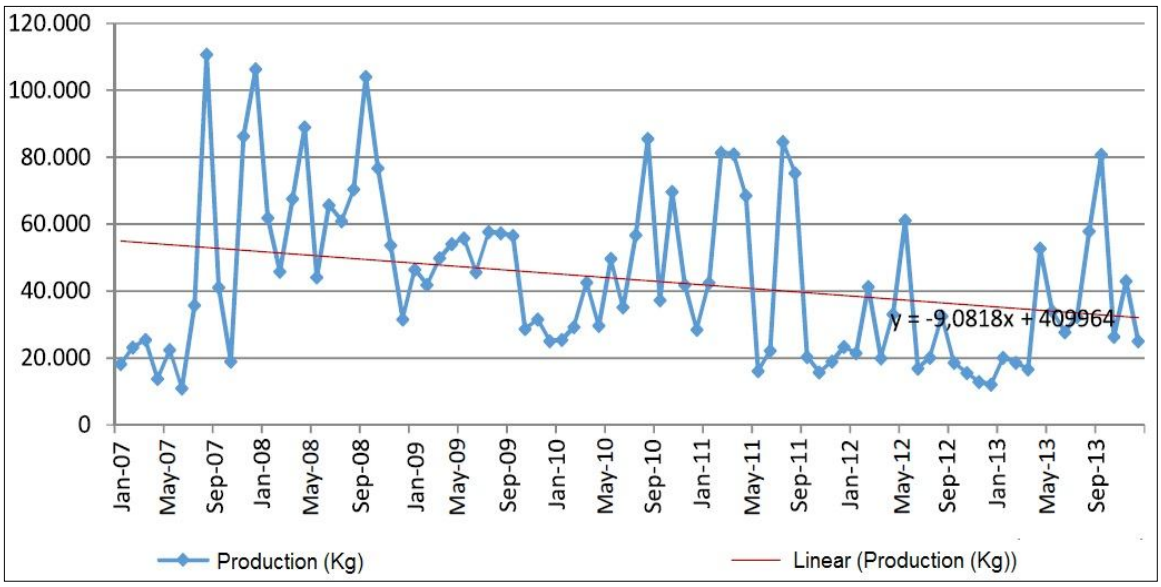

Figure 3. Fisheries catch in TNKJ year 2007-2013 (Source: Ramadhan et al 2016).

Socio-economic driver

Population. The number of population in Karimunjawa sub-district did not show any significant growth. Total population in Karimunjawa sub-district was 9242 persons in 2015. According to Figure 4, the number dropped when compared with that of year 2009 (10,216 persons).

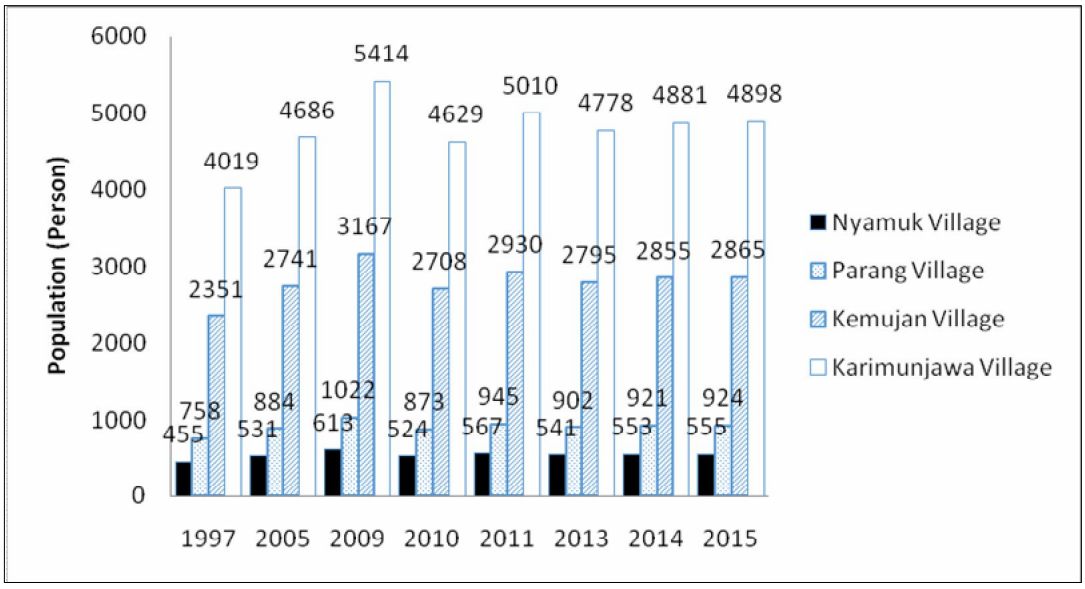

Figure 4. Number of village population in Karimunjawa District Year 1997, 2005, 2009, 2011, and 2013 (Source: from various sources).

Based on the interview results, this was caused by the increase of awareness towards education, resulting in parents to send their children away to attain higher education in Java Island and eventually live in Java Island. Especially in Parang Village, which has increased in their wellfare ini 2010. However, from year 2014, the population increase with the 0.36% growth rate in 2014-2015 (BPS 2016). Karimunjawa village has the most population which is around 53% (Kemujan village 31%, Parang village 10%, and Nyamuk village 6%), this was caused due to the ecologic pressure in Karimunjawa Island is heavier than the other islands. The pressure also occurred in 2017, which came in a form of flood in the area (Shani 2017).

Economic pressure. Regional income is one of the driving force factors in natural resources management. Central java province is one of the provinces that have the most rapid development. This can be seen from the high rate of growth but the average income rate is less than that of other Indonesia's provinces (Kuncoro 2013). Every region stimulates their regional income with several tools such as regional tax, retribution, and separated regional treasury management. The Jepara regency government has stimulated regional income through tourism in Karimunjawa Islands. Some facilities are built for tourism development in Karimunjawa. Tourism also include in Jeparas' development masterplan 2012-2017 (Rencana Pembangunan Jangka Menengah/ RPJM Daerah Kabupaten Jepara 2012-2017). Other economic pressures is poverty rate. Poverty rate in Karimunjawa Sub-district is considered high. From the total of the households (2794 head of household/HH), 1.054 are considered "poor/Pre-prosperous". Whilst 850 HH are considered *Sejahtera1*/Prosperous 1", 462 HH are *Sejahtera 2*/Prosperous 2 and 113 HH are *Sejahtera3*/prosperous 3 (BPS 2016). The high level of poverty adds more pressure to the environment.

Resources dependency. Most of the residents in Karimunjawa Islands work as fishermen. Out of the total of the workforce, 47% are fishermen, whilst the rest work as farmers, industrial workers, traders, excavation workers, construction workers, civil servants, retirees and other service (Figure 5). This indicates that the people are highly dependent on the natural resources, especially marine resources. Other than marine resources, the residents are also dependent on tourism, especially when the Central Java government established Karimunjawa Islands as one of Central Java's destinations. Some fishermen changed their profession as tour guides. According to the interview results, working as a tour guide can increase their living standards.

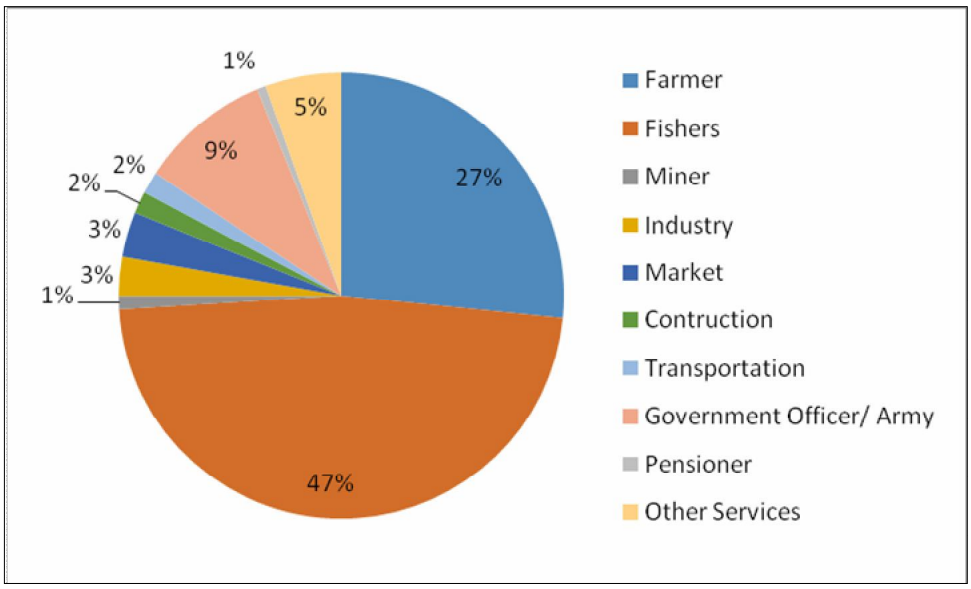

Figure 5. Population based on their livelihood (Source: BPS 2017).

Ecology. According to BTNKJ (2014), the monitoring results in 2013 showed that out of 12 sampling locations, there are 8 locations which experienced reduction (Figure 6). This was caused by the weather and the impacts of tourism activities, especially in Menjangan Besar 1 region. The ecosystem is taken advantage of by fishermen as tourism destination for snorkeling. The usage pattern has affected the coral reefs. Based on respondents' perception, 70% respondents stated that the snorkeling activity brings damage to the coral reefs. The damage was made by lack of tourists' awareness and the tour guides' supervision.

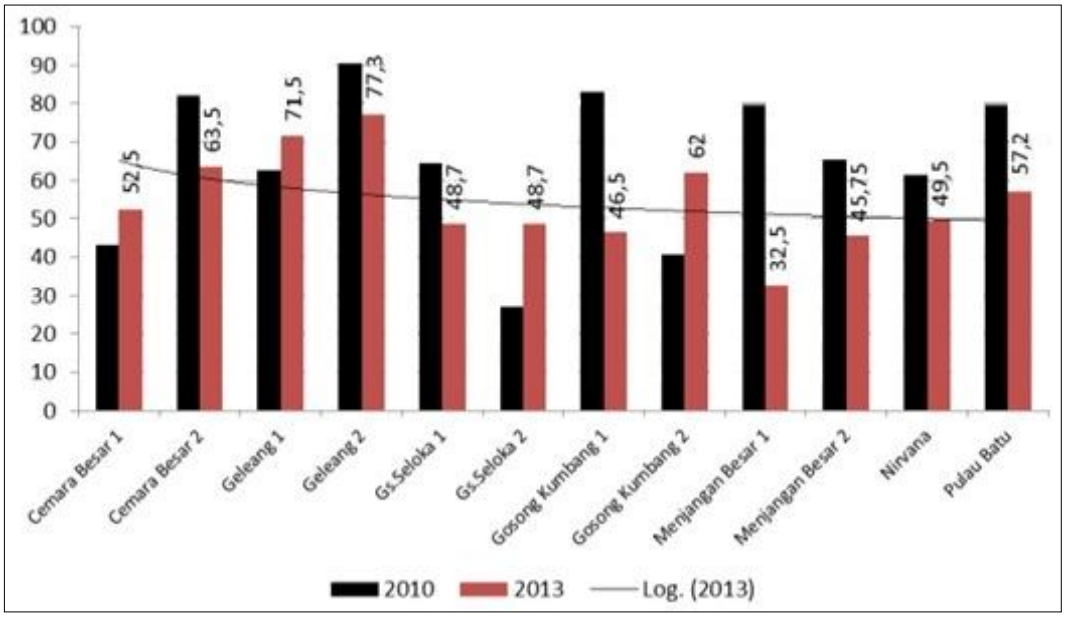

Figure 6. Percentage of coral reefs closures in 3 m deep (Source: Syaifudin et al 2013).

Most of the fishermen in Karimunjawa Islands rely on their fisheries catch. Geographically, Karimunjawa Islands is the intersection between other islands and java island (Figure 7). The great marine resource potential has made an attraction for the fishermen across the northern coast, especially the fishermen from the northern coast. According to interview results with BTNKJ officer and fisheries supervisor, usually the perpetrators of border-crossing are the fishermen from outside Karimunjawa. The presence of these fishermen adds more ecologic pressure for the marine resources and the sea in the area. In Figure 7, it can be seen that Karimunjawa is the passage way for the distribution of forest products from Kalimantan and Sumatera to Java island and is also the destination of the fishermen across the northern coast and Madura coast to catch fish.

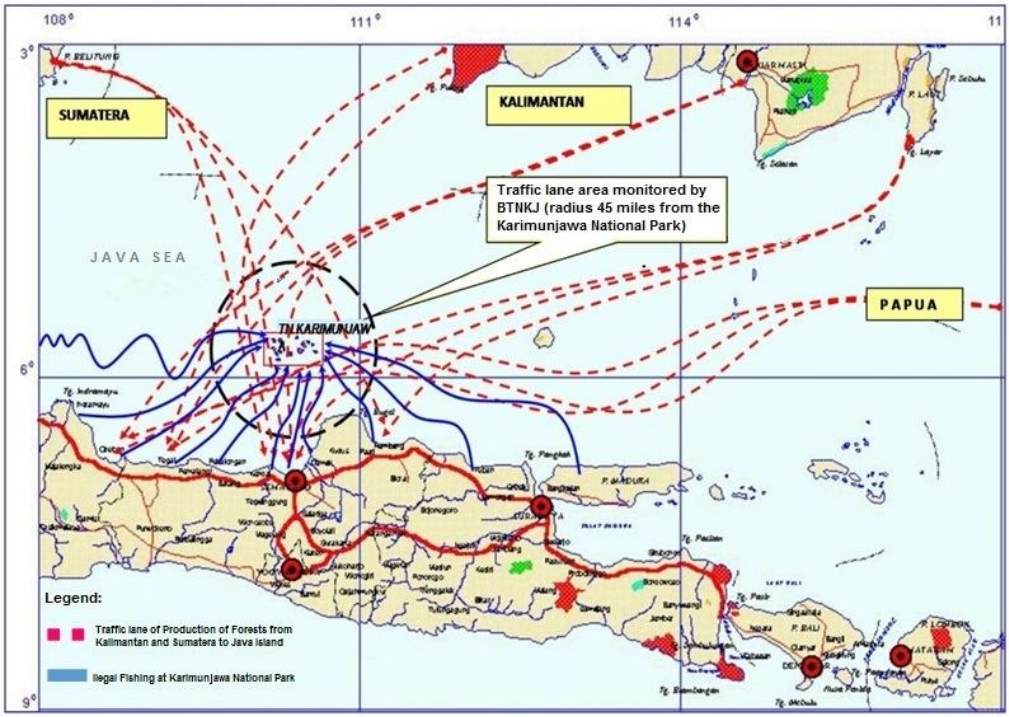

Figure 7. Map of the Passageways that go through Karimunjawa (Source: BTNKJ 2016).

Institutions. Karimunjawa Islands has natural resources potentials that can be improved through developing its marine tourism, which has been established based on the Decree of Central Java Governor No. 556/21378 on 26 October 1982. In 1982, Karimunjawa Islands was established as marine nature reserve, with the purpose to protect the ecosystem. In 1988, Karimunjawa Islands became Marine National Park based on a Decree of Forestry Minister No. 161/Menhut-II/1988. In 1990, there was spatial planning through zonation (Law no. 5 year 1990), which later was managed as conservation area (Law no. 31 year 2004 on Fisheries). The zonation-based spatial planning is in accordance to the Documents of the Main Plans of Karimunjawa National Park by the Government of Province Central Java 1988. Karimunjawa islands management status provided in Table 1.

Until 2017, the zonation system has left problems such as the biota and ecosystem condition which was getting worse and there are still damages - it also still cannot perform its functions and aims as a conservation area (Yusuf 2007). Efforts made by the Jepara Region Government are providing supervision for the zonation regulation, nature conservation, marine resources and tourism development, and the environment and resources management. Even though there has not been an integration between the resources management and the regulation or establishment of activities for certain purposes, and it is still sectoral (Yusuf 2007). According to Yuliana et al (2016b), implementation of zoning system is not yet effective in managing the fishers fish-catching activities. Because the surveillance is not running well, the level trend of fishers in 2010 to 2014 was polynomial (there was a rise in the compliance in the period 2010-2012, and then there was a fall from 2012 to 2014), and the boundary markers were not clearly visible.

Table 1

Karimunjawa Islands Management Status

Year	*Status*	*Legal basis*
1982	Established as a National Park and Marine Tourism region	Decree of Central Java Governor No. 556/21378, date 26 October 1982
1986	Established as marine conservatory area	Decree of Forestry Minister No. 123/Kpts-II/ 1986, date 19 April 1986
1988	Established as a National Park	Letter of intent of Forestry Minister No. 161/ Menhut-II/1988, date 23 February 1988
1989	TN Karimunjawa zonation	Decree of Director General of Forest Protection and Natural Conservation No. 127/Kpts/DJ-VI/1989
1999	Established as Taman National Karimunjawa	Decree of Forestry and Plantation Minister No. 78/Kpts-II/1999, date 22 February 1999
2005	Taman National Karimunjawa zonation revision	Decree of Director General of Forest Protection and Natural Conservation No. 79/IV/set – 3/2005
2012	Taman National Karimunjawa zonation revision	Decree of Director General of Forest Protection and Natural Conservation No. 28/IV/set – 3/2012

Source: BTNKJ (2016).

Pressure. Food needs rise along with population increase. Before Karimunjawa Islands became a tourism destination, coral reef fish were not included as the catch target, because coral reef fish were not preferred and have no economic value. However, when tourists began to swarm Karimunjawa Islands, coral reef fish have become favorites and preference for meals. The increase in the number of tourists has triggered the exploitation of coral reef fish. Based on interview results, the potassium use became common in 2006.

Karimunjawa sea is not only the place on which karimunjawan fishermen's lives rely, but also for the fishermen from outside Karimunjawa (Figure 7). Some of the regions in the Karimunjawa National Park endure pressures from fisheries activites, like Bengkoang island, Menyamakan, Burung, Menjangan Besar, Cemara Kecil, Krakal, and Katang. Whilst the lightest pressure occurs in the eastern and western side of Karimun

island, Tanjung Gelam, east Kemujan, Nyamuk and Parang island. The pressure status of the fisheries activities can be seen in Figure 8. The presence of the fishermen especially those from Tegal, who use trawls, often times causes disputes among the fishermen. The presence of the trawl net fishermen is considered as the main cause of coral reefs damage and decrease of fish products in Karimunjawa sea. The condition also disturbs the activities of bubu fishermen. Trawl nets have also caused bubus to drift away, burdening fishermen to retrieve their bubus. Also with its mesh size which allows to catch small fish. Disputes also take place between anglers and spear fishermen, although the dispute has been settled with an agreement between both parties.

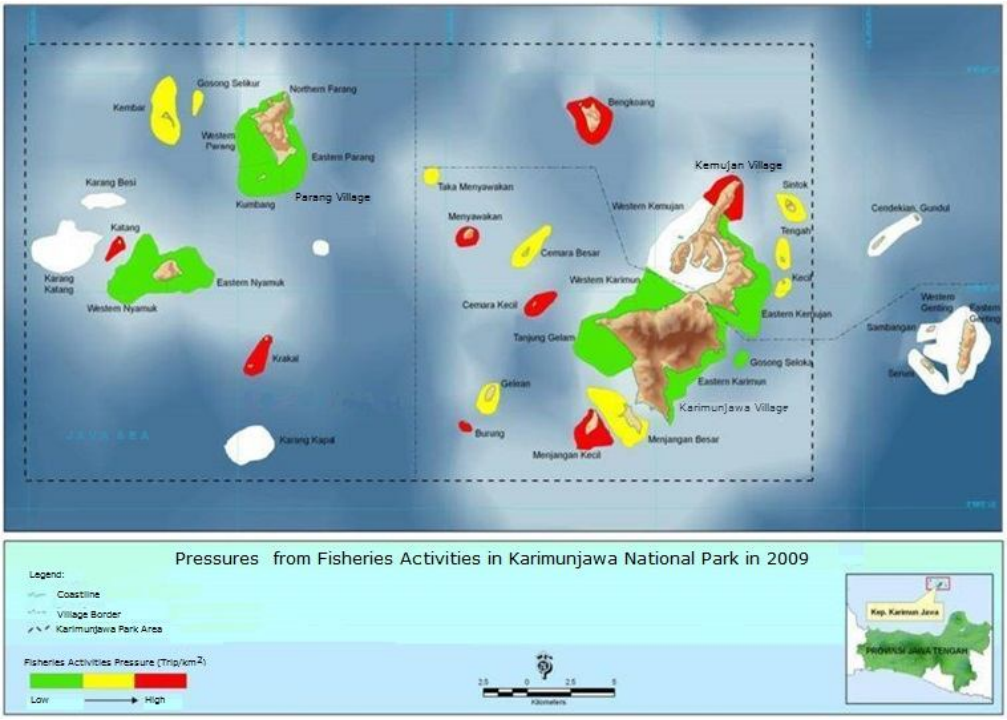

Figure 8. Pressures mapping from fisheries activities in Karimunjawa National Park (Source: BTNKJ 2016).

Conflicts did not only occur between fishermen. In Karimunjawa management, there are also inter-institution conflicts. Conservation area does not mean there must not be any activities within it. National park is a conservation area that has natural ecosystem which can also be utilized for human needs, while preserving it. Based on a focus discussion between the stakeholders of Karimunjawa National Park, the problems in the conservation area is the recurrence of conflict of interests between conservational, fisheries, and tourism sectors. Conflicts that occur in Karimunjawa National Park are:

- inter-sectoral conflict: conservation – fisheries – tourism;
- inter-institutional conflict: Fisheries Office – Tourism Office, Fisheries Office – BTNKJ, BTNKJ – Tourism Office, Central Government – Regional Government;
- inter-resident conflict: pros – cons on tourism subject;
- fishermen conflict: anglers – spear fishermen, foreign fishermen – local fishermen;
- residents – BTNKJ conflict: the residents feel their borders are being restricted.

State. The government of Central Java Province has promoted Karimunjawa as one of their tourism destinations after Borobudur Temple. They attempt to make Karimunjawa Islands as an exclusive marine tourism competing with Raja Ampat Papua and Bali island. The plan is funded by the government of Central Java Province and the government of Jepara Regency. Several infrastructures have been built, such as Karimunjawa Port and Legon Bajak Port in Kemujan island, and the renovation of Dewandaru airport. This is proven by the spike in the number of visits from both local and international tourists.

Aside from that, there has also been increase in the number of hotels and homestays in Karimunjawa (100 units). The number of tourists can be seen in Figure 9. There was also growth in 2011, where local tourists rose up to 147%, from 15,070 tourists in 2010, to 37,208 tourists in 2011. Within the same year, there was also increase in the number of international tourists which was 29%, from 1,567 to 2,016 tourists, within the next year the number rose up to 148% or 5,005 tourists.

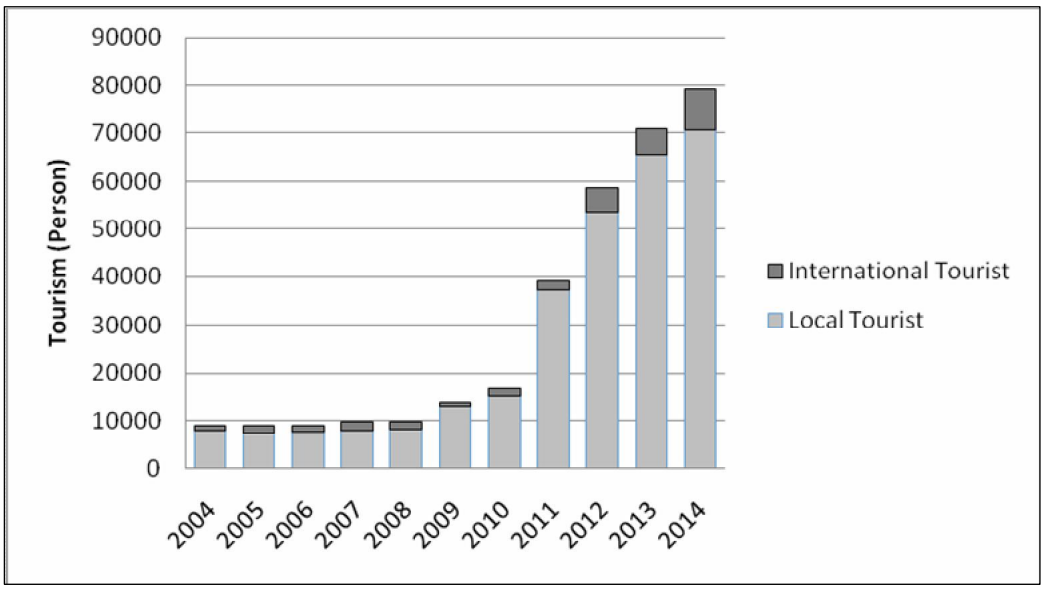

Figure 9. Number of tourists visiting Karimunjawa (Source: Bappeda 2015).

Impacts. The physical impact from such situation is the coral reefs damage. The condition of most of the coral reefs is damaged within the medium-level category, with the coverage percentage between 26-53% and the variety index ranges between 1,611-2,590 (Yusuf 2013). According to the interview with a diving instructor, the coral reefs condition within the > 6 meter-deep is still the same with that of year 2013, but the number and size of coral reef fish continues to decrease. Meanwhile the condition of the coral reefs within the 3-6 meter-deep is worse compared to that of five years prior. Other than the coral reefs, there have been changes in land-use. Some of mangrove areas have turned into lodges. Some land in the hill area has also become lodges and tourism attractions.

The exploitation of coral reef fish and the practice of destructive fishing caused drop in the fisheries products. This is felt by the fishermen. The socio-economic impacts that occur in the resources management are the impending conflict of interests between governmental institutions, government and residents, and residents. The number of tourists which rose sharply creates inconvenience for the residents especially the Moslem residents. The tourists, especially international tourists have brought cultures such as: drinking alcohol, inappropriate dress not just in the beach but also in the city. The parents become anxious, afraid the younger generation would become affected by the western culture.

Conflicts of interest appear in two sectors which are conservation-fisheries and conservation-tourism. Secondary conflict which is no less important is the conflict between tourism and fisheries sector. The hierarchical relation between the three main sectors and the conflict that occurs between those three sectors can be seen in Figure 10. The conflict between conservation and fisheries came in a form of zonation violation, use of banned and harmful fishing tools, and infrastructure provision. The zonation violation is often perpetrated by small-scale fishermen who are Karimunjawa fishermen and foreign fishermen (as mentioned in previous chapter).

In the land area, potentials for conflict appear when mangrove area is used for hotel construction. The land ownership which is owned by private/individual parties

creates burden for the government to ban land clearing. This can be seen in Karimunjawa Islands, where certain mangrove areas are cleared for hotel constructions.

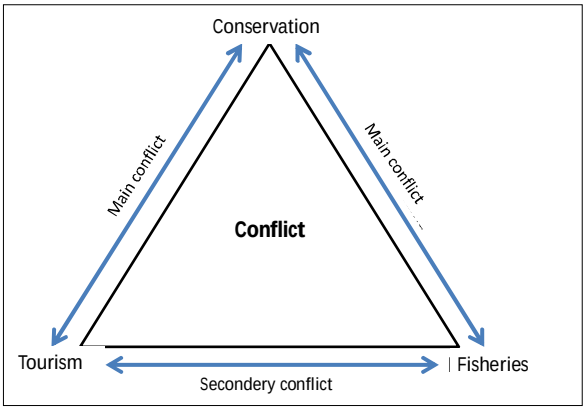

Figure 10. Hierarchical relation between three mains sectors (D'Anna et al 2016).

Response. Attempts to counter the conflict of interests on fisheries and conservation issues are made by conducting combined patrols between DKP, BTNKJ, PSDKP, TNI-AL, and Pol-Air. POKWASMAS is also made to help the supervision of marine resources. In conducting the supervision, there is only one personnel that holds three positions at a time which are as a supervising officer (PSDKP), Special Police and also KP Office. This clearly becomes the weak point of the marine resources supervision in Karimunjawa National Park.

Differences of visions on the development of tourism and conservation sectors create a conflict of interests. The development that occurs in Karimunjawa is made to support the tourism sector. Transportations, ports, airports, and road constructions are done to support and attract the tourists who visit Karimunjawa. However, the government seems to neglect the capacity of the region, and therefore creates new problems such as scarcity of clean water and electricity as well as food and lodging needs. Secondary conflicts between tourism and fisheries sectors occur when the fisheries infrastructures turn into tourism sector. Also the functional alteration of fishing boats into tourism boats and the changing profession of fishermen into tour guides.

Discussion. Karimunjawa Islands experiences a great ecological pressure, mainly due to population increase, housing expansion, development in fisheries activities, marine tourism development and increase in water transportation activities. The DPSIR framework on resources management in Karimunjawa Islands can be seen in Figure 11.

Most human resources (85.71% residents don't enroll to school, do not graduate from elementary school, graduate from junior high school and high school) have low education level. The low level of education has caused limited skills and capabilities to have alternative jobs, making fishermen as the main profession. The population increase along with globalization causes heavier competition in finding earnings. The main problem which seems to keep repeating is low income in the smaller islands. The low income residents would be highly dependent on natural resources. This creates unwanted impacts on terrestrial environment and marine ecosystem (Douglas 2006).

The residents in Karimunjawa islan are not only natives, but the newcomers also came in high number and open business in Karimunjawa Islands. The discrepancies of quality and skills emanate risks for social conflicts. At the fisheries sector, the conflict occurs among the fishermen, which is (a) conflict between compressor and non-compressor fishermen, and (b) conflict between trawl fishermen from outside the island and the local fishermen. The conflict between fishermen in Karimunjawa occurs when the spear fishermen use compressor to dive under the water and catch all kinds of fish, making the anglers feel disadvantaged due to their less catch. The conflict was then settled by making an agreement letter that states that the spear fishermen must not disrupt the anglers (in this context, both parties must not be placed in the same catch

area), the spear fishermen must not catch black grouper fish, and cannot catch stone grouper and giant grouper fish from November to March on 18-29 Hijri based on Islamic calendar. If they conduct any violation, they will have to pay the penalty fee between Rp 2.000.000 and up to maximum Rp 5.000.000. Within the agreement it is also written the ban of using potassium and catching fish within the core zone. Efforts to settle the conflict with foreign fishermen are conducting socialization and cooperation with the local Fisheries Office.

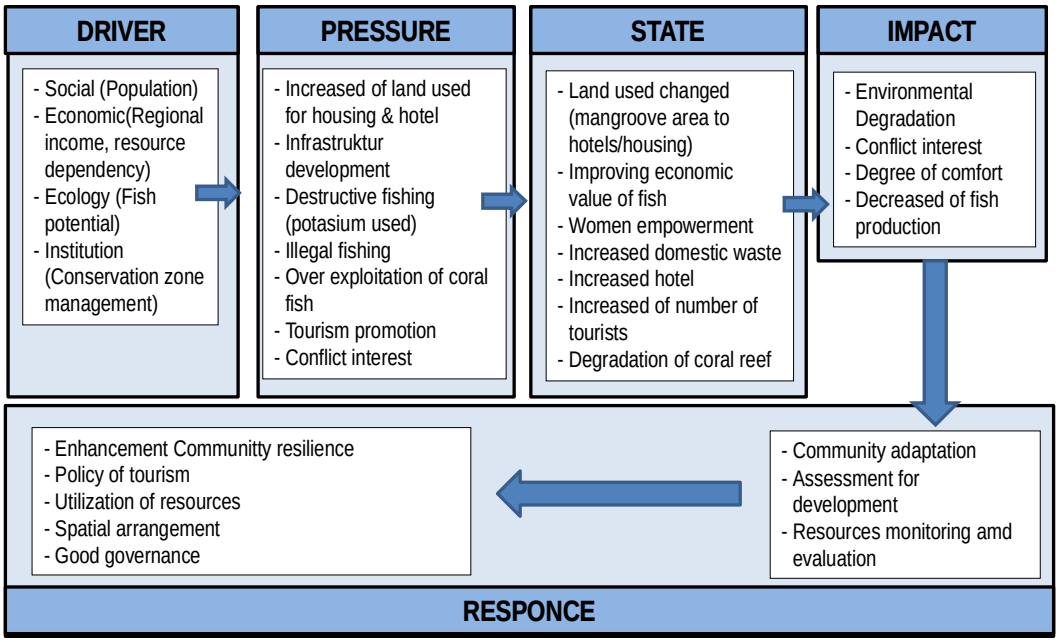

Figure 11. DPSIR framework on resources utilization in Karimunjawa Islands.

Tourism is one of developing sectors in small islands. The increase of tourism advertisings has risen the number of tourists who come to Karimunjawa Islands. The rise in tourists also increases the population and contributes to the needs for clean water, housing, and food. Population becomes the driving force in the occurrence of the problems in Karimunjawa Islandss. The rise in population becomes the cause of environmental degradation and socio-economic issues (Agyemang et al 2007). The positive impacts of tourism sector are the income increase, increase in opportunities for business (to accommodate the tourists' needs, provide services), and increase in jobs (Yoeti 2008). The increase in the number of tourists who visit Karimunjawa Islands makes positive impacts, such as the surging economic value of coral reefs fish, new professions like tour guides, restaurants. Food-providing service also creates new profession for the housewives.

The changes in Karimunjawa Islands have caused the residents to adapt by changing their professions. Most of the fishermen have turned into tour guides/diving instructors and providing boat rentals, especially when the holiday season comes. The profession changes can improve the prosperity level and reduce the destructive fishing practice, because the residents begin to experience the advantages of the tourists' presence. The profession changes also happen in Gili Trawangan. Based on the interview with the fishermen in Gili Trawangan, almost all fishermen change their profession to tour guides and tourism service.

Ever since the tourism sector develops, Karimunjawa Islands has experienced numerous changes. Tourism also causes negative impacts, such as resources damage, rising domestic waste, coral reefs damages due to snorkeling activities and the anchors of the tourism boats, forest destruction (Yoeti 2008), water scarcity (Gössling 2001). Domestic waste continues to rise along with the number of tourists who visit Karimunjawa Islands. Karimunjawa Islands does not have a proper waste disposal location. Therefore the waste is disposed in a former swamp which is located in the

center of the sub-district. The waste is expected to fill the area and solidify in order to become new area for housing. To overcome the waste issue, the Jepara Regency government has planned to build Final Disposal Area (TPA) in the hills. The plan will be taken into action once the former swamp has solidified and cannot contain any more waste. This creates potentials for water pollution and worsen the quality of the water and the residents' health in Karimunjawa Islands. Other significant changes from tourism development include changes in land functions, especially the mangrove land which is cleared for lodges. The changes will certainly affect the quality of other environments.

This also happened in the Thousand Islands, where the housing expansion has caused mangrove clearance, such as in Tidung Besar island, Thousand Islands, Jakarta, which causes abrasion (Farhan & Lim 2012). The ecological pressures in Panggan island in the Thousand Islands are the impacts of tourism activities (snorkeling and diving) towards the coral reefs damage (Muhidin et al 2017). Also in Gili Trawangan, where almost all the regions in the island become housing areas (Kurniawan et al 2016).

The resources utilization by many parties for many purposes adds more burden of the ecological pressures in Karimunjawa Islands, hence there needs to be a management that does not only focus on the socio-economic aspect but also ecological aspect, such as zonation regulations that are based on the residents' aspirations and other interests (Suryanto 2000; Yusuf 2007). In the management of Karimunjawa National Park, there are stakeholders who play important roles. Balai Taman Nasional Karimunjawa (BTNKJ) is an institution that holds the authority to manage Karimunjawa National Park. Other stakeholders are the Ministry of Marine Affairs and Fisheries, Marine Affairs and Fisheries Office, Indonesian Marine Corps, Indonesian Maritime Police Force, Tourism and Culture Office, regional and provincial governments, and non-governmental organizations (e.g. Wildlife Conservation Society/WCS).

The concept of sustainable development in small islands is based on two important assumptions which affect the management and policy strategy, which is the homogeneity in the residents regarding the utilization of natural resources and the sustainability of it across generations, where the current generation must be able to preserve natural assets for the well-being of the next generations (Douglas 2006).

Conclusions. Karimunjawa Islands, in spite of being in the area of Karimunjawa National Park, is still known to have the problems that small islands have, such as environmental degradation due to the nature of small islands which is vulnerable to environmental changes. Based on the DPSIR analysis, the problems in Karimunjawa Islands are mostly anthropogenic. Those are mangrove clearance, changes in land functions, and destructive fishing practice. This can be seen from the rise in the numbers of lodges, decrease in mangrove forest and number of catch. It also causes other impacts such as the increase in domestic waste, needs for fish which triggers the exploitation of marine resources. Tourism sector also gives both positive and negative impacts. The positive impact is that it creates more jobs alternatives for fishermen and their families. The negative impact is the coral reefs damage and increasing ecological pressures in the Karimunjawa water. Inter-sectoral conflicts (fisheries and tourism, tourism and conservation, tourism and fisheries) and intra-sectoral conflicts (spear fishermen and net). As a group of small islands, Karimunjawa Islands must be specifically managed. This is due to the distinctive characteristics and limitations that are had by small islands. Resources management is prone to cause inter-sectoral conflicts. Therefore, there needs a comprehensive, strategic, and integrated policy on the resources management in small islands.

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