Developing one map of national marine resources of Indonesia

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Abstract. Indonesia is the largest archipelagic country in the world, with two thirds of waters containing large marine resources. However, the coastal and marine resources have not been optimally utilized due to the limitation of Spatial Zoning Plan for Coastal and Small Islands (RZWP3K). In addition, there were many institutions which produce thematic maps of the coastal and marine resources (MGI) using different basemap, standard and technical specifications. Hence, same thematic maps provide different information. For these reasons, One Map Policy (OMP) is required to overcome the problems. The objective of this research was to develop datasets of one map of the coastal and marine resources needed for developing RZWP3K by using thematic layer maps produced by their respected Ministries/Agencies as the custodianships. The current custodianships of thematic maps in Indonesia is defined based on the Head of Geospatial Information Agency Decision Number 54 Year 2015. The method used the OMP approach was based on one reference, one standard, one database, and one geoportal. The research resulted the dataset of MGI integrated to the national basemap in a geodatabase format. From this research, it was concluded that the thematic maps of the coastal and marine resources which were produced in many institutions can be integrated to a national basemap and standard specification. The integrated thematic maps are then useful for developing the RZWP3K.

1. Introduction
1.1. Physiography of Indonesia and its Marine Resources
Indonesia is the largest archipelagic country worldwide, extending between the Australian and Asian Continents and the Indian Ocean and the Pacific Ocean. Geographically, Indonesian archipelago is located between the 94 and 141 degrees East Longitude and between the 6 degrees North and the 11 degrees South Latitude. Indonesia’s claim as an archipelagic nation has documented as part of important national history. Historically, Indonesia has always regarded the seas within its archipelago as internal waters, hence the internal water become territorial sovereignty water. Indonesia's word for 'fatherland' - 'tanah air', means 'the land and the water', so that the seas between island bounding the islands together to form the territory of Indonesia. As an archipelagic nation, Indonesia also has right on claiming the Exclusive Economic Zone (EEZ) as regulated on the United Nations Convention on the Law of the Sea (UNCLOS) 1982.

That has been commonly stated that Indonesia has 17,508 islands. Recent update, Indonesia submitted 16,056 islands during the 9th meeting of United Nations Conference on the Standardization of Geographical Names (UNCSGN) in New York, 21-30 August 2017. This submission was an update of the previous submission of the number of islands to UNCSGN which reported that Indonesia had
submitted 13,466 islands. Those islands submitted were islands that had been verified with names and coordinates. Since the geospatial survey of islands continues, the number of the islands submitted to UNCSGN will possibly change in the future.

Furthermore, total area of the Indonesian archipelago is 4,986,325 square kilometers, with land area is 1,904,569 square kilometers and water area is 3,081,756 square kilometers [1]. Meanwhile, the Geospatial Information Agency (BIG) stated that the water area of Indonesia including the EEZ was 6,315,222 square kilometers with 99,093 kilometers of coastline [2]. Thus, the seas and coastal area dominated the physiography of Indonesian archipelago.

Since the Indonesian archipelago is in a strategic location across major sea lanes from the Indian Ocean to the Pacific Ocean, Indonesia's sea-lanes have long been a key highway for naval vessels sailing between the Asia-Pacific region and the Indian Ocean. Almost all maritime traffic transiting South East Asia must enter Indonesian waters at some points. There are three designated sea lanes, called as Archipelagic Sea Lane I, II, and III that running along a north-south axis the archipelago. The Indonesian submission of the sea lanes came under consideration at the 67th Meeting of the Maritime Safety Commission of the International Maritime Organization (IMO) in 1998, where the IMO accepted the partial designation of Indonesian archipelagic sea lane passages [3]. The designation of the sea lanes is part of an obligation of the recognition of Indonesia as an archipelagic country according to UNCLOS 1982, which is an archipelago is "a group of islands, including parts of islands, interconnecting waters and other natural features which are so closely interrelated that such islands, waters and other natural features form an intrinsic geographical, economic and political entity, or which historically have been regarded as such."

With such geographical area, Indonesia has abundant coastal and marine natural resources. Mangrove forests are found in most of the coastlines of Indonesia. Papua, Kalimantan and Sumatra are three big islands of important mangroves ecosystems [4]. The stand of mangroves varies between type of species and region, some can reach up to 50 meters in height. Mangroves forest found in intertidal area, at height between mean sea level and high tide. Therefore, mangroves area is flooded during the high tide. In general, the ground is layer of dense mud that containing thick levels of organic materials that exposed during the low tide. However, some mangroves can grow on sand substrate as that found in the eastern islands of Indonesia such as in Sumba and Kei islands. The area of mangroves Indonesia is about 3 million hectares nationwide. This is about 23 percent of all mangroves ecosystems in the world [5]. Other important ecosystem in shallow water area is coral reef and seagrass. Scientists have noted that Indonesia is the center of coral diversity. It was reported that 82 genera and about 590 species of scleractinian corals have been recorded in the Indonesian and its surrounding waters [6][7][8]. The seagrass coverage in Indonesia was estimated for 30,000 kilometers square, is the largest among other Asian countries [9].

In terms of fisheries, Indonesia is one of the main fish producers in Southeast Asia. Capture fisheries and aquaculture occur in marine, brackish and freshwater. Marine capture at the second largest position with 6.01 million tons in 2014 [10]. Besides that, there is also considerable potential of offshore oil and gas mining and other minerals also contribute to national economics. The economic potential of the marine resources worth as much as US$ 1.2 trillion/annually or about 10 times the state budget [11]. With those potential marine resources, the president of Indonesia, Joko Widodo, declare that the future of the nation is in the sea.

However, there are also several issues on the coastal and marine conditions. The coastal and marine resources deterioration has occurred in many places due to development practices and unfavorable exploitation of the natural resources. Some issues like tidal flood, mangroves degradation, coral bleaching, coastline abrasion, and illegal fishing occur in many places in Indonesia. In the long run, those issues could result in reducing the fish production.

1.2. Policy on provision of Geospatial Information in Indonesia

The management of natural resources in Indonesia is carried out by many ministries/agencies and local governments, with reference to their duties and functions or their respective interests. Since it is part of
natural resources management activities, provision of Geospatial Information (GI) especially thematic geospatial information is also carried out by many ministries/agencies and local government. This condition has resulted in the implementation of GI in institutional manner. This institutional GI implementation then has led to overlapping of land use or spatial use conflicts, uncertainty on spatial information, spatial allocation in restricted areas, social conflicts, and others. The impact of institutional GI implementation is certainly also can hinder the development of the region or infrastructure.

Law Number 4 Year 2011 on Geospatial Information (GI Law) has been enacted on April 21, 2011. According to the GI Law, the implementation of GI is grouped into 2 main outputs, namely the implementation of Basic Geospatial Information (BGI) and implementation of Thematic Geospatial Information (TGI). The implementation of BGI is conducted by the Geospatial Information Agency (BIG) (Article 22 paragraph 2 of the GI Law), while the implementation of TGI is carried out by government agencies (ministries/agencies), local government, and/or person (Article 23 Paragraph 1 of the GI Law). One Map Policy (OMP) is a further arrangement on the implementation of TGI by ministries/agencies and local government so that TGI between ministries/agencies and local government can be integrated with reference to the same baseline map. The benefits of TGI from OMP products are to realize transparent and efficient governance, accelerate regional-based development (spatial and infrastructure), avoid spatial conflicts, guarantee investment location issuance, and so on.

BIG's empirical experience in assessing the quality of the Regional Spatial Planning (RTRW) maps concludes that most of existing district/municipal RTRW maps are not compiled using the thematic maps that have been specified in the Public Works Minister’s Decree Number 20 Year 2007 on Technical Guidelines of Physical and Environmental Aspect Analysis, Economics, and Socio-Culture in the preparation of Spatial Planning. The unavailability of thematic maps of in scale of 1:50,000 both ministries/agencies and local government is the cause of this situation. This has resulted in many problematic District/City RTRW maps, resulting in many spatial use conflicts in the regions.

Considering those problems stated above, the Government of Indonesia issued OMP which is part of the Economic Policy Package VIII to address the spatial utilization conflicts. The purpose of this OMP Regulation is to accelerate the provision of 1:50,000 scale thematic maps, so that the District/City RTRW map can be accurately compiled. The District/City RTRW maps along with their accurate supporting thematic maps are fundamental TGI data that can ensure a sustainable land use allocation, including for infrastructure development.

1.3. Problems

Unfortunately, the thematic geospatial data about those environmental issues as mentioned above at Section 1.1 and Section 1.2 are limited both in terms of their availability and quality. Likewise, data about coastal and marine natural resources and habitats considered limited in terms of the availability. Some data provided based on a specific purpose and hard to be accessed, so that is not useful for others. Some types of data might be provided by several institutions but using different standards and technical specifications. But, the most important is that the data are already dated and need to be updated. On the other hand, demand for the data, especially geospatial data is increasing following the awareness on management the natural resources to ensure sustainable development by ensuring continuous functions of the coastal and marine environment.

Meanwhile, spatial planning is considered as a suitable tool for managing marine and coastal area. The need of spatial planning for coastal and marine has been expressed, among others by the enactment of Law number 27/2007 about Coastal Area and Small Islands Management. The idea is to organize coastal and marine area into several zones by considering its physical conditions and potential uses. By doing this, hopefully there is a balance on the spatial usage of the marine and coastal area, between exploitation and conservation of natural resources and environment. This spatial planning development obviously requires good geospatial data to provide accountable planning.
1.4. Objectives
The objective of this research is to develop the datasets of one map of the coastal and marine resources needed for developing Spatial Zoning Plan for Coastal and Small Islands (that translated from “Rencana Zonasi Wilayah Pesisir dan Pulau-Pulau Kecil” and abbreviated as RZWP3K) on the basis on OMP requirement each thematic layer which is produced by its custodian. It is hoped that the related institutions can start developing RZWP3K so that the conflict of spatial use in the coastal region can be avoided.

2. Principle of One Map Policy
OMP is a strategic direction for the fulfillment of a single map referring to one geospatial reference, one standard, one database, and one geoportal (Presidential Regulation on OMP, 2016). Those four components of OMP are the requirement to produce an accurate, accessible, and accountable TGIs. The requirement of using single geospatial reference is a fundamental factor for producing integrated TGIs. Article 19 of GI Law states that TGI made by ministries/agencies and local governments must refer to BGD (Geodetic Control Network and basemap). A national single reference system used in Indonesia is SRGI 2013. This is a national coordinate system that consistent and compatible to global coordinate systems [12]. BIG has already distributed the 1:50,000 scale topographic map of Indonesia (RBI) covering the whole Indonesia to the 18 ministries/agencies to be used as the basemap for the implementation of thematic mapping.

‘One Standard’ is a component in OMP that plays important roles in standardizing the mapping method so that all geospatial information produced are accurate and accountable. In addition, this ‘one standard’ component is useful for accelerating the mapping process in Indonesia considering the vast territory of Indonesia to be mapped. To face these challenge, both ministries/agencies and local governments are encouraged to work together within Working Group, even though they have role as the custodian of thematic map. In this case, the mapping standard can be used by other parties as a quality control for the output maps as well.

A single database requirement in the other OMP component that is required to ensure that geospatial information is easily accessible and can be shared using national geoportal. Geospatial Information System (GIS) technology is required in the implementation of OMP to provide accurate geospatial information. The utilization of GIS technology is essential particularly for data operability and sharing since geospatial information dataset is unlikely to be produced using a single geospatial information provider or software. Database management system (DBMS) is one of the major components of GIS software DBMS will facilitate data integration and exchange [13].

The final goal of the OMP is that the output TGIs prepared by ministries/agencies as the custodian of the TGIs can be shared through the Geospatial Information Network (JIGN) or the national geoportal. The output of TGIs must be “clean and clear” so that it can be used together and integrated each other using GIS technology in the JIGN platform. As stipulated in Presidential Regulation Number 27/2014, the JIGN consists of geospatial information nodes in the central government (ministries/agencies) and in local government. All the network nodes are integrated by connecting to the existing network nodes in BIG. The JIGN's operation for TGI data sharing is useful to support the realization of transparent and efficient governance. Moreover, the sharing data on JIGN will facilitate the synchronization process of TGIs to facilitate problem solving on spatial conflicts [14].

2.1. Scope of One Map Policy
OMP aims to accelerate the provision of TGI which fulfills one reference, one standard, one database, and one geoportal, for the development of spatial planning in district level (at the scale of 1: 50,000). Benefits that can be gathered from OMP is an improvement of thematic data on each sector according to regulatory standard/regulation, and control planning and development policies, such as by implementing integrated spatial planning. Besides that, OMP will increase accuracy of spatial data, hence avoid overlapping of licensing among investment sectors controlling the utilization of natural resources toward sustainable development. Based on Presidential Regulation Number 9 Year 2016, the
target of OMP implementation (2016-2019) is 85 TGI s by involving 19 ministries/agencies in 34 provinces. It is acknowledged that the number of thematic maps required is far beyond the scope of the OMP implementation targeted within 2016-2019, both in terms of scale and the themes. However, the principle of OMP shall be applied to the production of all thematic maps so that the maps are useful for supporting governments’ decision making.

2.2. Implementation of One Map Policy
The implementation of OMP based on Presidential Regulation Number 9 Year 2016 aims to support the government agenda on national development, such as infrastructure development. The geospatial information (GI) development activities carried out in this OMP consists of 3 phases, namely compilation, integration and synchronization. The achievement target of each phases is set out on the action plan. The 85 TGI targeted can be divided into TGI Status, TGI Spatial Planning and TGI Potential. TGI Status is TGI that contain legal aspects related to land tenure. TGI Spatial Planning is TGI which contains aspects of spatial utilization and planning. Whereas TGI Potential is TGI which contain information on Transportation and Utilities, Environment and Region.

The TGI compilation and integration activities are intended to solve map geometry problems, while the TGI synchronization phase is intended for resolving the overlapping or conflict between land usages. BIG is responsible for handling mapping problem related to map geometry in cooperation with related ministries/agencies which is incorporated in TGI Working Group (Satgas-1). Meanwhile, the Ministry of Coordinating Economy is responsible for resolving spatial conflicts by involving related ministries/agencies that act as the TGI custodian (Satgas-2). Solution on spatial use conflicts will be formulated based on agreement among ministries/agencies. The TGI synchronizing process will be hierarchically based on the type and degree of the conflicts to be addressed from the policy makers from echelon 2, echelon 1, minister, to the president. The ministries and agencies also urge to allocate sufficient budget necessary to fulfil their responsibility to the implementation of OMP in their own institutions.

3. Methods
3.1. Approach to Develop MGI One Map
The approach on development of one map of the coastal and marine thematic maps (MGI) was summarized in Figure 1 below. The process of one map development started with coordination among stakeholders. The stakeholders included ministries/ agencies which were responsible for particular TGI(s) or refer as the custodians and other ministries/agencies, NGO and other parties that also required the TGI(s). Those stakeholders then form a working group to accommodate discussion on technical and administration substance subjected to the development of the TGI. The technical substance included standard of integrated one map as well as classification and database standard of the one maps.

Figure 1. Approach of one map development process.

The next step was data compilation process. In this step, the thematic maps were collected from the ministries/agencies to be compiled and verified. After that, all the thematic maps in a shapefile or
geodatabase file format were integrated to the national basemap produced by BIG which uses Indonesia Geospatial Reference System (SRGI). SRGI is an Indonesian coordinate reference system which was consistent and compatible with the global coordinate. Meanwhile, the national basemap consisted of Indonesia Topography map (RBI), National Marine Environment map (LLN), and Indonesian Coastal Environment map (LPI). Those basemaps were produced by BIG. In the data integration process, all of the topological errors of the thematic maps were corrected and the file formats were standardized into the format of ArcGIS geodatabase. In case topological errors of the thematic maps found, the topological errors were evaluated and necessary corrections were performed until the topological errors were cleaned. These data integration processes resulted one map for each thematic map as the main product of OMP, which was ready to be synchronized. The data synchronization was to harmonize among the status thematic maps. This synchronization process was the toughest process because this process was heavily in policy negotiation rather than technical mapping. In this paper, the data synchronization process was not elaborated.

4. Results and Discussion

4.1. Data availability

Most of the coastal and marine thematic maps (MGI) are not yet included in the targeted one map in the action plan of the Presidential Regulation Number 9/2016 about the Acceleration of One Map Policy. However, the provision of the MGI must follow the principle and process of the one map development. The availability of MGI resulted from several projects that had been done in the past. Among the projects dedicated for providing the MGI are Digital Marine Resource Mapping (DMRM) (1996 - 1999), Marine Resource and Evaluation and Planning (MREP) (1993-1998) and Marine and Coastal Resource Management (MCRM) (2001-2006) projects. Those projects implemented by the National Coordination Agency for Surveys and Mapping (BAKOSURTANAL) – now BIG. The implementation of the MCRM project then was conducted in collaboration with the Ministry of Marine Affairs and Fisheries (MoMAF), following the establishment of this ministry in 2000. In addition, there is also Coral Reef Rehabilitation and Management Program (COREMAP) for monitoring condition of coral reef and related benthic habitat. Besides that, BAKOSURTANAL and now BIG has continuously work on the provision of basemap and thematic map of coastal and marine geospatial data.

The data produced from those projects mentioned above varied in scale, theme and conditions. The available MGI in the form of basemap are Maritime Boundary, LLN, and LPI. The Maritime Boundary map form the national boundary in adjacent to other countries form the territory of Indonesia. Most of the maritime boundaries are already settled down but some are still in negotiations. Indonesia border at the sea with 10 neighboring countries, namely Malaysia, Thailand, Vietnam, Singapore, Australia, the Philippines, India, Republic of Palau, Democratic Republic of Timor-Leste and Papua New Guinea. Some of the boundary delimitations are already definite but some still in progress of negotiation.

The LPI and LLN maps provide information specifically for coastal and marine areas, especially bathymetry, coastal types (sandy, muddy, or rocky), as well as other basic information related to navigation and administration in the marine areas. The difference between LLN and LPI maps is at the portion of the land and water area to be mapped in each map sheets. In general, the LLN map cover mostly the water area, while the LPI map cover the coastal area with land portion up to 40% of the map sheet area. The LLN map is available at the scale of 1: 500,000, 1: 250,000 and 1: 50,000, with coverage of 100%, 6.67% and 4.84% respectively. Meanwhile, the LPI map is available at the scale of 1: 250,000, 1: 50,000, 1: 25,000 and 1: 10,000, with coverage of 74.06%, 49.52%, 2.37%, and 0.33% respectively. The map index of LLN and LPI can be seen in Figure 2 and Figure 3.
In contrast to the basemap that provide only by BIG, the thematic maps are provided by many institutions. There are several working groups of thematic one map that work together to provide the national coastal and marine resources geospatial data. The thematic maps and the contributor institutions are listed in Table 1.

4.2. Data integration

Data integration is another important part of the one map development including the one map of coastal and marine resources. Data integration ensures thematic map has single reference which is the basemap produced by BIG. Therefore, all thematic maps compiled from Ministries/Agencies must be verified by BIG. The data integration is the responsible of the respected Ministries/Agencies (the Custodianship), even though the members of Working Group of the thematic map shall participate during the integration process. The process of data integration also includes verification and integration of the database so the thematic maps follow the standard database rule. This is important for data sharing and data utilization.
Table 1. List of thematic maps and the contributor institutions.

| Thematic Map         | Source of Data                                      |
|----------------------|-----------------------------------------------------|
| 1. Mangroves         | KLHK, BIG, KKP, LAPAN, Wetland International        |
| 2. Coral reef        | LIPI, BIG, KLHK, LAPAN, KKP, TNC                    |
| 3. Seagrass          | LIPI, BIG, KLHK, KKP, LAPAN                         |
| 4. Oceanography      | ESDM, BIG, KKP, BPPT, LIPI                         |
| 5. Seabed cover      | ESDM                                                |
| 6. Salt pond         | BIG, KKP                                            |
| 7. Sea lane          | Kemenhub, Pushidrosal                               |
| 8. Seismic           | ESDM and BIG                                        |
| 9. Tides             | BIG, Pushidrosal, BMKG                              |
| 10. Marine Ecoregion | KKP, KLHK, BIG, LAPAN, Wetland International        |

Abbreviation:
- BIG: Geospatial Information Agency
- BMKG: Bureau of Meteorology and Geophysics
- KKP: Ministry of Marine Affairs and Fisheries
- KLHK: Ministry of Environment and Forestry
- ESDM: Ministry of Energy and Mineral Resource
- Kemenhub: Ministry of Transportation
- LIPI: Indonesian Science Institute
- LAPAN: Indonesian Aerospace Agency
- Pushidrosal: The Navy Hydrographic Survey
- TNC: The Nature Conservancy

4.3. One map product development

The availability of coastal and marine thematic maps in Indonesia is already stated previously in Section 3.1. However, some of the thematic maps do not pass the one map criteria since those spatial data has yet fulfill the standard of one map. Among the MGI that already satisfy the one map standard are one map mangroves, coral reef, and seagrass. The mangroves mapping in Indonesia have been conducted by several institutions and NGO (Wetland International Indonesia). The mangroves mapping that has been conducted nationally started by BAKOSURTANAL using Landsat satellite imageries in 2009. Based on this mapping, the mangroves was estimated for 3,244,018.46 hectares [15]. This mangroves mapping is continuously updated by using remote sensing approach on the mapping process. Field work has been done supplementary to validate the mangroves mapping. Following the advancement of remote sensing technology and the availability of satellite imageries, the mangroves mapping continuously updated using better resolution of satellite imageries. Some areas have been mapped using high resolution satellite imageries (HRSI) such as Quickbird, GeoEye, WorldView, and Pleiades for Java and Bali islands. The mangroves mapping carried out by BAKOSURTANAL/BIG in coordination and cooperation with respected ministries and institutions such as the Ministry of Environment and Forestry, MoMAF, LAPAN, LIPI, and the Wetland International Indonesia. Those institution are among the institution that form the National Working Group of Mangroves. The custodian of one map mangroves is the Ministry of Environment and Forestry. Figure 4 shows the development of one map of Mangroves Indonesia, the scale and main source of satellite data used for the mapping.

One map of coral reef and one map seagrass are the other MGI product. The custodian of one map coral reef in Indonesia is LIPI. The coral reef map has been carried out by BAKOSURTANAL/BIG and MoMAF through MREP and MCRM projects, and by LIPI though COREMAP project. The mapping also conducted by NGO such as TNC. All of the coral reef and seagrass data have been compiled and integrated by BIG. Currently, BIG is conducting coral reef and seagrass mapping in the province of Maluku and Maluku Utara, as well as at some areas in the islands of Sumatra region. Meanwhile, LIPI
designated several stations for coral reef monitoring. Figure 5 and Figure 6 shows the one map coral reef and seagrass Indonesia.

**Figure 4.** One Map Mangroves Indonesia and the development (source: compiled by authors from BIG thematic map database, 2017).

**Figure 5.** One Map Coral Reef Indonesia (source: compiled by authors from BIG thematic map database, 2017).
The other coastal and marine geospatial data that already compiled and integrated to the basemap are oceanography (water quality), salt pond, and sea-lane, and seabed-cover maps that are used as input for the development of Coastal and Small Island Zonation Plan (RZWP3K). The oceanographic water quality data collected consisted of brightness, depth, temperature, conductivity, turbidity, salinity, Dissolve Oxygen (O), and potential of hydrogen (pH). The oceanographic data represented in point, with attribute of time and date of the data measurement. Meanwhile, the mapping of Salt Pond was carried out by BAKOSURTANAL/BIG between 2010 and 2014 to support one of the MoMAF program which was the “salt-farmer empowerment program” or known as PUGAR to achieve self-sufficiently of domestic salt consumption. Besides that, this map also used to calculate potential production of salt, so that the government can predict the amount of imported salt to meet the domestic consumption needs. High resolution spatial imageries were used for the mapping. Some areas in Java were mapped in a parcel base completed with “by name by address” attributes. The Sea-lane map provided by the Ministry of Transportation, whereas the Seabed-cover map provided by the Centre for Marine Geological Research, the Ministry of Energy and Mineral Resources. The Seabed-cover map shows information about marine sediment exist at the seafloor. There are four basic types of marine sediments, all of which are grouped and ordered by the origin of their particles, the grain sizes, and where they are deposited. The area has been map covering 228 sheet maps in scale of 1:250,000.

All of the one map products mentioned above were developed by considering scientific aspects of geospatial information development which are useful for developing RZWP3K.

5. Conclusion
There are several points that can be underlined regarding the development of one map of Marine Geospatial Information (MGI) in Indonesia. First, the implementation of One Map Policy (OMP) is important to standardize the marine resources data to provide accurate, accessible, and accountable geospatial data. Second, the products of one map marine resources that have been developed are useful for integrated spatial planning. Therefore, stakeholders related to the coastal and marine spatial planning development could start to develop RZWP3K map on the basis of one map policy. It is also understood that the implementation of One Map Policy requires strong coordination and collaboration among stakeholders. Advancement on spatial information technology would facilitate improvement on data quality and data sharing. Development of One map marine resources require improvement of Geospatial Information human resources.
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