Chapter

Strengthening Democracy in Indonesian Marine Spatial Planning through Open Spatial Data

Adipandang Yudono and Permana Yudiarso

Abstract

Sea and coastal areas are locations that have enormous potential that can contribute greatly to the national economic growth. The potential of marine and coastal areas includes the potential of fisheries. Fish life in shallow water or estuary is relevant to the existence of seagrass beds as their habitat. Seagrass in coastal waters is one of the attractions of fish for reproduction (spawning ground), fish growth place (nursery ground) and feeding ground. Good management requires a well-structured plan that takes into account geographical conditions and the sustainability of the plan in the future for the role of marine spatial planning. Marine spatial planning is a spatial guidance to manage well coastal and ocean areas with more integration and sustainability through identifying and mapping all marine issues. One method of mapping issues in marine spatial planning is open spatial data. The coherence and synergy of spatial planning can be achieved through dialogue between the elites and the public. A solution to bridge political communication between the elite and the public is open spatial data. In this context, the technicalities of open spatial data are important factors for achieving consensus. Relevant non-technical issues, such as data management, human resources and leadership factors are critical points for this potential open spatial data.

Keywords: seagrass, fishing areas, coastal conflicts, marine spatial planning, open spatial data

1. Introduction

The aim of this study is to explore the model of open spatial data between communities and official government to meet bottom-up and top-down approaches in achieving consensus of marine spatial planning for strengthening democracy and sustainability, particularly in social pillar. The social problem between local coastal communities and coastal developers gives attention for the sustainability of coastal and marine resources. Discussions were held in the neighborhood until it was agreed to do an open spatial data by all coastal communities who still maintain the local traditional culture with technical assistance from the Indonesian Ministry of Maritime Affairs and Fisheries. An agreement was reached from the preparation of spatial data as to how the community then utilized the spatial information for the purpose of protecting and managing coastal and marine resources in Indonesia.

Managing sustainability of marine and coastal resources, it is recognized that the crucial process in open spatial data is a change in the way people think about the use of natural resources, so that they are not damaged and depleted. The people who initially thought that marine resources were not their property finally realized that in fact they had allowed the destruction process because they have not exercised control when there were parties who used it excessively, such as investors who develop coastal areas for massive business activities. The development of local knowledge led the community to try to organize themselves by forming groups which were then used as a part of essential actor for negotiating and mapping the use of coastal areas through a legal context in the form of Indonesian marine spatial planning.

2. Marine spatial planning applied to seagrass management

Seagrasses thrive in aquatic ecosystem, especially in open tidal areas and coastal waters or lagoon that are basically mud, sand, gravel, and dead coral faults, with a depth of 4 meters. Seagrass beds are formed on the seabed which is still penetrated by enough sunlight for growth [1]. In the world, there are estimated 55 species of seagrass, 12 of which are found in Indonesia. Almost all substrates can be overgrown with seagrass, ranging from muddy to rocky substrates. But extensive seagrass beds are more often found in thick sandy-mud substrates between mangrove swamp forests and coral reefs [2]. Some species such as *Thalassia testudinum* can grow rapidly, with a leaf growth rate of 2 cm per day.

Coastal water seagrass habitats are of critical importance to many factors in the life cycle of fish such as spawning ground, nursery grounds, and feeding grounds. The costal living organisms that live in association with physical coastal and marine environment include baronang fish (*Siganus sp.*), groupers, green turtles, dugong, crustaceans, mollusks (*Pinna sp., Lambis sp., Strombus sp.*), Echinodermata (*Holothuria sp., Synapta sp., Diadema sp., Archanster sp., Linckia sp.*), and sea worms (*Polychaeta*). Therefore, waters that have seagrass beds are productive fishery regions, where many methods can be employed, such as net sets, lift nets, clam collectors, and seaweed collectors.

The existence of seagrass beds makes the location of fish life relevant to the fishing area at the marine spatial planning areas. The utilization of Indonesian marine fish resources in various regions is uneven. In some territorial waters, there are still big opportunities for underexploited development, while in some other areas, it has reached overfishing conditions. The division of fishing areas between small- and medium-scale fisheries has not been well implemented. Fishing pressure is common in coastal areas where small- and medium-sized fishermen carry out fishing activities at the same time.

The main problem faced in an effort to optimize fishing is the very limited data and information regarding oceanographic conditions that are closely related to potential fishing areas. The Indonesian fishing fleet is dominated by small-scale community fishing fleets, while the number of fishermen from year to year shows significantly increasing numbers. The fleet of fishers departs from the base not to catch but to find fishing locations so that it is always in an uncertainty about the potential location for fishing, so the catch is also uncertain. Besides that, as a result of the uncertainty of fishing locations, fishing vessels spend a lot of time and fuel searching for fishing ground locations, and this means there is a waste of fuel.

3. Seagrass distribution in Indonesia

Seagrass ecosystems are dynamic, where conditions are not always the same at all times. Changes in environmental conditions can affect the growth of seagrass, having increased or decreased numbers, so that the area of seagrass in a location can change at any time. Information on the area of seagrass can provide an indication of overall seagrass status. If there is a highly damaged physical ocean condition, this shows the pressure or threat to the ecosystem. Conversely, if the area is stable or rising, this shows the high chance of seagrass to be sustainable. Calculation of seagrass area is done in two ways. First, step by conducted remote sensing analysis using Landsat ETM + satellite images, Landsat 8 OLI, SPOT-5 that have

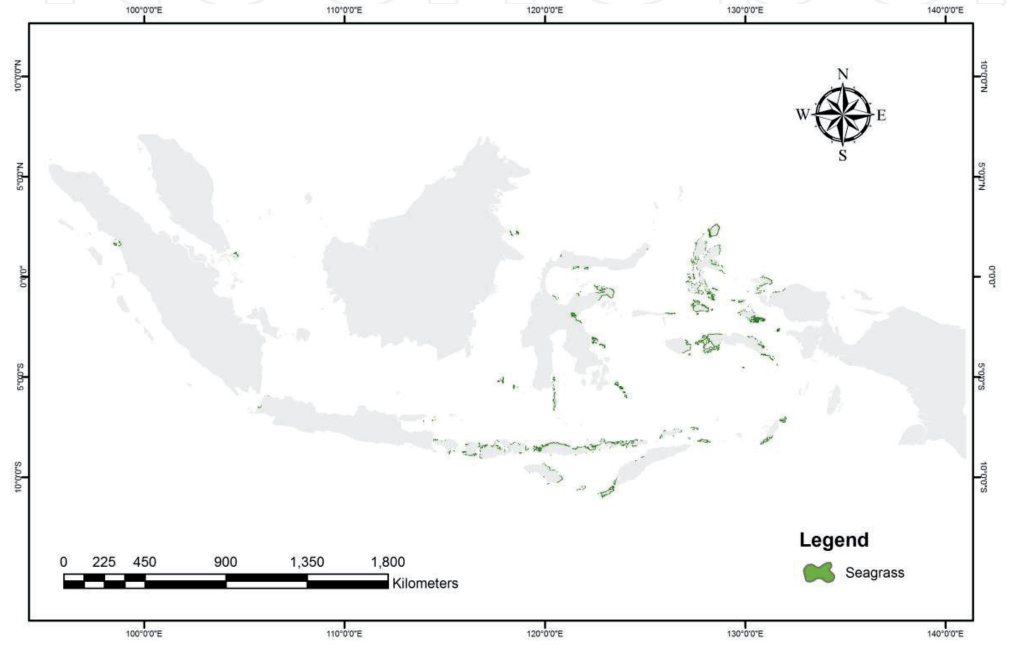

Figure 1.
Seagrass distribution in Indonesia.

Species	Number of locations to be found (out of 423)
Enhalus acoroides	357
Thalassia hemprichii	371
Cymodocea rotundata	311
Cymodocea serrulata	141
Halodule pinifolia	85
Halodule uninervis	201
Halophila ovalis	247
Halophila minor	21
Halophila spinulosa	3
Halophila decipiens	2
Thalassodendron ciliatum	37
Syringodium isoetifolium	200

Table 1.
Seagrass species in Indonesia.

been verified on the ground (ground truth) of 22 seagrass monitoring locations in Indonesia. Secondly, collecting seagrass area data generated from mapping activities is carried out by various agencies such as the Indonesian Geospatial Information Agency (BIG), Ministry of Maritime Affairs and Fisheries (KKP), and also The Nature Conservancy [3]. The analysis shows that the area of Indonesian seagrass is 150,693.16 ha. In Western Indonesia, the area of seagrass calculated is 4409.48 ha, while in the eastern part of Indonesia, it is 146,283.68 ha (See **Figure 1**) [3].

In general, *Enhalus acoroides* and *Thalassia hemprichii* are types of seagrass that are often found in Indonesian waters. From the information gathered from 423 locations, it was found that *Thalassia hemprichii* had a wider distribution, *T. hemprichii* was found in 371 locations, while *Enhalus acoroides* was found in 357 locations (See **Table 1**) [3].

4. Threats to seagrass habitats in Indonesia and the world

The main problems affecting seagrass ecosystems throughout the world are due to continuous dredging and stockpiling activities and water pollution including salt waste disposal from desalinization activities and oil production facilities, the inclusion of pollution around industrial facilities, and waste hot water from a power plant. Until now the world's seagrass damage has reached 58%, and since 1980 every 30 minutes, the world lost seagrass the size of a soccer field [4, 5]. Furthermore, the distribution of global seagrasses has been lost by about 29% since the nineteenth century [6]. The main cause of the loss of seagrass globally is a decrease in water brightness, both due to increased turbidity of the water and increased input of nutrients to the waters. In temperate regions, the loss of seagrass is caused by the conversion of coastal areas into industrial estates, settlements, and flooding from the mainland. Meanwhile, the main cause of the loss of seagrass beds in the tropics is an increase in sediment input into coastal waters due to logging on land and logging of coastal mangroves that coincide with the direct influence of fishery cultivation activities.

The widespread decline of seagrass beds in Indonesia can be caused by natural factors and the results of human activities, especially in coastal environments. Natural factors include strong waves and currents, storms, earthquakes, and tsunamis. Meanwhile, human activities that contribute to the decline of seagrass areas are coastal reclamation, sand dredging and mining, and pollution. For example, seagrass cover on Pari Island (Thousand Islands) has been reduced by 25% from 1999 to 2004 allegedly due to rampant development on the island [3].

5. Achieving consensus to diminish natural coastal conflict management through marine spatial planning

Sea and coastal areas are locations that have enormous potential that can contribute greatly to the national economy. The potential of marine and coastal areas include the potential of fisheries, the potential of environmental services, the potential of marine energy, and the potential of mining. This potential must be managed well in an integrated and sustainable manner. Good management requires a well-structured plan that takes into account geographical conditions and the sustainability of the plan in the future.

Preparation of marine spatial plans and small islands is a crucial point to achieve optimal management of marine and coastal areas. An integrated spatial plan between land and sea, which does not only consider ecological and environmental aspects, should also be implemented in the planned area, in accordance with Law No. 26 of 2007 concerning Spatial Planning and Law No. 1 of 2014 concerning Management of Coastal Areas and Small Islands.

Environmental balance aspects that will be influenced by the physical construction activities in the sea and coastal areas need a study in the activities of the preparation of the intended spatial plan, so that activities can run in a harmonious and sustainable manner. Thus the spatial planning for the sea and coastal areas to be compiled should implement an integrated spatial plan between the sea area and its land area as well as accommodate the aspirations of the community from the planning and utilization to control processes.

Marine spatial planning has a crucial policy for solving spatial use conflicts, namely, by identifying and mapping all uses, regulations, and conflicts that occur [7]. Initially, conflicts occurred in the ecological aspects, then toward social conflict, and finally toward economic conflict [8, 9]. The conflict mapping is a technique used to describe graphically, connecting parties to problems and with other parties. One method of mapping this conflict under open spatial data context is a participatory mapping from local coastal communities.

6. Aquatic ecosystem management through participatory mapping in marine spatial planning context

Updating marine data and information can be done by involving communities who live in coastal and marine habitats through participatory mapping. To examine in detail the role of participatory mapping as a tool of negotiation between the community and the government, the author will explore the journey of participatory mapping in general and its application in Indonesia.

Participatory mapping was initiated from participatory research that was created in the 1960s with the rise of social oppression due to the Second World War triggered in Europe. Furthermore, the emergence of Marxist influences in overcoming the entry of the problem of social justice in the social sciences in the 1970s triggered the development of marginal community-based research methods. One of the innovations in the social research method was participatory mapping initiated by Freire to bridge dialog between elites and citizens in alleviating the problems of marginal communities [10].

Society as an actor who directly receives the results of spatial planning determined by the government has a role to participate in the spatial planning process in various forms, one of which is the provision of spatial information. In Indonesia, the provision of spatial information has been regulated under Law No. 4 of 2011 of The Indonesian Geospatial Information, article 23, paragraphs 1 and 4, and Law No. 26 of 2007 of The Indonesian Spatial Planning, article 65, that spatial planning provides opportunities to the community with a participatory-based approach in the procurement of spatial data and information to achieve spatial planning consensus.

There have been many manuscripts published by geospatial and spatial planning scholars regarding community management based on spatial data and information for planning and management purposes [11–14]. In general, based on the political elite point of view, the government is greatly assisted in making decisions related to spatial planning as a valuable input in creating harmonization of the development agenda of the government with the needs of affected communities from planning.

Participatory mapping in Indonesia was initiated by nongovernmental organizations (NGOs) with indigenous peoples to advocate spatial planning to protect their land ownership from land development by investors for commercial activities that often receive support from the government, such as establishing oil palm plantations. In this spatial planning advocacy, the role of participatory mapping has a crucial point to provide input to the government and investors on the land ownership belonging to indigenous peoples.

Participatory mapping activities relevant to spatial planning activities in Indonesia can be identified in two parts:

1. Mapping management activities for inter-ethnic advocacy zones.

2. Mapping the activities of advocacy zones management among indigenous or rural communities on the development agenda of the government.

Participatory mapping activities related to advocacy zoning mapping can be taken as an example in the case of Pahawang Island (see **Figure 2**). Here, the local community is mapping the area to create a consensus between traditional fishermen and modern fishermen in fishing arrangements. The result of this participatory mapping is that an agreement is reached between the two groups of fishermen who are only allowed to catch fish using conventional methods (e.g., using fish hooks) and do not use equipment that can disrupt massive fish ecosystems, such as the use of trawls, bombs, and potassium cyanide [15].

The impact of participatory method that carried out by traditional fishermen groups, who always using traditional equipments for fishing advocacy, with modern fishermen groups, who usually the equipments that can disrupt massive fish ecosystems, achieved the consensus to use only traditional fishing equipment was the number of fish around Pahawang Island increases and traditional fishermen can continue fishing. Furthermore, participatory mapping by traditional fishing communities on Pahawang Island has encouraged the government to establish a legal basis through the establishment of a basic map of fishing zones in the form of village regulations.

Another example of seagrass mapping project in Indonesia is Dugong and Seagrass Conservation Project (DSCP) granted by GEF, UNEP, and Mohamed bin Zayed Species Conservation Fund, 2016–2018. Dugong (*Dugong dugon*) and

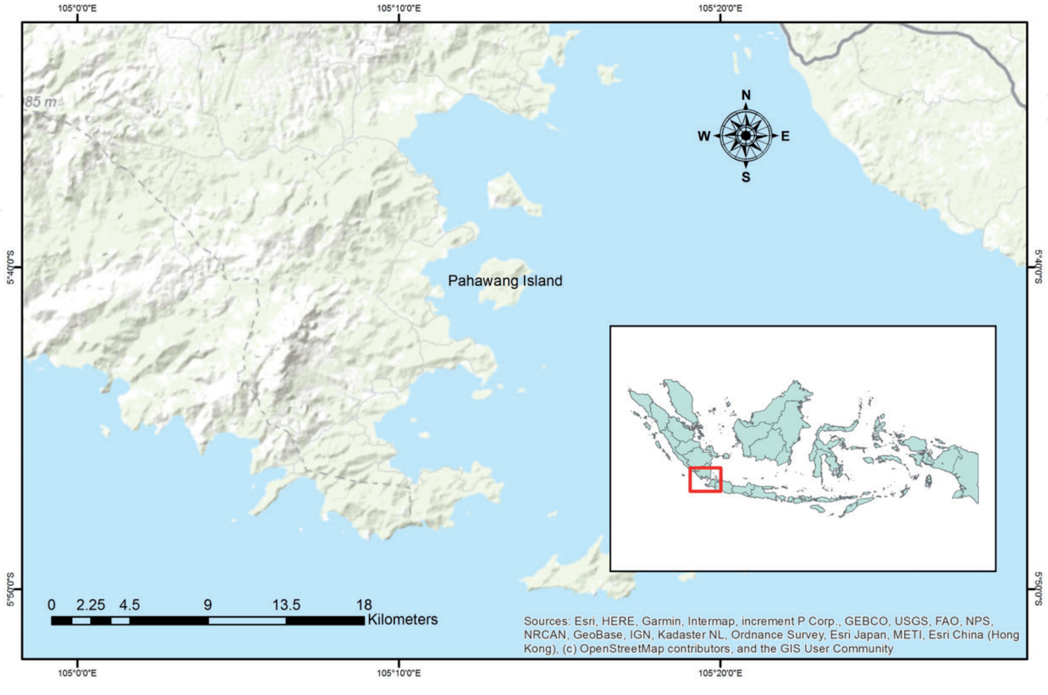

Figure 2.
Pahawang Island in Indonesia.

seagrass are the main issue where the threat to seagrass ecosystem can affect dugong. The project is set up in four locations, namely, Bintan-Riau Archipelago, Kotawaringin Barat-Central Kalimantan, Alor-East Nusa Tenggara, and Toli-Toli, Central Sulawesi, where the population and habitat mapping are developed. One of the goals is a community-based conservation and management.

Participatory mapping activities in inventorying natural resources in the areas where indigenous peoples live have created local spatial knowledge in identifying the types of natural resources. According to Sabu [16], the implementation of participatory mapping in Indonesia has opened the insights of indigenous people in the management of natural resources that exist in their regions into four aspects, including political, social, economic, and cultural aspects.

- Political aspects

Participatory mapping provides basic territorial information as a tool for communicating and negotiating between parties (communities, governments, and entrepreneurs) who have an interest in particular areas in achieving territory management consensus [16].

- Social aspects

Participatory mapping activities open up the insights of indigenous people in managing natural resources in their homes through:

  - Local spatial knowledge about the identification of natural resources and threats faced in the area of residence
  - Identifying communities involved in managing resources in the homes of indigenous peoples
  - Contributing to create solidarity between indigenous peoples [16].

- Economic aspects.

Participatory mapping helps to identify valuable local natural resources, so as to create a sustainable fulfillment of the daily needs of indigenous peoples' living environments [16].

- Cultural aspects

Participatory mapping can create local wisdom to identify, preserve, and develop traditional customs and habits in area management inherited from indigenous ancestors. Examples of areas that have religious purposes can be planted with plants that have a symbolic value, such as banyan trees [16].

7. The strategies of open spatial data alliances in the context of marine spatial planning

Studies conducted by scholars in the management of geospatial information show that open spatial data alliances are closely related to transparent and open institutional governance and organizational behavior [17–20]. Specifically, Budhathoki and Nedovic-Budic argue that the main factor in creating an atmosphere of spatial data and information sharing within and between institutions is the existence of collaboration-cooperation-coordination (3C) [21]. To examine in more detail about this 3C, in this section a broader concept of 3C will explore relevant open spatial data.

- Collaboration

In the 3C concept, collaboration is the first step toward creating transparency and openness between institutions to share in realizing shared goals, which in general is an improvement in the quality of institutions. Colleagues involved in collaboration must trust and respect each other in correspondence and open readiness to acknowledge the information provided [22, 23]. (Characteristics of collaboration and relations with cooperation and coordination can be seen in **Figure 3**).

As the first step toward creating openness conditions, collaboration has not guaranteed any commitment or responsibility for an individual, association, or foundation. In general, this collaboration does not yet have full legal force if disputes/problems occur in the future. Relevant to the context of this research, collaboration between organizations that produce and manage spatial data and information initiates the creation of willingness for each institution to share their knowledge and assets in order to achieve the common goal of achieving national welfare.

- Cooperation

Cooperation is the second stage in the 3C concept in order to create mutually beneficial relationships between the institutions involved. At this stage, the formed partnership already has a legal basis, in the form of a memorandum of understanding (MoU), to share capabilities, skills, knowledge, and assets to achieve common goals [24].

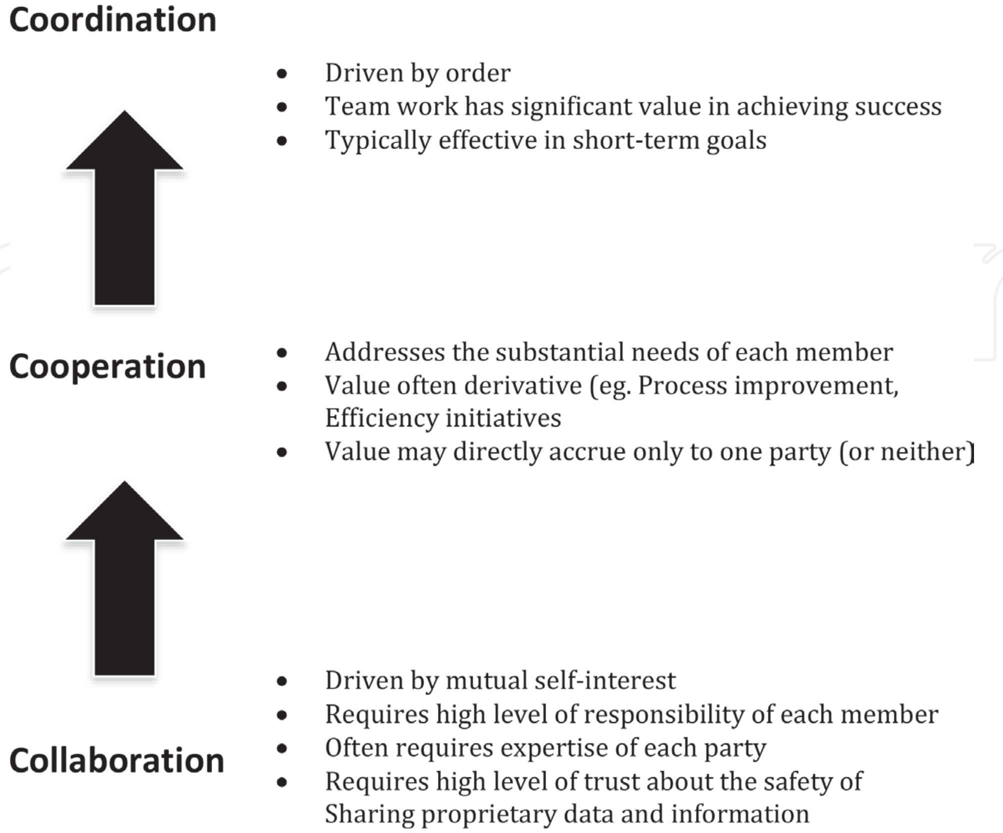

Figure 3.
Characteristics of collaboration-cooperation-coordination (3C) and the relationship of 3C elements.

The relevance of the concept of cooperation in this research is the collaboration between institutions in producing and managing spatial data and information on the coastal areas in order to create a commitment to safeguard the unity and sovereignty of the state through coherent marine governance in various levels. (Characteristics of collaboration and relations with cooperation and coordination can be seen in **Figure 3**).

- Coordination

In the 3C concept, coordination has the highest level of partnership between institutions. At this stage, between institutions, they have understood the interdependence between responsibilities and coordinated their respective tasks [25]. Coordination ensures that all units, divisions, and parts of an institution recognize their targets to be achieved. At this stage, all individuals must be well organized in ensuring that the institution's great goals can be achieved by implementing agreed commitments. (Characteristics of collaboration and relationships with collaboration and coordination can be seen in **Figure 3**).

In the context of this research, coordination between institutions in producing and managing spatial data and information is able to integrate, synchronize, and carry out tasks in a sustainable manner to realize the strengthening of safeguarding state unity and sovereignty through effective and efficient marine governance.

8. The proposed model of open spatial data in the context of marine spatial planning

Strengthening democracy in marine spatial planning, including general spatial planning context, can be done through open spatial data between actors, both between communities and between elites, as well as from the community/public to elites and vice versa. Based on the arguments given in the previous subsection, the researchers propose a model of open spatial data between public and elites.

The form of democracy in the context of marine spatial planning is carried out through active communication between the government and public, especially the coastal communities. In determining the level of communication activities by both parties, this model refers to the model of Arnstein's participation [26] and the model of the level of participation and public involvement in government science projects from Haklay [14]. The purpose of this model proposal is to identify the level of public participation in the government in creating collaboration, cooperation, and coordination to share spatial data and information on marine spatial planning, including general spatial planning context. (See **Figure 4**).

- Level 1: taken for granted

At this stage, political communication between public and elites regarding the planning agenda and development agenda has not been achieved. In terms of the people who live in affected areas, planning is passive, that is, just accepting the agenda set by the government, whereas from the government perspective, it is assumed that the community does not need to be involved in the planning process, so that the government has full authority for the direction of planning in the targeted area.

- Level 2: information sharing

At this stage, collaboration between public and elites has taken place. People who live in areas affected by planning from the government take the initiative to provide

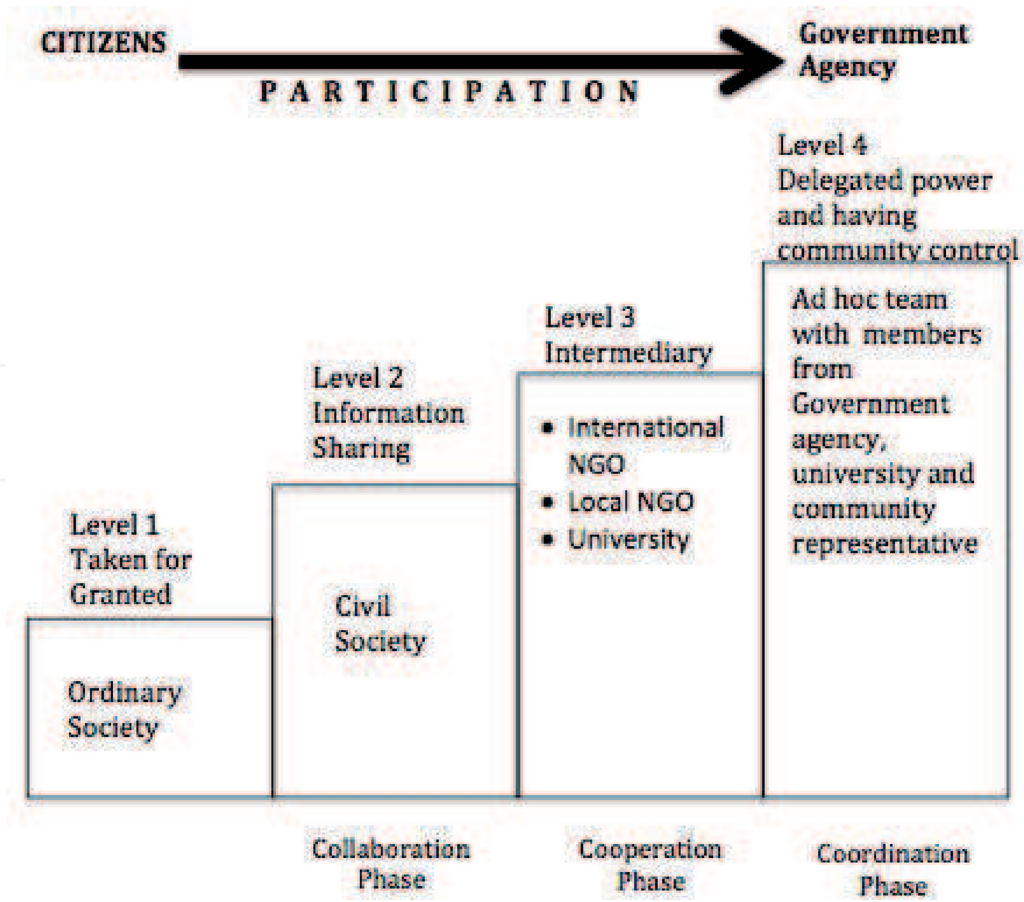

Figure 4.
A stepped model for community participation in government agency agendas.

up-to-date information on issues and problems in their neighborhoods to be submitted to the government. Providing information is delivered through public hearings or delivered online on applications that have been built in several areas. One of the public hearings is participatory mapping as a form of open spatial data from the public to the government. While from the government's point of view, they began to accept public input to harmonize the planning and development agenda that had been made.

- Level 3: intermediary

At this stage, the partnership that exists between public and elites has shifted from a form of collaboration to cooperation through the role of a neutral intermediary in bridging input from the community and ideas from the government. The planning process from the government to the community sometimes gets a deadlock. Thus, this situation requires a facilitator who can bridge political communication in planning, in which an intermediary actor is generally chosen based on a credible reputation that is trusted by both parties, for example, academics.

In the context of open spatial data, the provision of spatial data in the form of participatory mapping from public to elites sometimes does not meet the standards set by the government. This complicates and confuses the government, so that intermediaries from professionals or academics are able to transform spatial ideas from the public into standard formats from the government so that it can be conveyed.

- Level 4: delegated power and having community control

At this highest stage, the form of public-elite partnership has achieved coordination. At this level, there is a representation of the community affected by the planning target to be part of an ad hoc team together with intermediaries, namely, academics in formulating a joint planning agenda for the realization of a harmonious life in accordance with community input and government programs. For the context of open spatial data both from the coastal community and the government, it has been realized very well without anything being covered up. In other words, transparency and openness of spatial data are guaranteed and reliable.

Overall, the proposed open spatial data in a nontechnical organization is strongly influenced by a willingness to change and transform to be more open. It requires the active participation of public and elites to collaborate, cooperate, and coordinate.

9. Conclusion

The study of open spatial data in government institutions cannot be separated from open data application in which the system of government agencies, which are concerned about public service interests, are willing to publicly share their data and information. This provides explanation and transparency of government performance in terms of the implementation of development and planning agendas.

This study has assessed potential spatial data integration between official spatial data and crowdsourced geographic information, which predominantly look from nontechnical perspectives. The nontechnical appraisal demonstrates that the integration of participatory mapping into official spatial data and information requires extensive rebuilding of data management, particularly human resources, policy, and organizational factors, which have a significant impact on geographical information utilization in government agencies and integration with participatory mapping products.

The coherence and synergy of spatial planning can be achieved through dialog between the elites and the public. A solution to bridge political communication between the elite and the public is open spatial data. By this, the technicalities of open spatial data are important factors to achieve consensus. Relevant nontechnical issues, such as data management, human resources, and leadership factors are critical points for this potential open spatial data.

The findings of this research attempt to make a significant contribution to knowledge in bringing together the management of official spatial and crowdsourced geographic information in planning practice. Official spatial data and crowdsourcing geographic information integration will require extensive rebuilding of spatial data streams and institutional plans. The official spatial data and crowdsourcing geographic information integration approach present spatial data streams, which are genuinely two-way and include plans of action. It enhances transparency and ease of working in a transparent environment, and it is an important step toward developing a more democratic from spatial planning.

The researcher concluded with an analysis of the management of open spatial data in government agencies at all administration levels and interactive mapping communities among citizens to indicate that the success of open spatial data can be achieved when government agencies can implement collaboration, cooperation, and coordination (3C) and citizens can actively participate in creating and sharing spatial data and information.

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Conflict of interest

I confirm there are no conflicts of interest.

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