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Analysis of Spatial Conflicts : A Model of Coastal Spatial Planning with a Spatial Connectivity Approach

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Abstract

Spatial conflicts seem unavoidable when the uses of coasts are to be managed. Mapping the conflict zones in coastal areas is required so that the conflicts can be properly managed. To do this, it is necessary to create a Model of Coastal Spatial Planning (MCSP) with a spatial connectivity approach. Based on the result of a prospective analysis, the zones which have a strong influence as well as a strong dependence (leverage variables) on the conditions of the coastal environment include static fisheries, seaweed farming, shipping lanes, electrict power plant, oil and gas industry, port and conservation. These zones are strong variables in the system of coastal areas. The zones that have a small influence but have a high dependence on the conditions of the coastal environment of Bontang City are the zones of tourism and coastal border.

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Alternative policies to manage the seven key factors (zones) are: 1) setting static fisheries by first calculating the carrying capacity of the area for fishing activities; 2) setting seaweed farming activities by providing legal certainty through spatial planning for seaweed farming; 3) optimizing the land for the electrict power plant and oil and gas industry zone in the coastal border and conducting a review of the site of the power plant waste disposal by minimizing the impacts it may cause; 4) regulating sea course by establishing shipping lanes for coastal communities; and, 5) preserving the conservation areas in terms of quality and quantity.

Keywords: spatial conflict; conflict; spatial planning; zone; coastal.

1. Introduction

A conflict mapping is a technique that is used to describe conflicts graphically, connecting the parties facing problems with other parties [16,23]. The conflict mapping is part of one of the analyses performed in the study of a Spatial Planning Model of Coastal Areas with a spatial connectivity approach. Coastal spatial planning can be used to manage and minimize spatial conflicts in using coastal areas [14,20,29]. Marine spatial planning is very important to solve the problem of space utilization by identifying and mapping all the uses, regulations and conflicts [23]. The conflicts initially occurring on ecological aspect may lead to social as well as economic conflicts [2,5].

The first stage in the process of drafting the zoning plan of a coastal region is by identifying and mapping its spatial conflicts, which are carried out on various activities (zones) in the borders of coastal areas or near the coastal areas, regardless of their compatibility [13]. The first step to manage coastal areas is to identify all of the uses (multiple sectors) and conflicts as inputs for spatial planning [22]. The planning process can identify and help out the conflicts in the coastal areas, the interaction of human activities, and the cumulative impacts of the activities, primarily in the areas of conflicts among a number of users [14,20,29,23,24]. The spatial planning of coastal areas integrates spatial features and social systems, which can be used to analyze and integrate ecological (natural resources) and socio-economic aspects (human activity) as an attempt to determine efficient strategies for sustainable development and allocate the users of marine resources through a political process for the sake of long-term decision making [14,20,30,15]. One of the important components that should be considered in coastal spatial planning is the process of zoning, which defines and uses zones in accordance with their respective uses [14,20,15]. Combining conflict identification processes in the formulation of the spatial planning of coastal areas is a step to reach a mutual agreement on ecological and socio-economic purposes [10,30,12,25]. The objective of this study is to identify conflicts and map the potential conflicts in adjecent zones. By learning the conflicts, it is expected that in the future applicable policy directions can be made for the regions.

2.. Methodology

2.1. Research Site

The study was conducted in a coastal area of Bontang City in East Kalimantan. Geographically, Bontang lies between 001' N latitude - 0˚12' N latitude and 117˚23' E longitude - 117˚38' E longitude. Bontang City covers area

of 497.57 km^2, dominated by the sea covering an area of 349.77 km^2 (70.30%) while the land is only 147.8 km^2 (29.70%). Bontang is located in the central part of the Province of East Kalimantan. There are various activities in the coastal area of Bontang such as fisheries, oil and gas industry, housing, tourism and conservation, thus putting pressure on the coastal ecosystem of Bontang. The study area is focused on the southern part of Bontang, most of which is still idle, making it easier to conduct spatial planning.

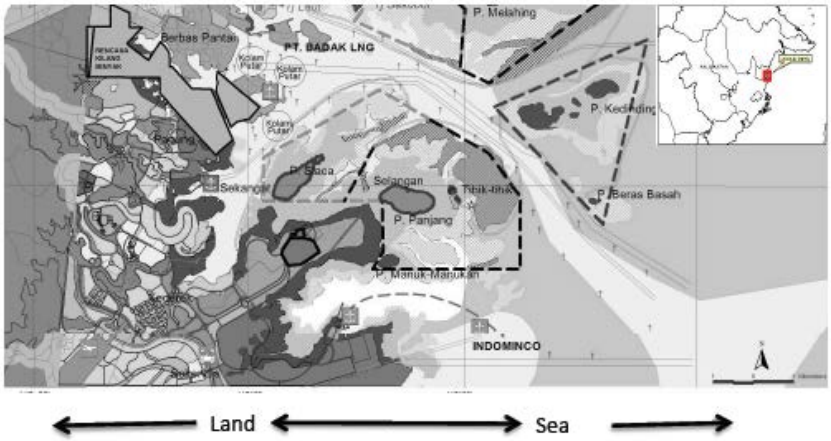

Figure 1: Research Site

2.2. Study Approach

This research approach began by analyzing the suitability of land / spatial allocation based on the data of biogeophysical location, community's existing utilization, and existing utilization policies (such as shipping lanes, conservation and other policies). In order to see the harmony between zones and as an important consideration to formulate appropriate policy directions, it requires the matrix of suitability / linkage between zones. [1, 13]. Zone-related matrix will explain the relationship between the two zones by using a conflict mapping analysis if the zones are adjoining.

This research used primary data and secondary data. The primary data were obtained through two techniques: observation and questionnaires. The observation was directly conducted in the field, while questionnaires were carried out after the respondents had been briefed on the purposes of the questionnaires and ways to answer them [26]. The secondary data were obtained through the study of relevant literature, like the previous studies of similar topics and other related documents.

2.3. Technique of Selecting Respondents

Selection of respondents in this study was carried out intentionally (purposive sampling) by considering their positions and roles in their daily activities. The respondents consisted of coastal community members such as fishermen, fish farmers, boat craftsmen, and those working in the coastal area or on land outside the coast; some respondents who represented the private sector; and the government officials of different levels in the relevant agencies in Bontang [17]. The technique used in this research was the questionnaires with 112 respondents.

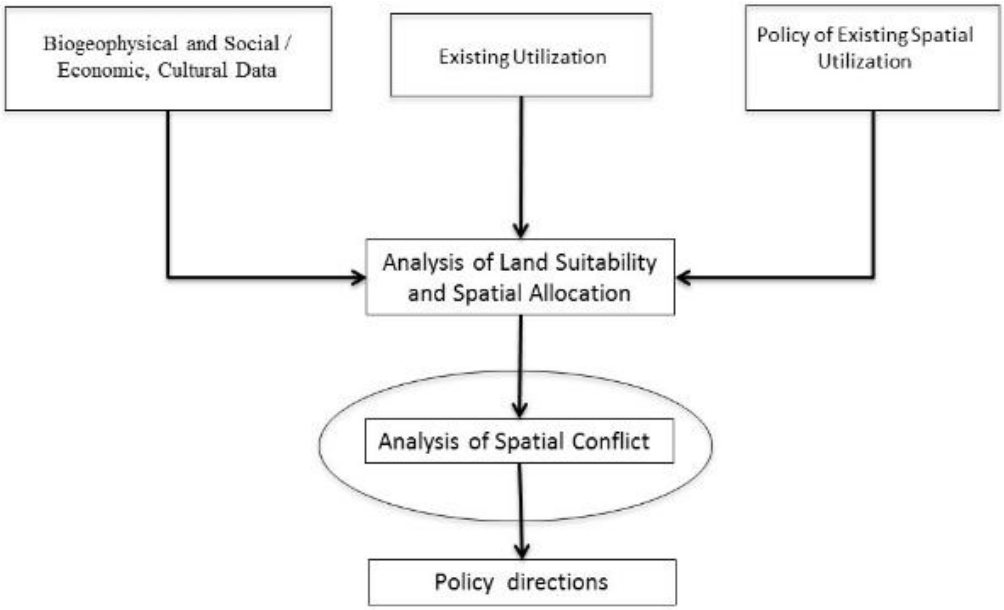

Figure 2: Study Approach

2.4. Technique of Data Analysis

The analysis result of spatial allocation in the process of preparing the zoning of the coastal area was followed by some further analyses, one of which was the analysis of conflict mapping. The mapping was done by identifying conflicts between zones to select the most appropriate zone by making a suitability matrix or linkage matrix between the zones which illustrate the relationship between the zones within a planning area to see the harmonization between the zones [13].

2.4.1. Analysis of Spatial Conflict Mapping

Spatial conflict mapping using a decision-making tool of **Marxan With Zone** as the data input was based on the stakeholder perspective. The opinions of stakeholders represented public and private sector, government and experts. The public and private sector were the main actors that interact directly with the coastal areas, so that their opinions were very important to map the conflict zones. The government, in this case represented by the officials of related agencies, is the policy maker regarding the coastal area zoning. Each stakeholder has a degree of influence on the decision-making process of area management and the high interest of coastal resources, while expert opinions are used as a heuristic tool (in the context of exploration) and as a scientific tool (in the context of justification) [8,5]. The experts are knowledgeable people who participate in the management process, both directly and indirectly [21].

Questionnaires were conducted to obtain the opinions of stakeholders to assess what might occur in the adjacent zones: (a) Mutual support, (b) No influence, or (c) There is a conflict (social, ecological, economic). As for the number of conflicts, there may be one, two or three conflicts.

To lessen the subjectivity of the opinions of the stakeholders on the matrix, the spatial conflict mapping was

assessed based on the weight of each group both public, government / private and experts. Education level, employment status, position / job title and work experience make up the weight of each stakeholder [21,9,32]. The purpose of weighting is to test whether the result obtained from average method is equal or will change when the weights of the stakeholders are included. The following equation is used to calculate the final ranking for each pair [21].

$$x = \frac{1}{S}\sum_{-=1}^{n} w_i\, x_i \qquad (1)$$

$$S = \sum_{i=1}^{n} w_i \qquad (2)$$

$$w_i = (P_I + SP_I) \qquad (3)$$

Equation (1) above shows that x is the aggregate ranking of all respondents, while ***n*** is the number of respondents. ***S*** in equation (2) is the total weight of all stakeholders. x_i is the ranking factor for respondent ***-i***, on the assessment of the status of the relationship between the two adjacent zones. If the status of the relationship between the two zones is mutually supportive, the score is 1 (one); if the status of the relationship between the two zones shows no influence, the score is 3 (three); if the status of the relationship between the two zones could potentially lead to one conflict, whether it is social, ecological and economic, the score is 5 (five); if the status of the relationship between the two zones could potentially lead to two conflicts, the score is 7 (seven); and if the status of the relationship between the two zones could potentially lead to three conflicts, the score is 9 (nine). Meanwhile, w_i is the weight of the respondents which is calculated by equation [3].

Equation (3) is the amount of the weight of each respondent (public, government/private and expert) ***-i*** obtained based on respondent education level and respondent employment status SP_i. The weight value of education level P_i for each respondent can be seen in the table below:

Table 1: Weights of Respondent Education Status

Highest Level of Education (*P*)	**Weight**
Doctorate holder (S3)	2
Master's degree holder (S2)	1.5
Diploma (D1) or Bachelor's degree holder (S1)	1
Elementary School, Junior High or Senior High	0.5

Source: [21].

Meanwhile, SP_i Is the weight of employment status for the respondent ***-i*** (public, government / private and expert). The weight for employment status SP_i is as follows:

Table 2: Weights of Respondent Employment Status

	Stakeholder/Respondent		Weight
Public	**Government/Private**	**Expert**	
Main Job	Dept. Head/Secretary	Experience > 20 yr	2
Side Job	Division Head	Experience 15-10 yr	1.5
Job of not utilizing coastal resources	Section Head	Experience 5-10 yr	1
Unemployed	Staff	Experience < 5 yr	0.5

Source: [21].

2.4.2. Prospective Analysis

A prospective analysis is an analysis that is used to view conflict management directives. Based on the prospective analysis, it will be obtained the information about key fectors and strategic objectives that play a role in policy strategy and various activities in the frontier area as the needs of the actors (stakeholders) involved in the area utilization. Furthermore, the key factors and strategic objectives (needs) will be used to define and describe the strategic directions of relevant policies.

This prospective analysis uses a matrix of the direct influence ratings of two zones if the two zones are adjoining. Generally, there are four kinds of influences when two zones are adjoining: (a) **no influence**, (b) **small influence** (there is only one kind of conflict, be it ecological, economic and social), (c) **medium influence** (there are two kinds of conflicts), and (d) **very strong influence** (there are three kinds of conflicts all at once, with a positive influence between the two zones).

Based on the identification of direct influences between zones within the coastal area, a score of 0-3 was applied on the matrix. According to [9], the influence between the factors used the following scoring system as set by selected experts: (a) 0, if there is no influence, (b) 1, if the influence is small, (c) 2, if influence is medium, and (4) 4, if the influence is very strong. Determining the dominant factors used add-on software of Microsoft Excel that will generate the level of influence and interdependence between the factors in the system with the analysis results as presented in Figure 2.

The analysis results of various factors or variables (**Figure 3**) show that the factors or variables that are on [3].

1. Quadrant I (input), containing the factors that have a strong influence with a less strong level of dependence. The factors in this quadrant are decisive factors or driving variables, which are the strongest in the system.
2. Quadrant II (stakes), including the factors that have a strong influence with a strong level of dependence (leverage variables). The factors in this quadrant are considered strong variables.
3. Quadrant III (output), containing the factors that have little influence with high dependence.
4. Quadrant IV (unused), including the factors that have little influence with low dependence.

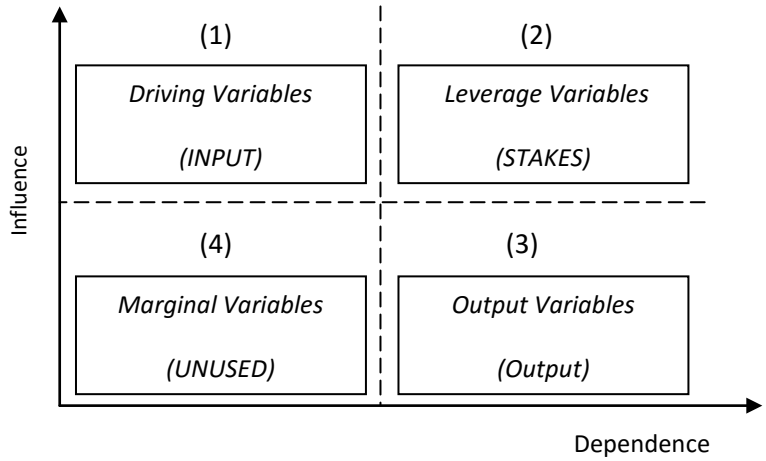

Figure 3: Level of Influence and Dependence between the Factors in the System. [3].

3. Results and Discussion

The overlay results of the land suitability analysis with the existing utilization and spatial utilization policy in the study area generated a spatial allocation as follows:

Table 3: Spatial Allocation of the Coastal Region in the Research Site

General Utilization	Conservation	Sea course
Seaweed Farming	Conservation of Coastal Waters	Shipping Lane
Oil and Gas Industry	Coastal Border	
Electric Power Plant		
Port		
Tourism		
Static Fisheries		

Source: Results of Land Suitability Analysis

Table 3 shows three regions of the spatial allocation in the study area: general utilization, conservation area and sea course. The general utilization area consists of six zones, namely Seaweed Farming, Oil and Gas Industry, Electiric Power Plant, Port, Tourism and Static Fisheries. The conservation area consists of two zones: Aquatic Conservation, and Coastal Border and Shipping Lane. To learn about the matrix of zone suitability / linkage, the next step is the mapping analysis of spatial conflicts.

The analysis of conflict mapping in this research with a questionnaire method was carried out by asking the opinions of each stakeholder as to the suitability / linkage between the two zones that are side by side. The question is: What will happen if the two zones are located side by side? The options are: (a) **they will support each other**, (b) **there will be no influence**, (c) **there will be a small conflict** (only one conflict, either ecological, social or economic), (d) **there will be a medium conflict** (only two conflicts, either ecological, social or economic) or **there will be a severe conflict** (more than three conflicts, either ecological, social or

economic).

Based on the analysis of the aggregate rankings of 112 stakeholder respondents with different ages, educational backgrounds, job titles, and employment status, the matrix of spatial use conflicts between the zones can be described as in Figure 4.

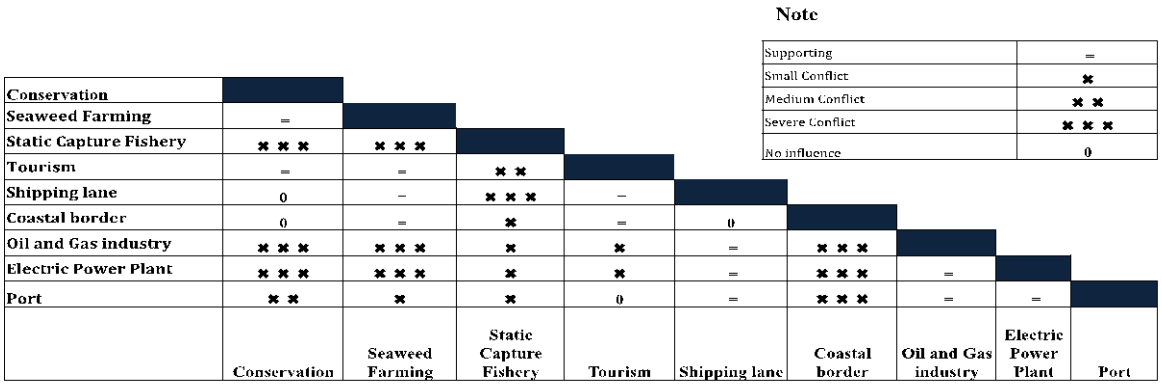

Figure 4: Matrix of Spatial Conflict Mapping in the Coastal Region of Bontang Based on the Analysis Results in 2016.

Figure 3. Shows that the spatial conflict that occurs between the conservation zone and the seaweed farming zone when the two zones are side by side with the zone of static fisheries (splint), oil and gas zone, and electric power plant zone will potentially cause heavy conflicts (ecological, social, and economic). Meanwhile, static capture fishery zone (splint) will potentially cause a severe conflict if side by side with shipping lanes. The fisheries sector had the potential conflict with other sectors in land use [8]. The coastal border zone will potentially cause a severe conflict if the zone is side by side with the zones of port, power plant, and oil and gas. Spatially, the description of the conflict can be seen in Figure 5.1. and Figure 5.2.

Several zones that mutually support, among others, the conservation zone with the tourism zone, the conservation zone with the seaweed farming zone, the seaweed farming zone with the tourism zone, the seaweed farming zone with the shipping lanes, and the seaweed farming zone with with the coastal border zone. The zone of shipping lanes can be mutually supportive with the zones of port, oil and gas, and power plant.

The various conflicts that arise require conflict management, a process that is directed at managing conflicts to create a more controlable condition through a particular engineering effort [13]. The management and the control of the conflicts will facilitate a decision-making process concerning the spatial allocation that considers the interests of the parties concerned.

The prospective analysis was done on the result of conflict mapping to obtain conflict management directives of any existing activity. The result of the prospective analysis was used to define and describe the relevant policy strategy. The following figure shows the result of the prospective analysis of the conflicts that occur in the coastal areas of Bontang.

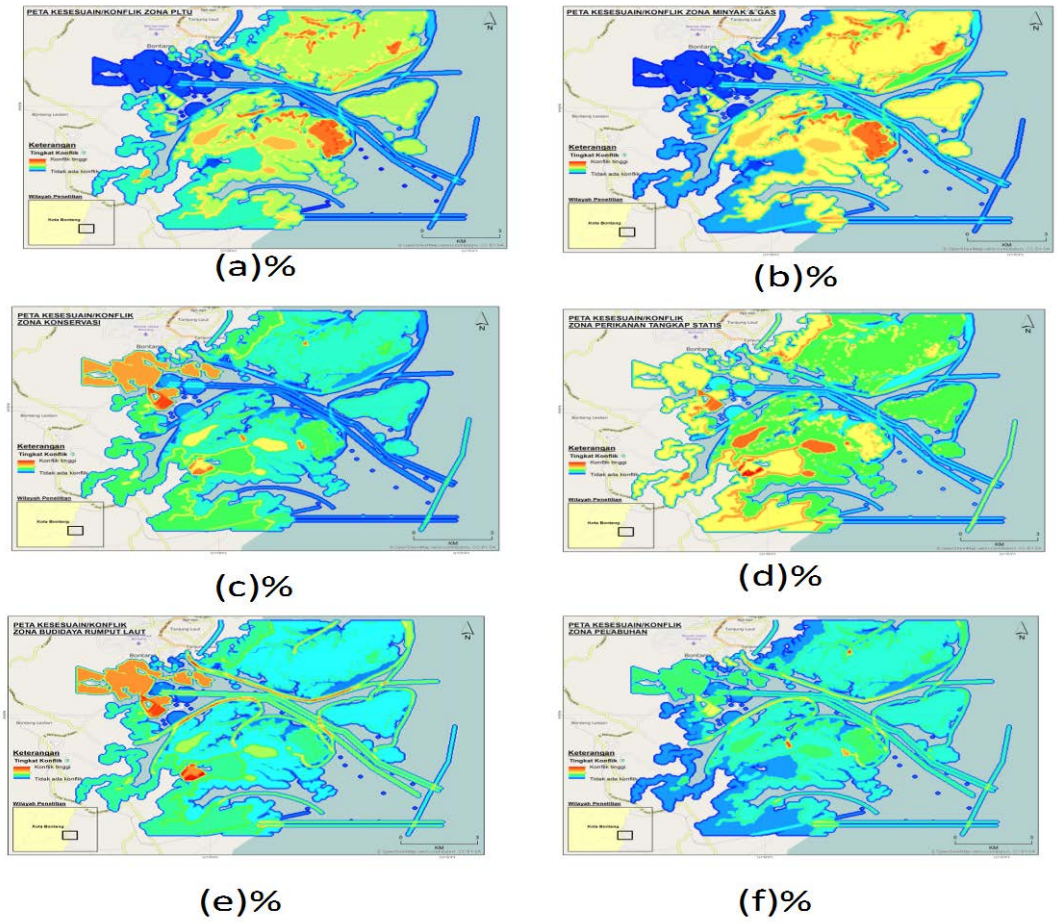

Figure 5.1: Map of Spatial Conflict between utilization zones; (a) electric power plant zone with the other zones; (b) oil and gas zone with the other zones; (c) Conservation zone with the other zones (d) static capture fishery zone (splint) with the other zones; (e) Seaweed Farming zone with the other zones; and (f) Port zone with the other zones.

Figure 6 shows the results of the prospective analysis, namely influence and dependence between the zones. Of the nine lever attributes / zones analyzed, there were seven factors or dominant zones identified that affected the system of the coastal areas of Bontang. Electric power plant and oil and gas have **a strong influence** with **a less strong level of dependence**. The factors in this quadrant are decisive factors or driving variabels which are the strongest in the coastal sites. Meanwhile, the zones that have **a strong influence** and **a strong dependence** (leverage variables) on the environmental conditions of the coastal sites are static capture fishery, shipping lane and port. These zones are all factors that are strong variables in the system of coastal areas.

The four dominant factors are included in the three quadrant, which have **a small influence** but have **a high dependence** on the environmental conditions of the coastal sites. The four zones are seaweed farming, conservation, tourism and coastal border. The influences of seaweed farming, conservation, tourism and coastal border zones are very small on the other zones but these zones are highly dependent on the condition of the

surrounding coastal environment. If the condition of the coastal environment is damaged, seaweed farming, conservation, tourism and coastal border zones are in danger of disappearance. Here is an alternative policy that can be used to manage the key factors / zones:

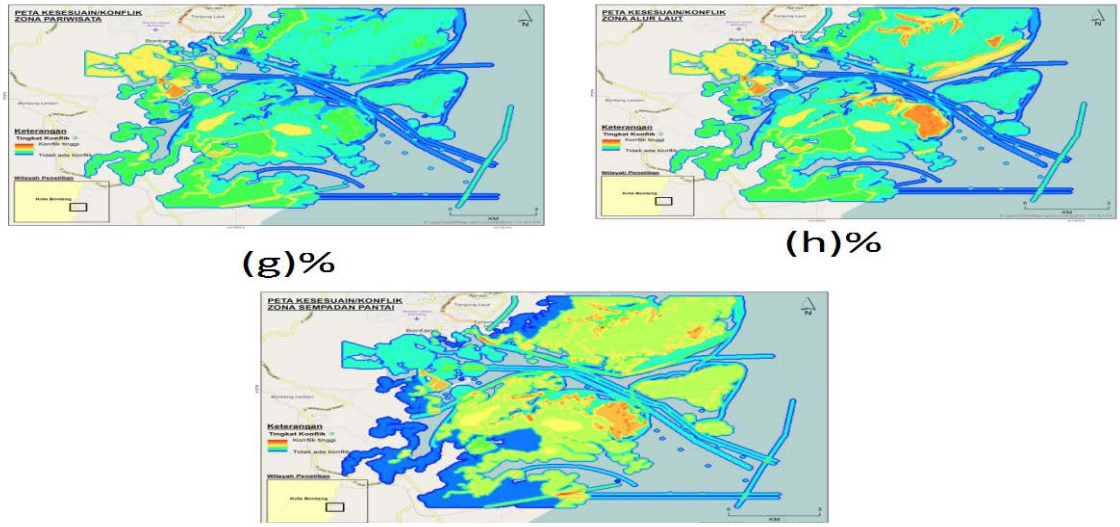

Figure 5.2: Map of Spatial Conflict between utilization zones; (g) Tourism zone with the other zones; (h) the zone of Shipping lanes and the other zones; (I) Coastal Border zone with the other zones.

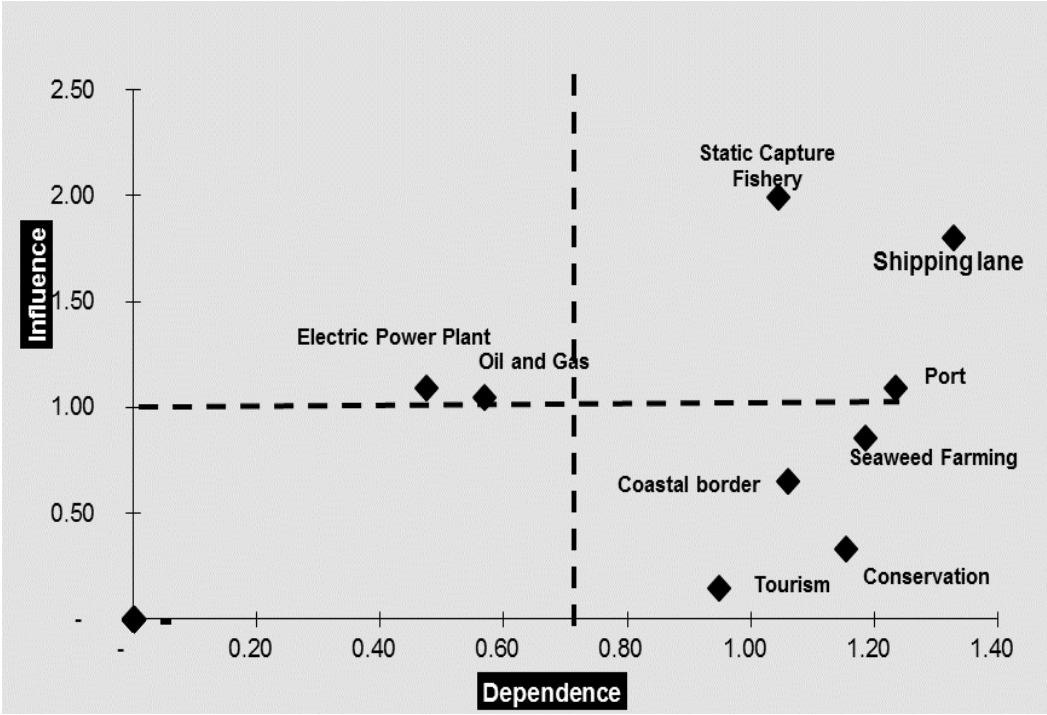

Figure 6: Influence and Dependence between Zones Based on the Prospective Analysis

Table 4: Policy Directions of Zone Priority

No	Key Factor /Zone	Issue	Policy Directions
1.	Static Fisheries (splint),	Static fisheries (splint) have a strong influence on the other zones such as shipping lanes, seaweed farming, and conservation. These activities are also highly dependent on the quality of coastal areas of Bontang.	The setting of static fishing activities (splint) is carried out by first calculating the carrying capacity of the area for fishing activities.
2.	Seaweed Farming,	Farming zone has a strong influence on the economy of coastal communities and is highly dependent on the coastal waters condition of Bontang.	Providing legal certainty through spatial planning of seaweed farming does the setting of seaweed farming activities.
4.	Shipping Lanes	Shipping lanes considerably influence seaweed farming activities but it is very meaningful for industrial and port activities in coastal areas.	Management of shipping lanes by setting shipping lanes for the coastal communities.
5.	Oil and Gas Industry,	The plan to develop Oil and Gas industry will strongly influence the loss of some coastal borders and the impact that may arise is that the waste disposal will influence the zones of Seaweed farming, fishing, and conservation.	Optimizing land for industrial zones of oil and gas in the coastal border and conducting a review of the waste disposal site to minimize its impact.
6.	Conservation Activity	The existence of conservation is very important for the sustainability of coastal waters of Bontang, which is located in the industrial area.	Maintaining and preserving the conservation area both in quality and quantity.

4. Conclusion

Spatial conflict mapping has become one of the important analyses in an attempt to formulate coastal spatial planning. By having an awareness of the existing conflicts between utilization zones, anticipatory solutions and future policy directions can be better formulated. The involvement of relevant stakeholders around the site planning is very important in the process of the conflict mapping in particular and in the process of coastal spatial planning in general. The more stakeholders with diverse educational backgrounds and professions are, the sharper the conflict mapping analysis will be. Finally, involving stakeholders from the start will make it easier in the spatial management of the coastal areas.

The constraints in this study lied in the process of collecting public opinion, in this case, the opinions of fishermen (stakeholders). They went to sea for a few days, so it took time to be able to interview them. The constraints in this study were also related to the number and diversity of the stakeholders involved, which was not evenly distributed, since not all the actors or coastal area users were involved such as industry, environmentalists, tourism players, etc. Keeping these in mind, it is expected that the future research should increase the number of stakeholders involved and the diversity. The technique used in gathering data should not be in form of questionnaire, but should use an active participatory technique by means of Focus Group Discussion (FGD).

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