Transforming institutional design in addressing sludge oil in Bintan seawater, Kepulauan Riau, Indonesia

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Abstract. The primary purpose of this study is to fill out the gap in the current research of environmental policy because the conventional approach still dominates it. By using soft-systems methodology based action research, problem-solving, the present study seeks the institutional design in overcoming the problem of sludge oil in Bintan seawater, Kepulauan Riau. Field research was conducted in several villages in Bintan coastal area, such as Pengudang, Tanjung Berakit, and Trikora. Participants in this study involved state and non-state actors, in particular, the Indonesian Coast Guard, Indonesian navy, environmental agency of provincial and municipal government, fisherman, and village government. Data were gathered with an in-depth interview, observation, and secondary resources. In summary, we offer a new institutional design to replace previous governance of the issue. This study contributes not only to add our understanding of the governance of marine waste, but also the practical solutions to address it.

1. Introduction
This research aims at investigating the sludge oil problem in Bintan, Kepulauan Riau. There are three pivotal reasons why this research is a must. First, the sludge oil in Bintan seawater is a serious issue because it has been prevailing for a long time ago. However, there is still not obvious policy yet until now. As a consequence, the problem cannot be solved until now. We assume that it is a multi-level governance problem. Multi-level governance is the process of policymaking involving many actors with a complex problem and common interest [1]. Second, sludge oil occurs because of the vague responsibility among layers of government. The lack of capability of the central government to negotiate with Singapore’s government tend to switch the issue as a local government problem. The rationale is regional autonomy of the governments at the local level making they more responsible for managing all task, including sea waste. Yet, the local government tends to argue that it is a trans-national issue involving Indonesia and Singapore so that the central government more responsible for handling the situation.
Lastly, pollution in Bintan seawater affected by sludge oil or back oil has reached a dangerous stage because it can ruin the marine ecosystem [2]. It may lead the surface of seawater, which means that it can induce climate change over a long period. Sludge oil is a depositing fuel oil waste come from a ship conveying fuel oil. The ships dispose of their waste before anchoring in Singapore’s port. It regularly occurs when the northern seasons because the stream of water moves to Bintan seawater.

The problematic situation explained above become an interesting issue to be explored. It has revealed that the problem is messy, involving many actors with many interests. For instance, in the central and local governments perspective (provincial and municipal government), sludge oil is a disaster disadvantaging the economic source and tourism; in the perspective of local people, the damage of seawater environment can be destroyed local economy; in Singapore’s government perspective, the main priority is to attract much more the ships to anchor in their port.

Prior studies have investigated multi-level governance in addressing environmental issues [3]. Unfortunately, much of the research used a conventional approach. It cannot catch the real complex situation and propose a solution properly. Thus, to address this research gap, the present study uses a system thinking approach through soft systems-based action research (SSM-based AR) to solve the problem of sludge oil in Bintan seawater. This study aims at investigating the problem of sludge oil in Bintan seawater, Kepulauan Riau, by using SSM-based AR with problem-solving intention. In doing so, the research problem can be formulated as follow: how does more appropriately institutional design address sludge oil? Furthermore, the objective of this research is to design institutional arrangements of sludge oil issues.

2. Methods
SSM-based AR was performed to analyze the research problem. Principally, SSM is a research method, in general, used to tackle a complex issue and immensely related to each other in the real world [4]. Indeed, SSM-based AR was an anti-thesis to conventional research in the field of social sciences. It was used in the study because sludge oil is a complex problem entailing many actors and interests [5]. This research focused on problem-solving SSM-based AR. Although it was a problem solving, it still was utilized a theory, multi-level governance. The theory was used not only to understand the phenomena but also to formulate specific recommendations in handling the issue.

Because of the large number of affected areas, we solely selected several villages as the locus of this study, such as Pengudang, Tanjung Berakit, and Trikora. The data were gathered through in-depth interviews, observation, and secondary sources. The interview was conducted on several participants from both governmental institutions and non-governmental institutions, as follows: Environmental Office of Bintan and Kepulauan Riau, Indonesian Navy, Indonesian Cost Guard, resort owners, fishermen, and secretary of villages. Data were analyzed by analyzing the root definition and conceptual model and comparing it with reality [6].

3. Results and discussion

3.1 Problematic situation reconsidered
Sludge oil in Bintan seawater is induced by the intentional behavior of the ships exceeding international seawater to dispose of their oil waste in Singapore strait. Admittedly, the port authority of Singapore has a regulation that the ship entering its jurisdiction is clean from any waste. Even though there are several tank-cleaning companies in Singapore, the ships prefer to throw their rubbish in international seawater. It occurs because the cost of tank cleaning is considerably expensive.
3.2 Problem structuring

The bother of the government to solve the issue arises because of several reasons. First, the government is stuck by the international regime in which Indonesia’s law cannot capture the ships throwing the tailing in international seawater. Otherwise, if the vessels discard their pollution in the Indonesian seawater, Indonesian rule can reach out to them. Second, the lack of commitment by the government in addressing sludge oil. The issue has not been attended by the central government in order to never become agenda setting. On the other hand, not only provincial but also the regency government has several limitations to tackle this problem, such as authority, means, and personnel. Third, there is a deficiency of polity because there is a limited number of prominent policies formulated and implemented by the government at both the national and regional levels. The government merely carry out meeting and coordination in responding to the matter thus far.

Although there is a variety of institutions responsible for handling the problem, the reality of government action not visible. The absence of government action yields the institutional void and status quo in this case. The institutional void is the situation by which there is a vacuum of power, no apparent norm, and policy in a political setting [7]. Status quo refers to the tendency to do nothing towards or preserve the current or prior decision [8]. In other words, the attempts carried out by the government cannot accomplish the problem because of the obstacles. It shows the failure of the government in implementing power. As a result, the circumstance is long-standing and certainly inbenefit society.

3.3 Rich picture

We argue that the problem of sludge oil in Bintan seawater is the problem of multi-level governance. This assumption is supported by the data indicating the convergence of authority among the actors (central, provincial, and district government) and the lack of diplomacy between the Indonesian and Singaporean government. Therefore, we suggest the transformation of institutional design by implementing a multi-level governance model to accomplish the issue. Transforming institutional design in the concept of multi-level governance involves re-configuring institutional dimensions, such as policy or regulation, structure, norm, a pattern of diplomacy, cooperation, and coordination among the actors. In terms of policy or regulation feature, the central government requires to revise the current regulation so that there is certainty while such government executes the power. In terms of institutional relations, governments should develop robust coordination and cooperation. It can be realized if the governments deprive their sectoral ego. In the aspect of foreign relations, the Indonesian government, through the Ministry of Foreign Affairs, should perform soft diplomacy to negotiate with Singapore’s government to jointly watching the ships entering international seawater in Singapore strait [9]. If the ship throws the tailing in international seawater, the Port Authority of Singapore and Indonesian authorities should render an equal punishment. These strategies aim to reduce the ships discarding their pollution in international seawater.
3.4 Formulating the root definitions: The problems of multi-level governance

It was clear that the problem of sludge oil is the problem of a multi-level governance strategy. Based on the logic, it is suggested that the root definition of the appropriate objective scheme relates to the establishment of the particular institution responsible for managing sludge oil as follows: a system owned by the Indonesian government (P) by transforming the organizational layout, enhancing coordination, sharing of power, independence and diplomacy among actors (Q) so that the sludge oil can be solved.

According to the SSM-based AR method, the root definition is verified through the CATWOE assessment. Table 1. outlines the CATWOE analytical elements composed of Customer, Actor, Transformation, Weltanschauung (viewpoint), Owners, Environmental restriction. It is also extremely related to the conceptual model [10]. Analysis of CATWOE, in this case, can be formulated as follows: (1) Customer: the ministry related to this issue, particularly Ministry of Environment and Forestry, provincial and district government, (2) Actor: the directorate in the ministries, Environmental Office of Kepulauan Riau, and Environmental Office of Bintan Regency, (3) Transformation: transforming institutional design based on multi-level governance model to overcome sludge oil in Bintan Regency, consists of central government (Ministry of Foreign Affairs and Ministry of Environment and Forestry), Government of Kepulauan Riau and Bintan (Environmental Office and Marine and Fisheries Office), and Singapore's government, (4) Weltanschauung: controlling and monitoring sludge oil by using a model of multi-level governance, (5) Owner: Government of Bintan Regency, (6) Environmental constraint: a number of overlapping regulations and the acceptance of Singaporean government.
Table 1. Analysis of CATWOE

| Dimension       | Description                                                                                                                                 |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| Customer        | Ministry of Environment and Forestry, central government institution related the issue, Provincial Government of Kepulauan Riau and Government of Bintan Regency |
| Actor           | The directorate in the ministries, environmental office in provincial and district government                                              |
| Transformation  | Transforming institutional architecture to overcome sludge oil in Bintan Regency                                                             |
| Weltanschaung   | A multi-level governance model                                                                                                              |
| Owner of the problem | Government of Bintan Regency                                                                                                                   |
| Environmental constraint | Imbrication of regulation and the response of Singaporean government                                                                         |

Source: The results of data analysis

3.5 Formulating the conceptual model

Figure 3 depicts our conceptual model of the problematic situation. The conceptual model established in this study outcomes a new model of sludge oil management by adopting the model of multi-level governance. This is in line with the theoretical perspective in which a multi-level governance model more compatible with addressing the issue.

![Conceptual Model Diagram]

Figure 3. A conceptual model of the transformation of institutional design to overcome sludge oil in Bintan

A description of the activities to be carried out to obtain the desired transformation underpins the conceptual model representation. The theoretical model is built on the basis of the preceding root definition. These operations are the appropriate model to govern sludge oil in Bintan. Activities are dependent and interrelated so that monitoring and controlling such activities is exceedingly essential.
Figure 3 also provides an overview of the conceptual model connecting each event as well as its connection to monitor and supervise the actions.

Performance criteria must be developed to test the conceptual model. In general, there are five criteria used, including effectiveness, efficiency, effectiveness, elegance, and ethicality. However, in this study, we merely employ three principles; (1) Efficiency: how much resources need to implement the model, (2) Effectiveness: is the model possible to develop, and (3) Efficacy: is the model exceptionally perform.

The issue of sludge oil can be resolved if the governments change from old to the new pattern. It relies on the structural arrangements of the government consisted of multi-level actors. The orientation among the governments must be transformed from command to cooperation and coordination. In addition, there are several strategies implemented by the government as follows:

1. Establish an institutional structure by revising the current regulation in order to gain new structures flatter and more accessible.
2. Establish the relationship of multi-level governance by changing the regulation, policy, norm, pattern, and behavior to generate the new pattern.
3. Initiate a bilateral relationship with Singaporean governance to tackle the sludge oil to obtain mutual understanding.

To implement the conceptual model in the real world, the arrangement, role, function, and activity of each line of government must follow the chart below:

![Institutional design of the Governance of Bintan’s Sludge Oil](image)

**Figure 4.** Institutional design of the Governance of Bintan’s Sludge Oil

### 3.6 Comparing the conceptual model with the real world

We provide the idea of change required to be conducted in tackling the problem by comparing the conceptual models with the real world. In the real world, it can be predicted that there are many barriers to realize the model, such as the habit of government used to work alone than cooperated and coordinated each other, a number of regulations do not work or compatible to the achievement of the efforts to address the problem, many disharmonize regulations, refusing from Singaporean government to cooperate, etc. Hence, the government should set up a variety of strategies to manage various impediments in implementing the new model of governance. In other words, policymakers must consider that the actors involved are not only serious about solving the problem, but they must also consider the new safety regulations by establishing new rules about protection and new concepts passed in solving the problem—solely based on the major task of each institution.
3.7 Intervention: Transforming institutional design
The final stage of the action research conducted by SSM is the formulation of recommendations for any amendments or actions required to resolve the problem. It is often defined as being systematically beneficial and culturally feasible to support the required change in the issue as research-related issues.

In brief, the measures considered systematically desirable and culturally viable for addressing sludge oil in Bintan are to transform institutional design through a multi-level governance model.

4. Conclusion
Sludge oil as one of the trigger factor inducing climate change should be addressed as soon as possible. By applying SSM-based AR, this study attempts to examine the institutional design of Bintan’s sludge oil governance. The results show the emergence of institutional design multi-level governance oriented to be applied. The government can adopt diverse strategies related to the transformation of institutional design to gain maximum advantage in solving sludge oil.

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