Causes, Dynamics, and Environmental Conflict Resolution Models in Coal-Fired Steam Power Plant Development Locations

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Abstract. This paper examines the causes, dynamics, and models of environmental conflict resolution that can be applied in the construction of a coal-fired steam power plant. The existence of power plants is a dilemma because it has negative impact to the society and environment that can lead to conflict. Environmental conflicts always begin with ecological degradation which becomes increasingly complex due to social factors. Discussions of environmental conflicts often focus on ecological damage but forget about the social impacts that will result. The causes of conflicts such as competition for natural resources, poor management of natural resources and the environment, and the dynamics of natural resources that cross borders require proper conflict management to deal with them. This study offers management conflicts models in resolving social-environmental conflict.

1. Introduction
The environmental context in this paper is related to the concept of ecosystems and fundamental ecological changes, compared to resource issues (Gaan, 2001; Libiszewski, 1992). Based on the previous research, conflicts related to the seizure of natural resources and environmental damage will also be related to social conflicts (Julianti et al., 2018; Niskanen et al., 2020; Prayogo, 2010). Conflicts related to struggles over access to resources cannot be categorized as environmental conflicts, because basically, the case is a socio-economic conflict. Ecological degradation leads to another problem like the scarcity of resources. Resource scarcity divides into four types of scarcity, which are physical, geopolitical, socio-economic, and environmental (Rees, 1991).

Definition of environmental conflict has two crucial implications, namely excluding non-renewable resources and a focus on renewable resources, which in this context environmental degradation results in scarcity of renewable resources (Libiszewski, 1992). However, these socio-economic conflicts are a factor in the dynamics of environmental conflicts. Conflicts are becoming more complex due to various causes in the modern era (Vanclay, 2020). Environmental conflicts occur as a result of ecological destruction. However, it does not necessarily directly lead to conflict. It becomes different from ethnic or religious conflicts, where several resource competition variables involve political contexts and differences in values owned by the community. This context caused environmental conflicts in each region to be different.

This study assumes that the main cause of conflict begins with environmental degradation due to the remains of burning raw materials for coal-fired steam power plants. Coal fired steam power plant is an
energy source that is not environmentally friendly. It uses fossil fuels, namely coal as the main raw material, which is one of the causes of long-term negative impacts on the environment. In this case, environmental degradation and scarcity of natural resources (Libiszewski, 1992) as a result of the power plant's operational. This environmental impact then develops along with the socio-cultural, economic, and ecological change, which in this paper the researcher calls the dynamics of conflict. Meanwhile, this series of environmental conflicts need the resolution to create a sustainable environment.

The dynamics of socio-economic factors have resulted in environmental degradation becoming more complex and leading to socio-environmental conflicts. The social impact and conflict analysis model will show demographic changes, economic changes, environmental changes, and humanitarian impacts. This social mapping will be the basis for determining the appropriate conflict resolution model to be applied in the communities around its location.

2. Causes and Dynamics of Environmental Conflict

Conflict studies that have been conducted related to energy sources or natural resources mostly raise issues of social conflict (Julianti et al., 2018; Niskanen et al., 2020; Prayogo, 2010). The background of political policy, community culture, and economic interests make the dynamics of environmental conflict very complicated (Barnett, 2000; Niskanen et al., 2020). Discussions related to the relationship between ecological degradation and the occurrence of conflict are still much debated. Environmental problems require an analysis of multidisciplinary science, namely chemical and biological processes, but also see the side of social phenomena that occur (Esteves et al., 2012; Libiszewski, 1992). The current conclusion that ecological degradation does not have a direct relationship to conflict, but there are stages of analysis of environmental impacts, social impacts, and conflicts (Libiszewski, 1992).

The conflict dynamics around the coal-fired steam power plant are also very diverse within different social conditions. However, it contributes to the physical changes in the environment. Therefore, based on the categorization of the indicators that cause conflict due to a decrease in environmental quality that results in environmental changes that trigger conflict. It is increasingly complex because of socio-political conditions and policies applied.

Table 1. Cause and dynamics of conflict

| Indicates Conflict                          | Possible causes of Conflict                   |
|-------------------------------------------|-----------------------------------------------|
| Overuse of resources                      | Environmental change                          |
| Access to resources                       | Ethno-political differences                   |
| Damage to environmental quality           | Center-periphery relationship                 |
| (pollution, overexploitation)             | Migration/displacement                         |
| Differences in ethical and religious beliefs | Demographic pressure                         |
| Simple scarcity                           | Shared resources                              |
| Problem due to group identity             |                                               |
| Friction caused through deprivation of    |                                               |
| lower status group                        |                                               |

Source: Barrow, 2010

2.1. Competition of Natural Resources: Water Consumption and Pollution on Power Plant

Conflict is not always a negative phenomenon, proper conflict management is an essential component of social change, democracy, and development. Environmental conflict implies conflict over renewable resources, but the basis of the resource problem returns to the issue of access and control of these natural resource. However, poor conflict management, both from the government system and local wisdom, is no longer able to prevent violent conflict. Therefore, several conflict triggers were issued by the United Nations (UN) regarding the issue of renewable natural resources which can be used as a reference in environmental conflict management (Hailu et al., 2012).
The concept scarcity of resources is described as a condition in which the demand for renewable resources, such as water, forests, and agriculture, is not fulfilled. This scarcity will increase the competition between user groups at that location. The social responses that emerge will vary from migration, technological innovation, cooperation to violent conflict. Therefore, three main reasons trigger competition against renewable natural resources that work separately or in combination. First, scarcity due to demand. This scarcity will arise when the demand for specific renewable resources cannot be met with what is available. The need for water and agriculture may be fulfilled at the current time but population growth, technological innovation as well as an increase in per capita consumption can reduce this capacity along with the availability of these resources (Hailu et al., 2012).

Second, scarcity due to supply. Scarcity due to the supply of natural resources indicates environmental degradation, pollution, and failure of infrastructure development which causes a reduction in the total supply of certain resources (Hailu et al., 2012). In this context, the reduced supply of natural resources to the environment means reducing the need for life from that environment which will encourage competition within the group. Third, structural scarcity. Structural scarcity occurs when different groups in society experience different access to specific resources. This scarcity generally occurs in areas where environmental management is poor. However, factors such as practical politics, gubernatorial dynamics, social and economic issues become important which can trigger scarcity.

The conflict that occurred at coal-fired steam power plant locations mostly triggered by scarcity due to supply. One of the resources most affected by the coal-fired steam power plant's existence is water resources (Sharma et al., 2020; Zhu et al., 2020). The study of the water footprint in the power plant area shows that the coal-fired steam power plant indirectly has an impact, not only because it consumes large amounts of water resources but also has a substantial environmental impact (Zhu et al., 2020). The liquid waste produced by some coal-fired steam power plants disposed of without following environmental procedures, that causes water pollution and harm aquaculture (Dandautiya et al., 2018; Islam and Al-Amin, 2019; Mulya, 2015).

The scarcity of water resources affects the lives of the surrounding communities, both from sources of livelihood for farmers and fisherman (Noorden, 2013), and also public health. This condition often results in a decrease in the quality of life of the community. When there is a change in the socio-economic life of the community, it is possible to cause conflict both horizontally and vertically due to competition of limited resources that they are trying to improve the quality of life of the community back to its original state.

2.2. Poor Environment and Natural Resources Management

The management of the environment and natural resources relates to the institutions, policies, and processes of their management, ownership, allocation, use, and protection. This second trigger or cause shows a critical view of how the conflict arises and complaints arise and poor management triggers conflict. On the context of this research, the second stages of triggered conflict are Unbalanced distribution of benefits and burdens on development programs, and also Lack of public participation and transparency in decision making (Hailu et al., 2012).

Infrastructure projects, industrial estates, and other development programs including coal-fired steam power plant can provide benefits to local communities. on the other hand, it creates serious impacts on the environment such as pollution, ecological change, and natural resources degradation, which can be major sources of problems. the environmental impact on a development program can create tensions if the community does not receive compensation for damages, either financially or otherwise (Hailu et al., 2012). in other words, complaints occur when expenses exceed profits. complaints can also occur when disturbing certain natural resources that have more meaning such as cultural, spiritual, and religious values.

Policies and interventions related to natural resources are usually made by the state, which is related to the private sector, without involving the active participation of affected communities or without transparency and consultation with stakeholders. Thus, the community and stakeholders are not involved in the decision-maker, in general, this group will oppose the decision and the outcome of the policy.
2.3. Cross-Boundary Resources Pressure and Dynamics

The challenge for managing renewable natural resources is their reach that transcends national boundaries. This is especially actual for issues of water, wildlife, fisheries, and water quality. However, this also applies to the management of waste, pollution, climate change, and disasters that transcend national borders. If there is a pollution of resources in one country as a result of a development program, it will also affect the quantity and quality of these natural resources in other regions or countries. Changes in land-use change will also result in soil erosion and deforestation which increases the potential for natural disasters or also conflict arises (Hess and Fenrich, 2017).

The coal-fired steam power plant produces air pollution not only affects the environment around its location but also has an impact on other areas. The results of The Air Pollution Model (TAPM) / calculation of puff and air quality dispersion (CALPUFF) for the concentration of pollutant surfaces generated by coal-fired steam power plants show that the source of emissions is large (Myllyvirta et al., 2020). For example, the spread of pollution is worst in Jakarta, when air masses arrive in the city from the Suralaya industrial zone, where five large coal-fired power plants are located. The concentration of PM2.5 pollutants caused by coal-fired steam power plants is, in this case, higher in DKI Jakarta than in Banten. It is partly due to the transformation of multiple SO2 and NOx emissions from the coal-fired steam power plant in Banten - where the two pollutants mostly concentrated into secondary PM2.5 where the wind blows and closer to Jakarta.

Marine biota pollution that occurs due to the disposal of liquid waste into the waters around the site also affects the condition of marine life and the species in it across national boundaries. Thus, the cross-boundary impact and pressure from the existence of a power plant do not only affect the location of the infrastructure but also harm neighbouring provinces or countries.

| Table 2. Cause and dynamics of environmental conflict on Power Plant Project |
|---------------------------------------------------------------|
| **Causes of Conflict**                      | **Dynamics of Conflicts**                  |
| Competition of Natural Resources:               | Water pollution, water crisis, public     |
| Scarcity due to supply                         | health, threatens marine life, and        |
|                                               | livelihood.                               |
| Poor Environment and Natural Resources         | Cultural/religious/spiritual values,      |
| Management:                                    | public acceptance, public                |
| 1. Unbalanced distribution of benefits and     | participation on decision making.         |
| burdens on development programs.               |                                           |
| 2. Lack of public participation and transparency in decision making. | |
| Cross-Boundary Resources Pressure and Dynamics | Public health, air pollution, water pollution, water management. |
|                                               |                                           |

Source: own elaboration

2.4. Environmental Conflict Management

The series of causes and dynamics of conflict above require conflict management to find the right resolution model. Conflict is a consequence that cannot be avoided with a change. It isn't always a bad thing. It can be said to be a signal of awareness to change. Without the presence of conflict, it shows the characteristics of an apathetic, indifferent, and helpless society. This becomes a separate obstacle to environmental sustainability compared to the conflict (Brown et al., 1995).

There is a paradigm shift between the old and the new environmental management. Traditional environmental management views to water, land, and air resources as unlimited resources. Management analysis is carried out in a fragmented and not holistic manner. Meanwhile, new views have evolved by considering natural resources as finite and integral to the ecological system.
The stages in carrying out environmental management are divided into five steps, which are exploration, analysis, objectives, follow-up, and evaluation. New rules of environmental management must consider economic, ecological, social, and technical factors (Brown et al., 1995). Economic issues to answer what should be paid, ecological issues to describe the impact, social issues to find out who is affected, and technical aspects to find out the solution. Some of the dimensions measured in conflict management are policy, environment.

2.4.1. **Collaboration.** The definition of collaboration can be said to be a temporary, formal relationship in the context of a working relationship (Brown et al., 1995). This resolution model can be minimized in the context of coal-fired steam power plant development, in the form of providing priority jobs for affected communities, as well as by carrying out assistance programs such as Corporate Social Responsibility (CSR).

2.4.2. **Coordination and Cooperation.** Coordination is part of a mutual agreement for commitment in teamwork. Then, the next step of teamwork and commitment that is built between groups with mutual benefits will form cooperation (Brown et al., 1995). This resolution model means being the highest resolution model in which both parties to a conflict have the same understanding and goals.

2.4.3. **Negotiation.** Negotiation is a crucial element that can change conflict management strategies. Negotiations aim for both win-lose and win-win solutions. Negotiation is a crucial moment in determining whether a confrontational step will occur and is the most destructive way of approaching conflict (Brown et al., 1995).

2.4.4. **Confrontation.** When cooperation is threatened with collapse and negotiations fail, then the next management conflict will move to the next most extreme strategy, which is confrontation. It can lead to open or violent conflict.

| Conflict Resolution         | Activity                                                      |
|-----------------------------|---------------------------------------------------------------|
| Collaboration               | Providing priority job for affected community, assistance program (CSR). |
| Coordination and Cooperation | Agreement or commitment as teamwork, including economy, social or environmental aspects. |
| Negotiation                 | Crucial step aim from win-lose or win-win solution.           |
| Confrontation               | Protest, complaints, violent conflict.                        |

Identification of problems from the economic, social, and environmental aspects is crucial to map the issues to be decided collectively. Sustainable development represents a balance between ecological and economic management. However, it is social mechanisms at the local-regional level that most determine the balance between environmental and economic priorities (Gaan, 2015, 2001).

In the context of coal-fired power plants, the stakeholders who play a role are the government, the coal-fired power plant management (private), and the community. It is necessary to have a holistic sustainability strategy to facilitate integration, increase efficiency, and proper environmental management, which requires mutual agreement. Methods such as collaboration, coordination, and cooperation are the most effective ways to prevent conflicts. The agreement is necessary to maintain the quality of life of the community and also protect the environment. Meanwhile, the negotiation and confrontation stages mean that something sacrifices in the process. Good environmental policy means...
an acceptable social policy. Thus, social agreements signify important in the realization of proper environmental management.

3. Conclusion

The existence of the coal-fired steam power plant creates several polemics, starting from environmental degradation to resource conflicts. Environmental damage causes the limitation of natural resources around the power plant's operational location. Environmental conflict more complex due to socio-political context and environmental management as well as government policies related to environmental management that is poorly implemented.

The causes and dynamics of environmental conflicts are strongly influenced by the socio-cultural conditions of the community. It has an important role in determining the resolution of the conflict. Thus, establishing stronger policies and projects with community involvement become crucial. Advanced research and a proper emphasis on creating strategies more feasible are imperative for reaching the target of sustainable development a healthy modern society.

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