

PUBLIC POLICY ANALYSIS ON DISASTER THREAT DUE TO GEO-ENVIRONMENTAL CONDITION OF TUGURARA RIVER IN TERNATE CITY, NORTH MALUKU PROVINCE

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ABSTRACT: This research was conducted to produce a public policy model to anticipate floods in Ternate City due to changes in the geo-environmental conditions of the Tugurara River based on geological analysis results. These model intended to help the local government in determining the policy to deal with the Tugurara River disaster threat. Analysis of geo-environmental conditions was conducted using statistical methods obtained from previous studies - furthermore, the theory of public policy analysis in determining the appropriate policy for handling the risk that will occur. Results revealed that runoff water correlates with extensive changes of the Tugurara River area. These area change becomes more because of runoff water discharge amount erode the rock on the river wall and cause the river wall as well as the presenting any material river wall along the river as a catastrophic outburst flood lava on a residential area three villages in 2011 (this condition is particular compare than another river in North Maluku or others). Therefore changes Tugurara River area, occurred very significant. The river engineering can refer to the flood prevention model that has been applied to the Jeneberang River in South Sulawesi by building Sabo Dam along the river, adapted to the particular characteristics of the Tugurara River. Therefore, the critical formulation of public policy alternative carried out by the Ternate City government is infrastructure development, community involvement, and networking development. After the public policy is determined, then further research can be conduct on the evaluation and comprehensive analysis of policy implementation.

Keywords: Tugurara watershed, Runoff, Broad river, Disaster hazard, Public policy

1. INTRODUCTION

Disasters are natural or human-made events suddenly or progressively, with a devastating impact that requires the affected community to respond with extraordinary actions — furthermore, natural disasters caused by two factors such as natural disasters due to physical factors and human activities [1]. Disaster management in Indonesia has been regulated both at the central level to the regional level. At the fundamental level, it restricted to Law Number 27 (2007) concerning Disaster Management. The law stipulates that the government and the provincial government as the responsible parties in the implementation of disaster management (article 5) make the National Disaster Management Agency (section 10).

Meanwhile, for the local government to make the Regional Disaster Management Agency (article 18), therefore, Presidential Regulation No. 18/2008 concerning the National Disaster Management Agency was made. Other regulations related to disaster management also regulated in Government Regulation No. 21/2008 concerning Disaster Management. One type of disaster that

threatens Ternate City is a flood due to changes in the Tugurara River surface runoff.

Therefore, the Ternate City government needs to formulate public policy regarding the threat of the Tugurara River flood disaster. Various existing public policy theories must support the policy formulation process. Public policy as the government's choice to do or not do something (whatever governments choose to do or not to do) [2]. Policy implementation is one of the stages in making a public policy process that includes the interaction of various variables, such as four critical factors or variables that affect the implementation as according to George Edward III, such as communication, resources, disposition, and bureaucratic structure [3]. Policy evaluation is the final stage in the public policy process to see how far the policies that have implemented have produced the desired or not impact. William Dunn developed a type of evaluation criteria that can use as the material for analysis, that is; effectiveness and efficiency, adequacy, equity, responsiveness, and appropriateness [4].

Meanwhile, geologically the erosion of river walls due to surface water runoff can cause flooding if not addressed. Soil erosion by water is

one of the most widespread and significant ecological, environmental problems worldwide, which results in reduced agricultural productivity, increased water pollution, and unsustainable development [5-10]. Soil erosion is a complex physical process, and the necessary explanations are the full interaction between precipitations and the surface of watersheds [11, 12]. The Tugurara River is one of the Gamalama volcano basins, which has the threat of disasters to communities such as the expansion of hot clouds, lava flows, and lava floods. Tugurara River located in the north of Ternate City, precisely in North Ternate Sub-district, which is inhabited by people in three sub-districts namely, Tubo urban village, Akehuda urban village, and Dufa Dufa village. Communities in these three urban villages, occupying along river banks and up to now the growth of settlements increasingly leads upstream of the Tugurara River, Gamalama volcano.

Gamalama volcano is one of the active volcanoes of Strato type with an altitude of 1700 m above sea level, has a slope of 0-8% at the foot of the volcano and a relatively steep slope of >45% at the peak of the volcano [13]. Gamalama volcano erupted the first time in 1538 [14]. Gamalama volcano eruption activity last occurred in 2003, and again eruption occurred in 2011, which for \pm eight years did not experience an explosion. Gamalama volcano eruption that occurred in 2011 takes place every year until now, Gamalama volcano located in the middle of Ternate Island, like a volcano island that has an area of \pm 40 km² in North Maluku Province. Tugurara River area geologically is the area of the young lava flow that had occurred before the year 2011-2012, i.e., in 1840, 1897 and 1907, with materials such as andesite basalt lumps that taper responsibility to rounded responsibility in the silt and silt matrix off [15]. Lava floods or lava flows that had occurred in the years before and back occurred in 2011, are a result of the amount of runoff water flowing into the river since the last 8 years, is a relationship of high rainfall intensity, which is not infiltrated with either due to a factor of reduced water catchment area, lithology conditions and slope of the slope in the Tugurara River area, so that it can lead to changes in the River [17].

Floods that occur due to a substantial runoff caused by rain and can no longer be accommodated by rivers or drainage channels, in addition to an excessive surface runoff because the soil saturated with water [16]. With the condition of the river like these, landslides on the river wall often occur on the Tugurara River, with an average wall slope of \pm 780 along the field observation with a distance of 2,708 m, from the river mouth [17]. These very threatening to the safety of the community in the three villages (Tubo Village,

Akehuda Village, and Dufa-Dufa Village), which located in the Tugurara River area, observing the increase in population and the built-up area that occurs each year towards the Tugurara River upstream [17]. Thus, it is necessary to analyze public policies based on geological conditions to overcome the threat of disasters in Ternate City due to changes in the Tugurara River.

2. PUBLIC POLICY ANALYSIS THEORY

Public policy analysis, even though it is part of the study of State Administration, is multidisciplinary, because it borrows a lot of theory, methods, and techniques from the study of social science, economics, political science, and psychology. Public policy studies began to develop in the early 1970s, especially with the publication of Harold D. Laswell's article on Policy Sciences. The main focus of this study is on the preparation of policy agendas, policy formulation, policy adoption, policy implementation, and policy evaluation. Public policy according to Thomas Dye (1981: 1) [2] is whatever the government's choice to do or not to do (public policy is whatever the government chooses to do or not to do).

The concept is comprehensive because public policy includes something that is not done by the government besides what is done by the government when the government faces a public problem. For example, when the government found out that a road was damaged and did not make a policy to improve it, the government had taken a system. The definition of public administration from Thomas Dye implies that; (1) the public policy is made by government bodies, not private organizations; (2) public policy involves choices that must be made or not carried out by government agencies. Government policy not to create a new program or to remain in the status quo, for example not paying taxes is public policy. James E. Anderson (1979: 3) [22] defines public policy as a policy set by government agencies and officials although it realized that public policy could be influenced by actors and factors from outside the government. In David Easton's view when the government made public policy, at that time the government allocated values to society because each policy contained a set of values in it [2].

For example, when the government established Indonesia Law No. 22/1999 and later replaced by Law No.32/2004 concerning local government, it was seen that the values to be pursued respected for democratic values and empowerment of local communities and local governments. Harold Laswell and Abraham Kaplan argued that public policy should contain social objectives, benefits, and practices in society [2]. These means that

public policy must not conflict with the values and social practices that exist in society. When the public policy contains values that live in the community, the public policy will be resisted when implemented. Conversely, public policy must be able to accommodate the values and practices that live and develop in society.

The process of public policy analysis is a series of intellectual activities carried out in a political activity process. While problem formulation activities, forecasting, policy recommendations, monitoring, and policy evaluation are more cerebral activities, James Anderson [18] as a public policy expert establishing the following public policy processes; 1) Formulation of the problem: what's the problem? What makes these a matter of policy? How can these problems be included in the government agenda? 2) Policy formulation: how to develop choices or alternatives to solve the problem? Are you participating in the policy formulation? 3) Policy determination (adoption): how is the option set? What requirements or criteria must be met? Who will implement the policy? What is the strategy for implementing policies? What is the content of the established policy? 4) Implementation: who is involved in policy implementation? What are they doing? What is the impact of the contents of the policy? 5) Evaluation: how is the level of success or impact of policy measured? Who evaluates the policy? What are the consequences of policy evaluation? Are there demands to make changes or cancellations? While Howlet and Ramesh [19] stated that the public policy process consists of the following five stages; 1) Agenda setting, which is a process so that a problem can get attention from the government; 2) Policy formulation, the process of formulating policy choices by the government; 3) Decision making, the process when the government chooses to carry out an action or does not carry out an operation; 4) Policy implementation, the method to implement policies to achieve results; 5) Policy evaluation, which is a process to monitor and assess the effects or performance of a policy.

Policy analysis is a review process that includes five components, and each element can change into another factor through specific methodological procedures. For example, forecasting procedures will produce a future policy, and suggestions will give rise to policy actions, and control will produce policy results, and evaluation will generate policy performance.

Public policy is decisions that bind many people at a strategic level (outline) made by public authorities. Henceforth, public policy will be carried out by the state administration run by the government bureaucracy. The main focus in the modern state's public policy is public service,

which is everything that the country can do to maintain or improve the quality of many people life.

Dunn William (2015) [20] distinguishes three main forms in public policy analysis, that is; 1) Prospective policy analysis in the kind of production and information transformation before policy actions are initiated and also implemented. Policy analysis here is a tool to be able to synthesize information used in formulating alternatives as well as policy preferences that are stated comparatively, predicted in quantitative and qualitative languages as a basis for policy decision making; 2) Retrospective policy analysis as the creation and transformation of information after the policy action is taken. There are three types of activity-based analysis developed by these analysis group which is discipline-oriented analysis, problem-oriented analysis, and application-oriented analysis. Of course, of these three types have advantages and disadvantages; 3) Integrated policy analysis is a form of analysis that combines the operating styles of practitioners who also pay attention to the creation and transformation of information before and even after policy actions are taken. Furthermore, this public policy must be reduced in a series of implementation guidelines as well as technical guidelines that apply to the internal in the bureaucracy.

3. RESEARCH METHODOLOGY

Geological and geo-environmental surveys are carried out directly with studies and measurements in the field, while indirect surveys are carried out using analysis of satellite imagery and geographic information systems [17]. Furthermore, the survey data were analyzed statistically to produce a correlation between the influence of geo-environmental changes in the Tugurara River and the threat of flooding [17]. Based on the results, an analysis of public policy theory is carried out to produce an appropriate formulation policy model. These study used the mixed methodology to combine qualitative and quantitative types with an evaluation approach according to William Dunn [20].

The survey and literature review activities were carried out by collecting data and information about laws and regulations, other policy documents, the results of the study, and the flood mitigation policies that had been implemented. Besides, brief and directed interviews were conducted with respondents from the elements: (1) government (decision/policy makers); (2) professionals (intermediaries); (3) the general public (beneficiaries). From the survey and literature review, data were obtained on flood

prevention policies and programs, legislation related to flood mitigation, river basin unit conditions, water resource management systems,

Flood mitigation policies implemented, obstacles in flood mitigation, and community participation in flood mitigation, both in-stream and off-stream. The results of the survey and literature review were mapped into a matrix of policies and regulations and community participation in flood mitigation.

4. RESULTS AND DISCUSSIONS

4.1. Geo-Environmental Analysis

Runoff water discharge is one of the natural factors that led to changes in the Tugurara River area, from the river area of 23,651 m² in 2010, changed to 56,282 m² in 2017 (after Julhija Rasai et al., 2017) [17]. The most significant runoff rate of 102,397 (m³/second) since the last eight years, from 2010-2017, is related to the change in the Tugurara River area in 2013 [17]. The high intensity of rainfall in 2013 can cause runoff water discharge the largest in 2011 resulted in catastrophic lava floods in residential areas in three villages (Tubo Village, Akehuda Village, and Dufa-Dufa Village). This condition is particular compare than another river in North Maluku or others.

The overflow of lava floods that occur in residential areas with the material in the form of lumps of rock > 4 m, sand, gravel and volcanic ash cause damage to residential areas [17]. The amount of runoff water discharge in the Tugurara River area is a relationship of high rainfall intensity, which is not well infiltrated can be caused by a reduction in the water catchment area, lithological conditions such as lava flow and a fairly steep slope in the Tugurara River area [17].

The amount of runoff water discharge in the Tugurara River area is a relationship of high rainfall intensity, which is not well infiltrated can be caused by a reduction in the water catchment area, lithological conditions such as lava flow and a fairly steep slope in the Tugurara River area. The reduced vegetation caused the reduction of water catchment areas in the Tugurara River upstream area due to the use of land in forest areas as plantation land, even now the plantation land has begun to change into the housing which is increasingly pointing towards the upper Tugurara River [17].

The Tugurara River area besides being deposited with young lava flows that occurred in 1840, 1897 and 1907, can also be deposited in basalt andesite lava flows as dark gray lithology, massive and hollow structures of exhausted gas that are not interconnected and somewhat circular

shapes, slightly angled deposited from the upper Tugurara River to the settlement area that occurred in 1907 [15]. The condition of the Tugurara River with some of these factors is that there is a higher rainfall intensity so it can also cause the runoff water discharge, as happened in 2013. Changes in the Tugurara River area occur because the amount of runoff water discharge can crush rocks on the river wall not compact and can cause avalanches along the river wall with an average slope of 78°, especially in the upper reaches of the river. The amount of runoff water discharge can bring material along the river from the size of sand, gravel to lumps and overflow in residential areas as a lava flood disaster in 2013-2014. Runoff water discharge is related to changes in the area of the Tugurara River, and it can be tested or verified using the Product Moment correlation test to see whether there is a relationship between the variables of runoff water discharge and changes in the area of the Tugurara River [17].

Based on the Product Moment correlation test (results test after Julhija Rasai et al., 2017), it is known that runoff water discharge is related to changes in the area of the Tugurara River, with the existence of a very strong positive correlation coefficient [17].

Furthermore, river engineering to prevent surface runoff that can cause floods and the sediment flow hazards has been carried out on several rivers in Indonesia. One of them is the Jeneberang River in South Sulawesi. The landslide of Mount Bawakaraeng and the Jeneberang River overflow in South Sulawesi are the threat of flooding in Makassar City. To anticipate these, Sabo Dam was built along the river as seen in Fig. 1 and Fig. 2. Sabo dam has the primary function as one of the sediment control structure, and the other purposes are to reduce flow energy velocity, during debris flow event [22]. These could be a reference for the Ternate City Government to construct the Tugurara River engineering policy.



Fig. 1 The process of local scouring on the downstream of sabo dam structures (after Maddi et al., 2018)

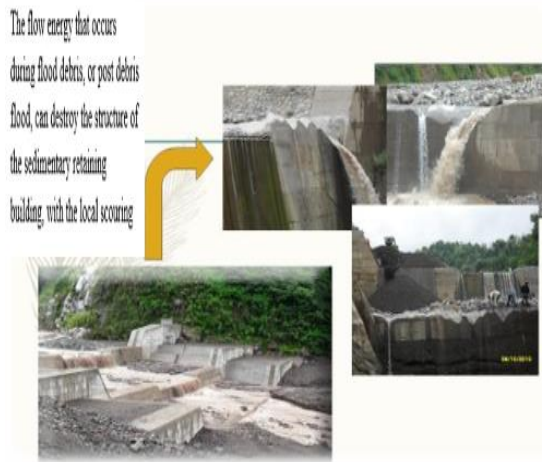


Fig. 2 The process of abrasion on downstream of the Sabo dam structure (after Maddi et al., 2018)

4.2. Public Policy Analysis

Flood mitigation is carried out in stages, from pre-flood (prevention), handling flood (response/intervention), and recovery after the flood. These stages are in a cycle of continuous flood mitigation activities, as in Figure 3 [21] which includes several types of activities. Flood prevention activities follow a cycle (life cycle), which starts from flooding, then examines it as input for prevention before the flood disaster occurs again. Prevention is carried out thoroughly, in the form of physical activities such as flood control development in the river area (in-stream) to the floodplain area (off-stream), and non-physical activities such as land use management to the flood disasters early warning system.

After prevention is carried out, also designed handling actions (response/intervention) when a flood occurs. Action to deal with flood disasters, including notification and dissemination of information about flood forecasting information and dissemination, emergency response, flood emergency response and assistance equipment, and flood fighting. Recovery after floods is carried out as soon as possible, to accelerate repairs so that the general condition usually goes. Recovery measures were carried out starting from assistance with daily living needs, infrastructure improvements (aftermath assistance and relief), rehabilitation and adaptation of physical and non-physical conditions, assessment of material and non-material losses, insurance flood damage assessment, and rapid assessment of the causes of floods for quick reconnaissance studies.

Community participation is a technical process to provide more extensive opportunities and authority to the community so that the city can solve various problems together. This division of administration is carried out based on the level of community participation in the activity.

Community participation aims to find solutions to better issues in a community, by opening more opportunities for the city to contribute so that the implementation of activities runs more effectively, efficiently and sustainably.

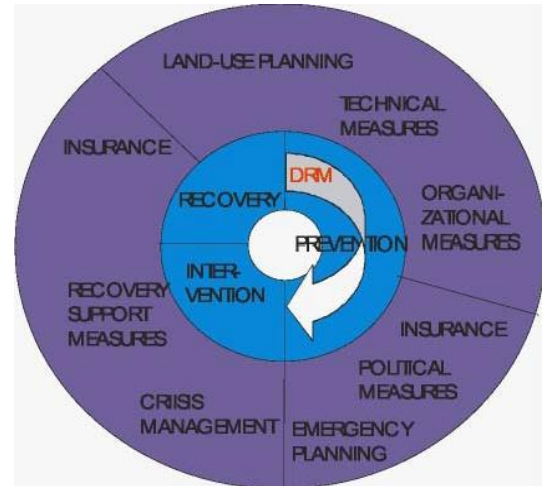


Fig. 3 Disaster Risk Management and Mitigation Circle (after Stephan Bieri, 2003)

The flood mitigation stakeholders are generally grouped into three, that is: (1) beneficiaries, people who benefit directly/indirectly; (2) intermediaries, community groups or individuals who can give consideration or facilitation in flood mitigation, including: consultants, experts, NGOs, and professionals in the natural resources sector; (3) decision/policy makers, institutions that are authorized to make decisions and legal grounds, such as government agencies and water resources councils. In line with people's demands for openness in government programs, government accountability can be assessed from the extent of community participation and stakeholders in development programs community participation, starting from the stage of concept making, construction, maintenance operations, and evaluation and supervision activities.

Determination and sorting of stakeholders is done by the Stakeholders Analysis method which consists of four stages, that is: (1) identification of stakeholders; (2) assessment of stakeholder interest in flood mitigation activities; (3) assessment of the level of influence and benefits of each stakeholder; (4) formulation of a stakeholder participation strategy plan for flood mitigation in each phase of activity. All processes are carried out by promoting learning activities and increasing the potential of the community, to actively participate, and provide opportunities to take part, and have authority in the decision-making process and allocation of resources in flood prevention activities. The level of community participation in flood prevention

activities consists of seven levels based on the interaction mechanism, that is; (1) rejection (resistance/opposition); (2) information sharing; (3) consultation (consultation with no commitment); (4) consensus building and agreement; (5) collaboration; (6) empowerment-risk sharing; (7) empowerment and partnership.

The type and level of community participation will differ depending on the kind of policy or activity. To facilitate the identification of the class and level of community participation in plans or events, the World Bank introduces social assessment which generally categorizes four types of systems or actions based on their characteristics and social impacts, namely: (1) indirect social benefits and direct social costs; (2) significant uncertainty or risks; (3) large number of beneficiaries and few social costs; and (4) targeted assistance. Indirect benefits, direct social costs, policies or activities that provide indirect benefits to the community, but cause social costs. Examples include the development of infrastructure, biodiversity, structural adjustment, and privatization.

Significant uncertainty or risk, a policy to solve problems whose form of resolution is unclear and there are insufficient information and commitment from the target group. Examples include interventions / post-conflict regional development. A large number of beneficiaries and few social costs, policies or activities whose number of beneficiaries or impact is substantial, but only a few cause social costs. Examples of these activities include the development of health, education, agricultural extension, and decentralization - targeted assistance, policies or activities that groups and the number of beneficiaries or impacts have been clearly defined. Examples of these activities include poverty reduction in an area, refugee handling, institutional reform, and victims of natural disasters.

In general, the leading causes of flooding are changes and escalation of human behavior in changing environmental functions. In the area of cultivation, there has been a massive spatial change so that the bearing capacity of the environment has dropped dramatically. The rapid growth of settlements and industry has changed the balance of environmental functions, even the retarding basin area provided by nature has also been spent. This situation significantly decreases water absorption capacity drastically. This condition is worsened by inadequate settlement drainage systems so that in particular rainfall, it causes puddles everywhere. Also, weak law enforcement also encourages the growth and development of illegal settlements on the riverbanks, even entering the river body. This situation worsens the environmental water system

because the capacity and drainage of the river decreases and water overflows occur. Illegal sand mining, especially in flood control areas, which are generally easily accessible also worsens the situation because of the ability of flood control buildings to go down.

On the other hand, it turns out that in the study areas, in general, there has been no effective policy implementation to control deforestation and changes in the function of space in the upstream region. These activities and changes further increase the flow of water that enters directly and quickly into the river body, and ultimately because the capacity of the river to drain and decreased, overflowing river water into residential areas, rice fields, and aquaculture and industrial areas. However, in general, the survey results show that there is no specific legal basis governing flood mitigation, let alone regulating community participation in flood mitigation.

Meanwhile, there are encouraging findings, that is community participation is visible and dominant, especially in emergency response activities. Even together with stakeholder groups from intermediaries, they formed a "fast reaction task force" which independently and without government intervention, was able to provide emergency assistance to flood victims. Field findings show that community participation is driven more by the spirit of solidarity in society, not a result of government efforts to promote it. Looking at community participation at the flood cycle stage, it turns out that it cannot be generalized. In certain scenes, the involvement is substantial and so dominant.

While at other steps it is difficult to find, even none. Need to be analyzed further to identify the type and level of community participation in groups of flood prevention activities. Stakeholder analysis illustrates that not all stakeholders (beneficiaries, intermediaries, and decision/policy makers) have the same role and influence at each stage of flood mitigation. Likewise, each characteristic/type of flood prevention activities requires different types and levels of participation. Following the grouping of activities introduced by the World Bank, three types of policies/activities are found in flood mitigation, that is: (1) indirect benefits, direct social costs; (2) large number of beneficiaries and few social costs; (3) targeted assistance. Indirect benefits, direct social cost activities were identified in structural activities outside the water body (off-stream structural measures) which included activities to increase and develop drainage systems, infrastructure development, water retention facilities, construction of water absorption systems, development polder system, and handling erosion and slope problems. Activities with a large

a number of beneficiaries and few social costs are found in long-term prevention nonstructural measures that include activities for regulating floodplains, controlling land use outside the floodplain, providing space policies, open space reservoir, the policy of public facilities and services, guidelines for surface water management, as well as education and information to the public. Targeted assistance activities were found in the short term flood emergency management activities, especially in pre-flood preparation activities, which consisted of mapping flood-affected areas, storing flood-retaining materials, including sandbags and gabions wire, identification of locations and arrangement of equipment utilization

required, inspection and maintenance of flood control equipment and buildings, and determination and provision of areas and refugee camps.

4.3. Recommendation of Tugurara Flood Disaster Management Policy

Based on the results of public policy analysis in the previous section, the formulation of public policy analysis can be summarized to assist the Ternate City government in developing the best policy in tackling the potential of the Tugurara River flood. (test results after Julhija Rasai et al., 2017) [17].

Table 1. The formulation policies analysis for handling the potential floods of the Tugurara River

Purpose	Criteria	Alternative Policy	
		Local regulation	Regulation of Mayor
Infrastructure development	<ol style="list-style-type: none"> 1. Improved drainage 2. Rehabilitation of river bodies and roads 3. Making residential and river barrier fences 	Involving DPRD, City Government and Community Representatives	City government initiative
Community involvement	<ol style="list-style-type: none"> 1. Public awareness of environmental clean lines 2. Obedience of the community to not build houses/shops on the banks of the river 3. Prohibition of throwing garbage in the river 	Involving DPRD, city government, and community	City government initiative
Network development	<ol style="list-style-type: none"> 1. The existence of river management and disaster management institutions/centers 2. River and disaster management database 3. Discussion / monthly FGD on river management 	Involving DPRD, city government and related stakeholders	City government initiative

5. CONCLUSION

A formulation of public policy analysis on flooding threat in Ternate City based on geo-environmental secondary data analysis has been conducted. The river engineering can refer to the flood prevention model has applied to the Jeneberang River in South Sulawesi by building Sabo Dam along the river, adapted to the unique characteristics of the Tugurara River. Meanwhile, targeted assistance activities were found in short-term flood emergency management, especially in pre-flood preparation activities, which consisted of mapping flood-affected areas, storing flood-

retaining materials, including sandbags and wire gabions, location identification and utilization arrangements: necessary equipment, inspection and maintenance of flood control equipment and buildings, and determination and location management of refugee camps. Furthermore, the critical formulation of public policy alternative carried out by the Ternate City government is infrastructure development, community involvement, and networking development.

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