Sustainability of the climate village program to prevent the impact of climate change on water supply and sanitation: a perspective from the PESTLE analysis

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Abstract. The issue of water sustainability and sanitation has developed in recent years, and it is predicted that by 2030 there will be increasing crises. In accordance with the six SDGs goals, it needs some efforts to ensure the sustainability of clean water and sanitation. The climate village program is one way to increase public awareness of the environment, especially providing clean water and proper sanitation and avoiding uncertain climate threats. This research was conducted with a qualitative approach using political (P), economic (E), social (S), technological (T), legal (L), and environmental (E) analysis in a village that was officially declared as a 'climate village.' Data collected by observation and conducting in-depth interviews with five informants who know deeply about this program. The result shows that the spirit of community cooperation is good enough to prevent environmental problems due to climate change. Every aspect of PESTLE shows a promising development, especially in Social and Environment. Still, it needs improvement for every indicator, especially financial assistance, to provide clean water and sanitation technology resistant to climate disruption.

1. Introduction

A global-scale assessment of the impact of climate change on water scarcity by utilizing the global hydrological model estimates that in 2050 as many as 0.5 to 3.1 billion people will be exposed to increased water scarcity due to climate change [1]. This condition becomes worse because there are still 946 million people who do not have proper sanitation. It also contributes to the transmission of cholera, diarrhea, dysentery, hepatitis A, typhus, and polio [2]. The level of waterborne diseases can be worse because of climate change effect, primarily floods, droughts, and storms that destroy water supplies and sanitary landfills and also pollute water. The cause is due to the high likelihood of inadequate sewage disposal and contaminated environment that spread feces into food and water [3].

Resilience water management requires a science-based approach and innovation in the community to enhance water resources development [4]. Besides, in the issue of climate change, a sustainable sanitation system is a component that needs attention, especially in the disposal of human waste[5]. Thus, increasing community capacity on sanitation will enable communities to have higher and better resilience to adapt to climate change [6].
Minister of Environment Regulation No. 19 of 2012 is a statute for Climate Village Program in Indonesia. One of the necessary policies in this regulation is providing clean water and sanitation for the community [7]. It can help people to solve the problem of clean water crisis and reduce the potential for diseases caused by waterborne disease [8,9]. Furthermore, public awareness of climate is vital to minimize health problems due to poor sanitation [10,11].

Previous research found that health problems due to climate change require further attention from multi-stakeholders and not only be the responsibility of the health sector [12]. This condition is in line with the Climate Village program because it uses promotive and preventive efforts to increase public awareness. Also, it protects the environment to prevent environmental-based health problems.

Research on the climate village program on the supply of clean and sustainable water has not been deeply identified, especially in 'climate villages' areas. Previous research had identified the role of the climate village in dealing with the clean water crisis [9]. However, it is still limited to conservation and has not identified broad factors such as the political, economic, social, technological, legal, and environmental (PESTLE) aspects. Also, in the concept of Sustainable Development Goals, stakeholder cooperation is needed for the success of clean and sustainable water supply (SGDS goal 6), and there is a role for Climate Action (SDGs goal 13) to succeed in these goals [13].

In the Sixth Goal of Sustainable Development Goals, countries in the world agree to ensure the availability of sustainable clean water and sanitation for all [4]. SDG 6 on clean water and sanitation and SDG 13 on climate change are inextricably linked. Climate change experienced will affect changes in the water cycle and affect sanitation provision.

The Paris Agreement on climate change and the 2030 Agenda require each country to increase the resilience of development interventions, including the provision of clean water and sanitation. The benefits of providing clean water and sustainable sanitation will reduce the overall burden of disease on people, especially the poor and marginalized, so that they are better able to cope with other impacts of climate change [14].

2. Method

The approach adopted in qualitative research was carried out through PESTLE analysis. This concept is a framework or tool that is usually used by strategic management to explore the environment in which an activity operates. PESTLE analysis often uses to analyze various problems more deeply so that it can identify more comprehensively. It will find conditions that need to be improved so that a program can run more effectively [15]. PESTLE analysis comes from these components [16]:

1. Politics: factors that determine the government interference can affect an activity.
2. Economy: financial factors that directly affect the operation of a program.
3. Social: Socio-cultural factors involving the population/community that can make a success activity
4. Technology: These factors are technological innovations that can affect the program.
5. Legal: These factors are about policies and laws used by organization and map strategies based on the laws.
6. Environment: These factors are influenced or determined by the surrounding environment.

This research was carried out in a 'climate village' in the province of West Sumatra. The selection of stakeholder informants in the study was determined by purposive sampling. Primary data are collected by obtaining the necessary information from parties who know deeply about the issues raised in the study [17]. There were five informants in this study: the person responsible for the climate village program, the head of the disaster alert group, the head of the hamlet, the village head, and community representation.

The study also examines data relating to the implementation of climate villages in the region using a literature study on provincial, state, and global policies regarding the provision of clean water and sustainable sanitation. The PESTLE approach will facilitate understanding of the dynamics of the problems observed and can be used to trigger further improvements in policy applications [16].
3. Result and discussion

The results of the research listed below have passed source and method triangulation to ensure data validity. The PESTLE analysis carries out to find out the extent to which climate village activities can be successful and sustainable to ensure better environmental management. Also, this analysis can use to describe the provision of clean water and sustainable sanitation.

3.1. Politics

In the context of dealing with climate change, all communities have an essential role. However, the tasks of each party in the area are not clearly spelled out. Even though the district and provincial environmental offices already have a proper job division, there are still many people who do not understand the climate village program. Even so, their behavior has led to activities that reduce environmental pollution. Socialization activities by the government are often carried out suddenly and are less well documented.

“The division of tasks in this program is under the direction of the program stakeholders, especially mothers, to participate a lot from the household scale” (Inf-1)

“What we want to do is not very clear, more to self-awareness to protect the environment” (Inf-2)

“Many people don't know about this program, so what is being done to protect the environment, water, sanitation, is only their awareness” (Inf-3)

“Each sector plays a role in their respective skills” (Inf-4)

“The responsibility of each agency for this program at the district and provincial levels is already running well. But for the village scale, further advocacy is needed from the government” (Inf-5)

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sanitation provision so that there is no overlapping of authority. Each institution involved has an apparent capacity of each constitution so that the determination of position is precise and suitable with the ability owned [21,22]. Therefore, the climate village program is one way to create community and government cooperation to build sustainable access to clean water and sanitation.

3.2. Economy
To ensure the sustainability of the climate village program, the success of this activity comes from the community itself. So that funding to maintain environmental sustainability comes mainly from non-governmental organizations, although there is assistance from donors and community leaders. Funds allocated by the government are limited to community training. Funds from the new Regional Revenue and Expenditure Budget (APBD) are limited to creating a Waste Bank and not assigned to other environmental activities.

"The funding should come from the community itself. Funds are available, but they are directed to the Waste Bank program" (Inf-1)
"Funding for this program is not sufficient, but for the Waste Bank it is already available" (Inf-2)
"There are no special funds for this program, nor do they exist in the APBD, it seems that more funds from the government are for training" (Inf-3)
"I see that there are additional funds from the private sector and DPR members, but more for environmental preservation" (Inf-4)
"Request for funds for the sustainability of this program has been requested from the central government" (inf-5)

In mitigating the impact of climate change on water availability, the government should allocate funds to provide clean water assistance to the community. Especially to disseminate preparedness in dealing with the drought that has an impact on proper sanitation activities. Also, it is necessary to provide funding allocation to buy clean water from the private sector and provide adequate sanitation facilities to avoid health problems due to climate change [23,24].

The economy becomes an essential aspect of community life to survive; the need for clean water is a basic need that must meet for the smooth running of daily activities. The provision of clean water and proper sanitation must be equitable and not limited based on the economic status or financial ability to get clean water and adequate sanitation. As the SDGs big agenda on goal number six says that by 2030 every person on the earth must have access to safe and affordable drinking water. Meaning that in the planning of clean water supply and sanitation must pay attention to economic aspects so that all levels of society can access clean and good water and proper sanitation. Water resources must be regulated and managed, following social, environmental, and economic functions in harmony [4].

The importance of the availability of good and safe water and sanitation improvement should not underestimate, because it is a big challenge and requires extensive investment [25,26]. The government has a responsibility to provide clean water for its citizens so that all levels of society can access clean water and proper sanitation. Besides, the existence of a climate village program is useful to increase public awareness of allocating funds to provide adequate sanitation facilities starting from households. This program will contribute to environmental protection, especially to reduce health problems due to climate.

3.3. Social
Before the climate village program launched, the environmental care program in this area were called "Bumi Ceria." Then, training and socialization was held to increase community involvement in the success of the climate village program. The head of the climate village program gives direction to the community to understand how to protect the natural environment. So, almost all people support for the success of this program. However, there are still people who have not appropriately behaved, especially even throwing trash out of place, and this condition is clogging up waterways and rivers.
"Of course, the benefits of this program will be felt by the community. So, better socialization is needed so that people are more willing to protect the environment" (Inf-1)

"We are unfortunate to see a lot of garbage scattered in drains and rivers, clogging the flow of water, and this affects other things including sanitation" (Inf-2)

"If I see, community participation in this activity is still 30%. There used to be a similar program, called Bumi Ceria" (Inf-3)

"Community participation is more about cooperation with environmental activities carried out by the government" (Inf-4)

"Although not completely, the community has started to support this program" (Inf-5)

The main objective of establishing climate villages is to encourage communities to adapt and take mitigation measures against the various impacts of climate change in their respective environments. However, many people do not understand the importance of the climate village program. People can experience the benefit of this activity, and they can start from simple movements in the household, such as preventing water shortages and scarcity due to climate change. Many efforts are urgently needed in the availability of clean water, individually and communally, such as dug wells, hand pump wells, bore wells, shallow hand pump wells, and rainwater containers. The construction of public hydrants, public taps, and water terminals in the community include in the communal system effort [7].

Clean water and sanitation are basic human needs that have a direct impact on the physical, social, and economic well-being of the community. Making plans and implementing good water supply and management should involve community participation. Therefore, the implementation, supervision, and maintenance of water supply and sanitation installations/systems can run optimally. SDGs goal number six states that by 2030 100% access to clean water and sanitation must be available that is reasonable and affordable for all. This concept confirms that there is no separation in terms of social status to get access to the availability of good and safe clean water, and proper sanitation [22,25,26]. The development of clean water and sanitation infrastructure must balance with the population growth rate. It is crucial to ensure the availability of clean water and proper sanitation facilities. Development in the aspect of providing clean water and adequate sanitation is not permitted by inequality so that progress is equitable for the whole community. Clean water resources are citizens' rights, so in the management and supply of clean water and sanitation, they must not be ruled out in their implementation [25,27].

Uncertain climatic conditions require increased community capacity to collaborate in preventing further impacts [28]. The community's cooperation should integrate with protecting the environment through the climate village program, especially maintaining water sources and working together in maintaining proper sanitation conditions.

3.4. Technology

Climate village programs have not developed as expected because there is no adequate technology to support this activity. The available technology provided is only in the form of garbage chopper machines for waste bank activities. Climate village managers hope there is information sharing about technologies that can be socialized and practiced by the community. So that, people understand how climate conditions are worth watching out for and certainly come from those who truly know about technology and information about climate awareness. At this time, there has been socialization from Meteorological Agency (BMKG) in the form of a climate field school to help read climate and rainfall, which can mainly use for the agricultural sector.

"Supporting technology for this activity is necessary, but it is BMKG who should disseminate the impacts of climate change, including its impact on water availability and sanitation" (Inf-1)

"There is no technology sharing for this activity, but it is expected to come from groups in the community" (Inf-2)

"Nothing else yet, this is to be expected if this activity develops far in the future" (Inf-3)
"Information for this is already available, such as the impact of climate change on disasters such as landslides, floods which can disrupt water availability and sanitation" (Inf-5)

The existence of technology makes human activities easier. In the provision of clean water and sanitation, technology has a central role. Technologies used to purify water that meets the requirements both physically, chemically, biologically, and radiologically according to the conditions in applicable regulations. The existence of technology makes it easy in the distribution process to reach all communities with access to clean water and sanitation. The use of technology makes the community can access clean water and proper sanitation easily. It facilitates the guarantee of quality, quantity, availability, affordability, adequacy, and accessibility in the provision of clean water and proper sanitation [29].

The future investment must prioritize some technologies to ensure the availability of clean water and sanitation to anticipate climate change scenarios. The issue of climate change can be a driver to improve technology in providing the availability of clean water and sustainable sanitation. Water quality, protection of water sources, and the maintenance process of available water supply systems must be guaranteed to be sustainable. This is caused by changing and unpredictable climatic conditions that will create several dangers such as pipe damage due to flooding, many points that become sources of contaminants, leaks, and intermittent supplies that affect large numbers of people. There are several technical adaptations to be carried out, such as identifying various new sources of clean water supply, innovations in the maintenance of clean water and sanitation facilities, and allocating funds to provide more reliable pipe material for reducing leakage [30].

3.5. Legal
Along with climate village regulations that have been issued by the Ministry of Environment, the communities involved expect to work together to increase climate awareness. However, there is no clear law or policy, especially the mechanism of punishment for environmental pollution at the Nagari level.

"There are no rewards/sanctions for activities that pollute the environment" (Inf-1)
"The regulations exist, but society is not yet open in this matter, there are still those who pollute the environment" (Inf-2)
"I clearly state that there are no strict regulations in this area regarding environmental pollution" (Inf-3)
"For now, there are no regulations, let alone sanctions. If there is only a warning" (Inf-4)
"From the central government, there are many rewards for climate village activities. To that end, it will be planned to make village regulations to overcome this" (Inf-5)

In general, the community independently protects the springs from pollution to ensure water availability. It is an effort to preserve the structure of springs, planting vegetation around the location of springs and making local regulations that guarantee springs. Besides, there are local rules that ensure the springs remain alive. There is a mandatory mutual cooperation rule once a month. If some people do not attend the activity, they will get equivalent fines or other sanctions.

Proper clean water if its quality meets health requirements and can be drunk after cooked. Water quality must meet health requirements that include microbiological, physical, chemical, and radioactive requirements. Therefore it is necessary to control water quality to prevent water quality degradation that can endanger the health [31].

The provision of clean water and proper sanitation must have clear and legally binding policies and regulations so that their implementation can be legally controlled. The available regulations must always be developed following existing situations so that no expired rules that are no longer relevant to the situation. Legal certainty is needed to manage clean water supply and proper sanitation so that the application of established rules can carry out optimally. Regulations issued must be followed by binding sanctions so that strict penalties can be given [20,27]. Also, better regulation is essential for better water
and sanitation services, especially the increasing population growth at this time. This will increase the demand for water and access to proper sanitation [32].

3.6. Environment
The community has local wisdom to protect the environment, such as saving water sources and cooperation to protect forests. This is indirectly supporting the success of the climate village program. The beautiful environment in this area also supports the success of the climate village program. However, more than half of the community's clean water sources in this area come from dug wells or shallow groundwater. Not all people receive 100% proper drinking water services according to the government's target.

"The role of the climate village is quite good, and the goal in protecting the environment is comprehensive, and the community has been empowered to do this" (Inf-1)

"This program is beneficial for maintaining the climate. So that the environment is maintained. The beauty of the environment in our area supports the success of this activity" (Inf-2)

"The culture of cooperation is a social-environmental factor that can make this program successful, so that it can reduce environmental problems (water and sanitation)" (Inf-4)

"We have local wisdom closely related to the success of the climate village program, for example, in saving water sources. There is also a protected forest program to keep water sources sustainable" (Inf-5)

In low-lying areas, there is generally enough shallow groundwater. If there is no other source of drinking water, shallow groundwater is the primary source of drinking water, and the community digs some wells there. If well water becomes the primary source of water, then the proper wells' construction must be considered. It needs to evaluate regularly to prevent scarcity of clean water. Poor water quality can cause water contamination, acidity, and dirty water. Pathogen contamination is also known to have been detected in groundwater [33].

Environmental conditions in this area are quite good, but there are still people who have open clean water reservoirs that become mosquito breeding grounds. Waste management in this area is still inadequate and insufficient. This condition has the potential for several climate-related diseases such as dengue and malaria.

One issue that arises due to climate change is changing rainfall patterns. This causes a reduction in the availability of clean water for sanitary hygiene. Water for hygienic hygiene purposes should be protected from pollution sources, disease-carrying animals, and vector breeding sites are safe from possible contamination [34].

The health sector is vulnerable to climate change, so it is essential to protect the health sector from its impact. Environmental conditions significantly affect health status. If environmental does not meet good conditions, it can cause various health problems in the community. Poor ecological sanitation can cause the transmission of some diseases to continue to spread, such as malaria, tuberculosis, filariasis, dengue hemorrhagic fever, cholera, and diarrhea [35].

The implementation of the efforts to provide clean water and sustainable sanitation must ensure the safety of the origin of water at the source and avoid pollution and contamination. The source of clean water is a minimum of 10 meters from a septic tank or source of fecal contamination. It prevents infection or contamination either by physical, chemical, or biological factors. Besides, the presence of vegetation around the source is to ensure the availability of water because the trees are useful as water retainers in the soil. Construction in the provision of clean water must be provided reliable, sturdy, dense water and not leak easily. Therefore, it can avoid pollution, hygiene, and comfort, not damage the scenery, and are safe for the environment and living things [36].

The existence of a climate care community formed from the climate village program is expected to prevent environmental vulnerability to climate uncertainty, impacting the availability of clean water and
sanitation. Related to public health, climate change adaptation is one of the preventive approaches, which is the approach of public health science in preventing environmental problems [37].

4. Conclusion
The government needs to make clear policies to guide the implementation of climate villages, mainly to provide clean water and sustainable sanitation. Although the source of funding for climate villages is mostly from the community, the government needs to allocate funds to provide qualified technology to provide clean water and sanitation, especially when climate problems occur. The atmosphere of community cooperation is good enough, but clear regulations are needed to follow up on violations that can pollute the environment.

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