STEM LITERACY AS THE KEY TO THE SURVIVAL OF A SINKING VILLAGE

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ABSTRACT

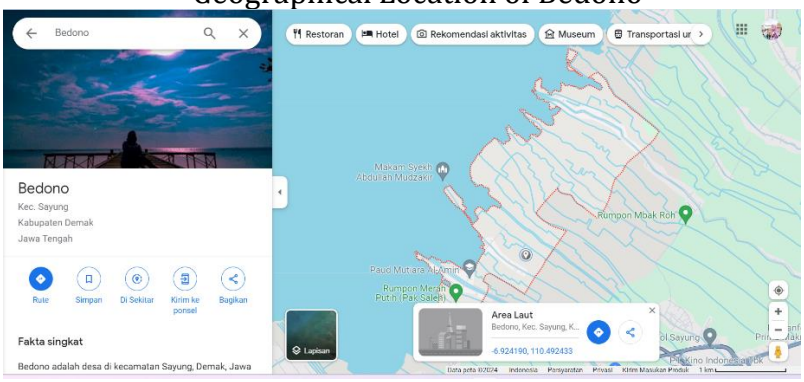
Bedono Sinking Village in Indonesia exemplifies the challenges faced by coastal communities due to rising sea levels. This study investigates how STEM literacy empowers residents to adapt. A qualitative case study approach was employed, utilizing semi-structured interviews and document analysis. Findings reveal that rising sea levels have significantly impacted livelihoods and social structures. However, villagers have demonstrated resilience through adaptation strategies like raising houses and planting mangroves. The study emphasizes the importance of STEM literacy in understanding the phenomenon, developing innovative solutions, and increasing community awareness. By improving access to STEM Skills (Communication, Creative, Critical Thinking, Collaboration) can build a more sustainable future in the face of climate change.

Keywords: Sea level rise, Adaptation, Sinking Village, Resilience, Collaboration

INTRODUCTION

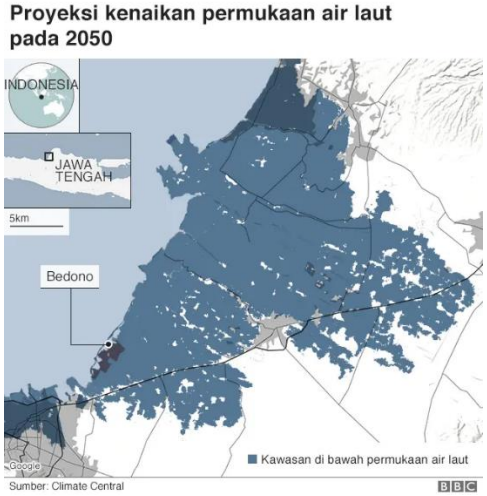
Bedono Sinking Village in Sayung Demak, Central Java, is like a nature painting canvas that tells the tragic story of climate change. In the past, this village was surrounded by rice fields and fertile pond land, becoming a source of livelihood and prosperity for the community. However, over the past 24 years, seawater has inundated and submerged much of its territory, turning this village into an ocean and forcing its inhabitants to live on water. This phenomenon is clear evidence of the real impact of sea level rise which is increasingly threatening and challenging the survival of coastal communities.

Picture 1:
Geographical Location of Bedono



Sea level rise is one of the most significant consequences of global climate change (IPCC, 2021). The main cause is global warming, which results in melting ice at the poles and glaciers in the mountains (Rheinberger et al., 2016). On the other hand, the thermal expansion of seawater due to rising temperatures also contributes to sea level rise (Cazenave & Nerem, 2014). The impact of sea level rise is not only limited to the submersion of coastal areas, but also brings various other consequences, such as coastal erosion, saltwater intrusion, and changing weather patterns (Nicholls et al., 2014). Bedono Sinking Village is a silent witness to the real impact of sea level rise. The lives of rural communities have changed drastically, their livelihoods are threatened, and anxiety about the future looms over them. This phenomenon raises a critical question: How can society adapt and find solutions to deal with this environmental crisis? This is where the role of STEM (Science, Technology, Engineering, and Mathematics) literacy becomes very important.

Picture 2:
Sea Level Rise Projection 2050



Source: BBC 2020

STEM literacy is not only about scientific and technical knowledge, but also about critical thinking, problem-solving, and effective communication skills (DeBoer, 2008). In the midst of environmental crises such as sea level rise, STEM literacy is key for society to understand complex phenomena, identify appropriate solutions, and take responsible action (Barron et al., 2007). Through a scientific understanding of sea level rise, communities can take appropriate adaptation measures. For example, raising the floors of houses, building embankments, and planting mangroves (Mazda et al., 2015). On the other hand, STEM literacy also opens up opportunities to develop innovative solutions, such as desalination technology to overcome saltwater intrusion, or more advanced tsunami early warning systems (Lowe et al., 2009). Indonesia, with a coastline of 91,000 kilometers and a coastal population of 60 million people, is a country that is very vulnerable to the impact of sea level rise (BNPB Disaster Data and Information Center, 2022). Therefore, STEM literacy is becoming increasingly important in the Indonesian context to:

1. Increasing public awareness: The public needs to understand the causes, impacts, and solutions of sea level rise. STEM literacy can help them get accurate and reliable information.
2. Develop adaptation strategies: Coastal communities need to be equipped with the knowledge and skills to adapt to environmental changes. STEM literacy can help them design and implement appropriate adaptation strategies.
3. Driving innovation: Innovative solutions are needed to address the impacts of sea level rise. STEM literacy can encourage scientists, technologists, and engineers to develop appropriate and sustainable solutions.
4. Build effective policies: Governments need to formulate appropriate policies to address sea level rise. STEM literacy can help stakeholders understand the data and information needed to formulate effective policies.

Some of the research and implementation of STEM literacy that are relevant to the context of sea level rise in Indonesia include:

1. Research on mapping coastal areas that are vulnerable to sea level rise (Research Center for Marine Science and Technology, LIPI, 2018).
2. Development of desalination technology to overcome saltwater intrusion (Agency for the Assessment and Application of Technology, 2020).
3. Development of a tsunami early warning system based on information and communication technology (Meteorology, Climatology, and Geophysics Agency, 2022).
4. Marine literacy education for children in coastal areas (Neri Kautsari, 2022)

METHOD

This study uses a qualitative method with a case study approach. The case study approach was chosen because it allowed researchers to conduct in-depth and detailed research on the situation in Bedono Sinking Village, focusing on how STEM literacy is helping communities adapt to sea level rise.

Data Collection Techniques:

1. Semi-structured interviews: Semi-structured interviews will be conducted with two main respondents: the Village Head and Mak Jah. The interviews will focus on their experiences with sea level rise, the adaptation strategies they use, and the role of STEM literacy in the adaptation process.
2. Documentation: Related documents, such as research reports, news articles, and government policies, will be collected and analyzed to gain a more comprehensive understanding of the situation in Bedono Sinking Village and the adaptation efforts undertaken in Indonesia in general.

Respondents:

1. Village Head: The village head has extensive knowledge and insight into the situation in Bedono Sinking Village and government policies related to sea level rise adaptation.
2. Mak Jah: Mak Jah is one of the villagers who still lives in the middle of Bedono Sinking Village. He can provide information about personal experiences and adaptation strategies used by village communities.

Interview Procedure:

1. The interview was conducted directly in Bedono Sinking Village.
2. Interviews are recorded with the consent of the respondents.
3. Interview transcripts will be created and analyzed thematically.

Data Analysis:

a. Thematic Analysis: Data from interviews and documentation will be analyzed thematically to identify emerging patterns and themes. These themes will then be used to build an understanding of how STEM literacy is helping communities adapt to rising sea levels.
b. Content Analysis: Content analysis will be used to analyze related documents to obtain information on policies, programs, and research related to STEM literacy and adaptation to sea level rise in Indonesia.

Picture 3:
Mak Ijah's house

This study uses a qualitative method because it allows researchers to understand in depth and in detail the experiences and perspectives of the two main respondents in dealing with sea level rise. The case study approach was chosen because it allows the researcher to focus on one particular case and conduct in-depth research on the situation in the village. Semi-structured interviews were chosen as the primary data collection technique because they allow researchers to obtain rich and in-depth information from respondents. Documentation is also collected to supplement the data from the interviews and provide a broader context.

Thematic analysis and content analysis are used to analyze qualitative data. Thematic analysis allows researchers to identify patterns and themes that appear in the data, while content analysis allows researchers to analyze related documents to obtain information on policies, programs, and research related to STEM literacy and adaptation to sea level rise in Indonesia. In literature studies, data analysis procedures and techniques are essential to ensure that research is conducted systematically and credible. Clear and well-defined procedures allow researchers to document the steps taken during the study, while proper data analysis techniques allow researchers to extract meaning from the data collected.

In this study, data analysis procedures and techniques are described in detail to allow readers to understand how the research was conducted and how conclusions were drawn. This is important to increase the transparency and credibility of research. This study uses a qualitative method with a case study approach to examine how STEM literacy helps the people of Bedono Sinking Village adapt to sea level rise. Semi-structured interviews with two main respondents and documentation were used as data collection techniques, and thematic analysis and content analysis were used to analyze qualitative data. Procedures and techniques for data analysis are described in detail to ensure that research is conducted systematically and credible.

FINDINGS AND DISCUSSION

Bedono Sinking Village, located on the northern coast of Java, Indonesia, has experienced significant impacts due to sea level rise over the past 24 years. This phenomenon has drastically changed the landscape of the village, submerging rice fields, ponds, and even people's houses. Sea level rise has drastically changed the spatial layout of villages. Rice fields and ponds that were once fertile and the main source of livelihood for villagers have now been turned into the sea. Houses near the coast were also in danger of being submerged, forcing them to move to higher ground. Sea level rise also has a significant impact on the social and economic life of villagers. Their main livelihoods, namely farming and fishing, have been disrupted. This leads to a decrease in income and an increase in poverty. Villagers also experience stress and anxiety due to the uncertainty of the future.

The residents of Bedono Sinking Village have shown persistence and resilience in facing this challenge. They have made various adaptation efforts to survive, such as:

1. Elevating Houses: Villagers have raised their homes to avoid rising sea levels.
2. Building Embankments: Embankments have been built along the coast to protect villages from erosion and flooding.
3. Planting Mangroves: Mangroves are planted along the coastline to help reduce erosion and protect villages from ocean waves.
4. Switching Livelihoods: Villagers have switched to other livelihoods, such as trading and making handicrafts.

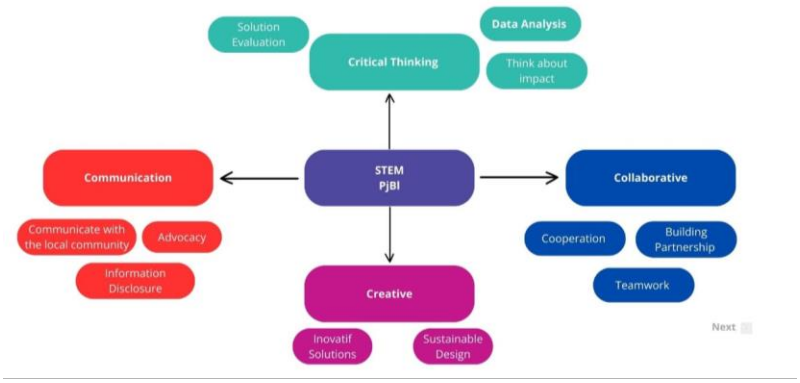
Figure 4:
Mangrove forest

SKILLS FROM THE MAK IJAH CASE: BEDONO SINKING VILLAGE
STEM SKILLS:

1. Communication:
   a. Effective Communication: Communicate with the local community to understand their situation and needs.
   b. Advocacy: Advocating for policies and solutions to address sea level rise and help affected communities.
   c. Information Disclosure: Disseminating information about climate change and its impacts to the wider community.
2. Creative:
   a. Innovative Solutions: Developing innovative solutions to help coastal communities adapt to climate change.
   b. Sustainable Design: Designing eco-friendly and sustainable solutions to protect coastal villages.
3. Critical Thinking:
   a. Data Analysis: Analyzing scientific data on climate change and sea level rise.
   b. Solution Evaluation: Evaluating the effectiveness of different solutions to address sea level rise.
   c. Critical Thinking: Think critically about the impacts of climate change and its implications for society.
4. Collaboration:
   a. Cooperation: Working with local communities, governments, and non-governmental organizations to address sea level rise.
   b. Building Partnerships: Building partnerships with various parties to support climate change adaptation and mitigation efforts.
   c. Teamwork: Work together in a team to develop and implement effective solutions.

The story of Mak Ijah and Bedono Sinking Village offers many valuable learnings about STEM, communication, creativity, critical thinking, and collaboration. By applying these skills, we can help communities affected by climate change and build a more sustainable future.

Figure 5:
STEM SKILLS



STEM literacy, which refers to the ability to understand and apply science, technology, engineering, and mathematics, can play a crucial role in helping the people of Bedono Sinking Village adapt to sea level rise and build a more sustainable future.

a. Understanding the Phenomenon of Sea Level Rise: STEM literacy can help villagers understand the causes and impacts of sea level rise. This can help them make more informed decisions about how to adapt to changing environments.
b. Developing Innovative Solutions: STEM literacy can encourage villagers to develop innovative solutions to address the challenges faced by sea level rise. For example, they can design flood early warning systems, develop desalination technologies to get clean water, or build structures that are more resistant to seawater.
c. Increasing Community Awareness and Participation: STEM literacy can increase public awareness of the importance of adaptation to climate change and encourage them to participate in adaptation efforts.

Based on the findings of the research, here are some recommendations to improve STEM literacy and adaptation in Bedono Sink Village:

a. Improving Access to STEM Education: Governments and non-governmental organizations must work together to improve access to STEM education for villagers. This can be done by providing training programs, building educational infrastructure, and providing easily accessible learning materials.
b. Developing STEM-Based Adaptation Programs: Adaptation programs designed specifically for the Bedono Sinking Village should be developed. The program should involve villagers in the planning and implementation process, and should utilize their STEM knowledge and skills.
c. Supporting Local Innovations: Local innovations developed by villagers should be supported and promoted. This can be done by providing funding, training, and access to the marketplace.
d. Enhancing Collaboration Between Parties: Collaboration between governments, non-governmental organizations, academics, and villagers must be enhanced to address the challenges faced by sea level rise.
e. Promoting Policies that Support Adaptation: Policies that support adaptation to climate change must be promoted at the local, national, and international levels. This policy must consider the needs and perspectives of vulnerable communities, such as Bedono Sinking Village.

The rise in sea level in Bedono Sinking Village is a clear example of the impacts of climate change faced by coastal communities around the world. STEM literacy can play an important role in helping society adapt to these changes and build a more sustainable future. By improving access to STEM

education, developing STEM-based adaptation programs, supporting local innovation, increasing collaboration, and promoting policies that support adaptation, we can help Villages.

CONCLUSION

Bedono Sinking Village, with its sad story of the sinking of settlements due to sea level rise, is a stark reminder of the urgency of action and adaptation in the midst of the climate crisis. In the midst of despair, a glimmer of hope appears in the form of STEM literacy. STEM knowledge and skills empower communities to understand these complex phenomena, formulate innovative solutions, and build resilience in the face of environmental change. Adaptation efforts carried out in this village, such as raising houses, building embankments, and planting mangroves, show the great potential of STEM literacy in real action. However, there is still a lot to do. Expanding access to STEM education, designing STEM-based adaptation programs, and supporting local innovation are key to a more sustainable future. Collaboration between parties, from the government to rural communities, is essential to strengthen STEM literacy and encourage collective action.

The story of Bedono Sinking Village is not only about tragedy, but also about determination and resilience. With STEM literacy as a compass, they are on the path of adaptation and building a future where humans and nature can coexist harmoniously.

Closing Message:

a. The Importance of STEM Literacy: STEM literacy is not only about science and technology, but also about critical thinking, problem-solving, and effective communication. In the midst of the climate crisis, STEM literacy is the key for society to understand, adapt, and build a sustainable future.
b. Active Role of Communities: Village communities, as key agents in the adaptation process, need to be empowered with STEM knowledge and skills. They must be involved in formulating solutions and taking concrete actions to address the impacts of climate change.
c. Multi-stakeholder cooperation: STEM literacy adaptation and development efforts require collaboration from various parties, including governments, non-governmental organizations, academics, and rural communities. Synergy and cooperation between parties are the key to achieving effective and sustainable solutions.

d. Building Hope: The future of Bedono Sinking Village and other coastal communities around the world is fraught with challenges. However, with STEM literacy as a tool and collaborative spirit, they have the potential to build resilience, innovate, and create a brighter future.

The Bedono Sinking Village is a reminder that the climate crisis is not only a global issue, but also a local reality that has a direct impact on people's lives. By making STEM literacy a key pillar, we can empower them to adapt, recover, and build a more sustainable future amid climate change.

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