

Improving Disaster Resilience in Small Islands: Sustainable Strategies for Adaptation and Mitigation

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Abstract

Bawean is a small island where it is the pulse point of the Indonesian Archipelago which is located in the middle of the archipelago and right on the equator. The objectives of this study are Analyzing socio-ecological systems, resilience as a concept is crucial, especially in the context of robustness, vulnerability, and sustainability. This research method includes: (1) Research Question is a stage where the author explains the core problems that will be studied in this paper; (2) Quality Assessment, is a stage carried out by researchers to identify potential literature related to the title presented; (3) Data Extraction, is a stage carried out to select the literature used and examine more deeply related to the observed object; (4) Data Synthesis and Analysis, knowing interpretations related to A Socio-Ecological Systems Approach Disaster Resilience for Small Islands and to detect follow-up to performance findings. The conclusion in this discussion refers to three topics related to social resilience, namely related processes that pay particular attention to human resilience in order to improve human capacity to recover from disasters in the shortest amount of time, related to ecological resilience, where ecological resilience is the maximum amount of energy or disturbance that a system can tolerate before experiencing a shift in its stability domain, and related to economic resilience, where it relates International organizations, academics, and policymakers are starting to appreciate the importance of community resilience.

Keywords: Disaster Resilience, Small Islands, Socio-Ecological



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Introduction

Resilience has gained increasing attention over the past few years as a key idea in catastrophe preparedness, emergency response, and crisis recovery (Zhang, 2022). Communities need a networked social support system that combines individual readiness and response with community resilience to withstand and recover from public health emergencies (Norris et al., 2008). Tangible and intangible components of community resilience are present (Cohen et al., 2013). As a result, measuring community resilience requires either monitoring local economic and social capital indicators or gathering locals' perspectives (Sherrieb et al., 2010). How resilient a community is viewed by the general public reflects public trust in the town's ability to withstand disasters and recover from them (Zhang & Shay, 2019).

In the wake of a common calamity, community members can examine the community's weaknesses and strengths, take additional steps to strengthen their adaptive skills, and thereby build a more resilient community (Pfefferbaum & Klomp, 2013). Social capital and psychological coherence, leadership credibility, community efficacy overall, place connection, and social trust within the community are the five main variables that can be used to evaluate perceived community resilience (Cohen et al., 2013; Leykin et al., 2013).

Socio-ecological resilience refers to the capacity of interconnected social and ecological systems to adapt to changes and disturbances while maintaining functionality and supporting human well-being. For instance, Suryono et al. emphasize that socio-ecological resilience in coral reef ecosystems is crucial for sustaining local communities that depend on these resources for their livelihoods (Suryono et al., 2022). This interdependence underscores the

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need for integrated strategies that consider both ecological health and social dynamics. In the context of small islands, such as the Maldives, the "Safer Island Concept" developed post-2004 Indian Ocean tsunami illustrates the necessity of designing disaster resilience strategies that address multiple hazards, rather than focusing solely on singular events like tsunamis (Riyaz & Park, 2010). This holistic approach is essential for reducing vulnerability to more frequent and imminent disasters, such as storms and flooding.

Moreover, the socio-ecological framework facilitates a deeper understanding of the complexities involved in disaster risk management. For example, the work of Zevenbergen et al. highlights that socio-ecological resilience encompasses the interactions between human and natural systems, which evolve over time and are characterized by uncertainties (Zevenbergen et al., 2020). This perspective is critical for developing adaptive management strategies that can respond to changing conditions and emerging risks. Similarly, the findings of Ismail et al. suggest that the nexus between sustainability and disaster resilience is dynamic, necessitating an integrated approach to post-disaster reconstruction that considers socio-ecological impacts (Ismail et al., 2017).

The role of community engagement and local knowledge in fostering resilience cannot be overstated. Research by Cayamanda indicates that a bottom-up approach, which involves local communities in resilience-building efforts, is vital for effective disaster management (Cayamanda, 2020). This participatory model not only enhances local capacities but also ensures that strategies are culturally relevant and context-specific. Furthermore, the integration of indigenous knowledge into disaster risk reduction plans has been shown to improve the effectiveness of these strategies, as evidenced by the experiences shared in studies from various regions, including Chennai, India (Tajuddin & Dąbrowski, 2021).

In addition to community involvement, the importance of institutional frameworks and governance in promoting socio-ecological resilience is evident. Effective disaster risk management requires coordinated efforts across multiple levels of governance, as highlighted in the research on cross-jurisdictional disaster preparedness (Eneh, 2024). This coordination is essential for developing comprehensive strategies that encompass both mitigation and adaptation measures, ensuring that small islands can effectively respond to and recover from disasters.

The island of Bawean, which is one of Indonesia's islands, is situated in the region of East Java Province's Gresik Regency. The Indonesian Archipelago's heartbeat, Bawean, is a tiny island that sits directly on the equator in the midst of the archipelago. Bawean Island appears to be a virgin girl always driven to better herself in order to overcome her sluggishness in the middle of the pace of progress brought about by the growth of regional autonomy. The potential of natural resources has therefore started to be rampantly activated. For instance, in agriculture, 6,043 ha of rice fields with an average yield of 3.5 tons per hectare are planted with rice. Cassava, sweet potatoes, soybean corn, peanuts, and other palawijaya are also available. Palm sugar, vegetables, bananas, durian, breadfruit, and red fruit are more produce items.

Cob fish, grouper, kite fish, and benggol fish, which can be converted into pindang fish, are among the fish that are used as game in the fishing industry. Products made from pindang fish on the island of Bawean once enjoyed strong competition. So that this pindang fish product can enter the markets of important Javan cities like Surabaya, Jakarta, Bandung, and even enter Singapore's export market through the Tanjung Pinang port. Bawean pindang fish is made in the traditional manner, however there is no question about the quality. Fish from Bawean can live for up to two months. The fame that this Bawean pindang once enjoyed is now simply a depressing tale. Since the 1980s, Bawean Island's fish farming industry has struggled, and as a result, some business owners have shut their doors from ongoing losses.

Seaweed is a marine crop that is currently the subject of intense development in Jatidawang Bay. What is wanted as a raw material for cosmetics for export to Japan.

Additionally, some Bawean Island residents engage in livestock activities for economic support, especially as Bawean Island is a rather ideal location for cattle raising. The coconut plantation industry is also being developed by the Bawean community. There are undoubtedly coconut trees in practically every resident's yard. Additionally, people in some areas weave pandanus, which is used to make mats, wall hangings, school bags, and other items. Malaysia and Singapore are the target markets for these products. Another intriguing development is that the residents of Bawean Island have started to engage in marble mining to boost their income, particularly in Sangkapura District. It's unfortunate that mining still uses outdated technology. His work continues to involve the use of labor from places outside than the island.

The purpose of this study is where for island peoples, islands do not only mean territorial locus, but cultural locus and personal locus, because it has a self-concept and meaning as a space of existence. Every island community always identifies and conceives itself in a socio-ecological.

Literature Review

The integration of socio-ecological approaches in enhancing disaster resilience in small islands is a critical area of research, particularly given the unique vulnerabilities these regions face due to their geographical and socio-economic contexts. This literature review synthesizes key findings from various studies that explore the interplay between social and ecological systems in the context of disaster risk reduction and resilience building.

Small islands are particularly susceptible to natural hazards, necessitating a nuanced understanding of local capacities and vulnerabilities. Rampengan et al. argue that disaster risk reduction strategies should prioritize building local livelihood resources alongside protective infrastructure, emphasizing that enhancing local capacities is essential for effective disaster management (Rampengan et al., 2014). This perspective aligns with the findings of Añasco et al., who highlight the importance of assessing community characteristics such as connectedness and available resources to improve resilience against disasters (Añasco et al., 2021). Their study underscores that a community's ability to measure and understand its vulnerabilities directly contributes to its capacity to survive and recover from adverse events.

The concept of socio-ecological resilience is further elaborated by Suryono et al., who define it as the capacity of social-ecological systems to adapt to changes and support human well-being (Suryono et al., 2022). This definition is crucial for small islands, where ecological health is often directly linked to the livelihoods of local communities. The work of Tajuddin and Dąbrowski reinforces this notion by exploring operational aspects of socio-ecological resilience, identifying barriers to resilience, and suggesting potential pathways for change through community engagement and multi-level approaches (Tajuddin & Dąbrowski, 2021). Their findings indicate that fostering resilience requires a comprehensive understanding of both social dynamics and ecological conditions.

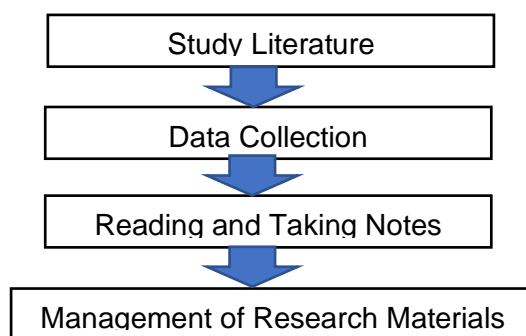
Community engagement emerges as a central theme in building disaster resilience. Cayamanda emphasizes the significance of a "bottom-up" approach, which involves local communities in disaster preparedness and response planning (Cayamanda, 2020). This participatory model not only enhances local capacities but also ensures that strategies are culturally relevant and context-specific. Similarly, Johnston's research highlights the necessity of establishing local committees for disaster management, advocating for proactive community involvement in disaster preparedness (Johnston, 2014). Such community-driven initiatives are essential for creating resilient social networks that can effectively respond to disasters.

Moreover, the integration of ecological and social resilience concepts is vital for developing adaptive management strategies. Matin and Taylor discuss the need for bridging gaps between human resilience and ecological systems, advocating for a systems approach that considers both environmental and social factors in disaster risk management (Matin & Taylor, 2015). This integration is echoed by Folke et al., who view socio-ecological systems as

complex adaptive systems, emphasizing the importance of understanding their dynamics to enhance resilience (Folke et al., 2016). The adaptive capacity of these systems is crucial for responding to the uncertainties and complexities associated with natural hazards.

Method

In the study entitled A Socio Ecological Systems Approach Disaster Resilience for Small Islands, this research will use the literature study method. The literature study method according to (Kartiningasih, 2015) is a method that consists of a series of activities related to data collection, reading and recording to managing research materials.



Source: Kartiningasih, 2015

Figure 1. Stage Study Literature

Kartiningasih also stated that the literature study method is carried out by all researchers with the same goal, namely looking for a basis or foundation for obtaining and building a mindset, frame of mind to hypotheses or temporary conjectures of research. The research will be carried out by collecting data from official sources and papers related to the purpose of the research carried out.

This research method includes: 1) Research Question is a stage where the author explains the core problems that will be studied in this paper. This stage is carried out by conducting a deeper literature study of A Socio Ecological Systems Approach Disaster Resilience for Small Islands. 2) Quality Assessment, is a stage carried out by researchers to identify potential literature related to the title presented. This stage is carried out using related literature that is considered to have the potential to support data to literature that is not in line with existing data such as community resilience, social, environmental, and others. 3) Data Extraction, is a stage carried out to select the literature used and examine more deeply related to the observed object. This stage is carried out by selecting the literature that corresponds to the results of the observation, then select the appropriate literature. 4) Data Synthesis and Analysis, knowing interpretations related to A Socio Ecological Systems Approach Disaster Resilience for Small Islands and to detect follow-up to performance findings.

Then the purpose of this research in the last stage is to conduct a study of the data that has been obtained from the literature by comparing the statements written by the researcher with the results we find. This stage will determine whether the data obtained is comparable or not to the literature used, while the literature used can not be comparable to the existing data.

Result and Discussion

Community resilience in the face of global catastrophes shows potential for enabling individuals and their communities to overcome obstacles and devise radical mitigation measures (Robertson et al., 2021).

In order to improve people's capacity to recover from disasters as quickly as possible, a related approach gives special consideration to human resilience. This strategy acknowledges the fact that communities have shown some resilience throughout time. Local

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adaptation tactics, community culture, tradition, knowledge, and experience are the cornerstones for constructing resilience (Manyena, 2006). One of the East Javan islands, Bawean Island is situated in the Gresik regency's north. This island, which is a part of Gresik regency and contains two subdistricts, is crucial to preserving the independence of the Republic of Indonesia. The population of the two islands continue to suffer a number of difficulties, both internally in light of their relative distance from the seat of administration and outside. This implies that the social resilience of this archipelago is susceptible to a range of changes in the environment, security politics, economy, and sociocultural norms.

The Bawean people have a reputation for being nomadic or migrating to other islands and other parts of the world. Java, West Kalimantan, Bangka and Belitung, and Batam are the archipelagic regions that the Bawean people migrate to. In the meantime, Australia, Singapore, Malaysia, Brunei Darussalam, Vietnam, and the Bawean people migrate to these nations. For the most part, Baweans migrate to Malaysia and Singapore. These two nations have almost 70% of the Bawean population. Typically, people come back to Bawean during the summer or during the month of Ramadan. It makes sense that transportation to Bawean is often congested and full during Ramadan since not only students and those studying in Java but also Bawean migrants who have lived in Malaysia and Singapore also return to Bawean.

Likewise, the social people of Bawean Island have a high social spirit and are good among others. This is in accordance with the interview of the Government Section as follows:

"The social conditions are always helpful, usually if you lower the boat, you can gotong royong so yes the sense of humanity is high"

The statement above explains that the social conditions of the people of Bawean Island uphold kinship between each other. The same opinion was also expressed by the Village Apparatus as follows:

Alhamdulillah, "the community here is still classified as harmonious and compact and the family is still quite close. The daily social conditions of the people of Bawean island can be said to be quite harmonious, social, and enthusiastic in helping each other both in terms of difficulties and things that are happy, such as examples of organizing events and others."

From the aforementioned interview, it can be seen that the Bawean community has a strong sense of community, supports one another, and exhibits a high level of empathy and collaboration. This group is also highly energetic and upholds a strong sense of family. The soul manifests on its own, unaided by anyone.

When a system crosses more than one domain of stability, this resilience with many domains contains a behavior that is dynamic and more general, enabling it to reach alternate stable states. It considers a number of stable states in addition to the system's overall resilience to shocks that may cause domain-shifting movements. Ecology places more importance on several stable states than on a single global equilibrium. Multiple stable states are also more common in natural systems (Matsinos, 2008).

The people of Bawean island where the people have a hard work spirit in fulfilling daily life.

"The natural resources are plenty, the supporters are there, and the work ethic is still high. However, the facilities and human resources are weak, therefore it is required to increase the village's and other connected organizations' assistance. The budget is taken from the APBDes earlier from the village fund from what funds need to be in the future in that manner is evident from the relevant agencies, for example,

from the sub-district and from the fisheries service, if from the village the village invites people who are competent."

The aforementioned assertion can be taken to mean that the Bawean Island population still values hard labor and that their natural resources are plentiful. The coastal community of Dekatagung Village's problem, however, is that it still lacks adequate human resources and needs direction from both the village and the sub-district or other relevant organizations.

"Thank God, the people here are also hardworking; they may only be quite mediocre, for example, but they are still willing to try hard work and to work side by side with each other for their livelihoods."

It may be inferred from this that the residents of Bawean Island have a spirit of hard work even though the fruits of their labor are only used meticulously to fulfill their requirements. Despite this, they continue to strive for hard work and are prepared to collaborate in order to do so.

Economic resilience can be defined as the ability of a community or economy to withstand and recover from external shocks, such as natural disasters. Huang et al. define community economic resilience as the financial capacity of a community to recover effectively from disasters, highlighting the importance of both individual and community-level resilience in the aftermath of such events Huang et al. (2019). This dual focus is essential, as the interplay between individual and community resilience can significantly influence recovery trajectories.

Community on Bawean Island where residents work hard to fulfill their daily needs. According to the Secretary of the Sangkapura Sub-interviews, District's this is accurate:

"Yes, there are supporters here. The spirit is strong, the natural resources are plenty, and the passion for work is still high. However, there are also facilities and human resource weaknesses, so more supervision from the village and related organizations is required. The budget is taken from the APBDes earlier from the village fund from what finances need to be in the future in this manner, according to the relevant agencies, for instance from the sub-district and the fisheries service, if the village invites competent individuals"

The abundance of natural resources and the continued high level of excitement for the work at hand provide support; the only weaknesses are the need for additional human resources and components from the community as well as from appropriate organizations. It is evident from the necessary agencies, for instance, from the sub-district and the fisheries office, if from that village invites the qualified individuals. The APBDes use village funds from whichever sources are necessary to create the budget.

From the aforementioned statement, it may be inferred that the Bawean Island still has a high level of enthusiasm for employment and vast natural resources. However, the coastal community of Dekatagung village has several drawbacks, specifically that its human resources are still insufficient and that it needs guidance from both the village and the district or other relevant organizations.

According to the results of the aforementioned interview, the coastal communities in Dekatagung village have a high level of excitement for carrying out their everyday lives. Fishermen, farmers, laborers, and other locals in Dekatagung do the majority of the community's job. In the same way that fisherman typically depart early in the morning and return in the afternoon before returning, so is the same with the farming community. In fact, the condition of the people on the coast does not make them lethargic and even quite energetic and enthusiastic in working every day.

Conclusion

The integration of socio-ecological approaches in disaster resilience strategies for small islands is crucial for sustainable adaptation and mitigation. By recognizing the interconnectedness of social and ecological systems, fostering community engagement, and ensuring effective governance, small islands can enhance their resilience to natural disasters. This multifaceted approach not only addresses immediate risks but also contributes to long-term sustainability and well-being for island communities. In addition to community involvement, the importance of institutional frameworks and governance in promoting socio-ecological resilience is evident. Effective disaster risk management requires coordinated efforts across multiple levels of governance, as highlighted in the research on cross-jurisdictional disaster preparedness. This coordination is essential for developing comprehensive strategies that encompass both mitigation and adaptation measures, ensuring that small islands can effectively respond to and recover from disasters.

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