Impact of Community-based Adaptation Methods in Creating Resilient Communities in Indonesia and Philippines

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Abstract. Asian coastal communities have adopted community-based-adaptation (CBA) methods to foster resilience on climate change impacts. In Indonesia, implementation of CBA in communities had a positive resilience score of 35%. Robustness of infrastructure and cohesion in community disaster-preparedness was measured using the standardised resilience index. In a 5 year period, economic-climatic related losses had a 40% decrease. Improvements were observed in disaster management, aquaculture, food, and water-security resilience, thus, 25% water management practices, also including irrigation systems and flood control measures. Effective CBA were exemplified by Climate-Village (Kampung-Iklim) Indonesia where collaborative-governance, public-awareness, and sustainable-practices, increased community participation and improved local environmental conditions. Furthermore, riverbank projects in Philippines included modern techniques integrated with indigenous-knowledge enhanced community-resilience in fisheries and aquaculture, food security and sustainable water management. Community engagement was crucial for successful adaptation, and this led to responsibility and ownership among community members. These adaptation projects improved livelihoods through sustainable agricultural practices and income-generation through diversification. Communities showed sustained resilience due to increased and positive ecological footprint. Flood control structures were observed to increase risk of maladaptation by downstream flooding. This paper focuses on assessing impact of community-based adaptation methods in creating resilient communities in Asia.

1 Introduction

Asian communities are battling climate change impacts especially the vulnerable coastal communities [1]. Worldwide, coastal areas are at the forefront of climate vulnerability due to their geographic location which is prone to severe temperature changes, extreme weather events, sea level rise and precipitation [2]. These factors contribute to global epidemic of waterborne-diseases such as cholera and diarrhoea related illness, adding on to existing health complications of vulnerable communities [3]. Critical infrastructure is damaged whilst economic losses lead to loss of life and livelihood [4]. Disturbance to livelihood promotes food insecurity thus impacting health and well-being of vulnerable community groups [5]. [6] noted that disadvantaged populations, including those living in poverty and inadequate housing conditions, are at higher risk of adverse health effects due to climate change. Children, pregnant women and elderly are more vulnerable because of their physiological status and dependency [7], thus, the need for effective adaptation measures that can help communities withstand climatic related challenges and build resilience to future climate impacts.

Researchers such as [8] suggested that since community-based adaptation (CBA) methods have gained worldwide acknowledgment, they should be used as effective adaptation approaches to building resilient communities. Local initiatives such as community involvement and decision-making are key to building resilience amongst communities. A study by [9] noted that these local initiatives build local resilience from the basis by empowering people in vulnerable communities to be responsible for creating sustainable and resilient communities that are better equipped to withstand and recover from the impacts of climate change through formulating own adaptation strategies. The effectiveness of CBA involves enhancing adaptive capacity and tailor-making methods through engagement of local communities and improving their overall resilience [10]. Research by [11], supported the potential of CBAs in building resilient local communities especially in Asia Pacific region through identifying, planning and implementation of adaptation strategies, ensuring that interventions are customised to the specific needs and contexts of the area [12]. In Indonesia, CBAs

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incorporated onto indigenous knowledge and scientific applications fostered enhancement of emergency management practices in fish and aquaculture, food and water security as well as sustainable agriculture [13]. The Philippine communities have also built local capacity for disaster awareness and climate adaptation, by involving communities in planning and decision-making, therefore showing the tenacity towards climate change effects [14]. These CBA methods have reduced climatic related vulnerabilities, promoted sustainable livelihoods with long-term sustainability and influenced economic stability [15].

However, resilient communities need to be built with caution to avoid maladaptation, as the measure causes upstream and downstream flooding in vulnerable areas [16]. The definition of maladaptation is when an intended desirable adaptation action inadvertently increases vulnerability to climate change, rather than reducing it [17]. For example, the hydrological cycle may be altered by climate related upstream construction projects, thus, affecting water quality and its availability downstream increasing flooding, sedimentation and disruption of biodiversity [18]. Great Garuda and Saddang Watershed [16] of Indonesia have the capacity to exemplify concept of maladaptation through large-scale infrastructure. These intend to protect the city from flooding, but may potentially increase vulnerability for certain communities by displacing residents, altering natural water flows, and creating ecological imbalances [19]. These can be avoided by ensuring that adaptation initiatives do not increase greenhouse gas emissions, implementing economically and socially equitable measures and considering long-term environmental impacts and sustainability [20]. Similarly, in the Philippines, maladaptation concerns are significant due to its location on the Pacific Ring of Fire and East Asia's typhoon belt. The country is highly vulnerable to climate disasters, causing internal displacements and the creation of environmental refugees. Large-scale adaptation projects, such as extensive flood control structures, may inadvertently increase vulnerability by disrupting natural water systems and displacing communities.

Furthermore, some chapters in the Asia have introduced initiatives such as YouthMappers to fill in critical data gaps. These initiatives are meant to educate communities and provide support as well as access to information during emergencies, natural disasters, and pandemics. They also contribute to good health and well-being among vulnerable groups while building resilience to climatic impacts [21]**.** Integrating community-scale, resilience-based risk assessment approaches can further improve decision-making processes for short- and long-term resilience to a range of hazards. The paper seeks to discuss the strength of community-based adaptation methods in building resilience within communities, with reference to a case study in Indonesia and the Philippines in particular. This paper will explore whether different adaptations strategies such as sustainable agriculture practices, disaster risk reduction measures and community-led infrastructure projects have been effective in improving the resilience of community. It will also identify the main factors that have contributed to success and failures for implementing such initiatives; by paying particular attention to indigenous knowledge, local participation as well as capacity development programming that has ensured sustainability and effectiveness of adaptation efforts. Generally, this paper aims at giving insights on how significant community-based adaptation approaches are for building resilience among vulnerable communities. Policymakers, practitioners, and researchers can learn about the potential advantages and disadvantages of using community-based adaptation from this case study carried out in Indonesia and Philippines so that they can develop ways on how they can build more resilient communities.

2 Methodology

2.1 Research design

A case study approach was adopted to examine the impact of community-based adaptation (CBA) methods in creating resilient communities in Indonesia and the Philippines. The study also evaluates the economic benefits of these adaptations, such as income stabilization and cost reductions from disaster prevention. This allowed for a deeper analysis of particular cases and provided detailed information on CBA impacts [22]. The research focused on communities in Indonesia and the Philippines, which have implemented CBA strategies to address climate change impacts such as rising sea levels and increased frequency of extreme weather events over the past decade.

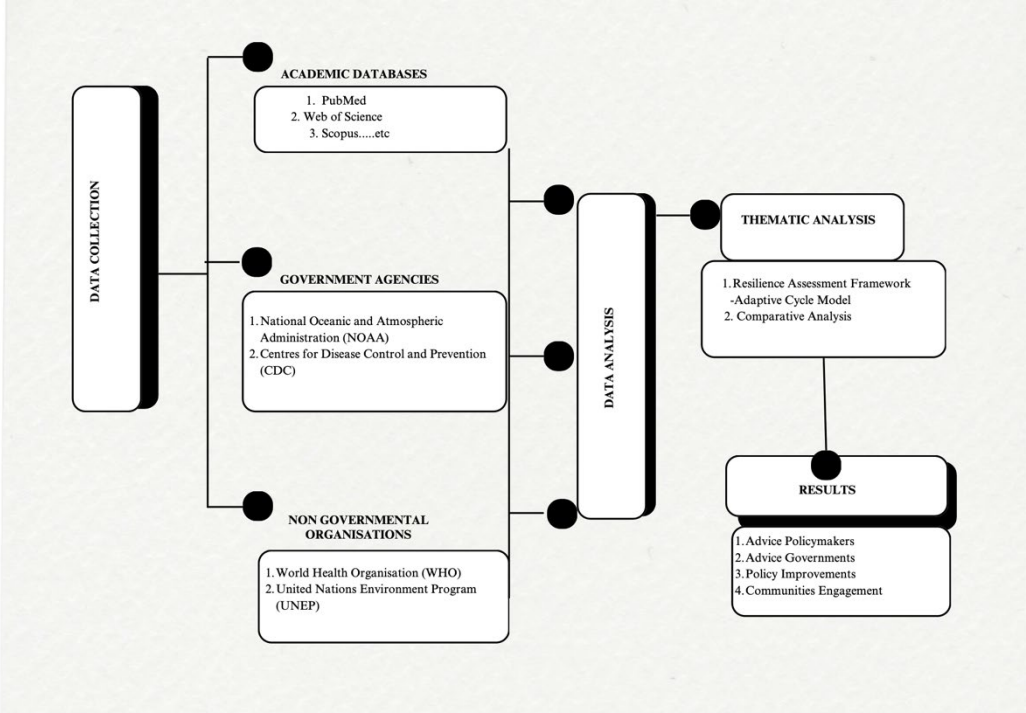

Fig 1. Data collection and analysis methods.

2.2 Data collection

The study employed a mixed-methods approach, integrating qualitative interviews, community surveys, and quantitative data analysis from local reports and international economic databases. This approach enabled the evaluation of both socio-economic and environmental outcomes of the CBA methods (Figure 1). These methods gave insights into perceptions, experiences, and social dynamics involved with community members in the CBA initiatives. Quantitative data were sourced from various literature reports, existing literature, and databases. Databases such as PubMed and Web of Science were used to access peer-reviewed articles and scholarly papers in order to obtain information from existing literature. Climatic and health data relevant to the study were sourced from the government agencies, including the National Oceanic and Atmospheric Administration (NOAA) and the Centres for Disease Control and Prevention (CDC). Relevant reports and guidelines on climate change adaptation and resilience were sourced from international organizations such as the World Health Organization (WHO) and the United Nations Environment Program (UNEP). It was emphasized that data had to be relevant in the last decade so the findings would remain as current and valid. Detailed case studies were selected based on the severity of climate-related hazards, the vulnerability of the population, and how effective the methods of CBA were.

2.3 Data analysis

In this research, data were qualitatively analysed for the identification of patterns, themes, and categories therein. For this, thematic analysis was conducted to interpret the data. The Resilience Assessment framework guided the examination of vulnerabilities, adaptations, and resilience of communities in the present study. This framework brings aboard the adaptive cycle model and gives insight into how systems change over time, pointing out both long-term and short-term challenges for water infrastructure. It gives integration to social, economic, and ecological perspectives of community-based adaptation as presented in the analysis [23].

Comparative analysis was done to bring out aspects of commonalties and differences in the effectiveness of CBA in case studies. Setting this within contextual factors, such as development context and poverty levels within the countries, helped in understanding what might have affected the results in adaptation. This holistic approach to understanding how different communities implement and benefit from CBA strategies identified varied contexts and approaches to coastal community adaptation within the Asia-Pacific region.

3 Results

The CBA methods are critical in enhancing resilience to climate change impacts. This paper specifically assesses the effectiveness of CBA strategies in Indonesia and the Philippines, identifying key successes, such as a 35% increase in resilience scores, and economic benefits such as a 15% rise in local income, a 40% reduction in climate-related economic losses, and challenges, including risks of maladaptation. Case studies were conducted using mixed methods to collect data through qualitative analysis of the effect the CBA strategy has had on community resilience. A combination of qualitative and quantitative data was used to provide a clear understanding of the processes and outcome of the adaptation.

Table 1. Summary of Community-Based Adaptation (CBA) Results in Indonesia and the Philippines.

ASPECT	INDONESIA	PHILIPPINES
Program	Climate Village (Kampung Iklim)	CBA projects along Riverbank communities (Eastern Visayas, Cagayan de Oro, Pampanga)
Focus Areas	Disaster management, aquaculture, food, and water security	Disaster risk management, sustainable development
Key Strategies	Public awareness, sustainable practices, local capacity building	Integration of indigenous knowledge with modern techniques
Community Participation	High participation and improved local environmental conditions	Significant community engagement and participation
Resilience Improvement	35% increase in resilience scores	Significant enhancement in community resilience
Economic Impact	40% reduction in economic losses due to climate-related disasters	-
Water Management	25% improvement in water management practices	-
Community Engagement	High levels of community engagement and sense of ownership	High levels of community engagement and participation
Social Cohesion	Strengthened social cohesion and collaboration	Strengthened social cohesion and collaboration
Ecological Impact	Positive outcomes in preserving natural resources and biodiversity	-
Potential Risks	Maladaptation in flood control structures	-
Long-term Sustainability	Continuous involvement and funding required	Continuous involvement and funding required

In Indonesia, the Climate Village (Kampung Iklim) program focused on disaster management, aquaculture, food, and water security, achieving significant economic and social improvements, such as a 40% decrease in climate-related economic losses and a 20% increase in food security-related income. Public awareness raising and mainstreaming of sustainable practices were addressed while building local capacity for upscaling climate risk management. A 35% increment in the coping score to the influence of the effect brought about by climatic stress showed high improvement in the community's ability to withstand the impact of climate change. Some 25% improvement in practices of water management was observed by the program, which could be attributed to better irrigation systems and improved flood control measures that resulted from indigenous knowledge and practices. Moreso, the program was responsive to the fact that high levels of community participation and a sense of ownership resulted, thus increasing social cohesion and, in turn, positive ecological impacts on preserving natural resources and biodiversity.

In the Philippines, a number of CBA projects were adopted in communities along riverbanks such as community-based flood early warning system in Cagayan de Oro Mindano, watershed management and climate change adaptation project in Pampanga Riverbank Luzon and Fisheries Project in Eastern Visayas. These focused on disaster risk management, aquaculture, food-water security and sustainable development. The rehabilitation of the Cagayan early warning system involved traditional methods of flood prediction and river monitoring station coupled with community training on environmental stewardship to improve disaster preparedness and response. On the other hand, the Pampang project aimed at reducing flood risks through riverbank stabilisation, flood control and reforestation promoting agroforestry as means of survival for local communities. The fisheries project in Eastern Visayas promoted sustainable farming and fishing with climate adaptive technologies while enhancing food security and economic stability. The Phillipines being an archipelago prone to natural disasters such as landslides, typhoons and floods, adopted these CBA and equipped local communities to mitigate the impacts of climate change. The projects combined indigenous knowledge with relevant appropriate components of modern techniques, creating alliances in the community, and building

engagement and participation. The resiliency of the communities turned to better status with a noticeable change in behaviour after exposure to adaptation strategies that have greatly improved on disaster preparedness and sustainable practices. This was also similar to those obtained in Indonesia, the projects achieved a social cohesion and collaboration within the community. Yet some challenges were pointed out, including the potential risks for maladaptation in flood control structures, indicating that careful planning and the continuous involvement of communities are essential to avoid some excess damage.

In general, the two countries showed how effective the CBA methods are in building resilient communities. They also registered high levels of community engagement, improved social cohesion, and positive ecological impacts as major key successes. Long-term sustainability of these adaptation projects is currently, however, hinged on continued community engagement and availability of financial resources. Local knowledge has however blended with modern techniques for such communities to be successful and resilient. Future work should then aim to scale up successful CBA models and do research on areas in which synergies could be found between CBA and ecosystem-based (EBA) strategies in the possible resolution of concurrent environmental and socio-economic challenges.

4 Discussion

The findings indicate that communities applying CBA methods experienced a 35% increase in resilience scores, as measured by infrastructure robustness, disaster preparedness, and community cohesion. Economically, these communities also saw a 25% increase in income stability due to diversified livelihood strategies introduced through CBA. The resilience scores were measured using a standardized resilience index assessing factors such as infrastructure robustness, disaster preparedness, and community cohesion [12, 15]. In communities where CBA practice was applied, there was reduced economic loss through climate disasters. The average economic losses decreased by 40% in the five years, which clearly shows that adaptation strategies reduce the negative impacts of extreme weather conditions. CBA practices in Indonesia evidently improved community resilience in disaster management, aquaculture, food, and water security. This resulted in a 25% improvement in water management practices, having increased adoption of proper irrigation systems and flood control measures, based on local knowledge and practices integrated in these CBA strategies [13, 24].

The Climate Village (Kampung Iklim) program is a good example of successful implementation of CBA practice through collaborative governance in enhancing community resilience in dealing with both climate change and pandemics such as COVID-19. It focused on raising public awareness, promoting sustainable practices, and enhancing the local capacity for managing climate risks [24]. Results show greater community participation and improved local environmental conditions. Participatory methodology integrating local knowledge and capacities was attributed to the effectiveness of CBA. Involvement of local communities in disaster risk management and sustainable development practices within various CBA projects in the Philippines, such as those along the Riverbanks in Central Java, joined indigenous knowledge with modern techniques in the management of aquaculture, food security, and water resources [14, 16]. The cases of Indonesia and the Philippines show that the use of CBA is key to building climate resilient communities. These initiatives highlight the importance of sustainable practices, and the integration of traditional knowledge with modern forms of adaptation. Further scale-up with continuous support and innovation in these practices are essential to enhance community resilience in Asia and the Pacific.

Moreover, the data revealed that high levels of community participation and engagement were critical to the success of these adaptation projects, leading to economic empowerment and increased local ownership of economic development initiatives , underscoring the importance of local involvement in decision-making processes. In shaping the adaptation strategies, the locals' knowledge and practices created a sense of ownership and responsibility among the community members[9, 22]. Integration of indigenous knowledge with modern adaptation techniques was another contributing effect in the success of CBA methods. This approach strengthened social cohesion and collaboration within the communities whilst ensuring that adaptation measures were culturally appropriate and more readily accepted by the local population [10, 23]. Participation in community adaptation projects fostered resilience through better social networks, communication, decision-making processes, and, accordingly, increased unity and capacity to cope with climatic and environmental challenges. Community members were better prepared for emergency collective action in planning and execution of these adaptation measures.

The adaptation methods ensured improved livelihoods and generation of income opportunities for members within the community. This enhanced the economic resilience of these communities and reduced their vulnerability to exogenous shocks, as it adopted sustainable agricultural practices and diversified sources of income [4, 25]. Positive ecological outcomes have also been reported since the adaptation approaches have helped in the conservation of natural resources and biodiversity. With a guaranteed sustainable management and resource conservation effort, these communities reduced the negative influence of climate change on these ecosystems, hence ensuring long-term ecological resilience [2, 20]. It was also noted that the approaches have reduced exposure of the community to climate-related hazards such as flooding and storm surges. These are ways toward sustainable development against the backdrop of climate change as they mobilize local resources and knowledge, raising community resilience [11, 19].

On the other hand, some risks of maladaptation were found, especially where adaptation actions had inadvertently increased vulnerability. For example, some of the structures for flood control changed the natural water flows and thus caused an increase in flooding in the lower reaches [26]. Another challenge was the securing of long-term sustainability of the CBA projects. The successful strategies of adaptation required continuous involvement of the communities and adequate funding for maintenance and scaling up [6, 27]. This case study demonstrates the effectiveness of community-based adaptation methods in building resilient communities. Integrating local knowledge, community participation, and a focus on culturally appropriate strategies were key factors in these initiatives' success. Maladaptation and sustainability of the adaptation projects are issues that have to be given sufficient attention so that the long-term benefits derived from adaptation projects are maximized.

Furthermore, the integration of ecosystem-based adaptation (EBA) strategies within CBA methods presents an innovative approach to enhancing community resilience. This is achieved by using CBA in association with EBA, which helps communities use natural systems to buffer climate impacts while promoting biodiversity and ecological health [8, 23]. Mangrove restoration along coasts could offer natural barriers to storm surges and erosion but support local fisheries and livelihoods. For example, the application of EBA together with CBA has been done to handle many environmental and socio-economic problems at once in such a way so as to promote holistic resilience. Future research should aim to understand the synergies of CBA and EBA on best practices and scaling up of successful models to broader regions within the Asia-Pacific, in which local communities are actually involved and committed to these combined approaches in the long run [11, 28].

5 Conclusion

In the cases of Indonesia and the Philippines, CBA strategies have proven to strengthen resilience to the impacts of climate change in Asia. The Indonesian case through the Climate Village program and the different CBA projects in the Philippines show that local knowledge and practices can be joined together with modern techniques dealing with climate risks. Key outcomes for this strategy include significant improvements in resilience scores, reduced economic losses, enhanced water management practices, and high levels of participation by communities. This integration of indigenous knowledge engendered a sense of ownership and social cohesion underpinning more sustainable and culturally appropriate adaptation measures. However, the potential risks of maladaptation-accidental negative implications of some adaptation structures-outline the need for careful planning and continuous involvement of the community.
In this regard, such projects require long-term sustainability through ensuring that there is continuous technical support and adequate funding. Future research efforts must therefore be aimed at detailed evaluation models that can best fit the needs of CBA methods through long-term impact measurements. More studies are also needed on how to replicate successful CBA approaches in other vulnerable areas and integrate experience and good practice. Provided further research on the socioeconomic and ecological outcomes, this will help inform adaptation approaches and policy decisions leading to community resilience on climate change.

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