Mobilizing Communities for Mangrove Reforestation in South Negros: Science- and Socio-cultural-based Approaches to Conservation and Management

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Abstract

Mangroves are vital ecosystems that play a crucial role in climate change mitigation by sequestering significant amounts of carbon and in climate change adaptation by safeguarding coastlines from erosion and extreme weather events. Mangrove forests in South Negros cover more than 1,000 ha, which constitutes less than 1% of the total land area of the 11 municipalities, and have very low regeneration potential. The Silliman University – GXI Reforestation Project aims to plant 500,000 seedlings of mangrove and beach forest species in 78 hectares located in five municipalities in Negros Oriental, and to monitor the rate of carbon sequestration in 1- to 5-year-old seedlings. The project uses integrated science and sociocultural-based approaches for mangrove conservation and management, including vulnerability assessments, baseline surveys to determine the community structure of mangrove forests in planting sites, determination of baseline blue carbon in the sites, and capacity building and training for participating People's Organizations (POs). Currently, the project is working with 16 PO partners, serving a total of 210 PO beneficiaries, with 74.76% of them being female community members. As of September 2024, a total of 141,296 seedlings of mangrove and beach forest species have been planted, with an overall survival rate of 67.28%.

Keywords: mangrove restoration, community mobilization, South Negros, science-based approach, and socio-cultural approach

Introduction

The Philippines, where population density and economic activities are concentrated along its coastlines, was ranked the 9th most affected country by extreme weather events in 2020 (World Risk Report, 2020). The impacts of climate change in the country are evident through the increasing frequency and intensity of storms, heightened flooding, seawater intrusion, coastal erosion, and episodes of severe drought (Mendoza et al. 2014). According to a study by Yusuf and Francisco (2010), the country is among the top three in Southeast Asia most likely to be impacted by climate hazards, including floods, droughts, cyclones, and landslides. The country's vulnerability is further compounded by the Philippine economy's heavy reliance on climate-sensitive sectors, including agriculture, fisheries, and forestry. These sectorsare particularly vulnerable to the impacts of climate change, including extreme weather events, rising sea levels, and shifting weather patterns, which threaten food security and economic stability (IPCC, 2019; FAO, 2021). Furthermore, the Philippines' exposure to multiple climate hazards, combined with limited adaptive capacity in rural communities, heightens the risk of economic losses and livelihood disruptions (World Bank, 2020).

Mangroves are essential ecosystems that play a pivotal role in mitigating climate change, possessing a global carbon stock that is significantly higher than that of tidal salt marshes, seagrasses, evergreen forests, and peat swamps (Wu et al. 2020; Alongi 2014; McLeod et al. 2011). By sequestering substantial amounts of carbon dioxide, they help reduce greenhouse gases in the atmosphere. Additionally, mangroves provide numerous services and benefits such as buffering against coastal erosion, protecting shorelines, and supporting the livelihoods of coastal communities by serving as fishing grounds and essential nurseries for fish stocks. Despite their importance, the area occupied by mangroves has been declining annually worldwide, with varying status by country and region (UN, 2021). In South-East Asia, for example, mangroves have been destroyed at rates of between 0.41% and 0.71% per year (UN, 2021). Notably, the total mangrove area in the Philippines decreased by 10.5% from 1990 to 2010 (Long et al., 2014). The rapid decline of mangrove forests in the country occurred in the 1960s and 1970s, driven by government policies that promoted the expansion of aquaculture, specifically that of milkfish and shrimp (Calumpong 1994; White & De Leon 2004). In addition, the loss of mangrove forests can also be attributed to human population growth and the development of coastal zones in the country. These threats negatively impact the climate resilience

and food security of coastal communities.

Mangrove reforestation efforts in the Philippines have a long history, dating back over 100 years. Early projects around Manila Bay focused on planting Rhizophora species and Nypa fruticans (Primavera and Esteban 2008). Since then, various efforts and initiatives have been undertaken by both government and non-government organizations to address the and degradation of mangrove forests in the country. Reducing emissions and enhancing environmental conditions have become global priorities for fostering sustainable development and mitigating the negative impacts of global warming and climate change (Raihan 2023). Recently, more mangrove restoration efforts have been conducted in the Philippines as part of its commitment to the United Nations Framework Convention on Climate Change (UNFCCC) in 2021, aiming to reduce and avoid 75% of carbon emissions from 2020 to 2030 (Yap 2021). While some of these projects have seen success, others have not. Two key factors contributing to the failure of certain initiatives were the selection of species—often limited to Rhizophora species and focused on single-species planting—and site selection for mangrove reforestation (Calumpong and Cadiz 2012; Primavera and Esteban 2008). The long-term survival rates of these projects are generally low, ranging from 10% to 20% (Garcia et al. 2013; PrimaveraEsteban 2008).

Another key factor in the success of mangrove reforestation projects is the crucial role that community involvement plays in these initiatives (Gevaña et al., 2019; Pulhin et al., 2017; Garcia et al., 2013; Camacho et al., 2011). In the Philippines, only certain coastal communities near mangrove areas are aware of the value of these resources. Promoting community-based mangrove management fosters a sense of stewardship among local communities towards mangrove resources (Pulhin et al. 2017). Apart from the ecosystem services provided by mangrove forests to these communities, this ecosystem also offers potential livelihood opportunities through the creation of policies and programs that provide incentives to locals who heavily rely on these resources (Garcia et al. 2013). To address the degradation of mangroves and beach forests, an integrated management approach involving baseline studies, establishing partnerships and community participation, capacity building, ecosystem rehabilitation, and policy enforcement is essential.

The SU-GXI Reforestation in South Negros Project

Silliman University, through the Institute of Environmental and Marine Sciences, has partnered with GCash (GXI) through their GForest

initiative to plant one million mangrove and beach forest trees in South Negros. This initiative is implemented in two phases. For Phase 1, 78 hectares across five municipalities in South Negros Oriental will be reforested with half a million trees over a five-year period, while the other half a million trees will be planted in 100 hectares covering three municipalities in Negros Occidental. Additionally, the Project will track carbon storage in both aboveground and belowground plant components, as well as soil carbon, while monitoring the rate of carbon storage over five years. This project employs a multidisciplinary approach to mangrove reforestation, which involves academia, municipal or barangay local government units (M/B LGUs), and People's Organizations (POs).

Establishment of Baseline Information

In 2019, a baseline study conducted across 11 municipalities under the BFAR-USAID Fish Right Program (SNFRP) revealed that mangrove forests covered slightly over 1,000 hectares, accounting for less than 1% of the total land area within the project site. These mangroves were concentrated primarily in the municipalities from Zamboanguita to Cauayan (Calumpong et al. 2019, unpub.). The study identified 28 true mangrove species, including the endangered Camptostemon philippinensis found in Danjugan Island, Cauayan, and Tambobo Bay, Siaton. The estimated average carbon storage values—both aboveground and belowground—varied significantly across municipalities, reflecting the diverse carbon sequestration potential of these ecosystems.

As part of the same project, a Participatory Coastal and Fisheries Vulnerability Assessment (PCVA) and Climate Change Adaptation (CCA) planning exercise was conducted in 97 barangays across the 11 municipalities of Southern Negros. Using the Tool for Understanding Resilience in Fisheries (TURF) (MERF, 2013), local stakeholders—including members of M/B LGUs and POs—validated and scored the vulnerability of their barangays based on predefined thresholds. The assessment revealed varying degrees of vulnerability, with 29.9% of the barangays classified as highly vulnerable and 26.8% classified as having very high vulnerability. Conversely, only 9.28% of barangays were categorized as having very low vulnerability (Calumpong et al. 2021, unpub.). To address these vulnerabilities, ecosystem-based actions were developed to guide LGUs in implementing climate-adaptive measures. One key action identified was the restoration of coastal protection through mangrove rehabilitation using appropriate technologies.

Using the baseline data, potential sites were identified for Phase 1 of

the SU-GXI Reforestation Project in South Negros. Five municipalities—Zamboanguita, Siaton, Sta. Catalina, Bayawan, and Basay were selected for rehabilitation efforts. Site inspections were conducted to assess potential rehabilitation areas, gathering information on species composition, substrate types, soil carbon storage, the current extent of mangrove forests, and the presence of POs recognized by the LGU in the area. As part of the is working site validation process, collaboration with the Department of Environment and Natural Resources (DENR) ensured that the selected planting sites were located on government land, helping to prevent potential land-use conflicts. This information enabled the SU-GXI Reforestation in South Negros Project to finalize the selection of planting sites, determine their exact size, identify the appropriate species to be planted in each area, and identify the PO partners implementing the reforestation project. Currently, the project with 16 different POs in 13 barangays in Negros Oriental (Table 1).

Table 1

Overview of Planting Sites, Total Area (hectares), and Target species for the SU-GXI Reforestation in South Negros Project

Municipality	Barangay	Site	ha	PO Partner	Species
Zamboanguita	Mayabon	Sitio Latason	3	Latason-Cabcab Fishermen Association (LACABFA)	*Avicennia marina, Avicennia lanata, Heritiera littoralis, Dolichandrone spathacea, Xylocarpus granatum, Sonneratia caseolaris, and Lumnitzera racemosa*
	Mayabon	Sitio Dumandan	2	Triple M Fishermen Association	*Avicennia marina, Avicennia lanata, Heritiera littoralis, Dolichandrone spathacea, Xylocarpus granatum, Sonneratia caseolaris, and Lumnitzera racemosa*
	Lutoban	Pulo	1	Basac-Malatapay People's Association (BASMAPA)	*Avicennia marina, Rhizophora stylosa, Bruguiera cylindrica,*
	Lutoban	Pulo	3	Lutoban Fisherfolks' Multipurpose Association (LUFMULA)	*Xylocarpus granatum, Sonneratia alba, and Lumnitzera racemosa*

Siaton	Si-it	Si-it Bay	2	Si-it Bay Fisherfolk Association (SBFA)	*Avicennia marina, Rhizophora stylosa, Bruguiera cylindrica,*
	Poblacion 3	Poblacion	1	Poblacion 3 Fisherfolk Association	*Xylocarpus granatum, Sonneratia alba, and Lumnitzera racemosa*
	Bonawon	Purok 7	2	Bonawon Fishermen's Association (BFA)	*Avicennia marina, Rhizophora stylosa, Bruguiera cylindrica,*
Sta Catalina	Fatima	Fatima	3.5	Fatima Women's Association (FWA)	*Barringtonia asiatica, Bruguiera gymnorrhiza, Calophyllum inophyllum, Dolichandrone spathacea, Heritiera littoralis, Millettia pinnata, Lumnitzera racemosa, Rhizophora stylosa, and Hibiscus tiliaceus*
	San Francisco	San Francisco	2	San Francisco Women's Association (SAFRAWMA)	*Barringtonia asiatica, Dolichandrone spathacea, Calophyllum inophyllum, and Millettia pinnata Bruguiera gymnorrhiza, Heritiera littoralis, Lumnitzera racemosa, Intsia bijuga, Barringtonia asiatica, Dolichandrone spathacea, and Calophyllum inophyllum*
	Nagbalaye	Nagbalaye	4.5	Nagbalaye Women's Association (NAWA)	*Rhizophora stylosa, Ceriops decandra, Bruguiera gymnorrhiza, Xylocarpus granatum, Heritiera littoralis, Lumnitzera racemosa, Intsia bijuga, Barringtonia asiatica, Dolichandrone spathacea, and Calophyllum inophyllum*
	Poblacion	Pasil-Guba	20	Women's Guba-Pasil Association (WGPA)	*Rhizophora stylosa, Ceriops decandra, Bruguiera gymnorrhiza, Xylocarpus granatum, Heritiera littoralis, Lumnitzera racemosa, Intsia bijuga, Barringtonia asiatica, Dolichandrone spathacea, and Calophyllum inophyllum*

	Caranoche	Caranoche	16	Caranoche Mangrove Community Association (CMCA)	*Sonneratia caseolaris, Lumnitzera racemosa, Xylocarpus granatum, Heritiera littoralis, Avicennia lanata, Rhizophora stylosa, Bruguiera gymnorrhiza, Ceriops decandra, and Intsia bijuga*
Bayawan	Pagatban	Pagatban	7	Pagatban United Small Fishermen's Association (PUSFA)	*Milletia pinnata, Barringtonia asiatica, Hibiscus tiliaceus, Heritiera littoralis, Dolichandrone spathacea, Calophyllum inophyllum, Sonneratia alba, and Lumnitzera racemosa*
Basa	Actin	Actin	3	Barangay Actin Fishermen's Association (BAFA)	Millettia pinnata, Barringtonia asiatica, Dolichandrone spathacea, Sonneratia alba, Avicennia marina Bruguiera gymnorrhiza, and Lumnitzera racemosa
	Bongalonan	Sitio Cotcot	2.5	Cotcot Trawler's Fishermen's Association (CTFA)	Millettia pinnata, Barringtonia asiatica, Dolichandrone spathacea, Hibiscus tiliaceus, Avicennia marina, Bruguiera gymnorrhiza, Lumnitzera racemosa, Rhizophora apiculata, Rhizophora mucronata, Rhizophora stylosa, Sonneratia caseolaris, and Heritiera littoralis
	Bongalonan	Bongalonan	2.5	Bongalonan Small Fishermen's Association (BSFA)	Pemphis acidula, Barringtonia asiatica, Calophyllum inophyllum, Osbornia octodonta, Avicennia marina, and Sonneratia alba

Establishing Partnerships and Community Participation

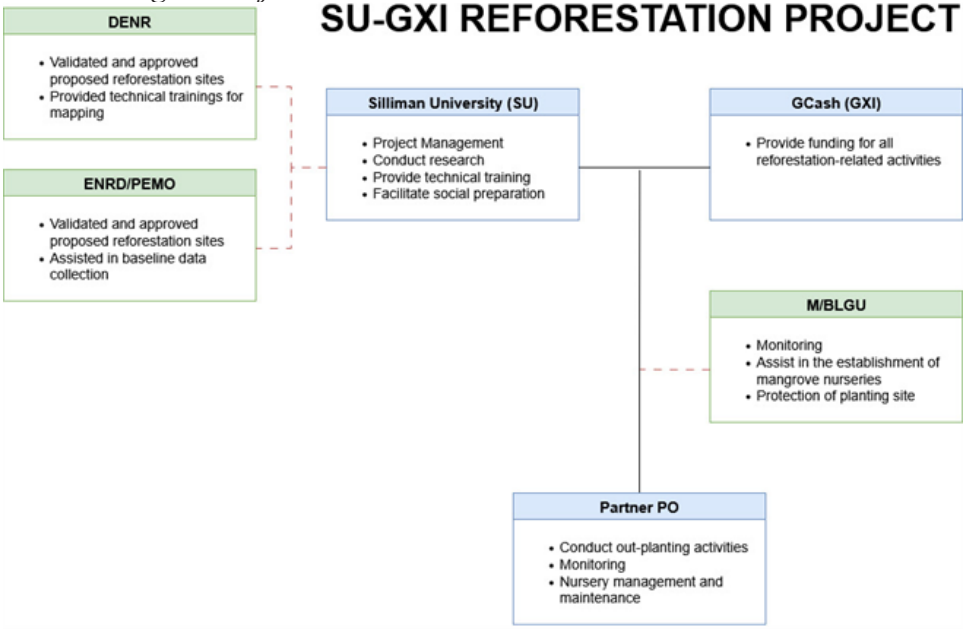
To effectively manage reforestation projects, it is essential to focus on collaborating with the LGU and local communities through partnerships. Partnerships in the SU-GXI Reforestation in South Negros Project were first established through the BFAR-USAID Fish Right Program (SNFRP), laying the groundwork for a seamless transition into the current project. This current initiative serves as a sustainability measure for the SNFRP, ensuring the continuation of key efforts, particularly in mangrove conservation and the management of mangrove forests and their associated faunal biodiversity, aimed at enhancing sustainable, resilient fisheries and safeguarding vital blue carbon sinks in the area.

The SU-GXI Reforestation in South Negros Project employs a multi-sectoral approach to mangrove rehabilitation and conservation. A key strategy involves building partnerships with M/B LGUs and People's Organizations (POs) to facilitate project implementation. This process included courtesy calls, meetings, and consultations with key stakeholders, such as Mayors, City/Municipal Agriculturists, City/Municipal Environment and Natural Resources Officers, City/Municipal Planning officials, barangay leaders, Environment and Natural Resource Division (ENRD) of Negros Oriental and Negros Occidental (PEMO), and representatives from DENR. To secure ongoing support and active participation from key stakeholders, Partnership Agreements were forged, outlining the roles and responsibilities of GCash (GXI), Silliman University (SU), POs, and M/B LGUs (Fig. 1). As part of its GForest initiative, GCash (GXI) provided funding for the reforestation project in South Negros. At the same time, SU oversees project management, offering technical support and training.

Silliman University also aims to assess the carbon storage of the planted species. The Project monitors changes in the annual carbon storage capacity of the reforestation sites, generating critical data to evaluate the project's contribution to climate change mitigation. The Project is carried out by the partnering PO, which is responsible for out-planting activities, nursery establishment and maintenance, as well as monitoring the planting sites and seedling growth rates. These efforts are supported and supervised by the M/B LGUs. The Department of Environment and Natural Resources and the Provincial Environment Management Office (PEMO) provided vital technical support to Silliman University in the capacity building, establishing baseline information, and selecting project sites. Their partnership and contributions were crucial to the successful initiation of the project.

Figure 1

Organizational Structure of Partnerships within the SU-GXI Reforestation in South Negros Project



Capacity Building

Another key strategy of the project is the capacity building of LGUs and partner POs, which is essential for the success of restoration and reforestation efforts like this. As part of the SNFRP, a series of Mangrove Management Workshops were held across eight municipalities—Zamboanguita, Siaton, Sta. Catalina, Bayawan, Basay, Hinoba-an, Sipalay, and Cauayan—to strengthen institutional capacity for developing and implementing mangrove restoration plans and policies. These workshops brought together participants from various sectors, including representatives from LGUs, Local Planning Officers, City/Municipal Agriculture Officers, City/Municipal Environment and Natural Resources Officers, barangay leaders, Fisheries and Aquatic Resource Management Council (FARMC) members, and POs. The workshops were designed to equip stakeholders with essential skills in mangrove assessment, drone-based aerial mapping and delineation, Blue Carbon data collection and analysis, as well as policies and effective rehabilitation techniques.

At the outset of the SU-GXI Reforestation in South Negros Project, a series of social preparation activities were conducted to orient potential

LGU and PO partners. These sessions provided an overview of the project, reviewed the Partnership Agreement, discussed proposed planting sites, and offered training on proper planting techniques, mangrove nursery establishment and maintenance, as well as site and growth rate monitoring. Cross-site visits to areas where local POs are engaged in mangrove reforestation were organized to enhance the knowledge of partner POs. These visits focused on mangrove conservation, species identification, propagule collection, and the preparation and potting of propagules for nursery establishment. Additionally, supplemental livelihood training sessions were conducted in Sta. Catalina, with the support of the LGU and SNFRP. These trainings aimed to provide women-led PO partners with expanded livelihood opportunities, fostering both social and economic improvements for their organizations.

Ecosystem Rehabilitation

The first step in ecosystem rehabilitation involved establishing mangrove nurseries across five municipalities. Nine mangrove nurseries have been established in the SU-GXI Reforestation in South Negros Project, which houses several mangrove and beach forest species. This was done to ensure the use of good planting materials, as the flowering, fruiting, and seed production of mangrove and beach forest species do not always coincide with the planting season; thus, raising seedlings in nurseries is a crucial part of the process. Suitable locations within the mangrove area were selected, and overhead netting was installed to reduce heat exposure. Fencing and additional netting were also installed to keep out predators. Propagules were potted in plastic bags using soil gathered from the mangrove area, and the seedlings and wildlings were watered with freshwater as necessary. Data, such as seedling diameter and height, were regularly recorded and monitored weekly to track growth rates. Seedlings are housed in the mangrove nursery for 3-5 months, ensuring that they are hardened and have a well-established root system, which allows for a higher survival rate.

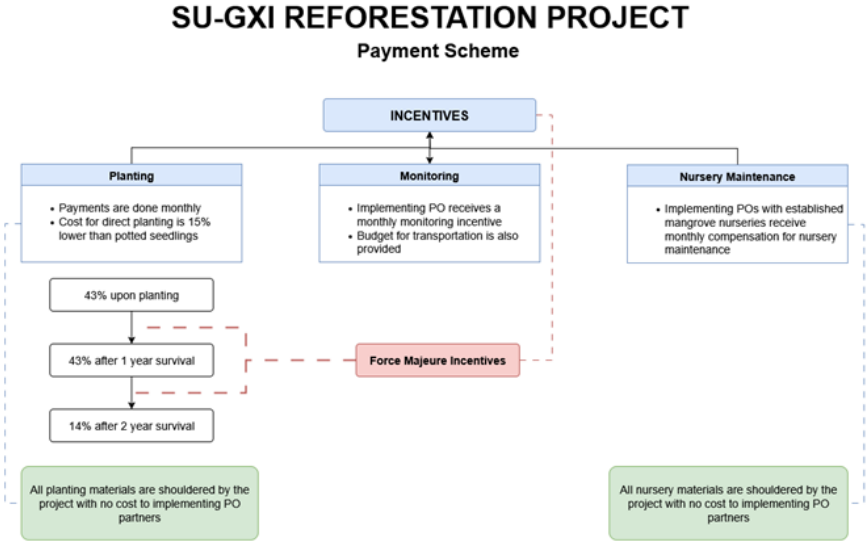
Once the seedlings were ready for out-planting, the implementing partner, PO, followed a 1m x 1m planting distance for mangroves and a 1.5m x 1.5m planting distance for beach forest species. The fifty seedlings initially tagged and monitored for growth rates in the nursery continued to be tracked for monthly growth rates after being planted at the site, together with the survival rates of all the seedlings planted. Baseline soil carbon samples were collected during the initial out-planting activity, with additional samples taken as new pure plots for different mangrove and

beach forest species are established. Partner POs were required to submit monthly out-planting forms to track the progress of their efforts. The SU-GXI Reforestation in South Negros team verified these reports each month to ensure the accuracy of the recorded data.

To encourage partner POs to plant, monitor seedlings, and maintain mangrove nurseries consistently, monthly incentives are provided (Fig. 2). These incentives include a fixed rate for all partner POs for monitoring and nursery maintenance. However, planting costs vary; seedlings that are directly planted are priced differently from those that are potted, with a 15% price difference between direct-planted and potted seedlings. This pricing strategy incentivizes POs to pot mangrove and beach forest seedlings for out-planting. Additionally, the planting cost is distributed to partner POs in tranches: 43% is given upon initial planting, another 43% after the seedlings have survived for one year, and the final 14% upon two-year survival. This payment scheme encourages POs to prioritize seedling survival and actively replant in cases of mortality with no additional cost to the project, except in circumstances beyond their control. Force majeure incentives are provided to partner POs when seedling mortality is caused by events such as typhoons, El Niño, or other acts of God. These incentives cover the full cost of the seedlings, contingent on a site inspection and damage assessment. The replanting efforts of the partner POs are also considered as part of the eligibility for these incentives.

Figure 2

Overview of the incentives and payment scheme for the SU-GXI Reforestation in South Negros Project



Policy Support

Ensuring the continued protection and management of existing natural mangrove areas and planting sites is crucial for the success of rehabilitation projects. The establishment of Mangrove Local Conservation Areas (LCAs) in eight municipalities in Negros Oriental, facilitated by the SNFRP, plays a key role in this effort. According to the ordinances, these LCAs are designated exclusively for conservation, research, education, tourism, and other special management purposes, including rehabilitation measures. Management Boards have been established to oversee these areas, comprising various stakeholders such as the Local Chief Executive, representatives from Local Planning Offices, City/Municipal Agriculture Offices, City/Municipal Environment and Natural Resources Offices, Sanguniang Bayan, academe, Bantay Dagat, the Philippine National Police (PNP), DENR sectoral groups, barangay leaders, FARMC members, and POs. The LCA organization has also implemented user fees, restrictions, and fines to ensure proper management and maintenance. Currently, out of the eight municipalities with proposed LCAs, four—Bayawan, Hinoba-an, Sipalay, and Cauayan—have already adopted these ordinances. The remaining proposed LCAs are still under review by the Municipal Councils. The current project regularly monitors the progress of the LCA ordinances in these municipalities, as they are crucial to the success of the mangrove restoration efforts.

Current Status of the SU-GXI Reforestation in South Negros Project

The SU-GXI Reforestation in South Negros Project is currently collaborating with 16 partner People's Organizations (POs) across 13 barangays in 5 municipalities within Negros Oriental. The project benefits 210 PO members, of whom 74.76% are women. In its first year, the project established nine mangrove nurseries, and by September 2024, a total of 141,296 mangrove and beach forest species had been planted. The project has planted 25 different species of mangroves and beach forest trees, with the majority being Rhizophora species, Millettia pinnata, Ceriops decandra, Avicennia marina, and Calophyllum inophyllum. Statistical analysis using Spearman’s Rho revealed that PO participation is a significant factor influencing higher survival rates at the planting sites ($p = 0.020$), which averaged around 80% in the previous months. However, as of September 2024, the rate has declined to 67.28%, primarily due to the impacts of typhoons Ferdie, Gener, and Helen, which severely affected most planting

sites. With continued monitoring and replanting activities to mitigate the loss due to force majeure, the survival rate remains relatively higher compared to the general survival rate in the Philippines.

Summary

The SU-GXI Reforestation in South Negros Project addresses the critical decline of mangrove ecosystems in the Philippines, which are vital for mitigating climate change and providing coastal protection. Despite covering less than 1% of the land area of South Negros, these mangroves play an essential role in sustaining coastal resilience. The project, a partnership between Silliman University and GCash (GXI), aims to plant 500,000 mangrove and beach forest seedlings across 78 hectares in five municipalities of Negros Oriental, integrating science-based approaches, including vulnerability assessments and blue carbon baseline surveys, alongside socio-cultural engagement through capacity building for People's Organizations (POs). Currently, 16 People's Organizations (POs) involving 210 beneficiaries, predominantly women (74.76%), are participating. As of September 2024, 141,296 seedlings have been planted with an overall survival rate of 67.28%. Three typhoons impacted this rate, though it remains relatively high compared to the general survival rate in the Philippines. Despite these challenges, participation in PO is a significant factor associated with higher survival rates. The project emphasizes community mobilization, establishing nurseries, and offering incentives for planting, monitoring, and nursery maintenance to ensure seedling survival and project success.

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