Building Coastal Resilience for Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA) in Small Islands in Concepcion, Iloilo, Philippines

THE GREEN-GREY INFRASTUCTURE (GGI) STORY OF BARANGAY LOONG

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CONSERVATION INTERNATIONAL Philippines

FONDS FRANÇAIS POUR L'ENVIRONNEMENT MONDIAL

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Building Coastal Resilience for Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA) in Small Island Communities through Green-Grey Infrastructure (GGI) Project
Municipality of Concepcion, Iloilo Province, Philippines
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The Barangay Council of Loong and the Baskal Operators of Loong Association (BOLA) with the participation of Kusog sg Magagmay nga Mangingsda sa Loong (KUMALO).

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1 Bechtel.org is a social enterprise that was established to deliver Impact Infrastructure to help improve the lives of people.

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Introduction

The Philippines is highly vulnerable to the impacts of climate change that include sea level rise, increased frequency of extreme weather events, rising temperatures, and extreme rainfall. This is due to its high exposure to natural hazards (cyclones, landslides, floods, droughts), dependence on climate-sensitive natural resources, and vast coastlines where all its major cities are located and most of the population reside. This exacerbates the increasingly depleting natural and marine resource base that supports livelihoods and provide critical ecosystem services to communities such as shoreline protection, flood control, soil stability, and habitats for biodiversity. Nature-based solutions (NBS) are considered strategic priorities by the government due to its remarkable potentials for enhancing national and local resilience to various climate change impacts.

The Fonds Français pour l'Environnement Mondial (FFEM) supports projects that strengthen coastal resilience, help coastal communities adapt to climate change, and are replicable and innovative. From November 2015 to June 2022, the agency supported the implementation of the 'Building Coastal Resilience for Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA) in Small Island communities through Green-Grey Infrastructure (GGI) Project"[2], in Concepcion, Iloilo, which was one of the severely devastated areas by Typhoon Haiyan in the Philippines in 2013. The project aimed to demonstrate the potential for natural systems to adapt to the consequences of climate change and the relevance of setting up grey (classic/traditional engineering) and green (ecosystems conservation) infrastructures to build resilience into coastal territories and communities especially during typhoons. The combined green-grey solutions are expected to have greater benefits to building climate change resilience and adaptations than the use of just one of two approaches.

To evaluate and select specific sites for green-grey infrastructure (GGI) implementation, a technical feasibility study was conducted, and results were subjected to stakeholder consultations. Based on vulnerabilities to climate change, mitigation potential, and applicability of green-grey engineering solutions, four (4) sites - Bagongon, Tambaliza, Loong and Bacjawan Norte - were selected for green-grey solutions, and one (1) site – Polopina - was considered for implementation of green solutions (Figure 1). The green solutions in Polopina, however, supported the implementation of green-grey solutions in other sites and contributed to the overall objective of building coastal resiliency in the Municipality of Concepcion.

Conservation International (CI) Philippines adopted a community-build model in the implementation of the GGI Project in Concepcion. The model emphasized the participatory, person-centered approach in designing, planning, implementing, assessing, and evaluating the project. Site-based GGI projects[3] were implemented by community organizations with funding support and technical assistance from CI Philippines. To become effective partners in the implementation of this innovative approach in building coastal resiliency to the effects of climate change, capacity

[2] The implementation of the FFEM-GGI Project was covered by a Memorandum of Understanding (MOU) between the DENR-Biodiversity Management Bureau and Conservation International (CI) Philippines and the MOU between the Local Government of Concepcion and CI Philippines

[3] In addition to the MOU between the Local Government of Concepcion and CI Philippines, site-based implementation was covered by Barangay Resolutions and Conservation Agreements among the Local Government of Concepcion, concerned Barangay Council, concerned implementing community organization and CI Philippines.

building activities on ecosystem-based adaptation and GGI, mentoring support, organizational development programs, and livelihood incentives were provided to partner community organizations.

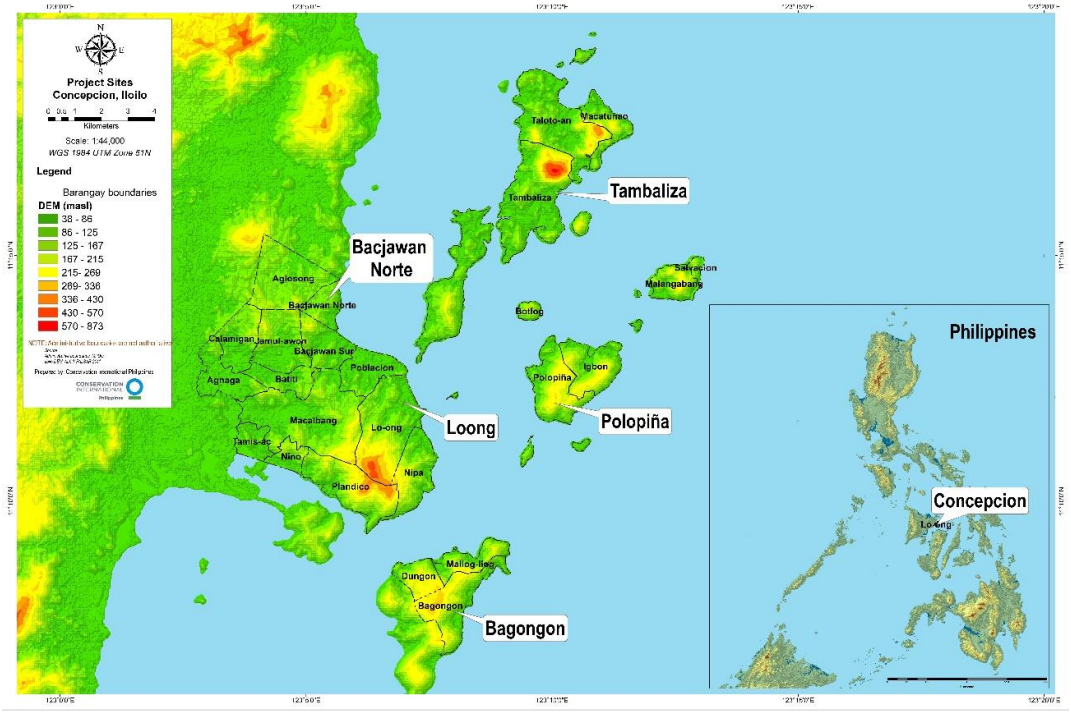

Figure 1. The FFEM-GGI Project sites in Concepcion, Iloilo, Philippines.

The Green-Grey Infrastructure (GGI) Project in Barangay Loong

Rationale for GGI Solutions in Loong

Loong is a coastal lowland barangay in southeastern part of Concepcion, Iloilo. It has seven (7) purok communities namely: Bukid, SEA-K, Gawad Kalinga, Mabinuligon, San Vicente, Diamante and Proper. From the town proper of Concepcion, Loong is accessible within 15-20 minutes via motorcycle/land transportation. It is also accessible from the neighboring islands via boats.

Loong is predominantly composed of plains and lowland but there are hilly portions with vistas of the shoreline. It has a long, straight beach area with mangroves located along the creek behind the coastal area in Purok Malipayon. The strip of mangrove measures approximately 10-meter wide and 150-meter long and has some old mangrove stands. A 50-meter breakwater made of rubble mound was established in Loong in 2014[4] to protect remaining mangroves. Mangrove planting was also done in 2014. Generally, Loong's beach and foreshore sediment type is mixed sand and rock, and the shoreline has a rocky gravel substrate. Natural beach vegetation such as "aroma", "bani", "banago" and "botong" thrive in the area. Aroma trees are good in preventing sand erosion because their root system is long and fibrous. Loong also has coral reefs and seagrass meadows. Threats to coastal habitats that have been observed in Loong include coral bleaching, impacts of typhoon and destructive anthropogenic activities, e.g., overfishing. Fishing and farming are the main sources of income in the barangay. Fishing is disrupted, and livelihood grossly affected, during extreme weather and unfavorable sea conditions. Rice and other crops (banana, cassava, fruit trees and vegetables) are harvested mainly for community or household consumption.

The Technical Feasibility Study conducted by CI[5] in 2018 that covered the potential sites for GGI application in Concepcion clearly showed the vulnerability of Loong to coastal hazards. Loong is vulnerable to storm surge and strong monsoon winds and waves due to its physical location facing the Visayan Sea. Storm surge has the potential to damage houses and properties, uproot mangrove trees, and wash away fishing boats and paraphernalia. There is also a creek, which increases vulnerability of beach front to flooding. In terms of social vulnerability, a considerable number of the 859 total households are located along the coast. Fifty-four (54) of these are proposed for relocation under National Housing Authority (NHA) as safety precaution as these are located within 40 meters of the beach, which is also used as parking area for boats. As the mangrove areas are degraded, the feasibility study also finds significant erosion on the beach that must be considered in designing the GGI project for Loong.

The objectives of the identified GGI project in Loong were: 1) to rebuild coastal sediment to replant with mangroves and expand the existing mangrove rehabilitation area; 2) for living breakwaters to serve as an oyster reef through the

[4] Established through the support of a non-government organization, Concern Worldwide.
[5] Conservation International. 2018. Technical Feasibility Study: Building coastal resilience for disaster risk reduction and climate change adaptation in small island communities in the Philippines through green-grey infrastructure. 110 p. + 4 attachments.

natural colonization of shellfish and to provide food and supplemental income to the community members, particularly women, who harvest shellfish in the area; and 3) to manage remaining mangrove stands and strengthen the management of the existing Community-Based Marine Protected Area.

To this end, the GGI project design in Loong consisted of: 1) the establishment of permeable living breakwaters as grey solutions; and 2) mangrove rehabilitation/enrichment planting and the establishment of a community-based Marine Protected Area (MPA) as green solutions (Figure 2).

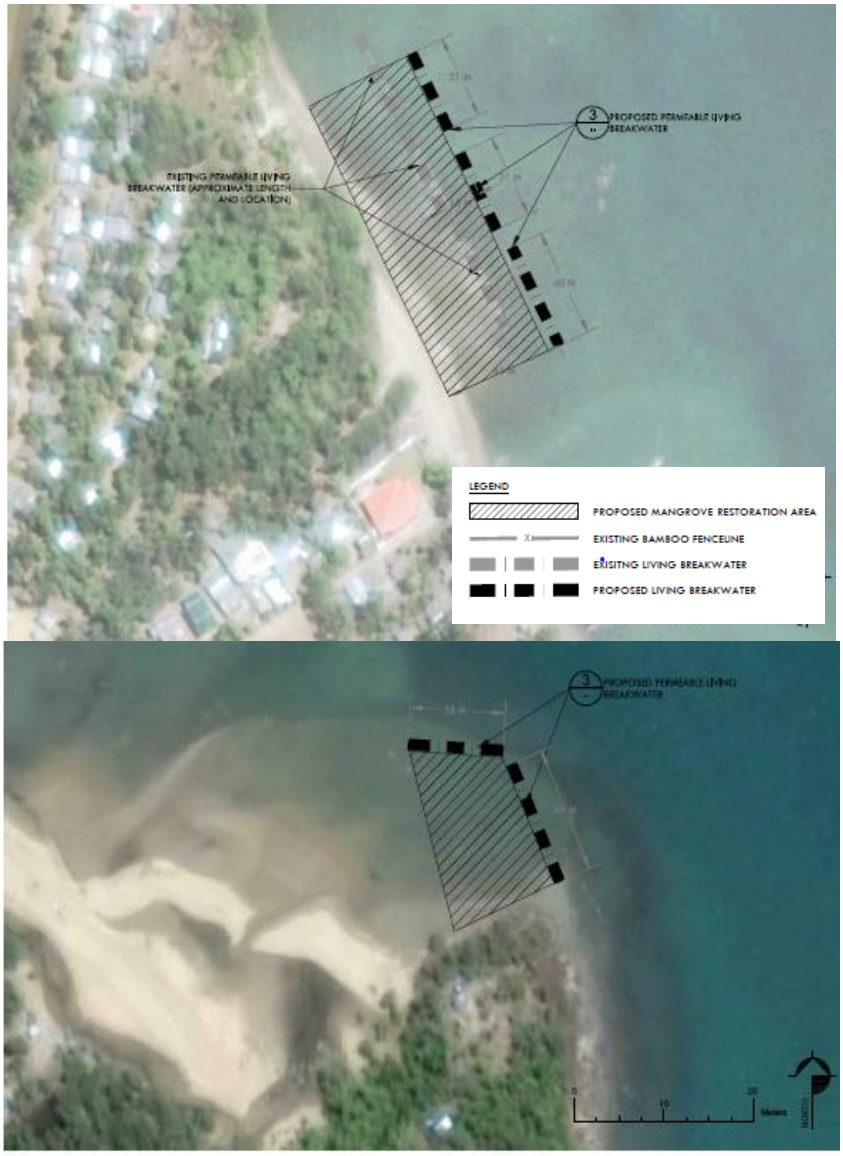

Figure 2. Green-grey infrastructure design in 2 sites in Loong.

Results

There are two (2) fisherfolk organizations in Loong, the Baskal Operators of Loong Association (BOLA) and the Kusog sg Magagmay nga Mangingsda sa Loong (KUMALO). CI Philippines partnered with BOLA in the implementation of the green-grey project in Loong based on the recommendation of the Barangay Council after a series of consultation was conducted. However, to engage more community members in Barangay Loong, BOLA collaborated with KUMALO to support the implementation of green-grey project particularly in the construction of the permeable living breakwaters. The two organizations also co-led the implementation and management of the green-grey solutions in the area, in close coordination with the Barangay government of Loong and the Local Government of Concepcion. Figure 3 summarizes the interventions and accomplishments of the GGI Project implementation in Loong.

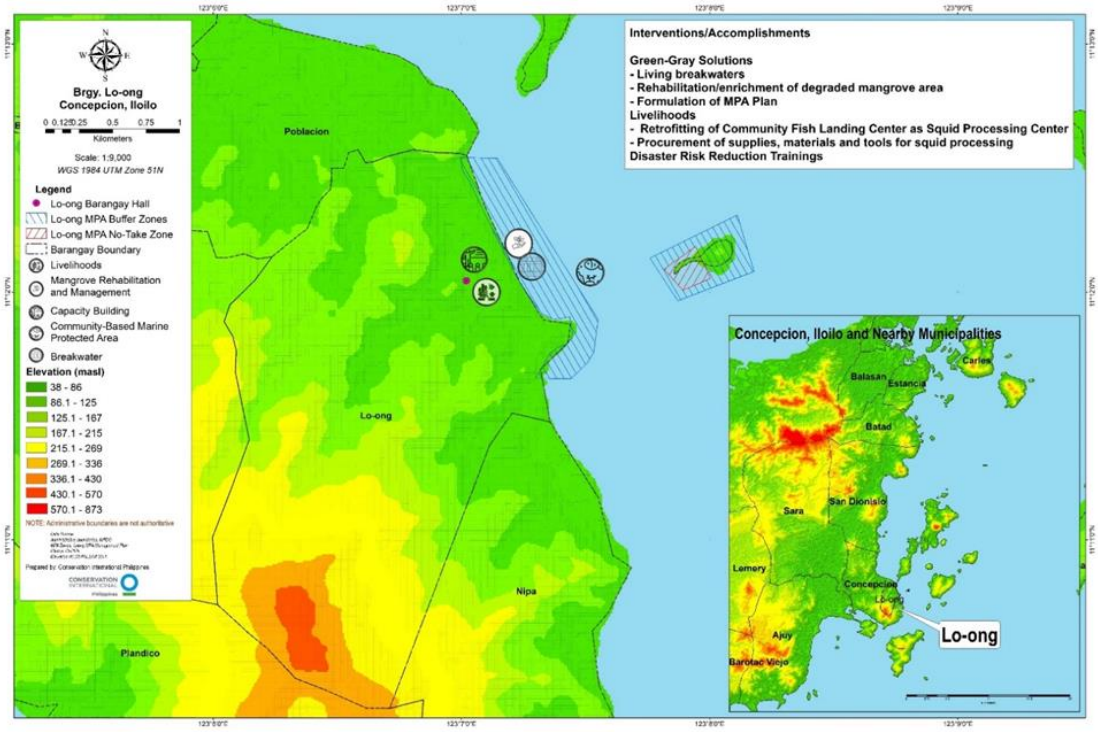

Figure 3. Map of green-gray interventions in Barangay Loong, Concepcion, Iloilo.

Green-gray solutions and benefits. BOLA, with the participation of KUMALO constructed permeable living breakwaters in two sites in Loong: 100 meters in Purok Malipayon (Site 1) and 80 meters in Purok Mabinuligon (Site 2) (Figures 4 and 5). The structures installed were 1 meter in height and 4 meters in width. The original target in Purok Malipayon was 102 meters of breakwater, however, from the total procured stones for the sites, the community organizations were only able to construct 100 meters as some of the stones delivered were rubbles and were not materials for breakwaters. The construction materials for these breakwaters are core/headstones and armor stones in a filter cloth base geonet textile made from coco coir fibers.

Figure 4. Drone shot of the semi-permeable living breakwater in Purok Malipayon in Loong (Site 1).

Figure 5. Semi-permeable living breakwater in Purok Mabinuligon in Loong (Site 2) that facilitated sediment accumulation favorable to mangrove planting.

While Loong is situated in mainland Concepcion, there is no road that leads to the shore of Purok Malipayon. Thus, the stones had to be transported to the construction site using a barge. From the dumping site on the coast, BOLA and KUMALO workers transported the stones from the coast to the breakwater area via the rafts they constructed for this purpose, then, at the breakwater site, stones were piled manually (Figure 6). Core stones were piled first, then armour stones next according to the detailed design of the breakwater (Figure 7).

Figure 6. Transporting stones to breakwater construction site at high tide (left) and manual piling of stones at low tide (right).

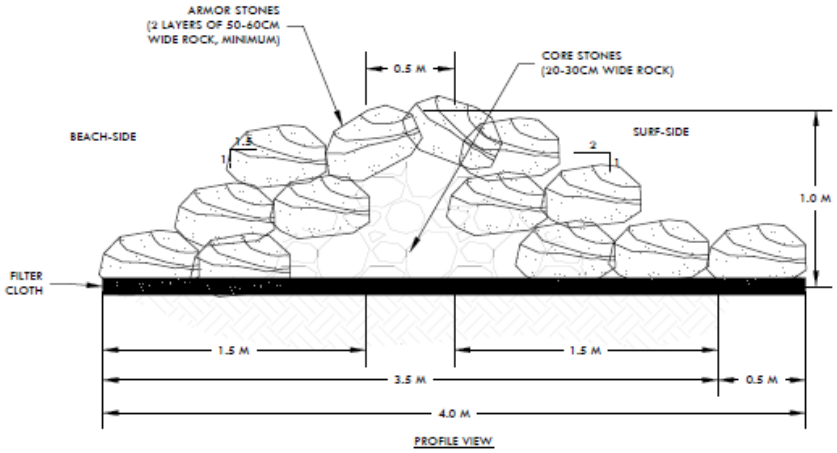

Figure 7. Details of the design of the semi-permeable living breakwater in Loong.

Pre-construction activities (i.e., construction of bamboo raft, planning and orientation, and delivery of stones) in Purok Malipayon (Site 1) were conducted from August to October 2019. Construction of the semi-permeable breakwater was initiated in October 2019, interrupted by the surge of COVID-19 virus infection in the area in March-October 2020, and completed in November 2020. In Purok Mabinuligon (Site 2), on the other hand, pre-construction activities were conducted in February-April 2021 with delivery of stones extended until May 2021. Actual construction of the breakwater was done from April to May 2021. For the breakwater construction, 14 BOLA members were involved with support from KUMALO workers.

Since the primary objective of the installation of breakwaters in Loong was to facilitate sediment accumulation in favor of mangrove planting and expansion of mangrove rehabilitation area, nine (9) sediment monitoring stations were established around (i.e., right side-seaward, middle, and left side) the breakwaters in Site 1 (Figure 9). These stations were set up with varying distances from the breakwater, i.e., 0m, 3m, and 5m. Sediment measurement from the monitoring stations was taken monthly from February 2020 to June 2021. Even if the breakwater in Site 1 had not been completed due to construction interruption brought about by the surge of COVID-19 cases in the area, sediment build up had been observed as early as March 2020 (Figure 10). Results showed that sediment accumulation was highest in the middle part of the

breakwater and least on the right side (seaward). Regardless, the sediment accumulation resulted in providing a substrate for mangrove planting in Loong (Figure 11).

Figure 8. One of the sediment monitoring stations in Site 1 breakwater of Loong

Figure 9. Sediment buildup around the breakwater in Site 1 in Loong in March 2020.


Figure 10. Sediment buildup on the shore side the breakwater in Site 1

Apart from facilitating sediment buildup for mangrove planting purpose, the installation of the semi-permeable living breakwater in Loong met its other objective, that was, to provide the community with additional source of food

and livelihood from the shellfish that colonized the surfaces of the structure (Figures 11-12). Shell gleaning on the breakwater has become an activity of women and children to supplement food for home consumption. Some shells are sold to generate additional income. The Barangay Council of Loong plans to put in place a regulation on the use of the breakwater to avoid damage or rearrangement of stones to maintain the engineering design of the gray structure.

Figure 11. Local oysters colonized the semi-permeable living breakwater in Loong, January 2021.

Figure 12. Local oysters are supplemental food for the local community, and some are sold for additional income.

For the green solutions, BOLA embarked on mangrove rehabilitation through planting and establishment of community-based MPA. The former is covered by a Barangay Loong Mangrove Rehabilitation Plan for March-December 2021. To rehabilitate 2 hectares of degraded mangrove area, BOLA needed to plant 20,000 seedlings. Sources of the seedlings were the two abandoned fishponds in Loong as there were issues in raising the seedlings in the mangrove nursery.

Enrichment planting was done by sixteen (16) community members (i.e., 5 females and 11 males) in degraded mangrove area near the semi-permeable living breakwaters and covered 0.5 hectare in Purok Malipayon (Site 1) and 1.5 hectares in Purok Mabinuligon from May to July 2021 (Figures 13-14). Seedlings were planted in rows (strip planting), equally spaced from each other at 1 x 1 meter. For this planting pattern and spacing, one hectare of mangrove required 10,000 seedlings. A total number of 20,000 seedlings were planted that included the various species of *Avicennia* (miapi), *Sonneratia* (pagatpat), *Rhizophora apiculata* (bakhawan lalaki), *R. mucronata* (bakhawan babae) and *Ceriops* (tangal). The target of rehabilitation/enrichment of 2-hectare degraded mangrove area was met.

Figure 13. BOLA members transported hauled mangrove seedlings (left) and cleaned the mangrove rehabilitation area in Loong prior to planting (right).

Figure 14. Mangrove seedlings planted on the accumulated sediment on the shore side of the breakwater in Sitio Mabinuligon (Site 2) in Loong.

As for the establishment of a 147.3-hectare community-based marine protected area (CB-MPA) composed of 14.1-hectare No Take Zone (NTZ) and 133.2-hectare buffer zone (BZ), the support provided by the GGI project in Loong came in the following forms:

- Provision of basic equipment and supplies (i.e., life jackets, solar light with sensor for marker buoys, life buoy ring, megaphones with sirens and mobile phones) for effective MPA enforcement and patrolling.
- Definition of the technical boundaries and coordinates of the MPA as inputs improved MPA management plan.
- Installation of six (6) MPA marker buoys to mark the boundaries of the MPA for monitoring and enforcement of regulations (Figure 15). Five of these were installed with solar lights with sensors.
- Fabrication and installation of two (2) MPA signages in Bago-Abo Islet and in Purok Malipayon (Site 1) behind the breakwater and mangrove restoration area to increase community awareness and support to MPA protection.
- Provision of capacity-building support through training and facilitation of community-based formulation of the MPA plan for 2021-2025.

Figure 15. MPA marker installation (left) and installed marker in Loong (right).

Livelihood incentives. As an incentive for the community participation in GGI project implementation, livelihood grants were awarded to BOLA by CI Philippines. **The livelihood project, which was identified for Loong was squid processing and production of squid-based goods, such as dried squids and bottled squid in different bases and flavors.** Although BOLA was the main partner of CI Philippines, this livelihood project was jointly owned and developed by BOLA and KUMALO. Squids are the major marine products that are caught by the fisherfolk, especially of the BOLA members. Majority of these catches are delivered to wholesalers in Iloilo City, while others are bought or consigned to local vendors in Concepcion. Some members of BOLA had previous training on squid crackers processing, and one was able to establish a personal business. Since there are surplus of fresh catch of squids, and to add value to these, the association proposed to venture into squid processing to include ready-to-eat squid meals aside from the popular dried squids. In this project, even class B or lower quality squids, could still be used hence, there would be no waste of raw materials.

To establish the squid processing livelihood, CI Philippines provided BOLA with the following support under the GGI Project:

- Provision of Funds to purchase fresh squids for BOLA's production of processed squids
- Provision of basic equipment and necessary supplies for squid processing (i.e., digital weighing scales, solar dryer, food processor and vacuum sealer)
- Physical enhancement of the under-utilized Community Fish Landing Center for it to serve as a squid processing center for BOLA and KUMALO.

From funds provided by CI Philippines, BOLA purchased 490 kilos of fresh squid from its members who are Baskal operators. From the 490 kilos of fresh squid, BOLA was able to produce and sell 93 kilos of dried squid. A kilo of dried squid is sold at Php 1,200.00 or $23.46.00. Thus, for 98 kilos of squid, the organization can earn back Php 111,600.00 or $2,181.81 if all the products are sold. However, due to COVID-19 restrictions, there were lesser wholesale dried fish traders, who reached Loong. Thus, the price dropped below Php 1,200.00. The net income (minus the expenses and labor costs) would be used by BOLA as revolving capital to continue the procurement of fresh squids for their squid processing requirements. The processing costs (splitting and drying) is Php 9,800 or $191 .59 for the 490 kilos at Php 20.00 or $0.39. Figures 15-16 present some activities for squid processing including the packaging of the dried squid products. BOLA and KUMALO also allocated P100,000.00 pesos (50,000.00 from each of the organizations) for the procurement of fresh squids and other materials needed in implementing the livelihood project.

Apart from the support provided by CI Philippines to the establishment of the squid processing center, the Local Government Unit of Concepcion allocated P500,000.00 for the installation of electricity and water supply in the Community Fish Landing Center (Figure 17). By July 2021, the center has one (1) unit chest Freezer, 1-unit upright freezer and 6 units of stainless-steel tables for squid processing. BOLA and KUMALO also have a motorcycle with side car that can be used in procuring raw materials and in transporting/delivering the finished products to the town proper. They have also existing utensils that was previously provided as a form of support after Typhoon Haiyan (Yolanda) by World Renew, a humanitarian organization. These utensils are also useful in squid processing.

Figure 16. Cleaning and splitting of fresh squids (left) and sun-drying (right).

Figure 17. Size-sorting of dried squids (left) and packaging (right).

Figure 18. The Community Fish Landing Center in Loong has been enhanced to serve the purpose of squid processing center for BOLA and KUMALO.

Capacity building on Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA). Loong received numerous capacity-building support on DRR-CCA from humanitarian and development organizations as part of the Typhoon Haiyan (Yolanda) rehabilitation. Because of its location in in mainland Concepcion, the communities here had more access to the support coming from the local government than the island communities of Concepcion. Still, selected members of BOLA and the Barangay Council of Loong participated in the Training on First Aid and Basic Life Support provided in 2018 through the partnership between Red Cross and CI Philippines under the GGI Project. The project also supported the development of the Barangay Disaster Risk Reduction and Management Plan for Loong, which also included Climate Change Adaptation.

Challenges and lessons learned in implementing the GGI Project in Loong

There were logistical challenges in implementing the GGI Project in Loong. A major challenge was the difficulty of delivering stones for use in breakwater construction. The access road to the dumping site adjacent to the breakwater construction site was narrow and used only by motorcycles. The narrow road was lined with electricity cables thus trucks could not penetrate the area. In one attempt, the delivery truck damaged part of the road so repair had to be done. The stones then had to be delivered using barge and delivery took longer time than expected since it could only be done during high tide. Some stones delivered were rubble and had to be replaced with the right size (core and armour stones). These factors delayed the start of breakwater construction.

From the dumpsite of delivered stones, BOLA and KUMALO workers had to manually bring the stones to the breakwater construction site. As these are too heavy, they had to purchase bamboos and construct a raft first as aids in transporting the stones to the construction site before construction could actually begin. This was another factor that delayed the breakwater construction. The raft construction took up time and should have been foreseen as a need during planning with the community partners. The breakwaters were constructed through manual piling of stones, an activity that could only be done during low tide. Construction was then stopped during high tide.

Since the breakwaters had to be constructed first to facilitate sedimentation and provide a substrate for mangrove planting, delays in completing the breakwaters consequently delayed mangrove rehabilitation activities. Typhoons, rough sea conditions and COVID-19 also adversely affected the implementation of the GGI Project. Loong experienced escalating COVID-19 cases a number of times, thus mobility and group activities were oftentimes restricted in 2020 and in the first half of 2021.

Some mangrove seedlings planted in Purok Malipayon were damaged by docking boats and algae washed ashore. For this, BOLA did replacement planting to maintain the mangrove rehabilitation area. BOLA, the Barangay Council of Loong and the Municipal Government of Concepcion committed to maintaining the rehabilitation area. There is also a need to establish a mangrove nursery in Loong to ensure supply of seedlings.

One of the objectives of the GGI project is to prove that ecosystems when conserved and/or restored and aided by gray solutions can provide measurable social, environmental, and economic benefits. However, these cannot be measured within the lifespan of the GGI project as these benefits can only be demonstrated over longer period of time.

Sustainability, conclusion, and recommendations

The GGI Project funding support contributed to building coastal resilience of the communities of Loong to climate change and disaster risks through:

- The establishment of semi-permeable living breakwaters in Purok Malipayon and Purok Mabinuligon that minimize wave impacts on the shore and facilitate sediment accumulation to provide favorable substrate for mangrove planting and protect remaining mangrove stands.
- The establishment of a 2-ha mangrove rehabilitation area where enrichment planting was conducted and would be continued by the community to maintain the green solution to building resiliency of coastal ecosystems and communities.
- The provision of supplemental sources of food and income to the community from the gathering of shellfish that colonized the semi-permeable living breakwaters.
- The establishment of 147.3-hectare Community-based Marine Protected Area composed of 14.1-hectare No Take Zone (NTZ) and 133.2-hectare buffer zone (BZ) through the updating of the MPA Management Plan, definition of the technical boundaries and demarcation of the MPA for enforcement of regulations and management actions, and installation of information materials for public awareness and support.
- The establishment of the squid processing livelihood, i.e. facility, materials and equipment for processing and local capacities for developing sellable products.
- The enhancement and deepening of the understanding by the community of climate change issues and the significance of ecosystem-based adaptation and innovative approaches like GGI, in mitigating the impacts of climate change and related disasters and risks.
- The enhanced preparedness of the community to CCA and DRR.

Coastal communities like Loong are undeniably vulnerable to the effects of the changing climate. The GGI project through the construction of the living breakwater and mangrove rehabilitation demonstrated that addressing physical vulnerability of the community is necessary to help build its resilience. Addressing social vulnerability through capacity building like training is also vital since members within the community are the first to respond during disaster.

The GGI community-build model emphasized that participatory and community-based strategies are valuable in project implementation. Applying the community build model harnessed local knowledge and skills and resulted in “ownership” over the long-term performance of the system. Inter-sectoral collaboration of BOLA and KUMALO with other organizations and community sectors is evidently important especially during the mangrove planting activity.

Replication of the GGI projects in coastal communities must greatly consider factors such as geographic location, tide levels, monsoon season, and access. These factors greatly affect timely implementation and costs for hauling and delivery of materials for gray structures. Local communities implementing the project should be

provided with basic tools and materials upfront as construction of gray structures require hard manual labor.

The role of the Local Government of Concepcion is crucial in providing sound technical assistance and ensuring the involvement of the community members in advocating for mangrove conservation, disaster preparedness and mainstreaming climate change adaptation into the local plans and policies. Participatory and community-based strategies are effective when local leaders and organizations are actively involved.

Incentives through diversified supplemental livelihood are also helpful for long term monitoring and sustainability of the GGI structures. This livelihood however must be cost-effective in utilizing locally available materials and resources in the community. The Local Government of Concepcion has been very supportive into local communities and its continuous support is important, especially in ensuring that the products of Loong reach more markets external to Concepcion.

Coastal resiliency benefits from GGI interventions will not be realized right away but in the coming years. A pre-condition however is that these green-grey infrastructures should be maintained for them to provide coastal protection in the long term. Maintenance means continuous replacement planting of mangroves that do not survive, monitoring of the planted mangroves and the entire rehabilitation area, maintenance of the mangnrove nursery as source of seedlings for mangrove planting, continuous monitoring of the integrity of the grey structures, enforcing regulations to protect the mangroves and nursery, setting up regulations on the use of breakwater for shellfish and seafood gathering, sustaining community awareness building and participation in relevant activities, and incorporation of these green-grey solutions in policies and development programs of the local government to facilitate budget allocation and funding support.

The GGI Project in Loong is covered by a Conservation Agreement signed by CI Philippines, the Local Government of Concepcion, Barangay Council of Loong and BOLA. The roles of each signatory in the implementation the GGI project and the maintenance of the infrastructures for a period of five (5) years beginning 2021 are stipulated in the Conservation Agreement. The implementation of the agreement is just one modality to sustain GGI in Loong.

The Local government of Concepcion is at the forefront of promoting the good results of the GGI project. These results can be utilized in leveraging further support from other government agencies, funding institutions, and would-be partners in the academe and private sector to sustain and expand ecosystem-based adaptation in Loong and increase coastal resiliency in Concepcion.

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