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AQUADAPT:

Nature-based solutions in Fiji

Evaluation under the IDRC-funded project “Knowledge brokering for nature-based solutions (NbS) in aquaculture transformation in Asia-Pacific: Support to the Aquaculture Innovation and Investment Hub (AIIH)”.

IDRC · CRDI
International Development Research Centre
Centre de recherches pour le développement international

In partnership with Canada

The project evaluated the effectiveness of various types of nature-based solution (NbS) in Fiji that contribute to climate change resilience by enabling off-grid farm operations and reducing reliance on costly fossil fuels. Aquaculture enterprises were assessed for this project based on the NbS they utilized and the potential benefits they offer in mitigating climate change impacts and enhancing production systems in Fiji.

Four enterprises were selected, and their descriptions are provided below:

1. **Farm Sites:** Aquaculture enterprises were assessed for this project based on the NbS they utilized and the potential benefits they offer in mitigating climate change impacts and enhancing production systems in Fiji. Four enterprises were selected, and their descriptions are provided below:

   Kerry Farms: Located in the western division of Fiji, around 12 Km from Nadi town. This region receives lower rainfall compared to central Fiji. The farm cultivated *Oreochromis niloticus* (GIFT Tilapia) and *Macrobrachium rosenbergii* (Giant freshwater prawns) using traditional earthen ponds. The farm has been inactive for over 5 years due to the increasing cost of water pumping. It consists of seven production ponds, each measuring on average 70 x 30 meters, and relies on a small river located approximately 15 meters below the farm for its water supply. Previously, the farm used electric pumps to draw water from this source, but the increasing electricity costs made this method uneconomical. In addition, the enterprise includes a fully operational tilapia incubator hatchery system.

   SEAPAC PTE Ltd: Situated near Navua town approximately 60 kilometres from Suva the capital of Fiji, specializes in farming *Penaeus vannamei* (whiteleg shrimp). The current farm consists of ten ponds, each measuring on average 4,000 m², which draw brackish water directly from the Navua River. This water is pumped using electric submersible pumps. The farm employs semi-intensive stocking densities 30pl/m² and utilizes electric paddlewheels for pond aeration. The farm's annual shrimp production is approximately (6.1 tonnes). SEAPAC is in the process of developing a new farm site located behind the existing farm; however, this new site is not connected to the main municipal electricity grid.

   Growa Fish Fiji Ltd: Is located outside of Navua town and specializes in culturing freshwater species in Fiji, primarily *O. niloticus* and *M. rosenbergii*. The farm is situated below the Wainikavika Irrigation Dam, which is the main source of water for the farm. This enterprise operates independently from the main municipal electricity grid, generating energy through hydro power from an on-site hydroelectric system and solar power. The farm consists of 7 production ponds with an average area of 4000 m² per ponds. The farm also has a functional freshwater prawn hatchery and processing and packing plant on site. Current production of the farm is approximately 1.5 tonnes of tilapia and 2.4 tonnes of freshwater prawns. The farm is planning to expand and would require a much higher capacity of energy.

   Muana-Ira Community based Mangrove Oyster project: Situated across from the Suva Peninsula, bordering Laucala Bay to the east in the Rewa Delta. This location includes the largest projecting island, Laucala Island, separated from the mainland by the Rewa River and its tributaries, approximately 44 Km from Suva city. It is the first pilot project site in Fiji for collecting spat and growing out mangrove oysters (*Magallana bilineta*) established in

2018 by the Ministry of Fisheries and Forests, Fiji (MoFF) in collaboration with the Pacific Community. The community-based farm uses the long-line hexyl system for the commercial production of mangrove oysters and is an unfed, nature positive, restorative aquaculture system

2. **NbS systems implemented in Fiji:** The project documented the following NbS innovations across the four sites. These innovations contribute to climate change resilience in Pacific Island Countries and Territories (PICTs) by enabling off-grid farm operations and reducing reliance on costly fossil fuels:

   Solar Energy: Three of the four aquaculture enterprises involved in this project were found to be using or are planning to utilize solar energy for their operations. SEAPAC is currently installing a 50-kW solar system to power all farm activities on their new farm site including paddle wheels, pumps and other farm activities. Growa Fish Fiji currently has 540W solar system with 3000w invertor that powers appliances and tools on the farm. Additionally, Growa Fish uses a 1HP solar water pump to transport water to their hatchery. This switch has significantly lowered their fuel costs by $80 per day, which were previously spent on operating a petrol generator.

   Kerry Farms is installing a 15HP hybrid solar submersible pump to draw water from the farm water source which is a river located 15 meters below the farm. They will also be using solar-powered aerators to increase fish stocking density and reduce the number of grow-out cycles needed, while still maintaining the same level of annual production.

Figure 1. Solar water pump in operation at Growa Fish Farm

Figure 2. Current solar panel system at SEAPAC farm.

Hydro turbine system: Growa Fish is the only company utilizing hydropower and is upgrading its hydro turbine system from 3 kW to a more powerful 5 kW at their Navua site. They have an unlimited supply of water sourced from the Wainikavika Irrigation Dam, which is gravity-fed to the farm, enabling them to effectively harness hydro-generated power.

Figure 3. The current 3kw hydro turbine system at Growa Fish Farm, whist the farm is in the process to upgrade this to a 5Kw.

Pond Liners: High-Density Polyethylene (HDPE) pond liners and knockdown tanks are considered Nature-based Solutions (NbS) due to their effectiveness in preventing water seepage. This feature allows for a greater stocking density in the ponds and decreases the energy required for filling and exchanging water. Currently, Kerry Farms is installing HDPE liners in two of their eight ponds, each measuring 70x30 meters. Additionally, they are setting up a 15-meter diameter HDPE knockdown tank to raise tilapia in an intensive system, with stocking densities of 25-30 fingerlings per square meter. Kerry Farms will also conduct a trial of an Agri-aqua system that utilizes wastewater from their grow-out systems to cultivate vegetables, serving as a natural method of bioremediation for the wastewater.

Bio-floc System: Kerry Farms will also utilise bio-floc systems in their 15-meter diameter HDPE knockdown tank. The bio-floc will be inoculated with inoculate bacteria that is imported from Thailand specific for freshwater aquaculture systems.

Agro-aqua polyculture: Kerry Farms will be testing an agro-aqua polyculture system that recycles wastewater from freshwater aquaculture into aquaponic vegetable gardens. This system will use the ammonia found in the wastewater from the ponds as fertilizer for the vegetables, while also helping to purify the wastewater before it is released into the environment

Trompe Aeration Systems: A trompe aeration system, which is a type of water-powered air compressor, harnesses the energy from falling water to compress air. This method offers a straightforward and efficient way to aerate water without the need for moving parts or electricity. Growa Fish Fiji employs this system to aerate their ponds, allowing them to increase fish stocking density without relying on alternative energy sources.

Unfed Aquaculture: The mangrove oyster grow-out farm run by the women's group in Muana-ira qualifies as a NbS because bivalve aquaculture is unfed, nature positive, and restorative, resulting in a positive net benefit for the environment. The community farm

currently employs 47 HEXCYL HD oyster baskets across a 50-meter area, containing a total of 2,100 oysters. These oysters have a market value of $3,500, priced at $20 per dozen. Furthermore, the MoFF has identified six more communities around Viti Levu for the development of community-based mangrove oyster farming in 2025.

Figure 4. Women in Muana-ira undergoing setup of oyster basket training and display of the mangrove oysters.

3. **Cost of NbS Implementation in Fiji:** The project examined the financial implications of implementing NbS in Fiji. A major challenge identified was the need to import specialized equipment that was not available locally, with 86% of these items sourced from China. The analysis concentrated on "landed costs," which included several components: the purchase price of the equipment (the largest portion), shipping costs, local taxes, duties, and inland freight (cartage). After reviewing all imported equipment, the study found that the average percentage breakdown of the landed costs was as follows: the purchase price accounted for 71% of the total landed cost, shipping costs made up 14%, and local taxes, duties, and inland freight accounted for 15%.
4. **Diseases Status and Biosecurity in Fiji:** The project noted that Fiji currently does not have any major aquatic diseases identified. However, enterprises involved in the project followed safe hatchery and farm protocols for disease prevention and control.
5. **Gender Roles In Aquaculture**: The project also explored gender roles in Fiji's aquaculture industry and highlights the significant roles that women and youth play in aquaculture.

   Farm Management: Interviews with various enterprises revealed that in family-run farms or those where the manager lives on-site, family members assist with daily operations. Women and youth contribute by participating in essential tasks such as water exchange, feeding fish, and other farming activities. On average, women dedicate about three hours each day to these management tasks.

   Harvesting and Post-Harvesting: The involvement of women in harvesting and post-harvesting activities received high praise from enterprises, particularly for their meticulous attention to detail in size grading and careful handling of aquaculture products. Women and youth from nearby communities are employed on part time basis for these tasks. On average, they contribute about 25 hours per week to harvesting and post-harvesting activities.

   Mangrove Oyster Project: This project is managed by the Community Women's Group in the village of Muana-Ira. The group collects mangrove oysters seasonally and sorts them

into baskets for a grow-out period of 18 to 24 months. After this period, they harvest the oysters and sell them to local restaurants.

Table 1. Different activities women undertake in aquaculture in Fiji.

Activities undertaken by women	No. of hours per week (hrs)	Number of Women involved	Percentage of women employed
Farm Management	25	23	39%
Harvesting and Post harvesting	20	31	53%
Marketing	5	4	7%

It was noted that women primarily carried out harvesting and post-harvesting activities. In fact, they represented 53% of all employees across the four aquaculture enterprises involved in these tasks. Additionally, women provided support to men during the daytime and evening feeding of the farmed commodities as part of farm management.

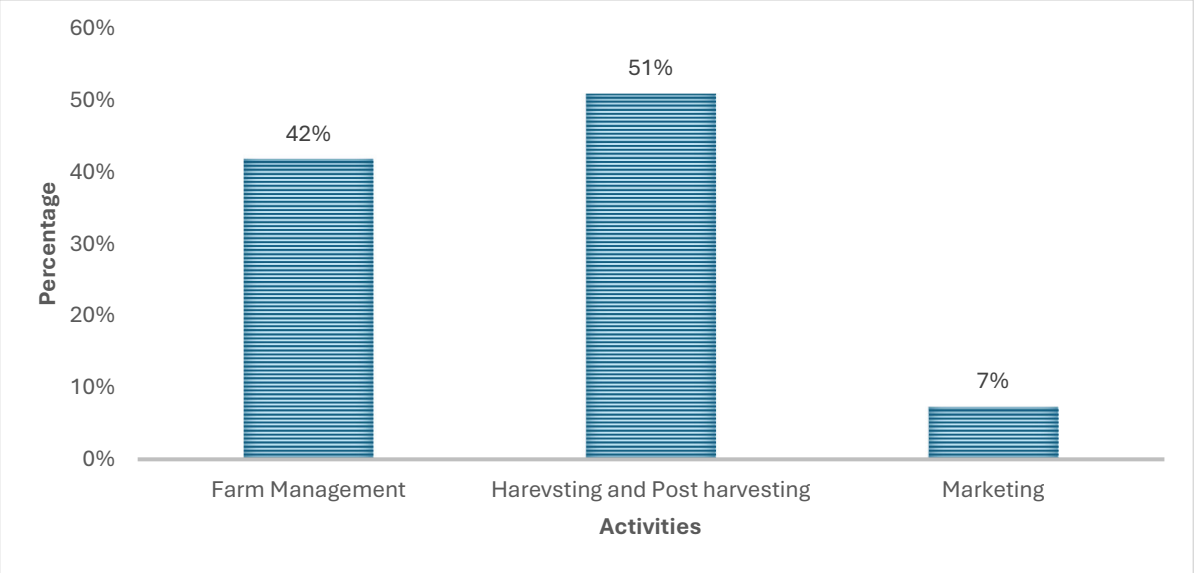

Figure 5. Distribution of women in different aquaculture activities in Fiji.