

Aquaponics to Eradicate Malnutrition From Extremely Poor Communities in Sri Lanka



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Title of the project:	Aquaponics to eradicate malnutrition from extremely poor communities in Sri Lanka
Location(s):	Padiyathalawa Divisional Secretariat (DS) division, Ampara District, Sri Lanka

Problem Description:

Due to affordability difficulties and lack of availability, many Sri Lankan poor communities suffer from nutritional deficiencies (malnutrition). Malnutrition is the condition that develops when the body does not get the right amount of vitamins, minerals, and other nutrients it needs to maintain healthy tissues and organ function. Due to the severity of malnutrition issues, this project selected Padiyathalawa Divisional Secretariat division in Ampara district after considering several other DS divisions in the Eastern Province.

Majority of Padiyathalawa's population is undernourished, many due to lack of protein, fruits and vegetables as they have to struggle to afford the food. According to a questionnaire survey conducted by the project team, it has been found that the villagers consume an imbalanced diet which contains less amount of protein and vitamins. Majority of Padiyathalawa's population (62% of surveyed villagers) earns below Rs. 10,000 per month per household as hard working laborers (95% of surveyed villagers earn below Rs. 15,000 per month per household). They live under extreme poverty and that is the main reason for their poor dietary habits.

Project Summary:

The project objective is to build an aquaponic unit in a poor village in the Padiyathalawa DS division that will produce fish and vegetables without any charge for select 50 poorest households (approximately 200 people) in the area and will sell the remaining portion of fish and vegetable to the local market. **The income from the aquaponics unit will cover the maintenance expenses of the unit and will contribute to the community to improve school education in the division (i.e buying school supplies, uniforms to the students and providing lacking facilities (lab facilities, buildings, etc.) to the schools).**

Project Rationale:

Poverty and malnutrition in Padiyathalawa

Due to affordability difficulties and lack of availability, many Sri Lankan poor communities suffer from nutritional deficiencies (malnutrition). Malnutrition is the condition that develops when the body does not get the right amount of vitamins, minerals, and other nutrients it needs to maintain healthy tissues and organ function. Due to the severity of financial issues in poor communities, this project selected Padiyathalawa Divisional Secretariat division in Ampara district after considering the several other DS divisions in the Eastern Province. Majority of Padiyathalawa's population is undernourished, many due to lack of protein, fruits and vegetables as they have to struggle to afford the food.

The project team was able to visit several villages in Padiyathalawa DS division with a questionnaire survey and had collected data from the

villagers. The result of the questionnaire survey is depicted in Chart 1 which clearly indicates that the villagers consume an imbalanced diet which contains (weight percentage) 90% of the main carbohydrate source (rice), 4% of vegetables, and around 5% of a protein source (fish, meat, dried fish, and milk powder):

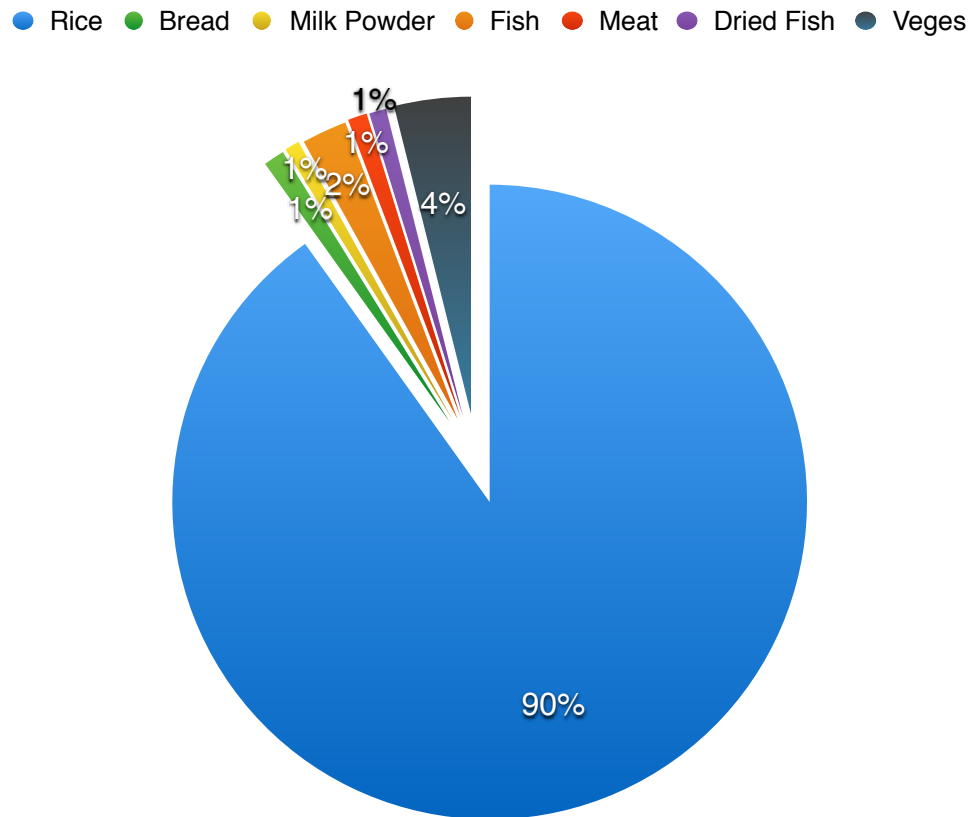


Chart 1: Questionnaire survey results [total number of households 116 (approximately 450 people)]

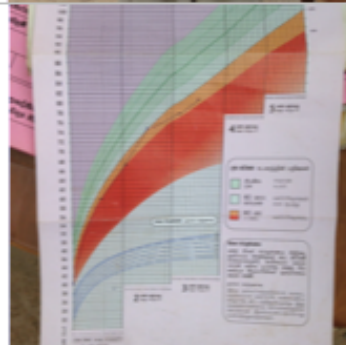
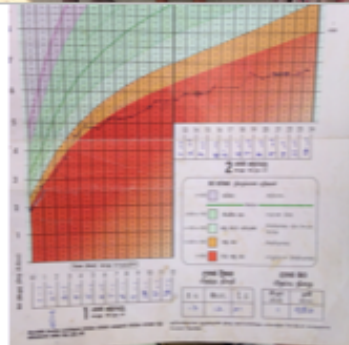
Majority of Padiyathalawa's population (62% of surveyed households) earns below Rs. 10,000 per month per household as hard working laborers. The extreme poverty is the main reason for their imbalanced dietary habits (**Many said that they cannot afford fish, meat, and vegetables**). Among the villagers, 63% of surveyed households have an average of two children under age fifteen. **Due to extremely low income, their parents are unable to afford their food and school education. As a result of that, many children suffer from undernutrition. And, they drop their school education early and support their parents to provide for the family.**

Padiyathalawa belongs to the dry zone and has been recognized as an arid region in Sri Lanka where it only rains during the north western monsoon season. More than 90% of the villagers do chena (farmland) cultivation (black-eyed peas and corn) and face many difficulties to save their crops from the drought and the wild animals. They have to obtain a bank loan to cultivate. At the end of the harvesting season they have to settle the loan by selling their harvest and that ultimately leaves them with no profit from the crops. During the dry season they struggle to find labor work to provide for their families. This process repeats every year and leaves them with debt and extreme poverty.

A few selected stories of the villagers:



Pemasiri and Malkanthi struggle to afford food, medical expenses of their disabled son, and school expenses of their two daughters. Pemasiri is unable to work due to his poor medical condition but owns one cow. His only income during the dry season is about Rs: 3,500 per month which comes after selling the cow milk.



Ranjith and Sandya struggle to feed their malnourished children (**both children are underweight**) due to unavailability of labor work. They do not have a land for cultivation.



Chandrika's husband died six month ago while she was pregnant. Now she is a widow and does not have a job to feed her children. She faces financial difficulties to afford her older son's school.

Response to the malnutrition issue

This project proposal comes to address nutritional deficiencies of select Padiyathalawa villagers by implementing an aquaponics unit in the area to provide fish and vegetables without any charge. As the project grows with time, the extra income earns by selling the excess amount of fish and vegetables will be contributed to improve school education in the division.

Aquaponics System

In soilless culture (hydroponics), instead of soil, various inert growing media (substrates) are used. These media provide plant support and moisture retention. Irrigation systems are integrated within these media, thereby introducing a nutrient solution to the plants' root zones. Hydroponics can control soil-borne pests and diseases by avoiding the contact between plants and soil, and because soil-less media can be sterilized and reused between crops. This reuse of substrates meets the particular demands of intensive production. Moreover, most soil-less culture methods use a fraction of the water necessary for traditional soil-based production because the nutrient solution is recycled. This approach provides alternatives to toxic soil sterilization to control pests and pathogens, and can help to overcome the soil-tiredness problems that monoculture practices have brought. Hydroponics becomes the most suitable farming in arid regions due to its higher water- and fertilizer-use efficiency.

Electricity is generally required to circulate or oxygenate the water. However, it does not require fuel to plough soil, it does not require additional energy to pump much higher volumes of water for irrigation or to carry out weeding control, and it does not disrupt soil organic matter through intensive agricultural practices.

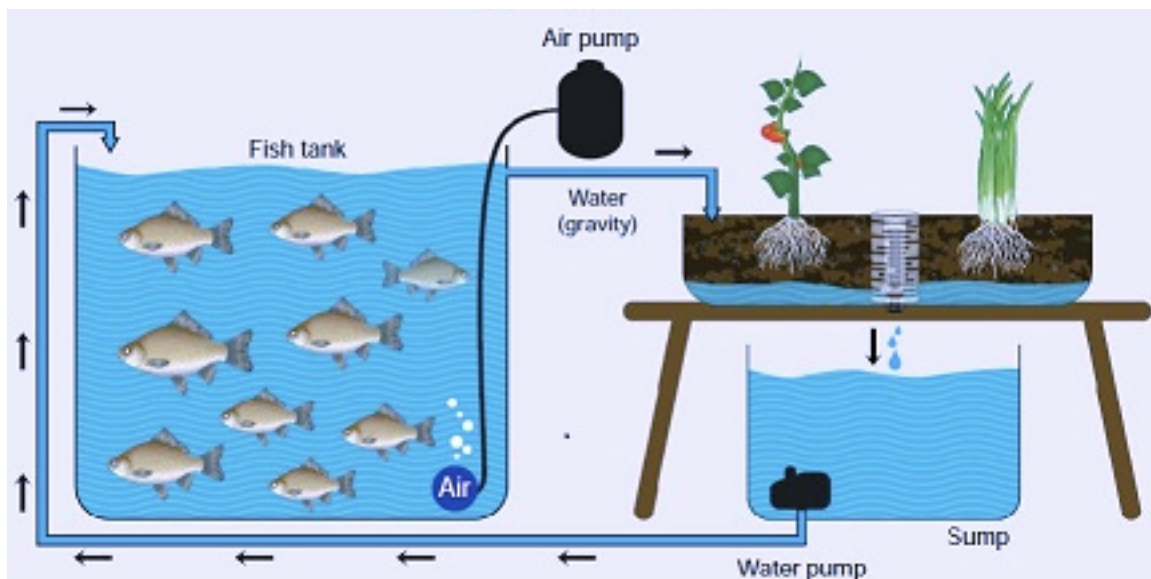


Figure 1: A simple aquaponics unit (Reference: <http://teca.fao.org>)

Aquaculture is the captive rearing and production of fish and other aquatic animal and plant species under controlled conditions. A recirculating aquaculture system (RAS) reuses operation water after cleaning and filtering and is the most applicable method for the development of aquaponics systems because of the potential use of by-products and the water nutrient content for crop production.

One major problem for the sustainability of aquaculture is the treatment of nutrient-rich wastewater, which is a by-product of the system. In an aquaponic unit, water from the fish tank cycles through plant grow beds and then back to the fish. In the grow beds, the fish solid waste is removed from the water using mechanical filtration method and dissolved waste is removed using biofiltration method. The biofilter provides a location for bacteria to convert ammonia, which is toxic for fish, into nitrate, a more accessible nutrient for plants. This process is called nitrification. As the water containing nitrate and other nutrients travels through plant grow beds the plants uptake these nutrients, and finally the water returns to the fish tank purified.

Project Description

The project objective is to address nutritional deficiencies of select 50 Padiyathalawa households (approximately 200 people) by implementing an

aquaponics unit in the area to provide fish and vegetables without any charge. Additionally, the project aims to unitize the extra income earned by selling the excess produce items to be contributed to escalate school education in the division.

Electricity is required for all the aquaponic unit. Fish feed needs to be purchased on a regular basis, and there needs to be a way to produce fish fry and plant seed.

Aquaponics is quite adaptable and can be developed with local materials and domestic knowledge, and to suit local cultural and environmental conditions. **Aquaponics does not rely on chemicals for fertilizer, or control of pests or weeds which makes food safer against potential residues.** Moreover, successful management requires knowledge and daily maintenance of the entire unit. Water quality needs to be measured and manipulated. Technical skills are required to build and install the systems, especially in the case of plumbing and wiring. It will always require a dedicated and interested person, or group of persons, to maintain and manage the system on a daily basis. Therefore, this project plans to hire a technical person and to train that person to maintain the aquaponics units on a daily basis.

The project plans to provide 100g of fish per person every other day, and three vegetable types (100 g of each type) per person every other day. Therefore, they will not require to spend money to maintain a healthy diet. However, they will still require to purchase rice and must be educated to prepare a healthy meal.

Planned fish species to grow in the aquaponics unit:

- Nile tilapia (*Oreochromis niloticus*)
- Mural (*Channa striata*)
- Giant freshwater shrimp (*Macrobrachium rosenbergii*)

Planned vegetable species to grow in the aquaponics unit:

- Eggplant (*Solanum melongena*)
- Green pepper (*Capsicum annuum*)

- Okra (*Abelmoschus esculentus*)
- Green beans (*Phaseolus vulgaris*)
- Angled luffa (*Luffa acutangula*)

Project implementation approach and partnerships

The first six months of the project must be completely dedicated to build the unit and to bring the entire aquaponics system to a stable stage. As a result of that, during the first six months, the project will not be able to provide fish and vegetables to the villagers for free. However, the project will be able to self-sustain after the first six months and will not require any further financial support.

The Divisional Secretariat will work together with Mahaweli Authority of Sri Lanka to acquire a land for the project. Sri Lanka Army and the villagers will support to build the unit in Padiyathalawa. The aquaponics unit needs continuous attention on a daily basis from the beginning to the end and will require to hire a technical person and to train that person to maintain the aquaponics units on a daily basis. Even though the project plans to grow fish fry within the unit in the long run, the Department of Fisheries & Aquatic Resources Sri Lanka will support to buy fish fry for the initial stage of the project. The Department of Agrarian Services Sri Lanka will help with the implementation of the hydroponics unit and will also provide the vegetable seeds. University of Peradeniya will support with any required laboratory tests for the project.

The list of partnership organizations:

- Divisional Secretariat office Padiyathalawa
- Department of Fisheries & Aquatic Resources Sri Lanka
- Department of Agrarian Services Sri Lanka
- University of Peradeniya
- Sri Lanka Army
- Mahaweli Authority of Sri Lanka

Management Arrangements

EWBSL will be responsible for project management and for carrying out all activities under the project. This entails ensuring that results and targets are reached within planned deadlines. There will be a project manager who will be managing the project team.

The main objective of the project team is to assure:-i) delivery of the project to agreed output milestones; ii) yearly financial reporting and forecasting to the funding sources; iii) yearly technical reporting inputs to the funding sources; iv) agreed monitoring data to the project manager; v) report on any other project matter including current downstream risks to the funding sources; vi) makes decisions on the priority of work, and would report the same to the funding sources. The project manager has the authority to run the project on a day-to-day basis on behalf of EWBSL. The project manager will have the responsibility to ensure that the project produces the required results as defined in this document and will be responsible for day-to-day management and will ensure that the project produces the results specified, to the required standards and within the constraints of time and cost.

Project work plan (First year)

[illegible]

Project monitoring and reporting

Technical monitoring and supervision of implementation of project activities will be conducted on a daily basis. In the inception phase, based on the detailed technical documentation and specifications, the project team will develop more detailed output-specific indicators, such as: fish harvest amount; vegetable harvest amount; temperature log; pH level log; nutrition level log; O2 level log; how production output changes with those log, etc. Reporting on the project progress and results will be conducted yearly.

Analysis of risks and undertakings

The following risks for the project implementation and mitigation measures were identified:

Type of risks	Likelihood/probability	Mitigation measures
Floods and heavy rainfall damage the grow beds and the crops.	Low-Medium	• The grow bed level will be raised above the typical flood level in the area.
Death of the entire fish population due to an infection or a disease.	Low-Medium	• Avoid using locally prepared fish feed that would bring harmful bacteria and pathogens to the system (The fish will only be fed with the pallet fish feed). • Maintain sanitation very well in the entire unit. • Monitor and maintain the optimum pH, nutrients, temperature, and O2 levels in the system.
Invasion of harmful pests and/or weeds in the hydroponics unit	Medium	• Monitor the plant leaves and trunk on a daily basis to identify any pests and take immediate action to apply organic pesticides to stop the pest invasion. • Monitor the grow bed on a daily basis to identify any weeds and take immediate action to remove the weeds and to apply organic treatments.

Type of risks	Likelihood/probability	Mitigation measures
Fish and vegetable market values drop substantially	Low-Medium	• Maintain a financial reservation for such an incident and introduce new fish and vegetable species that have better market value. • Keep track on the market price so that early identification of market value fluctuation can be done.
Power failure for more than 12 hours	Low-Medium	• An electricity generator will be purchased with the budget to supply electricity to the unit during any power failure.

Project budget

Activity	Unit	# of units	Unit value (USD)	Total Cost (USD)
Building the aquaponics unit (capital cost)				
Reinforced concrete base for the tank	lump sum			11,700.00
Brick cost	lump sum			1200.00
GI pipe cost	lump sum			800.00
Rubber net cost	lump sum			50.00
Roofing cost	lump sum			1350.00
Pipes and fittings cost	lump sum			250.00
Pool pump	lump sum	1	100.00	100.00
Air pump	lump sum	2	110.00	220.00
TDS/pH meter	lump sum	1	65.00	65.00
Water Test Kit Nitrite Nitrate	lump sum	1	45.00	45.00
Electricity Generator	lump sum	1	2995	2995.00
Subtotal capital cost:				18775.00
Operational costs				
Feed cost	monthly	6	1000.00	6000.00

Activity	Unit	# of units	Unit value (USD)	Total Cost (USD)
Electricity Cost	monthly	6	30.00	180.00
Costs for additives	monthly	6	35.00	210.00
Chemical testing equipment	monthly	6	35.00	210.00
Overhead costs	monthly	6	7.00	42.00
Capital purchases	monthly	6	15.00	90.00
Salary of skilled labor	monthly	6	140.00	840.00
Subtotal operational costs:				7572.00
Total budget framework:				26347.00

Donations

The project completely relies on donations. Your support to the possible level will be very much helpful to implement this project in Padiyathalawa area. Please use below information to make your donation:

Bank deposit or money transfer (E.g., Xoom, Moneygram, Western Union) directly to the bank account:

Account No : 057-1001-3001-5231

Account Name : ICSBE

Bank : People`s Bank, Peradeniya

Swift Code : PSBKLKLX

Send a Check (Cheque), postal address:

EWBSL

Department of Civil Engineering

University of Peradeniya

Peradeniya

Sri Lanka

20400

(Please send us an email (kosgolla@icloud.com, ranjith@fulbrightmail.org) with your contact information so that we can email you the project progress reports. Thank you!)