**Vale ni Wai Siga**

**Concept Narrtive:**

Our starting point in this project was to analyze the site’s inherent forces and potentials—both destructive and beneficial—and to integrate them into a self-sufficient and unified cycle aimed at addressing the village’s energy deficit.

* **Runoff and Flooding:**
One of the key destructive forces affecting the site during the rainy season is surface runoff and sudden flooding originating from the surrounding mountains. To harness this force, we designed a small dam at the site’s upper terrace, accompanied by the strategic planting of mangrove trees. This intervention slows and regulates incoming water, making it accessible for downstream agricultural use. Furthermore, three overflow points from the dam are equipped with small-scale local hydro turbines, converting the force of water into auxiliary on-site electricity.
* **Site Slope and Terracing:**
The land is divided into three elevation levels through terracing, allowing the controlled descent of water across the surface. This strategy not only prevents soil erosion and moderates water speed, but also enables traditional surface irrigation methods (flood irrigation), turning the land into a safe and arable environment.
* **Solar Energy Capture:**
Next, we identified the area with the highest sun exposure—away from tree shadows—for installing the main structure. This multifunctional system is designed to generate both electricity and potable water. Based on the calculated energy needs, 307 solar panels are positioned facing north, aligned with the sun’s path in the southern hemisphere.
* **Bamboo Structural System:**
The solar panels are mounted on a spatial bamboo framework, which also serves as a dual-purpose infrastructure for water collection and purification.
* **Coconut Fiber Water Filtration:**
The bamboo structure supports 15 linear elements, each containing a core of coconut fibers extending from beneath the panels outward. Under the panels, the fiber is denser, acting as a first-level filter for rainwater that flows down the panel surfaces into the fiber channels.
* **Fog Harvesting Function:**
As the fibers extend outward, their density decreases, transforming into a mesh-like structure capable of capturing moisture from ambient fog. These lines are oriented perpendicular to the prevailing winds, enhancing the condensation process and maximizing water collection from the atmosphere.
* **Seaweed-Based Filtration:**
Beneath the full length of the system, tubing filled with cultivated seaweed provides a secondary layer of bio-filtration. This component ensures that water collected from both rain and fog is further purified to become suitable for drinking. The seaweed used in this process is grown within prepared agricultural beds on the lower terraces.

**Technical Narrative:**

**What technologies does your design incorporate? Why did you choose them?**

**• FREF Proposed Solar Panels**
These photovoltaic panels, recommended by FREF, are used to convert abundant solar radiation into clean electricity. Their integration is ideal for tropical regions with high solar exposure. Solar energy is both sustainable and reliable, making it an optimal source for powering rural infrastructure year-round.

**• Spatial Bamboo Framework**
A lightweight structural system built from locally sourced bamboo supports the solar panels and provides infrastructure for water filtration. Bamboo is chosen for its high tensile strength, fast growth rate, and deep roots in local construction traditions. Its use fosters community engagement through accessible building methods and materials.

**• Coconut Fiber System**
Derived from native coconut trees, these fibers are used as passive filtration material. They naturally absorb moisture and filter particulates from rainwater and fog. This system is biodegradable, abundant, and easily harvested and maintained by the local population—supporting circular economy principles.

**• Fog Harvesting Technology**
Integrated into the coconut fiber structure, this passive system captures humidity from the atmosphere through condensation. It is especially effective in humid, fog-prone environments such as mountain foothills. The harvested moisture undergoes primary filtration via the coconut fiber layer.

**• Algae-Based Water Filtration**
As a secondary and final stage of purification, algae are cultivated in site-built agricultural beds. These biologically active organisms clean the water further and also yield nutrient-rich biomass. This supports food self-sufficiency and offers medicinal or nutritional value to the local community.

**• Vortex Hydro Turbine**
This system converts the kinetic energy from runoff and seasonal floodwaters into electricity. The design suits small-scale rural contexts and utilizes the site's natural hydrology, particularly effective in high-rainfall, mountainous regions.

**How much energy and water does your installation generate each year?**

**• Electricity**
The system targets 75 kilowatts of peak electricity through solar power. Approximately 300 solar panels, each rated at 250–300 watts, are required. With ideal solar exposure, each panel generates between 400–500 kWh annually, totaling around 135,000 kWh per year (135 megawatt-hours). This output fully meets the energy needs of a small rural settlement, including water systems, agriculture, and public lighting.

**• Water**
Using a 1,652 m² fog net system, integrated with coconut fibers, the installation can harvest around 1,507,375 liters (or over 1,500 m³) of potable water per year. This estimate is based on an average capture rate of 2.5 liters/day/m² in Fiji’s humid climate. The collected water is directed for drinking and irrigation.

**What are the system inputs? What are the system outputs?**

**• Inputs:**
– Runoff and Floodwaters (used for hydropower, irrigation, filtration)
– Solar Radiation (powers photovoltaic system)
– Humidity and Fog (captured for water harvesting)
– Rainwater (collected for drinking and irrigation)
– Marine Algae (used in bio-filtration and nutrient cycles)

**• Outputs:**
– Electric Energy (solar and hydro-based)
– Purified Drinking Water (from fog, rain, and runoff)
– Irrigation Water (filtered and nutrient-rich)
– Edible and Medicinal Algae (used in food and health applications)

**Prototyping and Pilot Implementation Statement**

Our approach to the prototyping and full-scale pilot implementation of the project focuses on utilizing local resources, techniques, and empowering the community, while also respecting the local ecology. From the very beginning of the design process, we aimed to develop the entire system using materials and methods that are readily available and familiar to the people of Fiji. This approach ensures that the community can engage with the project and maintain its sustainability.

One of the key components of the project is the use of local bamboo for the main structural framework. Bamboo was chosen due to its high strength-to-weight ratio and its historical usage in vernacular architecture throughout the region. It provides an ideal solution for both the support of solar panels and the construction of water purification infrastructure. The bamboo connections are made using coconut fiber ropes, which are hand-harvested, spun, and naturally biodegradable. This not only makes the structure eco-friendly but also reinforces local craftsmanship and knowledge.

Another essential element of the system is the coconut fiber that is utilized for water filtration. The fibers, extracted from the coconuts native to the region, serve as a passive filtration material. Their natural hygroscopic properties allow them to absorb rainwater and moisture from the air, which is essential for the water purification process. This material is abundant and can be easily processed by the local population, thus ensuring that the community can contribute to and maintain the system.

In the water filtration process, we also incorporated marine algae (seaweed), which is readily found along the coastal regions of Fiji. We have specifically adapted part of the land for cultivating and growing algae, which will be used to filter and purify rainwater and fog. The water used for algae cultivation is sourced from the runoff and floodwaters from the mountainous areas. By controlling and calming these waters, we not only prevent flooding but also harness their natural flow for irrigation and energy generation.

Once the algae are harvested, they are integrated into the algae-based filtration system, which is part of the final stage of water purification. The seaweed, which serves as a biofilter, is used to further purify the collected water from rain and fog. After passing through the coconut fiber filtration system, the water enters the algae-based filtration system, where it undergoes further biological treatment, ensuring that it is safe for drinking and other uses.

In the initial phase of prototyping, we will build a small-scale unit that integrates solar panels, the coconut fiber fog nets, algae-based water filtration, and a miniaturized version of the hydroelectric vortex turbines. This prototype will be built in collaboration with local community members, artisans, and youth groups to ensure hands-on involvement and knowledge transfer. Local participants will help in the assembly, allowing them to understand the process and contribute feedback on the design.

Once the prototype proves successful, we will scale up the implementation, utilizing local labor, materials, and workshops to ensure that the community is fully involved. The construction process will be supplemented with educational workshops on algae cultivation, renewable energy production, and water purification techniques. These workshops will be conducted by local leaders, educators, and women’s groups, promoting equal participation and long-term engagement.

Our ultimate goal is not just to create a sustainable system but to empower the community to take ownership of its maintenance and further development. By engaging local expertise, building upon traditional practices, and incorporating modern sustainable technologies, we aim to create a resilient, self-sufficient community that is capable of managing and maintaining the project for years to come.

This approach integrates community involvement, local resources, and the technical aspects of the design into a holistic and sustainable model for both prototyping and full-scale implementation.

**Operations and Maintenance Statement**

Our design is structured in a way that its operation and maintenance throughout its life will be both sustainable and reliant on active participation from the local community. To ensure long-term operations, we have used natural and locally available materials that are easy to maintain and recycle, such as bamboo and coconut fibers. These materials, known for their low maintenance cost and recyclability, are integrated into the production and upkeep of the system. The local communities will play a central role in the maintenance and operation of the system.

One of the key components of the system’s maintenance involves monitoring the performance of the solar panels and hydropower turbines. Since the system relies on renewable energy, maintaining these devices is simple and can be carried out with local skills. To assist with this, we will conduct training programs for the local community on how to monitor, maintain, and perform minor repairs on the system. This ensures that the system continues to function effectively and efficiently over time.

For the coconut fibers and marine algae used in the water filtration process, we will provide educational programs on planting, harvesting, and utilizing these resources. As these materials are naturally abundant in the region, local community members will be able to produce and use them with ease. Furthermore, for algae cultivation, we will teach local farmers how to grow algae not only for water purification but also for agricultural use, creating a sustainable and self-sufficient agricultural cycle.

The combination of training, resource use, and active community participation will allow the system to thrive and remain functional for the long term, with minimal external intervention.

**Environmental Impact Assessment**

any intervention within a natural environment, it may have some effects on the surrounding ecosystem. The key is to anticipate these impacts and implement appropriate measures to minimize or completely avoid environmental harm.

One potential impact is the alteration of natural water flow due to the installation of small-scale vortex turbines and controlled runoff systems. While these are intended to prevent destructive flooding and generate electricity, changing the hydrological pattern might affect soil moisture levels, native vegetation, and the habitats of aquatic or riparian species. To mitigate this, our design uses a terraced system that slows down water naturally rather than redirecting it abruptly. These terraces mimic natural contours and allow infiltration, reducing the risk of erosion or ecological disruption downstream.

Another concern could be overharvesting of local materials such as bamboo, coconut fibers, or seaweed. While all these materials are renewable and locally available, unsustainable extraction could lead to habitat degradation or biodiversity loss. To address this, we have committed to sustainable sourcing practices. Bamboo will only be harvested from designated areas that allow for natural regeneration, and we plan to cultivate new bamboo stands as part of our afforestation initiative. Similarly, coconut fibers will be collected from existing plantations without damaging the trees, and seaweed used for algae-based filtration will be grown on-site in specially prepared beds. This not only ensures a renewable supply but also reduces the ecological pressure on nearby coastal ecosystems.

We have also taken into account the possibility that introducing new filtration systems and algae cultivation methods could inadvertently alter the micro-ecosystem of the area. For this reason, we are using native species of seaweed and algae already adapted to the region's environmental conditions. Furthermore, our system does not involve the use of synthetic chemicals or artificial additives, making it safe for integration with the natural habitat.

To monitor and minimize potential environmental impacts, we plan to conduct regular ecological assessments in collaboration with local experts and community members. Workshops and training sessions will equip the community with the knowledge to recognize early signs of ecosystem stress and adapt practices accordingly. This participatory monitoring ensures local empowerment and continuous environmental stewardship.

Overall, our approach to mitigating ecological risks is based on respect for local biodiversity, sustainable resource use, and community engagement. We believe that by grounding our project in traditional ecological knowledge and reinforcing it with modern sustainable practices, we can create a positive, regenerative impact on the natural ecosystem rather than a harmful one.

**Thanks For Your Attention**