**Heartland: Where the land lives in us**

**Concept narrative**

Heartland is a way to produce a piece of art that provides clean water and energy to Marou Village. The concept of *Vanua,* an iTaukei word that means land, home, and community. This idea inspired us to envision an object capable of symbiosis that offers clean water and energy while receiving culture and community in return.

Inspired by the natural resistance of palms to cyclones, we designed a modular structure based on their morphology: lightweight, branched forms crafted from natural and minimal synthetic materials such as bamboo, palm fronds, and steel rods. The module blends in with its surroundings, respecting existing line trees and the natural contours of the land.

Each unit harvests rainwater through a concave spiral at the top, channeling it into a soakaway system for storage. The water descends visibly along a rain chain, falling toward a ground-level catchment point. This gesture provides a sense of transparency and reinforces the symbolic and functional presence of water throughout the site. During the dry season, the water is filtered for domestic use using a treatment system based on activated carbon derived from coconut shells. This local material is abundant in the region and it is known for its high adsorption capacity of chlorine, pesticides, heavy metals, and organic compounds, offering a sustainable solution that valorizes abundant organic waste in tropical regions, promoting low-impact, and the use of local resources. Above the module, a palm-weave canopy supports the solar panels arranged in patterns of traditional regional textiles. The energy generated can be used for residential and commercial purposes, including the operation of the project itself.

Moving southwest, residents, students, and visitors will find a vibrant clearing where the modules coexist with nature, blending seamlessly into the landscape. The ground has a geometric plastic grid that protects the solid structure and allows it to stay firm and permeable. Along the path, the sound of water flowing through percolation ditches creates a calm, immersive atmosphere.

To ensure a space that is accessible to everyone, including those with accessibility requirements, the design includes wide circulation paths (1.2 m), level surfaces, and adapted features that provide a safe and comfortable experience for all users. The elongated pavilion is dedicated to gastronomy and crafts, functioning as a marketplace where both locals and tourists can engage in cultural and commercial exchange. Further along, the pavilion leads to a small natural amphitheater surrounded by native trees and modular structures, serving as a scenario for local musical performances. Continuing the path, a semi-open classroom is available for students from Yasawa School, who will learn about the system functionality through interaction with the modules. Workshops organized by and for the community will improve technical capacities and support participatory planning processes, promoting empowerment and long-term sustainability.

This creates a cultural space for education, commerce, and socialization, thereby strengthening the identity of Marou Village. The modular system’s flexibility allows the community to adapt and reconfigure the space according to their needs and context.

**Technical Narrative**

The system integrates low-impact technologies tailored to the climatic, ecological, and cultural context of Marou. It is based on rainwater harvesting, solar energy generation, natural filtration, efficient storage, and modular construction using local materials. These technologies were selected for their low cost, local availability, ease of maintenance, and resilience to extreme weather conditions.

Each module has a concave spiral roof that channels rainwater into a soakaway infiltration system. This solution takes advantage of the natural slope and protects the water from contaminants and evaporation, while also serving as structural counterweight. The catchment surface per module is 69.44 m², allowing for an estimated annual collection of 137.22 m³ of water. With 12 modules, the system will be able to collect approximately 1,646.63 m³ per year. The total storage capacity proposed is 300 m³ to ensure water supply during the dry season and provide a safety margin in case of extreme rainfall.

The collected water is filtered using activated carbon made from coconut shells, which is a local agricultural residue with high adsorption capacity. This filter removes contaminants such as chlorine, pesticides, heavy metals, and organic compounds, ensuring safe water quality for domestic use. The filter replacement is estimated every 6 to 12 months, depending on the water quality, and will be determined after monitoring the collected water to optimize replacement intervals.

At the same time, the power generation system uses crystalline silicon solar panels mounted on handwoven palm latticework. Each module has 55.55 m² of solar surface, with a tilt angle of 18° and an azimuth of 0°. According to the *Fiji Power Potential Map* by the World Bank Group, the complete installation (12 modules) will be able to deliver an estimated production of 192,720 kWh per year, with a total installed capacity of 120 kWp and to ensure uninterrupted off-grid operation during periods of low solar irradiance, the energy storage system has been calculated to be approximately 611.25 kWh which is enough to provide two full days of autonomy without any solar input. This is based on a daily demand of 244 kWh for community operations.

The energy storage will be in lithium iron phosphate (LiFePO₄) batteries, selected for their high energy density, operational efficiency (80% safe depth of discharge), long lifespan (over 4,000 cycles), and minimal maintenance requirements. Each battery unit is calculated to have a nominal capacity of 13.44 kWh (48 V, 280 Ah) and the 46 battery units are estimated to meet storage requirements. The batteries are organized in a modular configuration for ease of installation, maintenance, and future expansion. This storage solution provides energy resilience and reliable power supply under extreme conditions, aligning principles of sustainability, autonomy, and energy security for Marou.

The system is scalable, modular, and replicable in other island contexts. Modules can be adapted for communal spaces, markets, classrooms, or shelters. The structure combines bamboo (flexibility and tensile strength), palm (shade and cooling), and steel (structural reinforcement), anchored with concrete foundations. The Maintenance is intended to be community-led and low-cost because users will be trained in panel cleaning, filter inspection, and water and energy data monitoring.

**System inputs**: solar radiation, rainfall, coconut shells, local labor.
**Outputs**: filtered water, renewable energy, operational data, and ecosystemic, social, and cultural benefits.

**Prototyping and Pilot Implementation Statement**

Our design approach is based on *Product Design and Development* by Karl T. Ulrich and Steven Eppinger. From the conceptual stage, we conducted a thorough assessment of user needs, which allowed us to define a set of product specifications such as clear and measurable requirements that outline what the system must achieve. Each specification includes a metric and a target value, enabling us to objectively evaluate whether the design meets user needs through quantitative evidence.

We identified 36 product specifications across six key categories: Natural Resources, Vulnerable Groups, Cultural Syncretism, Vanua, Affordances, and Tradition (Table 1.1 in the Annex). From these, we consolidated a list of 24 metrics (Table 1.2 in the Annex), some of which apply to multiple specifications. These metrics establish performance ranges, and guide both the design and prototyping process, ensuring an optimal response to the context and community priorities.

The prototype will include only the components needed to validate key metrics. Focusing on material resilience, construction techniques using vernacular materials, the efficiency of the rainwater harvesting system, and the effectiveness of natural filtration methods to produce water suitable for domestic use. We will build representative elements such as the concave spiral water collector, sections of the palm woven solar canopy, and key structural details, all mounted on a temporary and transportable base (e.g., cinder blocks or compacted gravel). The prototyping process will be carried out in three phases: technical and community planning, physical construction, and participatory evaluation. We estimate a total duration of at least 12 weeks.

We recognize the importance of technical support during implementation and will collaborate with a civil engineer and an architect to develop a safe and context-appropriate rollout strategy. We will also integrate tools and materials readily available on the island—such as woven palm, local cane, clay, bamboo, and volcanic stone to reinforce the cultural relevance and ownership of the design.

Community engagement is central to our process. Therefore, one of our main objectives is to ensure accessibility for vulnerable groups, following the principles of ISO 21542 on accessibility in the built environment. Prototype construction will be a participatory process involving community members, including artisans and students from Yasawa School. This will strengthen local technical capacity and promote collective ownership of the design. The experience will also serve as a foundation for future scaling and adaptation of the system.

To validate the design’s effectiveness and community acceptance, we will also conduct feedback sessions with local stakeholders, including interviews, collaborative mapping exercises, and on-site functional testing with diverse age groups and profiles. This feedback will provide key insights to refining the design before broader implementation.

As a team, we hope island residents will review and validate the proposed spatial layouts. To support this, we will use public consultation tools and collaborative design methods to co-create additional spaces with the community.

**Operations and Maintenance Statement**

The modular design of the installation prioritizes simplicity, durability, and community ownership to ensure long-term operability and resilience. Each module integrates low-maintenance technologies such as crystalline silicon solar panels and rainwater harvesting systems with passive filtration (activated carbon), designed to function autonomously with minimal intervention. The structural components made from bamboo, palm, and weather resistant steel were selected for their robustness, local availability, and ease of replacement or repair using community resources.

The photovoltaic system is designed with independently mounted panels each functioning as a self-contained “slab-like” unit. This configuration avoids the typical failure cascade seen in conventional interdependent solar arrays, where the collapse or damage of one panel compromises the integrity of the entire system. By isolating structural dependence, the design provides resilience in case of extreme weather events or accidental damage.

The operation will primarily be community-led, supported by an initial training and capacity building program. Through this program local residents will be equipped with the knowledge to monitor system performance, conduct routine maintenance (e.g., panel cleaning, filter replacement), and carry out basic repairs. The maintenance schedules will be co-developed with the community to align with seasonal cycles and local priorities.

The soakaway water system was chosen over sealed cisterns because it reduces operational complexity by leveraging natural infiltration processes and eliminating the need for active pumping or pressure regulation. The Solar system diagnosis and the rainwater metrics could be tracked through simple analog gauges or optional digital tools, depending on the technological familiarity of the community.

Over time, community governance structures such as cooperative maintenance teams or rotational stewardship will be established to foster accountability and knowledge transfer. This participatory approach not only reduces long-term costs but also strengthens local stewardship, climate resilience, and socio-ecological integration.

**Environmental Impact Assessment**

As part of the design process, a preliminary nature-related risk assessment was conducted based on available environmental information for Fiji and the characteristics of the proposed intervention. This assessment helped identify potential risks associated with the siting, operation, and maintenance of the system. In order to improve the prioritization and management of these risks, it will be necessary to gather or measure more location-specific indicators, such as soil quality, local hydrological dynamics, baseline biodiversity, and seasonal precipitation patterns.

The three main risks identified are:

1. **Disturbance of soils and native vegetation**: During the installation phase some localized impacts on topsoil and existing plant cover may occur. To mitigate this risk, non-invasive foundations will be used, earth movement will be minimized, and the structures will be placed in already disturbed areas whenever possible.
2. **Surface runoff and localized flooding**: Given the high rainfall in the region and the potential soil compaction in some areas, there is a risk of surface water accumulation. To mitigate this, at least 250 m² of rain gardens will be implemented to manage runoff, reduce erosion, and prevent localized flooding. These gardens will include native Fijian species such as the Old World forked fern (*Dicranopteris linearis*), Terminalia catappa *(Sea almond),* and the pothos vine (*Epipremnum pinnatum*), all of which are well-adapted to varying moisture conditions. One of the sub-benefits of these rain gardens is to dedicate a conservation area of flora biodiversity inside the site.
3. **Contamination or mismanagement of stored rainwater**: The soakaway system is designed to store up to 300 m³ of rainwater. One of the main risks with water storage is sanitation risks if not managed properly. To mitigate this, passive filtration layers (activated carbon) will be included, along with community-based monitoring and maintenance protocols to prevent stagnation or vector proliferation.

The overall design was developed to minimize environmental risks through passive solutions, low-impact materials (such as non-exotic bamboo and locally sourced coconut fiber), and the integration of green infrastructure that allows the environment to buffer and regulate the potential impacts of the installation. Additionally, a community governance approach will be promoted for system monitoring and maintenance, strengthening local capacities and fostering a regenerative relationship between the infrastructure and the ecosystem.

In order to have a correct measure of the impact that the project has on nature, the assessment identifies the need to monitor key environmental indicators to enhance future risk management. These include:

– Soil composition and infiltration rate

– Seasonal precipitation and stormwater accumulation patterns

– Baseline biodiversity (flora and fauna)

– Water quality of stored rainwater (e.g., pH, turbidity, microbial load)

– Vegetation cover and resilience in restored areas

**Annex**



