Concept

Ever Present Navitii is inspired by two plants. The Pandanus plant's leaves have traditionally been used for weaving mats, baskets, hats, and fishing gear. The Frangipani flower symbolizes purity, peace, renewal, friendship, and hospitality. These two plants represent the community's close connection to their natural surroundings and cultural traditions. The design aims to reflect this deep connection to local culture and nature by weaving seamlessly into the landscape, as if it has always been part of the environment. This biomimetic design creates dappled shade, reduces heat, and allows for airflow—similar to how a tree canopy naturally cools its surroundings. The structure consists of several parts, each fulfilling different functions, much like the various parts of a plant. Each "leaf" serves a unique purpose, providing space for agricultural work, social interactions, and sustainable energy production. While the shape of the design is an abstracted organic form, the supporting structure is based on a parametric wooden design, ensuring both flexibility and stability. It offers the necessary shade for yam cultivation and integrates 400 m² of solar panels on the roof, providing a sustainable energy source for community needs and collecting water, which is directed to the cisterns through an integrated gutter system.

The landscape also integrates water management measures that slow down water flow and reduce erosion. A three-stage wetpond system minimizes rainwater runoff and decreases erosion risks. Additional bioswales and rain gardens around the structure help during heavy rainfall events and flooding by directing excess water and improving infiltration. Furthermore, water is channeled and filtered into cisterns through these LID measures to provide water for residents and effectively utilize rainfall for agriculture and the community.

Materials

The parametric structure will primarily use locally sourced materials. Vesi (Intsia bijuga) is particularly durable, heat-resistant, and moisture-resistant. When properly processed, it requires minimal maintenance and can last 50 to 100 years in outdoor conditions. It is crucial to use sustainably harvested Vesi wood. To enhance stability, wood-clad galvanized steel beams are integrated to secure the structure against extreme weather conditions like cyclones. These beams provide structural support and efficiently distribute vertical and horizontal loads. Additional cross-bracing further reinforces the structure to absorb torsion and tensile forces caused by strong winds, ensuring the entire structure is cyclone-resistant.

Locally sourced concrete and stone will be used for foundations and load-bearing structures, particularly to increase durability against floods and storms.

For the solar energy installation, flexible monocrystalline solar panels with ETFE coating will be used. These panels offer high energy efficiency and are ideal for tropical climates. The ETFE coating provides extra protection against UV radiation, salt corrosion, and mechanical stress, making the modules durable, low-maintenance, and perfectly suited to local conditions. Flexible modules can be used, adapting to the organic shape of the wooden frame.

Wetponds: Materials and Plants for Filtration

Filtration in the wetponds will be achieved using locally sourced sediments, such as clay-rich and iron-rich materials, as well as sand and gravel. Organic filter layers like coconut fibers will support biological filtration.

Plants for Filtration:

- Phragmites karka (native reed): Stabilizes the soil and absorbs excess nutrients.
- Eleocharis dulcis (water chestnut): Grows in shallow waters and effectively reduces suspended solids.
- Cyperus involucratus (papyrus-like sedge): Tolerates standing water and supports natural water filtration.
- Typha domingensis (cattail): Absorbs nitrogen and phosphorus while stabilizing wet soils.

Plants for Bioswales:

Integrating suitable native plants into bioswales enhances water filtration, nutrient absorption, and erosion control.

- Phragmites karka: Stabilizes soils, reduces erosion, and promotes nutrient uptake.
- Cyperus involucratus: Helps reduce suspended solids.
- Eleocharis dulcis: Absorbs nutrients and improves water quality.
- Ischaemum muticum (native grass): Stabilizes banks and reduces erosion.

- Typha domingensis: Binds excess nutrients like nitrogen and phosphorus.

Technical Narrative

We chose solar energy because it is currently one of the most developed renewable energy sources with relatively low environmental impact. The 400 m² solar panels are estimated to generate approximately 18,260 kWh per year, translating to around 118.26 MWh annually.

Battery Capacity and Selection: Lithium-ion batteries will be used because they offer higher usable capacity and greater longevity compared to traditional lead-acid batteries. They are suitable for high discharge rates and ideal for off-grid systems. The battery capacity has been calculated to meet a daily energy demand of 244 kWh (based on the simulated needs of Marou Village). Autonomy during bad weather or solar outages is set for 5 days. The installed capacity will be increased to approximately 1,600 kWh to account for system efficiency and reserve.

DC and AC System Integration: The direct current (DC) generated by the solar modules will be used to charge batteries or power small DC consumers like LED lighting. An inverter will convert the DC into alternating current (AC) to run household and community appliances like refrigerators and tools. The modular design allows for future system expansion.

Structural Installation and Cyclone Resistance: The solar panels will be installed on a robust structure designed to withstand Category-5 cyclones. Wood-clad galvanized steel beams ensure stability. The ETFE-coated panels, with their flexible design, offer less wind resistance, reducing the risk of damage. An MPPT (Maximum Power Point Tracking) controller will optimize the charging current to the batteries, ensuring high energy yield under varying weather conditions.

System Inputs and Outputs

Inputs:

- Sunlight: The 400 m^2 solar panels utilize daily sunlight exposure. The region averages around 5 to 6 hours of direct sunlight per day.
- Rainwater: The cisterns collect rainwater from roof surfaces and have a total capacity of 27,500 gallons (approximately 104,099 liters).

Outputs:

- Electricity: The solar system produces approximately 18,260 kWh annually, primarily supplying households and community facilities. This includes lighting, refrigeration, and other essential electrical appliances. A buffer of about 4,260 kWh is allocated for unexpected loads.
- Stored Water: Rainwater collected in the cisterns will be used for irrigating yam crops and agricultural purposes, reducing the community's dependency on seasonal rainfall.

- Processing and Control: An integrated inverter converts the stored DC power from the solar system into usable AC power to operate agricultural and household devices.

Prototyping and Pilot Implementation

In collaboration with engineers, simulations will be developed to replicate real conditions such as wind, rain, and heat. The prototyping process will begin with a partial structure. For example, one "leaf" of the structure could be built to test structural stability, water management efficiency, and solar panel performance. Such a prototype could be operated for 3 to 6 months to gather reliable data.

Community Collaboration

We will closely collaborate with the community through participatory workshops where they can provide feedback on their needs and cultural aspects. Traditional elements, such as woven mats or culturally significant patterns, could be integrated into the structure. For instance, the woven mats could be used as roofing material where no solar panels are installed. Their involvement in the prototyping process ensures that the design is both functional and culturally appropriate.

Operation and Maintenance

The design promotes long-term maintenance through the use of durable materials, modular components, and local knowledge. The community will be involved from the construction phase to gain practical experience. Maintenance work should be carried out by skilled personnel, with comprehensive inspections every 2 to 3 years.

Community Involvement in Maintenance

By directly participating in the construction of the structure, the community will gain the necessary knowledge for its maintenance. Routine tasks such as cleaning the solar panels and checking the water systems will be performed by locally trained teams. Additionally, workshops will be offered to teach solutions to basic problems, such as replacing solar panels or clearing blocked water channels.

Environmental Impact Assessment

Potential Impacts: The installation is designed to minimize disturbances. Most constructions, except for electrical installations, will have a low environmental impact. Potential impacts include limited soil disturbances and temporary vegetation loss during the construction phase.

Positive Impacts:

- Bioswales improve rainwater management and prevent runoff and erosion.
- The integration of native plants enhances biodiversity and soil health.

Mitigation Measures:

- Careful Excavations: Limited soil excavation during electrical installations to avoid excessive disturbances.

- Vegetation Restoration: Replanting native vegetation in affected areas.
- Community Monitoring: Locally trained teams will monitor any damages, especially after storms, and carry out minor repairs, such as replacing solar panels or optimizing water flow.

Bioswales could capture and filter up to 80% of surface runoff, while retention ponds could reduce soil erosion by up to 30%.