PERMACUL(SU+RE): Designing a Sustainable and Regenerative Agricultural Eco-park through Permaculture

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Abstract. To protect the beauty and diversity of Quirino from the impacts of natural and human-made disasters, the call for sustainable and regenerative developments strengthens. With the introduction of permaculture in the province, it can serve as a framework for these developments. As such, the study seeks to showcase the potentials of permaculture by integrating its principles in the landscape design of Faraon Integrated Farm, as it aims to be a sustainable and regenerative agricultural eco-park. To achieve its goal, a series of literature studies, analyses, and conceptualization was conducted to identify the areas where permaculture can be incorporated. As a result, a permaculture-based landscape design of a sustainable and regenerative agricultural eco-park with a closed-loop system is developed. The eco-park was divided into six (6) permaculture zones, arranged according to the amount of attention it needs, consisting of areas chosen and designed based on the twelve (12) permaculture principles. To improve its sustainability and regenerative capacity, various technologies, practices, and techniques were also incorporated into the design, such as intercropping, use of natural farming inputs, vermicomposting, rainwater harvester & catchment, and utilization of renewable sources of energy. By imitating the Earth’s natural processes and relationships, permaculture can create sustainable and regenerative developments that could preserve and enhance the natural environment.

Keywords: Agriculture, Permaculture, Regeneration, Sustainability

1. Introduction

Known as the Philippines’s “Unexplored Paradise of the North,” Quirino has numerous picturesque and breathtaking spots waiting to be seen and experienced. [5] As an agricultural province, it is susceptible to the effects of typhoons, drought, soil degeneration, and degradation. With that, it is time for Quirino to invest in sustainable and regenerative solutions to preserve its natural beauty and diversity while remaining economically sound. Sustainability takes into account environmental, social and economic aspects in finding solutions to world problems within the limits of the Earth [1]. At the same time, regenerative developments aim to close all the open loops that cause environmental damages, and consequently, direct these resources back to the system where they are needed. [4]

This is where permaculture comes in. Permaculture, according to David Holmgren, is “consciously designed landscapes which mimic the patterns and relationships found in nature, while yielding an abundance of food, fibre and energy for provision of local needs.” [11] It is an ecological design approach [7] that creates systems that can heal the planet for future generations. And to realize its potential benefits, the study aims to integrate the permaculture principles in the landscape design of a sustainable and regenerative agricultural eco-park.
2. Methodology

2.1. Study Site
As per recommendation by the local government of Quirino, a farm in Brgy. Villa Pagaduan, Aglipay was selected as the study site, the Faraon Integrated Farm. The three-year-old farm is the only registered farm tourism site in Quirino, making it a priority for development.

![Location Map, Site Map, Site Photos](image)

**Figure 1** Faraon Integrated Farm [A] Location Map, [B] Site Map, [C-F] Site Photos

2.2. Research Methods

2.2.1. Data Collection
Primary data were collected through Rapid Rural Appraisal (RRA), maps and plans, and census and statistics to understand the daily activities in the farm, its current condition, its profile, and land characteristics. RRA includes direct observation, transect walk, and key informant interviews [3] with the owner, organic agriculture expert, and the provincial agriculture and tourism offices. On the other hand, secondary data were collected through journals, reports, theses, books, manuals, brochures, online courses, and documentaries.

2.2.2. Data Analysis
For a more in-depth analysis of data, the study used Permaculture Decision Making Matrix and Market Analysis. The Permaculture Decision Making Matrix provides the designer with information on how elements are related and arranged to create a permaculture system. This matrix is composed of (1) Topography, (2) Sectors, (3) Permaculture Zones, and (4) Permaculture Principles. The topography and shape of the land tell how the water and soil behave in a specific environment. With that, the permaculture landscape can optimize the water as it moves through the site. On the other hand, sectors pertain to all forces that permeate the site from outside, such as sun direction, prevailing winds, and noise. By understanding these, the landscape can be designed as a direct response to them. Next, zones are based on the way elements are placed and arranged in the system (i.e., how near or far are these elements to the center of human activity). Lastly, the permaculture design principles provide the designer a guide on how the different elements in the system would relate to each other, giving a theoretical backbone for the design. [10] On the other hand, market analysis is the quantitative and qualitative valuation of a market to help in planning and decision making. [8] For this study, the researcher conducted a qualitative market analysis to show the marketability of developing farm tourism sites in the province. However, due to constraints, a quantitative market analysis was not conducted.

2.2.3. Design Development
After analyzing the collected data, a permaculture-based landscape design was developed to directly respond to the strengths, weaknesses, opportunities, and threats found during the analysis.
3. Findings

3.1. General Condition
Faraon Integrated Farm is a relatively isolated farm envisioned to serve as a haven for people who want to get away from their busy lives and to provide the owner with most of his daily needs for a long time. For two years, the owner has been developing it by planting various crops and building recreational areas. In 2019, it became an accredited learning site of the Agricultural Training Institute, where the owner trains and teaches people on farming. With that, the farm has also started transitioning to organic agriculture.

3.2. Physical and Biophysical Aspects

Site and Site Boundaries. Faraon Integrated Farm is composed of five lots with a total land area of 60 201.8 square meters. It is located near the barangay and a Communal Irrigation System (CIS) canal line. The farm is surrounded by forest and agricultural lands on the north, east, and south, while a fish farm is situated on its west side.

Circulation. In terms of circulation, the farm’s only access from the provincial road is through a service road because most of the site has steep slopes. On the other hand, the pedestrian circulation inside the farm is mostly free. From the service road, guests must climb up the customized stairs on the hill to reach the other parts of the farm.

Structure. With most of the existing structures in the farm being temporary (e.g., nipa huts, chicken coops), they can easily be transferred and reused in the proposed design. On the other hand, the permanent structures include a training hall and a groundwater pump. The training hall is used for training, storing equipment, and resting, while the groundwater pump serves as a source of water for irrigation and daily activities (e.g., bathing, washing). All these structures are located near the house, making it easier to perform daily activities.

Vegetation. The farm is mostly comprised of agricultural vegetation as it is its primary purpose. It is composed of high-value crops, cash crops, fruit trees, and nitrogen-fixing trees. On the other hand, more than a hectare of the farm are forested. The landscaped areas are where recreational and educational activities usually happen, while the wetland on the lowest part of the site contains water all year round.

Agro-climate. Aglipay has a Type III climate which is characterized by a short period of the dry season and no definite period of the rain season. The average temperature in Aglipay is 26.70 degrees Celsius. Being located in the moist zone, Faraon Integrated Farm receives an average rainfall of more than 1 500 millimeters. Areas in the moist zone are agriculturally more productive than those located in the dry zone as it receives more rainfall.

Soil. Most of the farm’s lands used for agricultural purposes are Alaminos clay loam, while the forest lands and wetland are composed of Cauayan sandy loam. According to PhilRice [12], these soil types are both acidic, with a medium level of N, a low level of P and K, and a medium level of organic matter, constraining crop growth. It is essential to treat and prepare these soils before usage by applying agrochemicals to enhance their quality.

Topography & Slope. The farm is located within the 0-18 percent sloped area, making it prone to slight to moderate erosion. Based on the transect walk, the farm has a rolling hills terrain. With this, the topography concludes that the lowest part of the site is a valley, creating a wetland. Lastly, the site has many high areas where people can get a nice view of the farm and its surroundings.
4. Analysis

4.1. Permaculture Decision Making Matrix

4.1.1. Topography

Hydrology Analysis. The hydrology analysis shows how water moves in the site to design according to it. As shown in Figure 2, the areas where the arrows meet can collect water and (re)use it before going out of the system. They can store rainwater and irrigate crops that need more water, like palay. Also, the areas with blue arrows are more prone to erosion and landslide, so the usage of trees and crops can help control these hazards.

Slope Analysis. The slope analysis shows the different elevations in the site and their potential hazards and opportunities. Figure 3 shows that relatively flat areas can accommodate recreational and agricultural activities, while low areas can act as catch basins for rainwater, and relatively steeper areas can be planted with trees and crops. Lastly, high areas can contain recreational activities that utilize the view.

![Figure 2 Hydrology Analysis](image1)

![Figure 3 Slope Analyses](image2)

4.1.2. Sectors

Figure 4 shows that the farm sectors include the sun, wind, water, wildlife, landslide, and view. The sun sector follows the natural sun path while the wind sector represents the Northeast and Southwest Monsoons. Based on the wind's direction and the farm's topography, the northeast and southwest sides are prone to landslide. On the other hand, the wildlife sector comes from all sides except for the side near a fish farm. The farm is also surrounded by hills, forests, and croplands, resulting in pleasant and desirable views from all directions. More importantly, the compass shows that most of the sectors come from the southwest, making it the most susceptible area of the farm.

4.1.3. Permaculture Zones

In Figure 5, Zone 0 are areas for farm management, including the owner's home. For Zone 1, this includes areas that require regular maintenance, such as accommodation spaces. In the proposed zoning, two Zone 0s and 1s are created for more efficient management and more user-friendly circulation since these areas have different elevations. As for Zones 2 and 3, these areas need less attention than Zone 1, such as the croplands, orchard, greenhouse, and camping area. Zone 4 contains wood and food forests, and lastly, Zone 5 includes the unmanaged part of the site.
4.1.4. Permaculture Principles

Given the farm’s existing conditions and how waste and energy flow in the site, Table 1 shows the potential applications of the permaculture principles in the proposed agricultural eco-park to make it sustainable and regenerative.

Table 1 Potential Applications of Permaculture Principles.

| Principles [7]                     | Potential Applications                                                                 |
|-----------------------------------|----------------------------------------------------------------------------------------|
| Observe and Interact              | 1. Data collection and analysis                                                       |
|                                   | 2. Management and maintenance of the farm                                             |
| Catch and Store Energy            | 1. Using the ponds and rainwater harvesters to store water for farm usage.             |
| Obtain a Yield                    | 1. Having enough croplands that would provide the farm and its guests with food        |
|                                   | 2. Unprocessed and processed crops and fruits can be an additional source of income    |
| Apply Self-Regulation and Accept Feedback | 1. Management and maintenance of the farm                                            |
| Use and Value Renewable Resources and Services | 1. Using solar panels and building of windmills as sources of electricity            |
|                                   | 2. Planting and using bamboos as primary building materials                            |
| Produce No Waste                  | 1. Reusing wastes as agrochemicals for the farm                                       |
| Design from Patterns to Details   | 1. Designing the farm based on the patterns naturally found in nature                  |
|                                   | 2. Placement of catch basin to areas where the water goes, and planting based on the terrain |
| Integrate Rather than Segregate   | 1. Using pond for catching water, irrigation, aquaculture, and recreational purposes. |
|                                   | 2. Using wetland for catching water and for recreational activities                   |
|                                   | 3. Using the training hall as a learning center and as alfresco                        |
|                                   | 4. Using forest lands as homes for wildlife and as recreational areas                  |
|                                   | 5. Developing the farm as an agricultural, educational, and recreational site         |
| Use Small and Slow Solutions      | 1. Management and maintenance of the farm                                             |
| Use and Value Diversity           | 1. Providing different purposes for the farm, including agricultural, educational, and recreational. |
|                                   | 2. Using intercropping to control pests naturally and to provide the farm with different crops. |
| Use Edges and Value the Marginal  | 1. Planting bamboo and fruit-bearing trees along edges to serve as wood and food source, as a buffer, and as shade |
|                                   | 2. Planting ornamentals that can be used to beautify the farm and to serve as agrochemicals |
| Creatively Use and Respond to Change | 1. Management and maintenance of the farm                                      |

4.2. Market Analysis

Farm tourism has been growing in the Philippines, boosting the country’s agri-tourism. In 2019, the country recorded 174 DOT-accredited farm tourism sites [2], including the Yamang Bukid Farm in Palawan that drew over 254,000 visitors in the same year. [15]

In developing Faraon Integrated Farm as an agricultural eco-park, the target market is the local and international tourists, farmers, students, and visitors who want to learn about agriculture and permaculture. As the only accredited farm tourism site in Quirino, the farm has a comparative advantage over other farms in the province regarding funding,
marketability, and government support. Faraon Integrated Farm would become the pioneering permaculture farm in Quirino. But more importantly, it can spark the growth of the province’s agri-tourism industry.

5. Design Development

5.1. Design Concept

Sanglad is an Ilocano word that means “to anchor.” As the design concept, it aims to showcase how permaculture creates a design that symbiotically integrates people and nature, synergistically connects all elements, and harmoniously incorporates different functions. To embody the design concept and incorporate permaculture principles, such as design from pattern to detail and integrate rather than segregate, the vernacular style, as the design theme, uses locally available materials and knowledge in building structures and creating spaces. [6] The design used bamboo as the primary construction material to make it more environmentally and economically sustainable as it lessens construction costs. At the same time, native and multifunctional plants are used for softscape materials.

To visually represent Sanglad in the design, the researcher uses roots as the form concept. Like how permaculture anchors people and nature, the roots anchor a plant to its environment to create a harmonious and mutually beneficial relationship. The design uses the characteristics of roots in terms of hierarchy for effective circulation, connectivity for integration of areas, and organic shape for space optimization and rurality preservation.
5.2. Landscape Design

Figure 6 The Proposed Permaculture-based Agricultural Eco-park

Given its hilly terrain, the site’s topography plays an essential role in laying out and designing the permaculture-based agricultural eco-park (see Figure 6), as it dictates where to place what and what to place where. In the proposed design, the farm is divided into three (3) major areas according to topography, namely, the lower area, hilltop area, and upper area.

**Lower Area (1-13).** The lower area has the lowest elevation and a relatively flat area. This area comprises home/admin/restaurant, kitchen garden, cottages 1, alfresco, dormitel, biological pool area, aquaculture pond, boating pond, training hall, nursery, entrance, tunnel.
garden, and parking area which mainly function to accommodate and entertain guests. The home/admin/restaurant primarily manages the whole development. On the other hand, the kitchen garden, ponds, and alfresco are placed near the restaurant for easier access. Although most of the features in the lower area are for recreation, they also function as rainwater catchment (e.g., ponds, biological pool), as a food source (e.g., entrance, gardens, ponds), and as a learning area (e.g., training hall, nursery). And to help with electricity, solar panels are also placed in all roofed structures in the eco-park.

**Hilltop Area (15-17).** On the other hand, the hilltop area has the highest elevation but limited flatlands. This functions primarily for recreation, which includes the camping area, viewing area, and cottages 2. The camping area is for people who want to stay overnight and experience the eco-park at night. With an average wind speed of 4 m/s, the agricultural eco-park is a perfect site to run wind turbines [14] placed in this area to maximize its elevation. Lastly, view deck and cottages are found in the area for guests to appreciate the totality of the eco-park and the beauty of Quirino.

**Upper Area (18-26).** Lastly, the upper area has an elevation between the lower and hilltop area but relatively flat terrain. This area includes the observatory, vehicle rental, duck pond, permaculture garden, greenhouse, farmer’s market, agrochemical plant, cottages 3, and pocket gardens. The observatory, together with the home/admin/restaurant, manages the upper area given its location in the eco-park. On the other hand, the greenhouse and agrochemical plant serve as the eco-park’s source of composts, fertilizers, and soil improvers to the eco-park. The duck pond serves as a rainwater catchment in the upper area for irrigation. On the other hand, the permaculture garden features an outdoor museum to teach permaculture and its application in the eco-park. Moreover, the farmer’s market is where processed products are made and bought.

Aside from these areas, some areas can be found all over the site – the croplands and the buffer area.

**Croplands (14).** The croplands are the primary source of income for the agricultural eco-park. The proposed design applies different organic farming techniques, making it sustainable and regenerative. Various intercropping practices are integrated (e.g., crop rotation, contour farming, companion planting) to increase crop resiliency, soil productivity, and erosion control. And to help lower costs in terms of chemical usage, nitrogen-fixing leguminous trees are planted around the croplands.

**Buffer Area (27-30).** The buffer area serves as the park’s barrier, which aids in controlling erosion and water flow, including the tree orchard, the food forest, the bamboo forest, and the unmanaged forest. The tree orchard is filled with fruit trees that can be harvested by guests to lessen labor costs. Also, the integration of chicken coops in the orchard would help fertilize the trees and lessen feeding costs. On the other hand, the food forest serves as an additional food source with its diverse selection of fruit trees and shrubs, while the bamboo forest serves as a wood source and added source of income as a high-value crop. Lastly, forest trails provided in the unmanaged forest are used to meditate or to connect with nature.
5.2.1. Circulation
As shown in Figure 8-A, the paths in the lower and hilltop areas follow the farm's contour, as taught by the principle of designing from pattern to detail. On the other hand, the upper area's circular path is a one-way ATV trail chosen based on the topography, the view, and the user experience it can give. Lastly, to increase field efficiency and lessen inefficiency costs, regular and rectangular paths are used as field shape in the upper area. [8]

5.2.2. Accessibility
Figure 8-B shows the public areas or those that can be accessed by anyone with or without paying fees, the semi-private areas or those with both public and private features, and the private areas or those accessible only to a particular person or group. Aside from a few areas, the design is publicly accessible. The public areas do not have entrance fees; however, the services offered in these areas can only be availed by paying for them so that the farm remains profitable.

5.2.3. Classification
As mapped in Figure 8-C, the different classifications of site features include agricultural areas that aid in crop and livestock production, educational areas that help teach and train people, and recreational areas that improve people's social and mental health. Since agricultural production is the park's primary function and income source, this area occupies about 75 percent of the eco-park. At the same time, most areas fall under two or more classifications, aligned to the permaculture principle of integrating rather than segregating.
5.2.4. Su+Re (Sustaining + Regenerating)
Lastly, Figure 8-D maps out areas for sustaining, which aid maintains environmental, social, and economic health while preserving the natural systems, and areas for regenerating, which aid returns wastes into the permaculture system. Based on the plan, most areas in the agricultural eco-park both function to sustain and regenerate. These areas are mostly composed of agricultural spaces, being the primary producers and reusers of wastes. Moreover, these areas sustain the farm economically for its agricultural production and environmentally for practices that preserve soil quality. In addition to these, the eco-park promotes social sustainability by providing jobs to the people of Quirino, resulting in a healthier and more equitable community. Being a province that primarily generates income from the agriculture and tourism industry, its people have more experience in these areas; thus, cultivating a culture of sharing among people. At the same time, it offers local and international guests space where they can relax mentally and physically by interacting with other people and with nature.

![Figure 8 Thematic Plans](image)

6. Conclusion
To alleviate the impacts of natural and human-made disasters, Quirino has to start building sustainable developments and regenerating its environment. Through permaculture, a design theory that mimics the relationships and patterns naturally found in nature and incorporates them into the landscape, Faraon Integrated Farm in Quirino became a self-sustaining agricultural eco-park. With the Permaculture Decision Making Matrix, the potential applications of permaculture in the farm were identified, resulting in the design
concept Sanglad, which harmoniously integrates people and nature to design a sustainable and regenerative agricultural eco-park. With this, the landscape design features elements that strengthen organic farming, utilize various renewable energy sources, and reuses wastes to create a closed-loop system. With these design interventions, the cost of running the agricultural eco-park decreases, while its ecological quality improves over time. At the same time, it creates a more cooperative and livable community by providing people with space to relax, interact and work. With the people and environment working synergistically together, the development would remain sustainable and regenerative for a long time. The agricultural eco-park proved that with proper integration of permaculture in the layout and design, sustainable and regenerative developments could be created.

However, the study on permaculture does not stop from the development of a sustainable and regenerative agricultural eco-park. With that, for those who wish to continue the study, perhaps on a different site, the researcher recommends developing a farming schedule that reflects the crops to be planted, the sequence of the crops, the time when to make and apply natural farming inputs, and other related methods to improve the agricultural aspect of the development. In addition to this, the researcher recommends quantifying and estimating the permaculture farm's economic feasibility, in the short run and the long run. As such, a comparison with other kinds of farms can also be made. Lastly, the researcher recommends applying permaculture in urban planning and design, which would be an excellent opportunity to see how it works in a landscape with more human elements.

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