

# Permaculture Design Plan for the María Amor Foundation



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**Submitted by:  
Joncarlo Avila (ME)  
Alexander Boggess (ME)  
Sarah Butts (CE)  
Andrew Morrison (CS)**

**Submitted to:  
Professor Stanley Selkow, Worcester Polytechnic Institute, Ph. D**

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**Cuenca, Ecuador Project Center  
Worcester Polytechnic Institute**

## Abstract

The María Amor Foundation, a women's shelter for domestic abuse victims, sits on a largely unused plot of land. The goal of our project was to design an integrated land-use plan to provide food for internal use as well as to sell. Onsite we interviewed employees of the foundation and visited local farms to learn about the needs of the foundation and local agriculture practices. Our final design included functional, sustainable features which allows the shelter to serve as a safe space for women to recover and reconnect with nature. We left the property with suggestions on how to evolve to be completely self-sustaining.

## Abstracto

La Fundación María Amor, un refugio de mujeres para víctimas de abuso doméstico, se encuentra en una gran parcela de tierra no utilizada en general. El objetivo de nuestro proyecto era diseñar un plan integrado de uso de la tierra para proporcionar alimentos para uso interno y para vender. En el lugar entrevistamos a los empleados de la fundación y visitamos granjas locales para aprender sobre las necesidades de la fundación y las prácticas agrícolas locales. Nuestro diseño final incluyó características funcionales y sostenibles que permiten que el refugio sirva como un espacio seguro para que las mujeres se recuperen y se reconecten con la naturaleza. Dejamos la propiedad con sugerencias como evolucionar hacia una propiedad completamente autosuficiente.

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## Executive Summary

The María Amor Foundation, located in Cuenca, Ecuador, has been dedicated to providing shelter for women and their children who are victims of domestic abuse since 2004. Ecuador is the top country in Latin America for abuse, incest, and teen pregnancy (Personal communication, Marlene Villavicencio, 30 October 2018). The María Amor Foundation sought to counter this through their mission of creating a safe and welcoming space for victims to recover. The foundation provides sanctuary for about 100 women and 150 children each year. Food, shelter and counseling are just a few of the amenities offered to the residents. Additionally, the facility is surrounded and protected by fences to keep residents safe. A newer building, the “Nina Huasi” shelter, was donated to the foundation at the end of 2013, and sat on a largely unused plot of land (Personal Communication, María Amor Foundation, 21 August 2018).

In order to better provide for the residents and allow them to feel more comfortable in their temporary home, the foundation decided to develop a farm. Due to The María Amor Foundation's commitment to living harmoniously, they had specified that the farm be designed to be holistically sustainable. Using the philosophies of permaculture and ecofeminism, as well as other best practices in landscape design, the idea was to develop the components of the farm so they worked in synergy towards being self-reliant. The plan incorporated existing recycling, composting, and food production strategies in order to maximize sustainability.

The goal of our project was to design a permaculture land-use plan for the María Amor Foundation. To fulfill this goal, we had identified four objectives:

1. Understand the best practices in sustainable landscapes
2. Record the needs and expectations of the stakeholders
3. Assess the limitations and opportunities of the land
4. Examine the possibilities for future expansions

To learn about permaculture and agriculture as a science, we conducted research and interviewed local agriculture experts. We proposed semi-structured questions for these interviews which can be found in appendix H. We chose this approach in order to prompt for certain information which also allowed the experts to make us aware of any blind-spots. Plus, according to Allan Cochrane, “The semi-structured interview format is one that works particularly well with elite professionals” (Cochrane, 2014, p. 44). We identified an expert from



the University of Cuenca whom we contacted. She was able to teach us about regional practices which helped us to implement practical solutions.

Onsite, after talking with an agriculture expert, Professor Ernesto Lovato, we realized he already had a vision for the property. He provided us with a map of the land (fig. 3) that included their biofilters, contour lines, and more. He advised our group throughout the design process and helped us make a plan which encompassed his and the foundation's visions.

After discussing how to care for the property, we had to learn about local farm practices to seamlessly incorporate the farm. Small organic farms around Cuenca provided case studies for permaculture plans, and interviews with open-ended questions were an effective means of gathering information. We used this information to identify aspects of agriculture such as what plants excel under local conditions, when they should be planted, and what practices we could use to ensure successful harvests. If permitted, we took pictures of the farm and recorded the interview for future reference.

Additionally, to help us plan how to use the land, we soil tested the property. We brought soil testing kits to determine the composition of the soil as well as pH levels. The composition includes six essential nutrients that plants need in large amounts to stay healthy. They are: nitrogen, phosphorus, potassium, magnesium, sulfur, calcium (Ersek, n.d.). This helped us decide how much compost to use and where.

Upon visiting a local farm we learned many sustainable techniques used to care for plants, animals and the land. This farm in particular had two separate composting locations. One was used for normal composting which takes about six months to completely decompose and become usable compost. The other was mixed with active yeast to accelerate the decomposition process. In this way, the farm had compost ready to use in only one month instead of six.

Local farmers also use simple ways to control pests on their farms. They would place cups of beer in various locations to attract slugs. The beer would attract and trap the pests, keeping them from destroying crops. They used old, repurposed sacks to cover crops at night to prevent insects and wildlife from eating them.

Since Nina Huasi has both a limited labor force and limited financials, it was important to create an incremental plan that was feasible for them to implement over many years. Their goal for the first year was that all of the food grown will go towards the residents at Nina Huasi. This will allow them to become food independent. After they grow enough food to feed the residents,

the excess food will go towards supporting the cafe at Mujeres Con Exito. The last step is to produce enough food to sell at organic markets in hopes of providing the foundation with a source of income.

Professor Lovato wanted to remove eucalyptus trees on the property because they were not native to the area. Removing the non-native trees would create a more welcoming environment for native wild animals. He also discussed the idea of adding wetlands to the river to act as a natural indicator for the health of the farm and the land overall.

María Amor's psychologist was able to give us suggestions on ways the women would become more involved. She told us that the women would be more likely to participate in agriculture if they spent more time outside. To do this, she suggested adding areas for the women to relax outside, as well as a path along the river.

Our landscape design encompasses a plan for the entire property. It includes values of permaculture to create the most practical land use plan for the María Amor foundation. It takes into account existing landscape features and buildings to layout an achievable, sustainable and functional farm. Each of these features is part of our master plan, and they will be broken up into increments for implementation in the timeline section.

We recommended a number of local indigenous plants are grown at Nina Huasi. We also recommended several medicinal herbs to grow in an herb garden. In addition to a number of plants and herbs to grow, we also determined raising, chickens, guinea pigs and pigs would be a viable source of meat and eggs for the foundation.

We recommend that these phases of implementation should be followed:

Increment 1:

- All fruit trees
- Chickens
- Crops in the large field
- Greenhouse revamp

Increment 2:

- Guinea Pigs
- All crops
- Herb gardens
- Fix current relaxing area with bench

- New reservoir
- Hire at least one dedicated full-time caretaker

Increment 3:

- Pigs
- All relaxing areas and trails
- Children's garden

## Chapter 1: Introduction

The María Amor Foundation, located in Cuenca, Ecuador, has been dedicated to providing shelter for women and their children who are victims of domestic abuse since 2004. Ecuador is the top country in Latin America for abuse, incest, and teen pregnancy (Personal communication, Marlene Villavicencio, 30 October 2018). María Amor sought to counter this through their mission of creating a safe and welcoming space for these victims to recover. The foundation provides sanctuary for about 100 women and 150 children each year. Food, shelter and counseling are just a few of the amenities offered to the residents. Additionally, the facility is surrounded and protected by fences to keep residents safe. A newer building, the “Nina Huasi” shelter, was donated to the foundation at the end of 2013, and sat on a largely unused plot of land (Personal Communication, María Amor Foundation, 21 August 2018).

In order to better provide for the residents and allow them to feel more comfortable in their temporary home, the foundation wanted to develop a farm. Due to María Amor’s commitment to living harmoniously, they had specified that the farm be designed to be holistically sustainable. Using the philosophies of permaculture and ecofeminism, as well as other practices in landscape design, the idea was to develop the components of the farm so they worked in synergy towards being self-reliant. For example, the plan incorporated existing recycling, composting, and food production strategies in order to maximize sustainability.

The foundation wanted to integrate qualities of a safe and nurturing environment. The women and children staying in the shelter had been displaced from their homes, and were now in unfamiliar surroundings. The main priority was that they should feel at home while staying at the shelter. Engaging them in the farm and other outdoor spaces would help them be more comfortable in the new environment, as many of the women have cultivated their own gardens in their former residences.

Our goal was to design a permaculture land-use plan for the foundation that provides a safe place for women to feel at home and empowered. In order to meet that goal, we had identified four objectives. First, we considered the stakeholders' visions and preferences. These stakeholders included the foundation, the residents, the stewards of the farm, and the land itself. Since the foundation focused on unity with the environment, the land had significant stake in this project. Secondly, the best practices in sustainable landscape design include ideas of human-centered designed landscapes, food sovereignty, and sustainable farming (Holmgreen, 2007, p.

3). To be sustainable the farm has to be relatively easy to use and maintain for the staff, the women, and the foundation. Third, the limitations, opportunities, and constraints of the land itself must be considered. This included mapping the natural resources of the land, testing the soil for its nutritional content, and documenting known predators and pests. Finally, objective four was to discover possibilities for future expansions.

## Chapter 2: Background

This chapter explores the vision of the María Amor Foundation, theoretical frameworks of landscape design, and the implementation of landscape design concepts in residential areas. More specifically it delves into designing permaculture landscapes and making a successful land-use plan. It introduces the views and opinions of the stakeholders, governing philosophies, sustainable technology already in use and some ideas for the future. Finally, this chapter explores similar projects in order to identify their failures and successes.

### 2.1 The Vision of María Amor

The vision of María Amor is “to be a benchmark in the enforceability and restitution of the rights of women and their children, framed in the recognition and respect of diversity, which provides opportunities for healing, economic autonomy, productive development to nature and the community for the exercise of full life” (Personal Communication, María Amor Foundation, 21 August 2018). The María Amor Foundation helps women and their children recover from domestic violence by providing a safe space to live. The foundation empowers these women by strengthening their self-esteem, enabling autonomous decisions, and providing training in skills for re-entry into society. By involving the women and their children on the farm, the foundation aims to reconnect the women with nature.

### 2.2 Viewpoints to Consider

Four primary stakeholders were taken into consideration to develop a vision for the landscape design: the foundation, the residents, the stewards of the farm, and the land itself. They each had a different set of values which needed to be considered, and combined into a complex dynamic for land-use planning. The foundation administration controls all the planning and funding for the shelter. Due to this, the farm needed to meet the expectations and the mission of the foundation. The residents were essential to the farm’s vision planning because it serves as a source of recovery and inclusion for them. A maintenance plan needs to be made easy and understandable for the stewards, so they can keep the farm in operation in a sustainable manner. Finally, the land itself needed to be recognized as a stakeholder because it is affected by the

landscape design. Maintaining the land's integrity and health is not only important from a permaculture perspective, but also in creating a successful and sustainable farm.

## 2.3 Theoretical Frameworks on Landscape Design

Landscape design processes rest partly on the needs of the stakeholders, but also on finding a design which encompasses certain theories. At María Amor, the foundation has decided that a permaculture framework will provide a nurturing environment for both the land and the residents. This section explores various aspects of landscape design including best practices in permaculture principles and ecofeminism concepts.

### 2.3.1 Permaculture Landscapes

The theory of permaculture refers to “consciously designed landscapes which mimic the patterns and relationships found in nature, while yielding an abundance of food, fibre and energy provision of local needs” (Holmgren, 2007, p. 3). The term was first coined by David Holmgren and Bill Mollison in the mid-1970s to describe an “integrated, evolving system of perennial or self-perpetuating plant and animal species useful to man” (Holmgren, 2007, p. 3). Permaculture describes an environmentally friendly way to grow food that incorporates practices of sustainability while connecting those practices closely with nature (Pickerill, 2002, p. 180). An example of a permaculture plan can be seen in fig. 1 below. Our deliverable is similar, with a land use drawing and descriptions of our reasoning behind each item.

Water sources and sunny spots are examples of land features which are taken into consideration when designing the space (“Permaculture Design Principles”, n.d.). The design process also notes challenges with the land such as flooding and erosion. As time goes on, the design and usage patterns will become more evident. By continuously monitoring usage patterns, the design can adapt to the most natural layout. A successful permaculture design will have a harmonious connection between the users and nature (Holmgren, 2007, p. 9). Strategically picking specific systems that require significantly less human interaction will allow those systems to become more self-regulated.

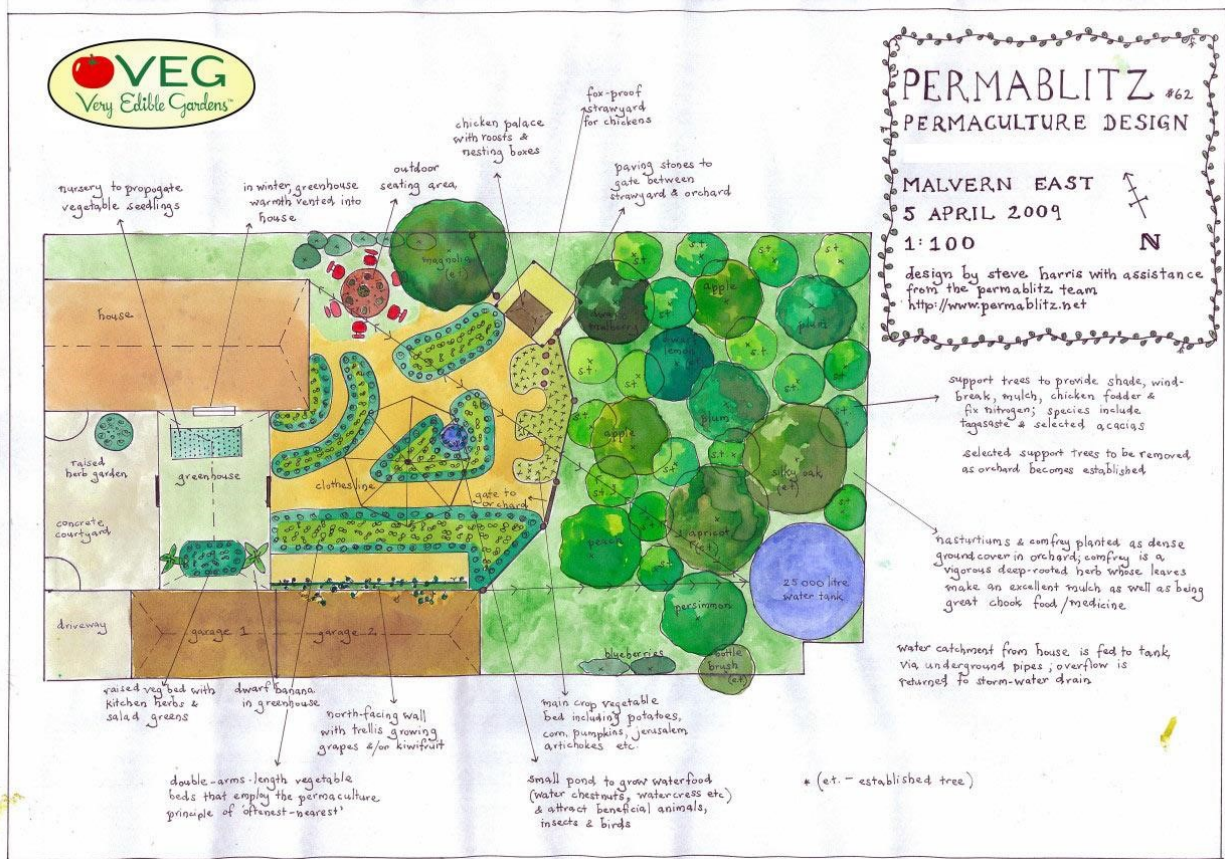


Figure 1: Permaculture Design Plan (Stive, 2013)

Allowing for positive and negative feedback from the land and its users is crucial to creating a successful, evolving permaculture farm. For example, consider two plants in close proximity, one plant provides protection from pests, while the other provides nutrients. A successful permaculture farm would facilitate these symbiotic relationships (Holmgren, 2007, p. 13).

Conventional fertilizer is a convenient way of adding nutrients to the soil. However, it has the potential to provide plants with too many nutrients which can hurt soil fertility. This does not adhere to the principles of permaculture. Instead, an organic solution can be integrated into the farm's ecology such as compost and manures generated on site. "The organic treatments resulted in a higher soil fertility capacity and in crops with higher quality protein, a higher starch content, and a greater ability to tolerate stressful conditions and long term storage in comparison with the inorganic treatments" (Granstedt & Kjellenberg, 1997). Generally, soil will be more sustainable when organic solutions are used (Holmgren, 2007, p. 19). More basics on compost can be found in appendix A.



There are six essential nutrients that all plants need to survive. They are nitrogen, phosphorus, calcium, potassium, magnesium, and sulfur (Ersek, n.d.). Certain plants will alter these nutrients in the soil in different ways. The compost or fertilizer used should provide the nutrients that the soil is lacking. Appendix B contains more information about this. To further preserve these nutrients, crop rotation can be used. Crop rotation involves rotating the crops to different fields. This works well because certain plants will deplete nutrients, while others replenish them. Without a rotating cycle, crops may continue to deplete a certain nutrient until there is little leftover.

Additionally, the diversity of crops and livestock on the farm will help maintain a self-regulated farm without the need for excess intervention (Holmgren, 2007, p. 20). This is imperative for creating a lasting and adaptive farm.

Another principle of permaculture involves developing the land by catching and storing resources in an efficient, environmentally friendly way. This can be done with rainwater collection systems, solar panels, compost bins, greenhouses and more. Certain steps should be taken to maximize efficiency.

In addition to efficient energy storage, permaculture farms aim to produce little to no waste. Recycling, reusing, repairing, composting, and pre-cycling are all great examples of reducing waste. These concepts are detailed in appendix C.

### 2.3.2 Ecofeminism

In synchrony with theories of permaculture, many ideas from ecofeminism are relevant to the goals of this project. At its core, ecofeminism concludes that there is “a unique connection between women and nature” (Godfrey, 2008, p. 104), and gives a feminist perspective on ecology (Godfrey, 2008). Vandana Shiva, a leader in the ecofeminist movement, asserts that a woman-centered farm is more sustainable and empowering (Shiva, 2004, pp. 2-3). These ideas support the rejection of sexism and instrumentalism as approaches to resource management. Given the context of María Amor, the landscape design can take ideals from anti-oppression, anti-domination, and anti-violence. As stated by Greta Gaard, “Life on Earth is an interconnected web, not a hierarchy. There is no natural hierarchy; human hierarchy is projected onto nature and then used to justify social domination” (Gaard, et.al, 1998, p. 3). Moving away from conventional resource extraction models will create a place that respects and cares for nature and

the Earth. In turn, this philosophy is helpful for involving the stakeholders of the farm and freeing them from any kind of domination, oppression, or violence, and provides reasoning to nurture their relationship with nature. According to the National Center of Biotechnology Information, that relationship will better match the goals of the foundation, making the residents happier (Capaldi, et.al, 2014), which in turn will help them recover.

Together, these theories nurture a concept of “sense of place,” which research shows can have a considerable impact as well. Susan Hanson says, “Sense of place is first of all an innate faculty, possessed in some degree by everyone, that connects us to the world. It is an integral part of all our environmental experiences...” (Hanson, 1997, p. 208). Sense of place is a connection to one’s surroundings, and it is vitally important because it brings a person stability and comfortability. More information can be found in appendix D.

## 2.4 Planning for Production and Residential Use

Involvement and inclusion of the residents is important to the foundation, and allows for a more productive and successful farm (“Permaculture Design Principles”, n.d.). There are many ways to improve engagement from the stakeholders. Adding an outdoor relaxation space would encourage residents to spend more time outside and give children a place to play and socialize. As noted from a previous project, “children brought an energy to the construction of the community gardens that was not only infectious, but also powerful at motivating us and other children to complete the garden” (Chow, et.al, 2017). Using repurposed materials would be an easy and effective way to add fun things for the children. Additionally, involving the children in this way has been shown to teach them the basics of gardening and agriculture (Chow, et.al, 2017). A small specific garden for children would encourage them to learn to cultivate their own gardens. Incorporating these ideas will result in an engaging farm with an involved community.

An ethnic community is defined as “a named human population with myths of common ancestry, shared historical memories, one or more elements of common culture, a link with a homeland and a sense of solidarity among at least some of its members” (Hutchinson & Smith, 1996, p. 6). Although the women staying at the shelter do not necessarily have a common ancestry, they have a common history and common culture which can be considered an ethnic community. Including design aspects which are inline to this community’s traditions and culture will promote their involvement. The way people identify with landscape varies drastically based

on their core beliefs. These different identities completely change a person’s view of nature and what landscapes they may or may not be attracted to.

Another difference that we needed to take into consideration is why people want to spend time outside. A study in Los Angeles revealed that different cultures used parks for different purposes. These ranged from social gatherings, sports games, relaxation, aesthetics and personal time (Loukaitou-Sideris, 1995). Landscape design should take these needs and expectations into account and highlight the values that are most important to the users.

In order to create a sustainable landscape including all of the above aspects, we can consider the “ten principles of landscape approach” (Sayer, et.al, 2013). These ten principles offer a set of guidelines for building a sustainable and functional landscape. According to these principles, one should consider the impact of the landscape in order to create the most functional and sustainable design. The most crucial principles are detailed below.

The first principle, “Continual learning and adaptive management” (Sayer, et.al, 2013) explains that a landscape should never be set in stone. An adaptive landscape, in this case, calls for a plan able to fit the changing needs of the environment and other factors. This landscape and its designers continuously seek new advancements and adapt to new situations. To achieve this, the landscape will also be designed with future changes in mind.

Principle two brings stakeholders into play by considering “different values, beliefs, and objectives” (Sayer, et.al, 2013). Since stakeholders in a landscaping project may have different views than the designers, one could find it difficult to find a middle ground. More on considering stakeholders in landscape design can be found in appendix E.

The design will include a number of logistical infrastructure decisions. For example, water distribution and use is something the farm should be conscious of. One water-saving technology already in place on the property is dry toilets. As the name suggests, there is no water involved in flushing, reducing the amount of consumed water. The dry waste is then turned into compost and used to fertilize the fields. Another consideration where water conservation can be applied is irrigation. There



Figure 2: Biofilter at Nina Huasi

are several small reservoirs that can be used for irrigation. The water from these reservoirs, the kitchen and the bathroom passes through several biofilters on the property. An example of a biofilter can be found in fig. 2. By utilizing plants and rocks, these biofilters sustainably remove and dirt, fat and other harmful chemicals from the water so it can be used as needed or be fed into an irrigation system. One successful irrigation system is drip irrigation. It is widely agreed that drip irrigation is one of the most efficient methods of irrigation as it delivers the correct amount of water directly to the plant's roots. Specifics on drip irrigation in appendix F.

#### 2.4.1 Sustainable and Synergistic Livestock

Each animal we considered was carefully examined for potential output (food, milk, manure, etc), required input (feeding, shelter, care), feasibility under the specific conditions at Nina Huasi, and synergistic effects. The research on these conditions for each animal can be found in appendix G. The main purpose for the animals was to provide food for the shelter. For this reason, the animals researched were chickens for meat and eggs, pigs for meat, guinea pigs for meat, and goats for meat and milk. Other animals were avoided for several reasons including cost, maintenance, and efficiency.

Often animals are treated poorly to save time, money, and space. It was critical to remember the values of ecofeminism and permaculture when designing the space for these animals. They should be treated with respect and fairness in order to adhere to anti-oppression, anti-violence, and give the residents of the shelter a chance to connect with nature and the animals. If they were neglected, the residents would only lose respect for them, which would diminish their bond with nature. To achieve fairness, the amount of care for each animal was based off of adequate conditions instead of the minimal. This included sufficient space, healthy food, satisfactory shelter, and careful maintenance.

#### 2.4.2 Herbs and Health

In many cultures, including Ecuadorian cultures, the use of herbs for their medicinal properties has been widely accepted as ancient wisdom (“Herbal Medicine Fundamentals”, n.d.). The use of herbs is the world's primary form of medicine dating back to approximately 5000 years (“Herbal Medicine Fundamentals”, n.d). According to the World Health Organization, 80% of the world's population still relies on traditional healing practices, including the use of medicinal herbs (Swierzewski, 2009). A medicinal herb is any plant or part of a plant that can be used for its therapeutic value. The main focus for herbalists (herbal practitioners) is to “treat

people as individuals irrespective of the disease or condition they have and to stimulate their innate healing power through the use of such interventions as herbs, diet, and lifestyle” (“Herbal Medicine Fundamentals”, n.d.). According to Swierzewski, “Herbalists take a holistic approach to medicine, which means that they focus on comprehensive health care that addresses the physical, mental, emotional, social, spiritual, and economic needs of the patient” (2009). Herbs can be used in three essential ways; to prevent an ailment, to treat an ailment, and to increase general health.

Produced from living or dried plants, herbs contain numerous interrelated compounds whereas most pharmaceutical drugs are generally a single chemical that is highly refined (“Herbal Medicine Fundamentals”, n.d.). In 1987, roughly 85% of modern drugs were derived from plants whereas today that number is currently down to 15% (“Herbal Medicine Fundamentals”, n.d.). Conventional physicians use strong chemicals to fight the disease and the patient may suffer from side effects as a result (“Herbal Medicine Fundamentals”, n.d.). Side effects can also result from herbal drugs and “can obviously be highly dangerous, like any other drug” (Meuss, 2000). When using herbal medicine, “It is necessary to know the individual plants, their potential actions and hence their indications” (Meuss, 2000). Herbs generally have no life-threatening side effects when used as directed by a herbalist because “knowledge alone will prevent failure and ensure success” (Meuss, 2000).

## 2.5 Learning from Similar Ideas

Projects like this have been tackled in the past, so it is possible to draw important information from these experiences. This will help us to avoid common mistakes and understand what has already been proven to work. Here we present two studies that relate to the vision of María Amor.

### Case 1. Ecofeminism and Sustainability at The Genesis Farm

The Genesis Farm is a “center where the search for alternative global systems, global spirituality, simplicity of life, land, stewardship and sustainable, ecological agriculture all come together” (Godfrey, 2008, p. 107). Similar to the goal of the María Amor farm, the Genesis Farm seeks to feed and support the community. According to Godfrey, the farm has been immensely successful in this goal, as well as in implementing ecofeminism into their work (Godfrey, 2008). One proponent of this is the attention they gave to learning. The Earth Literacy Center, through

the Genesis Farm, offers programs that are designed to teach individuals not only how to connect with nature, but also see themselves as a part of nature. This technique has been quite rewarding for them, as people are more likely to connect with nature if they are equipped with strategies to do so. They also teach the idea of “sacred agriculture” (Godfrey, 2008, p. 108), where they treat the Earth as a living being, and subsequently treat the farm “with a deep spiritual commitment and love” (Godfrey, 2008, p.108). This creates a “positive, harmonious, respectful relationship” (Godfrey, 2008, p. 109) with nature, which is an objective of our project. Furthermore, the farm is dedicated to respecting all walks of life regardless of religion or beliefs. This openness and love for everybody promotes a style in which the Earth is treated and respected. One thing to be wary of is ecofeminism’s exclusiveness for humans, or even just for females at times. Patricia Siemen, the director of the Center for Earth Jurisprudence, sees this limitation, and states: “While the ecofeminist lens is important, we also need a cosmological perspective that recognizes that we humans are just one part of this larger whole, the larger Earth community” (Godfrey, 2008, p. 112).

#### Case 2. Learning from Permaculture Communities

A study was published in 2017 that compared three intentional ecovillages and one traditional village under the criteria of organic food production, low-impact human settlements, sustainable local economy, participatory government and social inclusion. The Global Ecovillage Network defines an ecovillage as “an intentional or traditional community using local participatory processes to holistically integrate ecological, economic, social and cultural dimensions of sustainability in order to regenerate social and natural environments” (Suh, 2017). The communities examined were the Findhorn Ecovillage, Crystal Waters, Ecovillage at Ithica and Mundang Ecovillage. None of the four communities completely live up to the standard of an ecovillage and we can take their successes and failures into account while designing our land use plan. The common struggles the communities face in food production is the inability to produce enough food for the entire community. Other problems included not having an on site sewage management system or a sustainable local economy. The most notable success of these communities is a strong sense of community identity and local trading systems. (Suh, 2017).

In terms of resource management, however, the communities had interesting ways of processing wastewater. The Findhorn Ecovillage has a sewage system called the Living Machine which is a greenhouse that breaks down waste through a series of bacteria and plant tanks.

Crystal Waters has a bed and wetland system and the Mundang Ecovillage is planning on installing a methane gasification plant. All of the ecovillages have alternative energy sources including wind and solar power (Suh, 2017). Currently solar power is used on the Nina Huasi property. These alternative energy and waste treatment ideas can potentially be implemented at Nina Huasi. The study indicated that most of the communities were unable to become economically self-sufficient and often relied on tourism and public education programs to make ends meet (Suh, 2017). We needed to make sure that above all the farm does what it needs to do; produce enough food for the shelter and have enough left over for profit. The four communities had weekly or more frequent town meetings as part of their participatory government (Suh, 2017). Public participation in the decision making process is key for a community like this to survive so we made sure that we got the participants involved in the decision making process of our design. All of these communities experienced various triumphs and failures and there is a lot we learned from studying these communities about use of resources, economic management and administrative organization.

## 2.6 Conclusion

The María Amor Foundation strives to be a safe place where women have suffered domestic abuse can come and find themselves again. The purpose of the farm was to both provide them with food and work experience but also to give them a space to reconnect with nature. Taking into account the current technology and the desires of the foundation we created a land use plan that incorporates ideas from permaculture, ecofeminism and local culture which integrated the ideas of similar projects done in the past as well as avoided their pitfalls.



## Chapter 3: Methodology

The goal of our project was to design a permaculture land-use plan for the María Amor Foundation. To fulfill this goal, we had identified four objectives:

1. Understand the best practices in sustainable landscapes
2. Record the needs and expectations of the stakeholders
3. Assess the limitations and opportunities of the land
4. Examine the possibilities for future expansions

### 3.1 Identify Best Practices in Sustainable Landscape Design

To learn about permaculture and agriculture as a science, we conducted research and interviewed local agriculture experts. We proposed semi-structured questions for these interviews which can be found in appendix H. We chose this approach in order to prompt for certain information while also allowing the experts to make us aware of any blind-spots. Plus, according to Allan Cochrane, “The semi-structured interview format is one that works particularly well with elite professionals” (Cochrane, 2014, p. 44). We identified an expert from the University of Cuenca, Ing. Lourdes Díaz, whom we contacted. She was able to teach us about regional practices which helped us to implement practical solutions.

### 3.2 Record the Needs and Expectations of Stakeholders

The foundation’s values played a large role in how we designed the farm. Our design included values of permaculture and sustainable practices to fulfill the foundation’s vision. On site, we talked with the foundations organizers to understand the scope of their mission.

Since the foundation intends to hire caretakers in the future, it was critical to make our land use plan as easy to follow and maintain as possible. The plan needed to incrementally add features since they will have a limited labor force of only a few dedicated workers.

We wanted to conduct informal convenience interviews with current and past residents of Nina Huasi to ask them their ideas for the property in order to incorporate facets of ecofeminism. Unfortunately, it was not practical since the women were difficult to meet with as they only stay for a few weeks, and they tend to keep to themselves. Instead we decided to meet with their psychologist, Marlene Villavicencio, as she understood their mindset. We wanted the residents to



feel connected to the land and nature, and the best way to do this was by implementing their ideas. We designed the questions around ecofeminism and sense of place by specifically trying to uncover what made them comfortable and what would foster their connection with nature. These questions can be found in appendix H.

After talking with an agriculture expert, Professor Ernesto Lovato, we realized he already had a vision for the property. He provided us with a map of the land (fig. 3) that included their biofilters, contour lines, and more. He advised our group throughout the design process and helped us make a plan which encompassed his and the foundation's visions.

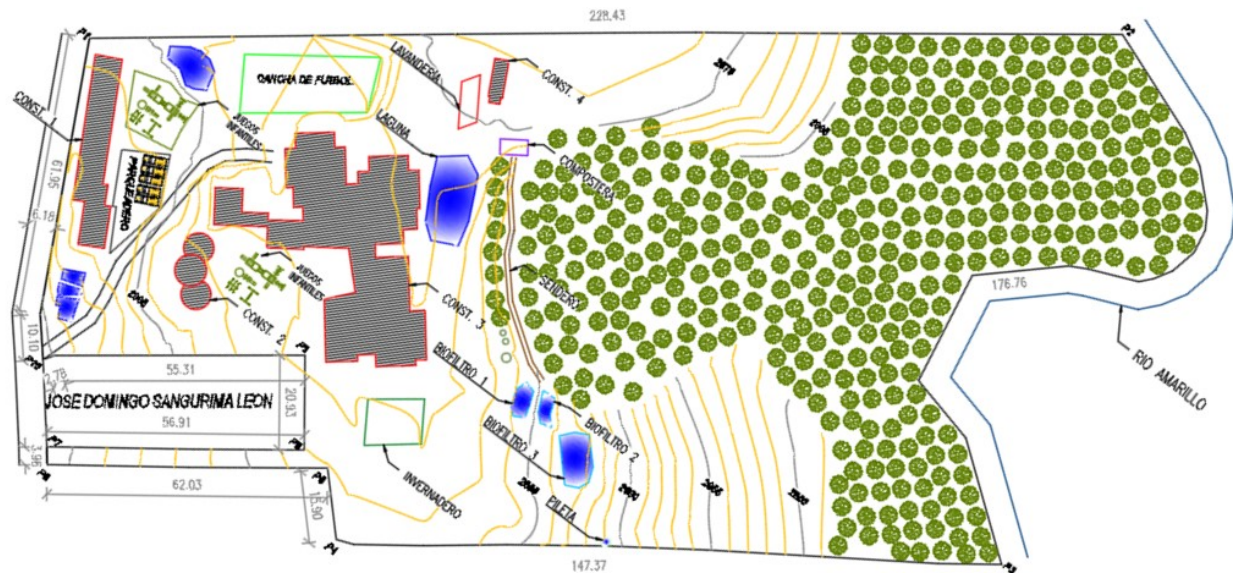


Figure 3: Map of the Land

Next, it was essential to incorporate the land as a stakeholder from a permaculture perspective. This means considering ways that the farm can nurture the land. We wanted this farm to continue to grow and be successful for years to come, so in order to conserve its resources we needed to be aware of the effects of our techniques.

### 3.3 Opportunities and Limitations of the Land

After discussing how to care for the property, we had to learn about local farm practices to seamlessly incorporate the farm. Small organic farms around Cuenca provided case studies for permaculture plans, and interviews with open-ended questions were an effective means of gathering information. We used this information to identify aspects of agriculture such as what plants excel under local conditions, when they should be planted, and what practices we could

use to ensure successful harvests. If permitted, we took pictures and recorded the interview for future reference.

In addition to recycling waste, an irrigation system which was easy to maintain and used minimal water was needed to help conserve the land's resources. Determining this irrigation system on site was crucial to a sustainable farm plan. We conducted a walkthrough of local farms in order to understand irrigation techniques, crop cycles, animal care, and farm layouts. We also asked the farmers about pests and predators in the area and how to protect against them.

We observed the land to determine the specific conditions, such as water availability, elevation, temperature, humidity, and sunlight. We conducted these observations by using measuring tools and doing archival research. The map in fig. 3 informed us about sloping, wind direction, and the exact layout of the land.

To determine which locations are the best for growing crops, we tested the soil of the property. We brought soil testing kits to determine the composition of the soil as well as pH levels. An example of the process can be seen in fig. 4. The composition includes the six essential nutrients that plants need in large amounts to stay healthy. This helped us decide how to use compost, and where to place crops.

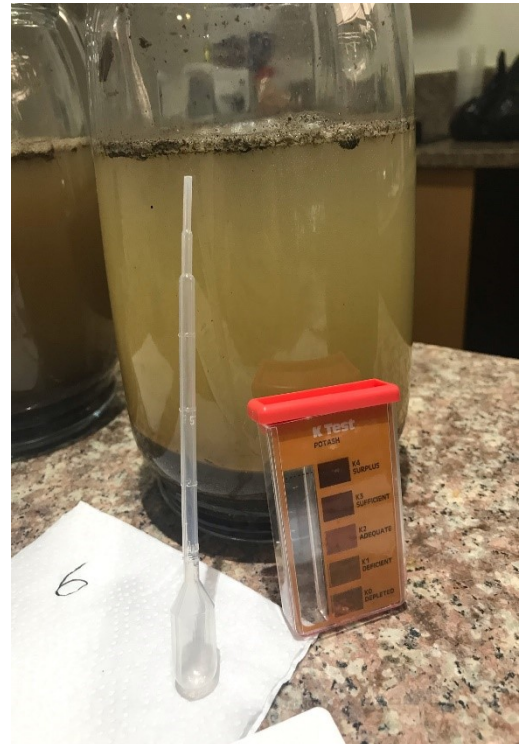


Figure 4: Soil Testing Kit

## Chapter 4: Findings

This chapter explores our findings onsite. It covers the best practices in local agriculture, expectations of the users, and opportunities of the land. Additionally, it examines the possibilities of future growth and projects. Each of our objectives will be addressed individually with the results from our methods for researching them.

### Objective 1: Understand the best practices in permaculture sustainable landscape design

Upon visiting a local farm owned by the Farez family, we learned many sustainable techniques used to care for plants, animals and the land. This farm in particular had two separate composting locations. One was used for normal composting which takes about six months to completely decompose and become usable compost. The other was mixed with active yeast to accelerate the decomposition process. In this way, the farm had compost ready to use in only one month instead of six.

They taught us simple yet effective ways to control pests on their farms. They would place cups of beer in various locations to attract slugs. The beer would attract and trap the pests, keeping them from destroying crops. They used old, repurposed sacks to cover crops at night to prevent insects and wildlife from eating them.

Another strategy they told us about was strategic placement of animals. Placing animals' pens in specific places will allow for their feces to run off and fertilize the fields naturally. Caution must be exercised so the field is not over fertilized. Also, placing the animal pens closer to the main building on the property could discourage local predators.

In regards to local animal practices, farms often had guinea pigs, chickens, and pigs. The guinea pigs were kept in large indoor rooms and separated according to gender and age. They were given plenty of places to hide. Their pens were cleaned regularly and lined with freshly grown alfalfa from the farm. Additionally, the chickens were either roaming around or kept in a sizable coop with nesting and perching areas. During the day, some of the chickens were allowed to roam around to scavenge for food, but were usually fed chicken feed and leftover vegetables. The pigs were fed verdes and any crops leftover that were not eaten or sold at the market. Based on the number of animals each farmer needed to support their family, we were able to calculate



how many were needed by Nina Huasi. The farmers usually had three pigs, twenty or more guinea pigs, and anywhere from ten to twenty chickens. This amount was able to be maintained by a single family, and was enough to support them as well as give them extra to sell for a profit. The farmers told us that the animals need to be close enough to the property to make them easy to care for, but far enough so that they would not cause too much noise. Professor Lovato suggested a closer location to the house and composting, which would cause more noise, but would be convenient.

VIDEO: <https://youtu.be/ybC8PciqTgw>



Figure 5: Video of Farm Tour

Local farmers also grew various medicinal herbs to serve a wide variety of purposes. Camomile, mint, lamb’s ear, oregano and rosemary were all grown to be used or sold at the market. These herbs can all be made into teas to help with anything from an upset stomach to menstrual cramps. We discovered from our sponsor, Business Director Yolanda Padilla, that the women and children would rather use herbal

<p><b>COUGHING? ADD ROSEMARY</b></p> <p>The eucalyptol in this aromatic herb is study proven to loosen chest congestion, making phlegm easier to expel. Plus, rosemary is rich in anti-inflammatory terpenes, which soothe a sore throat.</p> <p><b>GOES WELL WITH</b></p> <p>WHITE BEANS POTATOES POLENTA APPLES</p>	<p><b>CRAMPY TUMMY? ADD MINT</b></p> <p>Peppermint contains menthol, a natural plant compound that relaxes pain-inducing intestinal spasms. This reduces belly discomfort by 40 percent.</p> <p><b>GOES WELL WITH</b></p> <p>EGGPLANT TOMATOES MELON GREEN PEAS</p>
<p><b>MENSTRUAL CRAMPS? ADD OREGANO</b></p> <p>Enjoying 2 tsp of fresh oregano daily during menstruation reduces or eliminates cramps. That's because this herb's thymol and carvacrol, relax uterine muscles to prevent painful contractions.</p>	<p><b>ACHY JOINTS? ADD CURRY POWDER</b></p> <p>The curcumin in curry inhibits the body's production of prostaglandin E2, an inflammatory compound that over-sensitizes nerves. This blunts joint and muscle pain as effectively as prescription medications.</p>

Figure 6: Herbs and their Uses (Varuna, n.d.)

medicines when they got sick instead of visiting a doctor or using conventional medicine. Some herbs we learned about along with their applications can be found in fig. 6.

## Objective 2: Address the needs, expectations and comfort of the users and get them involved in agriculture

Since Nina Huasi has a limited labor force, it will be important to create an incremental plan that was feasible for them to implement over many years. Their goal for the first few years was that all of the food grown would go towards the residents at Nina Huasi. This will help them to become food independent. After they grow enough food to feed the residents, the excess food will go towards supporting the cafe at Mujeres Con Exito. The last step is to produce enough food to sell at organic markets in hopes of providing the foundation with a source of income. We utilized their timeline of goals in order to structure our own timeline of construction.

Professor Lovato wanted to remove eucalyptus trees on the property because they were not native to the area. Removing the non-native trees would create a more welcoming environment for native wild animals. He also discussed the idea of adding wetlands to the river to act as a natural indicator for the health of the farm and the overall land.

María Amor's psychologist, Villavicencio, said that the women would be more likely to participate in agriculture if they spent more time outside. To do this, she suggested adding areas for the women to relax outside, as well as a path along the river for them to walk along.

## Objective 3: Assess the limitations and opportunities of the land itself

The total area of the property is 23035.7 m<sup>2</sup>. The land is rectangular and has a relatively steep slope and many areas of heavy vegetation. Most of the fields will have to be cut into terraces because of the slope. A large portion of the land was also covered by the house, playground, parking lots and forest. This reduced the amount of land we had to work with to roughly 9844 m<sup>2</sup>.

There are two composting stations on the property. It is important for the animals to be placed near these stations so their feces can be easily added to the compost. The crops should also be nearby for convenience of fertilizing.

The property experiences wind that blows mainly towards the west and receives rain almost daily during the wet season. The door to greenhouses and animals pens should be perpendicular to the wind to prevent a draft. The land is also exposed to strong sunlight for the entire day.

Our soil tests gave us vital information on soil nutrients. The tests revealed that the pH level was steady between a 6 and 7 throughout the areas with sufficient space for crops or animals. This means the land is almost neutral and within the optimal range for plants to grow.

It is best to have a mix of all essential nutrients. Due to this, we wanted at least a two



Figure 7: Compost Soil Test Results

(adequate level) for each nutrient, but higher numbers were ideal. Upon gathering the results for nitrogen, phosphorus, and potassium, we discovered that the property’s nitrogen levels were depleted, while the phosphorus and potassium levels were usually adequate. The compost, on the other hand, had an abundance of nitrogen and

adequate levels of phosphorus and potassium. The compost results are shown in fig. 7. This is good because the compost can be mixed with the soil to boost the nitrogen levels. For example, in the greenhouse where compost had been mixed in with the soil, the nitrogen levels were brought up significantly. See table 1 for nutrient levels and fig. 8 for the locations of each test.

Table 1: Soil Test Results

Soil Nutrient Content at Nina Huasi					
Location ID	Description	Nitrogen	Phosphorous	Potassium	pH
1	Upper Small Field	0	2	2	6
2	Lower Small Field	0	2	2	7
3	Upper Compost	4	2	3	7
4	Lower Compost	4	2	2	7
5	Behind the House	0	2	3	7
6	Greenhouse	4	1	1	7
7	Upper Large Field	0	2	2	6
8	Middle Large Field	0	2	3	6
9	Lower Large Field	0	1	2	6
10	In front of Laundry	0	1	3	7

0: Depleted
1: Deficient
2: Adequate
3: Sufficient
4: Surplus



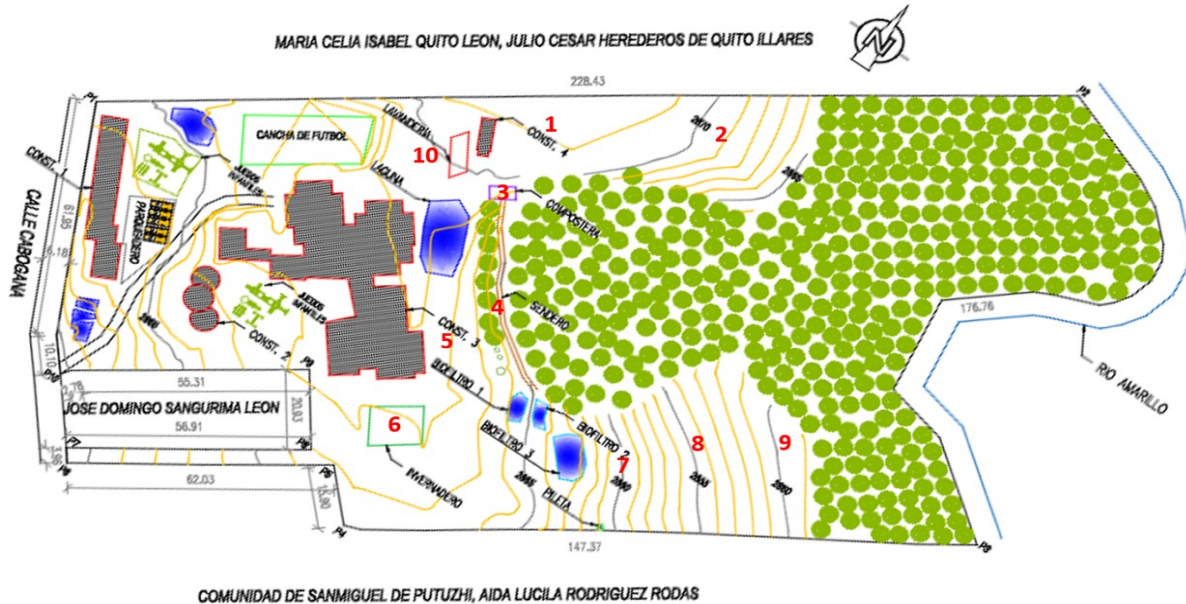


Figure 8: Soil Test Locations

For the purpose of irrigation, around the property there are several biofilters that could be utilized by intentionally flooding the pileta (fig. 9), a structure that aerates the water from the biofilters, allowing the excess water to flow down to the crops via channels. This way effectively waters the slopes. Some channels were in the process of being dug. However, given the low elevation of the pileta, it will not have the ability to bring water to the entire property. In order to use the water from the river for irrigation, it would need to be pumped up from the bottom of the slope to the crops. During the rainy season the river experiences a high flow rate, though there is always a chance the river will cease to flow during the dry season. Using a pump to irrigate crops with river water is the most energy intensive solution as water will be traveling uphill. A rainwater catchment system above the crops could be installed since it rains regularly and would no additional energy. This system would collect runoff from the roofs of the buildings on the property and store it in large tanks. The reservoirs discussed earlier can also be used as a cost-effective option. Water could then be directed to the crops manually or through a series of pipes.



Figure 9: Pileta at Nina Huasi

#### Objective 4: Find opportunities for future growth

After collecting our data of the property, talking with other stakeholders, and brainstorming, we found areas where Nina Huasi can develop alongside our agriculture land use plan. All of these will help Nina Huasi further realize its vision to help women establish healthy relationships with nature.

One of these areas is sustainable energy. The property receives a lot of sun and also has access to a river. Renewable energy would make the property more eco-friendly as it would reduce its reliance on non-renewable sources of energy. Using local energy sources also encourages the users to think about the way they consume energy.

Another place of development would be to use constructed wetlands to indicate and restore environmental conditions. Wetlands are very sensitive ecosystems and their prosperity means that the surrounding environments will be healthy as well. Also, positioned downhill from the crops, the wetlands would receive the irrigation runoff. Despite their sensitivity they are also very resilient and have the capability of removing contaminants from the runoff before it runs into the river and spreads to other areas (Reddy et al, 1997). Constructing wetlands around the river would alert users if the river ever became polluted and would remove that pollution before it entered the property.

A third area Nina Huasi could improve in is removal of non-native plants on the property. Invasive species do not invite native animals and spread quickly. One notable invasive species on the property are eucalyptus trees. Removing these trees would not only provide room for native tree growth, and it would also provide building material. Constructing with eucalyptus saves native trees from being chopped down for wood.



## Chapter 5: Recommendations

This chapter explains in depth, the details of our design and recommendations for Nina Huasi. It lists plants, herbs and animals which should be grown on the property. It also analyzes the physical master plan for the entire property before illustrating a timeline to implement each feature.

### Recommendation 1: Plants and Animals

All the suggested crops should be rotated to preserve nutrients. Alfalfa and chocho are nitrogen-fixing, so they can be rotated to replace nitrogen from other crops. The reasoning for each plant, as well as growing requirements, can be found in Appendix I.

We recommend that these plants be grown in the fields at Nina Huasi:

- Alfalfa
  - Nitrogen-fixing
- Quinoa
- Chocho
  - Nitrogen-fixing
- Corn
- Garlic
- Onion
- Potato
- Jicama
- Oca
- Melloco

We recommend that these plants are grown in the greenhouse at Nina Huasi:

- Ají
- Broccoli
- Cabbage
- Lettuce
- Cauliflower
- Tomato

We recommend that these fruit trees be grown at Nina Huasi:

- Plum
- Peach
- Mora
- Lemon
- Fig
- Tomate de Arbol

We recommend that these medicinal herbs be grown at Nina Huasi:

- Chamomile
- Mint
- Lamb's ear
- Rosemary
- Oregano

We recommend that these animals are raised at Nina Huasi in their respective amounts:

- Hens (15-20)
  - Chickens are easy to take care of so twenty will not be difficult. They will also provide four to five eggs daily. We recommend buying egg-laying chickens to maximize egg output. We recommend buying chicks to start.
- Guinea Pigs (1 Male, 5 Females)
  - Guinea pigs reproduce rapidly. Six will allow for them to start breeding and producing food. More guinea pigs would be difficult to separate and control, and might reproduce more than needed without careful attention.
- Pigs (2)
  - Each pig provides a lot of meat, but also require a lot of attention and food to raise. The farm must be built up first so that there will be enough excess food to feed them. Two will be a good starting point without being overwhelming. We suggest buying piglets instead of breeding pigs as it can be difficult, and pigs have eight to twelve piglets at a time.

We recommend the following in terms of composting:

We recommend that the property continues to produce compost following the procedures already in place. In the event that there is a greater need for compost than what is being produced, yeast can be added to the mixture to speed up the decomposing process.

## Recommendation 2: Landscape Design



Figure 10: Final Design

Our landscape design encompasses a plan for the entire property (fig. 10). It includes values of permaculture to create the most practical land use plan for the María Amor foundation. It takes into account existing landscape features and buildings to layout an achievable, sustainable and functional farm. Each of these features is part of our master plan, and they will be broken up into increments for implementation in the timeline section. The following drawings are for our sponsor, so they are in Spanish.

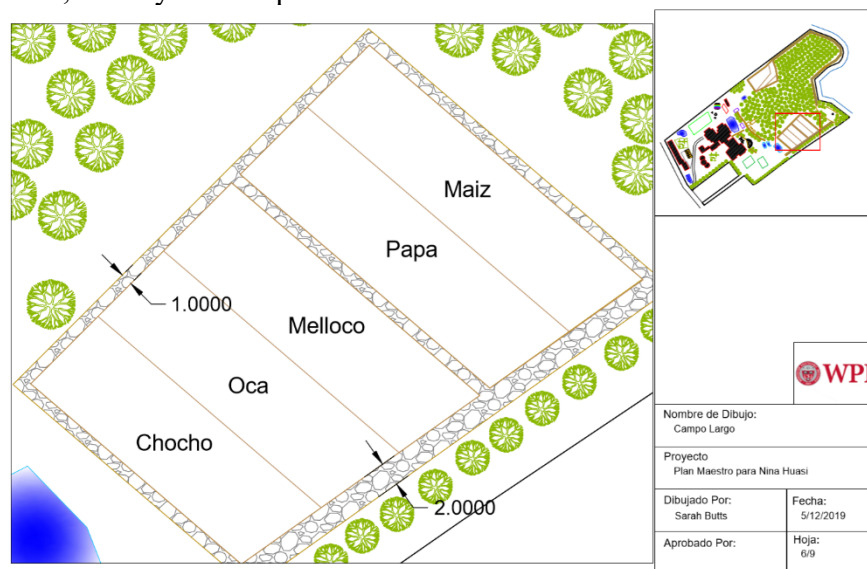


Figure 11: Large Field

The growing fields are placed in locations in which terraces and clearings already exist. They were placed here to minimize effort needed to prepare them for crops (figs. 11 and 12).

Jicama can be interplanted with onion (cebolla) and garlic (ajo). Since jicama takes so long to grow, the onions and garlic will provide food when the jicama is still growing. Melloco can also be interplanted this way if needed.

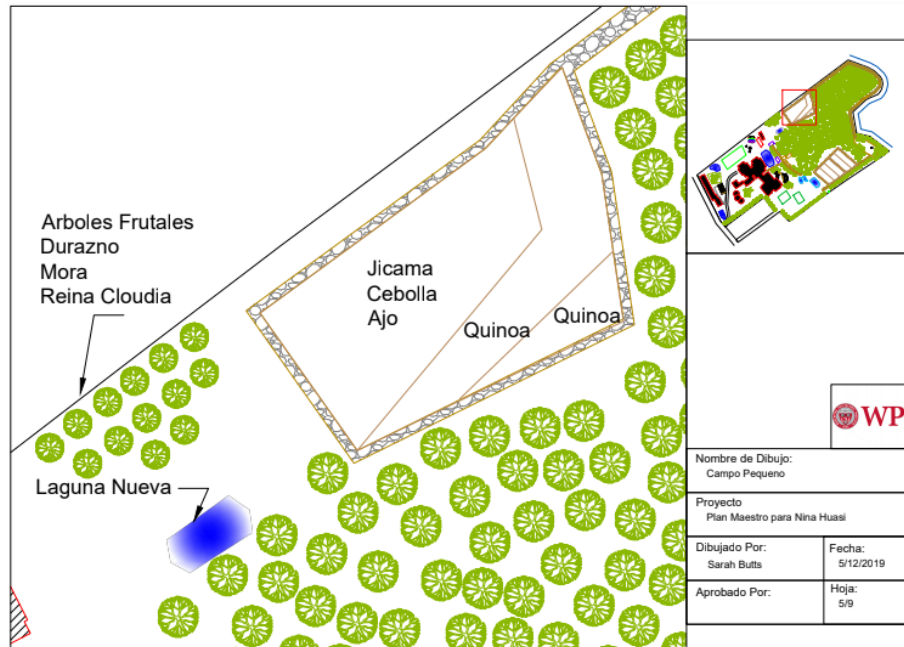


Figure 12: Small Field with Reservoir

A cluster of fruit trees should be placed next to the smaller field to provide plenty of fruit. A new reservoir should be placed close by to allow for easy irrigation (fig. 12). It will allow workers and volunteers to more easily access water for fruit trees and crops. If more water is needed, we suggest implementing rainwater catchment systems.

Our animal pens are positioned an adequate distance apart from one another with their doors facing perpendicular to the wind (fig. 13). They are close together to make caring for them more convenient for workers on the farm. They are placed close to the main buildings to offer protection from local wildlife. They are also placed amongst the trees in the forest to offer protection from the wind and sun. Each animal has certain requirements for their pens. We recommend that the pigs be given strongly reinforced pens that prevent them from breaking or uprooting them. The guinea pigs should have at least eight sections in their pen so they can be properly separated. We recommend splitting their four meter by one meter pen into eight half meter by meter sections. The chickens should have a coop that protects them from predators as

well as a pen for them to roam. We also recommend planting alfalfa close to the animals to make feeding the guinea pigs easier.

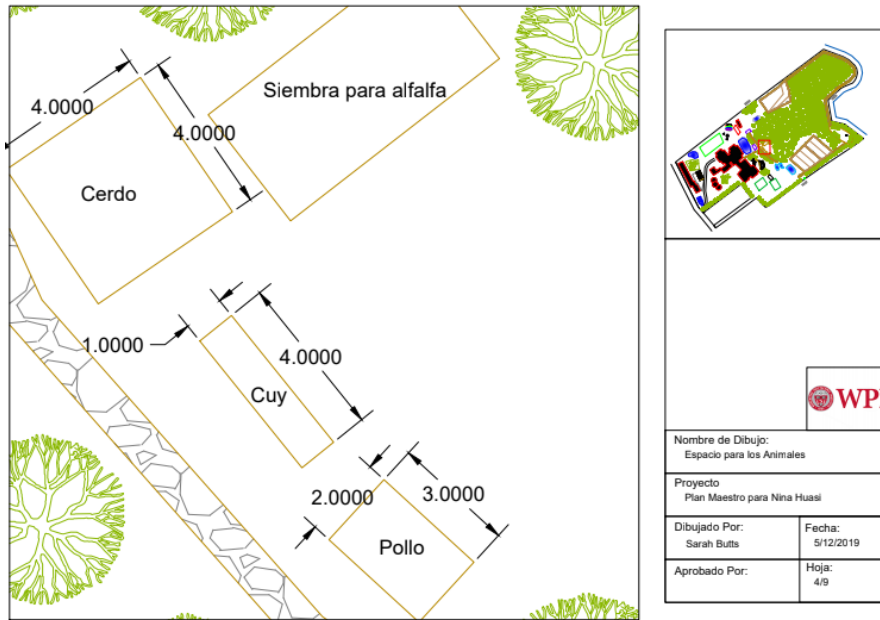


Figure 13: Animal Pens

We suggest a path that runs from the back entrance of the shelter to the greenhouse (fig. 14). We recommend an herb garden, a bench, fruit trees, and a bird garden along this path. This will bring nature closer to the shelter, and give the residents an additional place to relax.

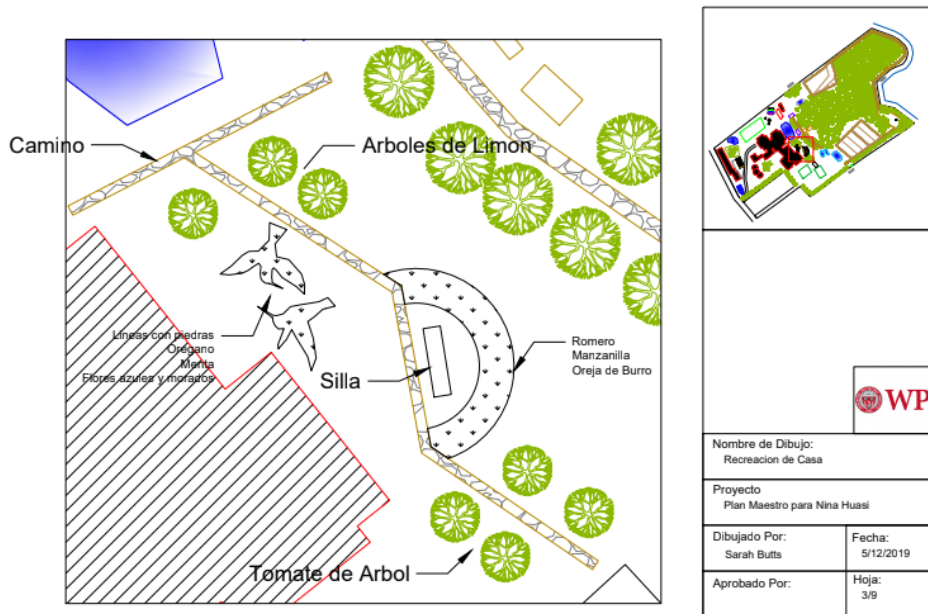
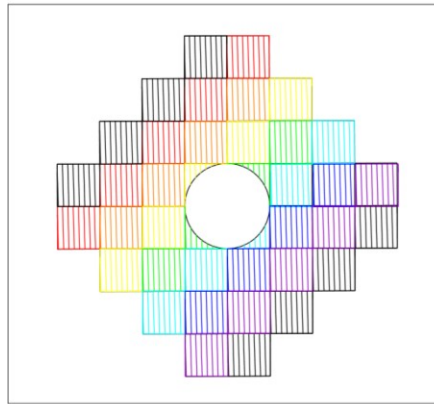


Figure 14: Herb Garden

Placing an herb garden between the laundry facility and the soccer field will allow for easy access of medicinal herbs when needed (fig. 15). The garden is in the shape of a chakana to incorporate local culture.

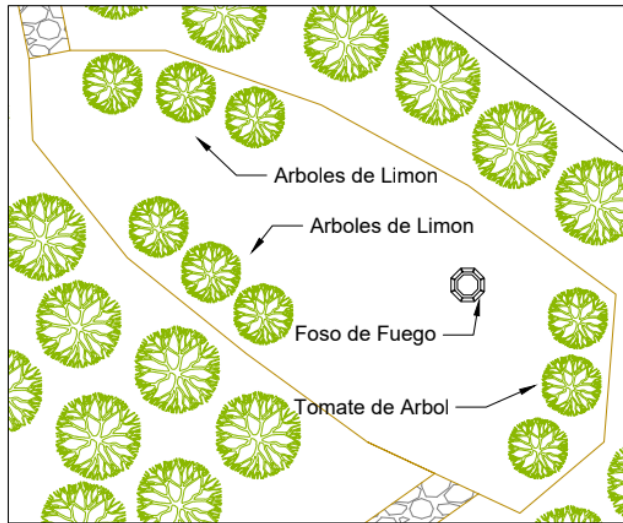


Hecho de hierbas y flores  
Encima de la colina

	
Nombre de Dibujo: Chakana de Hierbas y Flores	
Proyecto Plan Maestro para Nina Huasi	
Dibujado Por: Sarah Butts	Fecha: 5/12/2019
Aprobado Por:	Hoja: 8/9

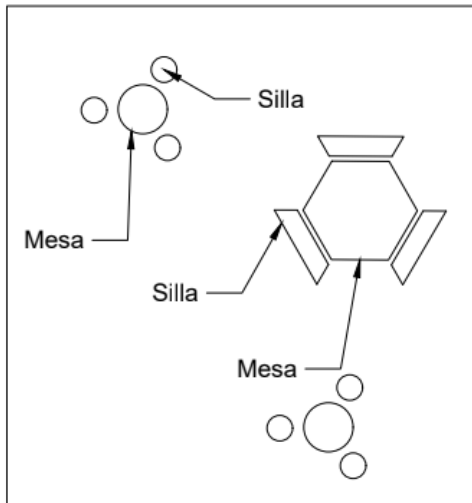
Figure 15: Chakana Herb Garden

A relaxation area is placed by the river to provide a secluded, quiet place for the residents to spend time with nature (fig. 16). Another area is placed by the soccer field and one of the suggested herb gardens so that the residents spend more time around the herbs and help facilitate any interest in gardening (fig. 17).



Nombre de Dibujo: Recreacion de Rio	
Proyecto Plan Maestro para Nina Huasi	
Dibujado Por: Sarah Butts	Fecha: 5/12/2019
Aprobado Por:	Hoja: 7/9

Figure 16: Relaxing Area by River



Nombre de Dibujo: Recreacion de Cancha	
Proyecto Plan Maestro para Nina Huasi	
Dibujado Por: Sarah Butts	Fecha: 5/12/2019
Aprobado Por:	Hoja: 2/9

Figure 17: Relaxing Area by Soccer Field



We recommend a few additional features. Placing fruit trees along the edge of the property will make use of normally unused space, and offer more privacy for the women's shelter. Changing the current herb garden into a children's garden will allow for the children to feel more involved while sparking their interest in sustainable farming. It serves as an opportunity to teach children not only about gardening but about the importance of sustainability and recycling. The old herb garden is the perfect spot for this because it is next to the playground and daycare center where the children are all day. Lastly, we suggest making a path down the right side of the property will allow residents to take a walk by the farm down to the river. This path doubles as an easy access route to the crops

### Recommendation 3: Timeline

We recommend constructing landscape elements in three stages. Since each element's construction depends on raised funds and availability of volunteers, it would be limiting to follow a year by year schedule. Increments can be implemented whenever labor and funds are available.

#### Stage 1:

- All fruit trees
- Chickens
- Crops in the large field
- Greenhouse revamp

#### Stage 2:

- Guinea Pigs
- All crops
- Herb gardens
- Fix current relaxing area with bench
- New reservoir
- Hire at least one dedicated full-time caretaker

#### Stage 3:

- Pigs
- All relaxing areas and trails
- Children's garden



## Recommendation 4: Future Projects

We recommend the following future projects for Nina Huasi:

- Cost analysis of our recommended developments
- Revenue stream analysis
- Removing eucalyptus and other invasive plants
- Using wetlands as an environmental indicator
- Sustainable water usage
- Sustainable energy usage
- The importance of a balanced diet

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## Appendix

### A: Basics of Compost

Compost bins are heated by the sun, resulting in increased microbial activity which produces a nutrient rich compost in a shorter amount of time (“Permaculture Design Principles”, n.d.). Once these systems are in place, they need to be monitored over time and re-examined to maximize the yield.

### B: Nutrients

Ideally, a permaculture farm should not have elements fighting over the same nutrients they need to survive. This may result in dead or damaged crops. Livestock and insects can also be used to control weeds and other invasive species in a natural way. It is important to remember that all parts of a permaculture farm perform various functions which are made possible by one another (Holmgren, 2007, p. 18).

### C: Recycling, Reusing, Repairing, Composting, and Pre-cycling

The idea of these principles is to see waste as a resource which might be used benefit the land. Simple ideas such as repairing broken tools can go a long way into helping the land blossom into a successful farm (“Permaculture Design Principles”, n.d.). Living resources, such as earthworms, are included as mutually beneficial for both themselves and the land. Earthworms eat plant waste and convert it into humus. The humus improves the soil environment and plant life by increasing moisture retention and microporosity (Holmgren, 2007, p. 15). We live in a disposable society where most products are made from plastics; an easy way to recycle could be reusing a plastic jug as a watering can. From reducing comes a concept known as pre-cycling. The idea of pre-cycling is to be conscious about what materials are being used and avoid bringing in materials that produce waste. Some examples of pre-cycling include using reusable bags instead of plastic shopping bags, using washable towels instead of paper towels, and purchasing products that use the least amount of packaging (Beckstett, 2017). Considering all options of recycling is important for a sustainable permaculture farm.



## D: Sense of Place Example

To properly implement the idea of sense of place, one must provide stability and a sense of identity (Massey, 1991). By forging positive relationships with their environment through ecofeminism, reconnecting them with nature, and creating a safe space, we can begin to provide them with a sense of place. It is important that we understand these philosophies and integrate them into the core of our plan.

## E: Stakeholder Engagement

One may find it easier to break the project up into more manageable sections or categories. In this way “each stakeholder will only join the process if they judge it to be in their interest” (Sayer, et.al, 2013). This will allow the stakeholders to easily join in on the project and encourage them to collaborate collectively, toward “a shared goal” (Sayer, et.al, 2013). Furthermore, in principle four, the different backgrounds of the stakeholders and how the landscape should meet as many of their needs as possible are included. It explains how a landscape design should include functionality for the “multiple needs, preferences, and aspirations” (Sayer, et.al, 2013) of the stakeholders. A landscape design which includes these differences “in a spatially explicit and ecosystem-driven manner that reconciles stakeholders’ multiple needs, preferences, and aspirations” could be considered a successful plan (Sayer, et.al, 2013).

## F: Sustainable Irrigation Systems

Drip irrigation consists of a tube that runs along the ground that slowly drips water onto the plants. The downside to this system is that if the water going into the tube is not filtered properly, debris can clog the tubing (Felix, Reinders, & Van Niekerk, 2018). Furthermore, subsurface drip irrigation, a system that directs water underground, saves even more water. What makes this so desirable for a sustainable farm is that since the water is released underground, it does not evaporate as quickly. This in turn decreases the amount of water needed to sufficiently water crops. Although this seems the most sustainable, implementing a system like this can take some trial and error. The soil quality and crop type determines how far the drip system should be placed underground. In addition, the amount of watering could affect yield. To counteract these challenges one can implement subsurface drip irrigation with minimal above ground irrigation to

maximize crop yield by making sure the crops are sufficiently watered (Ayars, et.al, 1999). As seen in fig. 18 below, a large commercial subsurface and above surface drip irrigation system can be planned.

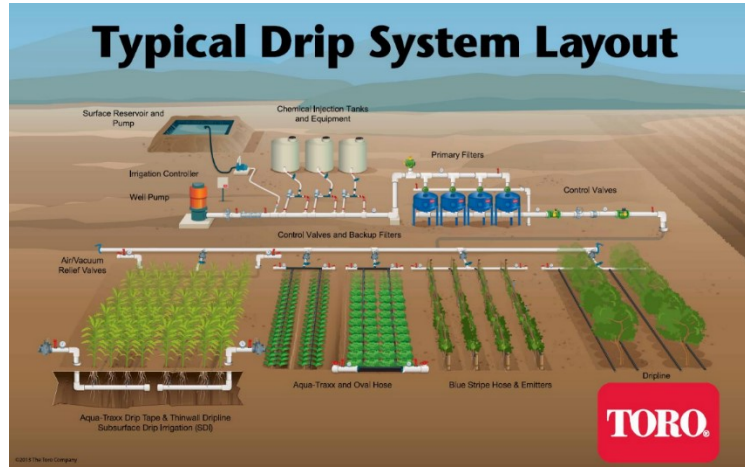


Figure 18: Drip Layout ("Typical Drip System Layout", 2013)

This layout shows how a typical drip system should be built at a large level, though on a small permaculture farm, the design could be simplified. An additional water efficient irrigation system is clay pot irrigation. In this system an unglazed, porous clay pot is filled with water and partially buried near the crops. The water leeches out of the pot at the rate that the roots take up water. The main drawback of this system is obtaining the pots (see fig. 19, below) (Bainbridge, 2001).

In addition to water saving strategies, crop rotation will aid in replenishing nitrogen levels in the dirt as some crops leech nitrogen to grow and others return it to the soil. By doing so, a farm could eliminate the use of fertilizers Weed control is also another benefit of crop rotation. With the proper rotation, nitrogen rich and weed free ground can be achieved without using fertilizers and pesticides. According to Wiley, although there is little experimental evidence, crop rotation serves as a practical and successful weed management system (Wiley, p. 96). Incorporating a proper crop rotation plan would eliminate the need for

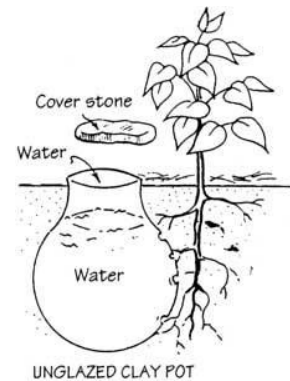


Figure 19: Unglazed Clay Pot (Vukasin, 1995)

fertilizers and serve as a useful weed management plan. A sample rotation schedule is illustrated below in fig. 20.

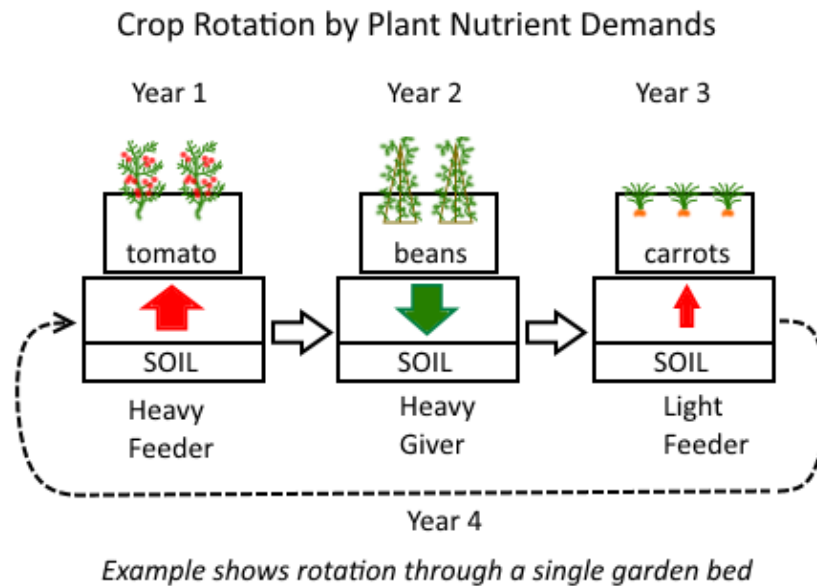


Figure 20: Sample Crop Rotation Schedule ("Deep Green Permaculture", n.d.)

## G: Livestock

Chickens are relatively low-maintenance and produce a good amount of food. An average hen can lay four or five eggs in a week (The Happy Chicken Coop, 2018), and they can also be butchered for their meat. Although they are easier than most animals, attention and preparation is still essential to successfully raising chickens. Step one is to decide what kind of chickens are the best fit. There are heritage breeds, egg-laying breeds, meat breeds, and dual-purpose breeds. Heritage breeds are normal chickens that live a long, healthy life. Egg-laying breeds produce more eggs on average. Meat breeds grow extremely quickly and can be slaughtered after only nine weeks. Dual-purpose breeds are a mix of egg-laying and growth-rate, but are lesser at both than the egg-laying and growth-rate specialized breeds. After deciding on the breed, the chickens must be purchased. It is cheapest to buy chicks, and they provide the additional benefit of knowing the breed and gender, but it takes time and money to raise them. Eggs can be purchased, but they must be incubated and it is not recommended for novices. Pullets are chickens that are about to lay their first egg, which can be bought if the extra effort in raising them cannot be expended, but they are much more expensive. After deciding the breed and purchasing strategy, a coop must be built for protection. Fig. 21 shows an example of all the necessary precautions to

design a successful chicken coop, and they can be built relatively easily. The chickens will need to be let out in the morning, and locked back in the coop at night for their safety. Chickens can also have synergistic effects with certain plants that make them ideal for a starting farm. “Many pests overwinter as larvae or eggs, and chickens will methodically scratch through remnants of the garden, devouring pests as they go and leaving fertilizer in their wake.” (Nutrena, 2018). Any pests or eggs left behind by the pests can be eaten by the chickens, which can reduce the amount of bugs for the next year.

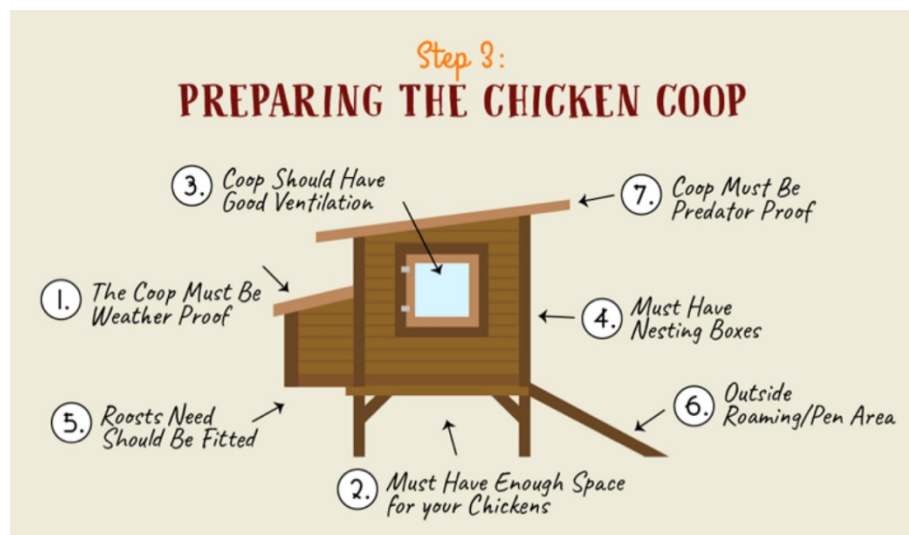


Figure 21: Preparing the Chicken Coop (The Happy Chicken Coop, 2018)

Guinea pigs as they reproduce rapidly and are a great source of sustainable meat. One pair of cavies (or guinea pigs), can produce 260 new pairs in two years. Additionally, they are strict herbivores that are extremely easy to feed because they are not picky, and while they may get tired of the same food over long periods of time, they can get accustomed to new foods easily. “Among the kinds of food cavies will eat and that prove to be useful are uncooked household scraps from some fruits and vegetables, grasses in general, and foliage of many weeds and annual plants. Cavies do not like aromatic (strong smelling) foliage in general, or foliage known to be high in oxalic acid” (Martin, 1991). They prefer soft foliage, but if none is available during the dry season, they will even eat alfalfa pellets and hay. Even water is not always necessary since they will acquire most of it from their food. Guinea pigs do need some consideration when it comes to protection and separation. For protection, a cage should be built to protect them from predators such as cats and dogs. They also must be separated by gender, age, and pregnancy, so the cage must have dividers. Fig. 22 is an example of a cavy cage. The

most complicated part of raising cavies is keeping them separated to prevent violence, and ensuring efficient reproduction. Martin suggests a thirty day cycle of rotating the guinea pigs based on pregnancy, gender, and age. The cavies should always be monitored for violence, and be removed if they cause too many problems. Cavies should also be monitored for sterility and diseases and replaced if caught (Martin, 1991).

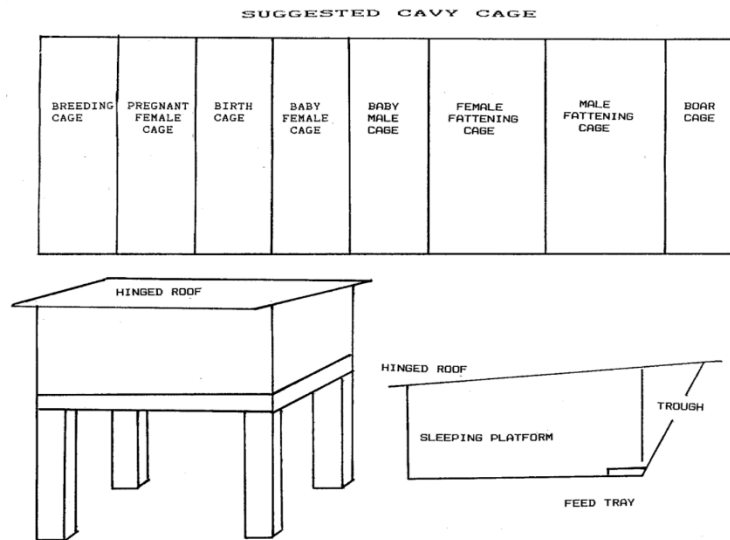


Figure 22: Suggested Cavy Cage (Martin, 1991)

Pigs can be extremely difficult to take care of and turn a profit from, but if done right they can provide a massive amount of meat without being too expensive. They should be slaughtered once they reach two hundred to two hundred and fifty pounds. This is important because this threshold provides the most meat for the cost, afterwards the pig will cost more to feed than they are worth, and their size can cause serious problems. Pigs are aggressive and immensely strong animals. They are known to escape their cages and are difficult to catch (Barth, 2016). Their pen should be reinforced as much as possible using either special hog fencing, electric fencing, or both. Pigs eat an enormous amount, in fact every thirty pounds of pig requires seven pounds of food (Morning Chores, 2016), so it is most cost effective to avoid buying feed as much as possible. Otherwise, it would be cheaper to get pork directly from a store. Grain, corn, mangels, forage turnips, beets, and pumpkins can be grown and fed to pigs (Maus, 2015). They will also eat any leftover table scraps, whey, and day old bread from local bakeries. (MorningChores, 2016). To prevent pigs from getting worms, one pound of garlic granules can be added to each ton of feed (Maus, 2015). Their food and water dishes need to be kept in strong containers to stop the pigs from flipping them. (MorningChores, 2016). Pigs love

to uproot grass which causes mud, ruins the land, and causes a strong smell. There are several options to prevent this. This includes covering their area in fresh straw or moving them periodically so they do not spend too much time destroying one area. Also, a mobile pig pen, seen in fig. 23, can be built to make this moving process easier. Finally, it is imperative that male pigs be castrated to prevent unwanted piglets (MorningChores, 2016).

Goats offer a permaculture farm many benefits. Goats offer the same benefits of cows, but overall require less attention. They can be raised for meat, as well as milk. Although goats may require more food than chickens and guinea pigs, they eat much less per animal and have a smaller footprint than cattle. This makes goats excellent candidates for a permaculture farm. Goats tend to eat up to 3 to 5% of its body weight in food daily (Coffey, 2004). Although it may seem goats do not consume large amounts of food, they must be pastured on a large plot with an abundance of vegetative forage which could prove to be a challenge on a permaculture farm. Goats can over graze pastures which could reduce crop yield and affect the growth of future crops. This can be combated by controlling where the goats can graze, allowing the plants to regrow and recover. If properly implemented and cared for, goats allow for a farm to produce an abundance of other goods (Coffey, 2004).



Figure 23: Mobile Pig Pen (MorningChores, 2016)

## H: Interview Questions for Women, Children, Local Farmers, and Experts

### Questions for the women

1. Think of your favorite place. What did you like about it? What do you miss most here?
2. What is your favorite flower and what does that flower remind you of?
3. What is your favorite fruit?
4. Where do you go to relax?



5. If you were designing a farm, what would you include?

#### Questions for other farmers in the area

1. What crops grow well in Cuenca?
2. What crops should we avoid?
3. Which crops are the most profitable?
4. Where do you get your seed/tools/fertilizer?
5. When do you plant these crops?
6. How much water does each crop require?
7. Do you have any special practices for making these crops produce more fruit?
8. How do you control pests on your land?
9. Are there any predators that pose threats to your livestock?
10. What are typical weather conditions such as rain/wind/temperature/humidity?
11. Are there any traditional farming practices we should incorporate in our farm?
12. Can you walk us through your irrigation techniques and crop cycles?

#### Questions for experts

1. What sustainable methods do you recommend on a permaculture farm?
2. Are there sustainable irrigation methods?
3. Are there sustainable pest control methods?

## I: Plant and Animal Detail

### **Crops for María Amor:**

1. Alfalfa – For the guinea pigs
  - a. Nitrogen-fixing crop
  - b. Full sun
  - c. Use ¼ lb of seed per 25 square feet
  - d. Space rows 18-24 inches apart
  - e. For livestock, alfalfa needs to be harvested and cured prior to flowering
  - f. If rain is imminent, do not cut alfalfa as it can lead to issues with mold
2. Quinoa
  - a. Full sun
  - b. Space rows 90cm apart



3. Chocho Beans
  - a. Also known as Tarwi
  - b. Nitrogen-fixing crop
  - c. Little resistance to wet weather
  - d. Minimum of about 6 months to harvest
4. Broccoli
  - a. Full sun
  - b. Sandy soil
  - c. Slightly acidic to neutral pH
  - d. Space plants 12-24 inches apart and 36 inches between each row
  - e. Fertilize three weeks after transplanting
5. Cabbage
  - a. Full Sun
  - b. Neutral pH
  - c. Loamy, Sandy Soil
  - d. Plant 12 to 24 inches apart
  - e. Don't plant with broccoli and cauliflower. Avoid close proximity to strawberries and tomatoes
6. Lettuce
  - a. Sun to partial afternoon shade
  - b. Soil type: Loamy
  - c. Plant 12-15 inches apart
7. Cauliflower
  - a. Full sun - at least 6 hours of sun
  - b. Loamy soil
  - c. Slightly acidic to neutral pH
  - d. Plant 18-24 inches apart with 30 inches between rows
  - e. Needs 2 inches of water each week
  - f. Ready to harvest 7 to 12 days after blanching
8. Tomatoes
  - a. Full sun - 6 hours of sun

- b. Loamy soil
- c. Acidic pH
- d. Place tomatoes stakes at the time of planting
- e. Side dress with compost every two weeks starting when tomatoes are 1 inch in diameter

**Fruit Trees:**

9. Greengage Plum

- a. 6-8 hours of direct sunlight
- b. Space 20-25 ft apart

10. Peach

- a. Full sun
- b. 15-20 ft apart

11. Mora

- a. Super hardy, will grow in any soil anywhere
- b. Prefers full sun to full shade

12. Lemon

- a. Full sun
- b. Should be wind protected
- c. 12-25 ft apart

13. Fig

- a. Full sun
- b. 20 ft away from all other plants apparently

14. Tamarillo

- a. Full sun to partial shade depending on how much water it gets
- b. Should be protected from strong winds

**Root Vegetables:**

15. Potato

- a. Full sun for six hours per day
- b. Tubers must be protected from sunlight

- c. Even water distribution

16. Oca

- a. Short day requirement
- b. Low heat and frost resistance
- c. 38cm spacing
- d. Can be interplanted with garlic or onions

17. Melloco

- a. Can be grown in nutrient poor soil
- b. Slightly acidic soils are the best, but not necessary
- c. Seven months to yield
- d. Should be densely planted
- e. Can be interplanted with garlic and onions

18. Jicama

- a. Very long growing period (150+ days)
- b. Needs full sun
- c. 30cm spacing
- d. Vines and leaves are poisonous
- e. Pinch off flowers as they grow