Syntropic Farming Guidebook

Work for nature and nature will work for you.

A special thanks to God for giving me the endless energy and the mental clarity that was needed for this and for bringing the right people together at the right to time to make this collective work a reality. Dozens of people have collaborated with me to make this book. Thank you to everyone who contributed, you know who you are.

Syntropic Farming:

A form of regenerative agroforestry driven by the power of natural succession which is beyond organic and beyond sustainable, it produces an abundance. A game changer for modern agriculture.

Introduction:

Syntropic farming is a method of agroforestry developed by Ernst Götsch. Its strength comes from aligning with the power of natural succession. Natural succession is the tendency for nature to rehabilitate land, taking it from barren to fertile and densely vegetated.

Ernst observed that this evolutionary process was driven by cooperation among members of the living system in a way that benefits the system as a whole. This is contrary to the Darwinian model which views evolution as being driven by competition. What may appear as competition or destruction in a natural environment is really an attempt to create balance for the benefit of the whole system.

With this perspective in mind, the farm is seen as a unified, intelligent, living system which is meant to evolve over time. For this to happen there are complex interactions occurring between the plants (and animals) and every living being serves an important purpose in the process. When these cooperative relationships are promoted correctly by the farmer, the farm develops into a strong, healthy, living system.

To do this, the farmer grows some forms of vegetation, which do not produce any usable crops, but that contribute positively to the farm. These are called **"biomass"** plants and trees. The farmer also "tucks in" plants and trees that produce a valuable harvest. These are called **"target"** plants and trees. This combination of vegetation is grown together closely, in a way that is mutually beneficial. The farmer also has a deep understanding of how the vegetation responds positively to pruning and cuts it back at strategic times to promote rapid growth.

After a few years, the system becomes partly autonomous. It can provide its own irrigation, fertilizer, crowd out undesirable plants and resist disease. It just needs some management from the farmer.

How does it resist disease? It works like healthy gut flora. When humans have a strong community of healthy microorganisms in their gut, there is no room for harmful agents to take hold. The same is true for a healthy farm system. For this to work, the system needs to be teaming with life. It needs an above average amount of biological density**,** as is seen in a healthy forest. When this is achieved, the farm resists disease and produces an abundance. The farmer simply has to design the system with detailed foresight and manage its maturation with strategic pruning, and the farm will take care of the rest.

Syntropic farming relies on intelligent, biodiverse and dense planting schemes. The planting schemes are made up of consortiums. The term consortium is used to describe a mix of both trees and vegetables which can be cooperatively grown together. This is similar to companion planting and intercropping, but more complicated because it takes into consideration the plants role in natural succession.

Because it is based on natural succession, the mix of plants which do well together are grouped by their life span. Some consortiums are present only in the beginning, while other ones dominate later on. A typical planting scheme will use the consortiums sequentially from the early stages of succession all the way to the final stages. A planting scheme is complicated because it takes into account the future vision of the farm. It does so in a way to optimally produce waves of harvests, one after the other, first starting with veggies and then later with fruit and wood from trees. Each wave represents the maturation of another consortium. As mentioned before, some of the vegetation will be grown for harvest, while other vegetation will be grown solely for the purpose of pruning and driving succession forward.

Syntropic farming can be used to rehabilitate degraded “dead” land or introduced to existing farmland. It can even be used to turn wild jungle into a food forest. The focus of this guidebook is to show how to introduce the method to existing farmland.

Syntropic farming recognizes that farmland and wild forest can have differing levels of vitality. It is not just a black and white situation. By studying this guidebook, you will learn to recognize “where” the land is in its evolution and strategies to help boost it from that point.

These principles came as a series of insights to Ernst as he closely observed nature and learned agroforestry techniques from indigenous people. Surprisingly, he initially studied genetics with the goal to manipulate nature for the benefit of humans, but later came to the conclusion that nature was highly intelligent and that it was far better for humans to learn to adapt to nature.

Ernst has some very detailed and logical ways of explaining things and his approach works where many others don’t, but it is important remember that these are best guesses based on human observation through practical application. The science behind syntropic farming needs further research.

What makes syntropic farming valuable is its high level of sustainability. After each cycle of crops, the land is better than it was before and everything needed to achieve this can be grown on site. Some people may mistakenly think that conventional farming is also self-sufficient. It appears that everything just grows from the land, right? Wrong, conventional farmers rely heavily on fertilizers, pesticides and herbicides as well as fossil fuel driven machinery for working the land. Even most organic farmers rely heavily on external inputs.

Syntropic farming achieves similar or greater yields without relying on resources from outside of the farm. This redefines what most people think of when they talk of sustainability. What is most phenomenal about syntropic farming is that it goes beyond being self-sufficient. The farm doesn’t just sustain itself, it eventually produces an abundance without external inputs. There are reports of harvests of 40 tons/hectare/year[1], compared to the best mono-culture yields which are about 11-15 tons/hectare/year.

What is even more surprising is that conventional farming actually leads to scarcity. How is that so? Research has shown that despite all the external inputs of conventional farming, soil quality actually degrades with time[2]. After reading through this guidebook, hopefully it will become clear why syntropic farming succeeds, where conventional farming has failed.

Syntropic Farming for Haiti:

Syntropic farming is being introduced to rural Haiti and this guidebook was created to share the results of that work. These farmers rely on their land for food, materials and income. They live in a tropical climate zone and all the work is done by manual labor and with hand tools. Mechanized farm equipment, irrigation systems and chemicals are not available to the average farmer. The country suffers from severe deforestation, soil erosion and loss of land fertility. Current agricultural practices are not meeting the basic needs of the people and severe poverty persists.

Community Syntropic Farm in Haiti

Syntropic farming offers a complete solution to these hardworking people. The method outlined in this document can be implemented in any tropical climate zone (and with adaptations **it** can also be done in subtropical and temperate climates). It provides a method for growing a forest full of food, wood and animal fodder, which rehabilitates the land and replenishes water reservoirs.

It is truly self-sustaining. It results in a strong, healthy farm system where chemical fertilizers, herbicides and pesticides become obsolete. Slash and burn farming techniques are not needed and in fact, not compatible with syntropic farming. The hard work of tilling becomes easier as the soil structure improves and tilling is only used if really needed.

The Story of Ernst’s Farm:

If done on a large enough scale, this way of farming can dramatically change a region. For example, in 1984 Ernst Götsch began to develop a large area of dry, deforested land in Brazil. The earth was so compacted and degraded that it could no longer be farmed. To regenerate the soil, he grew trees which he later pruned to produce mulch.

After the trees were pruned, everything on the farm changed. The temperature dropped, the soil structure and quality dramatically improved. The land is now a 500 hectare (1200 acre) rain forest. Seven hectares of the rain forest are home to a productive, cacao farm. Ernst's cacao farm produces yields similar to conventional cacao farmers[3], "somehow" without continuous external inputs and the cacao is considered far above average in quality. Ernst makes a good living from his cacao business. The amount of farm labor needed to manage his farm is similar to conventional cacao farms in the region[4].

Because syntropic farming operates from a holistic perspective, both the farmer and the land benefit from the activity. For example, when widespread disease (witch broom disease) infected cacao trees in Brazil, Ernst's farm was affected, but much less than conventional farms. The benefits of this system relate to the way it is integrated into the rain forest and cannot be achieved by just being adjacent to a rain forest. For example, some cacao farms which are next to this 500 hectare rain forest suffer from ailments, such as cutting ants, while Ernst's farm remains healthy and strong.

Also, the micro-climate on his land has changed. After decades, the rainfall has increased and all 17 streams on his property flow all year round, even in the dry season. Refer to this short video for more details: https://www.youtube.com/watch?v=gSPNRu4ZPvE.

Ernst's Farm Before - 1984

Ernst's Farm After - 2015

Syntropic farming is a big topic. There are multiple complex concepts, which build one on top of each other. It's important to have a solid understanding of these principles, but the real learning comes through years of farm management. The goal of this guidebook is to give people the confidence to start a syntropic farm. This will be achieved by providing the principles in a straight forward and structured manner and then giving some concrete planting schemes.

These schemes only represent one possible way to do this. In reality, there are endless ways to apply these principles. Each region has unique natural factors that will influence the best design for a syntropic farm. Even in areas close to each other, the environment can vary. This presents a challenge to the farmer, but also an opportunity for the pioneers who wish to use their creative powers to adapt this technique to their local environment.

This document is not a standalone resource. Plan on needing a good syntropic farming consultant to help with design and periodic farm management, especially around the second year, when the intensive pruning usually starts. Also, this guidebook is a work in progress. It will be updated occasionally to include the evolving knowledge gained from the lessons learned in Haiti.

Pros and Cons of Syntropic Farming:

Benefits:

1) Crop yields are large.
2) Income is steady over the growing season. Crops are chosen and planted to yield harvests in stages throughout the year and over years.
3) Income increases over the years as the fruit and lumber trees start to mature.
4) Land space is optimized. The production of vegetables is done alongside fruit and lumber trees.
5) Costs are minimized (pesticides, fertilizers and mechanized farm equipment are not needed).
6) Soil quality improves. It becomes more fertile, soft, aerated and workable.

7) The farm is less reliant on frequent rainfall because of improved water retention.
8) The working environment is pleasant as the trees eventually provide partial shade.
9) Less weeding. The ground is covered with mulch, which suppresses grass and competitive plants.
10) Everything grows. As the farm environment improves, even finicky species can be cultivated.
11) Improved plant health and resilience towards pests and diseases because there is strength in biodiversity.

Disadvantages:

1) The full rewards are delayed.
2) The farm can look “messy” to the untrained eye.
3) It takes time and energy to learn.
4) Sun-loving, cash crops can only be grown for about 4 years on the farm.

Does it really work?:

Yes! Numerous syntropic farms are thriving all over the planet. Some have demonstrated amazing yields and resistance to disease. For example, a study comparing Ernst’s cacao farm to neighboring conventional farms found that his produced similar cacao yields, while it needed no fertilizers or pesticides[5].

There are positive studies from Bolivia as well. A syntropic orange tree system produced significantly higher yields than a similar mono-culture farm. That mono-culture farm had twice as much aborted fruit due to fruit flies[6]. In another study, a comparison of a syntropic cacao system to a mono-culture farm found that the return on labor was nearly twice as much from the syntropic farm[7]! Another cacao comparison showed there was significantly less diseased trees (Witches’ Broom) on a syntropic farm compared to conventional farms and the yields were similar or higher[8]. More studies are pending.

How Does it Work?:

The mechanics behind a successful syntropic system can be simplified and described by two fundamental characteristics:

1. Energy capture and handling
2. Accelerated growth and evolution

Nature has the ability to create fertilizer right from thin air. The syntropic farmer knows this and instead of trying to do nature’s job, looks for ways to help it do it’s own job better. Many forests have unfilled niches so that their full potential to capture energy is not utilized. Also the growth and evolution of a natural forest system can be very slow. The syntropic farmer remedies these problems by filling every niche to create a dense, biodiverse forest system which can optimally capture and handle energy and then accelerates its growth and development by cutting back certain vegetation at strategic times.

When you think of energy capture, think of optimally mimicking nature with dense planting schemes and when you think of accelerated growth, think of pruning and farm management. In reality both practices overlap and influence each other and so are not mutually exclusive.

Energy Capture and Handling:

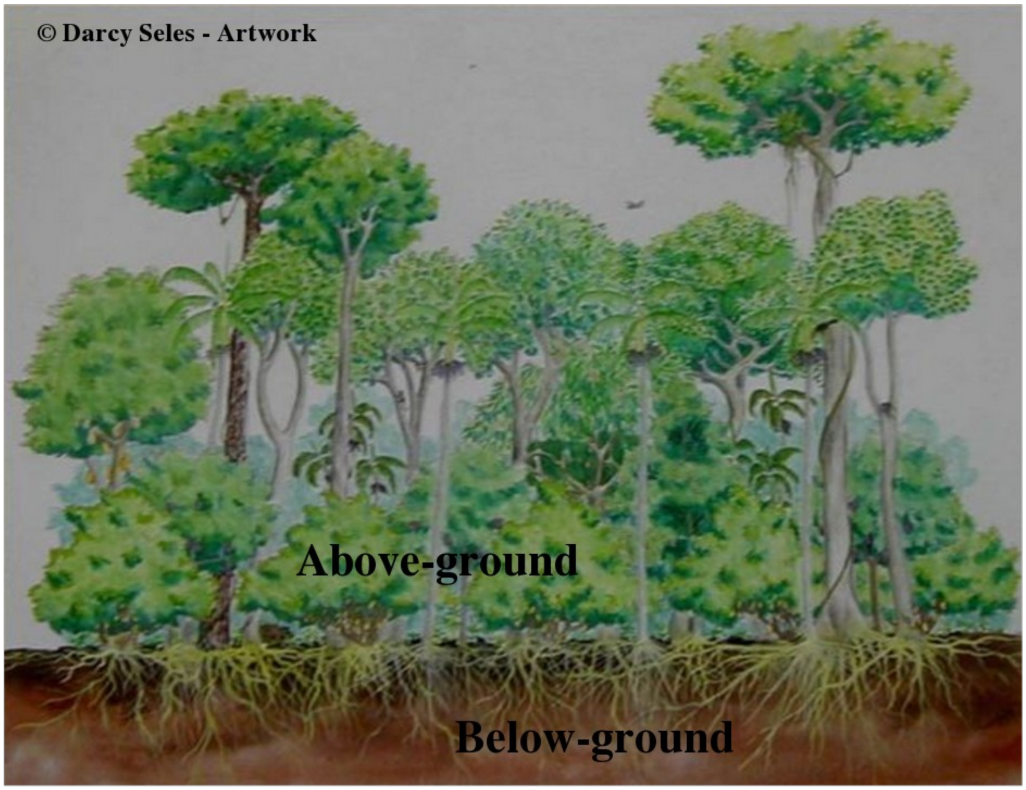
What energy does a forest system capture? The most important is solar energy. Plants capture energy from the sun through the process of photosynthesis. They also bring in carbon and nitrogen by assimilating atmospheric gases. The plants breathe in carbon dioxide and exhale oxygen. Photosynthesis stores the sun's energy, with the help of water, by turning the carbon into sugars. Nitrogen is extracted from the air by bacteria which live symbiotically with plant roots and they can also be found in decaying wood. Minerals and other nutrients which are trapped in the earth can be mobilized by soil microbes so that they become usable to the plants.

Energy is handled by complex networks and relationships between the vegetation and other life forms in the system. The forest supports these networks in multiple ways but especially by providing a protected environment. So when a syntropic farmer creates a dense, multi-layered forest system for optimized energy capture, he/she simultaneously improves energy handling by providing excellent protection from the elements. Protection is also provided at the level of the forest floor by keeping the soil covered with organic matter. This is such an important practice in syntropic farming it will come up repeatedly in this guidebook, but for now let's move on to discuss the different aspects of the forest living system.

A Living System:

Remember, all the life forms on the farm come together to create a unified, intelligent, living system which evolves in a way to the benefit the system as a whole. Ernst likes to call this the "macro-organism" to emphasize that it has a life of its own. But because the word macro-organism has a different and distinct definition in the field of biology, this guidebook will instead use the term "living system" or "forest system".

What does a healthy living system look like? As a general rule, it is dense, diverse, and well adapted to its environment. This means you want lots of living things and you want them to be different. Most people can quickly imagine what this means above the ground. This is a healthy forest with a large mixture of trees, shrubs and other vegetation. This part of the system is crucial because it moderates exposure to the wind, rain and sun. Multiple levels of vegetation help the land absorb these elements, while simultaneously providing protection at times of extreme weather.



Healthy Living System

The above-ground part of the system is only half of the picture. What you see above-ground is usually mirrored below-ground and what goes on below-ground is possibly even more important. Why? Because the below-ground part plays a special role in processing and retaining the various factors needed to sustain the system as a whole, such as water, sugars, nutrients, minerals and organic matter. This handling of various factors is known as nutrient cycling.

Plus the below-ground area retains the fertility of the system through times of distress and disturbance. A healthy system can handle various insults and bounce right back because of the hidden strength below-ground.

Now that you have a good idea of the roles of the above and below-ground parts of the system, let's break it down in another way. Let's think of the system in these three parts:

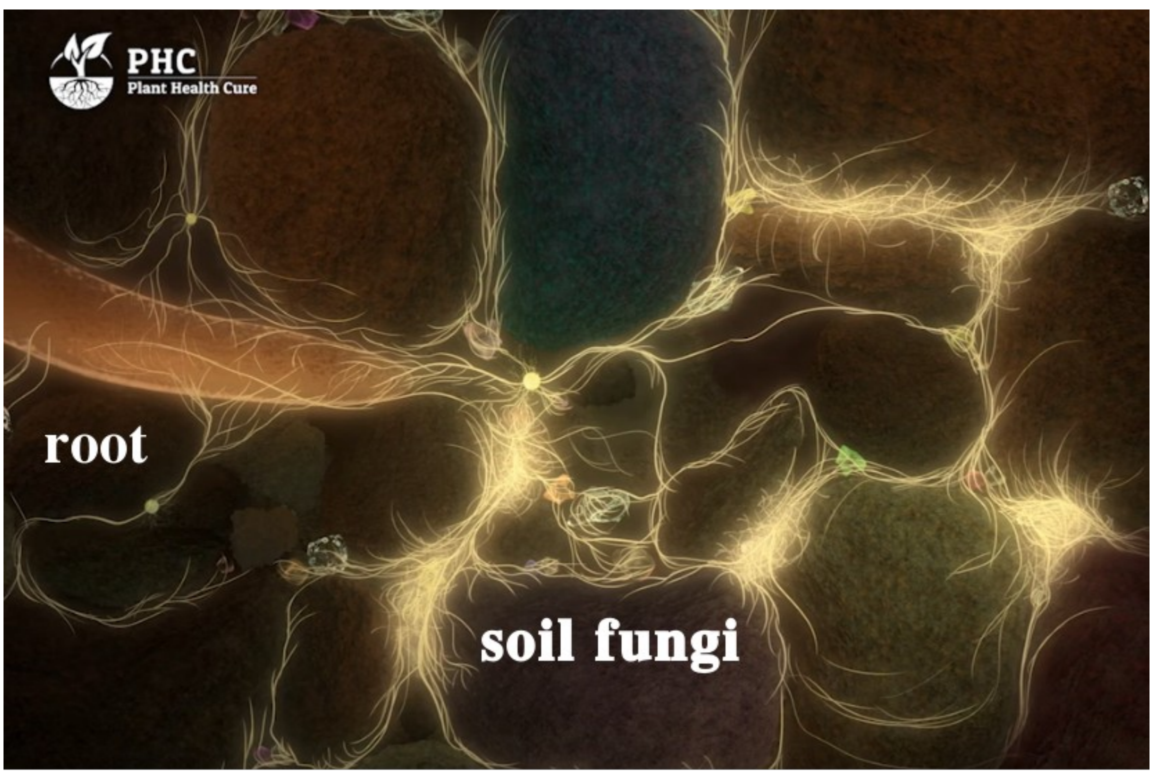
1. **Soil Food Web –** the structure, content and the living things in the soil
2. **Creatures** – beneficial insects and animals, including wise humans ;)
3. **Vegetation** – diverse trees and plants with a lasting presence

Soil Food Web:

Soil is different than dirt. Good quality soil is alive. It has the correct mix of physical and chemical properties to support many life forms. The more life that is present in the soil, the better. These life forms live together in an underground community and are connected by networks. This entire arrangement is known as the soil food web. A good soil food web has many important purposes:

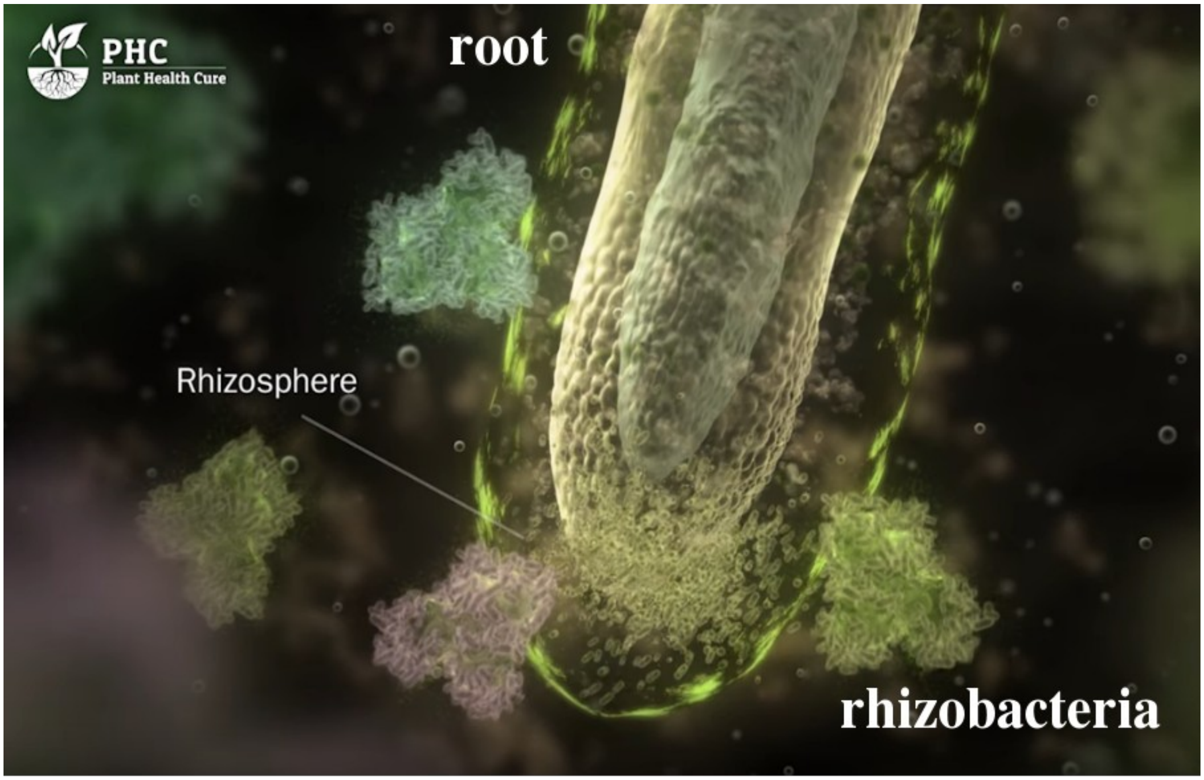
1. Modifies nutrients into usable forms
2. Helps hold nitrogen from the atmosphere and makes it accessible to the plants
3. Improves soil structure and aeration
4. Contains healthy soil organisms which prey on crop pests
5. Makes water and nutrients accessible to the plant roots, that are far beyond their direct reach
6. Holds and stores water in a balanced way; Moisture is retained during times of drought. During times of heavy rain, the water is dispersed and aerated to prevent waterlogging.

One important member of the soil food web is soil fungi. Soil fungi require moist, undisturbed soil, with lots decaying wood and lots of living roots. Perennials and trees are important because their roots remain intact and alive season after season, providing a home for the fungi. The soil fungi and the plant's roots are symbiotic. The fungi create a network of small-sized filaments which help the plants to absorb nutrients and water that would otherwise be out of reach, increasing their zone of absorption by 7 times, on average. Fungi also is important for immunity. When thinking of soil fungi, think "immunity and transport network".



Soil Fungi and Root Interaction

Healthy soil bacteria are also very important. They help protect and feed the plants. Soil bacteria are known as rhizobacteria. They are capable of breaking down minerals and releasing them so that they are available to the plant's roots. Sometimes "poor soil" actually contains many minerals, but they are just locked up in an unusable form. Soil bacteria makes them accessible. Rhizobacteria also form a shield or barrier around roots to prevent harmful bacteria from attacking, this is known as a rhizosphere. When thinking of soil bacteria, think "force field and nutrient releaser".



Rhizobacteria and Root Interaction

The relationship between soil fungi, soil bacteria and the plant's roots is mutually beneficial. Why? Because the plant's roots feed the fungi and bacteria sugars. A healthy soil food web depends on all of these players and more. When one element is missing or under-represented, then the system is weak and illness can manifest.

Soil mesofauna are also important to the soil food web. Soil mesofauna are sometimes too small to see with the naked eye. They are tiny (1-2mm) organisms that assist in the decay of organic matter and thus help provide the structure of the soil needed by the plants. These critters can also prey on bad bacteria and other unwanted organisms. Healthy soil can harbor as many as 200,000 of these organisms in a single square meter!

Soil Mesofauna

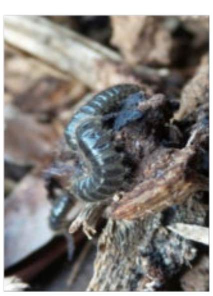
Invisible to the naked eye, but valuable to the farm.

© Andy Murray - all collage photos

Creatures:

Beneficial creatures serve various important roles and their presence on the farm should be encouraged. For example, worms and millipedes decompose organic matter. Pollinators such as bees, moths, butterflies, flies, beetles, bats and hummingbirds substantially improve crop yields. In fact, 35% of the world's crops for human consumption depend on pollinators. Toads, lizards, birds, beetles and spiders are natural pest predators. Smaller animals such as birds and monkeys help disperse and plant seeds. Larger animals bring manure to the property. Plus some seeds need to pass through their digestive tract in order to germinate properly. One of the most important creatures on the land is a wise human, assuming that farmer understands the principles of syntropic farming. Lastly, an established community of beneficial creatures leaves no space for harmful pests to take hold. This is why it is important to avoid pesticides. They can kill the good and bad life forms, leaving the farm weak and unprotected.

Decomposers



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Pollinators

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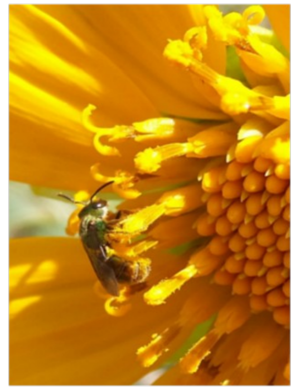

Pest Predators

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Vegetation:

A strong and diverse community of trees and plants form the largest part of the living system. As mentioned before they serve important roles above and below-ground. That's why it is important that most of the vegetation is allowed to become a more or less permanent presence on the land.

Remember how the soil food web and the soil fungi are dependent on living roots? This is where agroforestry differs from conventional farming. Trees and other perennials are cultivated in large numbers. They are seen as highly valuable even if they are a biomass plant. If they block too much of the sun for the target plants, they are simply pruned, but not killed. The farmer realizes that tilling the soil is hard on the roots and the soil food web and so limits this practice to the minimum. In addition, slash and burn practices are abandoned as they kill all vegetation, destroy the natural seed stock and damage the soil. The farmer would have to start from scratch.

The farmer goes to great lengths to cultivate a strong, dense stand of vegetation on the farm, as this serves so many important roles for the unified living system. One of the keys to achieving this dense vegetation growth is by understanding how multiple layers of vegetation can be grown together in a mutually beneficial way. This is achieved through stratification.

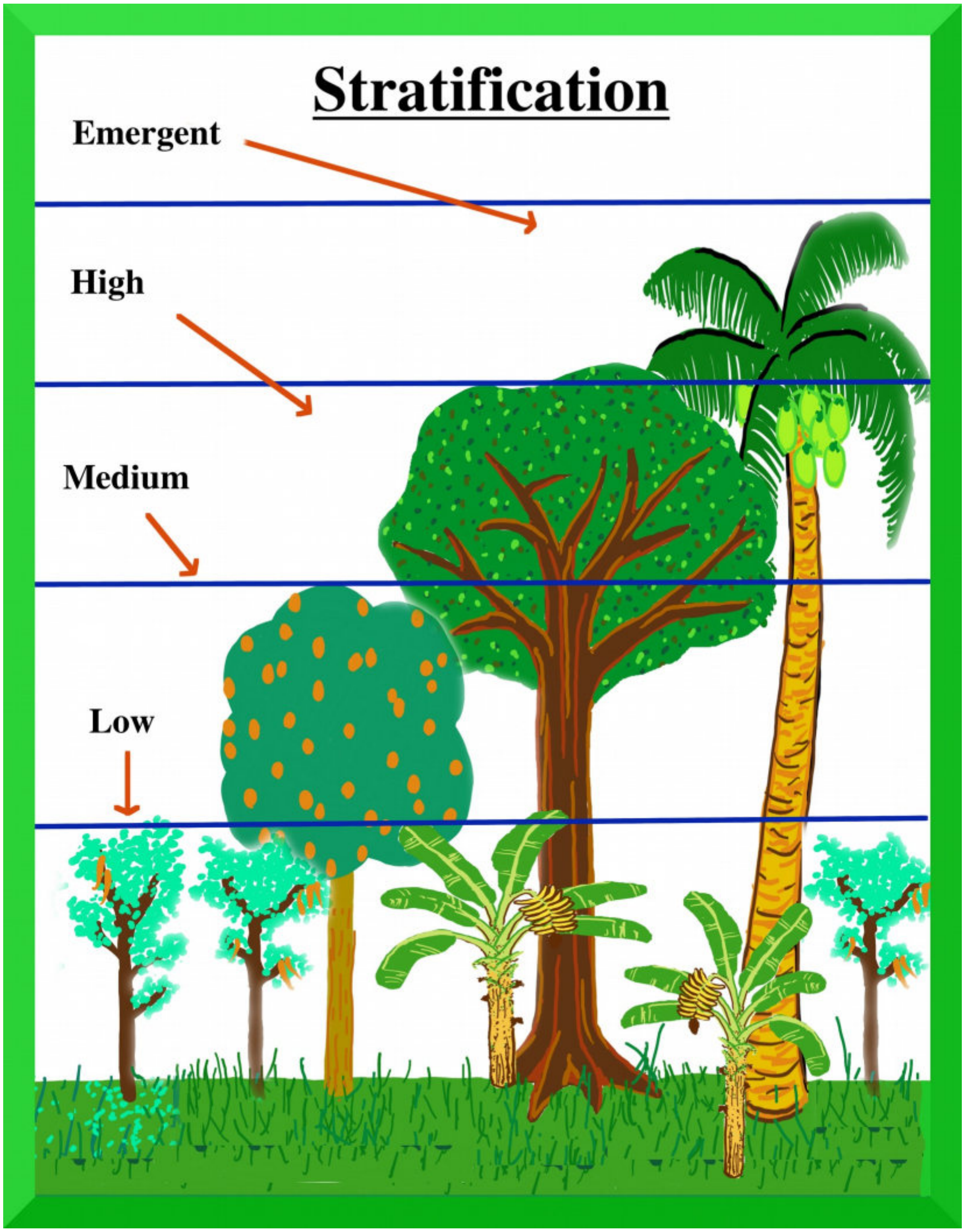
Stratification:

In a consortium of trees, a stratification level refers to the different relative heights of the trees. The levels for syntropic farming are categorized as; **emergent, high, medium and low**. These levels can be further divided when needed, such as high/medium and medium/low.

When trees of the same consortium are compared to each other, a stratification level or stratum will always correlate with the tree's height, but the height is not the determining factor. A tree's stratum is actually determined by its need for **sunlight**. Those needing the most sun are emergent and those needing the least are low.

Normally the need for sunlight and the height of the tree will go hand in hand, but not always. Some consortiums of mature trees are taller than others. Compare the giant redwoods to other climax forests. So in this example the emergent members such as the giant redwoods will be much taller than those of a typical forest. Despite the large discrepancy in height, both are still emergent stratums and both need full sunlight. For that reason, an absolute height measurement cannot be used to classify stratums universally. Now that we understand this, lets learn about some of the other characteristics of stratums.

Emergent trees are the trees that poke above the top of the forest. The high stratum is next and medium level is below that. Many fruit trees mature to be in the high and medium stratums. Lastly, the low stratum is below all the other strata and gets the most shade (think coffee). cacao is an intermediate stratum tree which matures into the medium/low level. Detailed stratum lists will be provided in the practical section of this guidebook.



Why is it important to learn about the stratification levels? Because the levels tell you how to correctly space the members of your consortium. Although many aspects of an agroforestry design can be modified, correct spacing must be maintained as it is based on the natural features of the vegetation. Trees of the **same level** need enough space so that their canopies can grow to maturity without contact. In some cases, they will be given even more space than this, to ensure good sunlight penetration for the lower levels of the farm. However, trees of **different levels** can be planted close together because their canopies will grow to different heights and they can share the same vertical space. If their canopies end up getting too close to each other, it's okay. They can always be pruned back.

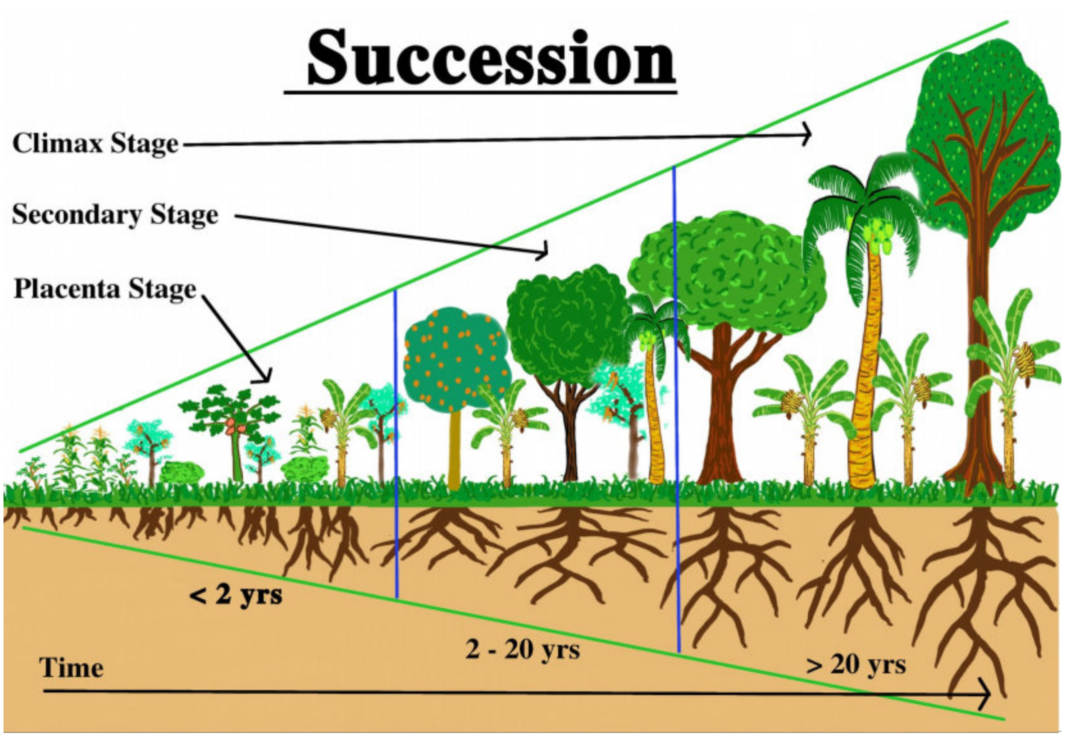
For the farm to absorb the most solar energy it is best to maintain a specific mix of the 4 stratums. This is a rough guide, but in general its best to maintain these proportions:

Stratification Proportions			
Emergent	High	Medium	Low
20%	40%	60%	80%

Each percentage refers to the total amount of land surface that is covered by the vegetation canopy in that level. The reason the numbers add up to more than 100% is because the stratum levels overlap. For example in some cases emergent, high, medium and low will all be covering the same surface of land.

These proportions are achieved both by correct planting in the beginning and also by pruning back later on. In reality, the trees are always growing and the farm is always changing. The canopy coverage is dynamic. So if the trees start to take up more of the intended space, they are simply pruned back again. These proportions will help guide the farmer's pruning practices but are not meant to be dogma.

We just covered a lot of material to help us see how the living system can capture large amounts of energy. Stratification tells us how to maximize planting density. Remember how capturing energy is achieved with dense planting schemes? But that's only half of the equation. The other half is achieved through the power of natural succession.



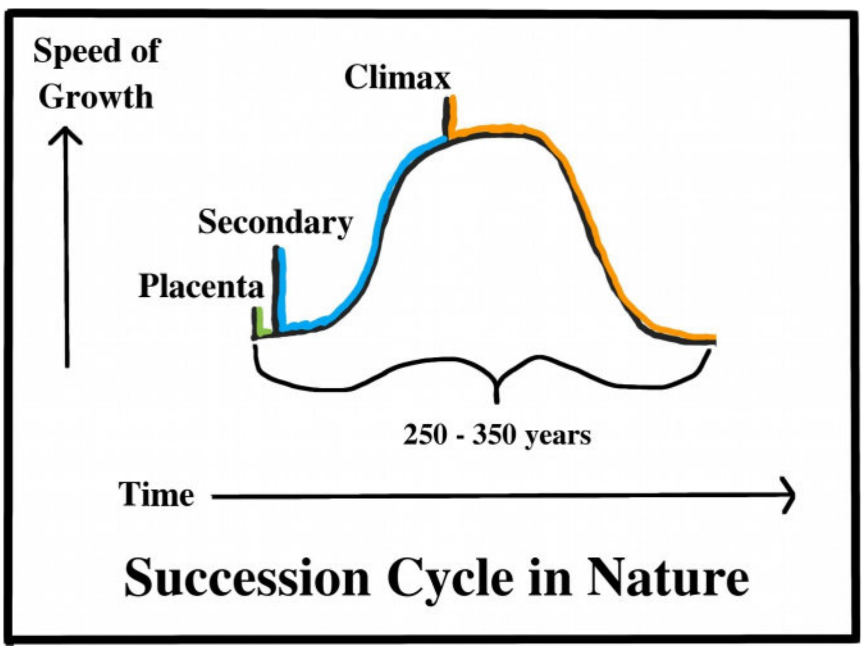
Succession:

Succession is the tendency for a natural system to evolve from simple to complex. Through the process of succession, plant life moves towards species that are capable of capturing and handling more and more energy. This results in energy concentration, which is exactly what the term “syntropy” means. Harnessing the power of natural succession is integral to syntropic farming.

Succession improves soil quality, biodiversity and moves the system towards longer living vegetation. If left undisturbed, nature will transform bare ground into a thriving forest or jungle and it can maintain this by itself. The jungle is far more productive and biodiverse than a field. This process is achieved through the maturation of a community of different plants, each of which serve specific functions and sometimes only short term roles.

To help understand succession, it is divided into distinct stages, but in reality it occurs seamlessly. In syntropic farming, the first stage is called the “**placenta**”. The next stage is called “**secondary**”. The final stage is known as the “**climax**”. Each stage improves the growing environment for the next so that one step at a time the land becomes more fertile and filled with more life until it reaches the climax stage.

At this point the speed of growth starts to slow and the system ages. Lower level trees die off due to the lack of sunlight. This produces the open forests that are pleasant to walk through. These climax systems are very long-lived and the trees that have survived are very well genetically adapted to the land, but eventually even those remaining trees die off from natural aging. But things don’t end there, a new cycle will start, more fertile than the last one. This topic will be covered in more detail below in the section “3 Phases of Evolution”.



Nature progresses very slowly through a single cycle from the placenta through a climax stage. One cycle can take 250- 350 years in nature! Fortunately, by accelerating natural processes, in syntropic farming this can be achieved in as little as 20 years.

The placenta stage is dominated by vegetation which can grow in harsh environments and soil conditions. These plants are often fast growing and produce large amounts of seeds. When thinking of placenta, think of weeds and "invasive species" and imagine a pasture or field setting. Most people think of invasive species as harmful, but in reality they have a purpose in nature. They bring balance and fertility to the land. When the farmer learns how to manage these species, they suddenly become useful.

Placenta species often serve a temporary role to improve conditions for the latter stages and then die off. The name "placenta' is meant to convey this life-giving quality. The term placenta also describes the fact that often all the other stages are present, but undeveloped during this time, just like a baby in a womb.

The secondary stage will have taller vegetation and trees. Their life span is longer and they require more fertile growing conditions.

Lastly, the climax stage can have very long-lived trees and plants. They are sometimes very finicky and produce far fewer seeds. During the climax stage a selection process occurs that favors species best adapted to the environment of the system. This can result in a relative decrease in plant biodiversity when compared to the secondary stage.

Stratums and Succession Stages:

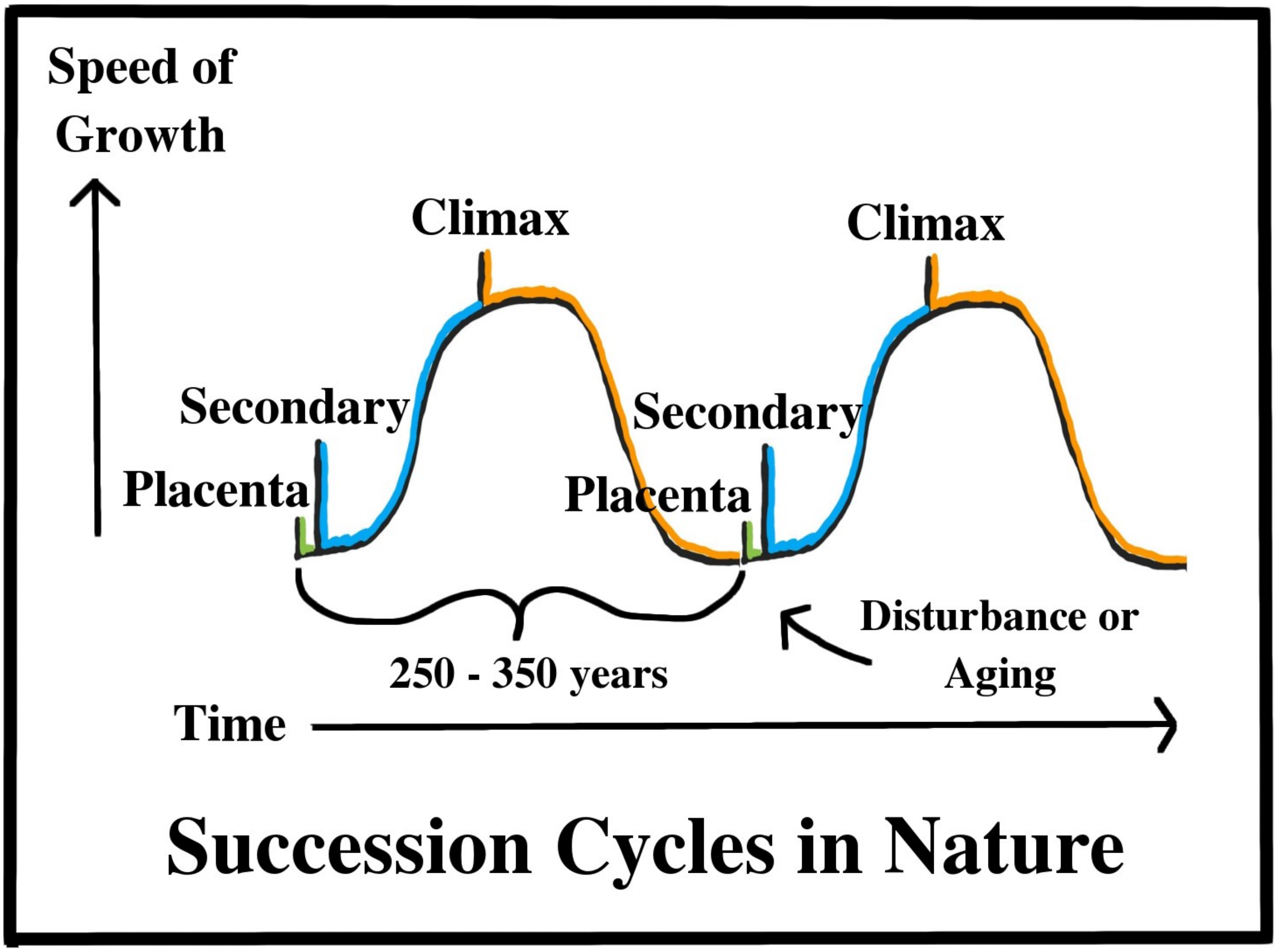
It's important here to clarify that the stratum level of vegetation is further defined by the succession level that it occupies at maturity. For this reason, it is important to refer to the succession stage when talking about stratums. For example, in the placenta stage the stratums are mostly occupied by vegetables. Whereas in the secondary and climax stage they are mostly trees.

Consortium Based on Stratum and Succession Level				
	Placenta I	Placenta II	Secondary	Climax
Emergent	Corn	Papaya	Eucalyptus	Mahogany
High	Tomato	Cassava	Mango	Cashew
Medium	Climbing bean	Water yam	Lime	Mandarin
Low	Pumpkin	Pineapple	Annatto	Coffee

3 Phases of Evolution:

Ernst recognizes that the climax stage is no end. After the climax forest is complete, the process of succession can start over again with a new more fertile placenta stage. Then the system evolves into a more fertile secondary and climax stages as well. The vegetative species on the land can be entirely different than the first cycle and improves over time. Fertility grows with each repeated cycle until there is enough so that it can produce an abundance of yields to sustain the largest life forms in that area.

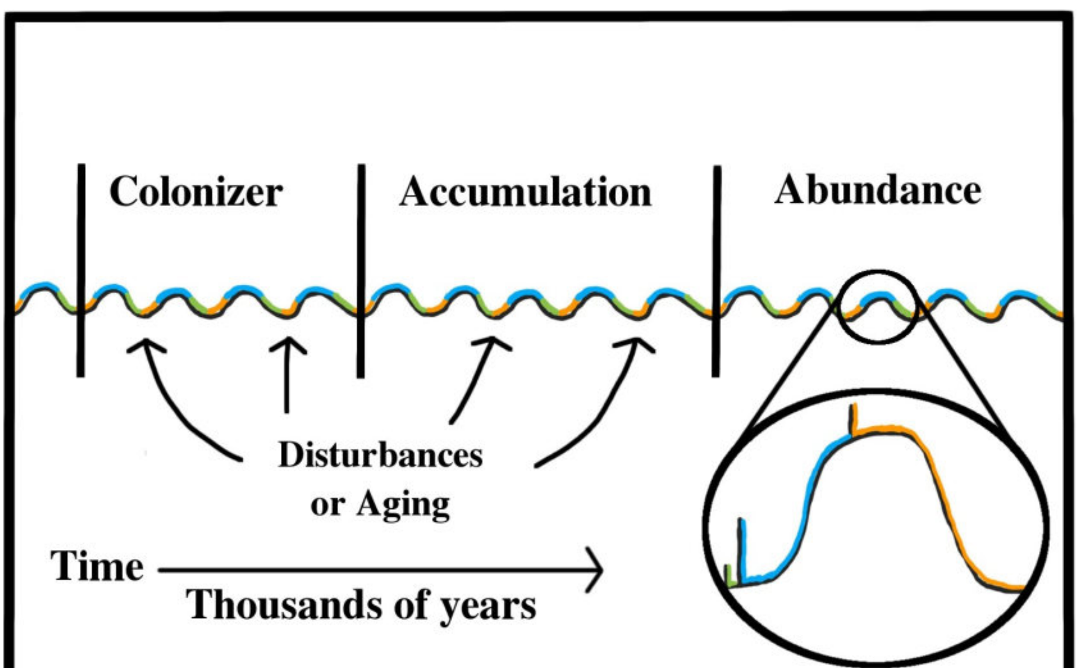
The most common cause for a climax cycle to finish is aging of the trees. But also, forces such as weather, fire, pests and animals are natural disturbances that can cycle a forest system. Ernst saw that when the trees came down they returned fertility to the ground and triggered a strong growth response in a way that benefited the system. This is true as long as the forest has achieved at least a secondary stage of succession and the below-ground portion of the system remains alive. A large disturbance is not beneficial if it totally decimates life or happens when the land is underdeveloped such as in the placenta stage. In this case, the living system has to restart from the beginning.



With continued beneficial disturbances, natural succession will repeatedly cycle until it passes through 3 phases. In nature this can take thousands of years. In syntropic farming, these phases are known as "**colonizer, accumulation and abundance**". The colonizer phase is nature's attempt to bring life to more or less dead ground. This phase is dominated by life forms that can grow in harsh conditions and serve the purpose to prepare the land for larger vegetation by depositing organic matter and altering the chemistry of the land.

Next is the accumulation phase. At this point the living system is able to support small animals (up to the size of a chicken). Here it starts to have some fertility, but things are tenuous, the system is not self-sustaining and needs to store large amounts of carbon to "fatten up". The system's relative needs for water and nitrogen are low at this point. Most farmland on the planet is stuck in the accumulation phase because modern agriculture continually resets the system through tilling, removing perennials and other disturbances. This prevents the living system from evolving into abundance. Its important to point out that modern agriculture makes it possible to feed larger animals during the accumulation phase, but relies on the continual input of fertilizers to do so. This is unsustainable and eventually comes at a large cost.

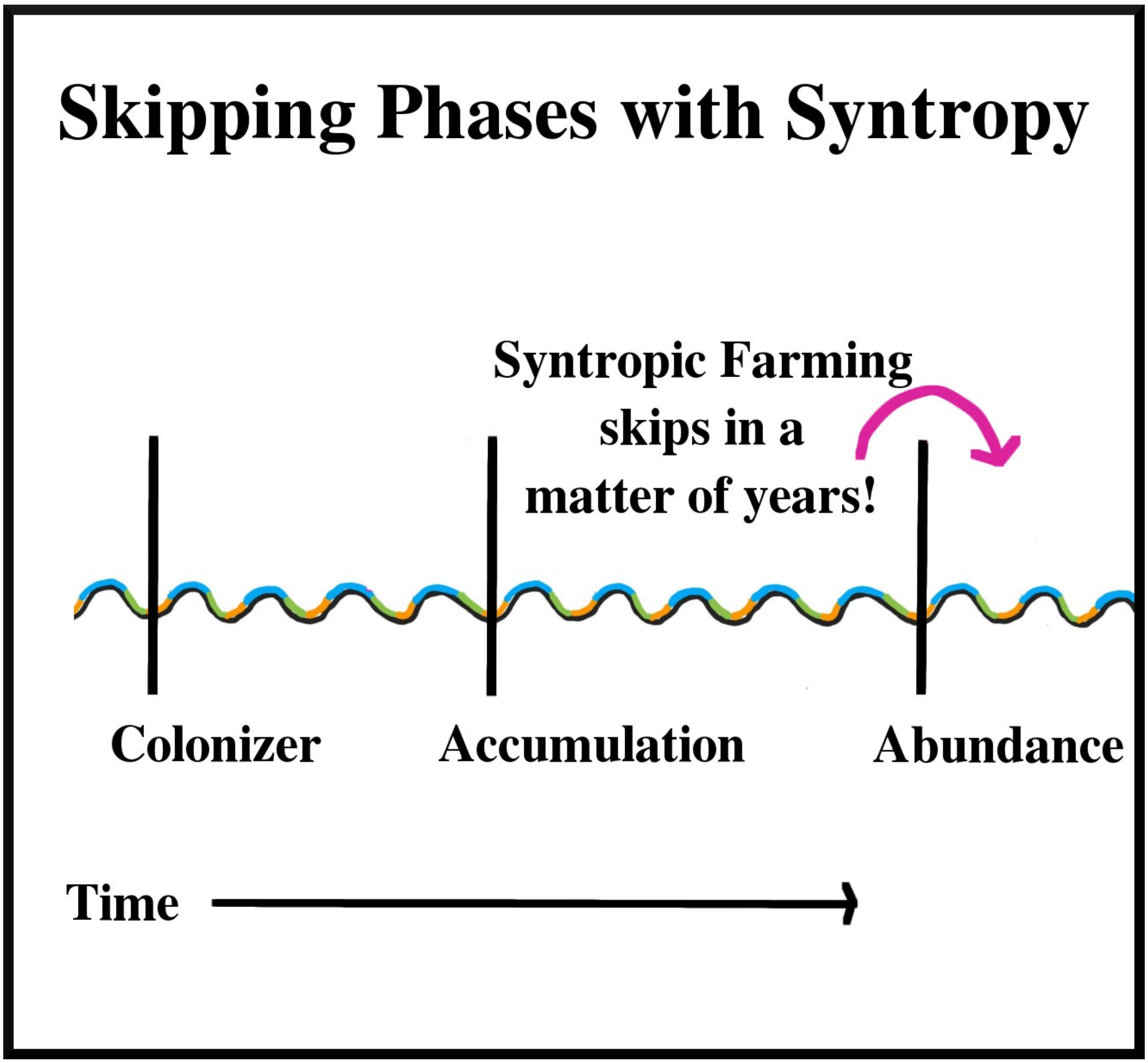
If the living system is allowed to evolve and passes through enough cycles, the land builds its fertility and eventually enters the abundance phase. At this point it releases large amounts of phosphorous but now needs nitrogen and water. Its fertility is reaching a point where it can support large animals and can do so indefinitely. The biomass, biodiversity and genetic variability within species on the land is increasing. It is so great that it is able to absorb its energy and nutrient needs from the sun, the air and unlock it from stores in the earth.



Cycles and Phases of Evolution

Syntropic farming is all about getting to the abundance phase. This is when good things happen with ease and the beauty is you don't have to wait decades or more to get there. If the farmer is starting with good land and can cover the ground with organic matter from day number one, then he/she can reach this point in as little as two years!

How does the farmer accelerate this evolution? By strategic pruning and management. Pruning the vegetation has multiple benefits which influence the speed of growth on the farm. Also the mulch which is created brings large amounts of carbon into the soil food web. By doing this, the system is fed what it needs much faster than in nature and is boosted from the accumulation phase to the abundance phase.



3 Keys to Syntropic Farming:

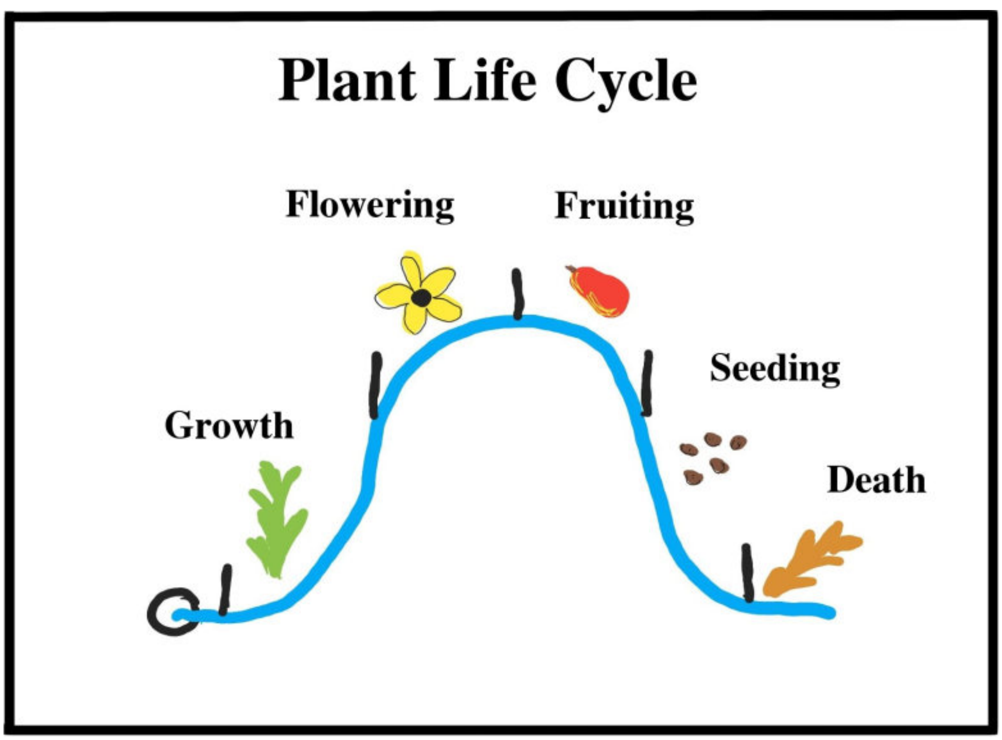
Now lets move on to the 3 keys to syntropic farming. The first two are relevant because they are pruning and management practices which help accelerate growth and evolution. By combining all three keys the farmer has the fundamental puzzle pieces necessary to build a healthy, living system. Here they are:

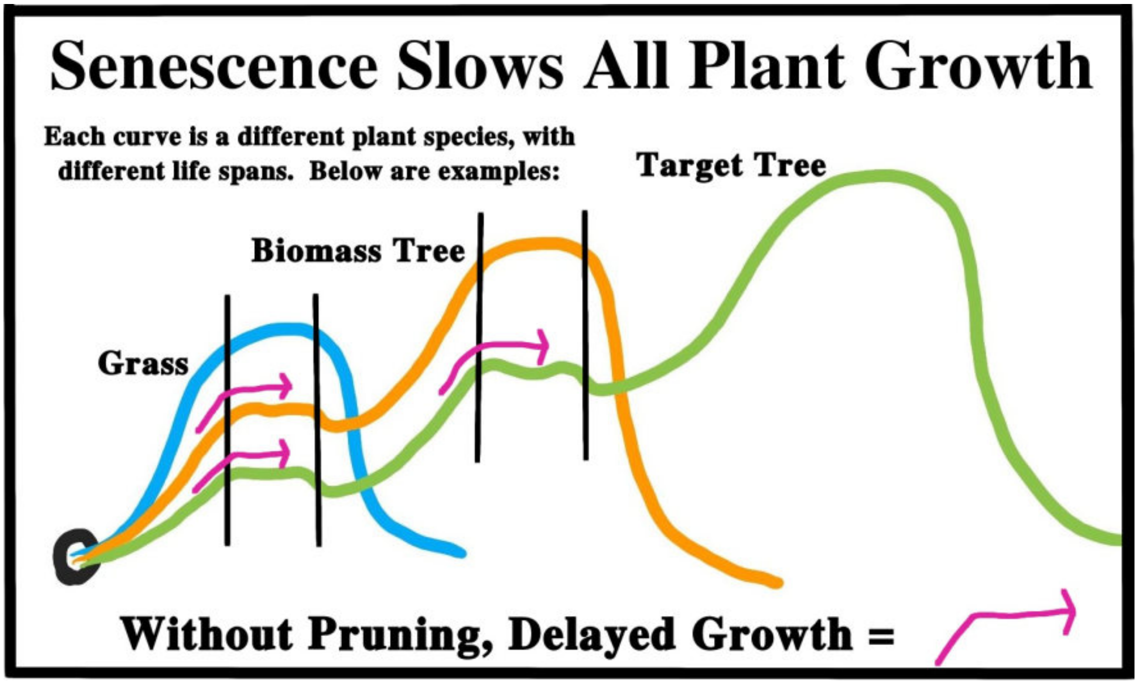
1. Prune to stimulate growth; 2. Cover the soil with organic matter; 3. Plant intelligent consortiums

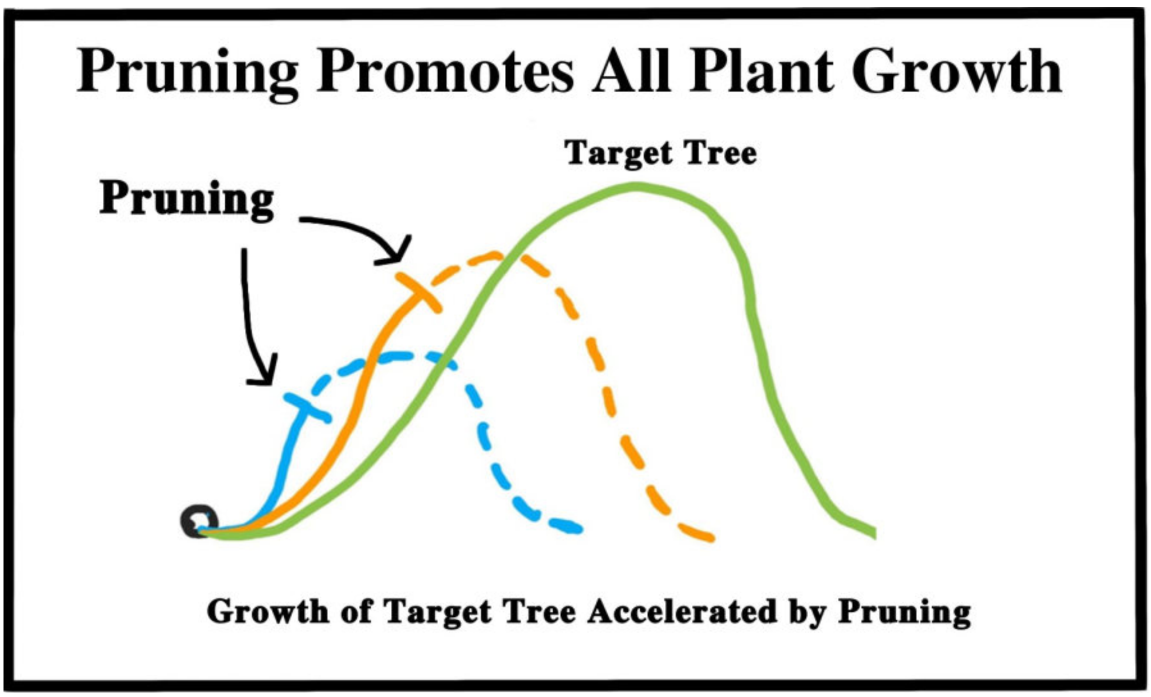
1. Prune to stimulate growth

Large scale pruning gives a huge boost to the system. Aging plants slow the growth of the entire system. But if you prune them they start a new growth phase. So pruning takes the symbolic foot off this brake pedal, but it is better than that, it also puts the foot on the gas pedal! It sends a growth message by releasing large amounts of ***plant growth hormones into the system***. This growth response influences the nearby plants, not just the pruned trees.

To understand why this works, its important to know that all plants go through a life cycle. First is a period of rapid growth. Then things start to slow down when the plant is flowering. After that the plant prepares to make fruit and seeds and becomes relatively dry. When a plant's growth slows, it has a negative influence on the surrounding plants too. This "halting" effect is avoided in syntropic farming by pruning. The biomass plants are pruned at the first sign of senescence, before flower formation has started. The target plants must be allowed to fruit, as that is the goal of their presence. But they should be pruned as soon as possible after harvest.







The biomass trees and vegetation will be the greatest contributor to this growth response. They are pruned heavily, especially in the early years. Target trees grown for fruit will be pruned less, but even they will contribute to this growth pulse. Lastly, selective weeding helps the farm. All the vegetation on the land needs to be monitored for signs of aging and pruned. In this way, every plant can contribute to the growth pulse. Although trees and shrubs were the first biomass plants that Ernst used on his farm, he now recommends certain grass species too.

The biomass plants are usually placed in a row along with the fruit trees. This row is called an A-line. The space in between two rows is called the B-area and is used for growing vegetables or biomass grass.

Biomass Plants in A-lines, Before Pruning

The growth hormone release starts as soon as the vegetation is pruned and its influence is determined by the size and characteristics of the pruned plant or tree. If the farmer has a biodiverse, dense A-line, then the entire B-area will receive an intense grow pulse. Planting of the B-area should be performed immediately after pruning. If plants are already established, often a visible increase in growth can be seen within just one week. cacao leaves will elongate and trees will increase fruit production. Corn can add 12 inches of length!

There are multiple other beneficial effects of the pruning. Some of the plants roots will die off, which gives organic matter to the soil and creates and open network for the soil food web to utilize. The area will receive more sun exposure and the system will receive a big dose of organic matter, but the rapid growth spurt cannot be explained by the composting of the mulch, which takes many weeks to happen. This is best explained by growth hormone release.

Biomass Trees are Heavily Pruned

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Management Sequence with Pruning for Growth

1. Grow dense rows **2. Prune for biomass** **3. Enjoy rapid growth**

If the farmer has mature fruit trees, then the pruning may be strategically timed to benefit fruit production. Many fruit trees prefer more sun during the flowering and fruiting stages. So pruning of the biomass vegetation is normally planned at the time of flowering to open the canopy for the sun. This is known as synchronization pruning. In the tropics, the synchronization pruning often happens in the dry season, so there is no growth pulse with this disturbance. The growth pulse requires ample water in the system.

Also you may notice in the pictures above, that many bananas are present. Ernst often says, if you want vegetables, then plant bananas. Bananas make great biomass. The plant is so valuable to the soil that some farmers grow it solely as a biomass plant and not for the fruit. The pseudostem of the banana is cut lengthwise and then into small pieces and laid on the ground. This can be placed next to the newly planted veggies.

The banana pieces also act as a death trap to the banana weevil. The banana weevil is a beetle that infests and damages the plants. It's attracted to the freshly cut banana and when it lays it's eggs in the banana parts, the grubs are not able to fulfill their life-cycle and die.

It's important to point out that the pruning is beneficial above and beyond the simple production of organic matter. If, for example, all the organic matter needed to cover the soil was always gathered somewhere else and brought to the farm, the farm would be missing the growth response triggered by heavy pruning. It's necessary to have vegetation grown on the farmland that can be pruned. The farmer should anticipate doing this at least twice a year, sometimes more frequently.

There are other reasons to prune in addition to the growth response and the mulch production. Pruning can be used as a clean up. It should be done regularly to remove dry, diseased or unproductive plant parts. Pruning is also done to maintain proper stratum levels. Lastly pruning can be used to thin the system. For example when its time to remove a plant or tree to make more space.

2. Cover the soil with organic matter

Cover the ground with a thick layer of organic matter and keep it covered. How much organic matter do you need? A lot! You need enough to block the weeds and grasses from growing. The amount needed to achieve that will vary depending on what material is used, but often this is a 10 cm thick layer or more.

Ernst says that the uncovered soil is like a wound on the earth. A thick layer of organic matter is healing. It becomes rich compost over time, acting as an organic fertilizer. It also protects the soil from the sun and prevents evaporation of water, reducing the dependency on frequent rainfall. By blocking the competitive grasses and weeds, it makes life easier for the farmer. Plus it keeps the harvest clean.

Lastly, remember the soil food web? It loves a thick layer of organic matter. The micro-organisms, fungi and worms flourish in this environment. The more wood that is included, the better the fungi will grow. Wood is always placed directly on the soil, to aid in decomposition, while the leaves and grass are placed on top. If organic matter is limited, then use it most around the target plants and trees.

Farmers who can import organic matter from the beginning will get a head start on their system. This is not possible for the average Haitian farmer. They must wait until the biomass vegetation matures. The biomass trees usually take 2 years, whereas grasses are ready within 1 year.

Cover the soil with organic matter, especially around the trees

Notice all the soil is covered

Vegetation grows much stronger when the soil is covered. Here all the rows are planted the same, but notice the ones with mulch!

3. Plant intelligent consortiums

A consortium is a community of vegetation that grows together cooperatively, fills all of the stratum levels and matures over time to pass through all the stages of succession.

This means you must design your system with foresight. Imagine how the plants and trees on the land will mature over time. This requires detailed knowledge about the different vegetation and their life cycles. Syntropic designing is highly complicated, but when done correctly it is very rewarding. The practical portion of this guidebook will help you with this. But let's go through one potential scenario of how an intelligent consortium may unfold.

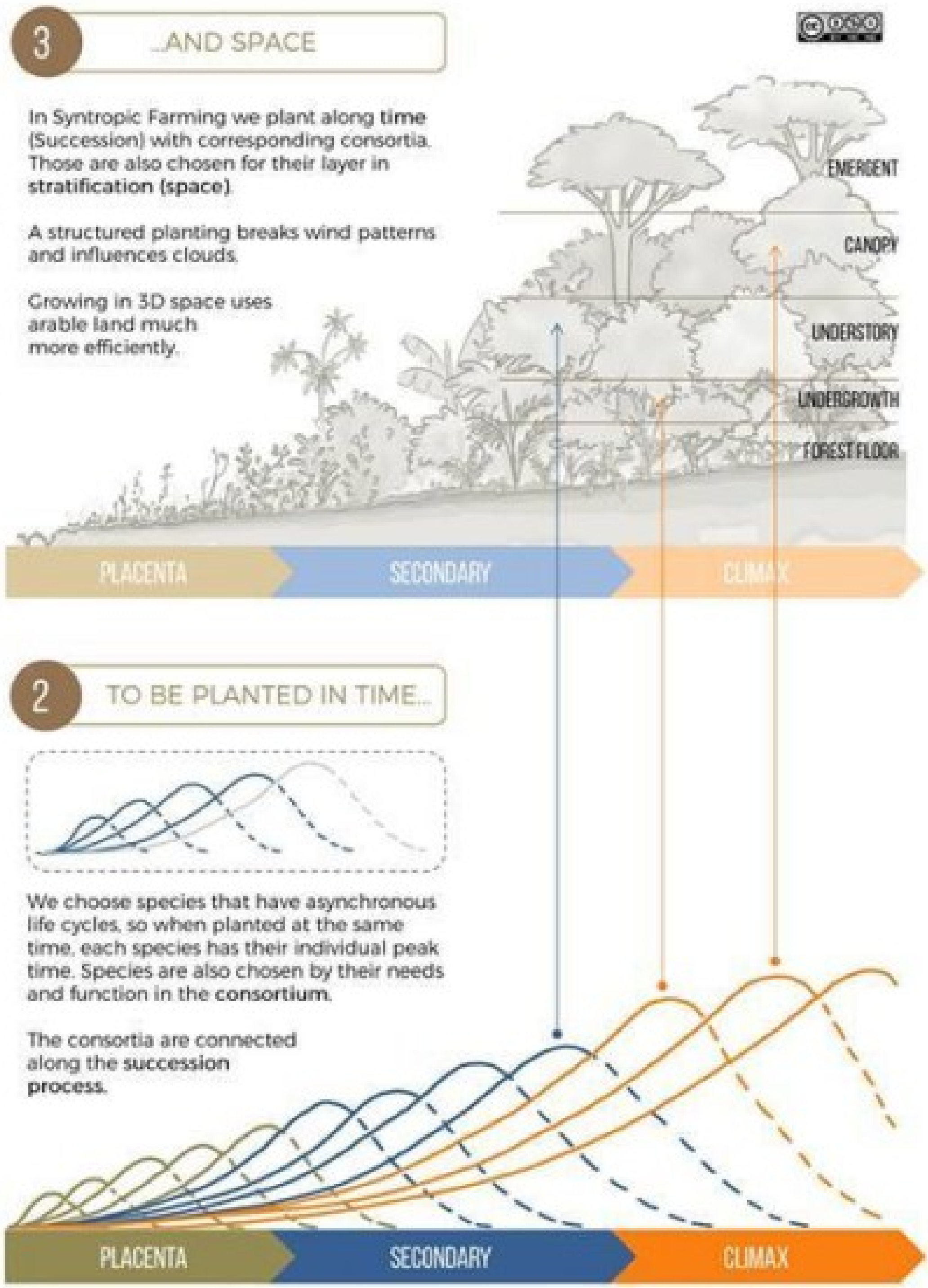
Assuming you are starting with open farmland, vegetables or pastureland will dominate initially, but over time the land will develop into a food forest. The vegetables grown in the early years bring the farmer income, but also provide a protected "nursery" environment for the tree seedlings.

Syntropic consortiums are known for tight intercropping schemes which produce harvests in waves. Vegetable yields can be expected in as little as 3 weeks and will continue for more than a year, one step after another, depending on what is planted. When an early plant is removed, it makes more space for the later ones to fill in. In this way, the land is optimally used and there is no space for competitor plants to take hold.

Veggies can be cultivated one round after another as the rainy season permits until the space is too shaded. By the first year the grass is ready and by second year the biomass trees can be pruned for leaves and wood. In developing countries the wood poles are highly valuable so the farmer may choose to use them for building and firewood, but it is beneficial to leave some of the wood on the soil to support strong fungal growth.

After the first 4 years, the land will start to be shaded. There are many ways the farmland can take shape at this time, depending on how it was originally planted. In general, the farm will shift to more shade loving crops, such as leafy greens and pineapple and shade-loving trees like coffee and cacao.

If trees were cultivated for lumber they will start to dominate the scene as well. By incorporating all of these elements in the initial planting scheme, year after year the farm will produce larger and more diversified yields. At times, during the first two years, it may make sense to heavily prune the entire system, at which point sun-loving, market crops can be grown on the land again.


3
...AND SPACE
In Syntropic Farming we plant along time (Succession) with corresponding consortia. Those are also chosen for their layer in stratification (space).
A structured planting breaks wind patterns and influences clouds.
Growing in 3D space uses arable land much more efficiently.
EMERGENT
CANOPY
UNDERSTORY
UNDERGROWTH
FOREST FLOOR
PLACENTA
SECONDARY
CLIMAX
2
TO BE PLANTED IN TIME...
We choose species that have asynchronous life cycles, so when planted at the same time, each species has their individual peak time. Species are also chosen by their needs and function in the consortium.
The consortia are connected along the succession process.
PLACENTA
SECONDARY
CLIMAX

Farm Evolving

4mos: corn, climbing bean and rice

1.5 years: plantain, papaya and pineapple

5 yrs: Banana, peach palm, cocoa, cupuaçu, citrus, avocado and firewood.

18 yrs: Banana, peach palm, cocoa, cupuaçu, caja, platonia, coffee, rubber tree, and firewood

40 yrs: Same as above plus bacaba, Brazil nuts and many other fruits

Planting Logistics:

Its best to introduce all the trees and plants for the living system at the same time in the beginning, if the land is fertile enough to accept them. Why? Because as the trees mature it becomes difficult to establish new members. Normally there is a two-year time frame where new trees can be added, after that a substantial pruning would be needed to introduce new trees. But it is best to start with all the trees and plants in the beginning if possible.

Also it is preferred to plant trees by seed in abundance and then remove the weaker members as they mature until the correct spacing is achieved for maturity. Seeds are advantageous as they require less work to cultivate compared to growing seedlings in a nursery. They are less expensive and allow for more genetic diversity. Plus by using seeds, the farmer allows the living system to determine which species will grow strongest in each location.

There are some exceptions though. Some trees cannot be cultivated by seed (breadfruit for example) and other fruit trees will not reliably grow the same fruit by seed (mango, avocado, etc) and must be grafted. Some tree varieties grow strong from cuttings and may be easier to establish on the farm than starting by seed and other seeds must be planted immediately after picking. If the farm system is not ready to accept them then these seeds will need to be started beforehand. For example, in parts of Haiti cacao seeds are ripe in the dry season and the seeds are best germinated immediately. In this situation, cacao needs to be started as a seedling. So although seeds are preferred, there are many times where growing seedlings is necessary.

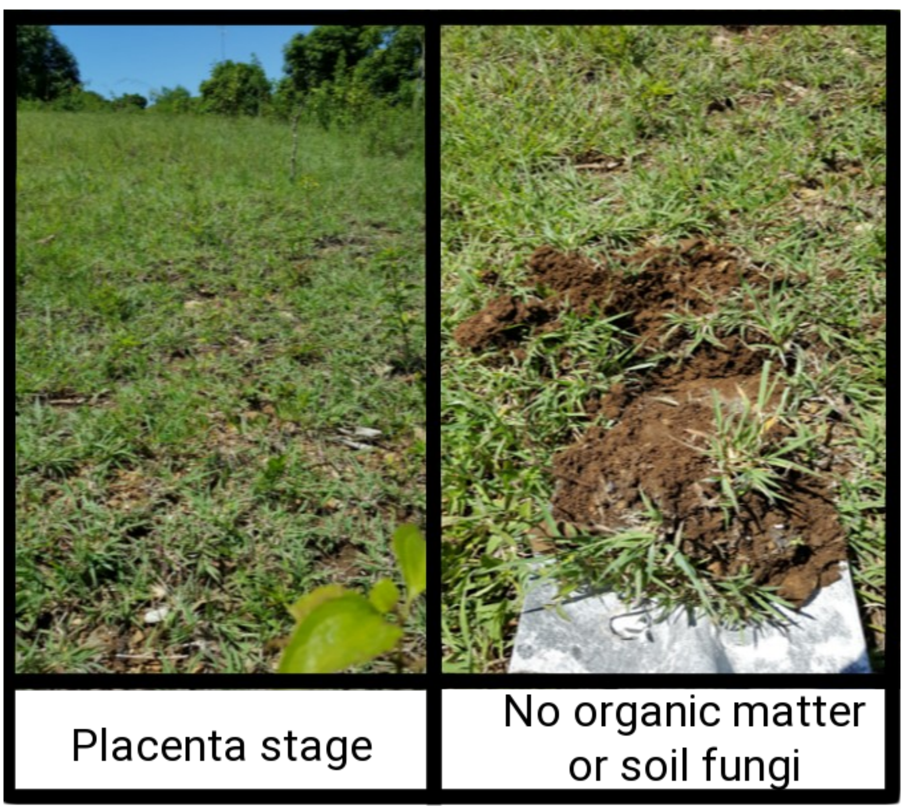
It’s important to recognize the indigenous vegetation species can be cooperative members of the consortium as well. During the placenta phase certain weeds will tend to grow which can be used as biomass plants for pruning. Random tree seeds will also find their way onto the farmland. Often they can be strategically planted by birds or other wildlife to fulfill a specific role for the system. If not, they can always be removed. But it is always best to wait and observe! These unintended trees can add diversity and may be filling a niche that was inadvertently left open by the farmer. It is much easier to remove a tree later, once you are sure it is competitive than it is to add one back.

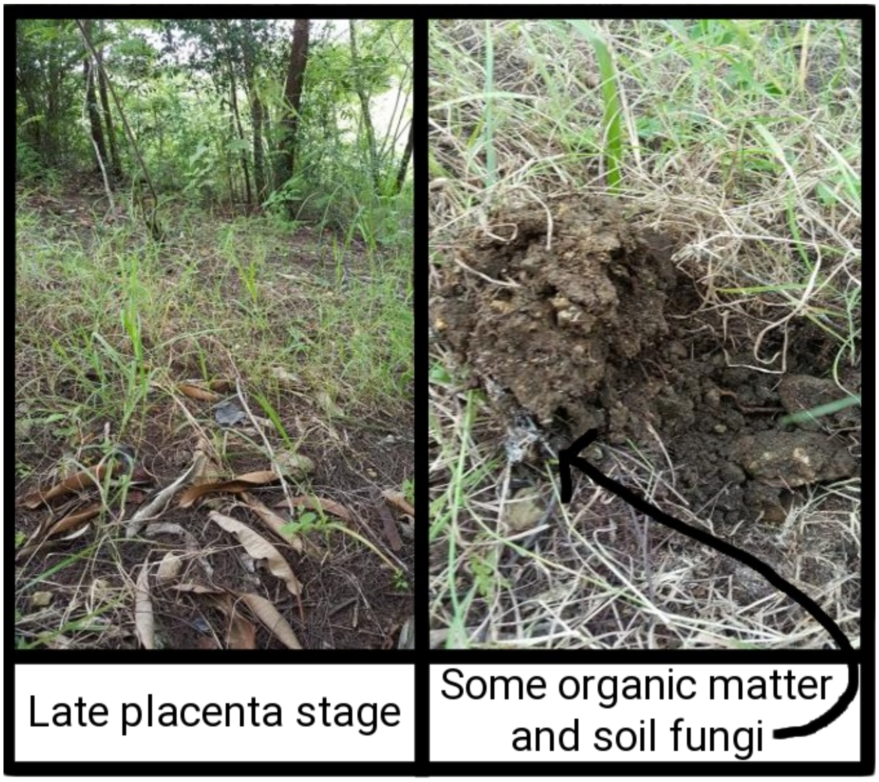
Abundance Phase Feedback:

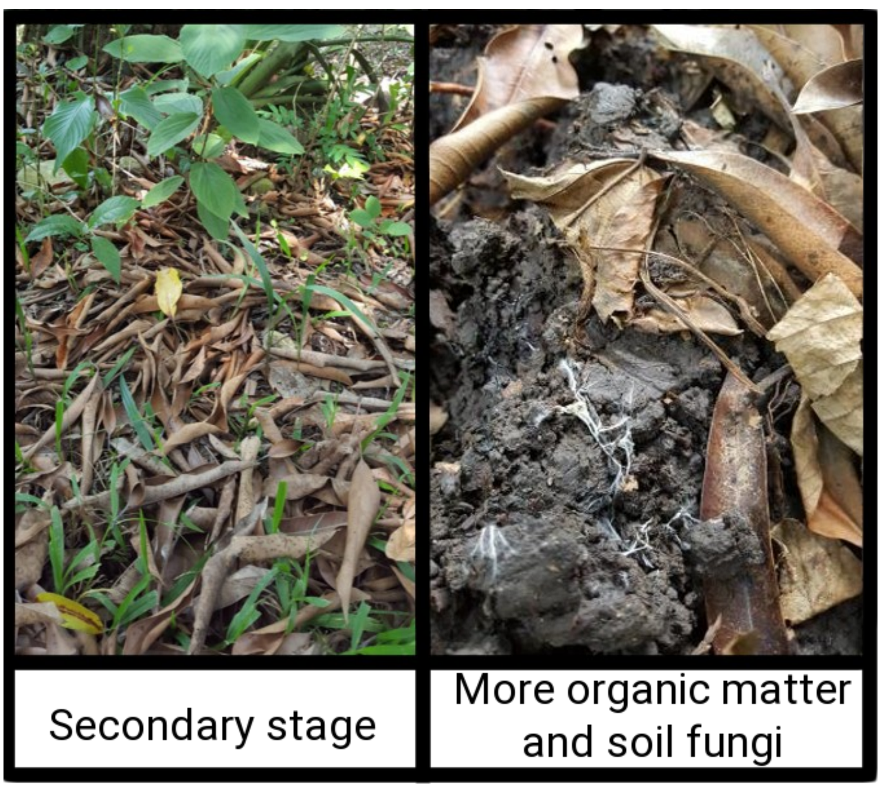
If the syntropic farmer has incorporated all of the fundamental principles presented here. If he/she has started with a good design and managed the farm system with a holistic perspective, the farm will transform over time. Many farmers just know when things are going well, but it is good to have some objective measures for feedback. How do you know when your farm is entering the abundance phase? Here are some tips:

1. Overall color improves, from gray hues to brighter shades of green.
2. Soil structure improves with a dominance of soil fungi.
3. Weed growth changes towards species found normally in the woods, as opposed to open fields.
4. Finicky species start to grow.
5. Long-lived tree species mature into the climax stage.

Vegetation Color Changes to Bright Green




Late placenta stage
Some organic matter and soil fungi


Secondary stage
More organic matter and soil fungi

Agricultural Paradigm Shift:

Syntropic farming represents a major paradigm shift from conventional farming, even typical organic farming. Remember that the farmland is seen as a unified, intelligent, living system and actions taken on the farm are intended to benefit the system as a whole.

From this holistic perspective, all land can produce abundance, but sometimes it is meant to produce something different than the farmer desires. It is good to have a plan, but also important to be open to change your plan if things don't go well. When you are able to see what it is that the farmland is meant to produce, everything is easier. Where there is abundance, the farm is economically sustainable. But where there is fighting, energy is wasted.

Maintaining a holistic perspective also means that the biomass vegetation is given equal value as the target plants and trees. Each play different roles, but are equally important. They cooperate and need each other for success. When the living system is kept strong and healthy it takes care of itself. Eventually the land needs less maintenance yet delivers high yields. The soil regenerates and there is an absence of pests and diseases.

The presence of diseases, pests or poor yields is a warning sign that the system is weak and imbalanced, remember the need for healthy gut flora? In this case, the syntropic farmer seeks to understand the root cause. He/she takes action to reestablish balance, such as strategic tree pruning, adding more biodiversity or introducing a natural predator.

Sometimes the entire system needs to be cut down and the farmer has to start over with a totally new design. In some situations the "pest" is the corrective action itself. It is attacking a part of the vegetation that is causing the system to be weak. In this case, the farmer simply allows the attack to unfold and then sees how to best engage with the system once the dust settles.

This perspective is vastly different from what most farmers know. They focus on their chosen target plants at the expense and exclusion of almost everything else. They exclude perennials, trees and soil preservation practices that help build natural fertility on the land. This results in a weak living system that is prone to attack and competition.

Instead of recognizing that the farm is weak, pest attacks are seen as the primary problem. They are usually met with counterattacks, such as the application of pesticides and herbicides. Poor yields are viewed as a lack of fertilizer and the soil is usually amended.

Although this conventional approach temporarily yields positive results, it does so at a cost. Not only is there the economic cost of these external inputs, but the greater cost is that the weakness of the farm system is left unrecognized, unfixed and is typically exaggerated as the pesticides impact beneficial organisms in the living system. Such a farm will become more dependent on fertilizers and pesticides and year after year the soil quality will continue to be depleted.

This is the serious situation faced on the planet at this time. The consequences of soil degradation are immense, including the loss of global food security and climate change (soil acts as a great place to store carbon). I hope that this guidebook helps more people to see how conventional agriculture is short-sighted and motivate them to support syntropic farming principles in one way or another.

Syntropic Planting Guide

Location Selection:

The focus of this guidebook is about using existing farmland. The planting schemes developed here are meant for tropical regions, specially for the mountainous area of Haiti or similar. To use this planting scheme, the land must be able to support the trees listed here. Although this technique will generate healthy soil, where it was not previously present, this particular design is not meant for severely degraded or desert-like land.

When given the opportunity to choose land, the following are good features:

- Some existing trees or vegetation (which can be taken down for mulch)
- Natural water sources
- Protection from tree eating animals (especially goats and cows)

Row Orientation:

The preferred direction to plant the tree rows is north/south. This creates a “wall” of trees that receive the most solar absorption. The wall gets good sun exposure even when the sun is low in the sky in the east and west.

If there is a concern for soil erosion, consider planting the tree rows on contour. This means that the row is perpendicular to the slope, or that it hugs the hill to hold back rain water. You may consider this strategy if there is a noticeable slope and the soil cannot be completely covered from the first day. If the soil can be covered and a dense planting scheme is used, such as the one in this guide, the system will hold rain water, on sloped land, even if the rows go up and down the hill.

However in Haiti, the average farmer will not be able to achieve full mulch coverage from day one and so it is important to consider putting the tree rows on contour.

A low tech, but highly accurate A-frame tool can be used to find the contour lines of the farmland. With a little training, the farmer can learn to mark his/her own land and plant the tree rows perfectly on contour. An excellent tutorial video showing how to build and use the A-frame tool can be found here: https://www.youtube.com/watch?v=logEDX2aTjo&list=PLcD1caiNhf5NBtguN19ja2ytJREf47e59&index=3

A-frame tool

Vetiver System - Photos

Cross section showing a 60 cm terrace formation, which formed over 2.5 years.

Here the terraces were manually created and vetiver is used to stabilize them.

On farmland in Haiti, vetiver has formed a terrace by holding back soil. This formed in only 8 months.

A mature vetiver hedgerow in the middle of a flat farm improves crop harvests.

Vetiver hedgerow (right) has slowed floodwater and trapped soil on the farm.

If the land is steep, then it is highly recommended to use a vetiver hedgerow as the biomass plant, with every other tree row. Vetiver is effective at preventing erosion within the first year, and also can form terraces effortlessly if it is grown as a complete hedge on contour.

Land Preparation:

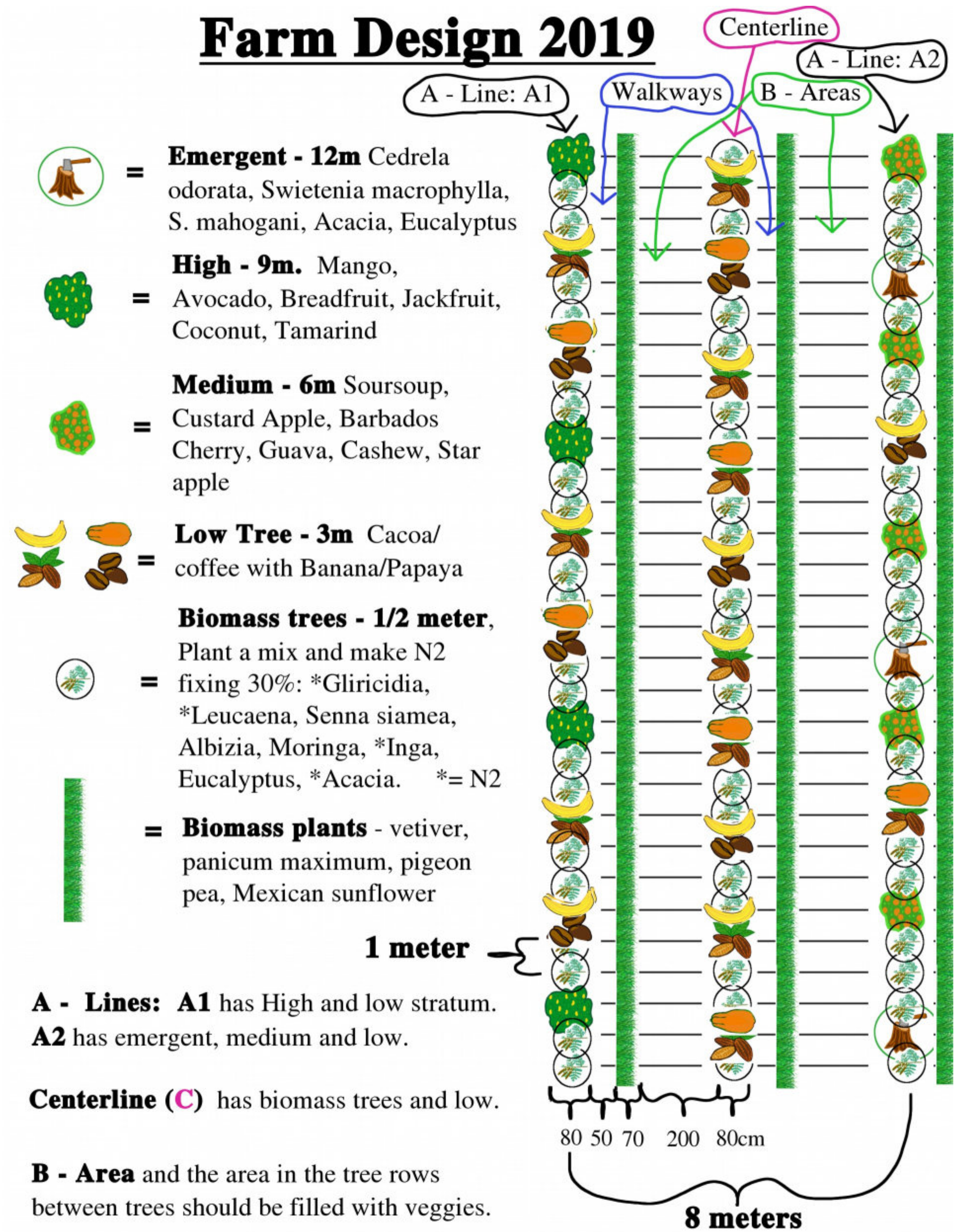
- Choose a location to start. If you plan to develop the farm step by step over years, be thoughtful about starting in a location that will not shade out the future land.
- Remove enough of the existing trees and plants to make room for the new system to grow. Keep any desirable trees, such as fruit trees, but lower branches may need to be pruned to allow sunlight to pass through. Other trees can be heavily pruned so that only the top of the canopy is intact. Trees that can regrow when the top is removed can be cut this way and treated as biomass trees.
- Fence the area or protect them from tree eating animals, where needed.
- Make or purchase compost, which is used when planting fruit tree seedlings.
- Gather as much mulch as possible.
- Stake out the rows in the preferred orientation. This design uses rows that are 4 meters apart.

- Till the ground only where you will be planting.
- Stake out planting sites for the individual trees.

Tree Planting Design:
Based on the following design as a guide, you can substitute any of the individual trees within a stratum category with each other. Refer to the design, the key and the minimum spacing drawings. It is important to:

- have all stratums represented
- have as much diversity as possible
- include long-lived, climax species
- do your best to plant all at the same time
- whenever possible, use seeds over seedlings and cuttings.

Consortium Design 2019				
	Placenta I	Placenta II	Secondary	Sec. III/Climax
Emergent	Corn, Okra	Papaya, Sugar Cane	Eucalyptus, Acacia	Mahogany, Cedrela odorata
High	Lettuce, Rice, Cabbage, Broccoli	Cassava, Banana	Moringa, Inga, Gliricidia, Leucena	Tamarind, Coconut, Mango, Avocado, Breadfruit, Jackfruit
Medium	Climbing bean, Tomato, Eggplant	Water yam, Taro, Pigeon pea	Soursop, Custard apple, Barbados cherry, Orange, Lemon, Grapefruit, Lime	Mandarin, Cashew, Yellow monbin
Low	Pumpkin, Sweet potato	Pineapple	Annatto	Coffee, Cacao



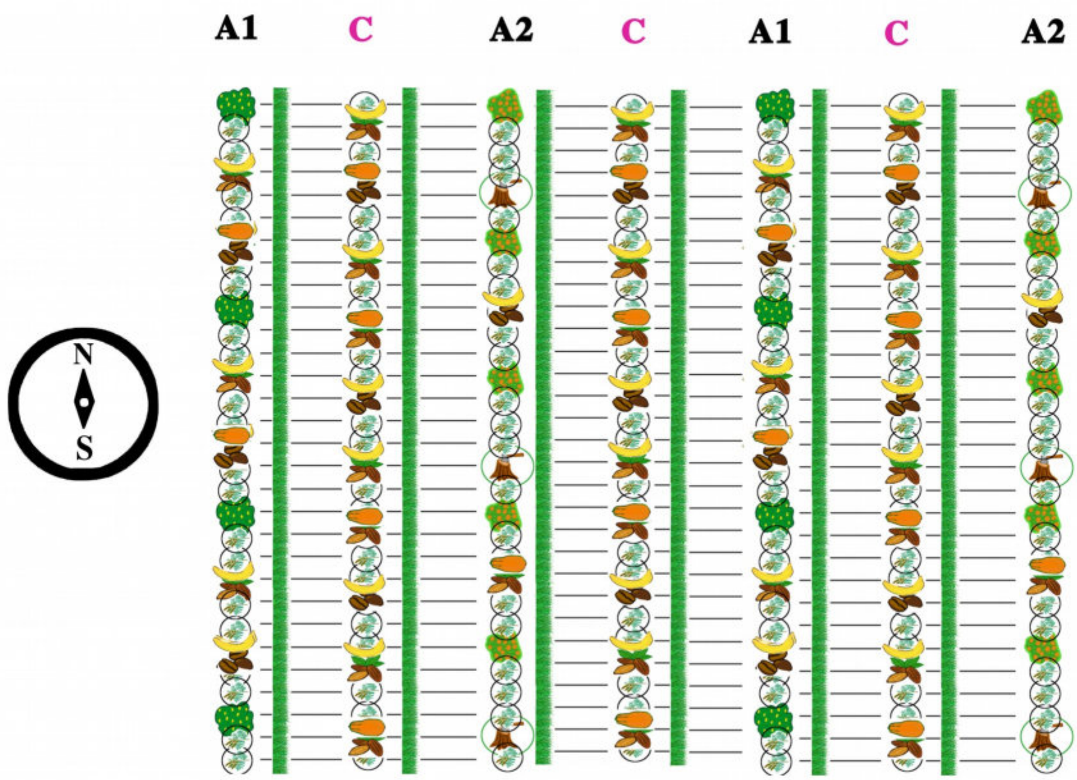
The low trees are planted with either banana or papaya on purpose. They provide shade when the tree is young. They should be planted on the north-west side of the cacao/coffee tree to protect it from the late afternoon sun. It's important to use at least 50% bananas as they are an important and unique source of biomass.

Design Overview

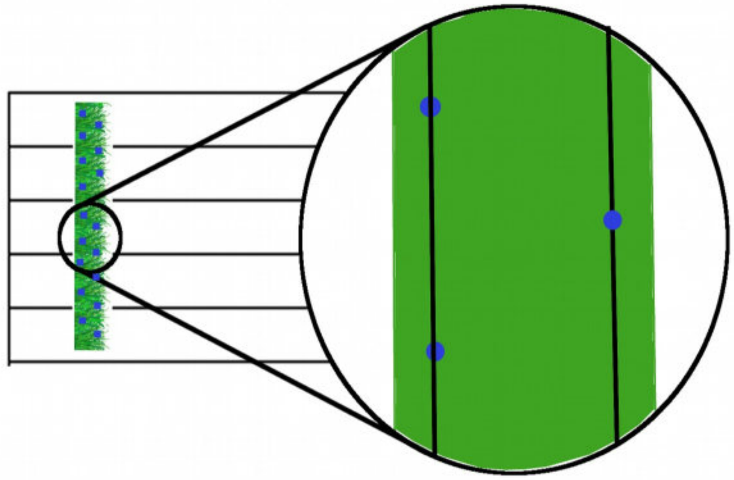
The design is meant to repeat. It can be extended in length and width. But it is important to notice how each tree row is different and keep the pattern consistent. The pattern is **A1, C, A2, C, A1, C, A2, C** etc.

A1 = High and low
C = Biomass trees and low (Centerline)
A2 = Emergent, medium and low

Each tree row has a walkway and a biomass nonwoody plant row. Also notice the centerline tree row will stay short. It is only biomass and low stratum. The biomass trees get their tops cut and the other trees stay short. Do not plant taller trees in the row, or the farm will get too shaded.



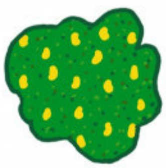
Biomass Plant Spacing



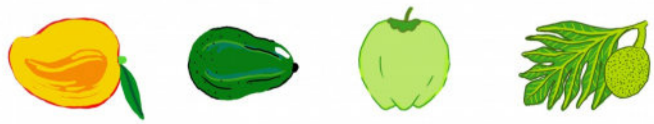
Vetiver, Panicum maximum, Pigeon pea or Mexican sunflower = 30cm (about the length of the foot.)

Tree Symbol Key

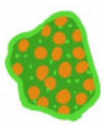
Emergent - 12m = Mahogany, Eucalyptus, Acacia, Cedrela odorata, Swietenia mahogoni, S. macrophylla



High - 9m =



Mango, Avocado, Coconut, Breadfruit



Medium - 6m = Soursop, Barbados Cherry, Guava, Custard Apple, Star Apple, Cashew

Low - 3m =

Cacao, Coffee

Biomass tree - 1/2m = Gliricidia, Inga, Eucalyptus, Moringa, Acacia, Cassia (Senna), Leucena

Minimum Tree Spacing Key

Emergent to emergent tree - 12m

Low to Low tree - 3m

Emergent to medium tree - 2m

Emergent to biomass tree - 1/2m

High to high tree - 9m

High to Low tree - 2m

High to biomass tree - 1/2m

Medium to medium tree - 6m

Medium tree to biomass tree - 1/2m

Biomass to biomass tree - 1/2m

Supply List:
It is best to map out the exact row plan for the farm and make a list based on this, but to help you get a rough estimate of numbers, see the information below. The following estimate is for 18 m length of the 3 rows (A1, C, A2) and assumes each row is the same length:
Emergent: 2
High: 3
Medium: 4
Low: 11
Biomass trees: about 100
Biomass plants: 240 grass slips or 80 pigeon pea seeds (about 1/2 kg)

If biomass tree seeds are not readily available for sale, this chart can help you know when they will be mature and available for collection in the field. Also, some trees can be started by cuttings.

Biomass Tree Propagation Chart - Haiti			
Tree Species	Seed	Cutting	Seeds mature
Gliricidia	X	X - only in April/May	March
Inga	X		April
Eucalyptus	X		Jan/Feb
Moringa	X	X	Nov/Dec
Acacia	X		Feb
Cassia	X		Feb
Leucaena	X	X	Feb
Albizia	X	X	Feb

Management:
Disclaimer: This section is also a work in progress. With more firsthand farm management experience, this will be developed more in the future.

Removing parts of plants by pruning, weeding or thinning is the major focus of farm management. There are many reasons to prune, and the farmer should keep them all in mind. Often a single pruning can serve multiple purposes at one time. Here are some examples:

- For more sun (synchronization)
- Create a growth pulse (not valid in dry season)
- Remove dead or diseased plant parts
- Remove undesirable plants and trees (weeding and thinning)
- To prevent senescence
- The ground needs mulch to cover the soil
- To maintain a space between tree canopies
- To keep a tree at a height which is best for the farmer to harvest fruit or wood

Here are some specific strategies to consider for some of the trees and plants grown in the design provided here:

<u>Biomass Trees:</u>
Wait until the trees are about 3 meters tall. When the rainy season starts, cut the top off each tree at chest level. Make a clean cut upward, on an angle. This keeps the tree healthy. Chop the leaves off the branches. Put wood on the ground first, then leaves on top. The farmer may wish to keep some wood for burning and building, but the more wood that is left on the ground, the stronger the soil will be, especially the soil fungi.

Through out the season, trim the lateral branches of the trees as needed so that the crops in the B-area have enough sun and space.

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1. Plant trees | **2. Now 2-3 meters tall (2 years)** | **3. Prune at chest level**

Healthy Pruning Tips

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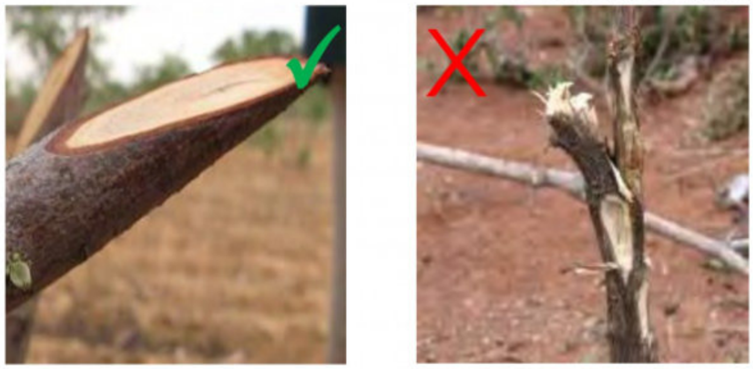

Cut clean, upward and on diagonal, using a sharp blade.

Blunt tools and downward cuts can damage trees.

<u>Biomass Plants:</u>
Bananas are a great biomass plant. It is encouraged to grow them in excess, beyond just the locations shown on the design. When the psuedostem can be harvested, cut it lengthwise and cut it into pieces. Place the parts on the ground around desirable trees and plants. This is especially helpful for soil water retention.

After Pruning, Bananas Cut Into Pieces and Organic Matter Arranged Around Trees

When other biomass plants are used, such as grass, pigeon peas, or Mexican sunflower, then cut them when the first signs of flowering are seen. Grasses can be cut down to about shin level, the other plants are cut to about knee level. Place the organic matter where desired, for example around the fruit trees. Repeat pruning is often required during the growing season.

Citrus Trees:
Citrus trees such as orange, lemon, lime and grapefruit are medium stratum trees. The are an excellent member for this system, but require special training and tools. The higher stratum trees planted alongside these trees will need heavier pruning. It is important to avoid having fruit trees shade the citrus trees.

Heavier pruning is needed for two reasons. First the citrus cannot have their tops cut off, so the surrounding trees will need to be pruned to allow space for the growing citrus canopies. Also the citrus temporarily need more sun during their flowering stages. So the trees creating shade for them will need to be pruned annually. To perform this type of management requires pruning high in the tree.

This can be dangerous and such management requires additional training and more specialized tools. Such pruning practices should only be performed by those with experience. It is for those reasons, citrus is not included in the list of trees above.

An alternate option to avoid most of this skilled pruning is to use emergent trees that are deciduous (lose their leaves in the dry season). In parts of Haiti, cedrela odorata (and probably swietenia mahogoni) behave this way and would make perfect companions for the citrus trees. They will naturally drop their leaves when higher sun exposure is needed. In this system, the farmer would still have to choose a high stratum tree that can be pruned heavily (possibly moringa, inga and gliricidia are good choices).

Future Years:
The placenta stage of the system lasts about 2 years. If some of the trees die, or you wish to add more variety, then don't worry, you can do it during this phase. After that it is not possible to add trees without a heavy pruning, as the system has started to define itself.

During the first 2 years, the farmer can add climax species. It is best to sow seeds directly. Ernst likes to cast the seeds broadly and let the system decide which ones will grow. In this way over time the farm will transition from an alley row system to a more natural appearing forest.

Indigenous species will often spontaneously grow in system as well. This is good, should be encouraged and often is nature filling niches left open in the original planting scheme. Work with nature and nature will work for you.

Future of Farming?:

Author: Roger Gietzen, MD

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