Field Guide to
Analog Forestry

IAFN RIFA
analogforestrynetwork.org

A Basic Overview

This guide was created for those who live or who want to live in productive and ecologically sound wooded areas: producers, farmers, practitioners, ecologists and everyone who loves nature and wants to steward the planet.

Analog Forestry combines methodologies to restore forests and augment biodiversity, and to create healthier and happier communities living in more productive and functional environments.

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www.fallsbrookcentre.ca

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Edited and illustrated by: Jenny DeMarco, Falls Brook Centre, 2009
Re-edited for the secretariat of the International Analog Forestry Network, 2012 and January 2015

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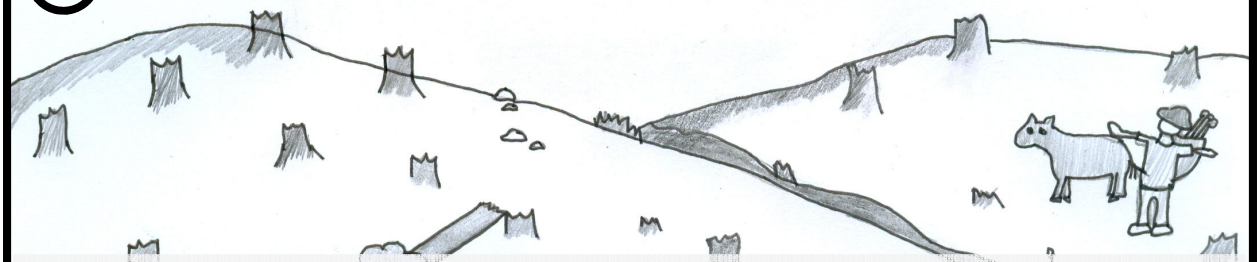
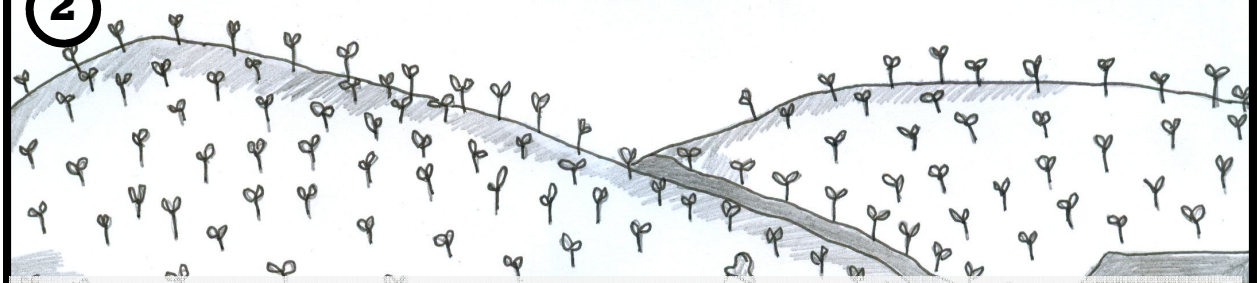
Chapter 1: What is Analog Forestry?

1 **Analog Forestry** is a process of ecological succession, which...



...facilitates the restoration of degraded and eroded landscapes.

2



...offers an alternative to monocultures, through community innovation.

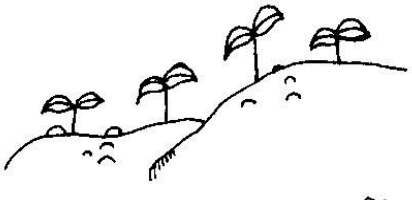
3

...seeks to conserve natural resources and beautify areas.

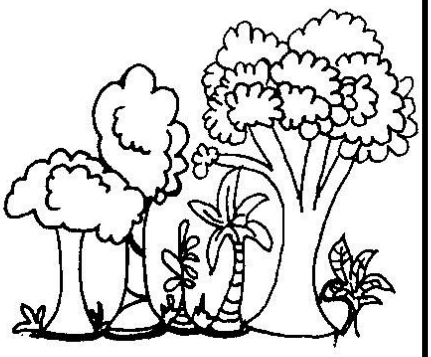
4

...generates income through the production of food and other non-timber forest products.

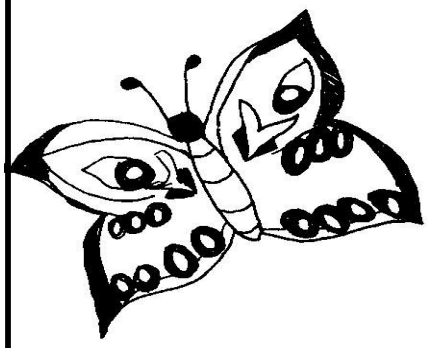
Analog Forestry



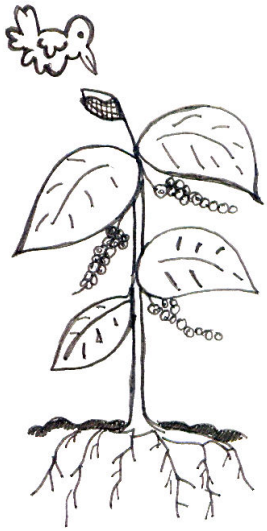
… is an excellent alternative to restore forests and to augment biodiversity,



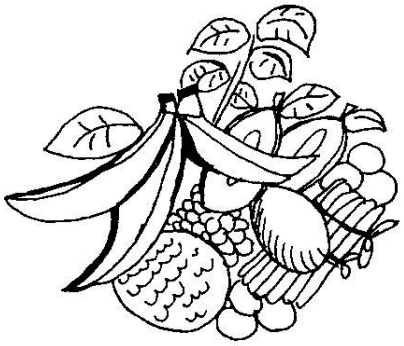
… is an effective tool to stop deforestation,



... provides habitat for species displaced by deforestation,

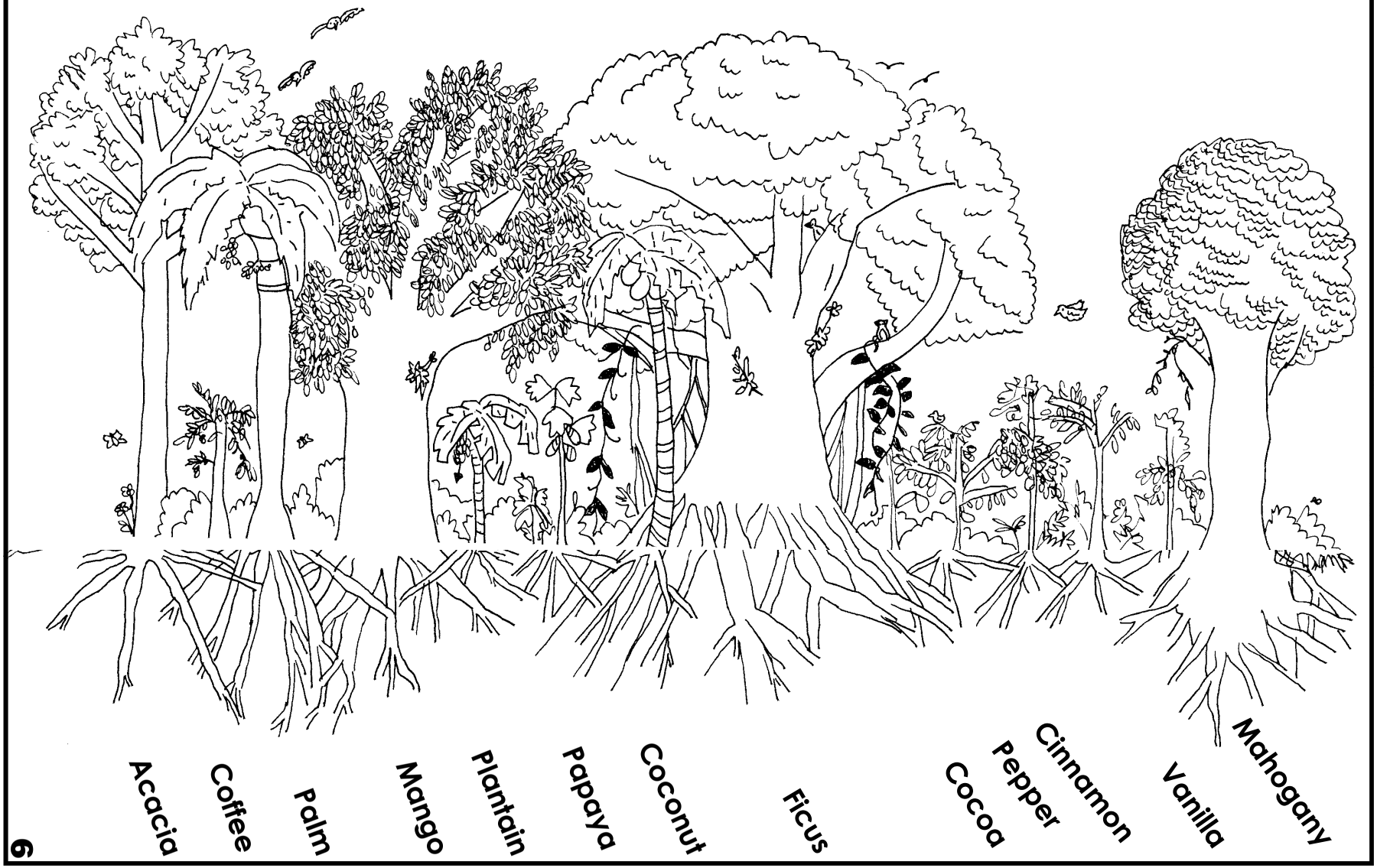


… uses native and exotic species that benefit people and the environment,



…. provides a diversity of crops and reduces the risk created by only having one type of crop.

Example of an Analog Forest in the Tropics



Principles of Analog Forestry

1) Observe and record: Where am I? In what type of forest? What species are present?

2) Understand and evaluate: Learn about the area, from both scientific and traditional standpoints.

3) Know your land: Examine the landscape's features, water systems, soil, and ecosystems, terrestrial and aquatic.

4) Identify levels of yield: Identify the capacity of the land. How can each section of the land be best used?

5) Map existing and potential water systems: Graphically represent the flows of water, sun, and wind

6) Reduce external inputs: Minimize the use of fossil fuels, and agro-chemicals. Maintain a closed loop of inputs.

7) Be guided by the landscape: Knowing your land and its surroundings are important for making a design.

8) Follow ecological succession: Use intermediate stages in your design that will lead to a climax forest.

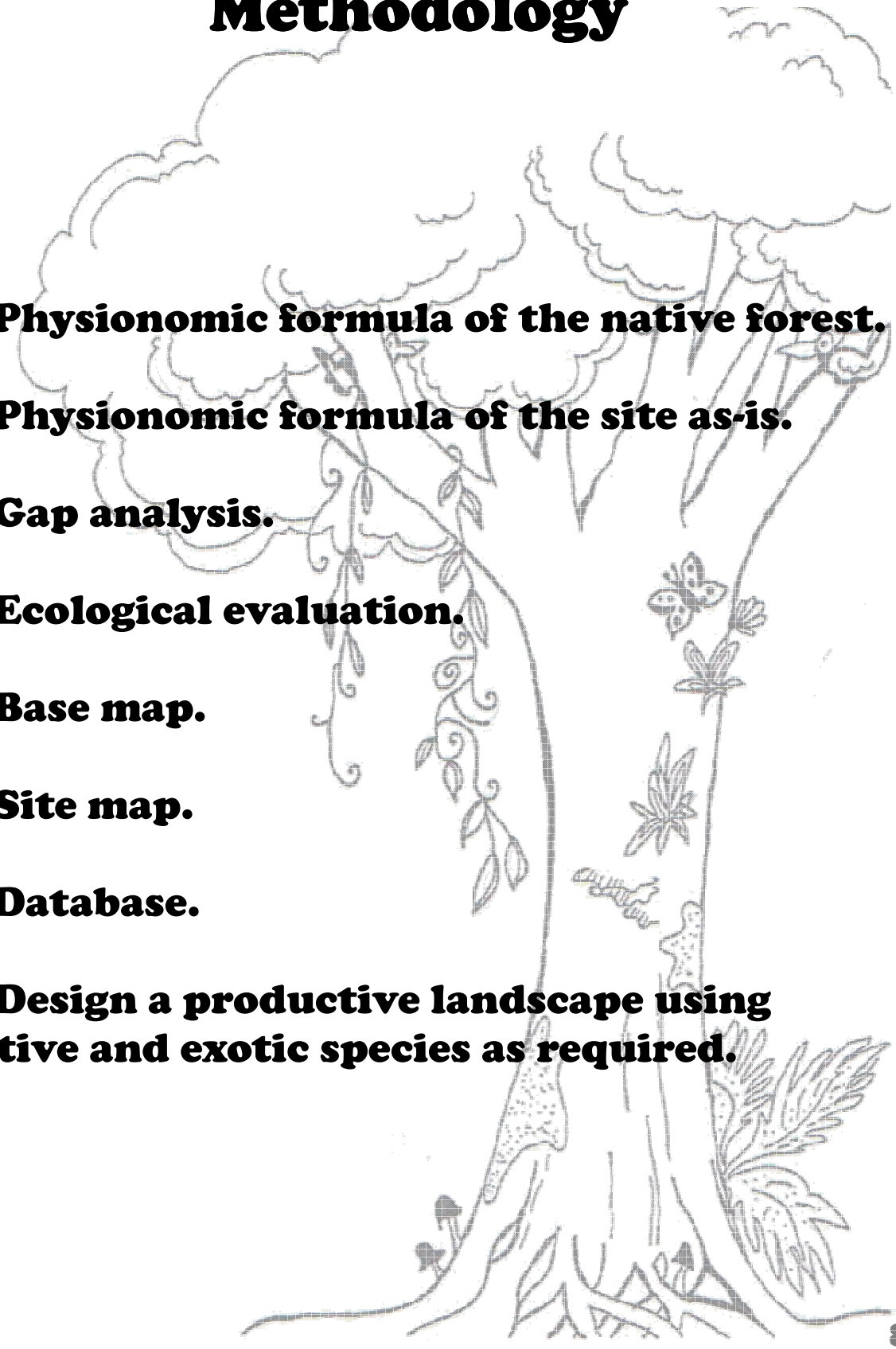
9) Use ecological processes: Designs can benefit from interactions occurring between elements of the ecosystem.

10) Value biodiversity: Increasing biodiversity species will increase ecosystem function and provide valuable services.

11) Respect maturity: Mature forests are some of the most productive ecosystems, and are the goal of Analog Forestry

12) Respond creatively: Prepare yourself for the unexpected be conscious that there are multiple pathways to success.

Methodology



1. Physionomic formula of the native forest.

2. Physionomic formula of the site as-is.

3. Gap analysis.

4. Ecological evaluation.

5. Base map.

6. Site map.

7. Database.

8. Design a productive landscape using native and exotic species as required.

Physionomic Formula

The Physionomic Formula describes the architecture of a mature forest and of the site desired for the establishment of an Analog or analogous forest.

A. Growth form categories	
1. Basic growth forms	Symbol
Woody plants	
Broadleaf evergreen	V
Broadleaf deciduous	D
Needle evergreen	E
Needle deciduous	N
Compound leaf evergreen	T
Compound leaf deciduous	W
Aphyllies (without leaves)	O
2. Other growth forms (non woody)	
Palms	P
Rhyzomatous plants (banana, heliconia etc.)	R
Succulents (Cactus)	S
Bamboo	B
Rosette plants (agave, terrestrial bromilia etc.)	K
Ferns	F
Epiphytes	X
Vines and creepers (liana)	C
Lichen and mosses	L
Herbaceous plants	
Grasses	G
Annual herbaceous plants	A
Perennial herbaceous plants	H

B. Structure categories	
1. Height (Stratification)	Symbol
> 35 m	9
25 - 35m	8
15 – 24 m	7
10 – 14 m	6
5 – 10 m	5
2 – 5 m	4
0.5 – 2 m	3
0.1 – 0.5 m	2
< 0.1m	1
2. Coverage	
Continuous (>75%)	c
Interrupted (>50 - <=75%)	i
Patches (>25 - <=50%)	p
Rare (>6 - <=25%)	r
Sporadic (>1 - <=6%)	e
Almost absent (<1%)	a

Using the Formula

Before designing the Analog Forestry site, determine the Physionomic Formulas of a nearby mature forest and of the site. Later, calculate the gap between the two sites. The gap determines which species of plant to introduce in order to transform the site into an area that imitates the form and function of a mature forest.

Steps

1) Formula of the mature forest **(F1)**:
Find a native forest in climax stage (mature) that has the same climatic conditions as the future Analog Forestry site. The closer the forest is located to the AF site the better.
Using the formula symbols on the previous page follow these steps:

a) Identify four areas of about 10m x 10m to evaluate per hectare of forest.
b) Define the number of levels or strata of vegetation.
c) Determine the different tree types and the height of the strata.
d) Determine the coverage of each strata.
e) Separate each strata with a coma (,) for example: V7c, V5p

Follow the same procedure for the other strata of vegetation including the layers of non-woody species like herbaceous plants, vines, palms, epiphytes, etc. separating each strata with a semicolon (;).

Example (F1): $\mathbf{V_{7c},V_{5p},V_{3p};C_{1\text{-}6c};P_{4r};R_{2c};E_{3\text{-}6p}}$

2) Apply the Physionomic Formula to the existing vegetation of the future Analog Forestry site **(F2)**.

Example of a degraded site (F2): $\mathbf{V_{5p},V_{3a};C_{1\text{-}3c}}$

3) Do a gap analysis between the two formulas to see what is missing from the future Analog Forestry site. In this example, there are strata of woody species and several non-woody species to note, namely:

$$\mathbf{V_{7c},\ V_{3a \rightarrow p};\ C_{4\text{-}6c};\ P_{4r};\ R_{2c};\ X_{3\text{-}6c}}$$

If there is a strata of the same type in the mature forest and in the future AF site, we use an arrow to indicate the difference in coverage between the two. Since we want our degraded site to move from the present coverage to the same coverage as the mature forest, we write AF site coverage → mature forest coverage (ej. $V_{3a \rightarrow p}$).

Ecological Evaluation

The Ecological Evaluation is a technique to judge the ecological sustainability of an ecosystem. The steps are:

1) Assign a value to each indicator below.
2) Add the values of group of indicators together and divide by the number of indicators in the group.
3) Add the average group numbers together and divide by the number of groups. The result is the average ecological value of the land.

Value	Soil - Soil Profile
1 to 2	Subsoil almost exposed.
3 to 5	Thin topsoil.
6 to 8	Deep topsoil.

Value	Soil - Apparent Density
1 to 2	Very compacted.
3 to 5	Compacted.
6 to 8	Not compacted.

Value	Soil - Macroorganisms
1 to 2	No signs of biological activity, no beneficial macroorganisms observed.
3 to 5	Some beneficial macroorganisms observed in small quantities, such as worms and arthropods.
6 to 8	Abundance of beneficial macroorganisms such as worms and arthropods.

Value	Biodiversity - Fauna
1 to 2	Very little visible presence or diversity of plants, reptiles, mammals, insects, amphibians.
3 to 5	Some visible presence and diversity of fauna.
6 to 8	Visibly abundant presence and diversity of fauna.

Value	Biodiversity -- Flora
1 to 2	Very little tree and non– tree species variability (one to three species maximum).
3 to 5	Little variability among species (more than 5 tree species present and few species in the understory).
6 to 8	High variability of both tree and non-tree species, more than 10 tree species and presence of epiphytes, soft-leaf shade plants and large plants in the understory.

Value	Structure - Seral Stage
1	Stage 1 - grasslands
2	Low vegetation, less than one year old
3	Low trees and bushes
4	Various trees, undergrowth with bushes and herbaceous species
5	Young secondary forest, high diversity of species
6	Secondary forest with a diversity of strata, presence of epiphytes, lichens, etc.
7	Mature secondary forest
8	Mature old-growth forest

Ecological Evaluation

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3) add the average group numbers together and divide by the number of groups.

Value	Structure - Complexity
1 a 2	Little complexity in the ecosystem, little species diversity and few interactions between elements
3 a 5	Moderately complex ecosystem, some species diversity and interactions between elements
6 a 8	Ecosystem has a smiliar complexity to a natural climax forest, abundant species diversity and many interactions between elements.

Value	Productivity - Economic
1 to 2	No productive system exists.
3 to 5	A productive subsistence and/or market system exists, but does not meet all the objectives of the landowner.
6 to 8	The productive system meets the landowner's subsistence and/or market objectives.

Value	Productivity - Ecological Functions and Conservation Value
1 to 2	Ecological functions are weak and no system for scientific study, carbon sequestration or tourism exists.
3 to 5	Some ecological functions exist (eg. purifying water, soil conservation, habitat,etc.) or some systems are developing for scientific studies, carbon sequestration or tourism.
6 to 8	Strong and stable ecological functions and/or stable systems for scientific study, carbon sequestration or tourism.

<u>Examples of sampling activities</u>

Soil: Dig a hole measuring 0.25 m^3 (50cm x 50cm x 50cm). This allows you to see the upper layers of the soil.

Macroorganisms: Count the macroorganisms (earthworms, arthropods, etc.) in the soil removed from the 0.25 m^3 hole.

Birds: Get up before sunrise and listen to the songs of the different birds. This will give you an idea of the number of species present.

Insects: Before sunset, place a white sheet in the forest and illuminate it with a flashlight. Come back a few hours later to see the diversity of insects attracted to it.

Don't forget!

It's important to ask the people who have lived in the area for a long time about the flora and fauna, because they may have unique perspectives and know about recent changes.

Ecological Evaluation

Fill out this form with the data of the Analog Forestry parcel. Complete one form for each part of the parcel that is ecologically different.

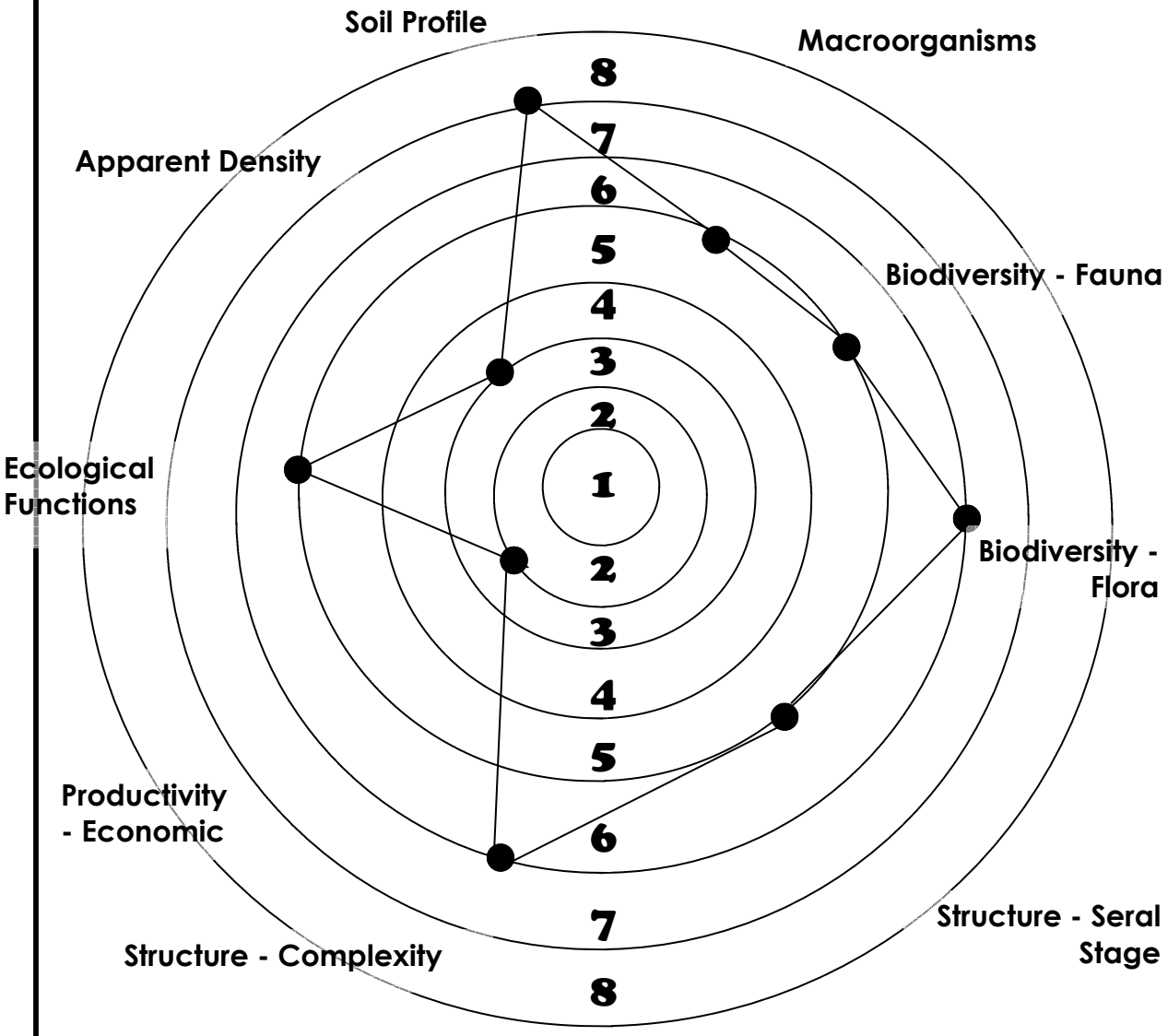
Form for recording data from the ecological evaluation.

Name:_____ Date:_____
Parcel:_____ Lot number:_____
Location:_____ Province:_____
Altitude:_____ Geographic Coordinates: X:_____
Median annual rainfall: _____mm. Y:_____

INDICATORS			SUSTAINABILITY VALUE
1. SOIL QUALITY INDICATORS		AVERAGE SOIL QUALITY	Sum of the averages divided by four.
a. Soil Profile		Sum of indicator values divided by three.	
b. Apparent Density			
c. Macroorganisms			
Total			
2. BIODIVERSITY INDICATORS		AVERAGE BIODIVERSITY	
a. FLORA		Sum of flora total value and fauna average, divided by two.	
Total			
b. FAUNA			
Birds			
Mammals			
Amphibians and/or reptiles			
Insects			
Total			
Fauna average (fauna values divided by four)			
3. STRUCTURE INDICATORS		AVERAGE STRUCTURE	
a. Seral Stage		Sum of indicator values divided by two.	
b. Complexity			
Total			
4. PRODUCTIVITY INDICATORS		AVERAGE PRODUCTIVITY	
a. Economic productivity		Sum of indicator values divided by two.	
b. Ecological Services and Conservation			
Total			

Ecological Evaluation

The Ecologial Evaluation serves to compare different sites, to determine which areas need the most attention and to monitor the evolution of a location over time.

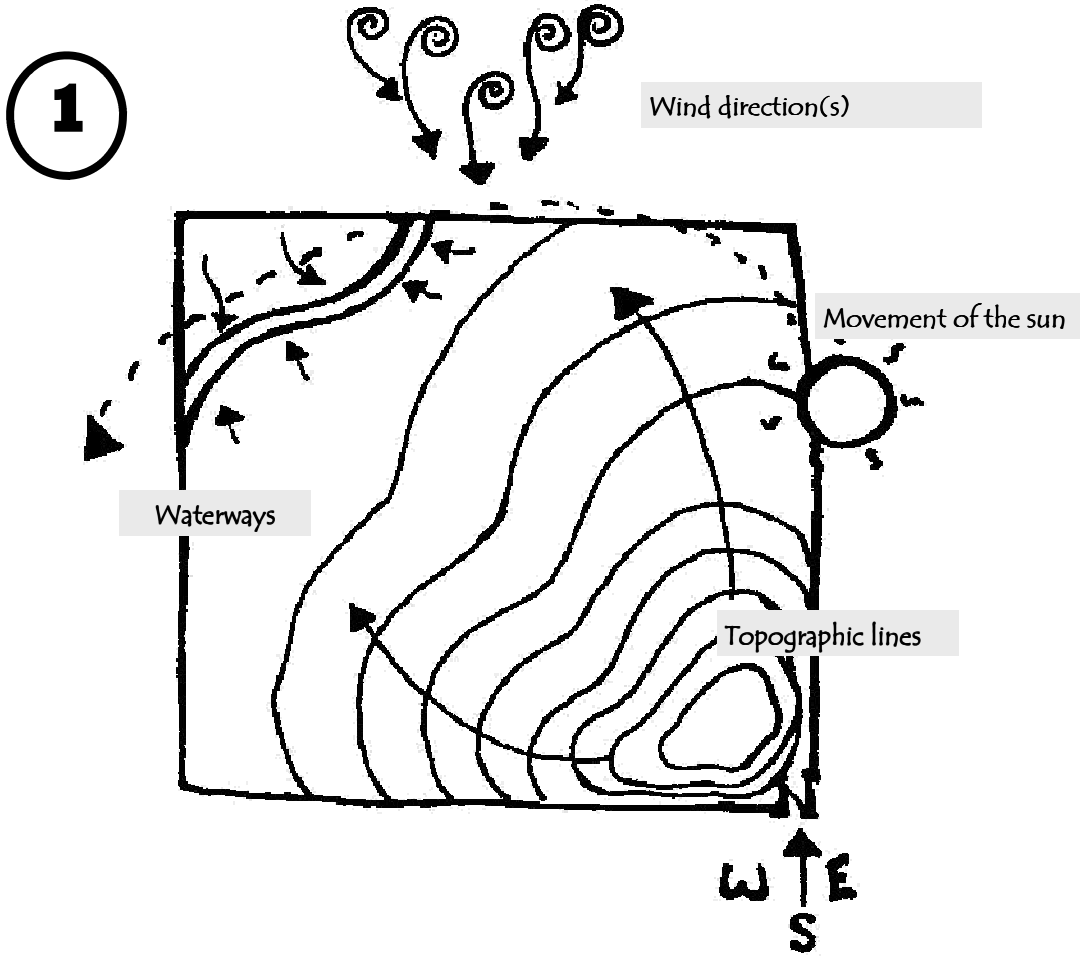


It is necessary to analyze the results from the Ecological Evaluation exercise on page 13. To do so, follow these steps:

1) **Draw eight circles one inside the other as shown in the image above.**
2) **Note the value of each indicator in its area of the "pie".**
3) **Draw a line between each value.**
4) **The ideal is to have values all in the "eight" zone.**
5) **The elements that have the lowest values or that are the furthest from the edge of the circle are the ones that need the most attention.**

Base Mapping

Base mapping is an exercise of drawing the principle existing elements of the site and the landscape around it. It allows an integrated vision of the land and its management, and helps to guide the design process.



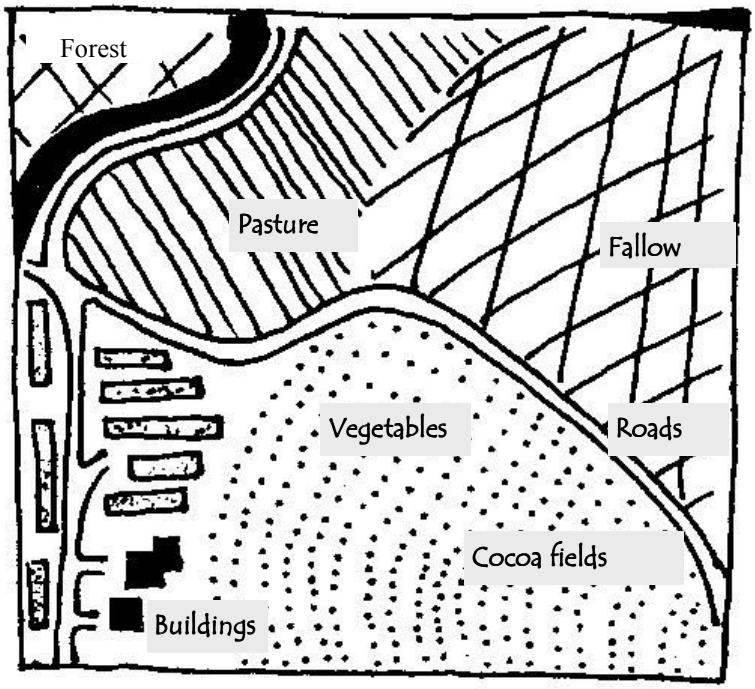
On a sheet of paper, draw:

- **the movement of the sun;**
- **wind direction(s);**
- **topographic lines;**
- **waterways.**

NB: It is important to also map neighbouring parcels that might impact the site with their activities, infrastructure or roads.

Site Mapping

2



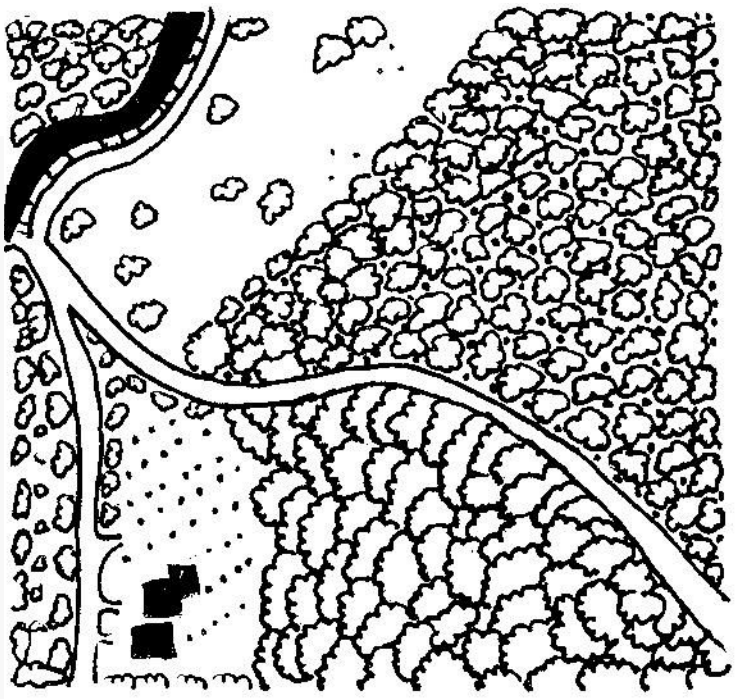
On a sheet of paper draw:

- **Buildings**
- **Roads**
- **Vegetation patterns**

3

Analog Forestry Design :

- **Include a detailed list of all the species to be planted and their location. Use the Gap Analysis as described earlier.**



Database

A database is used to obtain information about which species can be used at the Analog Forestry site. This database helps to choose appropriate species during the design process. Below is an example of the database:

Scientific Name	Common Name	Form of Growth	Uses	Ecological Functions
Acacia mangium	Acacia	Rapid, pioneer and 3rd strata. Woody leguminous tree.	Wood, carpentry, construction, joinery.	Nitrogen fixer, shade.
Albizzia lebbek	Carob	1st strata	Forage.	Soil structure.
Mangifera indica	Mango	3rd strata	Edible fruit.	Shade, food, soil protection.

Fields in the database include:

Scientific Name
Common Name
Form of Growth
Micro Habitat
Root Charateristics
Seeds and Flowers
Ecological Functions
Soil Requirements
Products
Markets
Propagation Information

Did you know?

Your neighbours, such as other producers or elders that have worked the land for many years are important sources of information about native plants and their uses.

Ask around, you never know who might share great information!

Design

The site design is very important because it is a tool that shows the short, medium and long term vision for the parcel. It is the guiding document from the first seed to the maturity of the analog forest.

1) The gap analysis shows which elements are missing from the farm.

Example:

Formula of the mature forest:
V7p, V6i, V5i, V4p, V3i; F1-2r; L1-5e; T1-6i; R3e; E1-2e

Formula of the existing forest:
V6r, V4r, V3e; G2i; P1-6e

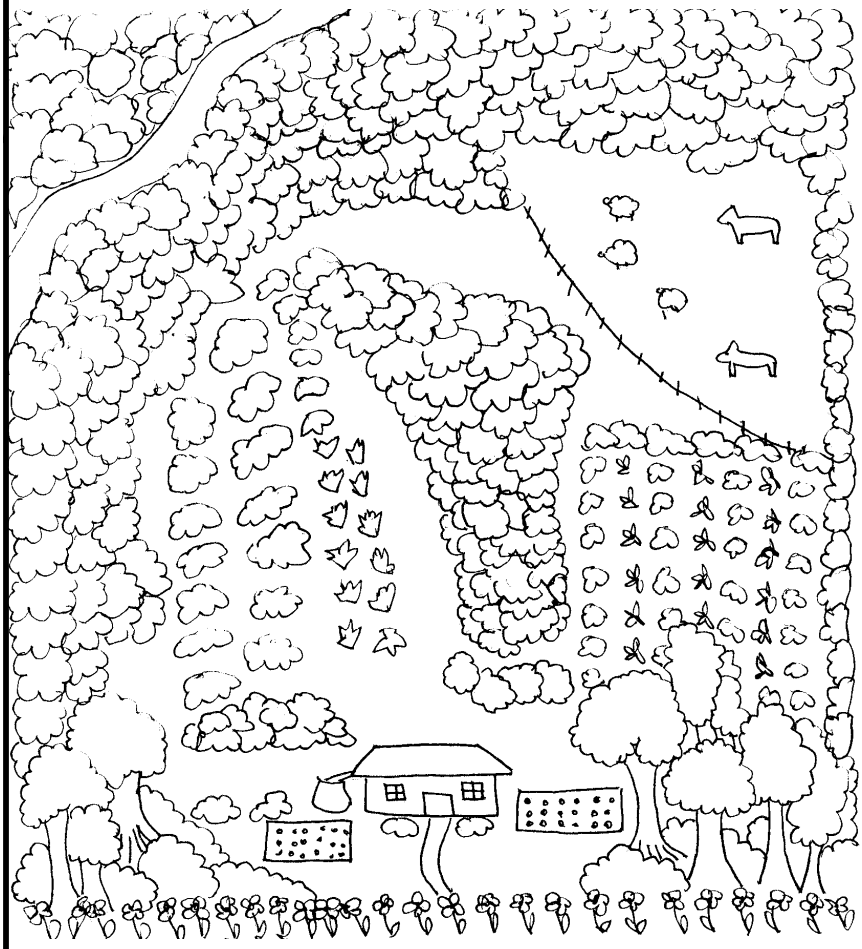
Gap Analysis
V7p, V5i, F1-2r; L1-5e; T1-6i; R3e; E1-2e

2) Using the database, pick productive species that are analogous in form and function to the mature forest, and that match the missing structures identified by the gap analysis. For every species to be planted, ask "what?", "why?" and "where?"

3) The species chosen for the site must correspond with the priorities of the landowner and the designer; for example, self-sufficiency, conservation, soil improvement, improving waterways, ecotourism, production or biodiversity restoration. The gap in forest structure must be filled by species that fulfill the objectives and favour the site conditions.

4) Plan out the implementation steps such as: production of the selected species in a nursery, location, when to plant, maintenance, fertilization, etc. It is possible that no planting will occur during the first year as the Analog Forestry design is finalized and the various preparations are finished.

Design



This example shows a conceptual design of and describes which species are to be incorporated in the Analog Forest.

Planting is prioritized according to the site objectives and the conditions of the land. For example, place plants that act as windbreaks to the windward side of the site.

V7p-V7c: Pumpwood, Beechwood , Teak , Uvilla, Sable

V6i–V6p: Oak, Honduran Mahogany, Jaca-tree, *Cabirma santa*, Jagua

V5 :Ramostan, Abiu , Black Sapote, *Spondios mangifera*, Beronne

V4h–V4r: Cherry, Orange, Lemon, Cocoa, Mandarine, Cinnamon

V3i–V3b: Species that attract pollinators to increase fertility and biodiversity.

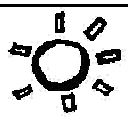
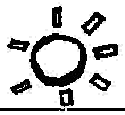
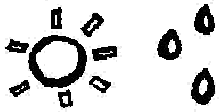
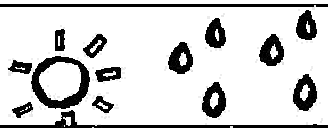
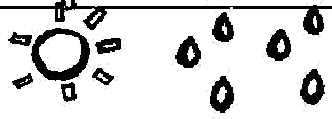
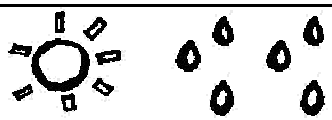
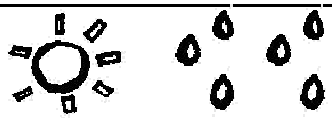
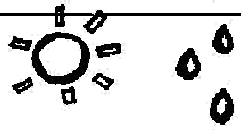
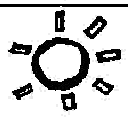
Ti – Tr: Vanilla, Mediterranean Smilax, Passion fruit

H: Endangered species can augment the site's biodiversity.

R: Plantain, Banana, Heliconias.

Timeline of Activities

This timeline helps us to organize and to plan work on the site as well as to determine what tools will be necessary.

January		
February		
March		
April		
May		
June		
July		
August		
September		
October		
November		
December		

Legend

Soil Preparation:

Compost preparation:

Seed Collection:

Preparation of seedlings:

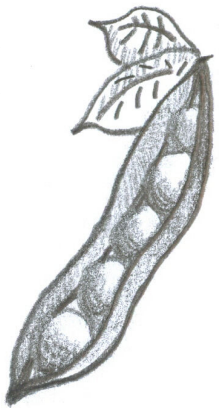
Transplant:

Maintenance:

Harvest:

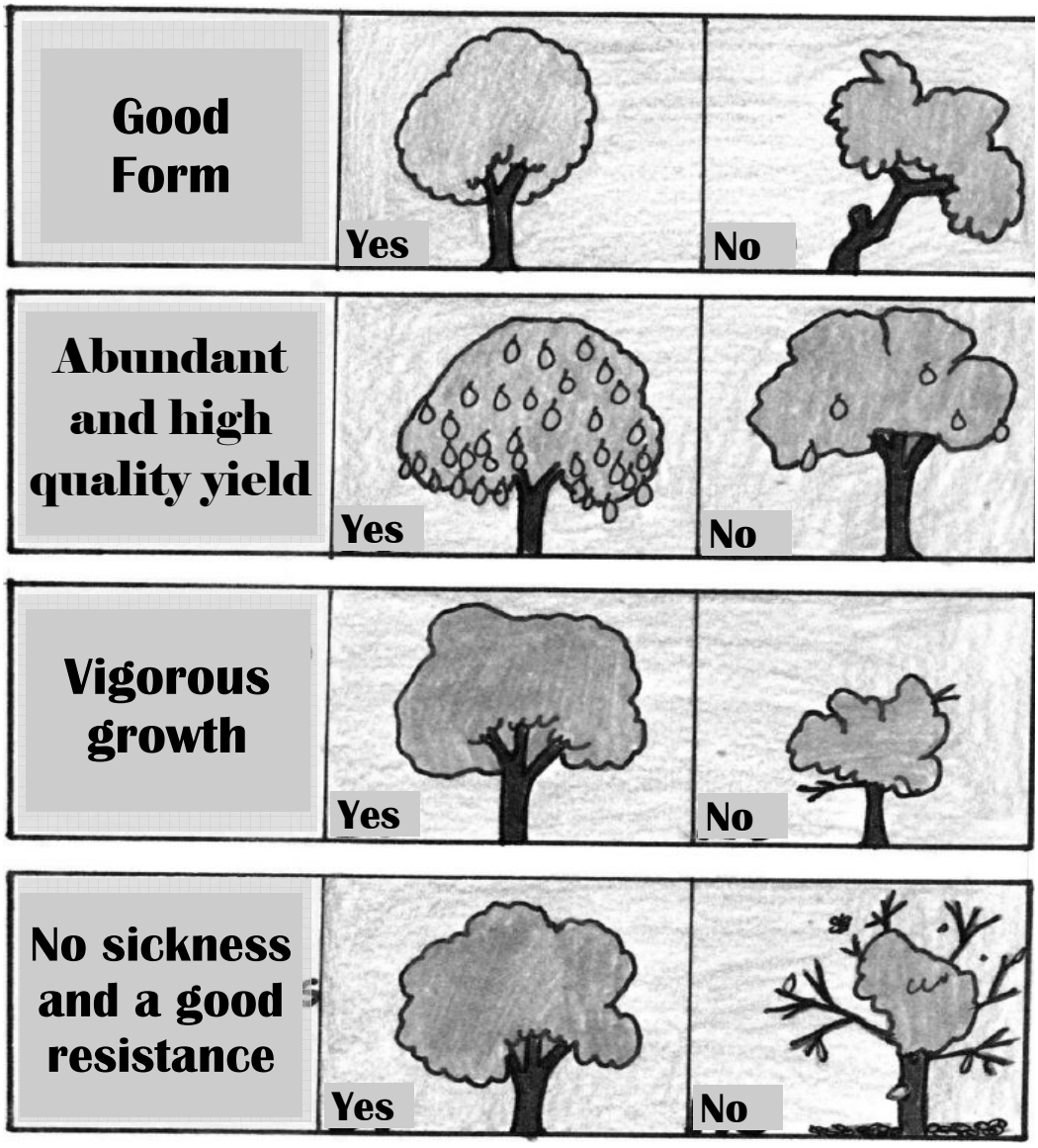
Seed Collection

Seeds are the origin of all forests.



Which tree you collect seeds from is very important. By selecting seeds from prosperous trees, the nursery stock will be of the highest quality. Remember to collect seeds from a few trees of the same species to incorporate genetic variation.

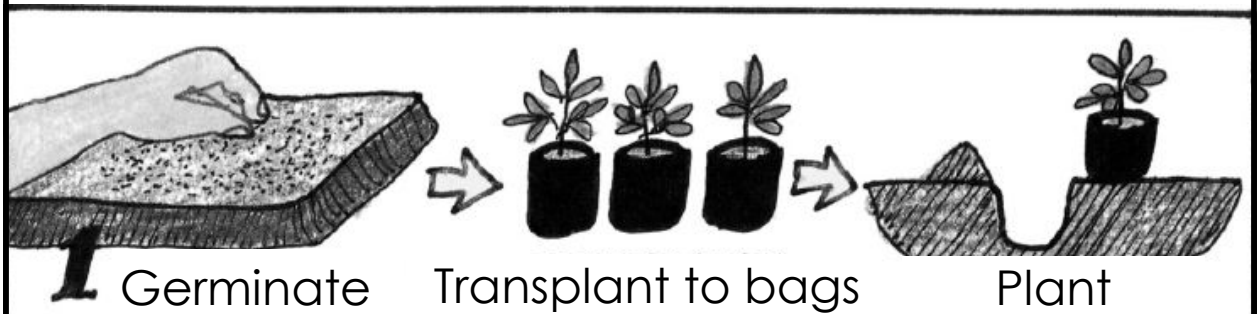
General Criteria of Good Trees



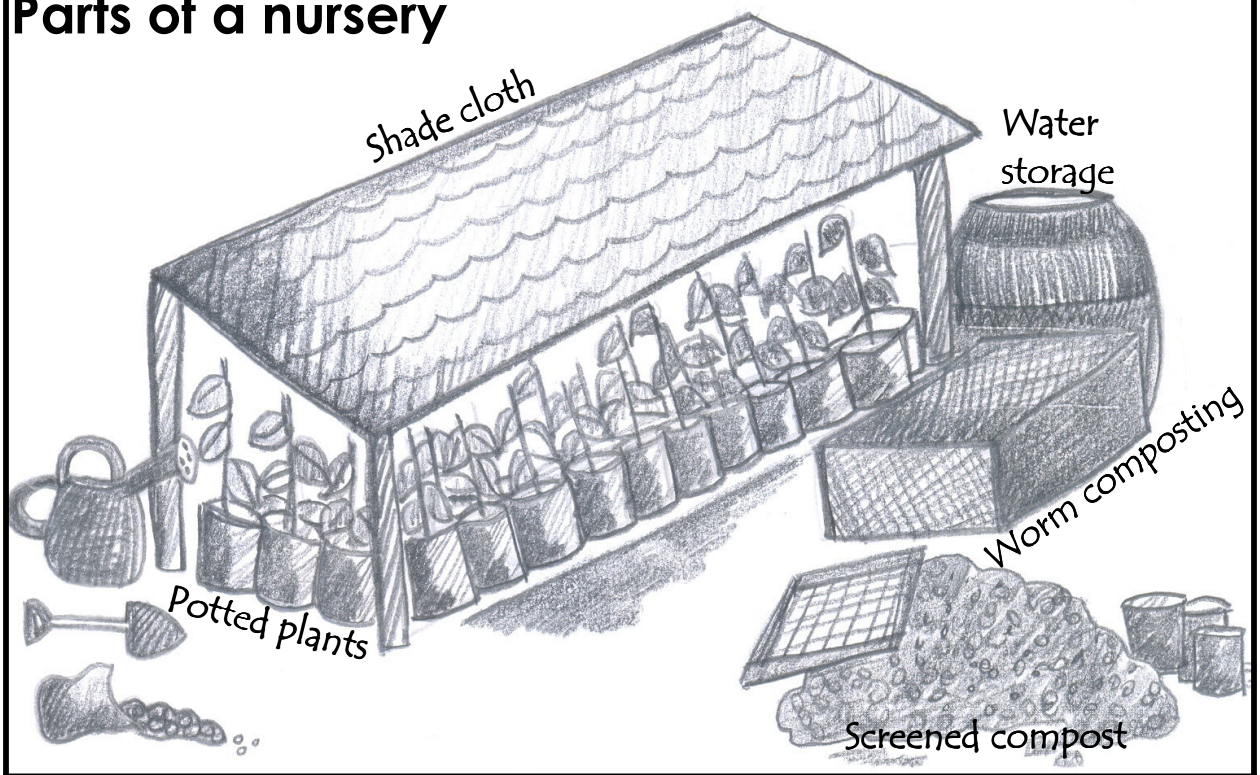
Source: Machete Verde: David Gagnon

Nurseries

The nursery is where plants are germinated and then transfered into pots before transplanting them to their final site.



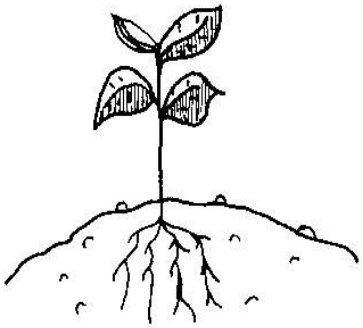
Parts of a nursery



Include non-tree species in your nursery!
(eg: epiphytes, heliconias, vegetables and medicinal plants)

Elements of Analog Forestry

Soil

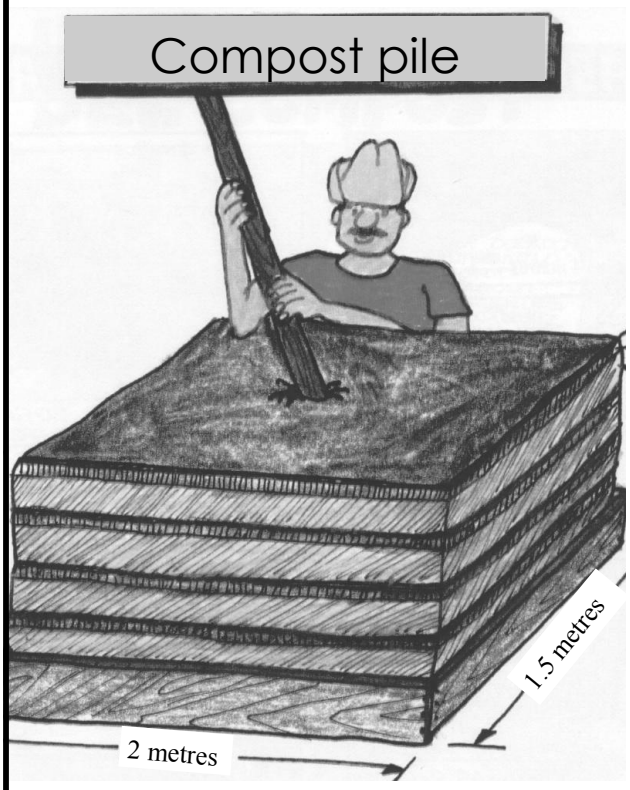


"Feed the soil first so that it can feed the plant!"

Plants growing on top of the soil originate from beneath the soil and require healthy soils to grow. The soil is as important as the forest.

Animals and biodiversity in the soil change according to the type of soil and how it is managed by the farmer.

Abundant and diverse soil life provides nutrients, aerates and retains water.



(Source: Machete Verde, Daniel Gagnon)

Use mulch or make compost to improve soil quality. Organic matter improves soil structure and enriches the soil. It also holds more nutrients available to the plant.

Compost Recipe:
- Fertile soil (10 wheelbarrows)
- Animal manure (6 wheelbarrows)
- Organic waste (especially legumes and medicinal plants)
- Ash (1/2 bag)
- Sand (2 wheelbarrows)

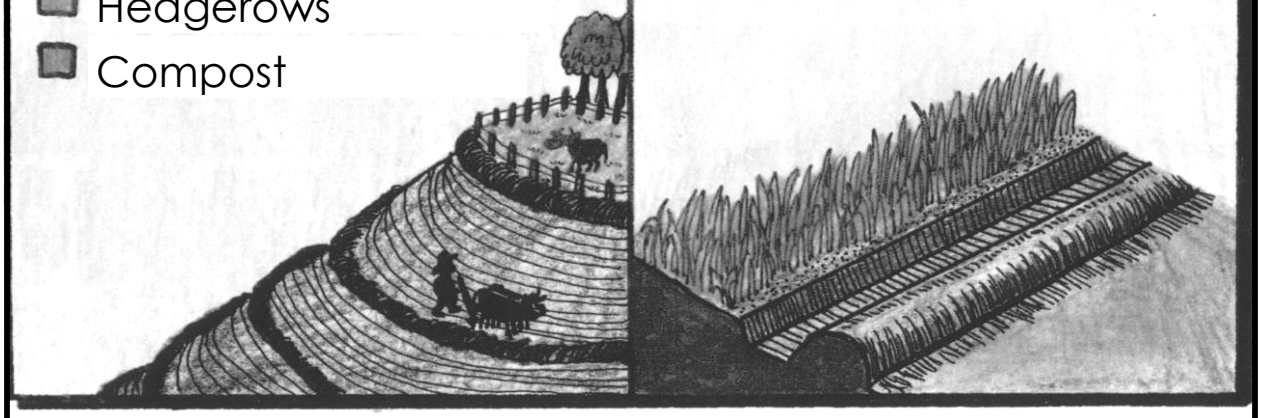
Mix ingredients together. Keep the compost pile moist but not wet. Turn the compost when it cools down inside (approximately every two weeks) so that it breaks down quicker.

Erosion

Conserve by Producing!

Erosion is the loss of topsoil or organic matter. It is important to prioritize increasing the rate of soil creation to counteract and reverse erosion.

Farming techniques	Mechanical techniques
☐ Type of crops ☐ Crop rotation ☐ Seed on contour ☐ Cover crops ☐ Mulch ☐ Hedgerows ☐ Compost	☐ Terraces ☐ Swales ☐ Control runoff ☐ Mechanical barriers eg. erosion fencing

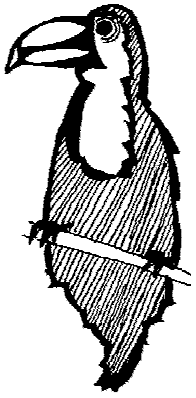


(Source: Machete Verde, Daniel Gagnon)

¿Did you know..?

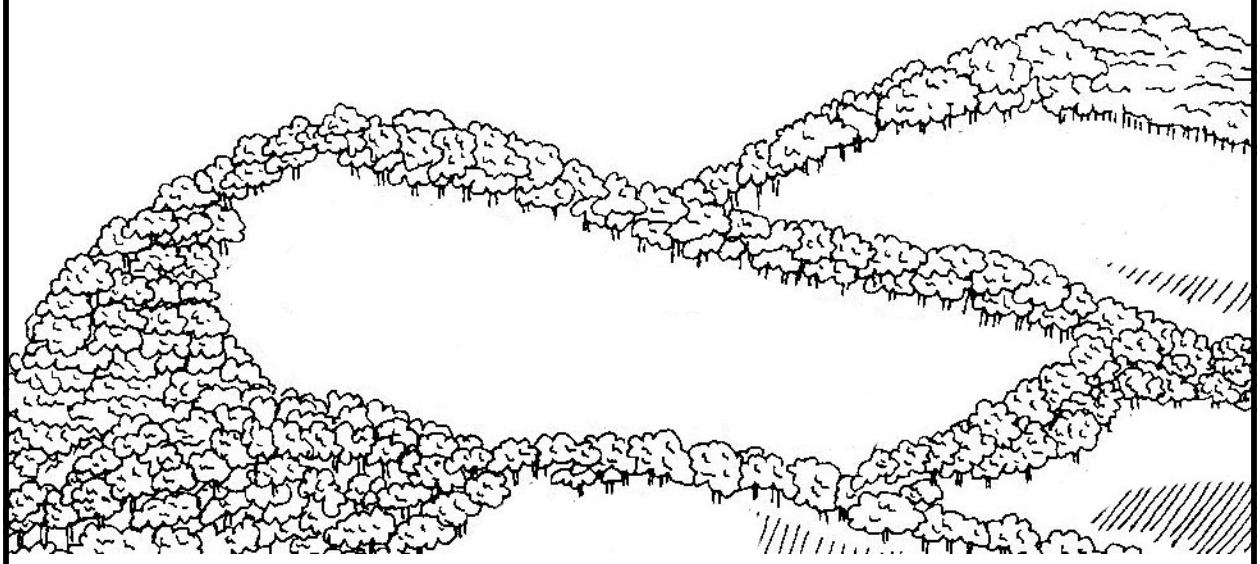
A hill without trees is like a house without a roof. A roof protects the contents of a house from rain the same way trees protect plants and topsoil on a hillside.

Biological Corridors



Did you know...?

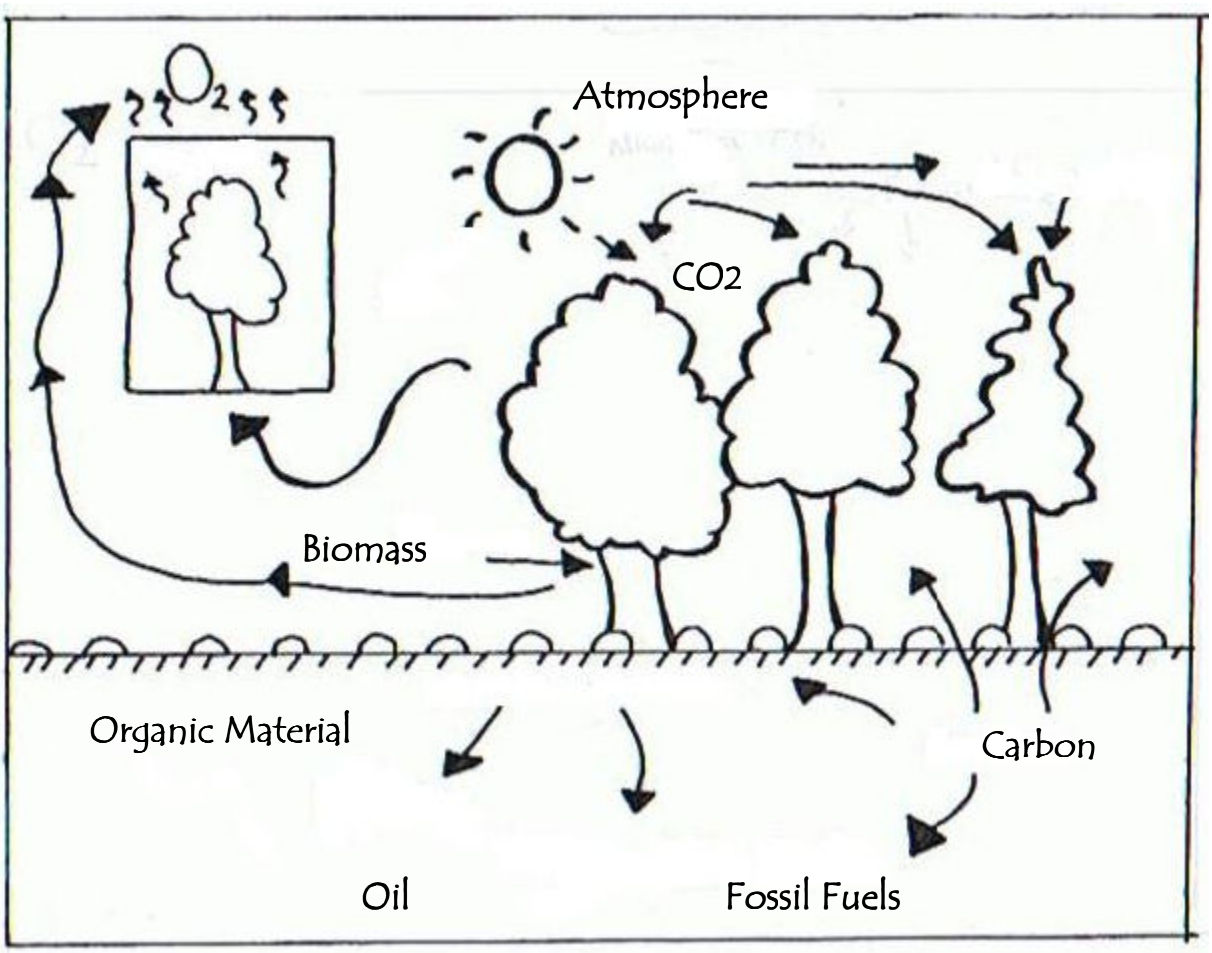
95% of a forests biodiversity is composed of non-tree species, however, trees account for 70% of the biomass!



One of the potential uses of Analog Forestry is to create biological corridors to unite patches of forest. This allows for the exchange of seeds - hence genetic stock - and the movement of animals between different ecosystems.

Carbon Cycle

Forests are a vital part of the planet´s carbon cycle

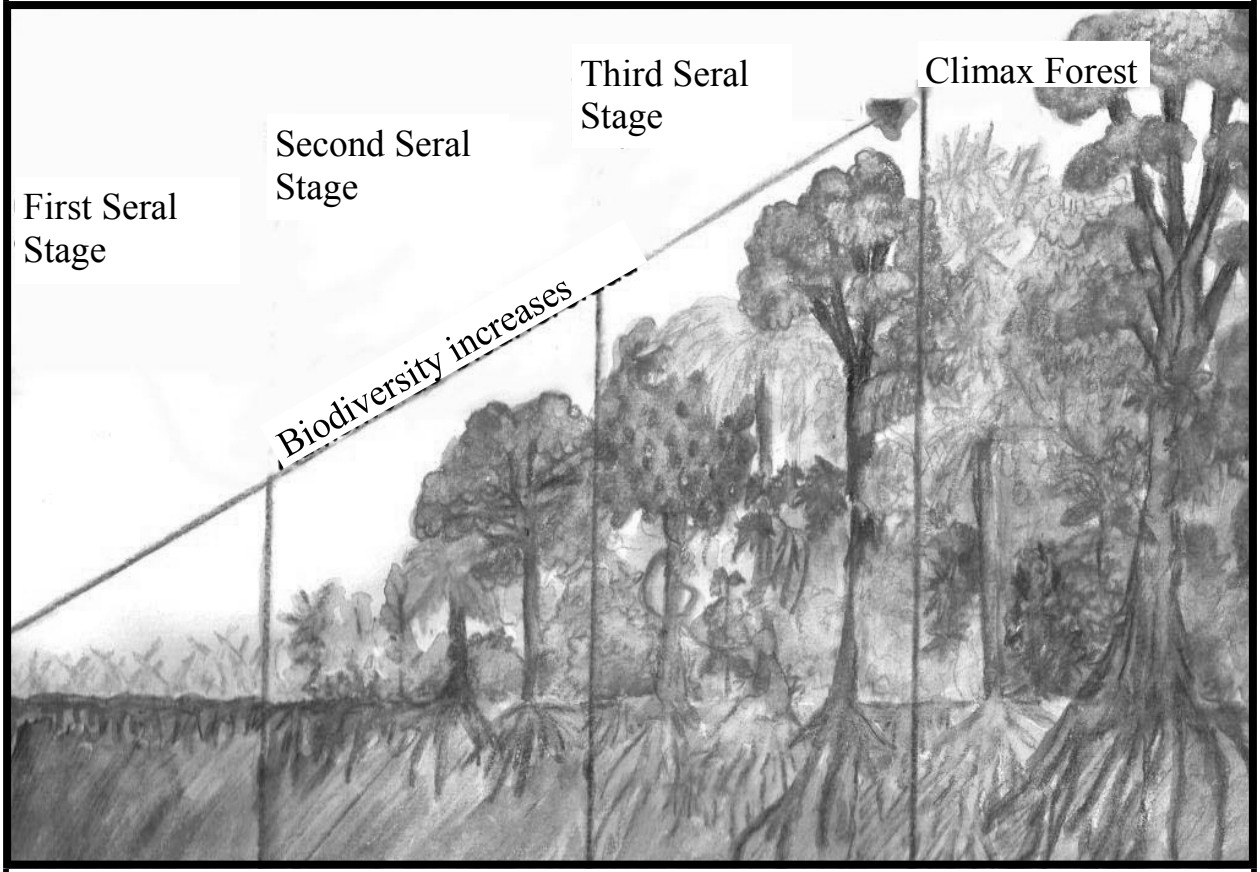


Trees are the lungs of the planet. They absorb carbon dioxide and release oxygen. In this way, trees can fix carbon into vegetation and the soil, hereby, slowing down climate change.

Ecological Succession

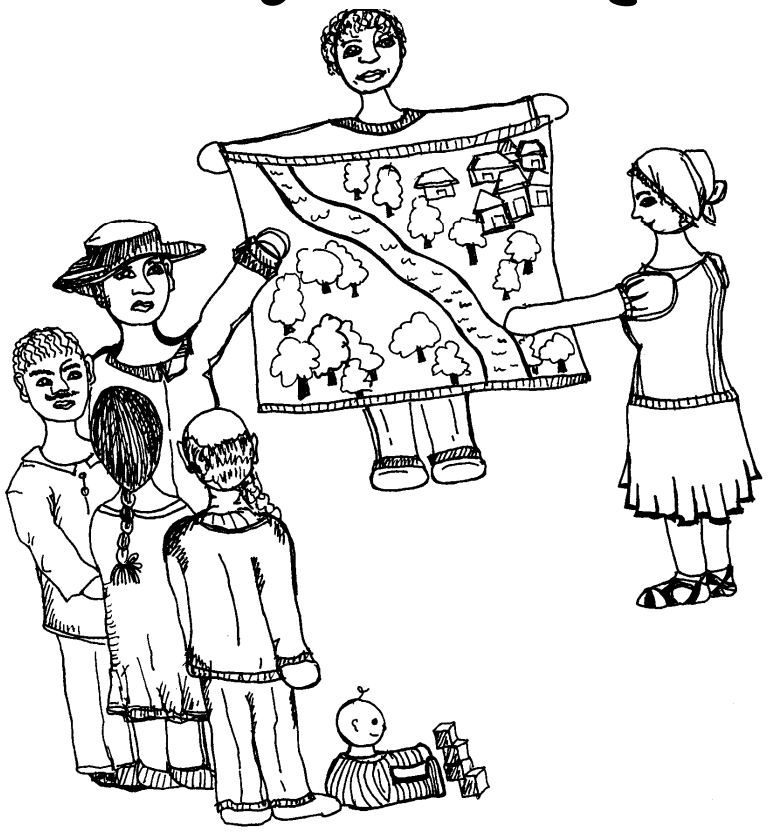
Ecological succession is a process by which the vegetation of an area progresses to a stable ecosystem.

Natural succession can take thousands of years to create a climax forest. While still ollowing the seral stages, succession can be accelerated and a climax forest can be created in less time.



In each stage of ecological succession, the complexity of the vegetation and the capacity of the soil to sequester carbon increases.

Community Participation



When the whole community participates, it is possible to create a common vision of the future and to develope large scale land management plans.

It is important that all community members including women, the elderly and youth are invited to participate in Analog Forestry initiatives.

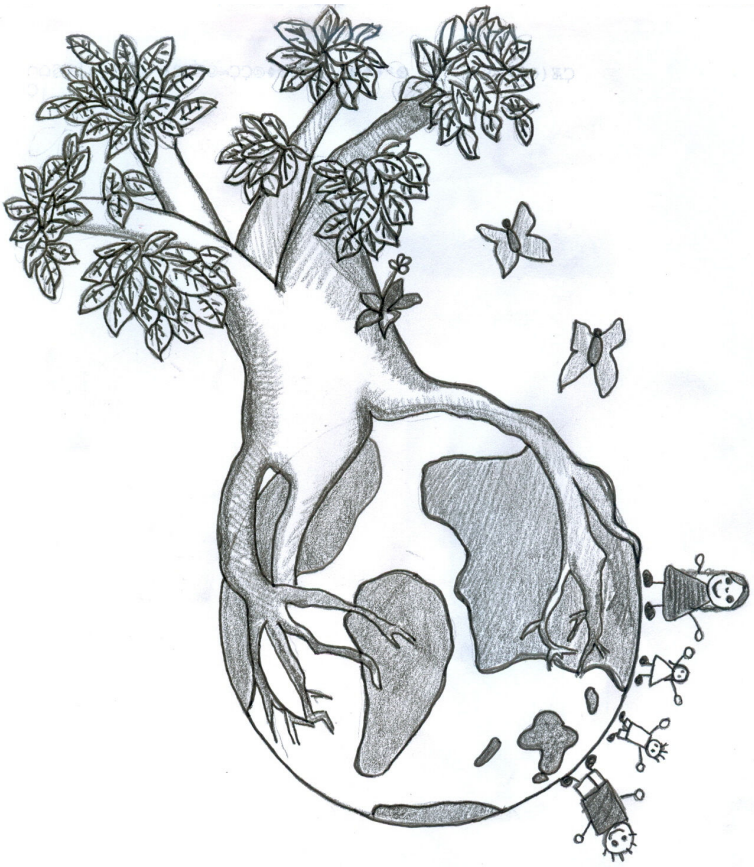
The community can also share work and resources like tools, seeds, knowledge, etc.

Community nurseries are a good way to share maintenance tasks and to ensure the production of the species necessary for the restoration project.

The Analog Forestry Network was created in 1996 with the mission to promote the application and appreciation of Analog Forestry techniques as a critical component of rural development.

The IAFN vision is the restoration of the planet´s life support systems, while providing economic opportunities to rural areas.

More information: www.analogforestrynetwork.org



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