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, to create healthier and happier communities living in more productive and functional environments.

IAFN RIFA
foresterianaloga.org

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Edited and illustrated by: Jenny DeMarco, Falls Brook Centre, 2009 and Francis Kujo Senu
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Thanks to the collaboration of IAFN accredited trainers Tatiana Espinosa, Adriana Pal, Carolina Sorzano and Lorena Gamboa
(June 2020).

Analog Forestry

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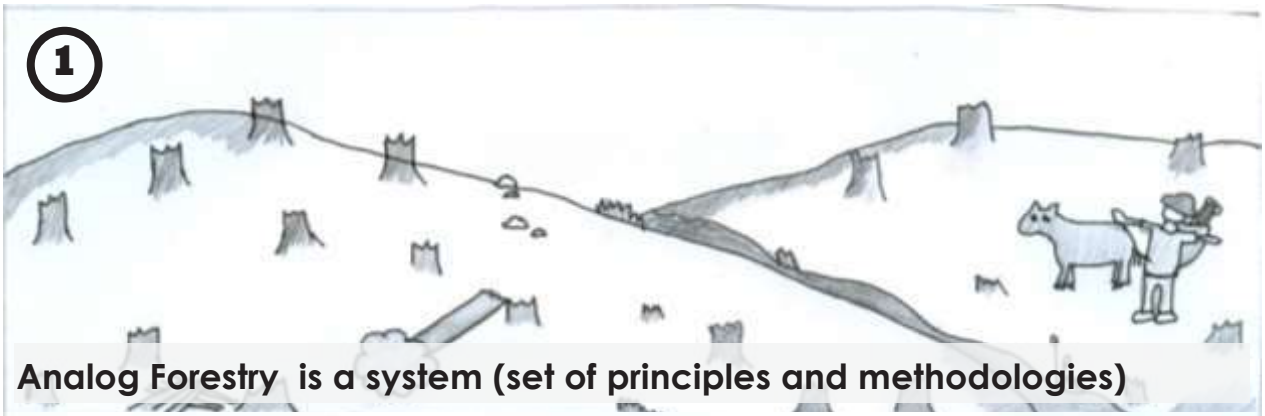
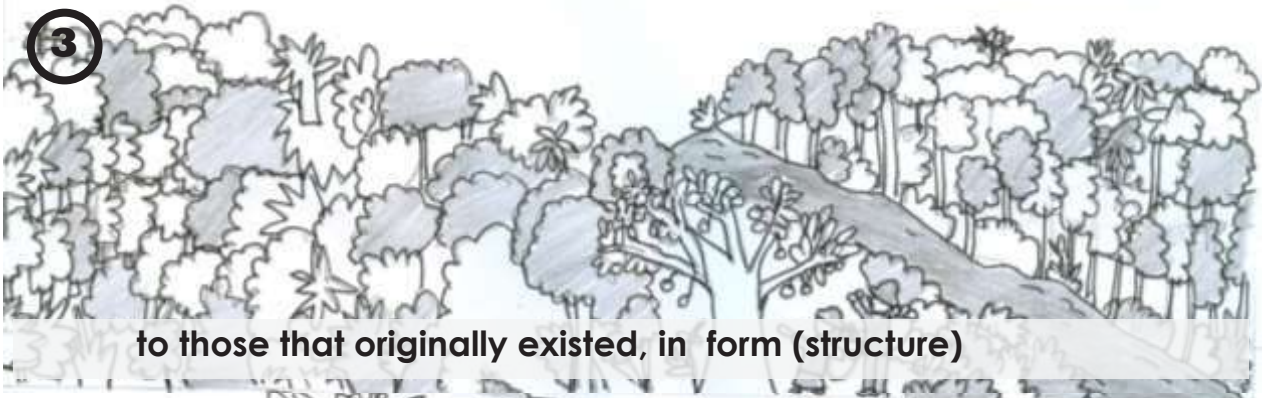
Chapter 1: What is Analog Forestry?



Analog Forestry is a system (set of principles and methodologies)

to recover biodiversity and create forests that are similar

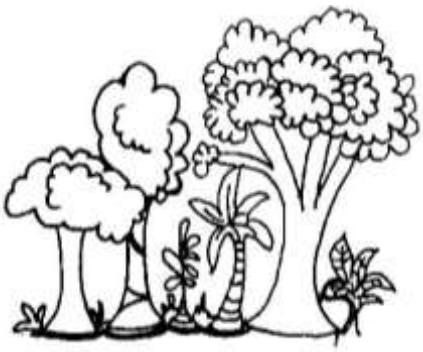


to those that originally existed, in form (structure)

and services they provide (Ecological functions)

Analog Forestry

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



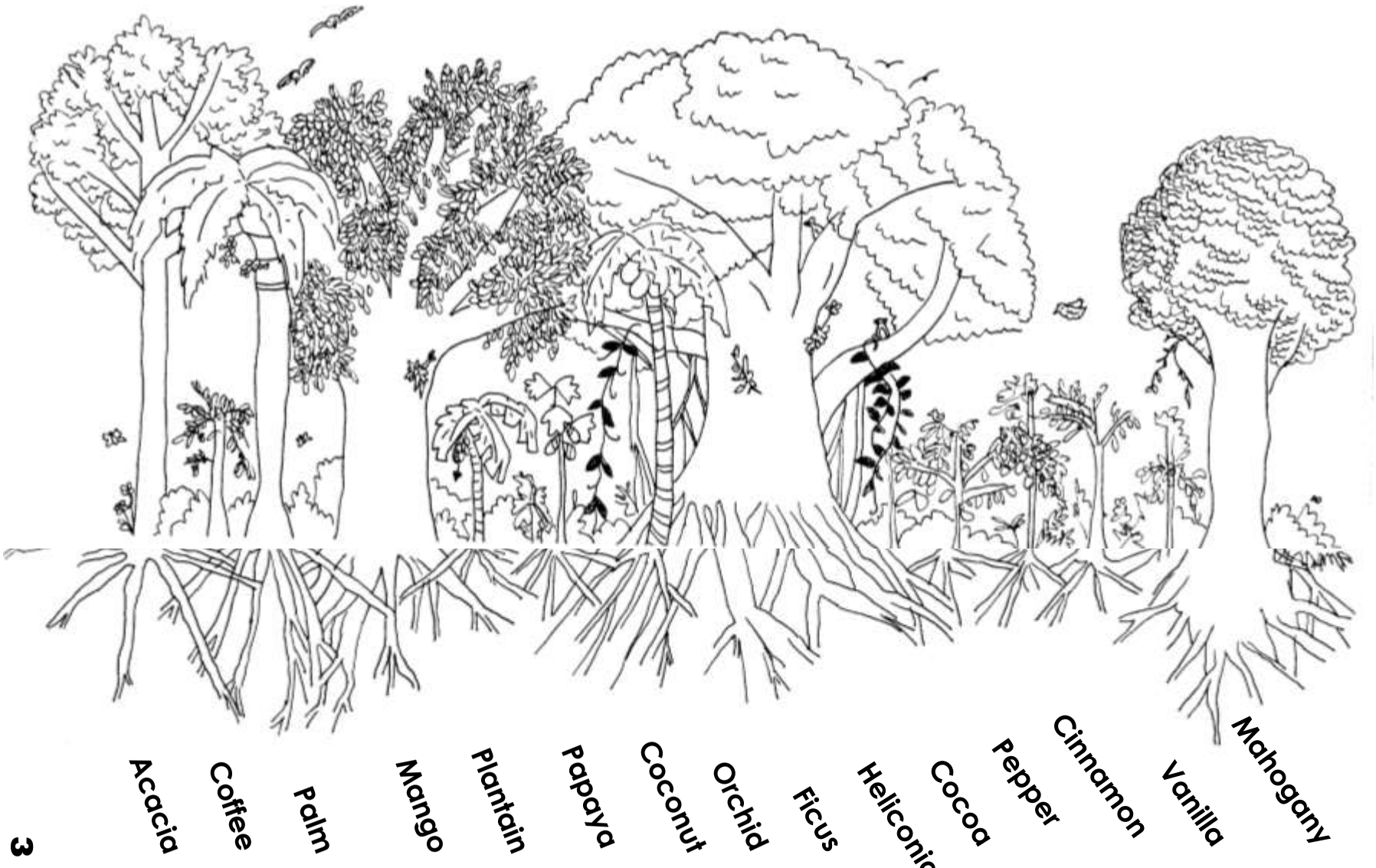
… is an effective tool to stop deforestation,

... 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

Baseline 1

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.

Design 2

4) Map out flow and reservoir systems: Graphically represent the flows of water, sun, and wind.

5) Identify levels of yield: Identify the capacity of the land. How much could you harvest in each area?

Management 3

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

7) Follow ecological succession: Imitate and accelerate the phases of the natural evolution of a forest. From a pasture, thicket, to a forest.

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

9) Value biodiversity: Increasing biodiversity species will increase ecosystem function and provide valuable services and forest garden products.

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

11) Reduce ratio of external energy in production: Minimize the use of fossil fuels. Encourage the recycling of nutrients and the use of natural fertilizers. How can we maintain a closed cycle within the plot?

Individual & collective expression 4

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

Chapter 2:
Methodology to apply AF

The application process of Analog Forestry

2.1 Physiognomic Formula (Structure):

a) In a Native Forest (F1)

b) In the Existing Parcel (F2)

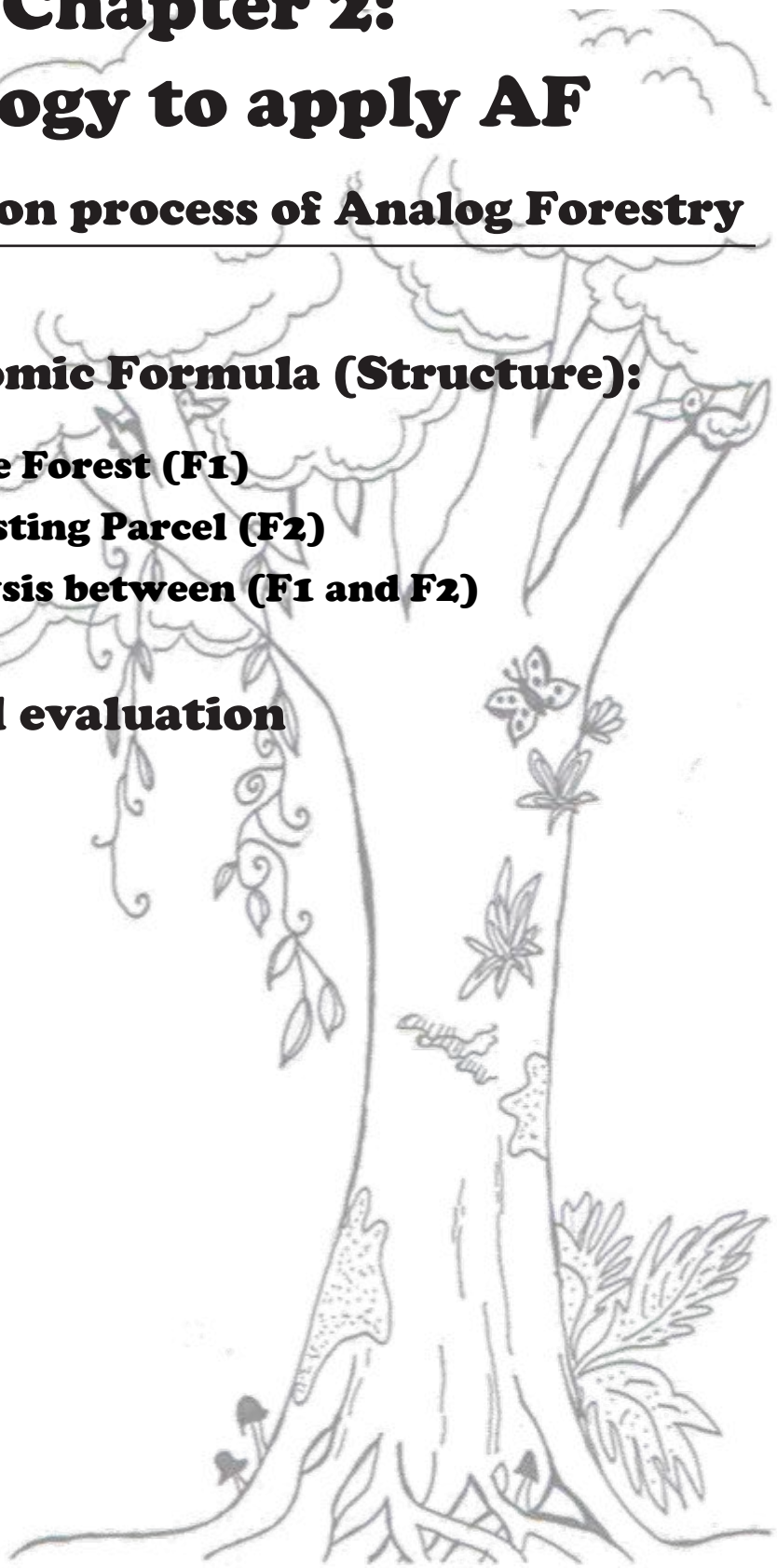
c) Gap Analysis between (F1 and F2)

2.2 Ecological evaluation

2.3 Mapping

2.4 Database

2.5 Design



2.1 Physiognomic Formula

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

A. Growthform categories	
1.Basic growth forms	**Symbol**
Trees and shrubs	
Evergreen (simple or compound leaves)	V
Deciduous (simple or compound leaves)	D
Needle evergreen	E
Needle deciduous	N
Aphyllies (without leaves)	O

2.Other growth forms (non woody)	**Symbol**
Palms (coconuts)	P
Rhysomatous plants (banana, heliconia, etc.)	R
Succulents (cactus)	S
Bamboo	B
Rosette plants (agave, terrestrial bromilia, etc.)	K
Ferns	F
Epiphytes (orchids)	X
Vines and creepers (lianas)	C
Lichen and mosses	L
Herbaceous plants	
Grasses (wheat, corn, sugar cane, rice, etc.)	G
Annual herbaceous plants (melon, pumpkin, caléndula)	A
Perennial herbaceous plants (oregano, chilies)	H

B. Structure categories	
1.Height (Stratification)	**Symbol**
higher than 45 m	9
35 - 45 m	8
20 - 35 m	7
10 - 20 m	6
5 - 10 m	5
2 - 5 m	4
0.6 - 2 m	3
0.1 - 0.5 m	2
lower than 0.1 m	1

2.Coverage / abundance	**Symbol**
Continuous (higher than 75%)	c
Interrupted (51 – 75%)	i
Patches/fragmented (26 - 50%)	p
Rare/scarce (6 - 25%)	r
Sporadic (1 – 5%)	b
Almost absent (less than 1 %)	a

Note: When natural regeneration of woody species less than two meters tall is found, they are classified as Perennial Herbaceous (H) and recorded as H3,H2, H1

Using the Formula

Before designing the Analog Forestry site, determine the Physiognomic Formulas of a nearby mature forest and of the site you wish to intervene. Later, calculate the gap between the two sites. The gap determines which species of plants 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 an evaluation area as seen by the human eye at 360 degrees or establishing a perimeter that considers 4 areas not less than 20m x 20m, of evaluation 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.

If you are familiar with the tree species, make a registry.

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): **V7c, V5p; P4r; R2c; X3-6p; C1-6c; H3p**

2)Formula of the future Analog Forestry site (F2):

Apply the Physiognomic Formula to the existing vegetation of the future Analog Forestry site.

Example of a degraded site (F2): **V5p; C1-3c; G3a**

3) Gap analysis (F1 - F2):

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:

(F1-F2): **V7c; P4r; R2c; X3-6p; C4-6c; H3p**

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 (ex. $V_{3a \rightarrow p}$).

2.2 Ecological Evaluation 

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

1) Verify the value of each index of the topics
2) Record the values in the table on page 10 and calculate averages
3) The final average is the average ecological value of the land

GUIDE FOR THE EVALUATION OF ECOLOGICAL SUSTAINABILITY INDICATORS

Value	Soil - Soil Profile	Value	Soil - Apparent Density
1 to 2	Almost absent topsoil	1 to 2	Very compacted
3 to 4	Thin topsoil	3 to 4	Compacted
5 to 6	Deep topsoil	5 to 6	Not compacted
Value	**Soil - Macroorganisms**	**Value**	**Biodiversity - Fauna**
1 to 2	No signs of biological activity, no beneficial macroorganisms observed.	1 to 2	Very little visible presence or diversity of plants, reptiles, mammals, insects, amphibians
3 to 4	Some beneficial macroorganisms observed in small quantities, such as worms and arthropods.	3 to 4	Some visible presence and diversity of fauna.
5 to 6	Abundance of beneficial macroorganisms such as worms and arthropods	5 to 6	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 4	Little variability among species (more than 5 tree species present and few species in the understory).
5 to 6	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.

Ecological Evaluation

GUIDE FOR THE EVALUATION OF ECOLOGICAL SUSTAINABILITY INDICATORS

Value	Structure - Complexity
1 to 2	Ecosystem of little complexity, little diversity of species and few interactions between elements
3 to 4	Moderately complex ecosystem, species diversity and interactions between elements
5 to 6	Ecosystem with a complexity comparable to a natural climax forest, abundant diversity of species and interactions between elements
Value	**Productivity - Economic**
1 to 2	No productive system exists
3 to 4	A productive subsistence and/or market system exists, but does not meet all the objectives of the landowner
5 to 6	The productive system meets the landowner's subsistence and/or market objectives
Value	**Productivity - Ecological Functions***
1 to 2	Ecological functions are weak and no system for scientific study, carbon sequestration or tourism exists
3 to 4	Some ecological functions exist (eg. purifying water, soil conservation, habitat,etc.) or some systems are developing for scientific studies, carbon sequestration or tourism
5 to 6	Strong and stable ecological functions and/or stable systems for scientific study, carbon sequestration or tourism

* For the analysis of these categories, one can use studies carried out in the area, scientific or not, which detail the ecosystem functions that exist in the area. If there are no studies, the analysis can be done by asking neighbors who have lived in the area for a long time, along with your own observations as learned in the chapter on forests and their functions.

Examples of sampling activities

Soil: Dig a hole measuring 0,25 m³ (50 cm x 50 cm x 50 cm). This allows you to see upper layers of the soil.

Macroorganisms: Count the macroorganisms (earthworms, arthropods, etc) in the soil removed from the 0,25 m³ hole.

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

Insects: Before sunset, place a white sheet in the forest and iluminate it with a flashlight. Come back a tew hours later to see 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 hve unique perspectives and know about recent changes.

CALCULATIONS TO OBTAIN AVERAGE VALUE OF ECOLOGICAL SUSTAINABILITY

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.

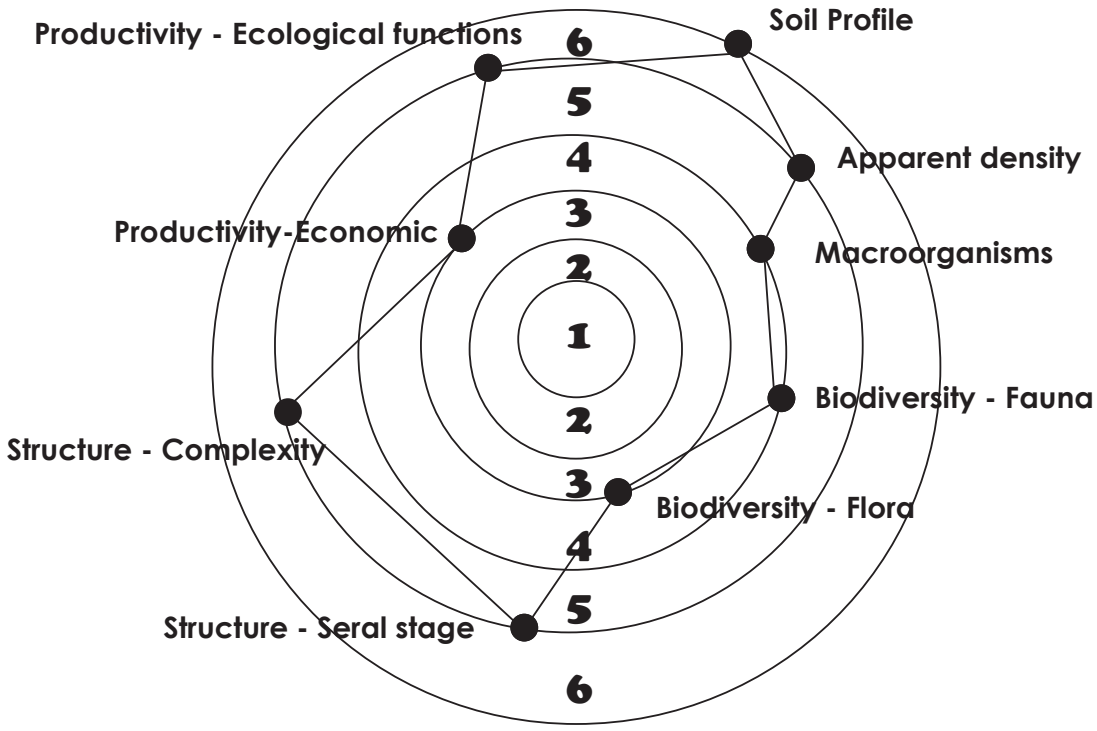
FORM FOR RECORDING DATA FROM THE ECOLOGICAL EVALUATION

Name:		Date:	
Parcel:		Number of lot:	
Location:		Province:	
Altitude:		Geographic Coordinates:	
Median annual rainfall	mm	Country:	
Median annual temperature:	C	Ecosystem:	

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

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.

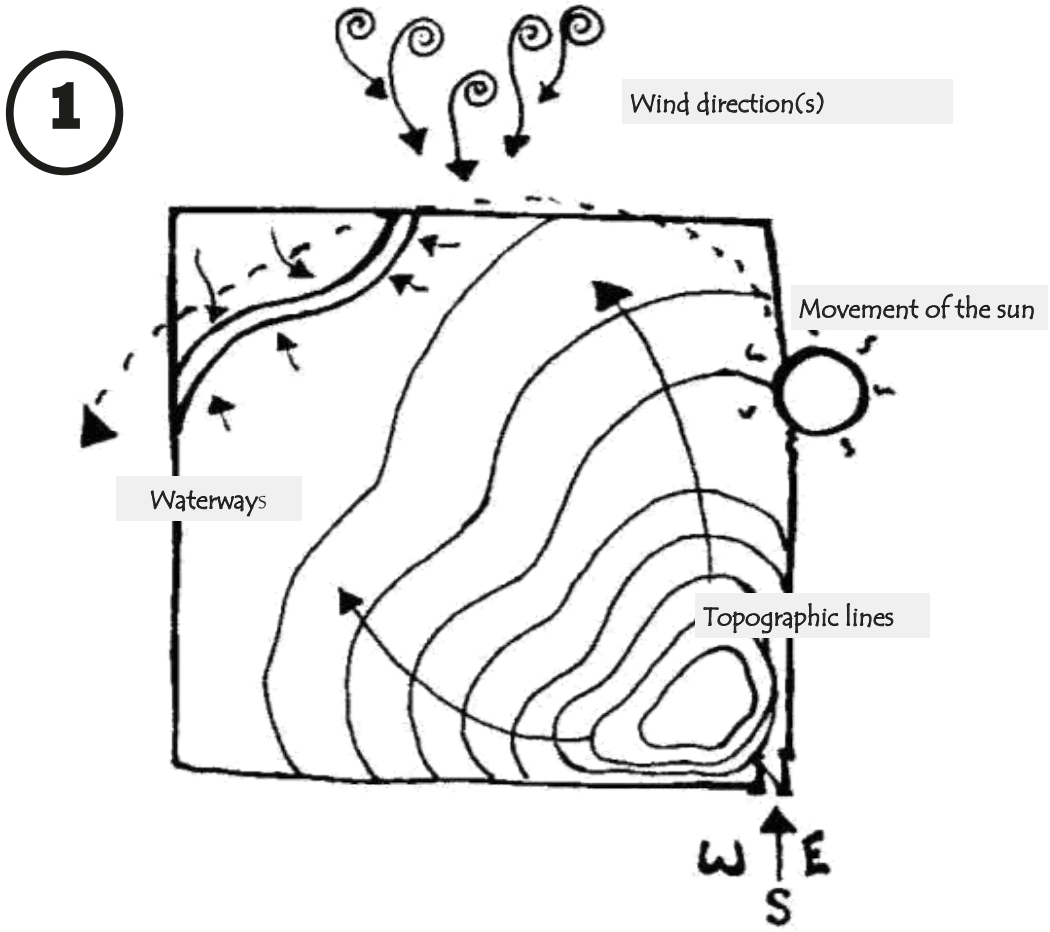


It is necessary to analyze the results from the Ecological Evaluation exercise on page 10 To do so, follow these steps:

1) Draw six 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 "six" 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.

2.3 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.



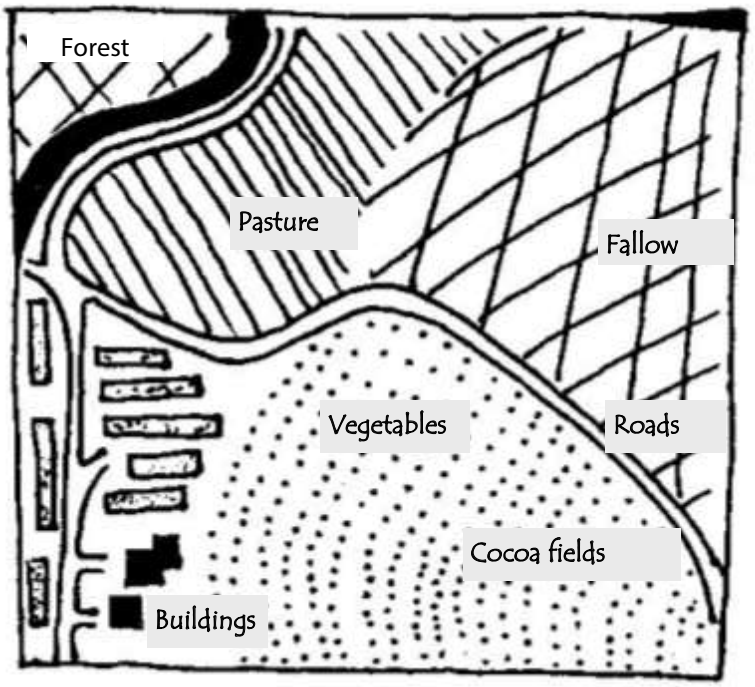
On a sheet of paper, draw:

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

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

Site Mapping

2



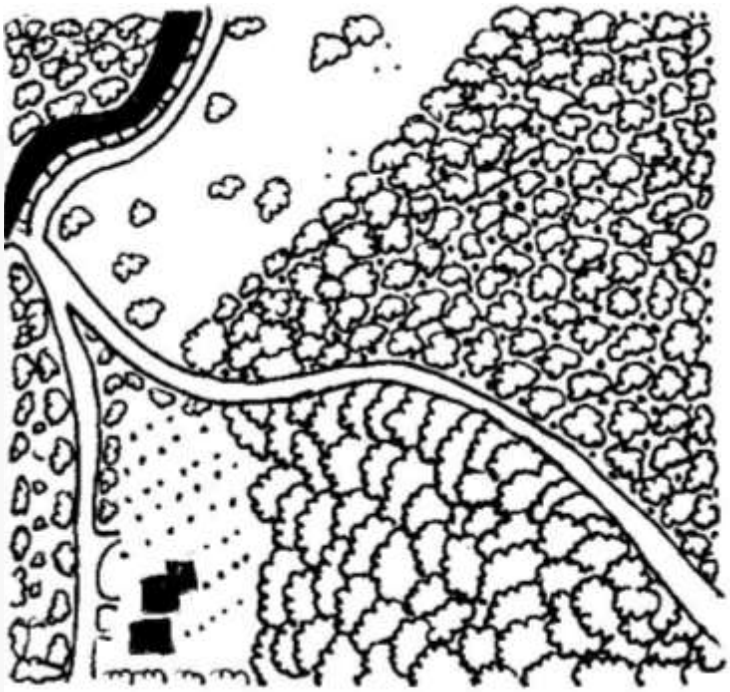
On a sheet of paper draw:

- **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.**



2.4 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	Growth form (symbol as in FF)	Human Uses	Ecological Functions	Propagation
Mangifera indica	Mango	V6 Tree	Edible fruit, timber medicinal	protects the soil	seed, grafting
Cocos nucífera	Coconut	P7 Palm	Food, fiber handicrafts leaves for thatching, Timber	Provides shade, Support birds	Seed
Teobroma cacao	Cocoa	V3 Small tree	Edible fruit, Chocolate from nut	Green matter, hosts orchids, bromelias	Seed
Pasiflora edulis	Passion fruit	L (1-4) Vine	Edible fruit, edible and medicinal leaves	Flowers attract bees and others. Fruit feeds small rodents	Seed, cutting

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!

2.5 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 (F1):

$V_{7p}, V_{6i}, V_{5i}, V_{4p}; R_{3b}; F_{1\text{-}2r}; X_{1\text{-}2b}; C_{1\text{-}6i}; L_{1\text{-}5b}; H_{3i}$

Formula of parcel (F2):

$V_{6r}, V_{4r}; P_{1\text{-}6b}; G_{2i}; H_{3b}$

Gap analysis (F1-F2):

$V_{7p}, V_{6r\rightarrow i}, V_{5i}, V_{4r\rightarrow p}; R_{3b}; F_{1\text{-}2r}; X_{1\text{-}2b}; C_{1\text{-}6i}; L_{1\text{-}5b}; H_{3b\rightarrow i}$

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/or 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 should be taken into account that not everything is planted in the first year (a schedule of activities must be designed in the short, medium and long term).

Design

This example shows a conceptual design 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: guarumo, melina, teak, uvilla

V6r -> i: oak, Honduran mahogany, jaca, cabirma santa

V5i: rambutan, abiu, black sapote, jocote

V4r—> p: cherry, orange, lemon, cocoa

R3b: plantain, banana, heliconia

F1-2r: ferns

X1-2b: orchids, bromeliads, and aerial ferns

C1-6i: vanilla, sarsaparilla, passion fruit, granadilla

L1-5b: lichens and mosses

H3b—> i: oregano, juanilama, verbena

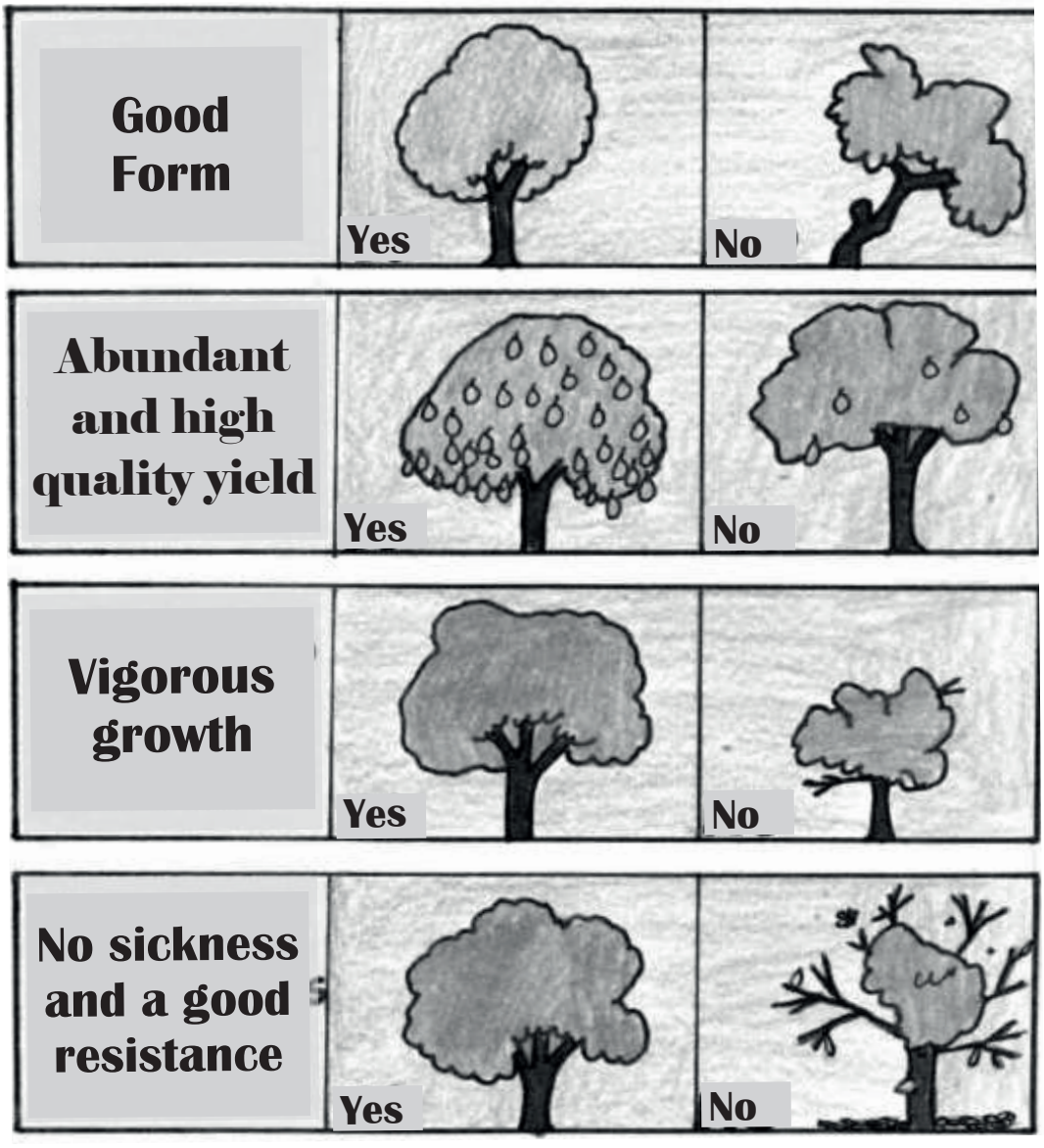
Chapter 3: Practices that support AF

3.1 Collecting seeds

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.

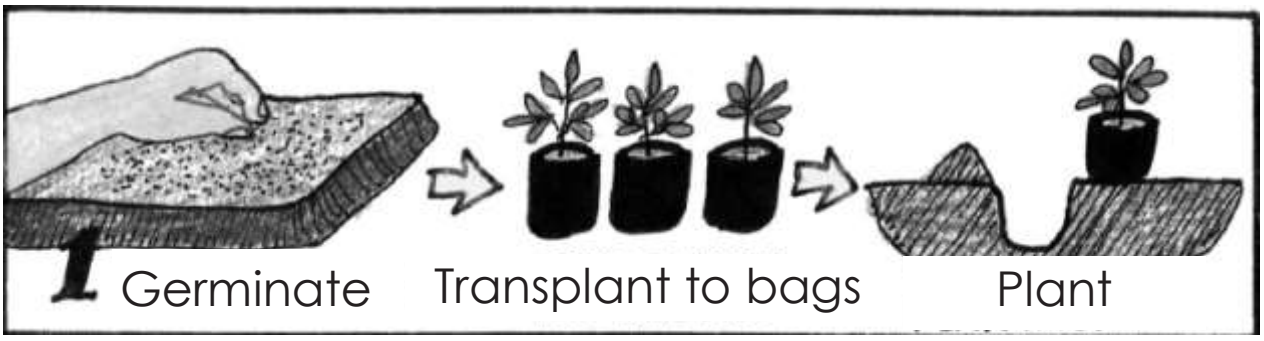
General Criteria of Good Trees



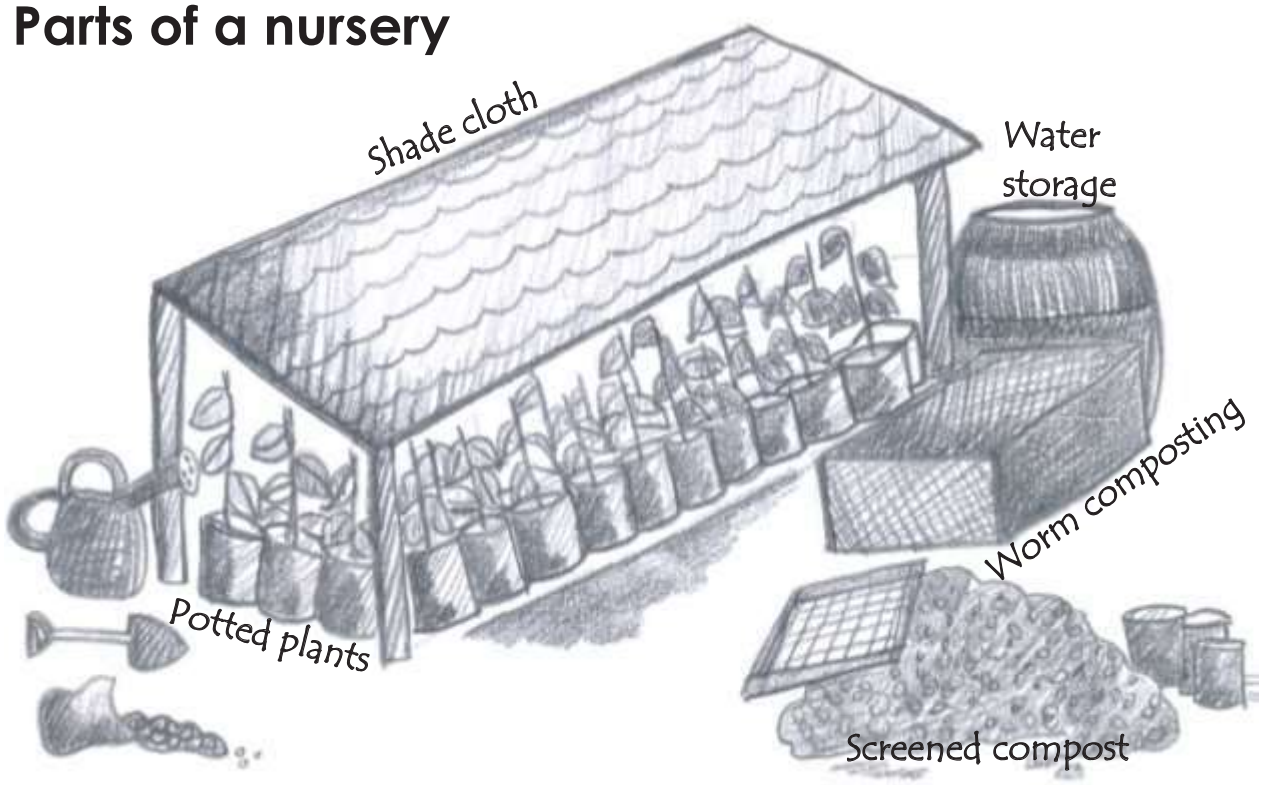
Source: Machete Verde; David Gagnon

3.2 Nurseries

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



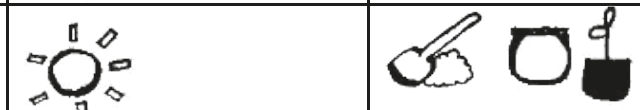
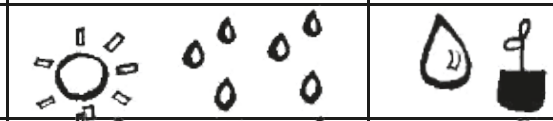
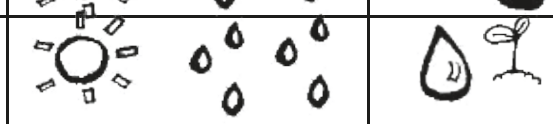
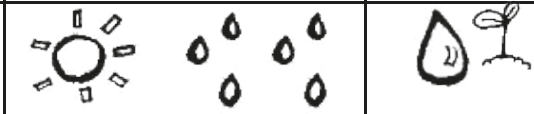
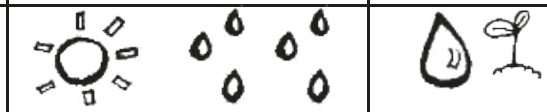
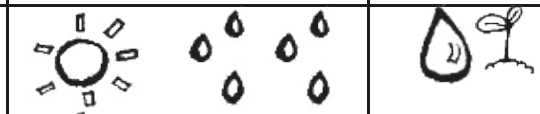
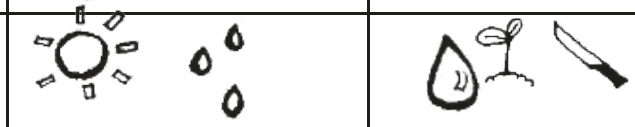
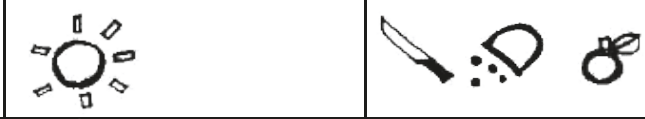
Parts of a nursery



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

3.3 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	

Soil Preparation:

Compost preparation:

Seed Collection:

Preparation of seedlings:

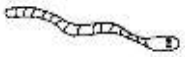
Transplant:

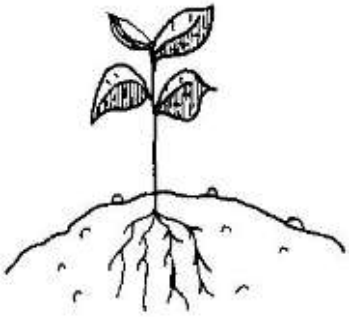
Maintenance:

Harvest:

Chapter 4: Elements that support AF

4.1 Soil and organic fertilizer





"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.

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:

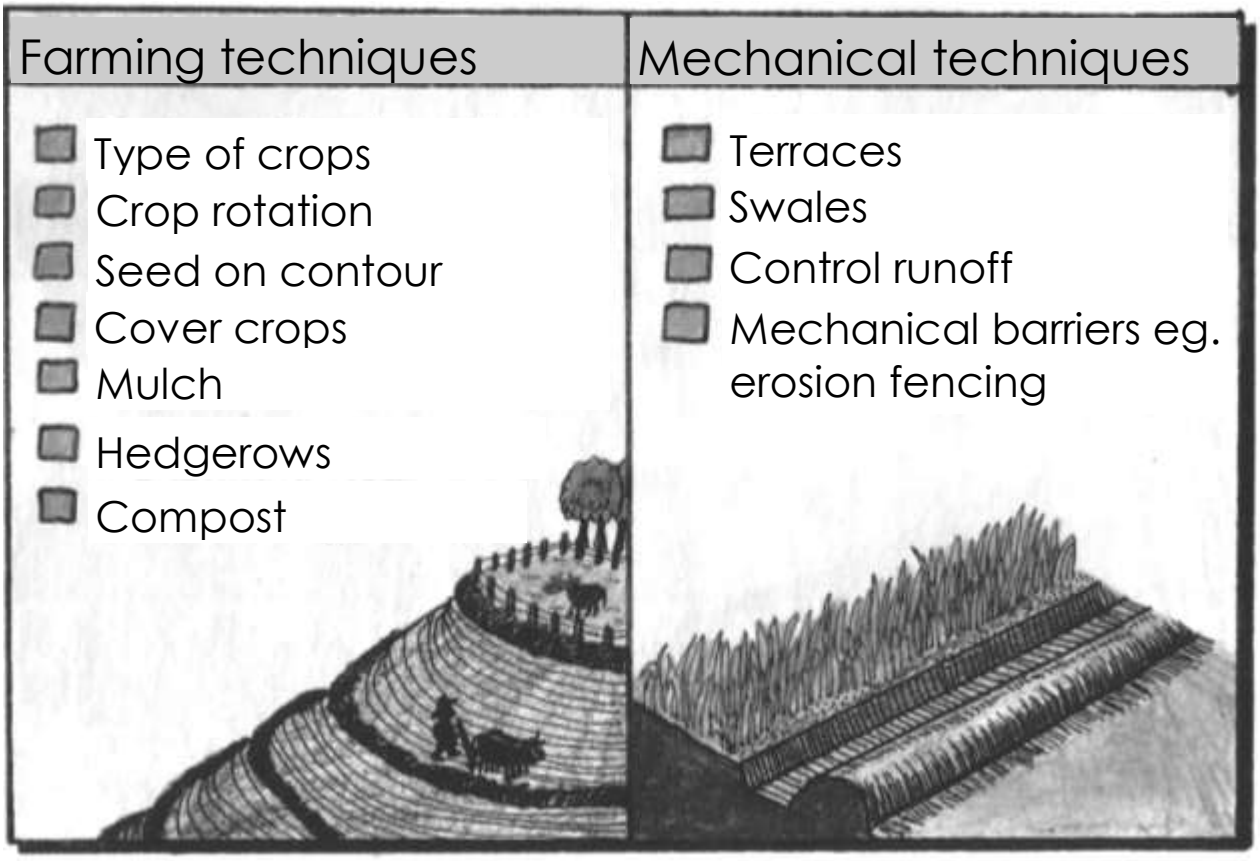
- Fertile soil (10 wheelbarrows)
- Animal manure (6 wheelbarrows)
- Organic waste (especially legumes and medicinal plants)
- Ash (1/2 bag)
- Sand (2 wheelbarrows)

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.

4.2 Erosion control

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.



(Source: Machete Verde, Daniel Gagnon)

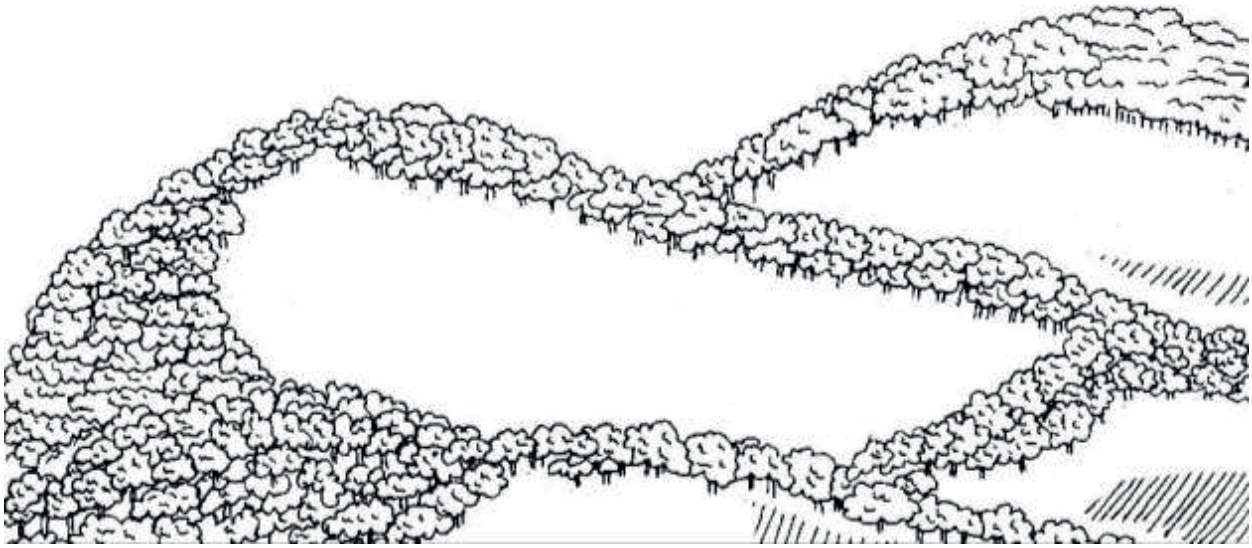
¿Did you know..?

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.

4.3 Biological Corridors

Did you know...?

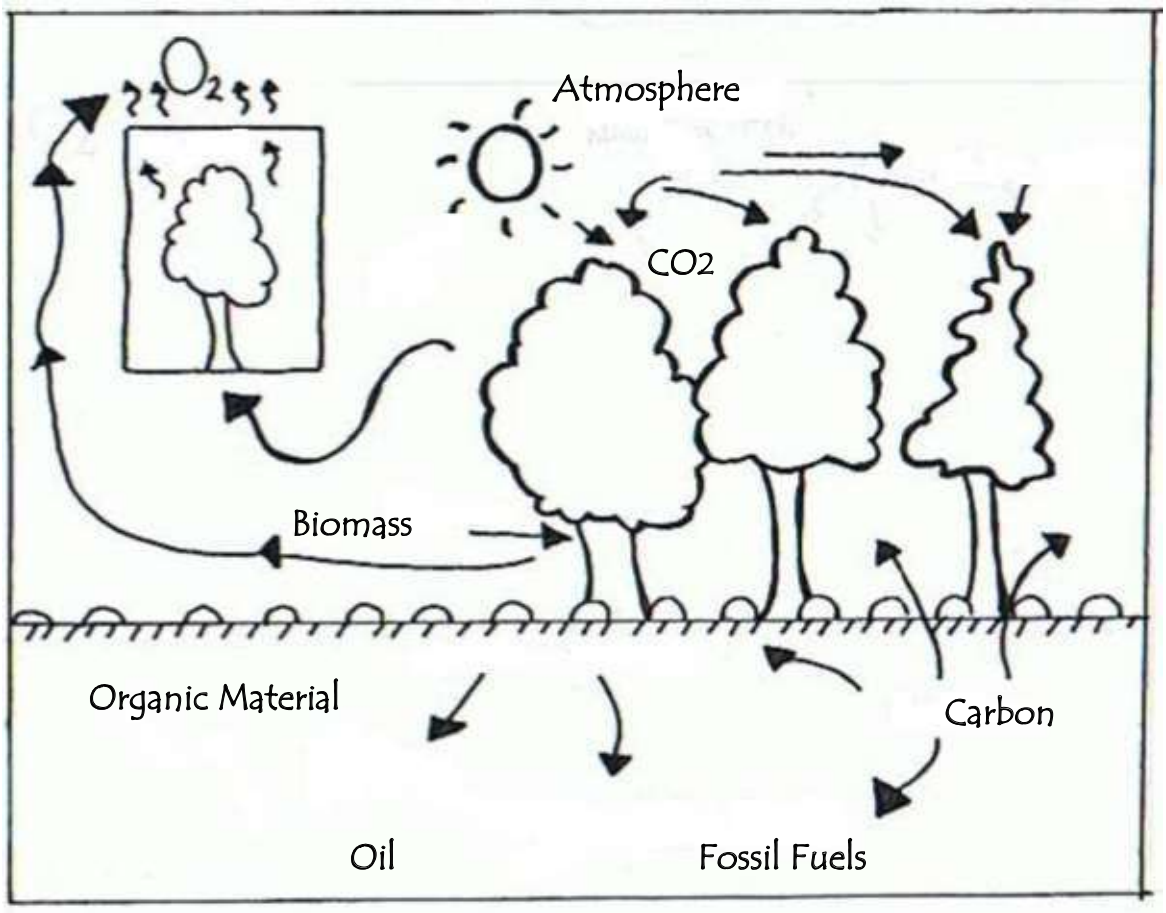
95% of a forests biodiversity is composed of non-tree species, however, trees account for 70% of the biomass!



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.

4.4 Carbon Sequestration

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

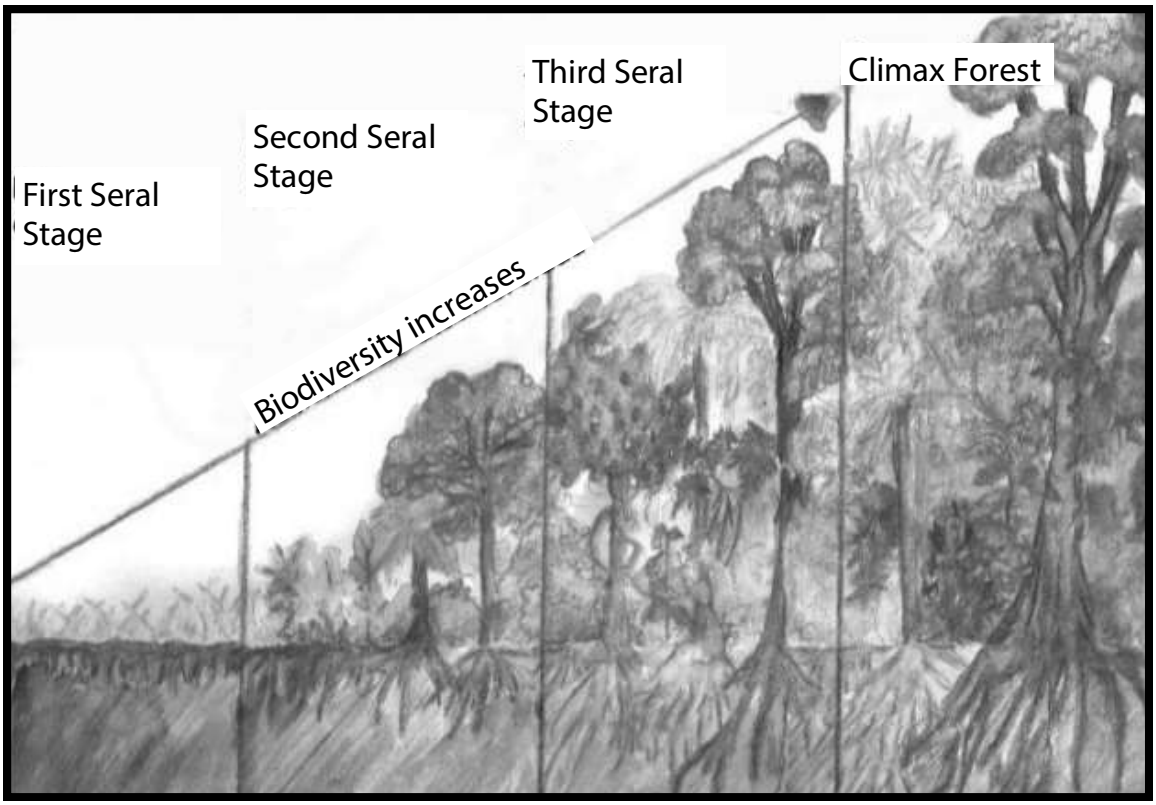


Trees are the lungs of the planet. They absorb carbon dioxide (CO2) and release oxygen (02). In this way, trees can store carbon in their wood, leaves and roots; in addition to increasing the amount of carbon in the soil. Thus, forests contribute to slowing down climate change.

4.5 Ecological Succession

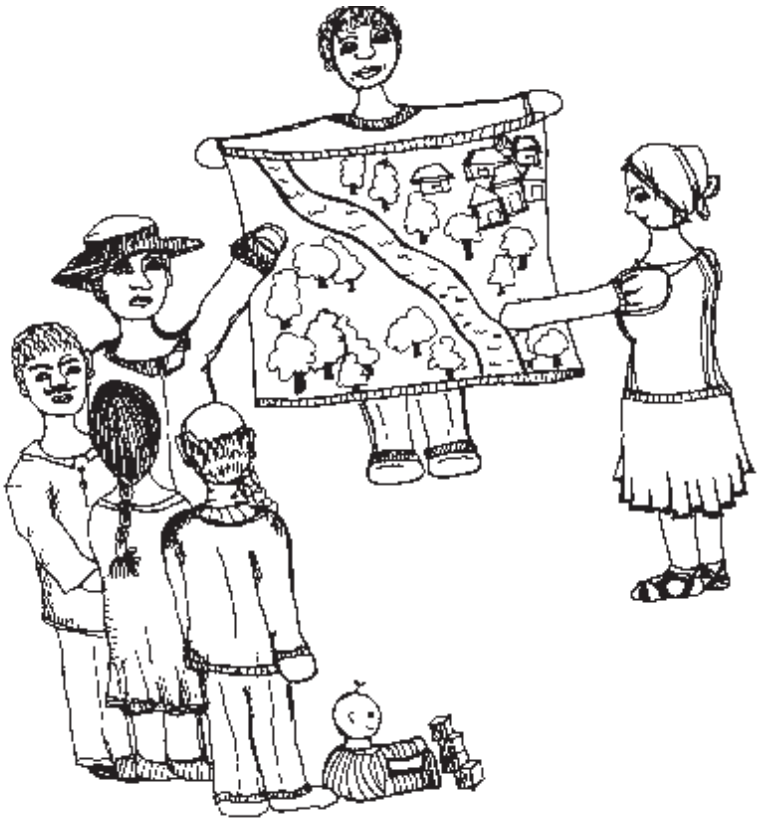
Ecological succession is a process by which the vegetation of an area progresses to a stable ecosystem.

Natural succession can take thousands of years to create a climax forest. While still allowing 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.

4.6 Community Involvement



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.

Glossary

Section A- 1. Growth form categories

1. Evergreen (V):

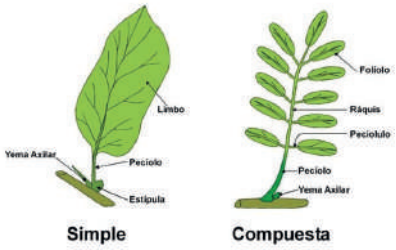
A tree, plant or shrub that keeps its foliage all year round.

2. Deciduous (D):

A tree, plant or shrub that loses its leaves at certain times of the year.

3. Compound Leaf:

A leaf whose lamina is divided into several small leaves.
The compound leaf allows more light to pass through.



4. Simple Leaf:

It is characterized by the presence of a single and unique lamina that is not divided or segmented into rachis, pines or leaflets.

5. Needles (E and N):

Trees with needles are characterized by presenting elongated, narrow needle-shaped or scale leaves. Most of the time the foliage is covered in resin. i.e: conifers, pines.

Section A.2 Other growth forms:

6. Rhizomatic Plants (R):

Plants where the stem grows horizontally below the ground and emit roots that go down where new herbaceous shoots grow at each node. Every year new shoots appear next to the mother plant. i.e ginger.

7. Bamboo (B):

We include it in a separate category due to its importance in the ecosystem, by generating large amounts of oxygen and retaining water. It is a grass (G) but we assign it a separate category.

8. Epiphytes (X):

Called "aerial plants", they grow on another "host" plant (tree or shrub), using it only as a support, but it does not feed on the host, that is, they are not parasites. i.e. bromeliads, orchids and aerial ferns.

9. Lichens (L):

Organisms formed by the union of a fungus and an alga. Main function is to colonize poor soils and exposed rocks in order to decompose organic matter making these soils much more fertile. We also find them on the trunks of live trees and bushes in humid forests.

10. Mosses (L):

A very important specie for the ecosystem, since they are the first organisms to appear on soil surfaces and rocks generating a wet and padded layer on which the rest of the plant species develop. Mosses are capable of holding 20 times their weight in water.

11. Grasses (G):

Family of plants with a cylindrical stem, gnarled and generally hollow, alternate leaves, flowers grouped in spikes and dry grain covered by the flower scales. i.e sugar cane, wheat, rice, corn, sorghum, barley

Others:

12. Stratum (layers):

Refers to the way a forest is divided horizontally: herbaceous stratum, shrubby stratum, tree stratum, emergent stratum ... not all the strata of a forest form its canopy. They are the levels that these canopies form at different heights and in different covers.

13. Canopy:

Also known as tree canopy or forest canopy, it is the habitat that comprises the crown and upper regions of the trees of a forest. It is the area of the forest where most of the branches and treetops are found, the roof of the forest, but the tops of the emerging trees are not part of it.

Notes:

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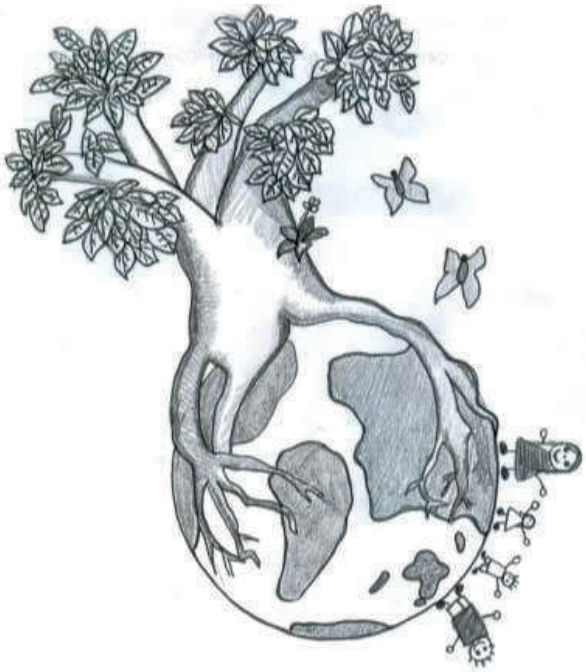

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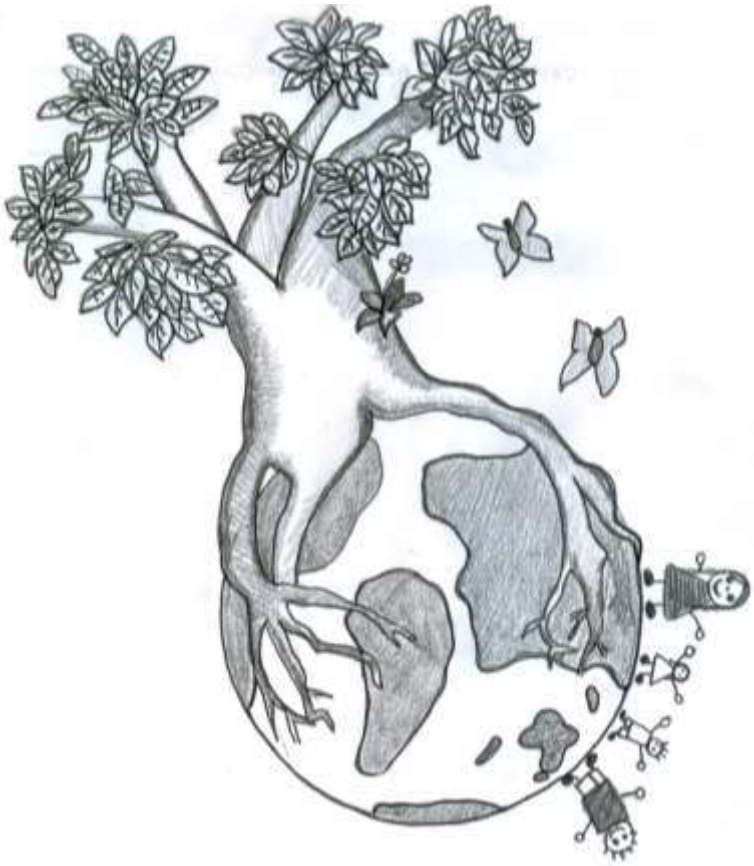
The Analog Forestry Network was created in 1996 with the mission to promote the application and appreciation of Analog Forestry techniques as a critical component of rural development.

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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