

Agroforestry to improve agricultural production in North Africa and the Sahel

Sabir Mohamed

École Nationale Forestière d'Ingénieurs - Morocco

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Thematic area: Water Harvesting and Agroforestry

Building Forward Better Initiative

Project “Strengthening natural resources management capacities to revitalize agriculture in fragile contexts”

Water Harvesting and Agroforestry Module

Agroforestry to improve agricultural production in North Africa and the Sahel

- Problem: what is the question?
- Definition of Agroforestry?
 - Definition,
 - Objectives / assets,
- Some AF techniques;
- Techniques to assist natural regeneration;
- Case studies.

Problem:

Demography + poverty + instability:

- Growing food needs;
- Growing wood energy needs;

Low-performing operating system:

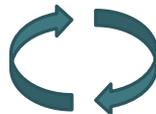
- Low land productivity (fertility);
- Small farm size (fragmentation);
- Inappropriate farming techniques (poor skill);

Peasants' reactions:

- Shifting crops: land degradation;
- Overgrazing: degradation of rangelands;
- Overexploitation of fuelwood: degradation of plant cover

Consequences:

- Desertification;
- Rural exodus.



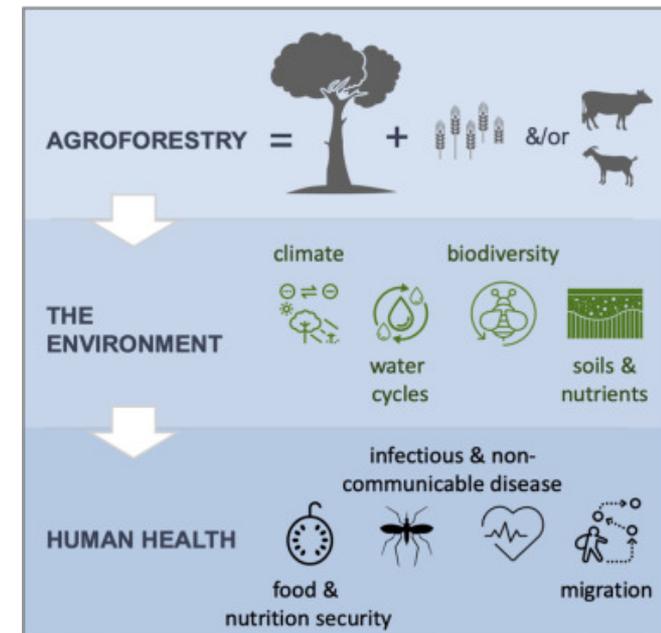
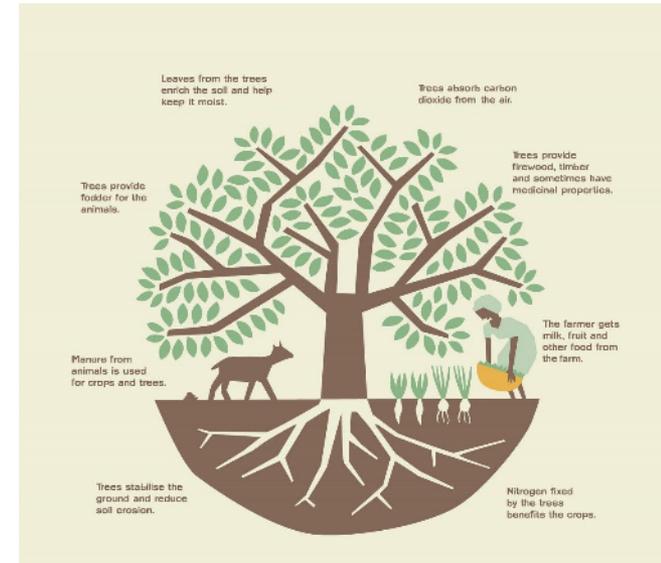
Definition of agroforestry:

Definition of AF:

- ▶ Woody / Crop / Animal Associations;
- ▶ Benefit from ecological and socioeconomic interactions;

Goals:

- ▶ Produce better and more: optimize biomass production;
- ▶ Diversify revenues: stable cash flow;
- ▶ Reduce risks: diseases, drought, etc.
- ▶ Sustainability of the operating system (production + conservation).

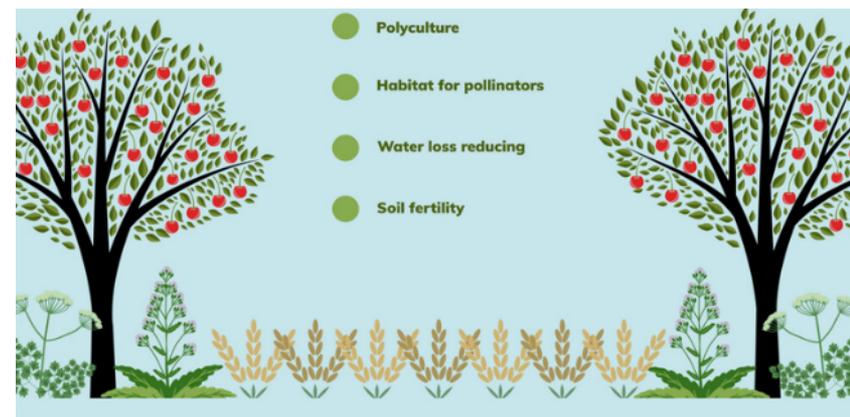
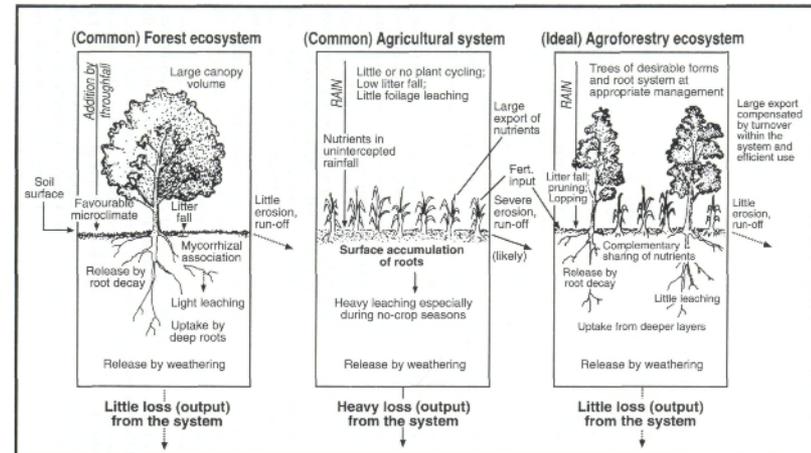


Definition of AF:

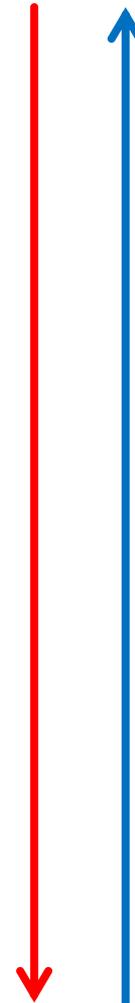
International Center for Research in AF, ICRAF, Nairobi.

“AF is a collective term to designate land use practices and systems where **perennial woody trees are deliberately cultivated** on land used for cultivation and / or breeding in a spatial or temporal arrangement and where **interactions exist both ecological and economic** between the woody species and the other components of the system”.

Agroforestry is an integrated resource management system for rural areas: soil, water, crops, trees, animals.



Model of transfer of matter and energy in a system : Tree / shrub / grass



Recovery
leaching
losses:
Water, N, P,
K, Oligo
Elements

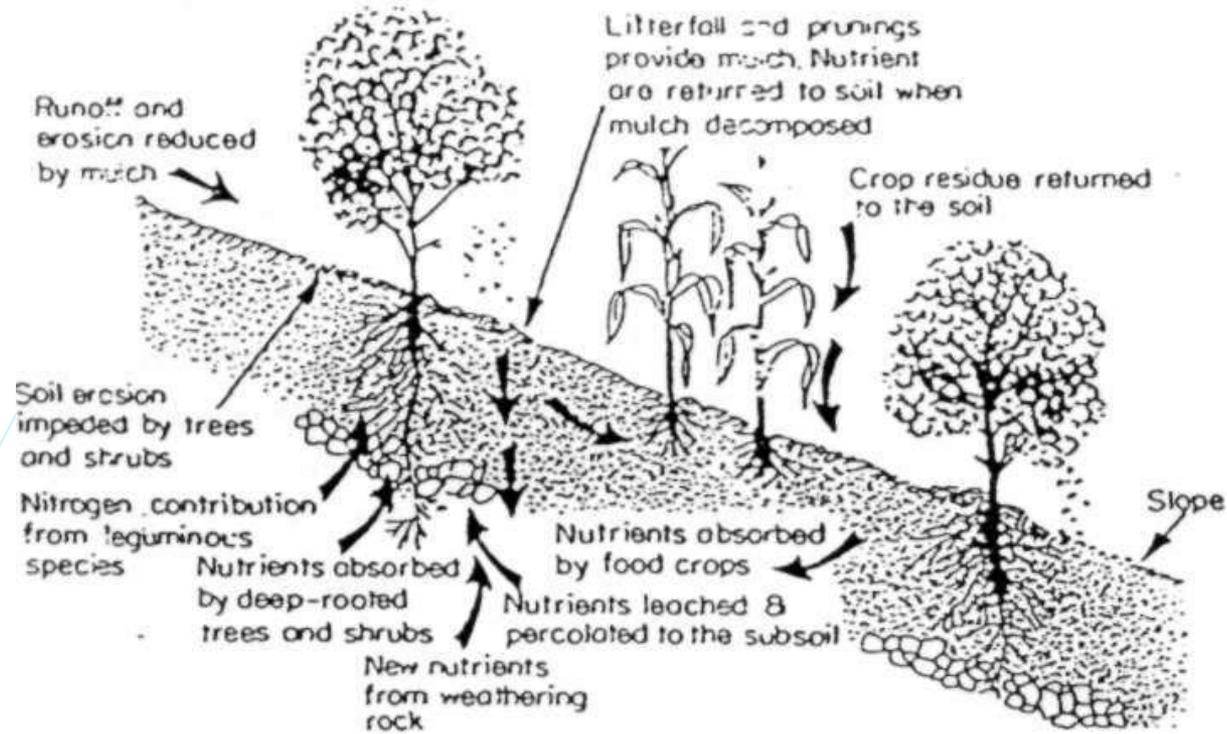


Figure 13 A schematic representation to show the benefits of nutrient cycling and erosion control in an alley-cropping system (Kang and Wilson, 1987)

Soil conservation = maintenance of soil fertility

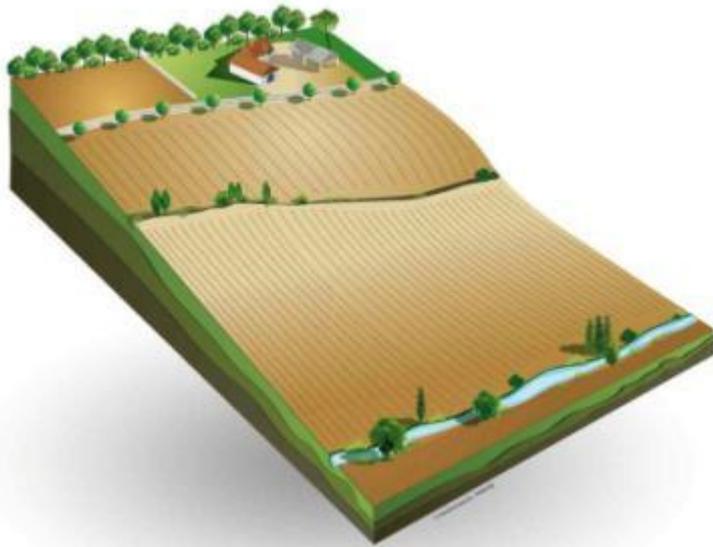
Which requires:

- Control of erosion,
- Maintenance of organic matter,
- Maintenance of soil physical properties,
- Maintenance of nutrients,
- Avoidance of toxicities.

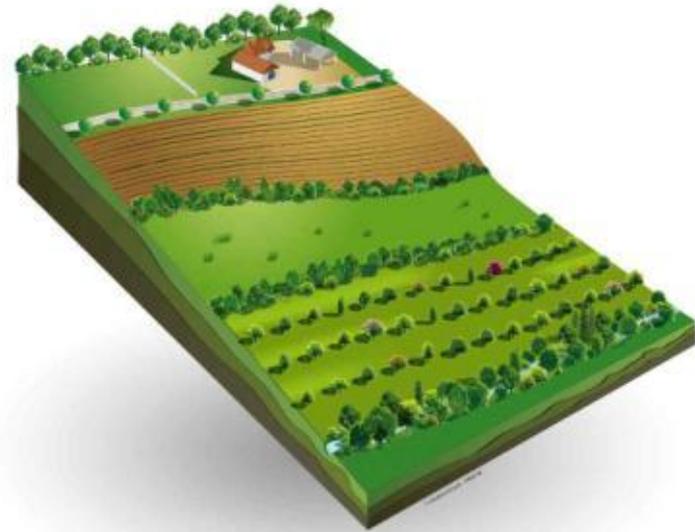
Current state:

Degradation process:

- Low vegetation cover
- Runoff
- Erosion
- Low productivity



Agroforestry
➔
Time



➤ Introduction of agroforestry system:

- Water and soil conservation (water balance)
- Plant diversification (biodiversity)
- Improvement of production (income)
- Rehabilitation of the natural environment (combating desertification)

Sustainability = Production + Conservation

Q1
Leaching losses are significant in agroforestry systems.

Q2
The ecological interactions between the components of an agroforestry system are positive.

Q3
Agroforestry systems increase evapotranspiration.

Q4
Role of organic matter :

Soils rich in organic matter are well structured.

Organic matter does not improve soil fertility.

The water retention capacity of a soil depends on its organic matter content.

Agroforestry systems store more C in the soil.



Some examples of agroforestry techniques

Alley cropping



AC + Polyculture



Crops under tree cover (almond + Saffron)



Crops under tree cover (olive trees + Iris)



Trees scattered in Mixed Cropping Systems

(Shea butter + Cotton)



Poplar + alfalfa



Trees on pasture land

Leaves as fodder



Shading trees



Shading trees

Contour plowing and planting to reduce soil erosion



Breaking of the slope,
Reduces runoff and
increases infiltration,
Improves of the protective
ground cover,
Increases the soil organic
matter,
Improves of biodiversity,
Improves landscape.

Trees in Hedges



**Hedge with Cactus +
Eucalyptus**

**Hedge with *Tetradenia
riparia***



Gully control with vegetation

Olive trees + fig trees



Linear oasis (Eucalyptus + cereals)



Trees in Home gardens

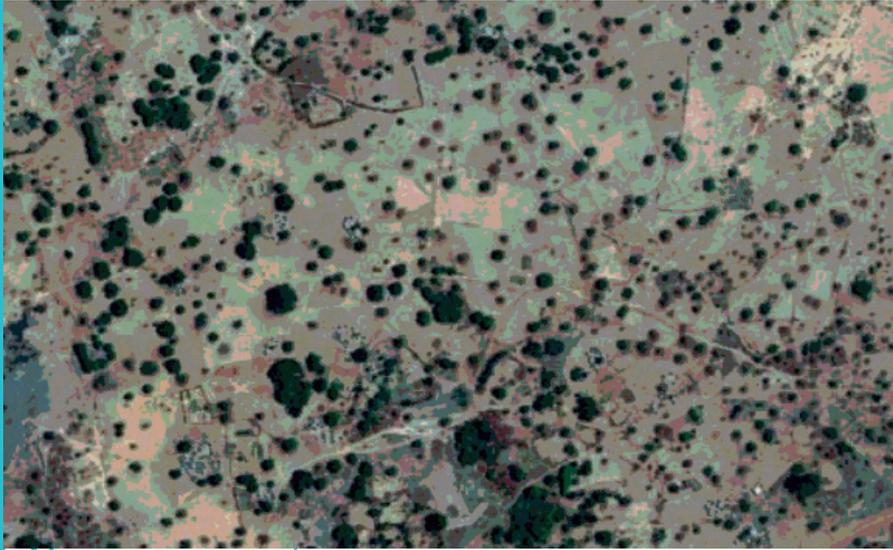


Eucalyptus for shadow

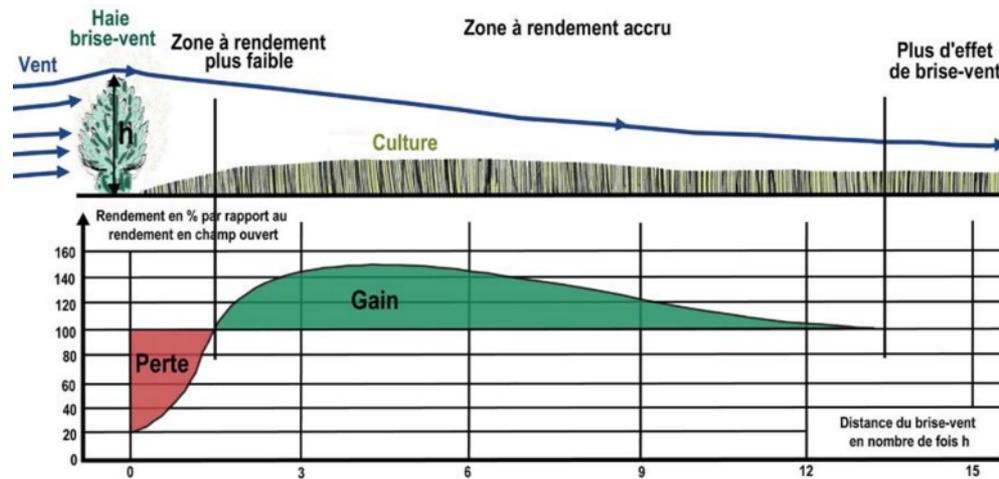
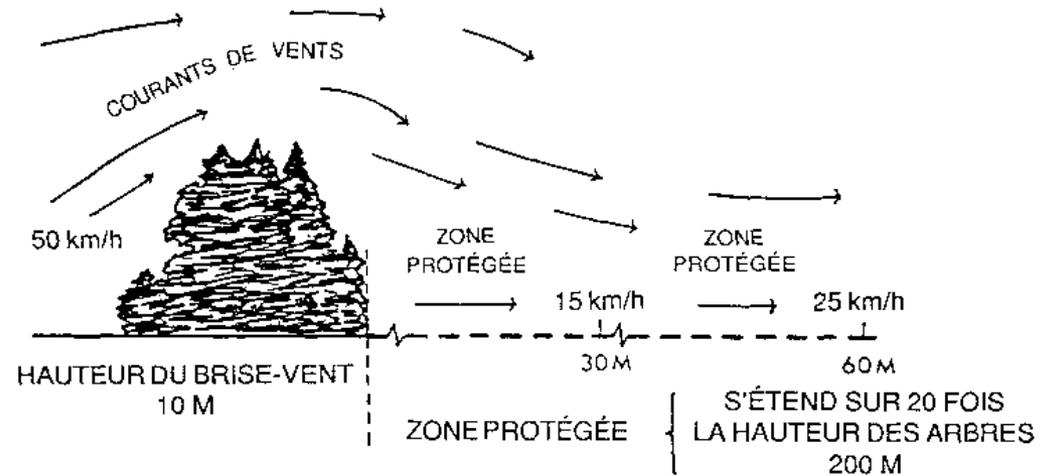


Mixture of fruit trees (olive, fig, vine))

Trees in small woods



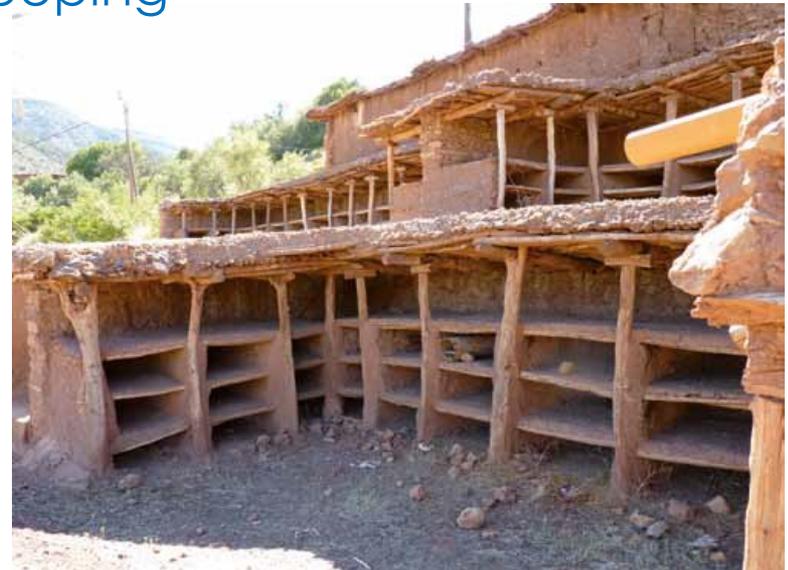
Wind breaks



Agroforestry and beekeeping



Traditional beekeeping



Application of Assisted Natural Regeneration (ANR) to Restore Degraded Lands

- ✓ ANR is a simple, low-cost forest restoration method that can effectively convert deforested lands of degraded vegetation to more productive forests.
- ✓ ANR aims to accelerate natural successional processes by removing or reducing barriers to natural forest regeneration such as soil degradation, competition with weedy species, and recurring disturbances (e.g., fire, grazing, and wood harvesting).
- ✓ ANR most effectively utilized at the landscape level in restoring the protective functions of forests such as watershed protection and soil conservation.
- ✓ ANR techniques are flexible and allow for the integration of various values such as timber production, biodiversity recovery, and cultivation of crops, fruit trees, and non-timber forest products in the restored forest.



Steps of ANR Implementation:

ANR is more suitable for restoring areas where some level of natural succession is in progress. As a first condition, sufficient tree regeneration must be present so that their growth can be accelerated.

Although the ANR method does not require significant research inputs before implementation.

The work plan should remain flexible, and the treatments are adjusted according to how the vegetation responds to interventions.



Step 1: Marking of Woody Regeneration

Site is surveyed to assess its successional status and to locate any natural woody regeneration growing above and below the weedy vegetation.

Step 2: Liberation and Tending of Woody Regeneration

Accelerate the growth of the marked seedlings by reducing competition from the weedy species for water, nutrients, and light.

All competing vegetations within at least 0.5 m radius around the stem of the marked seedlings are removed.

Fertilizers may be applied to the seedlings to further enhance their growth.



Step 3: Suppressing Weedy Vegetation

Once the desired number of wildlings has been marked and ring-weeded, the suppression of other weedy vegetation throughout the site is the next critical step.



Step 4: Protection from Disturbance

Protecting against fire and other forms of disturbance is the most important ANR activity (animals, human activities).

Long-term community involvement and support is critical in preventing the reoccurrence of disturbance events.



Step 5: Maintenance and Enrichment Planting

Maintenance of ring weeding, and liberation of any additional seedlings that establish or that are newly found,

The frequency of maintenance operations can be adjusted according to field observation and monitoring data on the growth of the liberated seedlings and the density of natural woody regeneration: two to three times a year.

Enrichment planting can also be carried out to accelerate canopy closure, add useful tree species, and increase floristic diversity.

Restoring the floristic diversity of the original forest can be an objective: trees lacking in natural regeneration will need to be planted (At the initial treatment stage or after canopy closure).



Labor Requirements

A team of three persons can therefore initially treat 1 ha of land in five days.

Maintenance operations require about half of the amount of labor needed for the initial establishment.

The total labor requirement for implementing ANR would largely depend on the frequency of maintenance operations.



Social Foundation Development

The social aspects are very important in ensuring the success of ANR.

The local people must understand the benefits of ANR and fully participate in the activities.

The creation of stable and reliable incentives for the communities is critical. Combining forest restoration with inter-planting of agroforestry crops can diversify income opportunities for local people.

Awareness raising, capacity building, and promotion of participatory processes in managing the forest resource should be integral components of the ANR approach.



Some case studies (success stories)

Biological recovery of degraded land Center-West of Burkina Faso

Protection of the soil with woody biomass produced by species in the agroforestry park such as neem (*Azadirachta indica*), Guiera senegalensis and Piliostigma reticulatum.



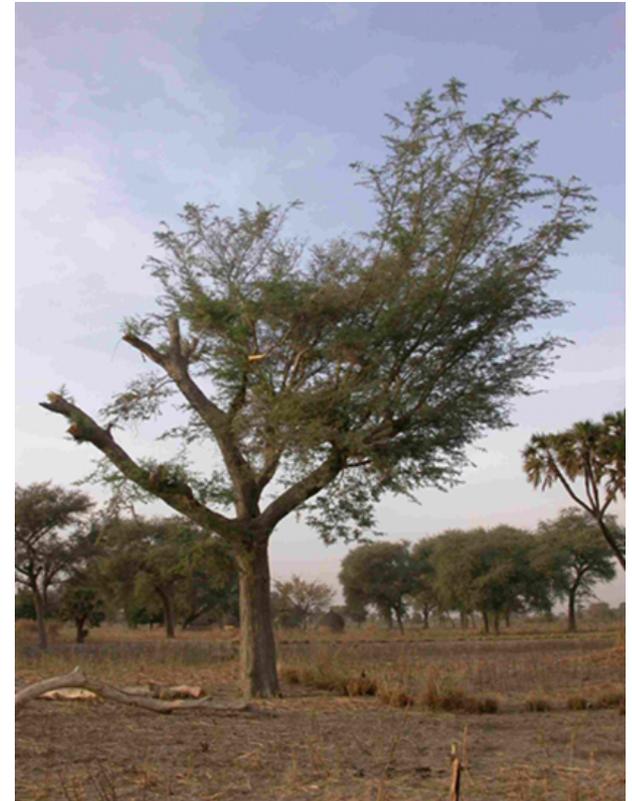
Rangeland improvement in Sahel Doukkala, Morocco



Windbreak made of Eucalyptus + Acacia planted on the limestone rocks,



A traditional agroforestry parkland with scattered trees beneficial for soil properties



Influence on soil properties: OM, Humidity,

Tree species : *Faidherbia albida* (syn. *Acacia albida*), *Sclerocarya birrea*, *Sterculia setigera* and *Combretum glutinosum*.

Crops: Millet (*Pennisetum typhoides*), groundnut (*Arachis hypogaea*) or watermelon (*Citrullus lanatus*) are grown in rotation.

The fertilizer trees

Capture nitrogen from the air (enrich the topsoil of an earth)

Improve soil structure

Resistant to drought (low water requirements)

Acclimatize to the Sahelian zones

Secure the plots

Reduce erosion problems

Increase crop yields (+ 30%)

Provide wood and fodder



The most emblematic agroforestry park in sub-Saharan Africa:

Faidherbia Albida.



A singular crown:

- ✓ Optimizes crop yields (soil fertility)
- ✓ Feed the herds with its leaves
- ✓ Bulwark against desertification



Agroforestry and shellfish in the Senegal Sahel (Ecovillage)

Chronic drought in the Sahel: many farmers abandon agriculture and migrate to cities to find work;

Desertification due to deforestation: dry season.

Petite Côte region.

Agroforestry: combining the planting of fertilizer trees, fruit trees and vegetables in a field to resist drought and food insecurity.

Baobab, Acacia albida.



Ethiopia: agroforestry stronger than famine

- Lasting drought
- Ten million people affected by food insecurity
- Rural exodus.

Village of Abreha We Atsbeha the peasants decided not to give up:

- State proposal: experiment with new agricultural methods: combine agriculture
+ trees + rainwater harvesting techniques.
- After two: we produce our food ourselves (three harvests per year).



To achieve this:

- Dig hundreds of wells
- Create terraces to cultivate the mountains
- Build dikes to hold water

Farmers also had to change their agricultural practices (principles of agroforestry):

- Introduced composting,
- Established crop rotation and diversified them,
- Planted with many trees: *Acidias Faidherbia albida*:
 - ✓ Orange, mango and avocado shade,
 - ✓ Enrichment of the earth with nitrogen,
 - ✓ Pods are harvested to feed livestock,
 - ✓ Feed the bees (honey sold in Europe).

The inhabitants of the village "Abreha We Atsbeha":

- Continue to work with researchers on new experiments,
- Contribute to duplicating this model in neighboring municipalities.

Head of the village: "When a person owns land, can work and eat as he pleases, he has another option than crossing the Mediterranean".



Thank you for your attention



Merci pour votre attention

شكرا على انتباهكم.