

# Why is that child hungry ? from a Natural Resource Management perspective.

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## Ecosystem functions

- Plant cover (energy flow)
- Water cycle
- Plant and animal diversity
- Living soil (nutrient cycle)

There are four fundamental functions in the environment – energy flow or conversion of solar energy into chemical energy via plants (plant cover) and cycling of this energy through animals; water cycle; biodiversity and nutrient cycle.

# Vegetative Cover

(Energy flow)



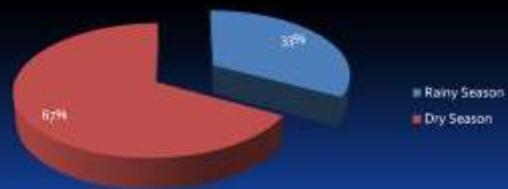
All energy used in natural systems ultimately comes from the sun. We either obtain this energy directly by eating plants, or indirectly by eating animals or animal products.



By relying predominantly on annual crops, only 33% of the days in the year are utilized i.e. Only 33% of available sunlight. If drought or other calamities occur 0% of the available sunlight may be used for food production.

= lost opportunity.

% of days in year utilized





% of land by land type

In some regions, 50% of the landmass is idle for 100% of the time = a lost opportunity.



This degraded land is not converting sunlight energy into chemical energy for any part of the year. This is a wasted opportunity because, with remedial action, it is quite capable of being productive again.



Niger – 8 month dry season is normal. What is abnormal is the total lack of vegetation.



This land is not desert. Trees have been cleared and grasses over grazed. During drought, the effect on livestock is devastating.

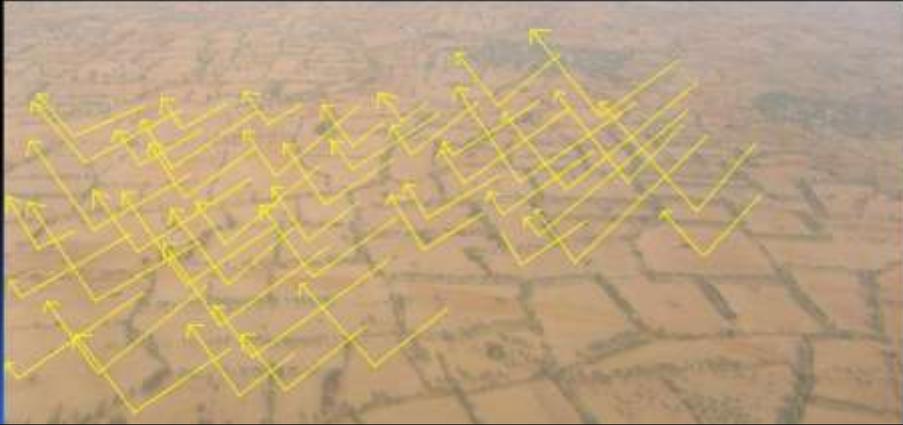
On a landscape scale, the lost opportunity for food, fodder, fibre & wood production is enormous!

X 50% of light 'catchment' area vegetated

X 33% of available light utilized / year

= 16% of available light used

over vast landscapes.



When sunlight hits this bare surface vast amounts of radiant energy are reflected into the atmosphere. On a landscape scale, this can have a negative impact on rainfall patterns.

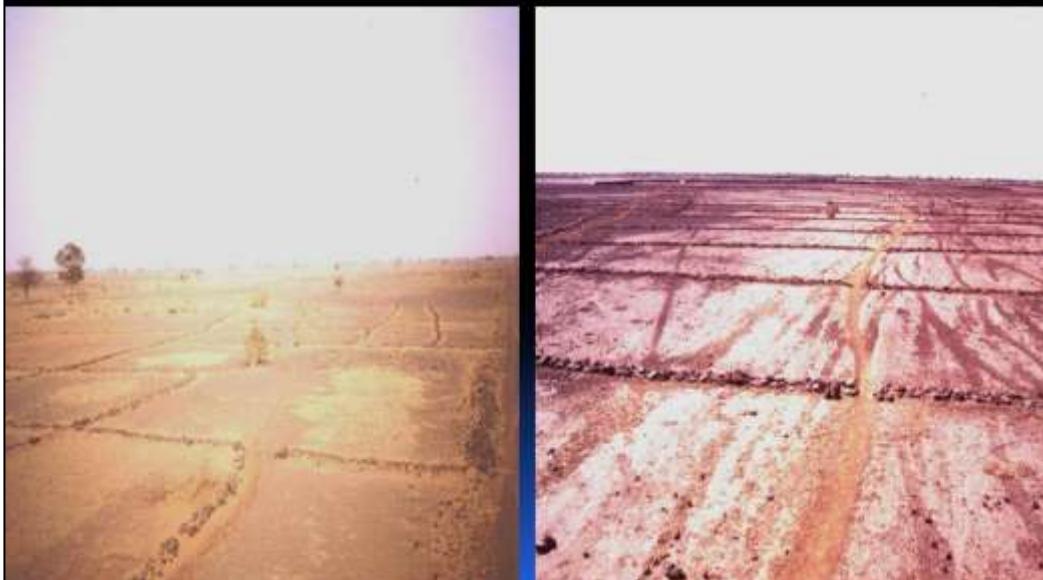
## Bioreclamation of Degraded Lands (BDL).

Dov Pasternak, formerly of ICRISAT.

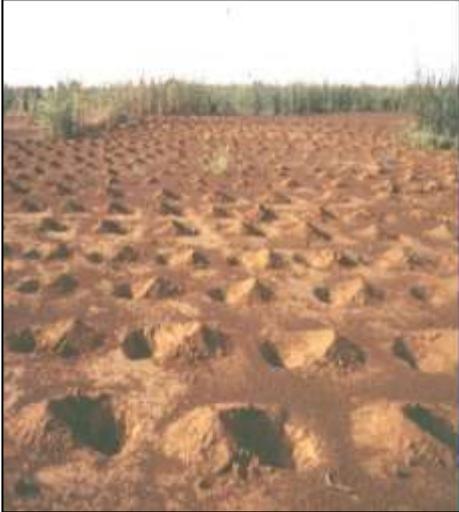
Turning wasteland to productive profitable land.



Illéla ouest en 1984



Illéla ouest: début des aménagements en 1990



Illéla ouest en 2004



## Agro forestry systems – fruit trees, FMNR,



Farmers in Niger have learnt to keep the land surface covered in vegetation for as much of the year as possible. Above left – cassava crop growing in the dry season without irrigation. Right: edible seeded acacia tree growing in the dry season. Below: FMNR – thick stand of trees, keeping the land covered in vegetation for 12 months of the year.

Trees are extremely important: all crops stop growing in the middle of the day in the lowland tropics because the heat is too much for them to continue growing, a light shade will actually increase crop yields by about **50 to 70%**. With shade from trees, farmers got about 50% higher yields in the good years than did their neighbours. But even more important for smallholder farmers, in the bad years, when their neighbours harvested virtually nothing, those with the shade got about the same yields as their neighbours did in good years. This is also of great significance to climate change: 15% shade would bring down the temperature approximately 10 °C.



With trees there is ample fodder – even in dry season.

Many tree species provide valuable fodder for livestock. When trees are cleared, this natural reserve of fodder is lost. When this happens and once the grass is depleted livestock become more vulnerable to hunger.

Additional benefit of perennial trees & crops:

Crops stop growing in the middle of the day because it is too hot. A light shade will increase crop yields by about 50 to 70%.

With shade from trees, farmers got about 50% higher yields in the good years than did their neighbours.

15% shade would bring down the temperature approximately 10 °C.

Farmers fear leaving trees in the field. They are concerned that shading will stop plant growth. In fact, a certain degree of shading is very beneficial in hot climates.



This land had been cleared of trees. Through FMNR trees have returned and as a result crop yields have increased from 300-500 Kg/ha – to 1000 – 1500 Kgs/ha.

In addition farmers now harvest more straw and firewood from their farms.

Ground cover spp. – seen as useless weeds at worst, or at best, sources of quick fodder which are uprooted for livestock.





Trees can often grow where and when annual crops can't, utilizing more of the available sunlight & Providing income, food, fibre, medicines, etc



Economic development – establishment and growth of wood markets. People now had an incentive to grow trees.

# Water Cycle



There is no less water in the world today than when it was created. But there is greater demand, and what water does fall as rain and snow is less well utilized because of land degradation and climate change.

In a normal water cycle, water evaporates from land, lakes and sea and forms cloud. Under the right conditions clouds release rain and when it falls, some soaks into the ground, recharging aquifers and springs, some soaks into the ground and is available to plants and some flows to lakes and the sea in rivers. In a healthy environment where there is plenty of vegetation and soils have a high organic matter content, water is released slowly and over time during drought periods, and more water is absorbed and retained during heavy rainfall periods, decreasing the severity of floods.

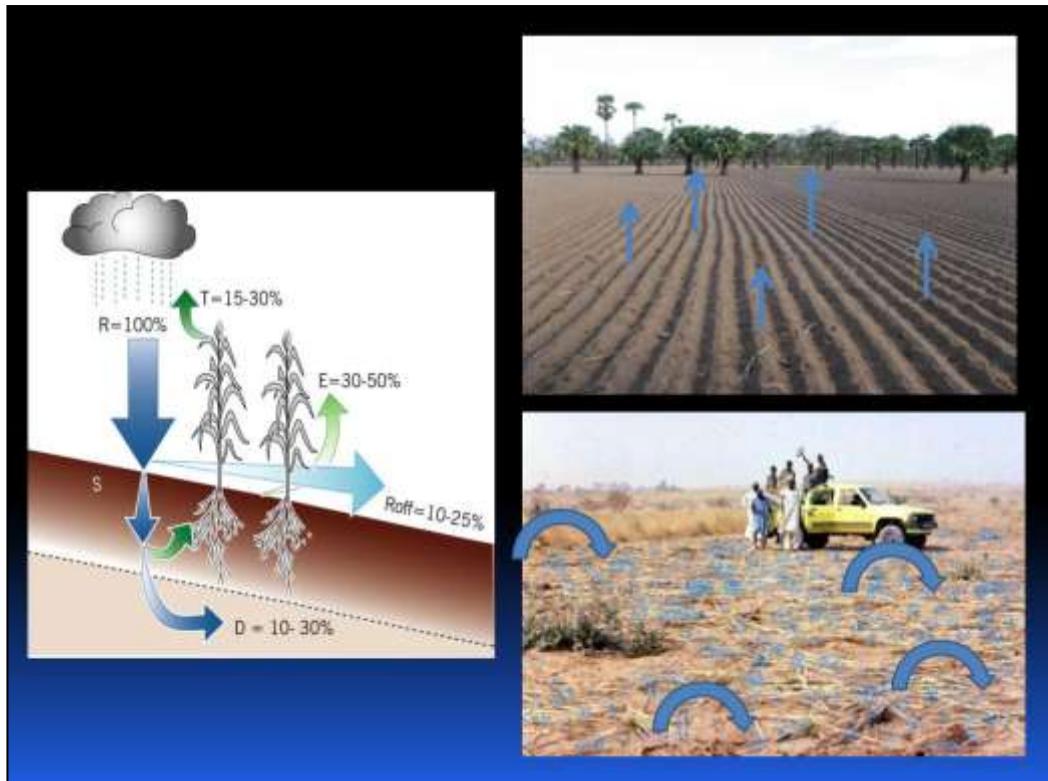


Farmers often complain of drought, and yet, often the real problem is that the land is not able to absorb the rainfall that does fall.

This was taken one day after rain. The hills in the background have been badly deforested. When it rains there is massive run off and flooding, in this case making it impossible to utilize good agricultural land during the rainy season.



The very next day, the stream stops flowing. So you go from feast to famine in a very short period. A healthy water cycle occurs when there is adequate vegetation. The water infiltrates the soil, which acts like a sponge, and is slowly released over time. Severe flooding and severe drought are less common.



Diagrammatic representation of moisture being retained in the soil through mulching.

Unprotected soils lose vast amounts of water through run off, seepage into deeper soil layers and evaporation. By simply following principles of conservation agriculture, in particular, mulching, evaporation and runoff are reduced dramatically.

Hand-hoe CF farmers in Zambia produced 1.5 tons more maize per hectare than did farmers practicing conventional ox-plow tillage. Among maize farmers, 1.1 tons of this increase was estimated to result from the CF technology: 400 kg from early planting and 700 kg from water harvesting and greater precision in input use in the basins. The remaining 400 kg was attributed to higher

doses of fertilizer, lime and high-yielding maize seeds.



Mulching impacts on –  
 moisture,  
 fertility,  
 erosion,  
 temperature,  
 weed control,  
 labour requirements  
 soil carbon,  
 food security,  
 income..

Zimbabwe test farm:

Conventional	CA
28.5 tons soil /ha lost	1 ton soil/ha lost.
90% rainfall runoff	6% rainfall runoff.

This heavy mulch will help retain significant amounts of soil moisture which would otherwise be lost.

Impact of mulch – crop growth is more vigorous and healthier in the mulched background section of this farm.



Reduced soil temperatures – increased crop survival and performance.  
Lower temperatures = less evaporation.

Agriculture without shading in Africa is very difficult. Bare soil in this slide reached 50 °C but in the shade of mulch it is 39 °C. Because of the lack of trees, people removed all mulch from the land – using it as substitute firewood or as fodder for their livestock. This caused increased soil temperatures and evaporation rates.



Mulch also reduces physical damage caused by windstorms.



Zai holes prepared  
in the dry season.

Severe drought  
year. Millet in  
foreground and  
background  
planted on same  
day.



**Zai**

**No zai.**

This farmer has prepared planting pits with organic matter in them. In the rainy season he sown his crop in the holes. Because of the increased fertility and increased water infiltration and retention, crop yields increase substantially.



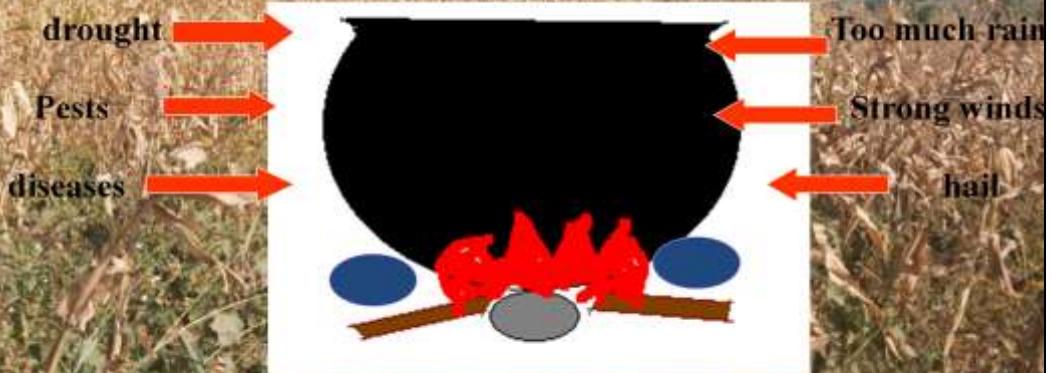
Abrha Weatsbeha, Ethiopia.  
'Water banking' allowed irrigation and 2-3  
crops per year. Today there are > 600  
shallow wells in this community.



Through soil/water works (trench bunds, damming of gullies..) water tables  
have risen 7 meters making irrigation from shallow wells feasible and harvest  
of three high value crops per year.

# Biodiversity

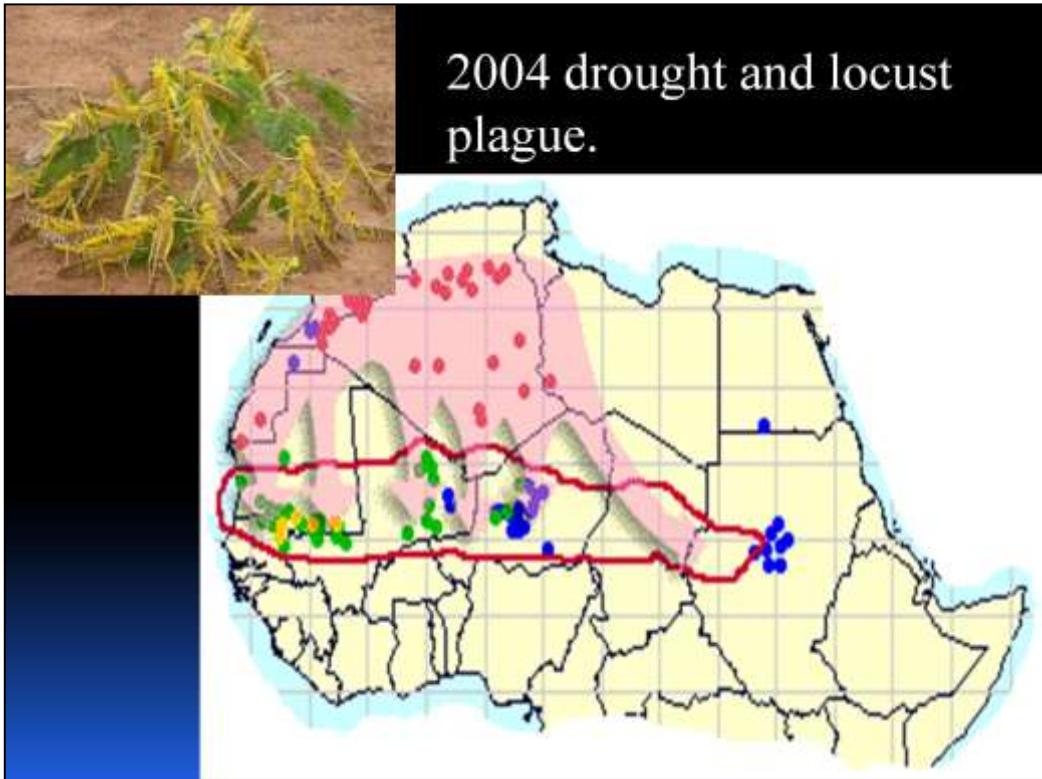
trying to balance a pot on a single stone!



Biodiversity is very important for creating more resilient agriculture. If a variety of plant and animal species are used in a farming operation, no matter what climatic conditions of pest/disease attacks occur, the farmer is much less likely to suffer total crop loss.



Millet crops in Niger are plagued by myriad problems, including locusts, stem borer and striga, a parasitic weed.



August 2004. Swarms (green) continue to arrive in West Africa and lay eggs that hatch after about 10 days causing hopper bands (yellow) to form within a large area of pasture and crops (red). Source: FAO

spring swarms newly arrived

warms from NW Africa hopper bands adults & groups

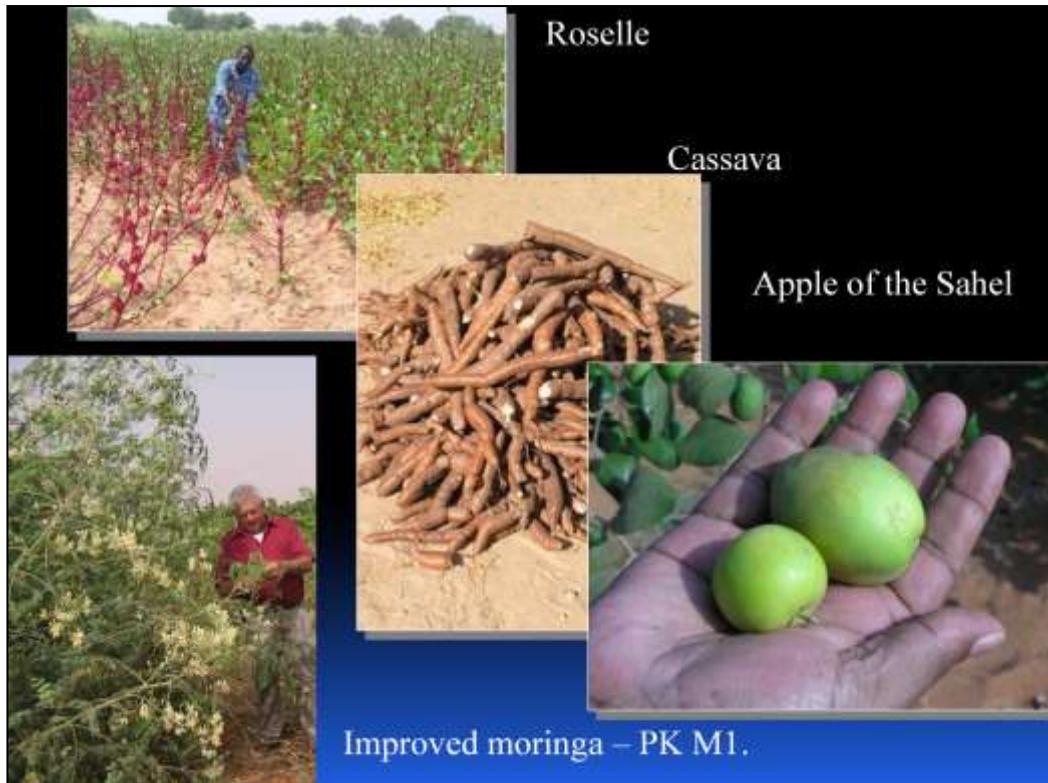
**According to Karen Homer, the World Vision Communications Manager in Mauritania, Locust swarms blackened Nouakchott on August 4, 2004, devouring the little greenery in the desert capital. A swarm covering an area as large as 1 km<sup>2</sup> is made of 50 million bugs and each eats about 2 grams of plants per day; immature locusts requiring more than that.**



*Bosica senegalensis*

Not far from the garden, *Bosica senegalensis* thrives. This is an indigenous tree providing a traditional source of food (Warning – it must be pre-treated properly to get rid of toxins). It was not affected by the prevailing drought and locust plague.

Moringa – right – a highly nutritious and hardy tree which can be grown in Sahelian conditions.

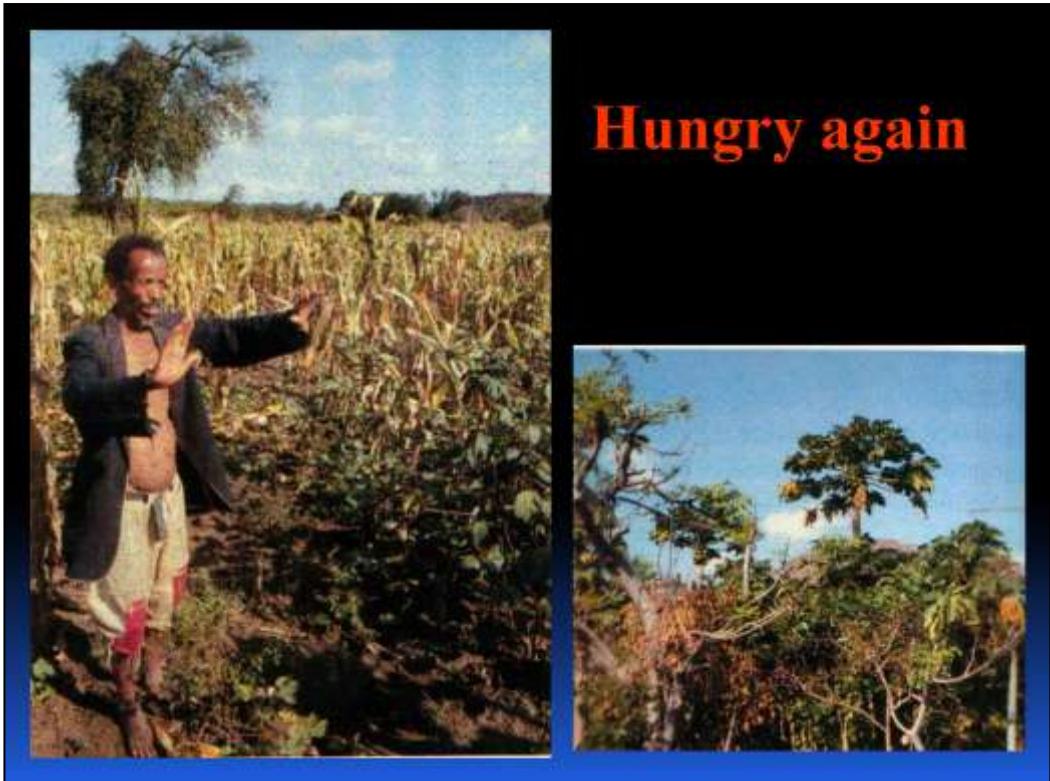


Even in the Sahel, there is a great deal of crop biodiversity which can be used in farming systems.



There are many neglected fruit and leaf trees of nutritional and economic value.

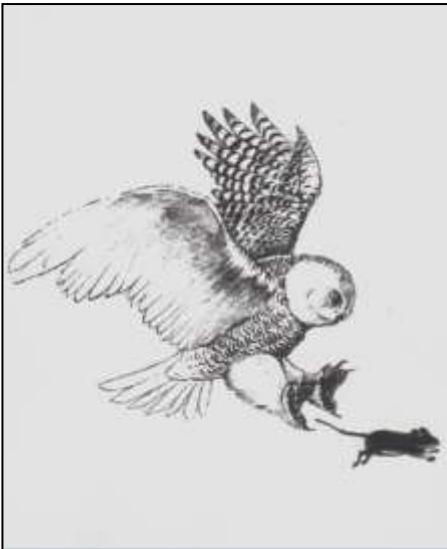




This farmer's main field is completely planted to maize. Because of unfavorable rainfall conditions, the whole crop failed. Yet, in his backyard garden, he grows a wide variety of crops which were barely impacted by the drought.



These trees are producing a 'crop' of firewood every two years.

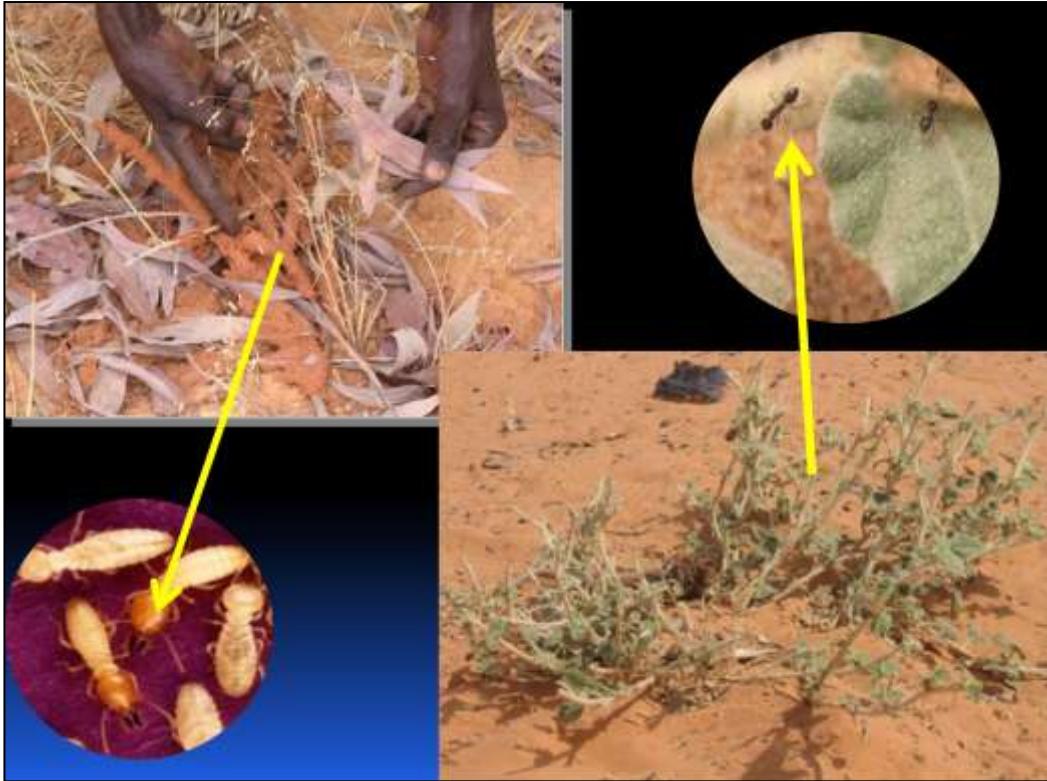


Not only diversity of  
domesticated crops and  
animals.



Biodiversity

Owls, cattle egrets play critical roles in keeping down pest numbers.



Biodiversity even of non commercial crops and animals is important.

Termites break down organic matter, incorporate it into the soil structure, aerate the soil and their tunnels increase water infiltration.



Spiders, preying mantids reduce insect numbers – for free and with no toxic residue.



No pruning.

3 months growth

one year old.

### Procera calatropis

- Grows in very arid areas
- Termite resistant.
- Used in traditional house construction
- 50-75 cfa/ stem.



## Management of biodiversity

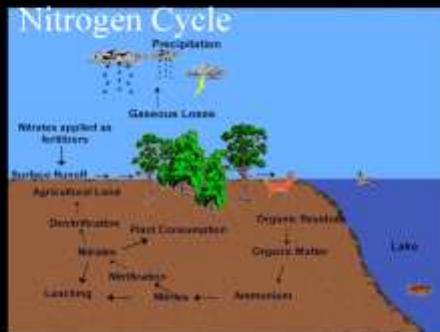
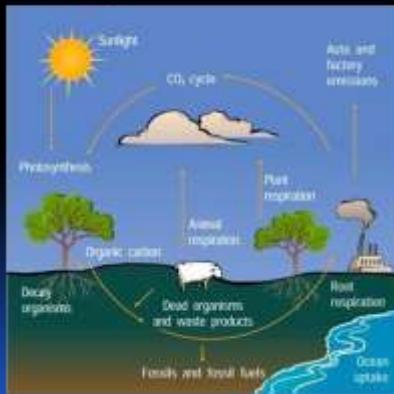
- enables farmers to benefit from 100% of the landscape instead of just 20-50%.
- enables farmers to be productive for 100% of the year, instead of just 25 – 50%

and

- enables farmers to continue being productive even in the face of environmental shocks such as drought, floods, severe storms and pest attack.

# Nutrient Cycle

## CO<sub>2</sub> cycle



In a healthy, functioning environment, soil fertility is maintained through natural processes which recycle nutrients and make them available to plants and animals.



We depend on the soil for food – for our life, yet in most places in the world, we have degraded and destroyed our soils. Instead of being full of life, many soils are biologically dead and therefore cannot support optimum crop and animal growth.



## Living Soil

- ~1 gram of productive soil contains
- ~ 100 million - 1 billion bacteria.
- ~ 25,000 species of bacteria
- ~ 8,000 species of fungi.

Healthy soil behaves like a living organism. All life and sustenance comes from the soil. If we treat the soil with respect, we go a long way towards creating food security.

Nutrient Cycle

A healthy soil is full of living organisms.



Bare surfaces are subject to very high evaporation rates. Winds and higher temperatures accelerate evaporation and loss of organic matter which in turns reduces total volume of life (micro-organisms and micro fauna and flora) in the soil, and its biological activity.

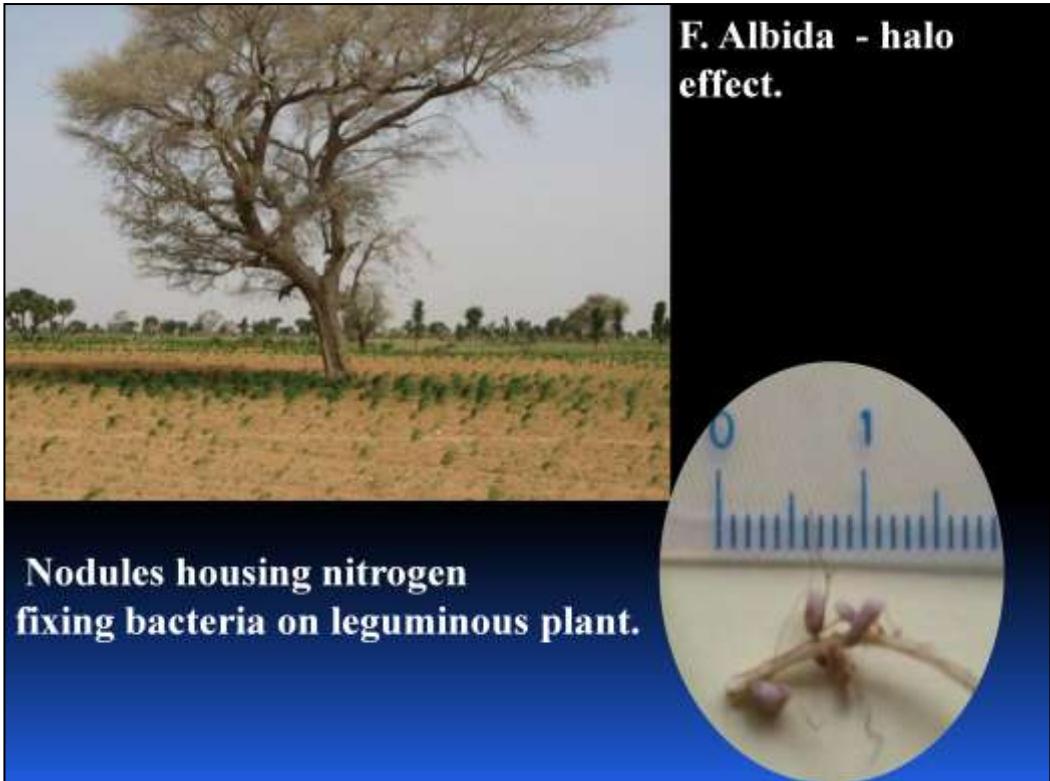


Almost universally farmers burn crop residue and organic matter. This destroys the soil structure and kills soil life.



A healthy soil is protected from the elements by plants or at the very least, mulch.

Top Right – fungi attached to plant roots in healthy soil increase plants access to moisture and nutrients



The same species in Niger is highly prized as a fertilizer and fodder tree by many farmers.

Soil Fertility and tree cover.

Soil beneath shrubs form 'fertile islands' in fallow sites and millet fields in semi-arid Niger.

Significantly higher concentrations (38–51% for C, N, P and 22% on ECEC for K<sup>+</sup>) *were found in the soil under the shrubs.*

This work shows that shrubs are of vital importance for the accumulation of nutrients and maintenance of soil fertility within agro-ecosystems of Niger.

Wezel et al. ORSTOM. 1999.



Halidou deliberately spreads leaf litter on his millet field as a mulch and source of organic matter.

## Why is that child hungry?

From a natural resource management perspective, that child is hungry because her life support system, the environment, has been damaged. It cannot provide abundantly, as it was created to.

That child is hungry because only 50% of the land is converting sunlight energy to usable energy for 30% of the year, while 75% of the rainfall runs off or evaporates, 95% of the available biodiversity goes unused and 90% of the soils are infertile and biologically dead.

Fortunately, like God, the environment is very forgiving, and will give us a second chance – if we turn from our destructive ways and walk humbly with it.

Only 50% of the land is converting sunlight to usable energy for 30% of the year, while 75% of the rainfall runs off or evaporates, 95% of the available biodiversity goes unused and 90% of the soils are infertile and biologically dead.



Greatest natural resource – people. Have to understand them and work with them to bring about positive changes.





Plan for Farmer managed agroforestry farming system.

Trees around border and in wind rows are edible seeded Australian acacias.

Black random dots represent FMNR.

Different shades of colour in strips represent different annual crops grown in rotation.

Fields are mulched utilizing crop residues and tree leaves.

Wood and seed is harvested from the acacias. FMNR provides indigenous fruits, fodder, fuel wood and building poles.

**Average annual economic benefits from a  
1/2 ha FMAFS vs control farm at Magajin  
Kware (2007-2009)**

<b>FMAFS Component</b>	<b>FMAFS (cfa)</b>	<b>Control (cfa)</b>	<b>% Increase</b>
<b>Annual crops</b>	<b>34,630</b>	<b>11,460</b>	<b>202 %</b>
<b>FMNR wood</b>	<b>6,500</b>		
<b>Acacia wood</b>	<b>5,660</b>		
<b>Acacia seed</b>	<b>10,750</b>		
<b>Total benefits</b>	<b>57,450</b>	<b>11,460</b>	<b>502 %</b>

FMAFS has yielded up to 500% increase in income.



Tigray, Ethiopia. Cactus is very drought hardy and produces fruit during the dry season when other crops are not growing.



Cactus bread.

## Play the String Game



### Instructions:

1. Take a card & hold it up for others to read
2. Hand ball of string to person of your choice while holding onto end.....
3. Tell the group what impact your 'card subject' has on the recipients 'card subject' OR what impact recipients subject has on yours

Challenge conventional paradigms.

*"But its always been done this way" does not resolve hunger and poverty.*

Success has more to do with 'winning hearts and minds'  
than finance, technology or brilliant systems

*(there's nothing as powerful as an idea whose time has come – Victor Hugo).*

Solutions may be staring you in the face – Look, ask, listen,  
test, be prepared to fail/ make mistakes – but LEARN from  
them.

*Usually, the seeds of a solution are embedded in the problem.*

Is there a simpler way of getting the same result? – Usually,  
yes. (FMNR)

Introduction	
Food Security from a NRM perspective	1 hour
String game	15 min
Questions / discussion	15 min
'What is FMNR'	15 min
BREAK	15 min
Edible acacias for food security	15 min
Wattle seed dreaming.	30 min
Exercise.	15 min



F. albida agricultural 'parkland', Zinder region, Niger.

**Nine year old F. albida fertilizer trees in a maize/conservation agriculture production systems. Malawi and Zambia.**

