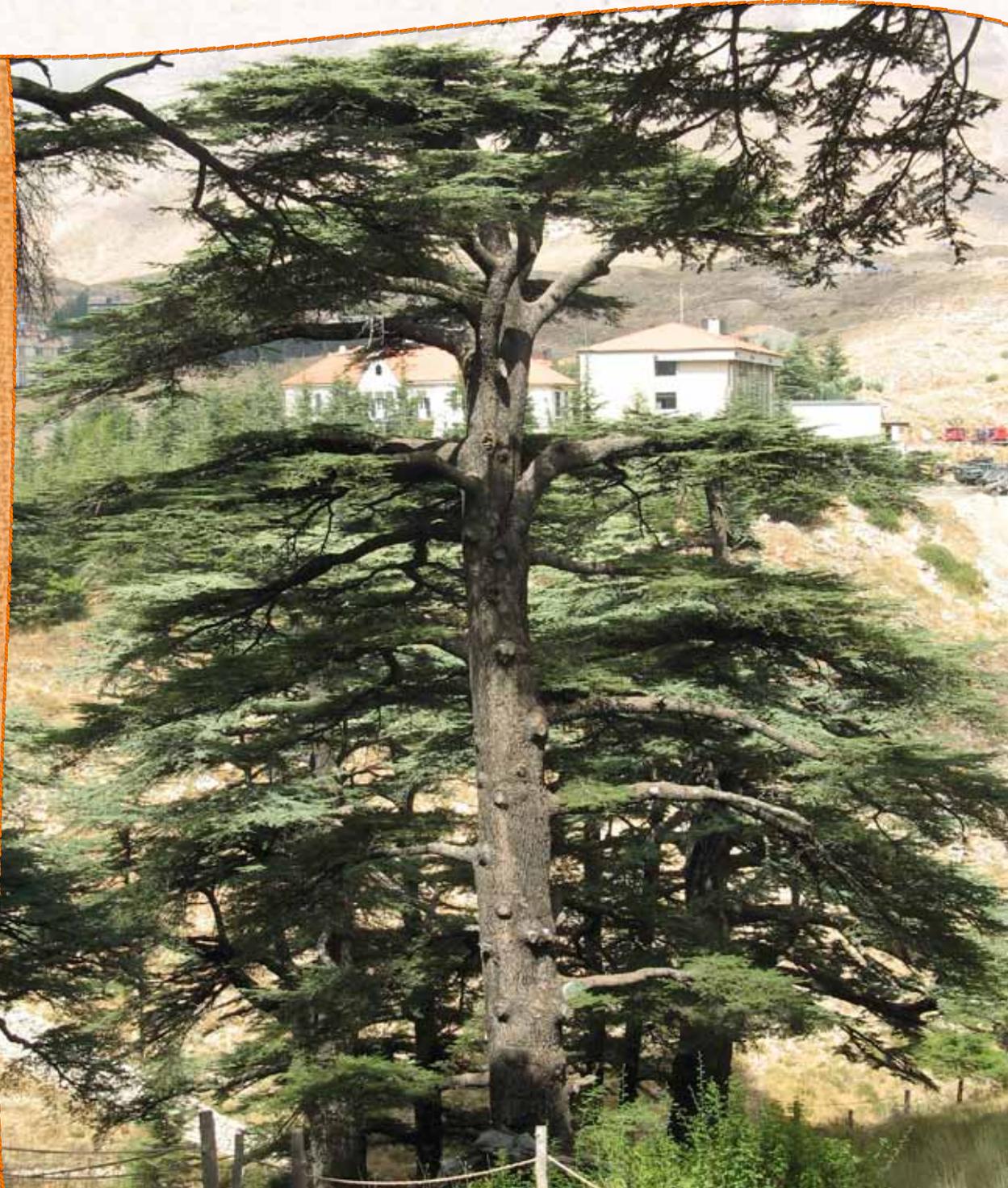


Natural resources scoping visit to Lebanon

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Introduction

I was invited to Lebanon by Paul Skayem, World Vision Lebanon Support Manager. The objective of the visit was to provide advice related to natural resource management, particularly in the area of forestry, and to give insight into a permaculture approach to natural resource management.

Over the course of four days, short visits were made to sites in Bsharreh, Bekaa and Marjeoun representing very diverse environments ranging from coastal Mediterranean, to high altitude mountains receiving higher rainfall, to drier parts of the country on the Syrian border. I met World Vision Lebanon staff and visited remnant forests, tree planting sites, tree nurseries and agricultural sites.

Rationale for investing in natural resource management

Economic development is one of the major focus areas for World Vision Lebanon. Primary industries (agriculture, fisheries, forestry) play a pivotal role in stimulating and making possible economic development. In turn, the sustained productivity of primary industries and hence economic development are dependent on the existence of a healthy functioning environment.

Primary industries and economic development need to be seen as a subset of the environment and not vice-versa. The four ecosystem processes (Annex I), water cycle, mineral cycle, energy flow and population dynamics, contribute to and make possible the sustained productivity of primary industries. These ecosystem processes build biological wealth¹ or natural capital, which is the source of raw materials and many services essential for food production and ultimately economic activity.

From a natural resource management perspective, bottlenecks reducing productivity of primary industries and hence economic development are associated with constraints to the full functioning of ecosystem processes. Anything that minimises the conversion of the sun's energy to biomass, degrades nutrient and water cycles, reduces biodiversity or distorts optimal species sex and age ratios reduces the sustained productivity and resilience of primary industries.

To a large extent, the environmental problems being experienced by Lebanon are symptoms of the breakdown and malfunctioning of the four ecosystem processes. Understanding the processes provides a useful lens for understanding environmental problems while pointing to possible solutions. This assessment has used this lens to look at environmental problems and to devise possible solutions.

By addressing these natural resource issues it is possible to realise large increases in productivity with few or no energy-intensive inputs, when starting with low productivity as the baseline. However, dealing with production issues alone is insufficient for ensuring sustained increases in productivity. An enabling environment, which is an essential ingredient for success, includes:

- access to markets;
- benefits that justify the investment;
- availability of appropriate technologies;
- adequate land and security of tenure; and
- risks that can be managed.

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¹ Savory, Allan. Generating Wealth, in Holistic Management™ In Practice. Special Edition 2000. Biological wealth, or natural capital is the source of raw materials we need and enterprises use in their value creation processes as well as the environment in which it and its employees live. Natural capital provides many services such as food, medicine, clean air, biological waste recycling etc. The amount of biological capital a community or nation can amass depends on how well the four fundamental ecosystem processes, at work in any environment, function.

continued from page 3...

Reforestation is a major feature of this report. Reforestation can contribute to World Vision Lebanon's economic development strategy in the following ways:

- stimulation of ecotourism;
- increased production, processing and marketing of timber, firewood and non-timber forest products (wild fruits, nuts, olives, honey, medicines, herbs, fodder, resin, essential oils, etc);
- increased investment in new market opportunities;
- increased employment through processing of forest products;
- reduced soil erosion (reduced cost to agriculture);
- reduced flooding (reduced cost to agriculture, reduced humanitarian emergency risk);
- improved fire control (reduced costs to society, reduced humanitarian emergency risk);
- increased water infiltration, increased water for irrigation, for drinking and environmental flows (greater resilience to drought and climate change);
- sale of carbon credits, biodiversity credits and access to REDD+ funding streams.

Permaculture, or "permanent agriculture", provides a framework for building sustainable production systems. Permaculture is an approach to designing human settlements and agricultural systems that mimic the relationships found in natural ecologies². Typically permaculture encompasses any system of sustainable agriculture that renews natural resources and enriches local ecosystems, but includes the design, installation and maintenance of indefinitely sustainable human communities set in balanced ecologies, both urban and rural. Permaculture ethics and principles are relevant to resolving environmental issues addressed in this review. A brief summary can be found in Annex II.

² en.wikipedia.org/wiki/Permaculture

Trip observations and discussion

I. Bsharreh

Bsharreh is a mountainous region with elevation ranging from 600-1,700 metres. The average rainfall has dropped from 1,000mm to 800mm. The district boasts the highest apple production in Lebanon and 2,500-year-old Cedar trees. Bsharreh is a popular tourist and skiing destination. World Vision Lebanon works in this region through government agencies, local NGOs, scouts, clubs and agricultural cooperatives.

World Vision Lebanon supports best practice nursery and tree plantation activities. I visited an impressive tree nursery producing 30,000 seedlings per year and a 500-hectare plantation site. Because of the cool climate and choice of mainly slow growing climax species (*Cedrus*, *Pinus* etc), seedlings are maintained in the nursery for at least two years before planting out and growth in the field is slow. Scouts and community-based organisations (CBOs) plant the trees. Costs are high as seedlings need to be transported, watered and nurtured for several years in the field to ensure successful establishment.

Field conditions for tree planting are very difficult. Soil carbon levels are low and consequently there is little soil biological activity. Soils are often bare and exposed to freezing temperatures in the winter and high temperatures and high evaporation rates in the summer. Bushfire and wandering livestock negatively impact reforestation success. Biodiversity is highly threatened in the district.



State-of-the-art tree nursery growing predominately *Pinus* and *Cedrus* species.



Well cared for 500-hectare plantation site. The site is equipped with watering facilities and hired staff care for the trees. Each year more trees produced in the nursery are added to the plantation.



The task is simply enormous. A local World Vision Lebanon-supported CBO is doing an excellent job at gradually expanding the forested area bordering this ancient Cedar forest. However, at this rate it will take many years to establish forests on a landscape scale.

Current nursery and forestry practices are excellent and should be continued in order to reintroduce indigenous *Pinus*, *Cedrus* and other indigenous species. However, while current forestry efforts are best practice, given the limited resources available, the small size of the CBO involved and the extensive area of degraded land, it will take many decades at the current rate of reforestation to make a significant impact.

World Vision Lebanon reforestation activities do not appear to have engaged communities, or at least, there appears to be little community ownership of reforestation projects. Trees are provided to municipalities and volunteer groups and maintenance is ensured through grants and donations which allow hired staff to be paid to care for planted trees.

Current approaches to reforestation emphasise technical requirements while social issues affecting success appear to receive inadequate attention. World Vision experience in other countries has shown that when individuals and communities are granted responsibility for managing the landscape (either through ownership or user rights) and are given technical training, and where there is potential for income generation, individuals and communities readily participate and the rate of revegetation accelerates (Annex III).

For example, in Sumba, Indonesia, after years of failed reforestation attempts, World Vision facilitated granting of land user rights for communities. Each participating member cultivated a section of land and planted trees which were individually labelled. In order to better care for the trees and gain an economic return even from the first year, participants planted cash crops (beans) in between the trees. Elements of this system could be adapted to suit Lebanese culture and environment.

As mentioned, climax species tend to be slow growing and hence it will take many years to realise direct benefits from tree planting efforts alone. Hence, in addition to climax species, greater emphasis should be given to rapid revegetation methods, including:

- Farmer Managed Natural Regeneration (FMNR) (Annex IV);
- planting large cuttings of species such as willow and poplar directly in the field³;
- direct sowing⁴ tree seeds and planting seedlings of fast growing pioneer species which can provide interim economic benefits.

As well as environmental benefits, species selected should preferably provide economic benefits such as timber and firewood and non-timber forest products such as honey, edible herbs and medicinal plants (Annex V) and fodder (Annex VI).

Naturally occurring species were found in Bsharreh. Through management of this growth and investing in their economic potential, faster reforestation rates would be possible and the forest would generate income for local communities in the short, medium and long term. Here are just three examples:



- i) **Rose hips** grow wild on the tree plantation site but appear to be unutilised. Rose hips can be used for herbal tea, jam, jelly, syrup, soup, beverages, pies, bread, wine and marmalade. They can also be eaten raw, like a berry, if care is used to avoid the hairs inside the fruit. Rose hips are particularly high in vitamin C, one of the richest plant sources available. They contain plenty of lycopene, an important and strong anti-oxidant, and are also a source of vitamin A and B, essential fatty acids and anti-oxidant flavonoids. Rose hips are beneficial in the treatment of rheumatoid arthritis, apparently due to both anti-inflammatory and anti-oxidant effects. Rose hips can be used to help prevent colds and influenza.

³ <http://www.youtube.com/watch?v=oNBy25BvTPY>, <http://www.bluestem.ca/start-cuttings.htm>

⁴ <http://www.regional.org.au/au/roc/1991/roc1991119.htm>, http://www.florabank.org.au/default.asp?V_DOC_ID=899
http://www.agric.wa.gov.au/objtwr/imported_assets/content/lwe/vegt/trees/f03498.pdf,



ii) Wild plum. This stand of hardy wild plum trees indicates that there is some potential for natural forest regeneration (FMNR). If assisted through pruning and thinning, such stands would grow faster. In the author's experience, most people do not even "see" such vegetation, perhaps because it has no economic value, or perhaps because it is perceived as being "common". However, even if there was no direct economic value, such species stabilise the soil, provide habitat for wildlife, and act as a nurse crop for more valuable planted species through creating more favourable environmental conditions. In any case, it may be possible to add value by top grafting this wild plum with commercial plum varieties.



iii) Wild herbs and medicinal plants are traditionally collected and used by women. However, there did not appear to be any activity in place to encourage or enhance sustainable and economic use of such plants in reforestation areas. This valuable knowledge is in jeopardy of being lost with urbanisation and changing values in Lebanon. Given both the size of the local tourist industry and the enormous and wealthy Lebanese Diaspora, Bsharreh could support a thriving rural industry.



In addition to indigenous and naturally occurring species, there is great scope for planting exotic species.

Left: Fast growing, multi-purpose *Robinia pseudo-acacia* (Black Locust) trees have also been planted by the CBO. *Robinia* can act as a "nurse tree" for slower growing *Cedrus* and *Pinus* species, providing protection from wind and excessive heat, while adding nitrogen and organic matter to the soil and providing nectar and pollen for bees⁵.

The wood is extremely hard, resistant to rot and durable, making it prized for furniture, flooring, panelling, fence posts and small watercraft. It has the potential to provide a short- and medium-term economic incentive for individuals and communities to participate in forestry activities.

Black Locust is highly valued as firewood for wood-burning stoves; it burns slowly, with little visible flame or smoke, and has a higher heat content than any other species that grows widely in the Eastern United States, comparable to the heat content of anthracite.

It is also planted for firewood because it grows rapidly, is highly resilient in a variety of soils, and it grows back even faster from its stump after harvest by using the existing root system. With fertiliser prices rising, the importance of Black Locust as a nitrogen-fixing species is also noteworthy. The mass application of fertilisers in agriculture and forestry is increasingly expensive; therefore nitrogen-fixing tree and shrub species are gaining importance in managed forestry⁶.

⁵ <http://www.honeytraveler.com/single-flower-honey/black-locust-acacia-honey/>

⁶ http://en.wikipedia.org/wiki/Robinia_pseudoacacia

Promoting non-timber forest products such as honey in reforestation areas provides individuals and communities greater incentive to actively protect existing forests and to participate in reforestation activities.



Beehives placed in a reforestation area.



Locally produced honey for sale in a tourist shop.

Whole new industries could be developed from non-timber forest products. For example, roses for perfume⁷ could be grown between trees while they are young. Due to the labour-intensive production process and the low content of oil in rose blooms, rose oil commands a very high price. Harvesting of flowers is done by hand in the morning before sunrise and material is distilled the same day. Other crops worth investigating include wild mushrooms, truffles and pine nuts.

Thus promotion of biodiversity provides an incentive for individuals and communities to participate in forest management and it contributes to economic development through income generation. Biodiversity promotion allows:

- whole landscapes to be utilised instead of only agricultural land. By managing and promoting regeneration of a wide range of plant and animal species, communities can benefit from up to 100 percent of the landscape. So called “wasteland” can be brought into productive use;
- year round production and therefore year round economic activity. Use of a wide range of plants and animals means that sequential harvests of various products (fodder, horticultural crops, timber, traditional medicines and edible herbs etc) and other income earning possibilities (from tourism and sale of biodiversity and carbon credits) arise;
- farmers to continue being productive even in the face of environmental shocks such as drought, floods, severe storms and pest attack;
- environmental restoration and conservation of plants and wildlife;
- increased environmental services which are critically important to human welfare and economic activities.

⁷ http://en.wikipedia.org/wiki/Rose_oil

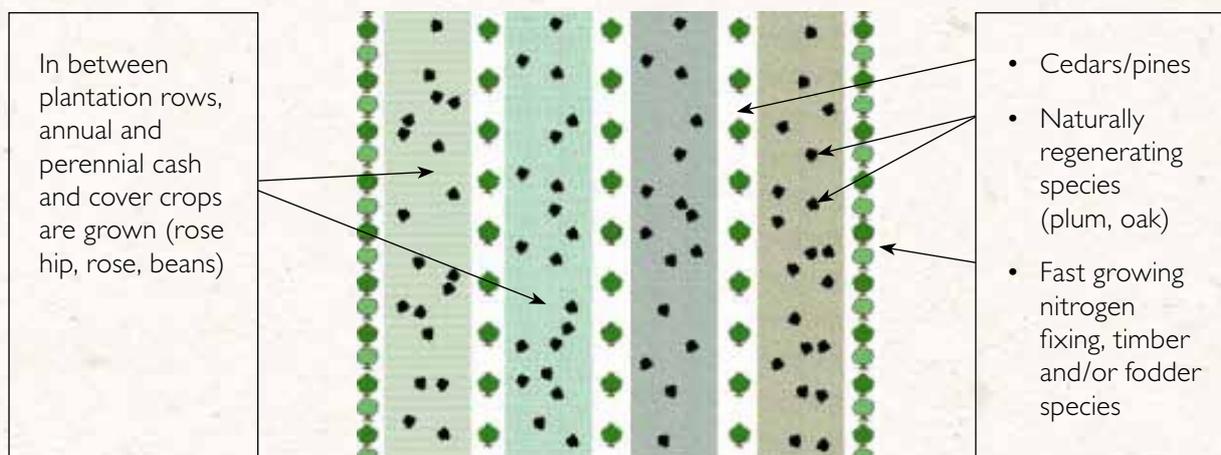
How communities are organised to manage forests and reforestation will depend on the culture and local circumstances. In Niger, farmers work best as individuals, managing trees on their own land. In Ethiopia, communities form cooperatives and manage common forest land collaboratively. In East Sumba, Indonesia, while the community all work on a single land unit, individuals manage their own trees.

Inclusion of greater biodiversity would complement existing forestry programs.



Left: Cedars are planted at very wide spacing to allow for their eventual great size. Effectively, the land in between these trees will be unutilised for many years.

The following diagram provides a guide to what forest restoration could be look like:



This hypothetical forest plantation includes:

- Slower growing climax trees suited to the particular environment planted at wide spacing.
- Natural regeneration of indigenous trees found on the plot enhanced through pruning and thinning.
- Faster growing nitrogen fixing/multipurpose trees planted at closer spacing to allow for income generation, to enhance soil fertility and provide protection for climax species.
- Fast growing cash crops and indigenous plants used for medicine and foods are grown in between rows of trees.
- The size of the “forest block” is determined by the management structure determined by the community (individually or group managed plots).

2. Bekaa and Marjeoun

In Bekaa and Marjeoun, World Vision Lebanon is facing similar reforestation issues as Bsharreh – species being grown in nurseries are slow growing and in comparison to the total land mass in need of rehabilitation, the impact is small. World Vision Lebanon is assisting with the technical issues of reforestation by providing seedlings and advice. But social issues, which cause and perpetuate deforestation, do not appear to be addressed.

Even in these relatively arid regions of Lebanon, there are indicators that natural regeneration of woody vegetation is possible; however, bushfires and continuous grazing are likely the greatest inhibitors of forest regrowth. These issues are more social than technical in nature and therefore more attention needs to be paid to them.



Three-year-old tree (from transplanting).



Large areas of land have been denuded of woody vegetation. Using tree planting techniques alone to reforest denuded areas would take many years and require vast resources.



Even in very dry regions of Lebanon natural forests occur and presumably would expand if assisted through community-led fire and livestock management.

With assistance through individual and community managed natural regeneration, reforestation rates could be greatly accelerated.

We visited Mr Fouad Yammine. His land, which is close to the border with Syria, is deforested, rocky and

arid, and has low soil fertility. It would appear that nothing could possibly grow here, but first impressions can be very deceptive. It is important to observe carefully what vegetation is present in the area and what the constraints to growth are (eg. drought, constant grazing, fire). Closer inspection showed that there were a number of “bushes” which are more likely to be trees, but constant grazing and wood harvesting have prevented them from reaching their potential. It was also noted that on the road to this property under similarly difficult conditions, figs, olives, *Pinus* species and *Acacia saligna* were growing without irrigation. Existing vegetation growing under similar conditions provides an indication of what might be possible on more degraded sites.



The seemingly barren landscape of Mr Fouad Yammine.



Yet, even under such arid conditions, remnant forest remains and on the way to this property a glimpse of what might be possible was seen on unirrigated hillsides – pines, olive.



Regenerating pine forest and unirrigated olive trees.



Simak or spinach trees self-sown and growing without assistance.



Self-sown fig tree growing on a barren hillside.

By building on what is occurring naturally, seemingly barren wastelands can be converted to productive and bio-diverse ecosystems. Could growing Simak, (a valued vegetable) and hardy trees commercially be a way of encouraging reforestation? Could promotion of the wild harvest of pine nuts, wild olives and figs be economically viable?

Exotic tree species can also play a significant role in reforestation efforts in Lebanon.



Left: *Acacia saligna* growing on a dry hillside with poor, rocky soil yet bearing a heavy crop of high protein seed.

The leaves of *A. saligna* are a source of fodder for livestock; its high protein, high energy seed can be used in human nutrition or fed to livestock (Annex VII). *A. saligna* fixes nitrogen and increases soil organic matter content and it produces excellent firewood and small poles.

A number of species suitable for fodder production can be grown on non-agricultural lands which are currently under-utilised (Annex VI)



Left: Intensive backyard livestock production. While hills which could be producing valuable fodder lie barren, farmers pay high prices to bring in fodder and feed concentrates for intensively raised livestock.

3. Urban environment

There was no time to visit World Vision Lebanon urban programs. However, waste disposal was mentioned as an issue confronting some communities⁸ and in one Area Development Program (ADP) in Beirut, there is a dump site right in the middle of a residential area. Various municipalities around the world have turned similar problems into assets⁹.

Recommendations

- Conduct a reforestation awareness workshop in selected communities. The aim of the workshop is to introduce the concept of forests for conservation, income generation, and increased agricultural productivity, to gauge community interest and to jointly develop management strategies appropriate to Lebanon's context. Participants will be exposed to community and individual forest management examples from other countries and Farmer Managed Natural Regeneration will be introduced.
- Facilitate a World Vision Lebanon staff and stakeholder experience sharing visit to the Humbo Community Managed Reforestation project in Ethiopia.
- World Vision Lebanon staff should attend a permaculture design course.
- Dependent on successful workshop outcomes, initiate community-based projects. Design projects should include short-, medium- and long-term income generating activities so that community interest will be maintained.
- In addition to planting climax species, plant and regenerate pioneer species with environmental and/or economic value.
- Conduct a value chain analysis of potential timber and non-timber forest products.

⁸ http://cdm.unfccc.int/UserManagement/FileStorage/CDMWF_AM_JM3KZ437F8IY363Q8QQL5K3I075QIZ

⁹ <http://webecoist.com/2009/05/10/garbage-to-green-10-landfills-turned-into-nature-preserves/>

Annexes

Annex I. Four ecosystem processes

Even a simple ecosystem is very, very complex (Keppel, 2003). By focusing on the fundamental processes that operate in any ecosystem we can work with this complexity and we can quickly gauge the health and productivity of the land. There are four basic ecosystem processes, sometimes called the four-ecosystem foundation blocks because they are so fundamental to ecosystem function: energy flow, mineral and water cycles and population dynamics. All four processes work together to create a healthy or unhealthy ecosystem. In order to have an effective water or mineral cycle, or adequate energy flow, an ecosystem must have communities of living organisms. For living things to thrive, they need effective energy flow to feed them, a water cycle that supplies adequate moisture, and a mineral cycle that supplies vital nutrients.



Poor ecosystem function. This river only runs during flash floods. Most ground is bare, so biological productivity is low and soil-building processes have stopped. Droughts and floods are the norm, and biodiversity loss is severe. – Allan Savory, see article at <http://www.managingwholes.com/zimbabwe.htm>



Healthier ecosystem function. This nearby river contains water year round. Ground cover and biological productivity are much higher and nutrients recycle faster. Flooding is less severe, drought is rare, and biodiversity is increasing.



Almost 100 percent of this deforested landscape in Bechaari is not converting sunlight energy into chemical energy for any part of the year. This is a wasted opportunity for the environment and for economic development because through reforestation it is quite capable of making significant contributions. Arrows represent sunlight hitting bare soil surfaces and reflecting back into space unutilised.

Energy flow

All energy in environmental systems comes from the sun, is converted by green plants to carbohydrates, and is available either directly as food to humans or indirectly through animals that eat the plants. When there are no plants there is no energy flow and no increase in biological wealth. This is a basic concept, yet many World Vision ADPs accept that large tracts of land are unproductive permanently through soil erosion and land degradation, or seasonally as agricultural land is left fallow and therefore unproductive for part of the year. Basic questions include: How much sunlight falls on green leaves and gets turned into food for the ecosystem? How much is wasted striking dead growth or bare ground?

Mineral cycle: Basic questions include: Are nutrients available to living things? Or are they locked in standing dead growth, or sunk below the root zone? Do they escape when plants burn or soil washes away? The nutrient cycle consists of the flow of nutrients through soils, plants and animals and in some cases the atmosphere. In situations where plants and animals are continuously taking up nutrients and they are not being replaced, the nutrient cycle is broken. Examples include the carbon and nitrogen cycles.

The carbon cycle: Carbon is essential for life yet agricultural practice in whole regions and countries accepts the complete removal and/or burning of crop residues, depriving the soil of organic matter and hence carbon. This impacts soils' ability to hold other nutrients and water, the soil structure, and importantly the level of biological activity in the soil. In areas where farmers do not access chemical inputs, as is the case in most developing countries, soil biological activity is critical for maintaining and enhancing soil fertility and crop yields. Soil biological activity is responsible for making available nutrients that are otherwise locked up, such as phosphorus and micronutrients.

The nitrogen cycle: Nitrogen is essential to all living systems and is often the most limiting nutrient. Nitrogen is the building block of protein. In the absence of nitrogen fertilisers, it is critical to maximise natural means of making nitrogen available to plants in the soil. Many agricultural systems involve continuous mono cropping of grains that have high nitrogen requirements. In the absence of leguminous plants (in pastures, in crop alleys or in crop rotations) soils rapidly become depleted in nitrogen.



Sterile soil, devoid of organic matter, Bekaa region. Through deforestation, continuous overgrazing and regular fires organic matter has been destroyed and soil fertility lost as the soil has been exposed to the erosive forces of wind and rain.

The water cycle: Water evaporates from land and water surfaces, and forms clouds that drop rain, sleet and snow. Some of this water percolates into the ground, some evaporates immediately or over time, and some is taken up by plants and animals and eventually released. Where soils are exposed, hard bare ground results in rapid water runoff, erosion, minimal water infiltration and quick drying of soil compared to ground covered with plants or mulch. Covered ground is like a sponge that can soak water up and release it slowly.

It is common practice to blame floods on heavy rains and drought on lack of rain, but often it is because of the mismanagement of soil and plant resources that floods and droughts are as severe as they are. Basic questions include: Does rain feed plants and recharge groundwater, or does it run off the land, causing erosion? Do springs and streams flow seasonally or year round?

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



Above and centre: Immediately following rain, water flows off the steeper land and floods lower areas. The hills in the background have been badly deforested. When it rains there is massive runoff and flooding, in this case making it impossible to utilise good agricultural land during the rainy season.

The very day after rain, streams are dry.

Population dynamics and diversity (also called **succession**): Basic questions include: Do many species have fairly stable populations of all ages? Or does the population of just a few species fluctuate widely? The degree of biodiversity and the age and sex structure of organisms within that diversity also play a role in the ongoing productivity and stability of primary industries. In agricultural systems there should be significant variety of crops, different species and breeds of animals, and different, complex agricultural systems as opposed to simple monoculture systems. Intercropping, multiple cropping, agro-forestry, improved fallow, crop rotation, use of cover crops, etc are agricultural systems which increase biodiversity and promote a healthy range in sex and age ratios of species utilised.

Reference: Keppel, w., Basic ecosystem processes: a short introduction. March, 2003.
<http://www.managingwholes.com/ecoblocks.htm>

Annex II. Permaculture ethics and principles

Ethics:

- care of the earth
- care of people
- contribution of surplus time, money and energy to achieve the aims of earth and people care

Permaculture principles include:

- Relative location – every element (such as house, pond, road, etc) is placed in relationship to another so that they assist each other. Permaculture stresses the importance of design to produce maximum productivity with minimal effort or input.
- Each element performs many functions. For example, a forest tree planted near a house can provide beauty, shade and protection from the sun. However, a deciduous fruit tree can provide beauty and shade in summer; allow sunlight to heat the house in winter; and bear fruit in season.
- Each important function is supported by many elements. Everything in natural systems is interconnected and permaculture works towards maximising the benefits of these connections.
- Efficient energy planning for houses and settlements with emphasis on locally generated and renewable energy sources.
- Emphasis on the use of biological resources over fossil fuel resources.
- Energy recycling on site.
- Using and accelerating natural plant succession to establish favourable sites and soils. Pioneer species are hardy and can colonise difficult environments. Many are nitrogen fixing and produce large amounts of biomass, thereby improving soil fertility, and they create more favourable conditions for longer lived and more valuable species.
- Polyculture and diversity of beneficial species for a productive, interactive system. By combining agriculture, animal husbandry and forestry, farmers can benefit from the synergies generated by each element in the system. Animals can utilise crop residues and turn a waste product into animal products and valuable fertiliser, which in turn benefits crops. Trees provide shade, fodder, timber, and fruits and nuts, and improve soil fertility.
- Use of “edge” and natural patterns for best effect.

Annex III. Turning “deserts” into food bowls by releasing the underground forest



Introduction

In developing countries around the world, many farmlands have become so degraded they no longer produce regular crops or pasture for livestock. They have lost virtually all of their natural vegetation – the glue that holds the earth together and provides the organic matter necessary for fertile soil.

In many regions in developing countries, 70 percent or more of the population are

subsistence farmers. In Sahelian Africa alone, this stands at 40-50 million people. As the climate dries and droughts become more prevalent, these people constantly face famine.

Yet, from deserts, through farmlands to degraded forests, vast tracts of seemingly treeless land conceal an “underground forest” of sprouting tree stumps, roots and seeds with the potential to rapidly restore forests given the right conditions.

This system, called Farmer Managed Natural Regeneration (FMNR), began as an experiment with a few willing farmers in 1983 in Niger Republic, West Africa. Though ridiculed and laughed at by their sceptical and scathing peers, within 20 years this simple, cheap and rapid form of reforestation had become standard practice across 50 percent of the nation’s farmlands.

It has doubled crops and family incomes, provided timber for building, cooking and keeping warm, restored the degraded soils, and helped communities adapt to climate change. Farmers who have adopted FMNR have not had to rely on food handouts during famine periods. FMNR helps people become economically sustainable.

Since 1999, World Vision has been promoting FMNR in Africa and Asia and the technique is gaining popularity at an accelerating rate year by year. Through workshops for awareness creation, exchange visits, demonstration plots, conferences, the web, written materials, video clips and PowerPoint shows, FMNR is being adopted within and beyond World Vision project boundaries around the world.

This article documents some of the more dramatic impacts and the spread of FMNR in Niger, Ethiopia, Ghana and Senegal, and calls for World Vision to capitalise on this by taking a more deliberate approach to the promotion and spread of FMNR within and outside of its programs.



Before FMNR



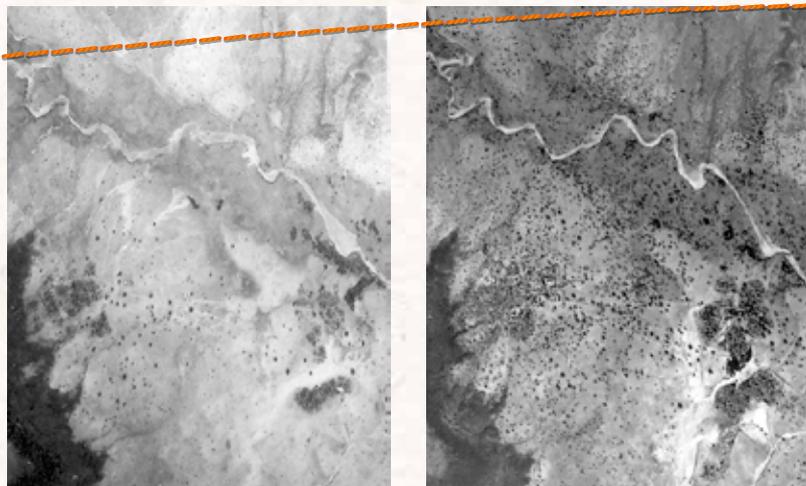
After FMNR

Birth and spread of a movement, Niger Republic

FMNR experimentation and promotion began with around 10 farmers in the Maradi Department of Niger Republic in 1983 by SIM International project staff¹⁰. During the severe famine of 1984, a food for work program was introduced that saw some 70,000 people exposed to FMNR and its practice on around 12,500 hectares of farmland. From 1985-1999, FMNR continued to be promoted locally and nationally as exchange visits and training days were organised for various NGOs, government foresters, Peace Corps Volunteers, and farmer and civil society groups. Additionally, SIM project staff and farmers were sent to numerous locations across Niger to provide training.

By 2004, it was ascertained that FMNR was being practised on over five million hectares or 50 percent of Niger's farmland. This averages out at a staggering reforestation rate of 250,000 hectares per year over a 20-year period, making Niger the only country in Africa experiencing net afforestation, prompting geographer Chris Reij to comment that "this is probably the largest positive environmental transformation in the Sahel and perhaps all of Africa".

US geological survey satellite photos taken in 1975 and 2003 show greatly increased tree cover. Trees show up as black dots.



Livelihood impacts

- Many villages in Niger now have 10-20 times more trees than 20 years ago. In the area where the project took place, 88 percent of farmers practised FMNR in their fields, adding an estimated 1.25 million trees each year.
- Household incomes have risen by around US\$200 per year equating to US\$17-23 million p.a. for the Maradi Region alone.
- Because of FMNR, farmers in Niger are producing an estimated additional 500,000 tonnes of cereals a year. This additional production covers the requirements of 2.5 million people out of a total population of about 15 million in 2009.
- FMNR also has an indirect impact on food security through tree crop products, which farmers can harvest and sell in local markets. Moreover, despite a near-doubling of the population since 1980, Niger has been able to maintain per capita production of millet and sorghum, which make up more than 90 percent of the typical villager's diet. Per capita production remained at approximately 285 kilograms between 1980 and 2006.
- Despite severe famine as a consequence of the 2004 drought and locust plague, farmers practising FMNR did not need food assistance ... (they) were able to meet their own needs through selling firewood and non-timber forest products.
- Over the past 10 years the utilisation of FMNR in Niger has resulted in the sequestration of between 100-200 million tonnes of CO₂e.

¹⁰ SIM International, or Serving in Mission International is a Christian, inter-denominational mission agency.

Adoption and rapid spread of FMNR in Ethiopia

In 2004, World Vision Australia and World Vision Ethiopia initiated a forestry-based carbon sequestration project as a potential means to stimulate community development while engaging in environmental restoration. The Humbo Community-based Natural Regeneration Project, involving the regeneration of 2,728 hectares of degraded native forests, brought social, economic and ecological benefits to participating communities. Within just two years of operation, communities were collecting wild fruits, firewood and fodder, and reported that wildlife had returned and erosion and flooding had been reduced.



Rapid forest restoration through the community managed FMNR program in Humbo, Ethiopia.

Following the success in Humbo, workshops were held in Mekele, the capital of Tigray Region in northern Ethiopia, in 2009 and 2010 and experience sharing visits to Niger and Humbo were organised. Within eight months of the second workshop, 273 people (including departmental heads, development agents, sector specialists, administrators, NGO staff and model farmers) had been taken on exposure and training visits within Tigray and 20,000 hectares of land and 10 hectare-FMNR model sites in each of 34 sub-districts were set aside for research and demonstration.

The Tigray Regional Government is the first government in the world to institutionalise FMNR by including it in the normal annual planning and implantation cycle of the Department of Agriculture and charging the Tigray Agricultural Research Institute with the task of researching and promoting best practice FMNR for Tigray.

The success and impact of Humbo has not been lost on the Federal Government of Ethiopia either. In April 2011, the Federal Government committed to reforest 15 million hectares of degraded land as part of a climate change and renewable energy plan to become carbon neutral by 2025.

The total impact of Humbo across Ethiopia and internationally is incalculable. A constant stream of individuals and groups has heard of or visited Humbo independently and many are applying what they learnt on their own land. The World Bank and World Vision have posted press releases and articles about Humbo on their websites, and articles on Humbo have been written in journals with wide readership.

FMNR in Ghana – from despair to “life and joy”

In 2008, communities in Talensi, northern Ghana, felt like they were hopeless victims of climate change. Their crops suffered from regular drought, insect pests, flood and damaging wind storms. There was a shortage of firewood, wildlife had long left the area, water sources were dry for much of the year, people and animals alike were regularly hungry and poverty was increasing. Indiscriminate clearing of the forest and annual burning of bushland contributed to the high rate of deforestation and environmental destruction.

Within just two years of implementing the Talensi FMNR project everybody from village level to government leaders were amazed that burnt out, barren landscapes could be covered in a forest 1-3 metres tall without planting a single tree. The communities are extremely thankful for all the benefits they are already experiencing because of this, including wild fruits being abundantly available, firewood close at hand, fodder for livestock and the return of some wildlife. A community which had either directly contributed to forest destruction, or which felt helpless to stop it, is now guardian of the forest – preventing and stopping bushfire and wanton destruction of the forest and facilitating its rehabilitation.



Above: Just two years into the Talensi project, nine communities have protected 125 hectares of land from bushfire and begun practising FMNR. In that short time fodder and firewood have become available, wild fruits and wildlife have returned and people feel confident that they are not hopeless victims of climate change and desertification, but that they can do something to reverse the environmental degradation surrounding them and create a better future for themselves and their children.

During the first two years of operation, the Talensi FMNR project laid a firm foundation through working with chiefs, traditional land custodians and government authorities. By mid 2008 the total area under FMNR was 125 hectares. Because of the enormous impact FMNR is having in participating communities and the acceptance and endorsement by traditional and contemporary authorities, World Vision Australia has approved a proposal for extension of the current project and expansion into three new districts of northern Ghana. From the initial pilot program it is expected that FMNR will be practised on thousands of hectares of land within five years.

FMNR in Senegal – appreciating the environment

World Vision Senegal has implemented two FMNR projects that have sought to promote restorative environmental practices in the regions of Kaffrine and Diourbel. These projects have changed people's attitudes and practice. Previously, "people did not care about the environment and if they saw someone cutting a tree they would not stop them as it was not their problem. Now, anybody seeing trees being cut will respond and try to stop it"¹¹. Within just three years, trees on 30,000 hectares of previously cleared farmland are now being restored through FMNR.

Because of the success of FMNR in this project and acceptance by authorities, communities and NGOs, World Vision Australia has approved funding for extension of the existing project to reach 100 percent of the World Vision program area in the Kaffrine region, expand FMNR into the Tamba, Kolda and Fatick regions, and engage national ministries and networks to institutionalise FMNR and other sustainable land use practices.

If the progression of the project extension follows that of the first phase, in excess of 100,000 hectares of farmland will be revegetated within the next three years and World Vision Senegal will potentially impact national level forestry policy and practice affecting millions of hectares of land. The Senegalese government is one of the chief proponents of the Great Green Wall against the Sahara Initiative, so adoption of FMNR as the primary means of forest restoration in Senegal will have spill over influence on all the Sahelian Great Green Wall signatory countries.



"Thousands of projects have come through here but this FMNR, there is no comparison, if we are the judges. We have nothing but our environment. Since we started working with FMNR we have already started seeing the benefits that we have not seen with any other project. The type of benefits we see pushes me sometimes to leave my home and just walk through my field to appreciate the trees and environment. When things get to where they need to be, we will see more yields and the path will be clear."

– Female lead farmer, Thiapy, Senegal

The action imperative – FMNR and the coming famine

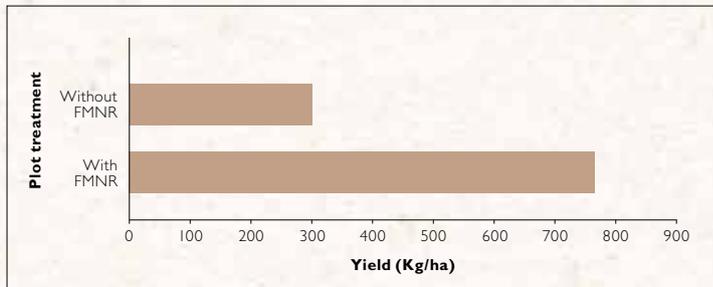
The current food crisis in East Africa gives a stark reminder that the need for solutions addressing the root causes of hunger is greater today than ever before. In 2010, international agricultural consultant Roland Bunch did a study in six African nations (Zambia, Malawi, Kenya, Uganda, Niger and Mali). He wrote about his findings in the 2011 State of the World Report and titled the chapter "The Coming Famine". He concluded that four major factors¹² are coming together all at once in a sort of "perfect storm" that will almost surely result in an African famine of unprecedented proportions, probably within the next four to five years. It will most heavily affect the lowland, semi-arid to sub-humid areas of Africa (including the Sahel, parts of eastern Africa, plus a band from Malawi across to Angola and Namibia), and he calculated that unless the world does something dramatic, 10 to 30 million people could die from famine between 2015 and 2020.

While promotion of FMNR positively impacts on sectors and cross-cutting themes as diverse as climate change, poverty, income generation, biodiversity, gender, nutrition and migration, the impact on food production alone gives sufficient justification for wide scale promotion and adoption. Today, millions of

¹¹ Forests and Water Officer, Aboubacca Cidibe

¹² The end of the practice of fallowing, shortage of animal manure, escalating cost of chemical fertilisers and climate change.

hectares of land around the world lie idle or are not performing optimally due to degradation and people unnecessarily go hungry. Yet in Niger, farmers have reported that land which had become too degraded to grow crops has been restored through FMNR. In some years, the presence of trees has resulted in survival of inter-planted crops while crops in the open have desiccated. Preliminary research results from the Senegal Agricultural Research Institute indicate that within two years of FMNR implementation crop yields have doubled.



Above left: Preliminary findings of the Senegal Agricultural Institute show that practising FMNR on farmland can result in a doubling of crop yields. **Right:** This photo was taken during a dry spell in the rainy season and shows superior growth and survival rates of crop plants growing close to trees compared to those in the open.

Call to action

In recent years FMNR has come to the attention of global development agencies and grassroots movements alike. The World Bank, World Resources Institute, International Centre for Agroforestry, USAID, and the permaculture movement are amongst those either actively promoting or advocating for the uptake of FMNR.

In 2010, FMNR won the Interaction “Best Practice and Innovation Initiative” award in recognition of high technical standards and effectiveness in addressing the food security and livelihood needs of small producers in the areas of natural resource management and agro-forestry.

In 2011, FMNR won the World Vision International Global Resilience Award for the most innovative initiative in the area of resilient development practice and natural environment and climate issues. This heightened awareness of and publicity for FMNR makes this an opportune time for World Vision to move beyond haphazard adoption of FMNR and become intentional in taking the lead on FMNR promotion.

The process is relatively simple and well within World Vision’s capacity. It involves:

- making key contacts;
- awareness creation through conferences, workshops, exchange visits, accessible information on the web and in written and video form;
- advocacy for favourable natural resource management policies and market development;
- training of FMNR trainers and champions;
- follow up.

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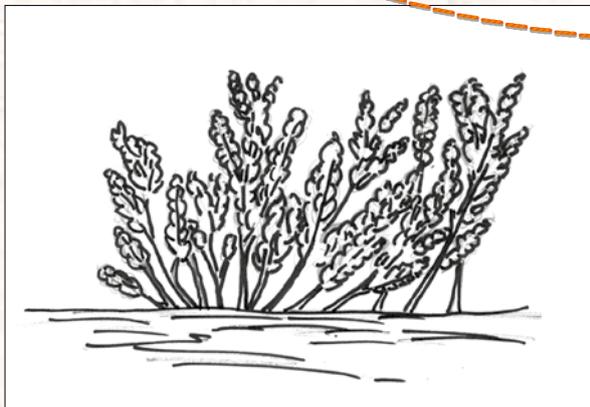
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Annex IV. Farmer Managed Natural Regeneration (FMNR)

FMNR is a simple, rapid, low cost and easily replicated approach to restoring and improving agricultural, forest and pasture lands. FMNR is based on the management of re-growth from existing tree stumps and roots with the ability to coppice (re-sprout) or from self-sown seeds in the soil that can germinate.

The basic method of FMNR is very simple. The farmer selects the stumps he/she will utilise and decides how many stems will be allowed to grow on each stump, based on the farmer's needs and ultimate purpose. Excess stems are then cut. With the remaining stems, side branches are pruned to half way up the trunk. A good farmer will return every two to six months for a touch up pruning and thereby stimulate faster growth rates and produce straighter stems. Pruning is extremely important for stimulating rapid growth of more valuable, straighter stems.



Multiple stems growing from a tree stump.



After pruning excess shoots, five stems have been selected and their lower branches pruned.

FMNR is simple in that it does not require establishment of tree nurseries, sourcing of superior seed, transportation of seedlings, planting out or special care. To practise FMNR farmers can use farm implements already in their possession such as harvesting knives and machetes.

FMNR is low cost because of the reduced input, labour and transportation costs. FMNR project implementation costs are approximately \$4 per hectare compared to \$150-\$200 per hectare for tree planting schemes. FMNR also has a 100 percent survival rate compared to very variable rates for planted trees.

Through FMNR very rapid and large scale reforestation is possible. Compared to a transplanted seedling, stems sprouting from tree stumps have a deep root system to draw water and nutrients with and large reserves of stored energy. Thus growth rates of two and three metres per year for the first few years are not unusual for FMNR. Because the main action requires stopping burning and indiscriminate cutting, along with targeted pruning of existing growth, very large areas of land can be reforested in a very short time.

As with other activities, farmers need an incentive in order to be motivated to practise FMNR. In other countries, giving farmers either outright ownership of trees or tree user rights has made it possible for large scale individual and community managed reforestation to take place very rapidly.

Many people do not realise the enormous regenerative capacity of tree stumps and think that environmental restoration can only take place through tree planting. However, FMNR is a proven and widely applied practice.

Suggested strategy

- Conduct awareness and FMNR training workshops with all stakeholders including forestry and agriculture departments, community members, traditional, political and religious leaders.
- With all stakeholders, identify forest area(s) to be restored and set legally binding boundaries.
- Empower communities to manage enclosure areas through granting of user rights.
- Through dialogue, determine an appropriate land management structure eg. individual tenure with loose networking agreement; cooperative; farmer groups; some adaptation of traditional forest management systems.
- Devise a certification scheme for the legal and transparent sale of sustainably managed wood and non-timber forest products.
- Assess best practice methods of promoting non-timber forest products such as honey, fodder, wild foods, gums, etc and make market linkages.

Case study: Abreha Atsbeha – from destitution to resilience

Conditions in Abreha Atsbeha, northern Ethiopia, were so bad that the government threatened to resettle the community. This threat shocked the community into action as they did not want to leave their inheritance which had been settled by their ancestors centuries beforehand. With assistance and through hard work, the community transformed their sub-district.

Dam construction, digging contour ditches and chains of ponds for “water banking”, and re-vegetation through tree planting and natural regeneration has resulted in at least 50 percent of the rainwater being trapped to recharge ground water stores. Some 180 wells have been dug for high value market gardening which produces two to three crops per year, irrespective of rainfall.

In some areas, creation of protected forest and digging of dams and trench bunds have resulted in water tables rising from nine metre depth to two to four metres. Dried up springs have started flowing again and streams flow for longer while pastured lowlands remain green the whole year. Flooding and siltation of grazing and cropland has all but ceased in the best areas.

This formerly barren area has been reforested through community efforts.





Seemingly insignificant self-sown trees **(above left)** have grown three to four metres in just two years **(right)**.



Soil and water conservation works successfully to trap water runoff and cause groundwater recharge.



Upstream water banking activities have resulted in water tables rising significantly, making irrigation economically viable and pastures are green year round.

Case study: Dan Saga, Niger Republic

Farmers involved in the Desert Community Initiative, located in the Aguié Department of Niger, take a central role in planning, implementing, managing, monitoring and evaluating their activities. By 1984 this once heavily forested region was nearly treeless. Sand dunes were beginning to form and crop productivity declined.

Through the adoption of FMNR and with the formation of 53 village committees, some 170 villages now sustainably manage their natural resource base. Some 130,000 hectares of farmland are now being managed under FMNR and once treeless fields are covered with 103-122 trees per hectare. A number of stakeholders including farmers, herders, men and women, researchers, Aguié Departmental and government services and International Fund for Agricultural Development project staff collaborate on these activities.

Starting in three pilot villages in 2001, field work focused on the following key activities:

- forming committees, task groups and associations;
- capacity building of communities, groups and individuals to initiate and lead research and development activities;
- promoting an enabling environment for open dialogue and exchange to facilitate the adoption of new ideas and to value and promote traditional knowledge and skills.

Various committees, inclusive of women, men, youth, village residents and sedentary Fulani herders, were formed to deal with specific tasks:

- Village committees plan new activities and supervise the work of four sub-committees.
- Agricultural sub-committees monitor crop experiments and seed production activities.
- Environment sub-committees supervise implementation, monitoring and FMNR policing.
- Social sub-committees manage cultural activities.
- Income generation sub-committees facilitate small enterprise activities.

Committee roles were formalised publicly to ensure that all community members, most of whom are illiterate, were informed. To add legitimacy to the office, committee members were equipped with a uniform and badge as a symbolic mark of their authority. Each week sub-committees collect information in their respective spheres of influence. The various sub-committees meet together each fortnight to share information. Finally, each month there is a village level general assembly, attended by village elders and the chief, in which all information from the sub-committees is fed back to the villagers, including youth, women and Fulanis. Decisions and action plans are based on this information.

Rules for management of FMNR have been established by environment sub-committees in consultation with all stakeholders. All community members are fully informed of the rules and of fines for infringements. Each committee member monitors a specified area and is responsible for reporting on infringements.

Each collaborating village has agreed to make payments to support the Desert Community Initiative. These payments, together with fines, are used for agreed purposes such as medical supplies, digging wells, or raising tree seedlings, that encourage unity and support work undertaken by the committees. While members of village committees are volunteers, villagers have typically decided they should receive a very small remuneration from this fund to encourage their participation. The fund also pays for fuel to enable the Forestry Department to help resolve conflicts between villagers and nomadic herders, and to support partnerships between extension services and villages.

The Land Tenure Commission, researchers, traditional chiefs and the new governance structures formed a partnership, supported by the International Fund for Agricultural Development, for participatory research that takes needs identified by farmers themselves into account. One outcome has been the provision of training in areas of identified need, which are diverse and include literacy, tree pruning and nursery techniques.

Increased productivity of the trees is reflected in an increase in both domestic consumption and the sale of tree products. One bundle of firewood sells for around US\$6 and the annual per capita income to villagers from wood sales alone ranges between US\$46 and US\$92; a significant contribution to household budgets given that the average annual income in Niger is less than US\$200 per person. In 2005, when over one third of Niger's population suffered from famine, sale of firewood and non-timber forest products meant that farmers avoided tragedy and reliance on famine relief. With increased confidence in their committees and the dramatic increase in wood available for home use and sale, villagers established rural wood markets, aiming to increase local control and reduce exploitation by middlemen.



The owner of this 16 hectare bio-diverse farm earns approximately \$450 each year without fail from wood sales alone.

FMNR and agro-pastoral-forestry area management have become standard land management practices in Aguié Department as a result of the effectiveness of the new governance mechanisms. There has also been a positive change in community attitudes and behaviour towards the environment. Community members know the high cost of environmental degradation in terms of human suffering and poverty. They are now benefiting economically and socially, from their environmental restoration efforts. Illegal tree cutting, which was an enormous disincentive and threatened the success of the project initially, has practically ceased in the whole area. As knowledge and confidence have grown, community members have progressively adopted new practices.

Observations from a September 2009 field visit include:

- Women are benefiting through full participation in decision making and activities and manage their own income generating farms.
- Youth are involved in decision making and committee activities. Even young children are taken out of school for special farming and tree planting activities. Some youth are active committee members. Youth maintain a number of farms and school gardens. Farm income goes into an account which they manage and they make their own decisions on how the funds will be spent. Thus, unlike other regions, even many educated youth feel positive about having a future in farming.
- Collaboration with government and NGO services is very strong.
- There is active participation of the whole community in experimentation, especially with new annual crops. Records and seed stock are maintained by educated youth. Currently 47 bean, 42 millet, 10 sesame and 12 peanut varieties are under trial. The community is convinced of the value of this work. In 2009, rains came to Dan Saga 55 days later than other parts of the district. However, because they had planted 70 day maturation millets selected from their test plots, the millet crops in Dan Saga were at the same stage of development as the crops in the rest of the district.
- Establishment of firm rules and regulations on natural resource management (particularly trees), along with collaboration with the forestry department and a community-based control system, has resulted in enhanced and sustainable use of resources. Unlike other districts, which are mining and destroying their natural resource base, resources in Dan Saga are well managed and will continue to provide benefits to the community indefinitely.
- Establishment of wood markets requiring membership and adherence to community endorsed regulations for wood harvesting have increased local incomes and helped reduce vulnerability to environmental shocks. Commissions from wood sales contribute to village committee and government forestry department running costs, increasing the sustainability of the work. This market helps people meet basic needs during the hunger months by providing income. During and after the millet harvest tree cutting activities are reduced, as there is less need for money.
- Each farmer has a deed to his land which indicates GPS coordinates which are also marked by bourns in the field. This has eliminated land disputes.

Annex V. Biodiversity, human nutrition and economic value

Diet in the eastern Mediterranean and especially Lebanon, Syria and Jordan is characterised by a heavy reliance on refined grains (white flour) as the primary source of energy. These countries are also experiencing an increase in the rates of chronic non-communicable diseases (cardiovascular disease, diabetes), reflecting the emerging “nutrition transition”. The “nutrition transition” seems to be occurring alongside chronic problems of under nutrition, specifically micronutrient deficiencies reflected in high rates of anaemia and stunting particularly among the urban and rural poor.

On the other hand, the region is blessed with great biodiversity and the population has access to many potentially edible wild plants that could be easily harvested and used. The harvesting and use of these wild plants is, however, on the decline due to the eroding knowledge and environmental degradation.

Wild edible plants contribute to a wide range of perceived health benefits including:

- lower heart disease rates (cholesterol, saturated fats, antioxidants, etc.)
- lower cancer rates (flavonoids, anti-oxidants, fibre)
- lower obesity rates (food variety, lower energy density)
- improved child growth (food variety, nutrient content)
- improved reproductive health (iron, calcium)

Wild edible plants contribute to dietary diversity and food security. They:

- are rich in essential nutrients
- provide diversity in groups of foods within meals
- are considered as healthy meals (constituting main meals or snacks)
- have a number of therapeutic and beneficial properties
- are natural and devoid of food preservatives and additives

Wild edible plants:

- are easy to prepare
- provide cheap ingredients and can be accessible
- are familiar to communities (low and high educational status)
- are palatable (attractive/exotic)
- can be preserved as pickles or dried to provide nutrients throughout the year
- can be consumed during periods of cold and food scarcity

Other characteristics:

- Collection of plants during season creates social bonds between members of the community.

Source: Wild Edible Plants: Promoting Dietary Diversity in Poor Communities of Lebanon
http://www.underutilized-species.org/Documents/PUBLICATIONS/wep_aub_feb_06.pdf

Main non-wood forest products¹⁴ found in Lebanon

The main non-wood forest products (NWFP) of Lebanon are edible fruits (eg. pine nuts), medicinal (eg. *Myrtus communis*) and aromatic plants (eg. sage and oregano). Other NWFP include fodder and honey.

¹⁴ Country reports. <http://www.fao.org/DOCREP/003/Y1797E/y1797e13.htm#TopOfPage>

General information

Lebanon was known for its dense and rich forests in ancient times. It is now witnessing a severe depletion of its natural resources. Land degradation and deforestation are not problems of the last decades only; they started more than a century ago and have continued. The total lack of control and appropriate legislation in the last few years, the increasing needs of the population, and the ignorance of the negative impacts of improper natural resources management have resulted in an alarming situation. The different forest ecosystems in the country are mainly threatened by deforestation, over-grazing, urban development, road development, bad agricultural techniques, excessive use of chemical products, hunting and industrial development.

PLANTS AND PLANT PRODUCTS

Food

The nut production of the stone pine (*Pinus pinea*) is highly important in Lebanon. The stone pine forests are the most abundant coniferous forests in Mount Lebanon (18 percent of total forest cover and 36 percent of the coniferous forest cover) where they extend over ca. 14,000 hectares (Baltaxe, 1966).

These forests are very important for nearby local communities. Besides the highly valued nut production, forests are also used for recreation, tourism, and as a source of fuel wood. Moreover, forests play a very important role in soil erosion control, especially on sandy slopes. As a production system, it remains very feasible and attractive to many landowners. Several villages in the middle mountain zone depend on pine nuts production for their main source of income.

The Ministry of Agriculture is encouraging nut production through banning the importation of pine nuts, thus protecting the growers and producers from unnecessary competition. This move has allowed the stabilisation of the pine nuts market while giving the whole production and exploitation cycle a great push forward.

In Lebanon, shelled nut production is estimated at 200 kg/ha (Abi Saleh *et al.*, 1996). The pine area used for nut production is 6,277 hectares. Eighty percent of the total Lebanese pine nut production is located in the Mount Lebanon area, 18 percent in South Lebanon, one percent in North Lebanon and one percent in Nabatiya.

Pine nuts make a significant contribution to the balance of trade (Abi Saleh *et al.*, 1996). The price was reported to be US\$15/kg in 1990 (national report, 1990).

Table 1. Production and area of edible nuts in Lebanon

Edible nuts	1998		1999	
	Production (1,000 tonnes)	Area (1,000 ha)	Production (1,000 tonnes)	Area (1,000 ha)
Almond	28.6	6.5	3.2	6.8
Walnut	2.9	0.7	3.9	0.8
Pine nut	16.5	6.1	14.9	6.0

Source: MoA & FAO (2000)

Table 2. Total export values of edible nuts in Lebanon

Edible nuts	Total export (tonnes)		
	1997	1998	1999
Almond	97	96	70
Walnut	2	1	30
Pine nut	-	-	0.2

Source: MoA & FAO (2000)

Carob production (*Ceratonia siliqua*) was encouraged by the government by allowing forest land owners to clean their forests and to graft their carob trees with better producing varieties. This allows a higher yield of juicier carob pods, thus improving the carob molasses industry. Molasses is used as a dessert and as a sweetener in some traditional pastries. Other uses for molasses could be developed as well. Carob seeds are exported and used in several industries, while the leftovers could be used as soil organic matter. Carob molasses is thought to have beneficial effects, ranging from regulation of the gastro-intestinal tract to improvement in overall health condition. Ground carob seeds are mixed with milk in babies' feeding bottles to prevent vomiting. The annual production is estimated to be 50kg/tree (MoA, 2001).

Fodder

The forests, especially oak forests, are used as rangeland by herders originating from Bekaa, North Lebanon and the Mountain Highlands (eg. Kfarselwan, Baskinta) as a source of grazing for about 350,000 goats and 150,000 sheep (Tellawi, 1993).

In the early seventies and before, grazing was more organised. Herders used to pay the owners (by money or manure) and pass only the winter period in the lowlands. Nowadays, some herders do not pay any fees and exploit pine forests the whole year (eg. Haret Hamzeh). These cases are also a consequence of political divisions during the war. On the other hand, urbanisation, changes in income sources and use of pesticides contribute to decreasing grazing activities.

Medicines

There are 236 species of wild and cultivated medicinal plants in Lebanon. Sixteen species are localised in certain regions and 29 are endangered. Several local species (*Linum toxicum*, *Erica manipuliflora*, *Viola libanotica*, etc) are considered as variants of recognised European species.

The emergence of the so-called "Chirch el Zallouh" or the Zallouh root has added to the threats on the high mountain flora. This plant (Zallouh root), the *Ferrula hermonis*, grows on Mount Kekmel, in the sub-alpine zone and is thought to improve sexual performance while improving overall health condition. This has led to over-uprooting of the plant, as the active ingredients are only found in its root system. The Ministry of Agriculture has reacted by issuing a decree prohibiting the uprooting and exploitation of this commercially important plant. Some researchers and scientists are working on the identification of the active ingredients of this plant, while some plant extracts are sold as herb teas in pharmacies.

As a part of its policy to protect natural resources, the Lebanese Government issued decisions to protect aromatic and medicinal plants and to control their exploitation. Decree 1/29, issued in February 1996, prohibits the export of aromatic and medicinal plants like *Salvia*, *Origanum*, *Myrtus*, *Chamomilla* and *Calluma*. This decision followed decision 1/38, issued in April 1982, which prohibited the export of all forest products.

Whereas decision 1/340, August 1996, aims at organising the exploitation of sage and oregano. The wild sage (*Salvia triloba* and *Salvia fruticosa*) and the local *Origanum* species suffered from uncontrolled exploitation and uprooting. The latest decision allows better control of the exploitation. Picking *Origanum* is only permitted between August and December, while exporting dried material is permitted all year round. Picking and exporting sage is permitted between 1 August and 31 December, with a prior permit from the Rural Development and Natural Resources Directorate. Uprooting both sage and *Origanum* is completely forbidden. The annual production of sage was estimated to be 50 tonnes (MoA, 2001).

The estimated market value of medicinal and aromatic plants produced by forests in Lebanon is US\$18,600,000, based on 1994 figures (Biological Diversity of Lebanon, 1996).

The most common medicinal plants in Lebanon are:

Anethum graveolens, *Artemisia arborescens*, *Ecballium elaterium*, *Inula viscisa*, *Nigella sativa*, *Plantago psyllium*, *Punica granatum*, *Rhus coriara*, *Rosa canina*, *Taraxacum officinale*, *Trigonella foenum-graecum*, *Tussilago farfara*, *Vinca libanotica*, *Ziziphus vulgaris*.

Table 3. Some medicinal trees found in Lebanon and their common uses

Species	Habitat	Medicinal uses	Other uses
<i>Alianthis altissima</i>	West mountains of Mount Lebanon, between 0-2,000m; in Bekaa, south Riyyak and in the south of Lebanon	Powdered bark used to treat intestinal tapeworms and for dysentery and other stomach trouble	Insecticidal properties
<i>Ceratonia siliqua</i>	Coastal areas, and on the inferior slopes of coastal mountains 0-1,000m	The pulp has anti-diarrhoea properties, the gum serves as a suspending agent, absorbent demulcent, lubricant	Food
<i>Clematis vitalba</i>	Localised in the northern part of the country between 0-1,000m	External usage against varicose ulcers	
<i>Cupressus sempervirens</i>	West and east mountains of Mount Lebanon between 300-2,000m	Mostly used to treat blood circulation disorders	
<i>Ficus carica</i>	Spontaneous	Laxative	Food
<i>Fraxinus ornus</i>	Between 0-2,000m	The extracted mannitol is used as an osmotic diuretic and as excipient	Aromatics
<i>Juglans regia</i>	West mountains of Mount Lebanon between 300-2,000m; in the Bekaa, south of Zahleh and towards Baalbek; and in Hermon	Leaves are astringent, eupeptic with a hypoglycaemia action. The extracted juglone is an antiseptic and keratinizing	Food
<i>Juniperus</i>	Between 1,000 and 2,800m	Diuretic and eupeptic	Soil improvement and protection
<i>Laurus nobilis</i>	Coastal areas, between 0-2,000m and in the south	External usage, stimulant	Aromatics
<i>Melia azedarach</i>	Coastal areas and mountains, up to 1,000m	Anti-helminthic, remedy for intestinal worms and parasitic skin diseases	Insecticidal properties
<i>Myrtus communis</i>	West mountains of Mount Lebanon between 0-1,400m	Mostly antiseptic, for pectoral (respiratory) infections	
<i>Quercus infectoria</i>	Up to 1,600m on western slopes	Astringent for external and internal usage	
<i>Rhamnus cathartica</i>	West mountains of Mount Lebanon between 1,400-2,000m	Laxative and purgative	
<i>Rhus coriaria</i>	West mountains of Mount Lebanon between 0-2,000m		Food
<i>Ulmis minor</i>	Sub-spontaneous	Tonic, astringent	

Source: Baalbaki (1997)

Perfumes and cosmetics

Some **aromatic plants** are used in the daily food of most Lebanese people, especially *Origanum sp.* Mixed with ground sumac flower, sesame seeds and olive oil, it results in the highly appreciated “zaatar wzayt”. Laurel leaves are used in several recipes; they were used in the past to perfume the laundry. Several wild leafy vegetables are used for salads and for cooking, while wild apple fruit, *Malus trilobata*, are used as pickles.

Several teas are prepared and hundreds of recipes could be given to treat all sorts of illnesses and diseases. One remarkable example is that of hepatitis cured by wild cucumber juice (*Echbaliu elaterium*) (FAO, 1998c).

Exudates

Pinus pinea is rich in resin. In Lebanon, the resin (*Katroun*) had been used as an insecticide applied to goats (FAO, 1991).

Other

Research on biological resources, or biodiversity research, funded by pharmaceutical firms or research agencies, is proceeding in a number of countries. Forest biological resources have been the subject of several agreements between Lebanese institutes and international organisations. Several studies have been supported by the International Plant Genetic Resources Institute for surveys, collection and characterisation of plant genetic resources of Lebanon.

Specific studies include a survey on local genetic resources of pistachio, characterisation and evaluation of the diversity of *Pinus pinea* forests, and a survey and characterisation of Lebanese almond germplasm.

Insecticides of plant origin which are readily biodegradable are perceived to be environmentally safe and ecologically acceptable. Several studies have been conducted at the Faculty of Agricultural and Food Sciences of the American University of Beirut on the bio-pesticidal properties of *Melia azedarach*. This tree species contains several liminoids that act as feeding deterrents and growth regulators of insects. Leaf and fruit extracts were found to repel white fly adults. Aqueous extracts of leaves and fruits were found to be comparable in their efficacy to certain tested commercial bio-rational and synthetic pesticides against the pea leaf minor.

ANIMALS AND ANIMAL PRODUCTS

Honey and beeswax

Honey production is an important activity at the level of small farmers. Beekeeping is based on fodder from the forests. The number of beehives in Lebanon is 100,000, of which 92 percent use modern techniques and 8 percent use traditional techniques. Thirty-six percent of hives are located in mountainous areas, while 33 percent are in the north. Total export of honey was recorded to be worth 75 million Lebanese Pounds (LL) (US\$49,500) in 1997 (Tellawi, 1993).

Table 5. Honey production in Lebanon (1997)

Type	Number of beehives	Production (tonnes)	Production (kg/bee hive)	Production value (million LL)	Price/kg (LL)
Traditional	8,063	38	5	884	22,150
New	91,973	990	11	19,447	18,700
Total	100,036	1,028	10	20,291	19,120

Source: MoA (2000)

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Lebanon quantitative data: Wild harvest from natural forests or other wooded lands and plantations

Product			Resource				Economic value			
Category	Importance	Trade name Generic term	Species	Part used	Habitat	Source	Destination	Quantity, value	Remarks	References
	1, 2, 3				F, P, O	W, C	N, I			
Plants and plant products										
Food	1	Pine nut	<i>Pinus pinea</i>	nu	F, P	W	N, I	Total production of 16,500t and export of 0.2t in 1999 - Wholesale price worth LL22,000		FAO, 2000
	2	Almond	<i>Prunus dulcis</i>	nu	F, P	W, C	N	Total production of 28,600t and export of 70t in 1999		FAO, 2000
	2	Walnut	<i>Castanea sp</i>	nu	F, P	W, C	N	Total production of 2,900t and export of 30t in 1999		FAO, 2000
	2	Carob	<i>Ceratonia siliqua</i>	fr	F, O	W	N	Annual production of 50kg/tree		MoA, 2001
Perfumes, cosmetics	1	Sage	<i>Salvia sp</i>	le	F	W	N, I	Annual production of 50 t		MoA, 2001
Animals and animal products										
Honey, beeswax	1	Honey		ho	F, O	W, C	N, I	Total export worth LL52 million in 1999 - 200-500 t/year		Tellawari, 1993

Importance: 1- high importance on the national level; 2 - high importance on the local/regional level; 3 - low importance

Part used: an - entire animal; ba - bark; bw - beeswax; le - leaves; nu - nuts; fi - fibres; fl - flowers; fr - fruits; gu - gums; ho - honey;

la - latex; oi - oil; pl - entire plant; re - resins; ro - roots; sa - sap; se - seeds; st - stem; ta - tannins.

Habitat: F - natural forest or other wooded lands; P - plantation; O - Others: Trees outside forests (e.g. agro-forestry, home gardens)

Source: W - wild, C - cultivated

Destination: N - national; I - international

LL1,000 = US\$0.66 (mean exchange rate in 1997).

Annex VI. Fodder species

Livestock play an important role in Lebanese rural economies but production levels could be enhanced through improved natural resource management. Free range grazing of livestock on communal (church or municipal) land is continuous and largely reliant on annual grasses and herbs. Continuous grazing is detrimental to long-term productivity of grass and leads to loss of more nutritious and palatable species and dominance of less nutritious, less palatable species. Tree cover has been largely removed and so livestock do not benefit from access to foliage of deep rooted perennial plants which can access soil moisture and continue to provide green feed year round.

Following is a description of a number of fodder species with potential for Lebanon which could be trialled for suitability, according to the appropriate agro-climatic zone for each species. An excellent explanation of the importance of trees for fodder production and a more extensive list of fodder tree species including carob, willow, poplar and honey locust can be found on this website: http://www.grahamandrews.com/fodder_trees.html

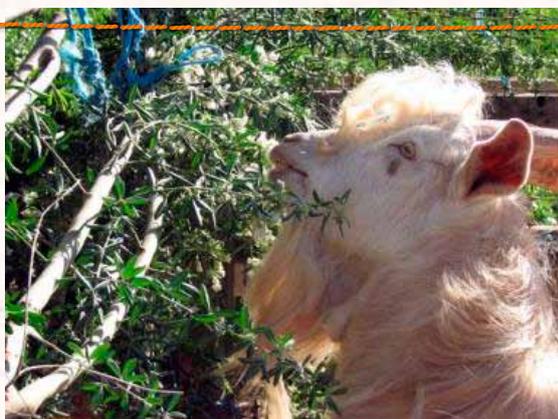
Saltbush (*Atriplex nummularia*)

Saltbush is commonly grown on saline soils in southern Australia as a fodder for livestock. The drought hardy plants are rich in vitamin E and provide a moderate quality feed source during the autumn feed gap when pastures tend to be of poor quality.

<http://www.futurefarmcrc.com.au/documents/Saltbushprovesvaluablelivinghaystack.pdf>

Tagasaste (*Chamaecytisus palmensis*, common name: Lucerne tree)

Tagasaste is a small spreading evergreen tree that grows 3-4 metres high. It is a member of the *Fabaceae* family and is indigenous to the dry volcanic slopes of the Canary Islands, but it is now grown in Australia, New Zealand and many other parts of the world as fodder crop. <http://en.wikipedia.org/wiki/Tagasaste>



Tagasaste delivers between 23 percent and 27 percent crude protein (14-30 percent in Western Australia) and 18-24 percent crude indigestible fibre. With proper application of fertiliser it can maintain these levels even when grown on poor soils.

Cattle can be set stocked on tagasaste since their tongues are too large to pick off the new shoot buds, and some leaves always remain on the plant. The removal of new buds by sheep that appear about six weeks after grazing can lead to plant deaths. Today the majority of tagasaste is used for

cattle grazing with plantations able to be grazed at any time of year. Though it can grow up to 4-5 metres in height when managed for grazing, it is kept to less than two metres.

On infertile white sands in Western Australia, tagasaste has increased animal carrying capacity from 1-2 Dry Sheep Equivalents with annual pastures to 8-10 Dry Sheep Equivalents (approximately one cow) per hectare with mature tagasaste. The yield of edible dry matter (leaves and fine stems) in the West Midlands is mostly in the range of 3-5 tonnes per hectare. Tagasaste also prevents wind erosion and excessive ground water recharge that were major environmental problems before. Tagasaste can sequester carbon at the rate of about six tonnes CO₂ equivalent per hectare per year. About half the CO₂ being stored is as organic carbon in the soil and half is in the wood of the branches, trunk and roots. <http://www.malleefutures.org.au/files/fodder.pdf>

Leucaena

Leucaena is highly valued as ruminant forage and as a fuelwood by subsistence and semi-commercial farmers throughout southeast Asia and parts of central Asia and Africa. It is planted in hedgerow systems with grass for cattle production in northern Australia, and as a hedgerow species in parts of southeast Asia and Africa. It is also used as a shade tree over coffee and cocoa, grown in dense rows as a living fence, and used to support vine crops such as pepper and passionfruit. Leucaena is the most commonly researched species for alley farming systems. It has been used as a reclamation species following mining, but is no longer used due to the weed risk.

http://www.tropicalforages.info/key/Forages/Media/Html/Leucaena_leucocephala.htm

- Leucaena is a high quality, long-lived leguminous forage tree. It is well adapted to the >600mm rainfall zone of Queensland, Australia (but is also very hardy and does well in regions receiving <600mm for at least part of the year).
- Leucaena produces very palatable, nutritious, high protein leaf for cattle, giving liveweight gains of 250-300 kg/hd/yr. This is twice that of grass only pastures.
- In Queensland, leucaena is normally planted in rows 5-6 metres apart with grass in between and directly grazed by cattle.

http://www.leucaena.net/leucaena_sust.pdf

Vigorous growth of nutritious foliage on young Leucaena tree.



Annex VII. *Acacia saligna*^{15, 16, 17}

Acacia saligna is a small nitrogen fixing tree native to the southwest of Western Australia. It is fast growing and tolerant of a wide range of soils, including calcareous and slightly saline types in temperate climates. *Acacia saligna* has been planted in North Africa and the Middle East for decades and is used for fodder, fuelwood, sand stabilisation, and as a wind break. In Australia it is most commonly used as an ornamental, but is being increasingly planted in agro-forestry systems for fodder production and soil conservation.

Human food. *A. saligna* belongs to a group of Australian acacias that have edible seeds and which have great potential for combating desertification and hunger simultaneously in semi-arid lands. The seeds have a long storage life and are tasty, safe to consume and nutritious: protein, carbohydrate and fat contents are 17-25 percent, 30-40 percent and 14-16 percent respectively. In West Africa, the seeds ripen when labour demand is low. Being perennial plants with extensive root systems, mature acacias can take advantage of out-of-season or poorly distributed rains that would be ineffective for annual crops. *Acacia* seeds are easily harvested and processed into flour. Through using simple and existing local technologies, flour can be incorporated into local dishes and “non-traditional” foods such as spaghetti, bread and biscuits. The seed also has great potential as a food supplement for livestock. In Niger Republic acacias have been eagerly adopted into the regular diet in at least 25 villages and World Vision is actively exploring market opportunities and potential for nutritional food supplements based on acacia seed.



Two traditional Ethiopian foods made with *A. saligna*: injera (**left**) and kollo (**right**).

Fodder

In semi-arid regions suffering from extreme environmental degradation, where families rely on livestock for their income and/or food supply, fodder is often in very short supply. *A. saligna* offers a means of at least partially addressing these urgent needs simultaneously on land that is currently under-utilised.

It should be recognised however that *A. saligna* will not meet its potential by simply planting it. Incentives for community engagement such as granting of user rights, creating appropriate management structures such as cooperatives, training in tree management, and development and promotion of acacia-based foods are essential ingredients to success.

¹⁵ <http://www.worldwidewattle.com/infogallery/projects/acacia-saligna.pdf>

¹⁶ http://www.winrock.org/fnrm/factnet/factpub/FACTSH/A_saligna.html

¹⁷ <http://www.fao.org/ag/AGP/AGPC/doc/Gbase/DATA/PF000540.HTM>



Above: Just 12 months after pruning, *A. saligna* has sprouted branches of between 1.5-2 metres. July 2009 (left), July 2010 (right).

Another beneficial feature of *A. saligna* is that it coppices well after pruning. In fact, farmers discovered that if it is not heavily pruned periodically its lifespan is significantly shorter and growth rates are reduced. This is a big advantage for both sustainable wood, fodder and seed production.