

Trip Report and Recommendations Regreening Tigray

15-22 July 2010

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Two boys play with recently cleared forest as a backdrop. What does their future hold - one of grinding poverty or one of abundance? To a large degree, the answer lies in our hands. The actions we take or fail to take in relation to their environment will have far reaching consequences not only for them, but for generations to come.

They wage unmitigated warfare both against the forest and the soil – carrying destruction before them, and leaving poverty behind.

U.S. Farmers Register, August 1833, on the impact of farming pioneers in America.

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Acronyms

ADP	Area Development Program
FMNR	Farmer Managed Natural Regeneration
NTFP	Non Timber Forest Products
SWC	Soil and Water Conservation
TARI	Tigray Agricultural Research Institute
WVE	World Vision Ethiopia

Introduction

The purpose of this visit was to contribute to the launch of an Farmer Managed Natural Regeneration (FMNR, Annex I) movement in Tigray Region, Ethiopia and scale up of forest management best practices for reversing deforestation. To this end, a regional FMNR workshop organized by WVE and WVA in collaboration with regional development partners was held in Mekele on the 16-17th July, 2010 and field visits were made to Abreha Atsbeha and Dessa'a Forest. The workshop had the following objectives:

- Identify the root causes of deforestation and opportunities for reforestation
- To bring current knowledge in best practice utilization of forest products (for fuel wood, charcoal and construction) to the attention of participants and policy makers
- To improve the indigenous knowledge and practices of the community thereby assisting participants to committing to implement FMNR on farmland, farm boundaries, enclosure areas and forest areas.
- To draw up action plans for the way forward
- For participants to commit to implementing FMNR based reforestation and sustainable management on farmland, farm boundaries, enclosure areas, forested areas and homesteads.

The FMNR workshop brought together communities, Community Based Organizations, religious leaders, policy makers, media and staff from regional government offices including the Land use and environmental protection, Natural Resource Protection, Management and Utilization, TARI, Energy and Mining, Agricultural Research and Extension System, local government Wereda (Eastern and SE Tigray zone), World Vision Australia, World Vision Ethiopia (WVE), national and program office and Area Development Program (ADP) , Mekelle University and NGOs. The workshop was opened by Ato Abay Woldu, the Regional vice president and Head of the Agricultural and Rural Development Bureau. Ato Abay explained the importance of natural resource management and conservation to attain household level food security and stated that it is indispensable for poverty alleviation. He also stated that forests and trees are critical for life in general and for agricultural production in particular because of their positive role in maintaining the water cycle and soil fertility. In the two day workshop four topics were presented by three presenters and thorough discussions were held among the participants. All participants were engaged in the discussions and actively contributed to preparing the action plans and to mapping out a way forward.

Workshop outcomes were very encouraging. Overall there was strong affirmation from participants to adopt the practice of FMNR in the region. WVE will provide a full report on the workshop proceedings. A follow up meeting was held with Belete Tafere, head of the Natural Resource Management Utilization and Protection Agency and staff and researchers from the Tigray Agricultural Research Institute (TARI) and the Land Use and Environmental Protection agency to determine next steps.



Regional FMNR workshop, Milano Hotel, Mekele.

For Ethiopia as a whole, certain forestry subsectors beyond round wood are commercially important, notably fuel wood entrepreneurs (USD 420 million per year), herbalists (USD 216 million per year), wild coffee producers (USD 130 million per year), honey and beeswax producers (USD 86 million per year) and furniture makers (no estimates available)¹. This is no small contribution to the national economy. Could Tigray become a leader not only in restoring degraded landscapes, but in wealth creation through developing sustainable forest industries while protecting dwindling remnant old growth forests? Why not? Certainly the skill and determination exist already. Certainly the will is there - participating in the FMNR workshop, one got the very strong impression that all stakeholders present were determined and passionate to create a 'Green Tigray'.

This report collates information collected during the FMNR workshop, from field visits and from selected articles. The recommendations are based on the findings and it is hoped that they will act not as a blue print, but as a guiding set of principles to follow in order to turn into reality the participants vision for a 'Green Tigray'.

Field Visit Observations and Discussions



Typical farmland cleared of all woody vegetation with bare hills in the background.

For the purposes of this report, there are three main land usage types: cultivatable land (Approximately 1.5 million hectares), area enclosures (Approximately 1.2 million hectares) and forested land (Approximately 224,000 ha).

Deforestation and land degradation.

Extreme environmental degradation has occurred throughout the region on all land types as evidenced by soil erosion, loss of trees, grasses and general biodiversity. Much of the original woody vegetation and grasses have been removed from cultivated land and from unprotected hillsides which historically have been used for grazing and wood extraction. Locals report that forests still existed in the vicinity of the regional capital Mekele as recently as 50 years ago.

Major contributors to deforestation include clearing for farms, wood cutting and charcoal production to meet growing urban needs². FMNR workshop participants added to the list: lack of awareness, poverty, greed, free grazing, non-adoption of alternative energy sources and the lack of land use policy and or enforcement for different types of land and limited land ownership reducing peoples' incentive to sustainably manage and improve natural resources.

Even where clear laws exist, there is a low level of enforcement and miniscule or even wavered punishment levels do not discourage forest destruction.

Very poor communities made even more vulnerable by recent droughts supplement their income through wood and charcoal sales. During the 2008-2009 droughts, desperate farmers lopped branches of the indigenous olive tree in remnant forests in order to keep their animals alive, even though the leaves have low digestibility. Even the roots of trees are unearthed and sold. Today wood being carted to Mekele from receding forests requires a two to three day donkey journey. As many as 500 donkey loads of wood and charcoal arrive at the main Mekele wood market every Saturday and Monday. This does not include the daily intake of around 100 donkey loads coming from closer sources or the wood and charcoal reaching two smaller wood markets in Mekele. Commercial interests based in urban centres also fuel large scale tree harvesting.



A former community forest guard caught in the act of digging up tree roots. Many rural people feel they have no other option than to sell wood to supplement their income. However, removing tree roots greatly increases the difficulty of regenerating the forest.



"I don't believe it, I don't believe it. This area was thick forest just two years ago - it was difficult to pass through it and people were scared of wild animals and bandits." Abrha Seged, local inhabitant and second year undergraduate in Natural and Cultural Heritage Conservation, Mekele University.



Donkey train – the donkey owners left for the forest at midnight the previous night and were just returning, nine hours later (3.00pm) when we came across them. In their case, the women use the wood to brew beer for sale. "We do this because we have no choice. We are poor". When asked "what will you do when the forest is gone"? They responded: "We will go still further".

² See Dessa'a Protected Area, An Assessment of Human Impact, Evolutionary Pattern and Options for sustainable Management, by Zenebe Gebreegziabher, 1999, Mekelle, Ethiopia, for a fuller account.

The rate of forest loss is alarming. Exceptional degradation is still ongoing around Dessa'a forest which has dwindled from 123,738 hectares in 1998-2001 to 118,635 hectares in 2010, and in some other remnant forests. This figure likely does not include the gradual thinning and degradation occurring within the forest.

Since 1991, conservation programmes with community participation gained top priority in Tigray. Major strategies include construction of stone terraces, reforestation and enforcement of grazing restrictions. Reforestation efforts included area enclosures and the establishment of community woodlots for ecological regeneration. Especially when economic benefits became apparent, communities increased their conservation efforts. Nine out of ten *tabias*³ now have woodlots on their lands. Most woodlots are managed at the village level by a village council, and are used only by members of that village. The local council identifies the areas to be closed and/or planted. The community members are involved in the decision making process during general meetings⁴.

The impact of conservation programs has been significant. Soil and water conservation (SWC) activities have been undertaken on 956,000 hectares; 1.2 million hectares are under vegetation enclosure management and there are 224,000 hectares of forested land. Each year some 40 million tree seedlings are planted with a 56% survival rate. These interventions have led to demonstrated significant improvements in terms of soil conservation, infiltration, crop yield, biomass production, groundwater recharge and prevention of flood hazard. The status of natural resources has improved (and locally strongly improved) since 1975, due to both to improved vegetation cover and to the implementation of physical conservation structures. Currently, average soil loss by erosion is around 68 % of its 1975 rate⁵.

In some areas, creation of enclosure areas and implementation of SWC measures have resulted in water tables rising from 9 meter depth to 2 to 4 meters, making irrigation cost effective. Dried up springs have started flowing again and steams 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. For example, conditions in Abreha Atsebha were so bad that the community was to be resettled. However with assistance and through hard work, the community transformed the catchment area. Dam construction, digging trench bunds and chains of ponds for 'water banking' and re-vegetation has resulted in at least 50% 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.

On farmland in Abreha Atsebha a quiet revolution is occurring. Self sown seeds of mature *Faidherbia albida* trees (Annex III) are germinating in fields after passing through the alimentary canal of livestock. Contrary to normal practice, which was to chop them out, farmers who today recognize the multiple benefits of this tree are allowing the self sown seedlings to grow.



Three semi trailer loads of charcoal like this one enter Mekele's largest wood market daily. The charcoal is coming from the Afar side of the Dessa'a forest.



What remains of Dessa'a forest: Farmland encroachment in foreground and signs of severe thinning and erosion within the forest (centre of photo).



Successful enclosure area Abreha Atsebha.

³ A *Tabia* is the lowest administrative unit comprising usually four - five villages.

⁴ *Forest Rehabilitation in Ethiopia* <http://povertyenvironment.net/files/CASE%20Ethiopia.pdf>

⁵ *Understanding the environmental changes in Tigray: a photographic record over 30 years. Tigray Livelihood Papers No.3.* Nysse, J. Et al. 2007.

<http://waswc.soil.gd.cn/subjects/soil%20erosion%20&%20swc/Environmental%20changes%20in%20Tigray,%20Ethiopia%20in%2030%20yrs,%20Mar%20'07.pdf>



Formerly treeless enclosure area showing very rapid growth through natural regeneration of trees. These *Faidherbia albida* trees are just three years old).



Restored farmland now covered with an emerging forest of young *Faidherbia albida* trees.



Soil and Water Conservation works successfully trapping water runoff and causing groundwater recharge. Note - thriving *Acacia saligna* trees planted 2-3 years previously.



Acacia ethebica photographed in hotel gardens. With silvicultural management, this species can grow both quickly and with good form. Notice the erect form, due to pruning. Because *A. ethebica* normally appears to be slow growing and specimens in enclosure areas display very irregular form, many people do not appreciate their regenerative capacity or value. However, with pruning (see Box 1.) even slow growing, multi-stemmed indigenous acacia species can produce valuable small poles relatively quickly. Other indigenous species with potential are present in enclosure areas also.



Enclosure area, View from township of 'Cactus' showing considerable natural regeneration of predominately one species, *Acacia ethebica*. Note: Even though it has been an enclosure area for around 15 years the trees are stunted at less than two meters tall.



The stunting can partly be explained by the lack of pruning (note multi-branched form of the trees) and the severe competition between trees due to lack of thinning.



Additionally, slow growth could also be due to physical damage to the trees. Nearly all trees examined had suffered extensive damage where branches and or bark had been torn from the tree.

Box 1 : *“It is clear that interventions are needed [on enclosure areas] to improve the number of species, and seedlings of the species. In addition silvicultural management to improve the quality and status of the trees are needed. The closed areas were established with the full participation of the local community. Yet there are some gaps regarding the future management and utilization of the closed areas. These gaps need to be filled soon so that the local community will feel more secure and be ready to invest in the closed area. In this regard, silvicultural interventions should be oriented towards managing and improving the productivity of the closed areas, in such a way that the needs for conservation of biodiversity and environmental sustainability, and the demands of the local people for biomass resources and secondary ‘forest’ products like honey can be met”.* Vegetation Improvement in Communal Closed Areas in Tigray, Ethiopia. Tewolde-Berhan, S. et al. <http://www.fao.org/DOCREP/ARTICLE/WFC/XIII/0854-B3.HTM>

It appears that communities have been given the responsibility of protecting enclosure areas without the full rights to benefit from them. Some communities such as Abreha Atsbeha have accepted that responsibility regardless and the environment is steadily improving. This environmental reversal is possible only if the local communities believe in it and put it into effect through their own organization. The local communities that have been doing this in Tigray helped by the Institute for Sustainable Development and the Bureau of Agriculture and Natural Resources, have done so by formulating by-laws to govern their activities⁶. However, other communities, such as Sergen, Adi akeyeti and Gamra have responded by removing all vegetation and allowing free range grazing in their enclosure areas.

To build on the excellent enclosure work already done in Tigray, providing communities with user rights along with organizational structures and training and awareness creation on responsibilities for sustainable management is required. See Box 2 (while this quote deals with planted trees, the same principles hold true for naturally regenerated trees). If applied in Tigray, lessons learnt in Niger Republic (Annex IV) could enhance effectiveness of compliant communities while attracting non compliant communities to abandon destructive habits and adopt more sustainable ones.

Box 2 : *“Tree tenure rights remain an issue of concern in Tigray. Although a farmer has the ownership right to (planted) trees on his homestead and cultivated lands, he or she needs to get permission from the local government to cut the trees, hindering economic gains from tree planting. Allowing households to decide on their own woodlot products may generate more local benefits for the communities in Tigray. Private tree planting on hillsides and degraded areas could potentially lead to large economic benefits”.* Forest Rehabilitation in Ethiopia <http://povertyenvironment.net/files/CASE%20Ethiopia.pdf>

⁶ The role of forest rehabilitation for poverty alleviation in Drylands Tewolde Berhan Gebre Egziabher Journal of the Drylands 1(1): 3-7.2006

Livestock:

Even though livestock are meant to be kept out of enclosure areas, extensive livestock induced denudation and erosion was witnessed in areas where social controls were inadequate. Due to continuous grazing pressure, grass and tree species have little or no chance to recover or to produce fodder at optimal rates. Up to 50% of household income may come from livestock, however particularly during drought, malnourished and sick animals are more of a burden than a benefit.

The need to provide poor farmers with alternate means of feeding their livestock (e.g. through intensive cultivation of appropriate fodder species and better livestock management practices including rotational grazing and cut-and-carry systems), is paramount for the success of any reforestation venture. Such interventions would result in better nourished livestock and reduced damage to the environment while demonstrating to the communities that the authorities have their best interests at heart (See Box 3).



Malnourished cow ranging freely in enclosure area.

Box 3: The question will arise as to how free range grazing can be stopped. This can be done, as has happened in many areas in Tigray, by a local community deciding to keep cattle in a relatively small area so that both grass and trees can grow. After closing the area off during the dry season, the grass can be cut and fed to cattle as well as be stored as hay. Branches from trees can also be lopped and the leaves can augment cattle feed and the wood be used for fuel. The role of forest rehabilitation for poverty alleviation in Drylands Tewolde Berhan Gebre Egziabher *Journal of the Drylands* 1(1): 3-7.2006



Bee hive shelter in the centre of an enclosure area. The success of the honey promotion program is inextricably linked with the success of enclosure areas in re-habilitating vegetation on a large scale. Vast areas of land are now covered in flowering plants such as Tabib, gerbia and acacias which provide bee fodder.

Honey Production

Promotion of modern beehive management and equipment, queen rearing by farmers, bee forage development and market development has resulted in honey production increasing from 130 quintals to 31,100 quintals and productivity increased from 10 Kgs/ hive to 35 kgs/hive.

The potential for an expanded honey industry is simply enormous⁷. According to the 2007 data, there are 204,000 bee colonies in Tigray of which only 53,282 have modern beehives. The majority of the colonies with modern hives were recently established⁸.

Other Biological Resources

Tigray has a wide range of high potential yet barely tapped biological resources (see Annex III). In some cases, a little more research and development is needed to unlock secrets blocking improvements. In others, identification and addressing gaps and blockages to market development are required. For example, for the case of gum and incense production, Mulualem Berhanu, general manager of Guna Trading House, told journalists in 2006⁹ that it could be possible to produce and export 250,000 tons of gum and incense from Ethiopia annually. However, he said only 6,000 tons of the stated volume of gum and incense potential is exported abroad due to lack of appropriate attention given to implementation of forestry policy and of proper handling of gum and incense trees. The perhaps surprising issue is that in a land ravaged by famine, there are in fact many biological resources which are readily available now and which can be drawn on immediately to restore the environment and to build prosperity.

⁷ <http://www.medwelljournals.com/fulltext/?doi=aj,2010.201.204>

⁸ http://www.gpia.info/files/u79/ey_Production_in_the_Tigray_Region__Ethiopia.pdf

⁹ http://english.peopledaily.com.cn/200604/16/eng20060416_258721.html

Recommendations

Introductory Discussion

Despite very significant gains in environmental restoration, the ongoing loss of old growth forest and the sheer scale of historical forest destruction requires a modified approach to reversing the trends. Ultimately, it is in everybody's best interest to succeed.

A comprehensive and win-win approach should be taken. As far as possible, vested interests from poor community members and those trading in forest products to consumers should not be alienated, but should be taken on board as collaborators in solving a very pressing problem which ultimately affects everybody. Strict sanctions without compensatory measures, which deny people their means of livelihood or inhibit consumers from affordably meeting their daily needs for cooking and heating fuel, will only create resentment and a negative backlash. Therefore wide consultation is required along with funding to assist in making the transition. Where sanctions are essential for success e.g. prohibition of cutting old growth forests, alternate means of livelihood need to be provided rapidly to those affected and alternate sources of firewood and charcoal need to be accessed from sustainable sources so that supply is not cut abruptly.

A comprehensive approach should include reducing demand for wood and charcoal through promoting increased efficiency and alternative energy sources on the part of consumers. Unsustainable exploitation of remnant old growth forests should be halted immediately. Affected communities' livelihood needs should be met through switching to alternate income generation sources such as honey production, gum extraction, eco-tourism, intensive fodder-livestock production, food for work/cash for work schemes for reforestation, forest guarding etc. In that significant tree regrowth is now occurring on over one million hectares of enclosure land, communities responsible for managing these areas should be given training in sustainable management along with user rights. Legal harvesting through thinning and pruning, according to strict guidelines should be allowed. This action would have a twofold impact: it will stimulate enhanced management, protection and greater productivity of enclosure areas by the communities themselves and it will supply firewood, charcoal and poles, effectively covering the gap in supply caused by halting clearing of old growth forests. At the same time, merchants whose livelihoods would have otherwise been threatened will be able to continue trading, but from sustainable supplies. Additional aids in this process may include:

I. Adopt and apply steps promoting an 'enabling environment' for successful agroforestry and forestry activities, including:

- revive traditional forest management processes. Ensure communities and individuals are aware of their responsibilities through joint creation of by laws on tree and natural resource management, and that community managed safeguards are in place to ensure compliance. At the same time, already existing laws prohibiting the destruction of old growth forests and the sale of protected species should be enforced with rigor. Fines need to be commensurate with the crime and they should be consistently applied.
- create community managed certification system for wood sales and establish monitored wood and NTFP markets, along with community managed methods of ensuring compliance. Simplify and streamline the process through which individuals and communities can certify their wood and charcoal.
- create an incentive scheme for communities and individuals engaged in successful tree planting, care, protection and sustainable management in order to stimulate interest in tree planting and sustainable management of plantations. Incentives could be in the form of waiving any taxes normally levied on exotic plantation timbers including *Acacia saligna*, *Eucalyptus*, *Grevillea robusta* and *Casuarina*.
- waver any taxes which may be levied on forest produce from sustainably managed/certified enclosure areas and farmland for three years.
- create an incentive scheme for assisting households and institutions to switch to alternate energy sources and energy efficient appliances. Incentives should also extend to charcoal produces to assist them to become more professional and to adopt more efficient equipment¹⁰.
- hold workshops, exchange visits, stakeholder sensitisation and awareness creation activities; utilize Behaviour Change Communication materials, mass media¹¹ (radio, TV, journals, newspapers, songs etc.) and popular celebrities as ambassadors.
- create new or strengthen existing legally recognised community organizations such as cooperatives or development groups, providing a social framework to work with and through.

¹⁰ Evaluation of hundreds of traditional charcoal kilns in Madagascar and Rwanda showed charcoaling efficiencies of only about 8 to 9%. In several countries, higher production efficiencies of 8 to 20% have been reported. The very low efficiencies obtained in practice can be increased considerably through a systematic effort to help charcoalers become more professional; efficiencies of up to 28% have been observed in practice. http://www-wds.worldbank.org/external/default/WDSContentServer/WDSPIB/1999/08/15/1000009265_3980623151040/Rendered/PDF/multi_page.pdf

¹¹ See also, *The Man Who Planted Trees*, an excellent resource for awareness creation and motivation. <http://www.youtube.com/watch?v=T2a4ti6uLMg> and http://www.amazon.com/Man-Who-Planted-Trees/dp/B0006HDBU8/ref=sr_1_8?ie=UTF8&s=dvd&qid=1281324289&sr=8-8

- grant legal user rights¹² for wood, non timber forest products (NTFPs) and fodder to communities and/ or individuals which have received training and accept responsibility for the sustainable management of forestry resources. This will allow them to benefit from their work, effectively giving the incentive needed to nurture and protect trees in cultivated land, enclosure areas and in existing forests.
- provide strong moral and physical support from district and local level ministries and departments.
- provide short term incentives such as food for work or cash for work if necessary to assist transition from destructive forest exploitation to sustainable management.
- monitor activities; continuously encourage practitioners; persevere through setbacks.
- provide FMNR training for communities; promote agroforestry and use of multipurpose trees in farm lands; discourage tree clearing on farmland.

2. Adopt and apply management strategies appropriate to each land use type.

Site specific recommendations include:

a) Enclosure areas –

- create awareness on environmental issues including climate change amongst leadership, professionals and local administration; facilitate behavioural change among communities.
- train communities in sustainable natural resource management methods, such as FMNR, tree planting, direct sowing, planting fodder banks, SWC etc.
- certify communities which received training and accept responsibility for natural resource management to begin pruning and thinning trees and harvesting fodder for home consumption and sale as soon as possible.
- seek external funding sources, such as the climate change adaptation fund.

Sustainable community based management of enclosure areas should be given high priority. Economic and environmental benefits from divulging responsibility and rights to the community will be realized quickly and will

have a multiplying effect, stimulating greater action by the target population and the spread of techniques to neighbouring communities. In addition, a sustainable wood harvests from enclosure areas is possible immediately and this activity will reduce demand for wood from threatened remnant forests such as Dessa'a.

b) Existing old growth forests such as Dessa'a

Ongoing destruction of remnant and vulnerable old growth forests is occurring. While tree planting schemes in Tigray are impressive and should be continued, the loss of irreplaceable mature indigenous trees should be stopped immediately through

- combined government, community and NGO intervention.
- community mobilization and empowerment and community managed compliance,
- replace destructive survival strategies amongst poor farmers living on forest boundaries. Replace clear felling and overgrazing with sustainable and regenerative activities, including alternative income generation options such as modern honey production methods, harvest and marketing of NTFPs, sustainable wood harvest (where appropriate), employment opportunities through enrichment planting and forest protection, eco-tourism,
- seek external funding sources, such as credits from Reduced Emissions through Deforestation and Forest Degradation and biodiversity credits.

c). Farmlands

- TARI to develop and promote agroforestry farming systems appropriate to the culture, economy and ecology of the region. In particular, multiple benefits *Faidherbia albida* offers as an agroforestry tree (FMAFS, annex II, and *Faidherbia albida*, Annex III).
- include the selected agroforestry method in university and forestry and agricultural training college curriculums, and forestry and agriculture rural extension packages;
- work through lead farmers and farmer field schools;
- host farmer exchange visits.
- seek external funding sources such as climate change adaptation funds.

¹² For a comprehensive discussion and in depth recommendations on policy and legislation issues, see: *Small and Medium Forest Enterprises*, Haile Gebremariam, A., Million Bekele, M., & Ridgwell, A., <http://www.iied.org/pubs/pdfs/135531IED.pdf>

3. Reduce wood demand from Urban centres and institutions¹³.

- reduce urban wood consumption through awareness campaigns and implementation of strategies to reach energy use reduction targets.
- create policies which require key government institutions including the army, universities and prisons to utilize renewable and/or alternative fuel sources.
- work with commercial interests and urban wood markets to establish a voluntary regulatory system ensuring that traders only purchase wood and charcoal from certified supplies.
- introduce and promote alternative fuels such as biogas, solar cookers, solar hot water heaters, wind and/or hydro and wind powered electricity and bottled gas.
- introduce and promote energy saving stoves
- test new technologies such as briquette machines for converting sesame stems and other combustible waste materials to easily transported, usable fuels.
- develop commercial tree plantations around towns that contribute to improving the micro-climate on one hand and to income generation for farmers currently engaged in forest devastation and land less youth on the other.
- influence Government institutions such as prisons, Mekelle university etc to have their own wood lot plantation using their own manpower and budget.

4. Increase fodder production on cultivated land and enclosure areas

- increase fodder production through improved management methods and planting of adapted multi-purpose fodder species.
- promote zero grazing at least until degraded land is restored, followed by controlled/rotational grazing under strict community devised by-laws and supervision.

Epilogue

In his novel, "The Man Who Planted Trees", author Jean Giono describes a decimated landscape with ancient ruins and dry wells which bear testimony to a former civilization's glory inseparably linked to a once verdant forest. Over time though clearing and charcoal making the forest and with it prosperity, disappear: Relative peace and abundance are replaced by social discord, poverty and eventually total abandonment of the region. The hero of the story Elzeard Bouffier, a lone shepherd, daily planted 100 acorn seeds. Over time a forest emerged, people returned and prosperity was restored. Giono concludes with the following words "when I reflect that one man, armed only with his own physical and moral resource, was able to cause this land of Canaan to spring from the wasteland, I am convinced that in spite of everything, humanity is admirable. But when I compute the unfailing greatness of spirit and the tenacity of benevolence that it must have taken to achieve this result, I am taken with an immense respect for that old and unlearned peasant who was able to complete a work worthy of God.

At this pivotal time, Tigray needs to create an enabling environment so that the latent Elzeard Bouffiers who already exist can flourish and go onto rapidly make Green Tigray a reality.

¹³ Understanding the environmental changes in Tigray: a photographic record over 30 years. Tigray Livelihood Papers No.3. Nyssen, J. Et al. 2007. <http://waswc.soil.gd.cn/subjects/soil%20erosion%20&%20swc/Environmental%20changes%20in%20Tigray,%20Ethiopia%20in%2030%20yrs,%20Mar%20'07.pdf>

Psalm 104:30

When you send your Spirit, they are created, and you renew the face of the earth.

Annex I. Farmer Managed Natural Regeneration (FMNR)

Farmer Managed Natural Regeneration, (FMNR), is a rapid, low cost, easily replicated approach to reforestation and agroforestry. FMNR is an empowering form of social forestry which gives individuals and communities both responsibility for care and nurturing of naturally occurring woody vegetation and the rewards from sustainable harvesting of wood and NTFPs. FMNR reduces the need to establish trees through costly, time consuming and sometimes ineffective tree planting.

FMNR has been found to have a significant positive impact on income (poverty alleviation), food security, disaster resilience and reduction of conflict. FMNR is a significant tool for both climate change adaptation and mitigation. It has proven effective from small scale to landscape scale, as a means of restoring degraded land, reversing desertification, enhancing ground water recharge and contributing to reforestation. With guidance, FMNR can be a prime motivator for improving local governance structures and enhancing positive community-local government engagement.

In Tigray many tree species have the ability to sprout from tree stumps and roots, and soil-seed stocks. In fact, thousands of hectares of seemingly treeless hills, farmland, and grazing lands in Tigray could be reclaimed rapidly using FMNR. However, continuous grazing, cutting for firewood and clearing and burning for land cultivation prevent regeneration.

The basic method of FMNR is very simple. The farmer selects the living tree stumps he/she will utilize and decides how many stems will be allowed to grow on each stump, based on the

farmers' needs and ultimate purpose for reforestation. Excess stems are then cut. With the remaining stems, side branches are pruned off up to half way up the trunk. A good farmer will return every 2 to 6 months for a touch up pruning and thereby stimulate faster growth rates and produce straighter stems.

While tree planting is important and can make a significant contribution, the advantages of FMNR include low cost, rapid growth, high establishment rate and ease of replication. As with other activities though, farmers need an incentive in order to be motivated to practice FMNR. In other regions, giving farmers either outright ownership of trees or tree user rights has made it possible for large scale community managed reforestation to take place.

Many people do not realize the enormous regenerative capacity of this regrowth and think that environmental restoration can only take place through tree planting. However, FMNR could make an enormous contribution to environmental restoration and income generation in Tigray. With just 400 multi stemmed trees regenerated per hectare and by selling one stem per tree per year at an average price of only 10 cents, the income for wood from 1.2 million hectares of enclosure area would be **\$48,000,000!** This income could be generated each year indefinitely while actually enhancing the environment. Additionally, there would be increased livestock production because of the increased availability of fodder (seed pods and leaves) and increased income from honey and other non timber forest product sales.

Annex I I. The Farmer Managed Agroforestry Farming System (FMAFS)

FMAFS represents an incremental gradation into a more complex farming system, offering more benefits than FMNR alone in terms of enhanced food security and reduced vulnerability to famine. FMAFS is an alley cropping, agro-pastoral-forestry system which incorporates a wide range of annual and perennial, indigenous and exotic plant species and livestock. The diversity in its design makes it flexible enough to meet individual farmer's varying needs and priorities.

In FMAFS, farmers determine the density and layout of tree plantings and annual crops and the types of indigenous and exotic trees. The foundations laid by FMNR are complemented by the introduction of other species including a range of high seed and wood producing Australian acacias. Acacias are planted along farm borders and in rows within the farm, providing human and animal food, firewood, timber, mulch, environmental restoration and crop protection.

Other valuable agroforestry species are used in FMAFS such as Pomme du Sahel (*Ziziphus rotundafloria*), Tamarind (*Tamarindus indica*), Boabab (*Adansonia digitata*) and Moringa, depending on the environment and farmers needs. Annual cash crops such as millet, sorghum, cowpeas, peanuts, hibiscus, sesame and cassava are planted in rotation between the tree rows, providing food and fodder and income. Crop residues are used as mulch for soil improvement and protection.

FMAFS provides significantly increased farm income compared to traditional millet farming or to FMNR alone, and more diversity in income sources. Farm labour inputs and income are also spread much more evenly across the year instead of being concentrated within a four month period. As with FMNR, the biomass produced by the trees counters the impact of low soil fertility and water stress by providing mulch and soil organic matter as well as protection from winds and fuel for firewood and income generation.

Implementation of FMAFS results in greater insurance against total crop loss during adverse events such as drought, insect attack or storms because not all species and products will be equally disadvantaged by the same event in a particular year. This biologically diverse farming system also tends to offer a range of habitats for beneficial predators of crop pests. Hence FMAFS assures a minimum income every year, even when annual crops fail.



Annex III. Biological Resources.

This annex lists some of the outstanding features of perennial species already available in Tigray Region. Trees and other perennial species can be planted or regenerated to advantage on farmland but also can be used to turn so called wasteland and underutilized hills into useful land. Through cultivating perennial species, farmers (and landless people) can utilize 100% of the landscape instead of the 50% of land currently utilized.

Traditionally, perennial species have not figured prominently on cultivated land, in fact it is practically a universal global practice to remove them from farmland. Yet they have enormous potential to greatly enhance resilience to environmental shocks such as drought and insect attack while providing food, fodder and environmental services such as reduced wind speeds and temperatures which in turn contribute to increased annual crop yields.



Faidherbia albida growing in cultivated field Abreha Atsbeha. Why is this the exception to the norm in Tigray's farmland?

Faidherbia albida is an extremely valuable indigenous species yet it was observed on farmland and in enclosure areas only at Abreha Atsbeha. In West Africa, crops growing under a canopy of the nitrogen fixing *F. albida* trees produce an extra 2.5 – 3 tons of stalks per hectare and two and a half times the grain (equating to an extra 1,200 – 1,500 tons of grain) with three times the protein content, compared to crops growing in the open. Twenty five trees per hectare provide a full fodder ration for one to one and a half sheep per year. This is three times the optimal stocking rate for the Sahel. The trees also host cattle egret and many other predators of insects, helping to protect crops against pests. An adult egret for example eats 30-50 locusts per day. The trees are unusual in that they shed their leaves during the rainy season when crops need maximum sunlight and bear leaves in the dry season when livestock and soils need protection from the strong sun and wind.

According to a review of research conducted in various countries increases in soil nitrogen content due to *F. albida* ranged from 15 to 156 %, but significant increases were also found in carbon, phosphorus, exchangeable potassium, calcium, and magnesium. The impact on millet yields ranged from 49 to 153 % increases; for sorghum, most yield increases ranged from 36 to 169%. This may explain why farmers in parts of the densely populated southern Zinder Region of Niger have created such a high-density agro forest of *F. albida*¹.

Faidherbia albida is slow growing at first but once its tap root hits the water table it is one of the fastest growing trees in Africa. Seeds can be direct sown in fields, but once mature trees are established, seeds which have passed through the digestive tract of livestock will sprout randomly wherever they have been expelled.



What seems like a treeless maize field is in fact peppered with an 'underground forest' of Faidherbia albida, just waiting for selection, pruning and protection in order to reach maturity.



Close up of seemingly insignificant Faidherbia albida seedling which is normally slashed each year in preparation for sowing annual crops. By creating awareness of the value of these trees and through training in FMNR, extremely rapid reforestation with large benefits to crops, livestock and the environment is possible on a large scale.



Enhanced growth of millet under Faidherbia albida tree, Niger Republic.



Millet production landscapes within Faidherbia parklands in Niger. Photo: M Larwanou



Pruning young Faidherbia albida trees will increase growth rate and the tree will have better form than if left to develop on its own.

Locally available and affordable tools are all that is necessary for pruning.



Nine year old Faidherbia albida 'fertilizer' trees in a maize/ conservation agriculture production systems. Malawi and Zambia national recommendations are to plant **Faidherbia** at 100 trees per hectare. Zambia, 2009. Photo: P Aagard.

Cactus pear or *Opuntia* spp., syn. *Nopalea opuntia*

The cactus plant is extremely drought tolerant and will grow on degraded soils, hillsides and wastelands with little attention. Poor families have come to depend on the cactus for survival as food shortages have forced them to rely almost completely on cactus pear during its three month harvest period. While the fruit is high in sugars and vitamin C it does not provide a balanced diet.



Fresh fruit must be eaten soon after picking before it perishes.



Demonstrated drought tolerance: cactus pear growing on a stone wall!

TARI scientists are undertaking cactus variety trials and have developed a number of processed food products. While fresh fruit is abundant in local markets, processing of fruit and cladodes is still limited and there is a need for further market development.

Currently cactus plants are poorly managed. There is a total lack of pruning, fertilizing or creation of micro-water catchments to improve yields. Despite this and despite the severe droughts being experienced, the plants produce prolific amounts of fruit. There is great potential for enhancing production through adoption of some cheap and simple management techniques.



Bread made from cactus fruit and wheat flour is one of many products requiring market development.



Poorly managed cactus plantation.

More intensive production of cactus on farm borders and in strategic sites on enclosure areas along with development of market outlets for acacia products would benefit the environment and local economy enormously.

Edible seeded Australian Acacias.

Australian edible seeded acacias 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%, 30-40% and 14-16% 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.

Acacia saligna was first introduced into Tigray in 1972 and it is used for land rehabilitation, wood and fodder production and for improving soil fertility. What is little known is that its seeds are also edible and very nutritious. These very hardy, fast growing, nitrogen fixing trees have exhibited outstanding performance in rehabilitation of degraded land in Tigray.



Rapid growth and good seed set of *A. saligna* in Abreha Atsbeha enclosure area.



A. saligna surviving on shallow rocky soils after two years of drought, Mariam Agamet.



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

The Tigray Region suffers from extreme environmental degradation; many families rely on livestock for over 50% of their income and / or food supply, yet fodder is in very short supply; there is a severe shortage of firewood and farmers rarely grow enough grain to last six months of the year. *A. saligna* offers a means of at least partially addressing these urgent needs simultaneously on land that is currently underutilized. Given that approximately 50% of the land in Tigray is hilly and therefore unsuitable for annual cropping, the potential for *A. saligna* is enormous.

It should be recognized 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.



Just 12 months after pruning, *A. saligna* has sprouted branches of between 1.5- 2 meters. 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.

Moringa stenopetalla

Moringa is an amazing food and medicinal plant indigenous to Ethiopia. Moringa can rebuild weak bones, enrich anaemic blood and enable a malnourished mother to nurse her starving baby. Ounce for ounce, it has the calcium of four glasses of milk, the Vitamin C of seven oranges and the potassium of three bananas. A dash of Moringa can make dirty water drinkable. Doctors use it to treat diabetes and high blood pressure. Not only can it staunch a skin infection, Moringa makes an efficient fuel, fertilizer and livestock feed. Moringa has triple the iron of spinach and more impressive attributes than olive oil. And it's not only good for you, it's delicious. Moringa is very drought tolerant, grows in poor soils and produces prolific amounts of edible leaves yet few farmers grow it at all, let alone in commercial quantities. Despite its value, it is largely unknown and unappreciated in famine prone Tigray.

Acacia mearnsii, A. decurrens and Acacia dealbata –

These introduced Australian acacia species have high potential but have barely been utilized in Tigray. They are fast growing and fix nitrogen. They can be used for environmental restoration, production of firewood and small construction timber and they make excellent agroforestry species. Acacia mearnsii bark is one of the world's highest yielding sources of condensed tannin.



Soils in Tigray Region are notoriously infertile and low in organic matter.



Large amounts of leaf litter beneath *A. mearnsii* trees can be used to build soil organic matter levels.

The above is by no means an exhaustive list. Indeed there are many more indigenous and exotic plants which could enhance agroforestry and forestry in Tigray including gum resin tree species (genera *Acacia*, *Boswellia*, *Commiphora* and *Sterculia*), species of *Ziziphus*, *leucaena*, *grevilia* and *sesbania* and *Chamaecytisus proliferus* (lucerne tree).

Annex IV. Dan Saga Case Study

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 formation of 53 village committees, some 170 villages now sustainably manage their natural resource base. 130,000 hectares of farmland are now being managed under FMNR and once treeless fields are covered with 103 to 122 trees per hectare. A number of stakeholders including farmers, herders, men and women, researchers and 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 focussed 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 and 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 formalized 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 committee. 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.



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

Increased productivity of the trees is reflected in an increase in both domestic consumption and 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 NTFPs 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.

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 September, 2009 field visit:

- 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 has 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.