Challenging assumptions,

building prosperous refugee settlements and local communities.

Potential for Farmer-Managed Natural Regeneration to address land degradation, fuelwood scarcity and livelihoods issues for both settlers and local communities in West Nile Sub-Region, Uganda.

Fig 1. Open woodland / pastureland restored from waste land, now managed through Farmer Managed Natural Regeneration, Offaka, West Nile Sub Region, Uganda.

Tony Rinaudo
Principal Natural Resources Advisor,
World Vision Australia

Contents

Acronyms

ANR……………………………………………Assisted Natural Regeneration

CBO……………………………………………Community Based Organization

FAO……………………………………………Food and Agriculture Organization

FBO…………………………………………… Faith Based Organization

FMNR………………………………………… Farmer Managed Natural Regeneration

ICRAF………………………………………… International Centre for Research in Agroforestry

NGO…………………………………………… Non-Government Organization

WV……………………………………………World Vision

Acknowledgments

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Glossary

Assisted Natural Regeneration[1] or ANR is a method for enhancing the establishment of secondary forest from degraded grassland and shrub vegetation by protecting and nurturing the mother trees and their wildlings inherently present in the area. ANR aims to accelerate, rather than replace, natural successional processes by removing or reducing barriers to natural forest regeneration such as soil degradation, competition with weedy species, and recurring disturbances (e.g., fire, grazing, and wood harvesting). Seedlings are, in particular, protected from undergrowth and extremely flammable plants such as Imperata grass. In addition to protection efforts, new trees are planted when needed or wanted (enrichment planting). With ANR, forests grow faster than they would naturally.

Assisted Natural Regeneration with thinning and pruning is as stated, simply ANR with the additional steps of thinning crowded growth between trees when they are too close and within a plant when there are multiple stems and through pruning some of the lower side branches on selected stems.

Farmer Managed Natural Regeneration[2] – the Systematic regeneration and management of trees and shrubs growing from living tree stumps, roots and seedlings on farmland, rangeland, forestland, land infested with invasive woody species or dominated through bush encroachment and even so-called wasteland. Successful FMNR involves land use practice changes which can enhance ecosystem functions.

Coppice / Coppicing. A coppice is an area of woodland in which the trees or shrubs are periodically cut back to ground level to stimulate growth and provide firewood or timber.

Coppicing is a traditional method of woodland management which exploits the capacity of many species of trees to put out new shoots from their stump or roots if cut down. In a coppiced wood, which is called a copse, young tree stems are repeatedly cut down to near ground level, known as a stool. New growth emerges and after a number of years, the coppiced tree is harvested and the cycle begins anew. Pollarding is a similar process carried out at a higher level on the tree.

Pollarding is a pruning system involving the removal of the upper branches of a tree, promoting a dense head of foliage and branches.

Apical dominance is the phenomenon whereby the main, central stem of the plant is dominant over (i.e., grows more strongly than) other side stems; on a branch the main stem of the branch is further dominant over its own side branchlets. Plant physiology describes apical dominance as the control exerted by the terminal bud (and shoot apex) over the outgrowth of lateral buds.

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[1] http://www.fao.org/forestry/anr/en/
[2] http://en.wikipedia.org/wiki/Farmer_Managed_Natural_Regeneration

http://www.fmnrhub.com.au https://vimeo.com/169042685
https://www.youtube.com/watch?v=0xF27ROVrbg

One day, Zakara, the rooster, looked up and saw Tankarki, the African Bustard bird perched in a tree. "Come down and eat with me" invited Zakara. Tankarki came down and they had a very good afternoon together. As evening drew near Zakara saw that it was late and so invited Tankarki to stay the night with him. When they came to the chicken coup, Tankarki cautiously peered in and noted that there were no windows and there was no escape route once the door was closed. Tankarki asked Zakara "what do you do if Mutum, the man, comes at night and puts his hand in to catch you?" Zakara cast his eyes down, and lowering his voice said "there is nothing we can do". Upon hearing this, Tankarki took to the skies, exclaiming "Hauka, Hauka" (it's madness, it's madness!) Hausa Proverb, Niger Republic.

"Hauka" is an actual representation of the sound made by Tankarki. "Hauka" is also the word for madness in the Hausa language.

The Ugandan government has generously accepted more than 1,000,000 South Sudanese refugees and provided small parcels of land. They cannot go back home in the foreseeable future and it will not be easy for them to move on should the land continue to degrade and lose its ability to support them. If they and their hosts continue to exploit the natural resource base in the same unsustainable way they have to date, they will be putting themselves into a very dangerous situation with few escape routes. Fortunately, like Tankarki, there is another, more sustainable option that will build a greater shared prosperity for both host and visitor alike.

Introduction

I was invited to West Nile sub-region (Map: Annex I) Uganda and hosted by the World Agroforestry Centre (ICRAF), in collaboration with World Vision (WV) Uganda.

In response to the needs of large influxes of refugees, ICRAF has established an extensive tree nursery which has so far raised trees of 21 species, many of which are multipurpose. Some species are "food" trees, which produce one or several of the following - fruit, leaves that are consumed by humans, and edible oils. There are also fodder species, species that fix nitrogen, fast-growing fuel wood species, and timber tree species. The nursery is unusual in that it includes rarely planted but important indigenous species.

ICRAF are rightfully proud of the tree nursery and planting program which they have established in a very short time using dedicated and passionate local technicians. On average, refugees request 35-55 trees per plot they are allocated, depending on its size. However, ICRAF also realises the limits of planting and the potential of Farmer Managed Natural Regeneration (FMNR, Annex II) to achieve low cost, rapid and scalable reforestation. ICRAF's own forest inventory found hundreds of regenerating stumps and seedlings per hectare in this once rich woodland ecosystem.

The situation in West Nile's refugee hosting area is one of rapid loss of tree cover and a severe fuel wood crisis, which threatens ecosystem services such as water and undermines the very future and sustainability of the refugee settlements and host communities. Recognizing this, ICRAF and World Vision sought to create interest in FMNR and initiate large scale adoption in West Nile Sub Region.

Interestingly, while FMNR in one form or another is a traditional practice in Uganda, it was formally 'introduced' and popularized by WV in Uganda in Offaka sub county, Arua district, West Nile sub region in 2010. Subsequently, an FMNR national conference was held in Kampala in 2012, the same year that WV Uganda launched the FMNR Uganda project which operated for four years in Kibaale, Abim, Nakasongola and Kotido in Karamajo districts. ICRAF played a research role in this project. Since 2015 ICRAF and WV and other key players such as Vi Agroforestry, District Natural Resource offices (Kibaale, Nakasongola, Abim, Kotido and Arua), the National Ugandan Farmers Federation, Tree Talk and many others have actively advocated, created awareness, taught and implemented FMNR activities within their own organizations and through their membership in the Uganda FMNR network[3]. In short, Uganda already holds a depth of experience, a pool of skilled and committed researchers, practitioners and NGO and government agency promoters, a growing body of scientific and anecdotal evidence and a reasonably widespread level of awareness of FMNR. All this lays a sound foundation for the rapid scaling up and out of FMNR in both refugee settlements and local communities in West Nile sub region specifically, and in Uganda generally.

Executive Summary

Deforestation has been massive in West Nile due to land clearing, the charcoal trade, tobacco production, unplanned bush burning, and recent and previous influxes of refugees. Notwithstanding this trend, West Nile sub-region holds potential for large scale, low cost and rapid reforestation.

Taking Bidi Bidi refugee settlement in Yumbe district as an example, FAO estimates that with annual fuelwood needs at 347,480 tons per year, there will be full depletion of above ground biomass within three years in a business-as-usual scenario. Yet, based on fuel wood yields in similar conditions, through FMNR implementation, fuel wood production in and around Bidi Bidi could be as high as, or even exceed 482,131 tons per year even as the forest continues to increase in biomass. Furthermore, the productivity of the land in Arua District is generally higher than in the Bidi Bidi area, implying that the even better results are expected.

<u>Key Recommendations include:</u>

- Develop a West Nile-wide FMNR plan which includes awareness creation, capacity building, equipping and empowering both refugees and local populations, securing gender sensitive land and tree user rights agreements and fire and livestock control measures.
- Investigate acceptability and economic and practical feasibility of improved cook stoves, insulated cooking boxes and solar cookers, composting, use of agricultural waste and FMNR generated twigs and small branches for charcoal briquette production, production of interlocking pressed earth bricks and instalment of small farm ponds to boost horticultural production.
- Vigorously develop and promote a bee-keeping industry, following the positive example of Yumbe's honey production[4].
- In addition to continuing to supply valued seedlings of fruit, fodder, fertilizer and timber species and to promote FMNR through trainings and outreach, ICRAF play a key role in leadership and essential research agendas, starting with documenting FMNR experience already gained in West Nile province.
- WV Uganda show leadership in promoting and supporting FMNR activities.
- SPORE and UNHCR environmental standards for environment and energy supplies include reference to FMNR implementation in refugee camp and refugee settlement settings.
- Local and central government to formulate and enforce regulation that incentivizes regeneration of trees.

[3] http://fmnrhub.com.au/tony-rinaudo-launch-uganda-fmnr-network/#.Wu5wm4iFM2w
[4] https://www.westnileweb.com/news-a-analysis/yumbe/yumbe-elders-offer-land-for-honey-processing-plant

Expected key outcomes:

- By restoring and maintaining vegetation cover, a healthy, functioning environment will be better placed to provide key ecosystem goods and services. In turn this will lay a firm foundation for sustainable economic, social and environmental development - for both refugee and local populations.
- Through partnering in environmental restoration, productivity will increase (crop, livestock and on farm and wild harvest), production will become more diversified, providing a steady income, employment opportunities and food security and dietary diversity, hence improved nutrition.
- Diversification will provide greater resilience in the face of climatic and other shocks.
- Forest cover, biodiversity and ecosystem function will increase even as basic needs for fuel wood and building timber are met.

Background

Deforestation and fuelwood shortage issues.

Various reports are available outlining the history, causes and extent of deforestation in Uganda in general[5] and for specific refugee settlements within West Nile[6] in particular. In short, deforestation is extensive, rapid and unsustainable and the consequences for a district and a nation largely dependent on its natural resource base for its livelihoods in the medium to short term will be disastrous.

Uganda is host to 1,045,236 South Sudanese refugees as of February 2016[7], most of whom have settled in West Nile sub-region. According to the FAO[8] rapid assessment report, the Bidi Bidi settlement is just one of several and is now the world's largest refuge-hosting area, with 272,206 refugees settled on a land area of approximately 250 km^2 in a total assigned area of 798 km^2. The report goes onto estimate that in Bidi Bidi settlement alone, each settler consumes 3.5 Kgs of fuel wood per day, equating to 347,480 tons per year, not including what is harvested for other uses by refugees and by the local population. Assuming clear felling of trees, the report estimates that the harvestable biomass resource could meet fuel wood demand for up to three years, but at a cost of the full depletion of the above ground biomass in the area. Given that the average refugee stay in camps in East Africa is 17 years[9], it is imperative for their wellbeing and that of the host communities to find sustainable solutions to pressing environmental issues. A business as usual scenario is clearly not an option. What is happening in Bidi Bidi is being repeated in other camps across the sub region, as well as in local communities, albeit at a slower but nevertheless, insidious pace.

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[5] http://www.mwe.go.ug/sites/default/files/State%20of%20Uganda%27s%20Forestry-2015.pdf
http://www.fao.org/docrep/004/AC427E/AC427E05.htm

[6] http://www.fao.org/3/a-i7849e.pdf
[7] https://reliefweb.int/sites/reliefweb.int/files/resources/UNICEF%20Uganda%20Multi-Hazard%20Humanitarian%20Situation%20Report%20-%20February%202018....pdf
[8] http://www.fao.org/3/a-i7849e.pdf
[9] Pers. Comm. Christopher Hoffmann, E. Africa Regional Humanitarian and Emergency Affairs Director, WVI.

Field Observations and Discussion

A brief field visit to Rhino Camp and Imvepi refugee settlements was made on the 30th April 2018. Judging from remnant vegetation, widespread and often dense presence of living tree stumps on some land types, vigorous bush encroachment and the presence of remnant closed woodlands, the current deforestation surge is only an acceleration and addition to a pre-existing, long term and ongoing trend.

Comparing the areas surrounding Rhino Camp and Imvepi refugee settlements with Humbo, Southern Ethiopia, an area with similar rainfall averages, it is reasonable to assume that the potential for reforestation and sustainable yield fuelwood harvest through FMNR is promising.

Fig 2. Reforestation site, Ethiopia, showing part of the central Humbo Mountain range in 2006 (left) and, following community mobilization and FMNR implementation, early 2013 (right). The area receives between 700 and 1000 mm of rainfall per year.

If anything, vegetation cover in Humbo in 2006 was more highly degraded (Fig 2) than that sighted in the visited sites in Arua district in May 2018. Yet, within two years of Humbo Community Based Natural Regeneration Project[10] commencement, fuel wood production from the most degraded and driest site reached 4.2 tons per hectare even as the forest was regenerating. By 2018, the same site produced 6.75 tons per hectare and the best site, 9.05 tons per hectare. Of significance also, each year excepting year 11, there has been an increase in firewood harvest as forest biomass continued to increase (Table 1).

[10] https://link.springer.com/article/10.1007/s00267-010-9590-3
http://fmnrhub.com.au/projects/humbo/#.WwdGkkiFM2w
https://wbcarbonfinance.org/docs/FINAL_STORY_green-growth-humbo.pdf

 

Fig 3. (Left) 2005 photograph showing degraded state of former forest, Humbo, Ethiopia, before initiation of FMNR activities. **Fig 4**. (Right) 2015 photograph showing emerging forest, despite nine years of continuous firewood harvest.

year	Abella Longena Tons/ha	Bossa Wanche Tons/ha	Hibicha Bada Tons/ha	Hobicha Bongota Tons/ha	Total/4 sites Tons/ha	Average Tons/ha
2008	4.2	4.9	5.45	5.85	20.4	5.1
2009	4.37	4.97	5.94	5.99	21.27	5.3
2010	4.71	5.16	5.81	6.50	22.19	5.5
2011	4.97	5.48	6.97	7.07	24.50	6.1
2012	5.11	5.78	7.02	7.5	25.41	6.4
2013	5.35	5.9	7.52	7.95	26.72	6.7
2014	5.71	6.04	8.11	8.01	27.87	7.0
2015	5.94	6.5	8.92	8.4	29.76	7.4
2016	6.32	6.78	9.12	8.72	30.94	7.7
2017	6.48	7.4	9.79	8.99	32.66	8.2
2018	6.75	6.63	8.76	8.37	30.51	7.6

Table 1. Fuel wood production figures, Humbo Community Managed Natural Regeneration Project, Ethiopia. Abella Longena, the driest, most degraded site, produced 4.2 tons of firewood per hectare two years after project commencement, even as the forest was regenerating. Source: World Vision Ethiopia Humbo CDM A/R Project Fuel Wood Utilization /Leakage/ Monitoring Report, December 2017.

 

Fig 5. Regenerating trees can be found every 1-2 meters on cleared farmland, Rhino Camp refugee settlement.

Fig 6. Normal farming practice involves slashing all vegetation, complete cultivation of the land and eventual total removal of all tree stumps.

Fig 7. (left) Open woodland with potential for thinning and pruning. **Fig 8.** (right) Bushland / bush encroachment forming dense impenetrable thorn tree thickets.

LULC class	Area within Bidibidi settlement boundary (ha)	Total area, including 5-km buffer (ha)
Closed woodland	3 356	8 935
Open woodland	39 492	69 164
Bushland and grassland	18 166	34 185
Cultivated land	10 598	29 829
Bare/open land	3 249	5 101
Burnt area	4 905	14 352
Water	1	126
Total	79 765	161 693

Table 2. Land classes and total area of land available in Bidi Bidi camp. Source: http://www.fao.org/3/a-i7849e.pdf

Land class	Area (ha)	Estm. Wood yield (tons/ha) in year 2.	Total (tons)
Open Woodland, Bushland, Grassland	103,349	4	413,396
Cultivated land	29,829	1	29,829
Bare/burnt land	19,453	2	38,906
Total	152,631	-	482,131

Table 3. Estimated fuelwood production potential in year two following FMNR program implementation, based on production figures from Humbo, Ethiopia.

Using land area data on selected land use types (Table 2), and multiplying total area by conservative estimates of fuel wood production based on the Humbo fuelwood yield data, fuel wood production in year two in Bidi Bidi camp may be as high as, or even exceed 482,131 tons (Table 3), even as the forest continues to increase in biomass. FAO annual estimates for fuelwood demand are 347,480 tons. Estimates need to be cross checked by ICRAF, but even so, these figures give a ball park figure of what might be possible. Potential fuel wood production from the closed forest (8,935 hectares) has not been included in the calculations, even though judiciary pruning would yield firewood without damaging this remnant forest stand or reduce its capacity to act as a wildlife refuge.

Given the extensive presence of living indigenous tree stumps and a large seed "bank" in the soil on the different land use/land cover types and noting that even apparently bare and/or burnt land, upon closer inspection usually contains many living tree stumps and tree seeds with the ability to germinate and grow given the right conditions, the potential for farmer managed natural regeneration of tree cover is enormous. In fact, the main requirements to redress deforestation and land degradation issues are not primarily technical in nature. The main requirements have more to do with mindset change - countering false beliefs, negative attitudes and destructive practices towards indigenous vegetation and land management. The objective of mindset change is to elicit a commitment for sustainable utilization and management of vegetation and land resources. Additionally, there is a requirement for facilitating all-stakeholder agreements for natural resource management coupled with the granting of binding tree/forest user rights.

In summary, based on the above estimates, within two years Bidi Bidi settlement community could sustainably meet firewood demand and harvest a surplus of 134,651 tons of fuel wood while increasing forest and agroforest biomass and ecosystem function year on year.

Recommendations

1. **Develop a West Nile-wide FMNR plan**. Even though the initial focus may be on refugee settlement areas, take a landscape and district wide approach to the fuel wood and land degradation crisis, fully including all stakeholders from the settlement and local communities, government agencies, NGOs, CBOs and FBOs and formulate an overarching plan. Bush fires, livestock and charcoal makers do not know boundaries and so it is necessary to include them in activities from the outset.

2. **Facilitate FMNR awareness creation** amongst both settlers (Annex III) and local communities across West Nile Province through seminars, multimedia, training and exchange visits to established FMNR sites in Offaka and Kibaale. Invite FMNR champion farmers and foresters from other districts to teach and share their experience, and have them return to provide follow up and encouragement. Respectfully and patiently challenge false beliefs, negative attitudes and destructive environmental practices. Set up pilot and demonstration and training sites at strategic locations such as within view of well used roads.

3. **Capacitate, equip and empower** individuals and 'communities' for FMNR implementation. Form new or strengthen existing organizational structures such as farmers or settlers' groups according to context. Develop tree and land management by-laws with all stakeholders and ensure appropriate and effective compliance mechanisms are in place for enforcement. Facilitate settler and local community appointment of FMNR volunteer champions who have a peer training and mobilization function and volunteer FMNR scouts who have a patrolling function. Some form of compensation or recognition may be required. However, a long-term sustainability view should be taken and mechanisms for the communities themselves to maintain these key roles should be initiated from the outset. Ensure government and NGO engagement and strategic support at all levels.

4. Facilitate agreement on **gender sensitive land and tree user rights**. Communities and individuals will be much more willing, even enthusiastic to implement FMNR activities if they have assurance that they will benefit from their labours - short, medium and longer term. In fact, without this measure they will almost certainly not comply for any length of time. The fastest way to give assurance is through legally binding, transparent agreements declaring land ownership, or at the very least - land and tree user rights for an agreed period and for specific usages. Once agreements are in place, public announcements should be made to all stakeholders.

5. **Fire control**. No tree planting, tree regeneration or land restoration scheme will succeed without effective fire management procedures in place. And yet, bush burning is the elephant in the room that is too often ignored because it is considered too hard to deal with. We need to be clear - if we choose to do nothing about bush burning, we choose to fail in achieving our objectives. We must recognize that change in this area is possible and has been achieved elsewhere when communities are empowered and know that it is in their best interest to prevent fires before they start, and to extinguish them when they break out.
   A carrot and stick approach is recommended. Totally ban bush burning, burning of crop residues and use of fire as a practice for farm clearing, hunting, and dry season grass burning

and appropriately punish apprehended offenders. Equip, train and empower volunteer fire brigades. Mobilize communities to create fire breaks. By laws need to be backed up by strong enforcement, all the while creating awareness on the livelihoods benefits of not burning. Benefits include more fodder, more fuelwood, improved soil fertility with greater moisture holding capacity and more wildlife. Provide incentives or prizes to communities which remain fire-free over a one to three-year period. Provide alternative methods of hunting (Annex IV), training in compost making and use of twigs from FMNR pruning and agricultural 'waste' as raw material for charcoal briquettes (Annex V).

6. Facilitate formation of **pastoralists groups and development of grazing plans**. Group formation, capacity building and joint planning towards attaining shared goals will build cohesion, lessen conflict and increase fodder availability and ecosystem health. Programs in other countries have shown that through FMNR fodder availability has increased and conflict has reduced and pastoralists have become strong proponents of FMNR.

7. Investigate acceptability and economic and practical feasibility of **improved cook stoves, insulated cooking boxes and solar cookers**.
   https://www.mishcon.com/assets/managed/docs/downloads/doc_2703/Efficient_Cookstoves_in_Uganda.pdf
   https://www.youtube.com/watch?v=FGLFeYNr2w0
   https://en.wikipedia.org/wiki/Solar_cooker

8. Investigate economic and practical feasibility of local **charcoal briquette production** (Annex V) based on agricultural 'waste' and twigs resulting from FMNR implementation. Design features should consider ways to harness 'waste' heat in the charcoal making process – for cooking (especially beans) and for heating water.

9. Vigorously promote a **West Nile sub region bee keeping** industry and aim to make Arua the honey capital for Uganda. Train, equip and empower settlers and local populations to become professional bee keepers. Conduct a market chain analysis and facilitate market access. FMNR experience in Kenya and Tanzania for example has shown that the high economic value of bee keeping is a very strong incentive for communities and individuals to increase tree cover and prevent bush burning. Bee keeping can be a very viable alternative to charcoal making (from cutting down trees) and hunting.

10. Investigate economic and practical feasibility of **compost production** using available organic matter, including leaves stripped from pruned branches during FMNR implementation (Fig. 9). With cultivation, over time farmland loses organic matter and fertility and becomes more prone to erosion and degradation. This will be an issue in the settlement farms which were already degraded from the outset. As soil fertility decreases, crop yields will decrease and it will become less and less attractive for settlers to farm the land parcels they have been given.

Fig 9. During an FMNR training workshop, participants collected the equivalent of 165 Kgs of leaves per hectare. If composted these leaves could become a valuable resource for maintaining soil fertility on agricultural land.

11. **Add value to standing trees** Research uses[11] and market opportunities for indigenous woody and herbaceous plants (food, fodder, fibre, medicinal, dyes, resins, etc., and application of improved cultural practices perhaps not previously applied to undomesticated plants. E.g. top grafting of felled Shea[12] nut and jujube[13] trees with superior selected cultivars. Rich sources of information already exist. E.g. Food Plant Solutions website[14] and publications (Fig 10) and the Uganda Tree Species Finder[15] .

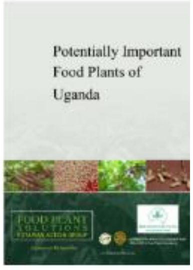

Fig 10. Food Plant Solutions publication on Ugandan food plants.

12. Promote small Farm ponds to capture and profitably utilize water runoff for higher value horticultural production (Annex VI).

13. Investigate economic and practical feasibility of producing **interlocking pressed earth bricks**[16] (Fig 11) especially from the excavated soil of thousands of small farm ponds if it has the right texture. Pressed bricks do not require baking and hence firewood is not used in the process.

Fig 11. Hand operated brick press, pressed

brick and use in construction.

14. **Create employment opportunities.** Investigate economic and practical feasibility of promoting small scale businesses run by settlers and locals. Candidates could receive training and be enabled to manufacture equipment being promoted in the district including - charcoal kilns, fuel efficient stoves, insulation boxes, solar cookers, bee hives and associated bee keeping equipment and brick presses.

15. **ICRAF play a key role in leadership and in piloting and scaling innovations and pursuing key research agendas**. ICRAF is providing a critical service through supplying seedlings; trainings in seed collection and processing and how to plant, raise and manage trees, for example, to provide prunings for firewood; promoting FMNR; and communicating and actualising the value of standing trees. All this should continue. However, action-research needs to be conducted concurrently to ensure that the interventions are the most appropriate and are applied in the best way. With respect to FMNR, questions could include: What impacts has FMNR already had in West Nile Province and Uganda in general? What is the actual fuel wood yield from each land class? What non-timber forest products will be produced through FMNR and what is the potential yield and financial

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[11] http://fmnrhub.com.au/edible-trees-refugee-settlements-nw-uganda/#.WvzUpoiFM2w

[12] http://www.globalshea.com/uploads/files/parkland_management_manual/parkland_management_guideline_901.pdf

[13] http://fmnrhub.com.au/fmnr-springboard-diversification-economic-development/#.WvzUF4iFM2w

[14] https://foodplantsolutions.org/programs/uganda/

[15] https://play.google.com/store/apps/details?id=org.icraf.gsl.iucn.ugandatreespecieslocator&hl=en

[16] https://en.wikipedia.org/wiki/Compressed_earth_block

value? How rapidly and by how much can biomass increase even as fuel wood needs are met? What are the best species, ideal tree density and the optimum way to prune for specific outcomes on each land class type? What is the cost benefit analysis of producing compost from leaf material generated from FMNR implementation? What is the non-timber forest product potential. What is the market potential for these products? What private enterprise partnerships are possible.

16. **WV Uganda show leadership in promoting and supporting FMNR activities and include FMNR in their West Nile Response strategy.** WV Uganda is the biggest implementer of FMNR in Uganda and has the longest experience. It also coordinates the Uganda FMNR network. WV Uganda is thus well placed to play a key role in teaching, follow up and coordinating FMNR activities within its programs and through the Uganda FMNR network partners.

17. **SPORE and UNHCR environmental standards for environment and energy supplies include reference to FMNR implementation in both refugee camps and refugee settlement settings**. Currently there is no reference to FMNR in these documents. Growth rate estimates of indigenous trees are based on the destructive, business as usual approach to vegetation and land management. However, sustainable management of indigenous vegetation through FMNR can result in rapid restoration even as fuelwood needs are met.

18. **Local and central government** formulate and enforce regulations that incentivizes regeneration of trees. Government could and should play a key role in speeding up the adoption of FMNR and in ensuring that the practice continues beyond any initial funded campaign.

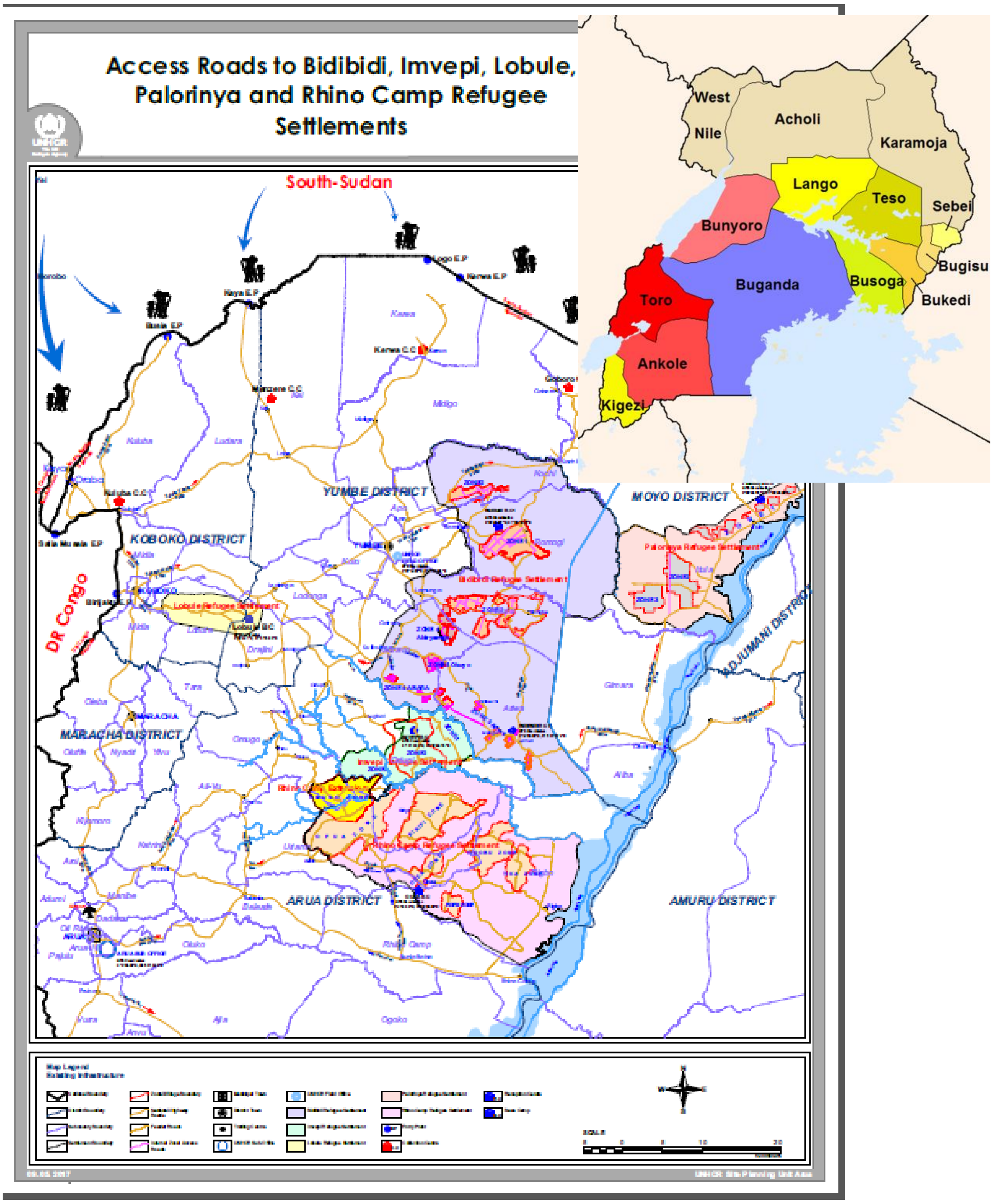
Conclusion

Large influxes of refugees into West Nile sub-region are accelerating pre-existing deforestation and land degradation trends. If a business as usual scenario continues, the threat of removal of all above (and even below) ground biomass near settlements, within a few years is very real. If this occurs, there will be severe consequences on numerous fronts, including - soil carbon, moisture regulation, crop and fodder production, availability of fuelwood energy, timber for building, and access to alternate income sources such as honey, wild fruits and traditional medicines. In turn, this has implications for viability of settlement camps as well as that of local populations, conflict and migration.

Implementation of a West Nile-wide FMNR plan which includes both refugees and local populations is recommended. Through FMNR, stakeholders could potentially meet fuel wood requirements while increasing vegetation cover and restoring degraded land. This in turn has the potential to increase food security, employment opportunities and income generation while maintaining and even improving environmental integrity. Inclusion of both refugees and local populations to work towards achieving common restoration and sustainability goals will increase harmony and reduce conflict over scarce resources. And, rather than being perceived as a burden, refugees will become a great asset as they play a pivotal role in land restoration and wealth creation.

Annexes

Annex I. Map of West Nile Settlement Camps.



https://ugandarefugees.org/wp-content/uploads/West-Nile-Guide-Map-for-Settlements-as-of-9-May-2017.pdf

Annex II. Farmer Managed Natural Regeneration.

By the 1980's donor and even NGO government appetite for massive tree planting schemes in the West African Sahel following the realization that they simply were very expensively, not working:

It is commonly acknowledged that since the UN Conference on Desertification, little has really changed for the better and where there has been success it has often been limited in size and scope. This is exemplified by the disappointing progress in village woodlots in the Sahel where between 1975-82 over $160 million was spent on various community forestry programmes. By 1982 the achievements were about 20,000 hectares of 'not doing very well' plantations (at a cost of approximately $8,000 per hectare). People do not see themselves as benefitting from such tree planting programmes[17].

Developed in Niger Republic[18] as an agroforestry practice in 1983, FMNR gained credibility during the 1984 famine through a Serving in Mission[19] Food for Work program and thereafter spread rapidly, largely from farmer to farmer across the country. FMNR is the systematic regeneration and management of trees and shrubs growing from living tree stumps, roots and seedlings. Where there is bush encroachment, the same principles of selection, thinning and pruning apply.

According to the FAO, FMNR is the practice of "actively managing and protecting non-planted trees and shrubs with the goal of increasing the value or quantity of woody vegetation on farmland". In FMNR, farmers select and protect the healthiest, tallest and straightest stems of native trees and shrubs sprouting from stumps or roots on ploughed and grazed land. They remove unwanted stems and side branches to reduce water competition and facilitate the growth of selected stems, which can quickly produce wood fuel and fodder. FMNR may also involve protecting and managing seedlings growing spontaneously from seedbanks in the soil and contained in livestock manure and bird droppings. The planting of seedlings may be incorporated in FMNR management practices to enrich existing vegetation, especially when coppicing stems are sparse and the soil seedbank is poor.

The main costs associated with FMNR are in the time it takes farmers to protect and prune the regrowth and those associated with promoting and teaching FMNR practices (where this is necessary). FMNR is simple to implement and can be scaled up quickly, provided that latent seeds and living tree stumps and roots are present at the site.

A key lesson gained from diverse experiences in FMNR is that property rights to trees are essential if farmers and communities are to protect them. Equally important is the need to transfer land rights and authority to local communities to enable them to access and use the natural resources they are protecting[20].

Niger suffered from severe fuel wood deficit prior to and during the 1980s, yet today some districts are exporting surplus fuel wood to neighbouring Nigeria while maintaining their tree cover and increasing crop yields plus livestock production over pre-FMNR levels. On farm tree cover has

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[17] Eckholm, E, Foley, G, Barnard, G, and Timberlake, L, (1984), Fuelwood: The Energy Crisis that Won't Go Away, Earthscan, International Institute for Environment and Development, London, 105 pp.
[18] Turning Back the Desert: How Farmers Have Transformed Niger's Landscape and Livelihoods. World Resources Report 2008 (pp142-157) http://pdf.wri.org/world_resources_2008_roots_of_resilience_chapter3.pdf
[19] https://en.wikipedia.org/wiki/Serving_In_Mission
[20] http://www.fao.org/sustainable-forest-management/toolbox/modules/dryland-forests-agrosilvopastoral-systems/further-learning/en/?type=111

increased from approximately four trees per hectare in 1984 to 44[21] trees per hectare today, with some farmers leaving and managing over 100 trees per hectare. While Niger has not solved its fuelwood crisis largely due to a 372%[22] population increase since 1980, the situation would have been very much worse had FMNR never been introduced.

Internal World Vision studies show that the cost of implementing FMNR programs are very modest compared to tree planting costs:

TREE PLANTING APPROACH: By the end of project, an investment of $2.22 per living tree had been made, with no change over time. i.e. more trees will only come about with more funding. This cost rises over time as tree survival rates decline year on year. At 40 trees per hectare, this translates to $88.80, noting that WV does not pay planting or re-planting labour costs.

FMNR APPROACH: By end of project, an investment of $1.27 per living tree had been made. Assuming an initial post-project rate of spontaneous farmer adoption of 33% per year, reducing to 20% after 3 years, the investment per living tree is just 31c per tree after 10 years, in the absence of any new funding. With an average of 40 trees per hectare, this translates to project costs of $50.80 and $12.40 at end of project, and ten years after end of project respectively. An International Fund for Agricultural Development study in Niger found that farmers labour in managing FMNR trees in the absence of a project was $14/hectare.

The impact of FMNR on crop yields and gross incomes in Niger is also significant. Gross income in the Maradi Region of Niger has grown by $17 - 21 million due to FMNR[23], which translates to around $1,000 per household each year[24]. Extrapolating this added income from FMNR to the entire five million hectares implies aggregate income benefits of $900 million/year[25] accruing to approximately 900,000 households or 4.5 million people.

This is even more significant considering the context: Niger is regularly listed as one of the world's ten poorest nations on the UN Human Development Index[26]. Niger's climate is extremely harsh and its soils for the most part are infertile. Average crop yields using traditional low / no input methods are in the order of 200-300 kilograms millet per hectare – barely a third of the average family's food needs for a year. Additionally, there was no government and minimal NGO investment in spreading FMNR. Despite the constraints, during the 20-year period following the promotion of FMNR, this practice spread to over 5,000,000 hectares, equating to a rate of spread of 250,000 hectares per year with minimal NGO or government intervention. Farm-tree population increased by an estimated 200 million trees, rapidly, at minimal cost, with 100% survival and ongoing replacement of harvested trees without new funding or interventions. Whereas Eckholm estimates tree planting costs to be in the order of $8,000 / hectare, cost estimates for an International Fund for Agricultural

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[21] Haglund E., et al, Dryland tree management for improved household livelihoods: FMNR in Niger. Journal of Environmental management 92 (2011) 1696 -1705.

[22] http://www.worldometers.info/world-population/niger-population/

[23] Haglund E., et al, Dryland tree management for improved household livelihoods: FMNR in Niger. Journal of Environmental management 92 (2011) 1696 -1705.

[24] Pye-Smith.C. 2013. The Quiet Revolution: How Niger's farmers are re-greening the parklands of the Sahel; ICRAF Trees for Change no.12. Nairobi; World Agroforestry Centre.

[25] Sendzimir, J., Reij, C.P., Magnuszewski, P. 2011. Rebuilding Resilience in the Sahel: Regreening in the Maradi and Zinder Regions of Niger Ecology and Society 16 (3): 1 http://www.ecologyandsociety.org/vol16/iss3/art1/

[26] http://hdr.undp.org/en/content/human-development-index-hdi

Development funded FMNR project in Niger are in the $14 / hectare range, and once introduced and adopted FMNR continues to spread at no cost to any external agency.

These achievements say much about the high potential for rapid uptake of FMNR given a more favourable adoption environment.

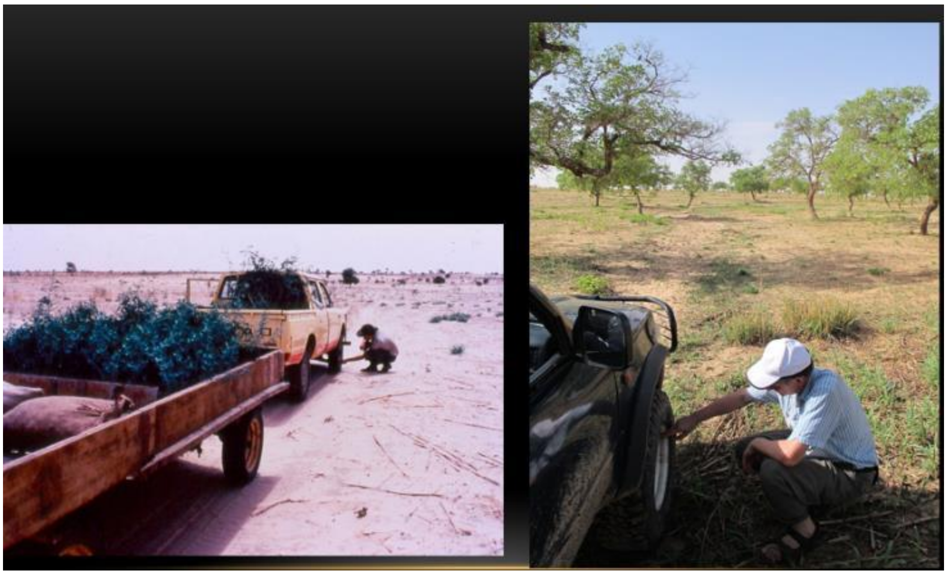

Fig 12. (Left) Photo taken in early 1980s of typical farmland in the Maradi district, Niger Republic. (Right) Photo taken in 2017 in the same general area. Much of the district is now covered with medium level tree cover and this despite 2016 being a drought induced food shortage year, implying that heavier tree harvesting for cash generation would have occurred.

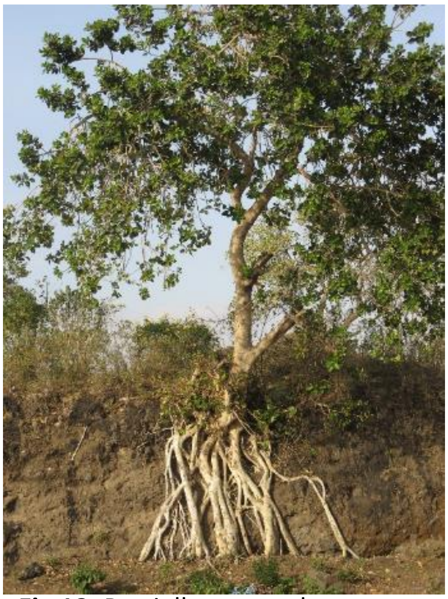

Fig 13. Partially exposed root mass of tree growing on roadside cutting, Moshe, Tanzania.

How to explain the rapid expansion of FMNR in Niger? In short, there had been a paradigm shift. Management of indigenous tree regeneration defied all the misconceptions about indigenous trees and opened the door to changed behaviour.

On the one hand, most tree species have inherent ability to regenerate quickly given a chance. When a tree is cut down, for most species the stump does not die and 30-50% of the biomass of the original tree remains alive beneath the soil surface (Fig. 13) with the capacity to coppice profusely and vigorously. This root mass has access to soil nutrients and moisture and often, ground water and it contains stored sugars – a healthy bank account which can be drawn from on demand when the coppice stems are in an environment conducive to growth, or at least, when there is an absence of factors such as fire and continuous cutting and browsing, all of which inhibit growth.

On the other hand, pruning lower side branches and thinning competing stems and branches focuses the benefits of apical dominance towards enhancing growth and form of the superior selected stems.

The regenerated trees grew quickly, enhanced crop and livestock production and provided a slew of additional products and services absent on farms cleared of trees. Each farm stood as a visual testimony to the falseness of deeply held 'truths' about trees on farmland. Each observer weighed in his and her own mind whether or not to follow what they ***saw*** to be true, or what they ***believed*** to be true.

Indigenous trees quickly became a valuable cash crop in their own right, while providing associated benefits to crop and livestock production. They were no longer seen as a liability or as weeds needing to be removed. In addition, at the time there was a growing perception that farmers themselves, not the government owned the trees they managed. Even though the law had not yet changed and all trees still belonged to the government, people acted on this perception that they now owned the trees and began paying attention to their trees in the same way that they paid attention to their annual crops and livestock.

Farmer observations of increased crop yield and resilience to drought, increased fodder and fuelwood availability and the economic and food security benefits that go along with FMNR convinced them to push the limits as to how many trees they could ***manage*** on their land. Indeed, *management* is the key word in the term "FMNR". FMNR is the intentional selection of which species will be managed, how many will be managed per unit land area and how they will be pruned - to give maximum benefit, whether that be for crop yield or tree product and service (fodder, fuelwood, soil fertility, wild foods, windbreak etc.), or for an optimum combination of each, determined by the farmer. The key to success is that the farmer, or more correctly, the land manager, decides.

Fig 14. One approach to FMNR is to leave four to six stems growing from the tree stump with the intention of harvesting one stem each year, while encouraging a new emerging stem to replace the harvested one. Each successive year, the stem being harvested will be bigger and will provide more firewood than what would have been the case had all stems been harvested in year one. In this way the landscape will never be left without a degree of tree cover, and each year there will be a tangible benefit to the farmer. Ideally, the farmer will leave one stem to become a tree and from there on, only harvest tree branches – say, one third to one quarter of the branches per year.

The principles of FMNR can also be applied to management of indigenous forest for designated purposes such as sustainable management for firewood production. Whereas it is common practice to clear fell forests for firewood and charcoal, by selectively harvesting tree branches sequentially according to a plan, forests can keep much of their integrity in perpetuity while meeting the needs of successive generations of people. Forests were maintained in this way for charcoal production in Basque Country, northern Spain (Fig 15).

Fig 15. Unlike most forests harvested for charcoal production in Europe over the centuries, this beech forest in Oiartzun, Basque Country in Northern Spain is unique. Instead of clearcutting which was the normal practice, the trees were instead pruned, to preserve the trees and maintain the integrity of the forest across generations. This form of tree management is called pollarding.

The main requirements for successful FMNR adoption have more to do with facilitating mindset change, that is countering false beliefs, negative attitudes and destructive practices towards indigenous vegetation and land management. The objective of mindset change is to elicit a commitment for sustainable utilization and management of vegetation and land resources. Additionally, there is a requirement for facilitating all-stakeholder agreements for natural resource management coupled with the granting of binding tree/forest user rights.

As discovered in Niger Republic over 30 years ago, if your assumptions at the outset are incorrect, the money you spend, the approach you take and the solutions you propose will at best be off target and, at worst, they will miss the mark completely. And so, one must ask the probing questions –

- Are biomass production estimates based on current land and vegetation management practices (which variously include harvesting of whole trees and suppression of regrowth through continuous and complete harvesting or regrowing stems, land clearing, regular use of fire, over and continuous grazing and complete eradication of trees on cultivated land) an accurate measure of fuelwood production potential?
- Is it true that indigenous trees, especially those growing *and managed* from mature stumps, grow slowly, and therefore, even if regenerated, will not be able to meet the demand for fuelwood?
- Are indigenous trees of low value, especially in comparison to exotics?
- Do indigenous trees (the right species, at the right density, managed the right way) really depress crop yields and fodder production, and are they therefore unsuitable for agroforestry and silvo-pastoral purposes?
- Is it true that cultivators and pastoralists will not tolerate growing indigenous trees on their farmland and pastureland and will not change their thinking?
- Is bush burning an impossible practice to reduce or even largely eliminate?
- Will pastoralists never agree to managing their herds, and the pastures they graze sustainably and more productively?

According to philosopher Henry James, your beliefs (assumptions) at the outset of a venture are the most important determinants of success. The answers you give to the above questions will determine the problem-solving approach you take, the technologies you employ, the size of your budget and ultimately, your level of success. Nearly forty years of experience working with farmers, NGOs, faith based organizations, research institutes and governments in 24 countries, along with a growing body of quantitative scientific data and much anecdotal evidence indicates that low cost, rapid and scalable solutions to the deforestation, fuel shortage and land degradation issues are available. If applied diligently, such solutions should not only be able to address these pressing issues, they will do so while enhancing livelihoods, ecosystem function and landscape level tree cover.

Fig 16. Young Faidherbia albida tree growing rapidly after pruning and protection from fire and livestock damage, Tigray, Ethiopia. Many people assume that indigenous trees grow slowly. This maybe because measurements are taken under "business as usual" conditions in which there is some combination repressing factors such as fuelwood harvest, fire, cultivation or livestock damage. However, for many species, and especially when trees are growing from already established tree trunks and root systems, this is not always true.

Annex III: Farmer Managed Natural Regeneration in the Emergency Relief context

The principles of FMNR hold true equally in local communities as in relief settlements, but perhaps the sheer scale of settlement camps and the need to act quickly before all forest resources disappear adds a sense of urgency to the settlement situation. But at heart, where there are living stumps and tree roots with the ability to coppice and/or tree seeds in the soil, or where there is bush encroachment in need of management, successful FMNR adoption is linked to

- Challenging false beliefs, negative attitudes and destructive actions towards landscapes and vegetation
- Awareness creation on the benefits of FMNR, engaging with the community to identify the causes of environmental damage and identifying what worked in the past and what hasn't
- Training on the technique
- Nomination and selection of volunteer FMNR champions from amongst the settlement members
- Strengthening of existing, or formation of new organizational structures such as development committees, cooperatives etc. There is strength and mutual support in belonging to a group and group members will be able to withstand threats such as ridicule, criticism and even deliberate theft and damage of their trees, better than individuals working on their own

- All stakeholder development of tree management by-laws and suitable mechanisms for enforcement. When communities share a common natural resource base, it is critically important to have a set of rules that everyone agrees to. Rules on which trees can be harvested by whom and how and the consequences of non-compliance guide how natural resources are managed

- Binding, legally protected user rights to the trees being regenerated. Practitioners need the assurance that if they invest their time in FMNR they will benefit. Without this assurance they will be very unlikely to practice FMNR beyond the point where they are being paid through food for work, or cash for work to do so. In the case of settlements, binding and mutually acceptable agreements need to be made with host communities

- Effective mechanisms for managing threats such as fire, livestock damage and theft of trees need to be put in place. The foundation for addressing threats is to have a community that is aware of the damage such incidents inflict on them (personally and collectively) and one that is convicted that it is in their best interests to minimize them:

    - In practice mobilizing communities to prevent fire outbreak and fight fires when they do occur can be difficult, but it is not impossible and there are precedents of success.

    - Successful programs will include pastoralists in all training and awareness campaigns. In ignorance many pastoralists use fire and continuous grazing as a means of feeding their herds, but these practices are destructive and in the long run destroy the environment and reduce fodder availability. Through awareness creation and training, pastoralists can learn how fodder production can increase through implementation of FMNR principles.

    - Regarding theft, communities and individuals which have a sense of ownership in tree resources will be more receptive to organizing themselves to protect their assets.

- Market linkages to timber and non-timber forest products. Beyond meeting fuel wood needs and environmental restoration, FMNR creates income generating opportunities which should be developed and promoted as early as possible. Linking FMNR with income generation is a sure way of increasing uptake and sustainability of the practice.

- Regular follow up by trusted staff and volunteer FMNR champions who are known and trusted by the settler communities. Follow up is particularly important, in the first year or so when practitioners may be easily discouraged, as new problems and threats arise and when pruning correctly is a new practice

Relief contexts have an advantage of having access to Food-For-Work or Cash-For-Work assets which can be used to promote FMNR. Such resources should be used with caution and to the degree possible without creating dependency. The objective should be to encourage settlers to practice FMNR because it has merit in its own right and will bring direct benefits. Especially in settlements where refugees will be present long term it would be a shallow success if FMNR was only practiced as a response to payment. Strong messaging encouraging settlers to adopt FMNR for its own benefits, and not for payments alone, should be provided regularly.

FMNR has the potential to lift the status of refugees in the eyes of local populations. Too often refugees are unfairly seen as a burden to the country where they are seeking asylum, whereas through FMNR they could become a very valuable asset in the work of forest and land restoration, which ultimately creates wealth for all.

Annex IV. Alternate hunting methods

Many hunters in West Nile sub-region use fire to flush out game. Fire is an effective hunting tool, but it is highly destructive to the environment, it will destroy all planted and regenerated trees and retard regeneration. Hunters should be trained and equipped to use alternate methods. In fact, fire is not needed at all for hunting rodents. A trap-barrier system has been developed by Australian scientists which has proven effective in catching rodents in paddy fields. See insert. Hunters can also be enticed to take on easier, more secure and lucrative occupations such as bee keeping.

community
trap-barrier system.pc

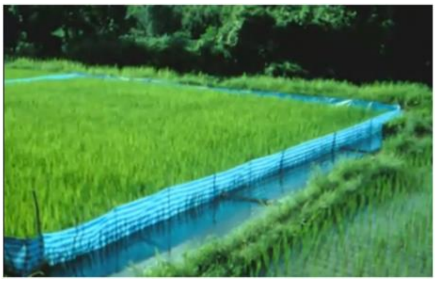

Fig 17 and 18. Community trap and barrier system. Rodents follow a wall of plastic until they find an opening which leads to a trap.

Annex V. Charcoal briquettes from agricultural waste and twigs.

Each season tons of crop residue, small stems from sprouting trees on agricultural land and agricultural waste such as husks and dry grass are burnt. As adoption of FMNR increases, large quantities of twigs will be left in the landscape following pruning. These twigs can become a fire hazard. If collected and converted to charcoal briquettes[27], in one stroke, these so-called waste materials will be converted into a valuable resource, while reducing the fuelwood demand from trees, increasing incomes and reducing the fire risk from having combustible material in the landscape.

[27] https://www.youtube.com/watch?v=wc1gbfyEpOs

https://www.youtube.com/watch?v=20vUIV1ulBw

Fig 19. WV facilitated establishment of a social enterprise in Same, Tanzania. The company purchases agricultural and other waste products including maize cobs, peanut shells, dry grass and sawdust and converts them to charcoal dust in locally manufactured kilns. The charcoal dust is transported to a facility where it is mixed with 'cassava water' as a binding agent, and compressed. As well as meeting demand for cooking fuel this enterprise has contributed to local income generation and created employment opportunities.

A slight modification to the tops of these kilns could enable settlers to utilize 'waste' heat for boiling water or cooking foods such as beans which require long cooking periods.

Annex VI. Farm Ponds

Water is supplied to settlers for household needs but no water is available for irrigation. With small plot sizes and reliance on variable rainfall, settlers are at the mercy of the weather and at best will always be less than subsistence farmers. By capturing surface runoff and storing it in small farm dams[28], farmers will have an opportunity to save drought threatened crops and/or to grow additional high value horticultural crops off season.

Fig 20. This covered small farm dam captures surface run off and a solar powered irrigation pump is used to irrigate high value horticultural crops. This intervention enhances food security, provides additional income for cooperative members and increases resilience to climatic shocks in Machakos district, Kenya.

[28] http://blog.worldagroforestry.org/index.php/2017/05/10/kenya-launches-national-program-to-harvest-rainwater/
https://www.youtube.com/watch?v=a29CqHdGqpg