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The Forest-Agriculture interface: a zone for enhanced productivity?

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Enhancing natural resources management for food security in Africa

Volume 26, Issue 2

The Forest-Agriculture interface: a zone for enhanced productivity?

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Message to Readers

Maria Helena Semedo[1]

We define the Forest-Agriculture interface as the physical and economic zone where forest and agriculture systems interact, producing oftentimes contentious outcomes. It is therefore challenging to determine how to optimize these interactions, mitigate the negative and accentuate the positive. This edition of *Nature & Faune* magazine is centred on the "forest-agriculture interface", a theme that has been woven into natural resources management and food security.

African countries are striving to reach and maintain a path of sustainable economic growth through agriculture-led development that reduces mass poverty, food insecurity and hunger, while safeguarding the integrity of the ecological environment. As targets for a successful implementation, the Comprehensive Africa Agriculture Development Programme (CAADP) has taken on the Millennium Development Goal (MDG) of reducing poverty and hunger by half by 2015, through the pursuit of a 6 percent average annual growth in the agricultural sector, and the allocation of an average of 10 percent of national budgets to the agricultural sector.

However, the principal agricultural techniques used in Africa (e.g., slash and burn shifting cultivation) can rapidly convert forests into farmland, and are perceived as the single most important cause of deforestation and land degradation. Shifting cultivation, which is a form of subsistence agriculture, together with unsustainable logging, fuelwood collection and mining, are some of the major causes of deforestation in Africa. Africa's rising population is a serious challenge complicating further the forest-agriculture interactions. Areas in which the conversion of forest land to agriculture occurs (i.e. the most direct and visible aspect of the forest-agriculture interface) are often of the greatest ecological importance, in terms of fragility and biodiversity richness. Therefore they need to be sustainably managed to meet the needs of current generation without compromising the ability for future generations to meet theirs. By definition, an interface is a boundary across which two-independent systems meet and act, or communicate. Healthy forest ecosystems contribute tremendously to agricultural productivity by protecting soil against degradation and erosion, maintaining river bodies, and assuring regular rainfall patterns. Their conversion into farmlands can on one hand result in better food and energy supply, rural employment and income opportunities, expanded agro- and forest industries, and an improved trade and foreign exchange balance, but on the other hand, lead to disturbing deforestation and land degradation, sapping thus the very foundation of agriculture itself.

Sometimes, the pursuit of short-term gains may lead to serious long-term losses to both the environment and the livelihoods of many people. This is oftentimes the case in many developing countries where the need for economic growth has driven governments into the mining of natural resources, including the use of forest and agricultural lands, with disastrous long-term effects on the environment and people's lives. With the rising price of fossil fuels, coupled with the looming threats of climate change, land use patterns may change in favor of biofuels production. In Africa, this is however a potential new source of pressure on land, food production and forestry.

This issue of *Nature & Faune* aims at highlighting the complexity of the interface between forest and agriculture in Africa. The editorial presents agroforestry, as a useful linkage between forestry and agriculture for increased productivity in agriculture and forestry. It recognizes the limitations of agroforestry at the current stage of

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knowledge, but argues that it is one of the ways we can apply knowledge from agriculture and forestry to improve environmental sustainability.

Christopher Nugent, in a pictorial representation of the interface between forest and agriculture, points out the potential uses of Google Earth™, which seems to have been largely ignored by many foresters. This Special Article draws attention to the potential of this free web application, which among other things provides insights into the dynamics between land-based sectors.

In an Opinion Piece, Jeff Sayer writes that the future of trees and of agriculture in Africa will depend greatly upon the prevailing macroeconomic situation. A second Opinion Piece by Kay Muir-Leresche presents some of the most essential aspects of economic value analysis that need to be taken into account when taking decisions on large scale conversion of forest land. Of the nine regular articles featured, four are on the Central Africa subregion, three on West Africa, two on Eastern Africa and one on Southern Africa.

In Central Africa sub region, Laurene Feintrenie's article questions the risks and opportunities of further oil palm development in Cameroon. Lamourdia Thiombiano and colleagues espouse a framework for climate-smart agriculture in the Congo Basin. Emilien Dubiez and collaborating authors provide a snapshot of the activities developed by the Makala Project (in Kinshasa, Democratic Republic of Congo) to improve the management of periurban forest ecosystems and to secure the supply in wood energy. Verina Ingram presents non-timber forest products in Central Africa from the stand point of forest to farm to market interfaces.

Views on West Africa include Ghana, Republic of Benin and Senegal. Richard Gyimah explores in his article, pragmatic ways of using Reducing Emissions from Deforestation and Forest Degradation (REDD) in southern Ghana's off-reserve area where large forest-agricultural mosaic landscapes exist. Roch Houngnihin and associates report of a study aimed at analyzing the contribution of sacred forests to sustainable environmental management. Cheikh Toure takes us to the eastern, northern and central regions of Senegal, where shifting agriculture has led to severe land depletion. Rural subsistence farmers share their knowledge with researchers on improving food availability by promoting the protection of the Forest-Agriculture interface through assisted natural regeneration of indigenous trees.

In Eastern Africa, we have articles on Uganda and Tanzania. Janie Rioux shows the importance of addressing land tenure while promoting agroforestry and connecting small-scale farming in Tanzania. Each edition of Nature & Faune features stories from African governmental or parastatal institutions; Uganda is the focus in this issue. Margaret Athieno Mwebesa communicates an important aspect of institutional coordination and joint action in Uganda used in Community Watershed Management that spans 100 watersheds spread across 70 districts.

Anne Bogdanski and Christa Roth provide us a peek into Southern Africa. They review some of the evidence in Malawi for undertaking research on maize/pigeon pea intercrop as a possible contribution to reducing pressure on forests.

Under our FAO Activities and results column, John Moehl introduces Special Programme for Aquaculture Development in Africa (SPADA). Outside of its aquaculture context, SPADA may be perceived as an approach or methodology that can be applied to many other areas of development, including at the Forest-Agriculture interface.

Take a glance at our announcement section to discover how the National Forest Programme facility has evolved into a Forest & Farm Facility. And we have news on the groundwater potential in Africa; find out what Jacob Burke and Ruhiza Boroto have to say on this sensational news item. This edition is deep and informative. So strap on your seatbelt, and let us get to it. Have a wonderful adventure discovering more about the realities of managing the physical and economic zones where forests meet farms in Africa.

Editorial

The Forest-Agriculture interface: A zone for enhanced productivity?

August Temu[1]

The history of civilization shows that *Homo sapiens* first started as hunter/gatherers. Sedentary production emerged as families and communities grew larger and as skills to domesticate and raise plants and animals were acquired. The farms were initially boundless, and not physically delineated. This enabled the development of nuclei of human settlements around which there was a decreasing intensity of farming activities that reinforced the increasingly sedentary family or community. A continuum of differentiated products, natural resources and other services emerged, with the most important (water and food) being at the closest range while the less crucial such as firewood would be gathered farther away from the settlement. Even within the food items, cereals and tubers became intensively cultivated while fruits were collected from the wild. Explicit rights over land emerged as land became scarce with population growth and more sedentary systems.

The expansion of communities went hand in hand with expansion of cultivation, leading to greater distances between farmland and forests. The establishment of governance structures required systems of land-use planning and over time this led to increasing separation of farmland from forests from the organizational standpoint, such as government ministries and in education systems.

In agriculture, modern science and technologies are increasingly directed at individual commodities. The scientists and development specialists have a reductionist approach which separates food crops, cash crops, trees, fruits, berries, wood, chicken, cattle, pigs etc as distinguishable 'business' units. However, to the smallholder farmer (then and even today) the land under his/her control carries an integrated set of enterprises that together underpin the family livelihood. To them, the integrated system meets a wide range of needs directly. The arrival of the green revolution was a turning point for farmers, where a single variety of crop could be massively propagated and through agrochemical support (fertilizers and pesticides) enabled to dominate the agricultural landscape. This created greater ecological distance between farms and forests. Not only have farms become increasingly mono-cultural, the soil micro flora and fauna are being reduced to only those which can withstand the uniform bio-chemical and physical conditions created. An ecological desert for non-compliant species is being created. This is not necessarily bad as it helps the world meet food security needs. This form of extensive monoculture dominates some countries in the North and Asia. Very few countries in Africa – South Africa and some parts of Egypt, Zimbabwe and Kenya have substantive monoculture plantations of food crops. Interestingly, similar developments have taken place in forestry with monoculture plantations of pines, cypress, eucalypts etc. These too are ecologically limited in terms of enhancing biodiversity and in some cases they have negative impact on the water resources (e.g. excessive consumption of water by some eucalyptus species in South Africa).

Luckily, in Africa current farming spans the whole range of systems from intensive

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monocultures (a segregate production system) to multi-storied agro-silvo-pastoral systems (a highly integrated production system), with the latter as dominant in most regions. For how much longer can this hold, given the search for land and attractive packages (including tax holidays) for foreign investment in agriculture? I will leave this question to politicians, planners and economists. Let me dwell instead on the productivity question.

In much of semi-arid and sub-humid Africa, farming of cereals is confined to roughly 3 to 5 months in a year – the so called cropping season. During the rest of the year, the land lies fallow. Livestock roam the landscape eating crop residues and hopefully also fertilizing the land. Under more humid conditions farmers tend to be much more integrated, with livestock partially or wholly confined to zero grazing, because fodder is available throughout the year. This is the essence of integrated farming and it forms a centerpiece of the productivity arguments I will present hereafter. If we set the objective as maximizing cereal production, it would seems to lead to intensive cultivation, mono-cropping, fertilization and intensive pest management. The outcome is a large amount of cereals. But this must not be confused with sustainable food security or even economic optimization. In the short run we may have overcome the cereal shortage, but sustenance of the inputs is crucial. In the developed countries where this model is applied, the farmers receive considerable subsidies – either direct financial subsidies on inputs or marketing, or at the least subsidized by mining the future productivity of the systems. This is because this type of agriculture is expensive, seldom profitable and not sustainable.

Without agricultural subsidies there would be less interest in food production in most of the large grain producing countries. In 2010 Malawi subsidized maize production. Farmers received fertilizer support and voila! Food became abundant for the following year. The immediate challenge for the Malawi Government was how to sustain the subsidies, and this became a budgetary (and by extension a political) problem.
There are investments that can increase grain production without creating funding distortions. In the neighbourhood of Malawi, in Chipata Eastern Zambia, maize production with *Sesbania sesban* (a leguminous nitrogen fixing shrub) was shown to enable farmers to shift from about 1,300 Kg/ha maize production to over 4,000Kg/ha, due to the shrub's ability to fix nitrogen. Under this production system *S. sesban* was planted as a fallow bush covering the land over the whole year. At the beginning of the growing season the *S. sesban* bush was cleared, all leaves were incorporated into the soil. The sticks were used for firewood and props for climbing crops. The threefold increase in grain production compensated for the one year lost in production, it comes at least cost and is sustainable. Wide scale adoption of this innovation by farmers and ICRAF is slow because the knowledge requires policy support and capacity building for farmers. Greater attention is needed in these two aspects.

It is probably counter intuitive to many to imagine that greater integration of forest and farm would result in enhanced productivity. The goal here is to raise current productivity of smallholders using affordable and sustainable inputs. Let us look at land productivity that can span all the seasons in the year. This is what trees and livestock can add to the farmer. Trees make use of the deep soil layers, making it possible to retrieve leached nutrients and water that would otherwise be unavailable to most short rotation crops. This enables trees to bridge farming seasons, thus providing fruits, nuts, fodder, gums resins and a wide variety of wood products, especially firewood during the dry periods. These tree products are essential and complementary to the cereals (for calories) as they meet the nutritional needs in addition to sustaining the livestock for additional protein. Besides, as they grow, trees open up the soils, breaking hard pans and enabling better infiltration of water to

recharge ground water systems. Recent research has demonstrated under the shade of a tree there could be 100 times more living creatures than on mono-cropped or bare land. This enhanced biodiversity helps to restore the overall ecosystem functions and services, thanks to the presence of trees or shrubs.

It is apparent here that a narrow interpretation of productivity, that is cereal yield per unit area, is good for calorie security. For nutritional security (minerals and vitamins) the integration of productive trees and shrubs is certainly worth our consideration. Sustained productivity of the land and diversification of the products is a robust and time-tested mode of production in much of Africa. The question is why this is not being adopted if all the benefits are so apparent. The good news is that climate change has entered the equation, and farming has to also be climate smart. This requires that thorough analysis of the farming systems is undertaken to ensure that they mitigate climate change, and hopefully incorporate opportunities for farmers to adapt to climate change effects. These new objectives will be better met through incorporating more trees on farms – that is Agroforestry.

It is important for us to understand what is meant by productivity. Three elements are involved in any production system – the inputs, the process and the outputs. In order to evaluate any production system we have to consider:

Efficiency - that is the ratio of total costs to total value of outputs must be less than 1 for us to be making a gain. This becomes a bit tricky where some of the outputs are environmental services whose valuation may be complex.

Sustainability – that is the residual ecological integrity (functionality) of the system is retained or even better than before the production. A long-term perspective is imperative for this form of analysis.

Is agroforestry a panacea? Absolutely not – it is one of the ways we can bring together and apply knowledge from agriculture and forestry to enhance productivity and environmental sustainability. It requires a new look at policies, institutional frameworks and improved knowledge management to ensure that future agriculture also addresses conservation of natural resources.

ANNOUNCEMENTS

National Forest Programme Facility evolves into a Forest & Farm Facility

Jerker Thunberg[1]

The evolution of the National Forest Programme (NFP) Facility into a new phase builds upon its experiences of the past 10 years and also on elements of the Growing Forest Partnerships (GFP) initiative. The new phase will combine the strengths of these programmes while meeting the remaining challenges in NFP implementation and new needs identified. The new programme is hence re-framed as the Forest and Farm Facility (FFF).

This FFF is framed in a context where natural resources are facing global challenges: population growth and inequitable and unsustainable consumption patterns are degrading ecosystems and threaten many rural peoples' access to land, food, fuel, construction materials and livelihoods. Vital ecosystem services, natural resources and invaluable biodiversity are often being endangered or forever lost. Smallholder, women, community and Indigenous Peoples groups who live close to forests understand the multiple benefits of forests and trees and what sustainable forest and farm management requires in practice. Recent evidence from international agencies highlights the advantages of local control in conserving the environment while meeting local needs. Yet the local groups are distanced from decision-making centers, markets and investment programmes, and their lack of organized representation in these, leaves their crucial contribution marginalized.

The need to include local people, their perspectives and voices in tackling this situation and to mediate and find viable compromises between views and perspectives of governments and civil society could not be more imperative; the stakes for forest and farm dependent people, and the global community overall, could not be higher. The NFP Facility and the GFP have made significant contributions to increase stakeholder participation in the NFP and other processes. However, to further improve the representation of local people a more focused support to strengthen their capacity to network and organize is needed.
Tackling the global challenges also requires integrated programmes that span from local to national and international levels and reflect the multi -functions and benefits of forests and farms. The NFP Facility has gained considerable experiences on how to deal with these complex issues. It has shown that an integrated and bottom up approach, coupled with sensitizing government bodies and establishment of multi stakeholder participatory platforms is key.

However, the forest sector in most countries remains isolated and not involved in the national policy dialogues on poverty reduction, food security, climate change etc. in spite of its crucial contribution to those policies and to sustainable development in general. Thus the proposed programme seeks to mobilize the international community to support the organization of local people, and to foster better multi -sectoral policy platforms.

The Facility will address these global needs by increasing its focus in promoting cross-sectoral coordination and further enhancing the organisation and capacity of local groups so they can engage in local, regional and national level policy dialogues and decision-

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making processes, and have better skills and opportunities to access financing mechanisms and investments for sustainable forestry and farm management. Local people will be able to contribute their ideas and knowledge, helping to ensure that forest and farm related policies improve their food security, livelihoods and the management of the natural resources in the landscapes on which they rely for living.

The Forest and Farm Facility (FFF) will develop and fund partnerships at local, national, regional and international levels, and will offer grants that enable local stakeholders to form organizations and alliances. It will also offer grants to governments to establish and develop platforms to better coordinate multi - stakeholder, multi -sector cooperation and dialogue. In this way, the FFF will catalyze more equitable and inclusive governance and finance mechanisms at national, sub national and local levels.

Supporting local people to organize and engage with forest and farm related policies adds value to donor programmes and global initiatives in three important ways.

First, it gives much-needed weight to local experience and perspectives in decision-making about forest and farm management integrating all related sectors.
Second, it scales up the formal market presence of enterprise groups that can attract pro-poor investment and help legitimize domestic-to-international market sectors that need local partners.
Third it creates the networks of local forest and farm based right-holders that will be essential for rolling out food security, climate smart agriculture, climate change adaptation and mitigation programmes (REDD+) as well as programmes focusing on illegal logging and timber trade (like FLEGT).

The FFF will be coordinated by a small and flexible management team and FAO has offered to continue hosting also this new phase. A Steering Committee will evaluate and refresh the vision, principles, policies, strategies and basic activities of the Facility and a Donors Support Group will develop eligibility guidelines for selecting partners and criteria for grant applications respectively.

The proposed total budget is USD 50 million for the five year period 2013-2017, to cover some 40 countries. Robust monitoring systems will ensure that priorities of smallholder, women, communities and Indigenous Peoples groups are upheld, and that investments are made in a transparent way.

Consultations with multiple partners have identified the following framework for effective implementation:
Mission: *To promote sustainable forest and farm management by supporting local, regional, national and international organizations and platforms for effective engagement in policies and investments that meet the needs of local people.*

Beneficiaries:

i) Smallholder, women, community and Indigenous Peoples groups, including their networks at sub national, national and international levels, who will receive direct support, improved access to information, capacity development in decision-making, and financing and investments for managing forests and farms in an integrated and sustainable way.

ii) ii) National and sub-national governments will benefit from direct support to establish or strengthen multi -sectoral platforms for dialogue on forest and farm related issues and from having established an operational collaboration base with smallholders, communities and Indigenous Peoples.

Impact will be measured in terms of income, food security and employment of smallholder, women, community and Indigenous Peoples groups from sustainable forest and farm management.

NEWS

Groundwater potential in Africa – a few facts

Jacob Burke[1] and Ruhiza Boroto[2]

On 20 April 2012, the BBC covered a sensational story about groundwater potential in Africa. On 17 June 2012, The New York Times's Opinion Pages covered the same story by the lead author of the research, Alan B MacDonald of the British Geohydological Survey, who had earlier provided a summary of the four messages the research findings wanted to get across:

1. *Groundwater storage is a much larger water resource than any other in Africa - so should be considered in any water scarcity assessments*

2. *There is a great variety of groundwater conditions across Africa*

3. *Generally groundwater can meet the demands of rural communities and small scale irrigation economically and relatively easily if accompanied by appropriate investigation*

4. *The demands of large scale irrigation or large urban centres is much more problematic and will require detailed investigations and favourable conditions to be successful*

The story was drawn from a paper in Environmental Research Letters in which the authors attempted to quantify groundwater resources in Africa in terms of storage and also potential borehole yields. It was building on previous mapping from WHYMAP, BGR, BGRM, BGS, country maps and also a review of about 300 aquifer studies. The research was part of a larger project funded by DFID who saw a strong need to translate groundwater information into something more easily accessible in terms of resilience and water supply investments for Climate Change adaptation and food security.

The links to the paper and to the home page of the larger research project of which it is part are:

ERL paper: http://iopscience.iop.org/1748-9326/7/2/024009/article

Project website: http://www.bgs.ac.uk/research/groundwater/international/africangroundwater/home.html

The New York Times's Opinion Pages article written by Alan B MacDonald can be found at: http://www.nytimes.com/2012/06/18/opinion/africas-hidden-water-wealth.html?emc=eta1

It is worth recalling that what counts for most groundwater dependent livelihoods is depth at which groundwater is found and the associated cost of energy to pump it.

How do these facts impact upon forest development and livelihoods in Africa? Watch out for the answer in the December 2012 edition of Nature & Faune!

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Ten Central African countries agree to improve forest monitoring

On the 26th of July 2012, the media office of the Food and Agriculture Organization of the United Nations (FAO) released news on a six million Euro (€6 million) project to set up national monitoring systems and strengthen regional cooperation in ten Central African countries. Excerpt from the news release follows:

- A new regional initiative will help ten Central African countries to set up advanced national forest monitoring systems, FAO announced today. The ten countries are part of the Congo Basin and include Burundi, Cameroon, Central African Republic, Chad, the Democratic Republic of the Congo, the Republic of the Congo, Equatorial Guinea, Gabon, Rwanda and São Tomé and Principe.

The forestry project will be managed jointly by the Central Africa Forests Commission (COMIFAC) and FAO in close collaboration with the Brazilian National Institute for Space Research (INPE). The Congo Basin Forests Fund, launched by the Governments of Norway and the United Kingdom through the African Development Bank is funding the initiative with €6.1 million.

The forests of Africa's Congo Basin, approximately 200 million hectares, are one of the world's largest primary rainforests, second only to the Amazon. The region's forests support the livelihoods of some 60 million people.

According to data provided by COMIFAC, the gross deforestation annual rate in Congo Basin was 0.13 percent between 1990 and 2000 and it doubled in the period of 2000-2005.

Although this deforestation rate is relatively low, the main threats to these forests include land-use change, unsustainable logging and mining. The impact of the direct threats, the rates of forest cover change and the subsequent emissions from deforestation and forest degradation activities remain poorly understood partly due to the lack of up-to- date and accurate information on the current state of forests in the region.

"Learning from Brazil, the national forest monitoring system is the key element to pave the road for substantive international support to protect forests and promote sustainable forest management," said Eduardo Rojas, Assistant Director-General of the FAO Forestry Department.

"This project will reinforce regional capacity and allow COMIFAC countries to strengthen their cooperation in the forestry sector, in particular with regards to their capacities to provide transparent and reliable data and information on forests. All COMIFAC countries are currently implementing forest conservation policies, and the national forest monitoring systems that will be supported through this project will allow countries to report on their results," said Raymond Mbitikon, Executive Secretary of COMIFAC.

FAO will provide technical support to the countries enabling them to use remote sensing technologies to estimate forest cover and forest cover changes as well as to estimate the amount of carbon stocks contained in forests in the region. The project will assist countries in preparing funding proposals for creating reliable and sustainable forest monitoring systems for each country, as part of the REDD+ initiative (Reducing Emissions from Deforestation and Forest Degradation in Developing Countries). It will also help strengthen regional cooperation and experience sharing.

REDD seeks to create a financial value for the carbon stored in forests, offering incentives for developing countries to reduce emissions from forested lands and invest in low-carbon paths to sustainable development.

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Special Feature

A pictorial representation of the interface between forest and agriculture

Christopher G. Nugent[1]

Summary

Our appreciation of land use changes, such as the relationship between Forest and Agriculture, can be heightened by studying 'photographic' images, such as aerial or satellite imagery. In the past, satellite imagery has not been easily accessible to African professionals mostly due to reasons of cost and their use for limited and specific studies (GIS for example). This article draws attention to the potential of Google Earth™, a free web application, to foresters as it provides excellent opportunities to more easily study forest developments locally or nationally and make comparisons across Africa and the rest of the world. In particular it can provide some insights into the dynamics between forestry and agriculture.

Satellite imagery on the web

This issue of 'Nature & Faune' is dedicated to the study of the interface between Forestry and Agriculture, and asks the question whether this can be a zone for enhanced productivity in Africa. There are number of ways of portraying this "interface". On the one hand there is the broad contrast between land space occupied exclusively by forest and the land given over to agriculture of one kind of another, which in many cases is 'former forest'. On the other hand there are the more intimate actions of a farmer on his land, who has the will and opportunity to integrate forestry-related decisions into his farming approach, conserving or choosing to plant certain trees that enhance his economic activities in various manifestations of 'agroforestry'.

There are tools that can help us visualise the actual interface between forest and agricultural land, and in the case of large-scale land-use we have satellite imagery. Google Earth™[2], in particular, provides imagery that is available to everyone with access to an internet connection in what is basically a free service that gives us a privileged insight into our physical environment, and the overall context in which we work. In recent months the resolution of images in Google Earth of some of the forest areas of Africa has been improving noticeably. On these images it is easy to locate forest and agricultural areas, and increasingly one can distinguish even individual trees in the best resolution images.

Satellite imagery informing forestry professionals

What can these images tell us, and can they provide insight into the nature of the interface between forest and agriculture?

First of all one can 'see' dense forest cover and catalogue the areas of forest and other land use quite easily, and for this Google Earth provides a quick and informative tool for foresters. Of particular interest is a new feature of Google Earth which displays historical imagery; while this feature is still not fully developed, and it is only the most recent images that are of good resolution, there are areas where it is possible to see how over the past 10/15 years the overall forest cover has changed – usually confirming how the forest limits are rapidly receding. Images can provide information and clues on other aspects such as the impact of management schemes, conservation experience or the spread of agroforestry technologies. It may still be necessary to check the actual situation on the ground before drawing conclusions from such images, and it should also be borne in mind that these images undergo processing particularly of the colour information, which can vary slightly between image sources.

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[2] *http://www.google.co.uk/intl/en_uk/earth/index.html*

Figure 1: Satellite imagery showing forest cover in the Western Region of Ghana (Google Earth)

Figure 1, an image saved from Google Earth™, is a stark visual representation of the forest cover in the Western Region of Ghana. At a glance one can distinguish the dark areas of still dense forest cover, the lighter areas of off-reserve agricultural activity and the bright spots of larger human settlements. A striking impression is created by the 'un-natural' straight lines of the borderline or interface between Forest and Agriculture; clearly the dark areas represent the forest reserves, while the rest of the area is lighter and more varied in colour and represents agricultural activities which now dominate right up to the reserve boundary.

One can imagine the ruler being used years ago by an officer laying out the forest reserves in the region, even if it is tempting to wonder about the logic of some of those lines which seem to ignore all natural landmarks or contours, see figure 3. After up to 80 years of existence these reserves have been maintained remarkably successfully, and now we are left with an "either-or" situation, *forest or agriculture*, where agriculture has replaced most natural forest cover everywhere off-reserve. It is an important reminder that the balance of power on the front line between the two is usually in favour of agriculture and that the relationship not always a comfortable one.

Figure 2: Contrast between the nature of forest cover between Ghana and Cote d'Ivoire

Figure 2 provides a comparison between the West of Ghana and East of Côte d'Ivoire – both areas with historically comparable natural forest cover. The apparent differences in this Google Earth image are quite marked and seem to suggest that different management strategies in the two countries over the years have led to quite different results. Both national areas have developed dynamic cocoa and coffee growing activities, but in Ghana there is a more clear-cut difference between on and off-reserve areas; in the latter productive agriculture off-reserve has largely removed the forest cover right up to the reserve boundary, which however has been respected. On the other hand in Côte d'Ivoire, although there are areas visible where forest cover is denser, and which correspond to reserves with a degree of classified protection, the interface is less well defined and the forest cover with reserve status has been 'nibbled' away on the edges as well as from within. However in the west of Côte d'Ivoire where agricultural settlement is more recent, the pattern is similar to that in Ghana with an apparent abrupt change in land use from agriculture to forest along reserve boundaries. The historical imagery from the region of Tai (W. Côte d'Ivoire – figure 5) show that even these boundaries are starting to be pushed back in some places.

Based on these pictures it is difficult to escape the impression that in areas such as West Africa, where there are significant pressures on land use, that the interface between Forest and Agriculture is very competitive in nature. Active protection, provided by the "forest guard" and the law, would seem to be essential and without it the forest will be replaced unequivocally by agriculture and the 'interface' will disappear. New co-management strategies of forest with community input are often considered and will have their place, as will extending agroforestry strategies into off-reserve areas. Nevertheless the images of the Ghanaian situation suggests that statutory legal and physical protection of forests has proved its worth and cannot yet be dispensed with.

Figure 3: Forest-Agriculture interface draws abstract designs on the Western Ghana landscape

Figure 4: High resolution image showing individual trees on and off reserve in Ghana:

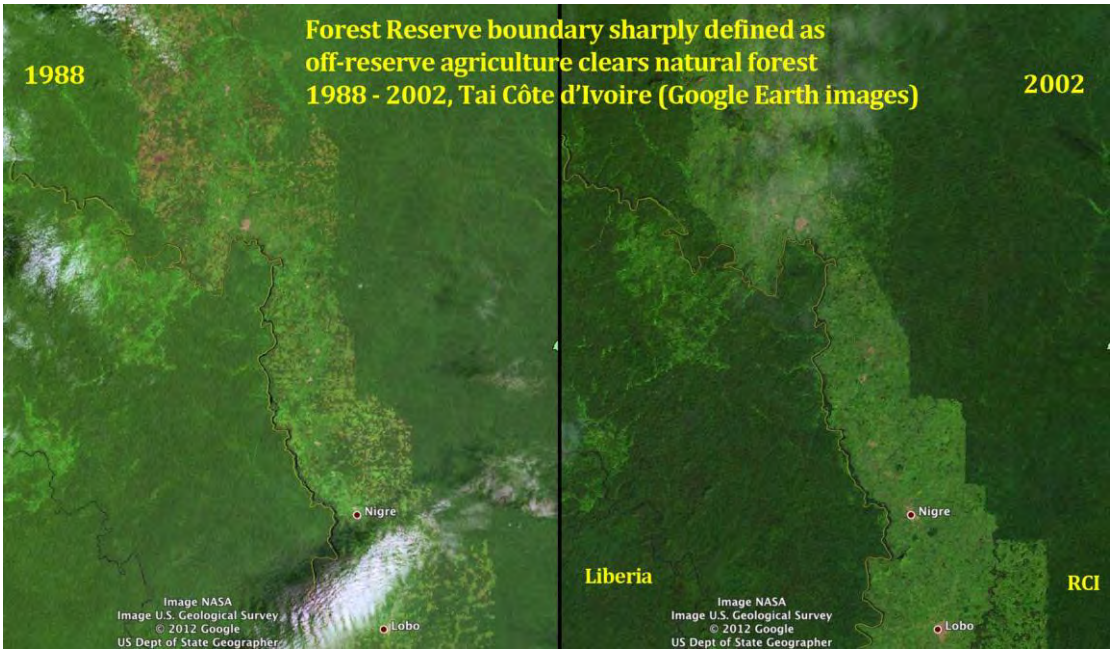

Figure 5: Forest cover changes around Tai, Côte d'Ivoire (using the Historical Imagery feature of Google Earth).

Looking elsewhere, in areas where there are larger expanses of natural forest cover, such as the Central African Republic, the satellite imagery of Google Earth can also tell us much about the relationship of forests to the changes being brought about by agricultural development, as in the following examples. Figure 6 again portrays abrupt lines of an "either-or" relationship between the natural forest and agriculture. Figure 7, on the other hand, illustrates a different context where the natural forest gallery exists alongside agricultural land use in a situation where certainly there will be productive advantages for the farmer to conserve and sustain the gallery as part of the overall agro-ecological system.

Figure 6: Plantation agriculture meets Forest in the Central African Republic

Figure 7: Forest Galleries and Agriculture in Central African Republic

Conclusion:

Google Earth images are available to everyone with access to an internet connection and can clearly provide the forester with much key information on the nature of the frontier between natural forest and agriculture in different areas, countries and climatic zones. It also has the potential of allowing us to monitor changes over the years, even if that is unfortunately usually a case of recording the progressive loss of natural forest. Hopefully future images will continue to record the relative success of Ghana in protecting forest reserve areas and justify resources being committed to that protection. In the future with high resolution imagery that shows individual trees it will be possible also to monitor progress of the promotion of agroforestry technologies that will contribute to improved productivity of the agro-ecological practices in use by farmers in Africa, using trees as alternative crops or sources of other benefits that enhance productivity and economic security.

Opinion Piece

The Forest agriculture interface

Jeffrey Sayer[1]

Trees have always played a major part in the livelihoods of African people. However the nature of their contribution has changed radically over history. The Populations who are totally dependent upon forests are now declining and hunting and gathering as a way of life is a thing of the past. But many people still harvest a wide variety of products from forests and woodlands all over Africa and retain/manage trees on their farms for the contributions they make to their livelihoods.

Most traditional farmers in Africa still retain trees on their land. Trees retained on farmed are needed for firewood, fruits and medicines, for shade, and in some cases because they contribute to soil fertility. There has been a very long history of successful mixed cropping systems in many parts of Africa that integrated trees and food crops. The orchard bush systems of the Guinea and Sahel zones across much of Africa are good examples. They mixed a number of tree species such as Shea butter (*Butyrospermum parkei*), *Parkia biglobosa, Faidherbia albida*, etc which provided benefits and products for the farmers and competed less with the crops for nutrients and water. Many farmers in the more humid parts of Africa have traditionally cultivated mixed gardens. Much of Africa's cocoa and coffee comes from smallholder systems where the farmers are also growing some food crops. Other crops are now grown mainly in industrial estates, the most notable example being Palm oil, but smallholders have always grown these crops and continue to do so. There are interesting programs underway now to introduce new tree crops to African systems. *Allanblackia spp* and *Prunus Africana* are showing promise as tree crops that could be grown by smallholders. The former is grown for its special oil which is solid at room temperature and therefore very valuable in the manufacture of margarines, while the letter has highly valued bark that is used to produce a cure for prostate cancer.

Agricultural researchers have long recognised the importance of trees in providing different services to farmers. There are been major efforts led by the World Agroforestry Center to promote agroforestry throughout Africa. However some of the systems proposed proved to be less than satisfactory in practice. There was a history of promotion of Alley cropping where rows of nitrogen fixing trees would be inter-cropped with arable crops. This often did not work very well because the labour requirements for the farmers were underestimated but also because the trees competed for water and nutrients with the annual crops.

In spite of the widespread efforts to promote trees within agricultural systems in Africa there have also been attempts by international agencies to encourage farmers to move into more simplified monoculture systems and eliminate trees. One of the most notable examples was the attempt in West Africa in past decades to uproot the tree crops from the orchard bush systems in order to facilitate mechanical cultivation for cotton, maize and other crops. In theory this might have worked as West Africa had many advantages in international markets for cotton. Unfortunately the heavy subsidies paid to cotton producers in other parts of the world meant that cotton was not profitable for many African farmers. These farmers lost their trees but then failed to be

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able to compete in the international cotton market and ended up as losers.

There are some interesting recent examples of spontaneous expansion of trees in agricultural systems in different parts of Africa. The areas of the Sahel and Guinea savannas where trees were uprooted in the 1970s and 80s are now being restored by the farmers themselves. Tree cover is expanding rapidly in many places. Farmers realise that the nitrogen and partial shading provided by trees such as Faidherbia *albida* more than offsets the fairly minor competition for water and nutrients from the trees. Areas where farmers were growing pure food crops a few years ago are now supporting mixed systems with abundant tree cover. This farmer managed regeneration is now occurring from Senegal all the way to Malawi and Zambia. Faidherbia has the unique property that it loses its leaves in the rainy season when field crops are growing. This expansion of Faidherbia *albida* has been led by the farmers themselves. It is an excellent demonstration of the way in which technologies that are appropriate are observed and imitated and spread very rapidly throughout African farming communities.

So the big question now is to what extent trees will be important parts of mixed farming systems in Africa in the future. Conventional economic and agronomic wisdom suggests that as human populations grow and people move to cities farms will be consolidated and will grow in size. Specialised mechanised agriculture will takeover. Many people believe that Africa will not be able to feed itself unless this happens. They argue that the very small farms that predominate in Africa today are not viable in the long term. The present tendency for land holdings to be split between the children as the heads of farming households pass on is creating conditions that are not viable in the long term. The argument is that if this continues farms will get smaller and smaller and less and less competitive.

The conventional wisdom is that agriculture can become more efficient and productive only when people move after off the land and work in services and manufacturing. When this happens economies will grow. Markets will emerge to which the remaining farmers will sell their products. The farmers will increase the size of their holdings, mechanise and have the purchasing power to obtain fertilisers, pesticides and improved planting material. Yields will then increase dramatically and prices will decline. This scenario is one that mimics what has been observed in Western Europe and North America. In those countries 60 years ago a large proportion of the population were engaged in farming as is the case in Africa today. Nowadays only a tiny percentage (in United States and Canada it is 4% and in Europe it is about 5%) of the population of industrialised countries are engaged in farming and everybody else has moved off the land into other economic activities. This has allowed for the emergence of a very efficient intensified but fairly uniform type of industrial agriculture.

It is possible that this will happen in Africa but it may take quite a long time. Africa's population is growing extremely rapidly and the potential to absorb all the future population in services and manufacturing industries must be limited. At present farm size is still declining throughout most of Africa. There is also the problem that as fossil fuel resources and fertilizers become scarce and more expensive small farmers may have difficulty in following the intensification pathway that occurred in Europe and North America. This may mean that ecological intensification and more eco-efficient agriculture will be the ways forward for Africa.

If indeed African farmers are mainly going to continue to live on very small holdings, perhaps of less than 2 ha per family, then other approaches to agriculture may be more appropriate. On these very smallholdings with little access to external farm inputs, the role of trees is clearly going to be much greater than it will be in more

intensive systems. On these small farms a mixture of trees, livestock and food crops can provide an ecologically efficient sustainable and resilient system. The question is whether these systems can produce a marketable surplus to meet the needs not only of the farm families themselves but of the growing urban populations. Many argue that this is not the case.

The recent trend towards large-scale land conversion by corporate farmers in high potential areas in Africa sponsored by international investors provides an interesting case. These farms will produce higher yields of commodity crops. However the extent to which these new sources of production will contribute to food security in Africa itself is still very uncertain. What they show is that Africa does have the potential for high yielding agriculture and it could be a major producer of food to satisfy global needs. The question remains as to the contribution of this "offshore" agriculture to the food security of poor farmers in marginal areas in Africa.

Whatever happens there is almost certainly going to be a long period of transition. Many Africans will continue to live on small farms in low potential areas for many decades to come. For these farmers a judicious mix of trees, livestock and arable crops may be the safest and most sustainable solution. Ways will have to be found so that even these small-scale farmers can produce surpluses that will enable them to engage in the market economy. If the small farmers are to emerge from poverty then they will have to be able to sell surplus food to pay for healthcare, education and basic necessities.
Perhaps the only thing that can be certain is that trees will continue to be important. It's not possible to predict exactly where and how they will be important. There is the potential for a large proportion of rural Africans in the more humid areas to have greatly improved livelihoods through the cultivation of smallholder tree crops. In dry, marginal areas mixed farming systems with livestock and trees still have some potential but possibly these will be the most problematic as Africa's population grows.

The future of trees and of agriculture in Africa will depend very much on the macroeconomic situation. If economies grow and manufacturing and services come to dominate the economy as in the West then there will be emerging possibilities for farmers to intensify and improve their livelihoods. If economies stagnate and the population continues to grow then the scenarios for rural Africans are quite bleak. Recent experiences in Malawi have shown that farmers will respond very effectively when fertiliser is provided. But when the supplies of fertiliser are disrupted for political or logistic reasons the farmers suffer. Such volatility in supplies and markets is likely to be a feature of Africa into the future. If farmers wish to keep their options open and retain resilient systems they should probably hedge their bets by encouraging an appropriate diversity of tree species in their farming systems.

Getting to real values in the Forest-Farm interface

Kay Muir-Leresche[1]

Introduction

There are many different scenaria in the encroachment of forests by farming: slash and burn in rotational or migrating subsistence system; slash and burn in static subsistence systems form part of the long history in Africa and in most cases have not led to serious depletion or conflict between forest and farm. The farmers and communities have often derived more income from the forests than from their agriculture. Colonization brought about commercial logging followed by resettlement by small-scale subsistence or large-scale commercial agriculture; deforestation (with little harvesting of timber) for large-scale commercial agriculture; deforestation for exotic monoculture timber plantations and other reasons for large-scale deforestation including mining and urbanization. The costs and benefits from all these systems are very different in their incidence (who they affect) and in their impact on the environment and the economy.

The incentives for this transformation vary: expanding populations and declining soil fertility leading to the need for more land, the need to produce more jobs and raw materials for local industry or for distant colonizers, the sale of resources to raise government revenues or to swell the personal bank accounts of individuals with power. Most encroachment happens without clear and deliberate policy to transform. Conflicts and misallocation of resources arise where the State can often override traditional tenure systems and reallocate resources without taking the rights of current forest users into account. The increasing pressure from urbanization, mining and international land leasing gives urgency to the need for clearly articulated, transparent policies that analyse the full costs and benefits of different resource use options. The effects of climate change, population growth and financial instability affect our environment, resources and food security and herald the importance of developing systems that will optimize resource use and maximize values.

At issue is how we analyse the impact of these actions so that we can see whether, and if so, where and when, it is in society's best interests for forest land to be converted to agricultural cropping and livestock production; when, where and how we can develop systems that reduce the negative impacts while retaining the benefits. If we analyse all the economic costs and benefits and we make this information widely available then we may be less likely to lose entire forests. We can clarify the role and importance of the forests and we can stimulate the invention of approaches that adapt conventional farming, agroforestry and forest conservation to allow us to achieve a balance between forests and agriculture. We may also find that in some situations there is a strong economic case for converting agricultural land to forest.

What are the values?

If our primary goal is to meet the MDGs then our concern is with both ensuring that these resources contribute to alleviating poverty and to ensuring that the resources are used sustainably. If Africa is to take her rightful place on the world stage, then she needs to use her very valuable natural resources to best effect. Countries need to generate the surplus that will enable the necessary investments in human and natural capital.

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We need to make optimal and sustainable use of our resources.

To do this we have to know the values of what is being created and undermined when using the resources so that we can calculate the full costs and benefits of our actions[1].

We need to look at the contribution to:

Direct values (usually, not always, traded and so can determine prices)
Values created by the products:
for forests those of trees (timber, firewood, gums, resins, medicines, fruit, nuts, relish, ropes, dyes, etc)
for agriculture (crops, animals etc)

Indirect values (not usually traded on the market, harder to estimate prices)
Values created because that system is in place:
for forests by the habitat and the forest ecosystem (wildlife, fungi, vines, soils, honey, water catchment services, carbon sequestration, genetic diversity etc)
for agriculture (it depends on the system: nitrogen fixing if legumes, or high methane gas costs if animals but useful dung for soils, etc)
the values from the synergies between forest and farm

Aesthetic, Spiritual and Existence (contingent values)
Values created by the contribution to human well-being outside of only material prosperity (wilderness, cultural, religious, etc)

While we cannot necessarily quantify all these values, we do need to articulate them all, so that decisions are taken keeping these other factors in mind. They are very important to our spiritual and social well being but they are also essential to our livelihoods now and in the future – when many of the indirect and contingent values will become increasingly highly priced values. Even with heavily discounted future values, it may be in our economic best interests (increasing earnings and employment over time) to retain forests, or even to convert farmland back to forests.

Core requirements

There are some key principles which result in changes to those values: scarcity (actual and technology) and societal (attitudes and needs).
Furthermore all systems must be adaptable or they will not survive. This is especially true for any allocation of values or resource allocation system. Values change over time. As something becomes scarce, its value increases. But there are many things that will affect this scarcity including changing technology and changing demand.

There is increasing international attention to the conversion of forest and smallholder, traditional farm systems, into large international land leases making it essential for countries to establish transparent systems to assess the trade-offs. The arguments for conversion are based on converting the economy into something cashable. The argument here is that it is not possible to assess the societal value of that change without taking into account all the values generated by the different land use options.
What we need to put in place is an information system that gathers information on all the relevant components creating value. The analysis should include both quantitative and qualitative elements, presenting it in a multi-criteria analysis matrix that highlights not only what will be gained or lost, but also who is affected. This must be an ongoing exercise and it must be transparent and widely available to all stakeholders.

[1] *There is a wealth of literature and debate on value and there is probably no absolute value since even "economic" values are based on value-judgements of potential usefulness to man. This paper proposes that all potential values to key stakeholders are at least acknowledged when large-scale conversion of forest to farm is considered.*

The major impacts – *a priori*- can be articulated even with limited resources and time

While each situation requires individual analysis to be able to make good policy choices there are some impacts that can be outlined in advance. What follows is just an overview of a few aspects but provides a guideline for how any policy analysis unit could provide some preliminary analysis even if they have not been given time or resources to gather the relevant information for a full analysis.

As the forests decline and become scarce so their value increases and the opportunity costs[1] of converting them increase. There need to be clear signals for this in decision-making processes.

In traditional systems slash and burn, whether rotational or migrating, are economically rational. They signify a situation where land is abundant, labor scarce and returns to settlement are low (there is no social or physical infrastructure). The systems have limited impact on the environment since they are allowed time to recover before being used again. The cultivation usually only occurs in patches with larger trees left in place and most of the indirect benefits from nearby forests still left intact.

For settled small scale farming the impact on the forests depends on the density of the human and livestock population and cultivation, degree of clearing, technologies used etc. It is at this interface that there is room for greater investment in agroforestry and of developing systems that may integrate more effectively with indigenous forests and species, where the values[2] reflect this to be advantageous. It is here that the synergies between farm and forest are very evident at the family farm level.

Clearing forests for plantation monoculture or commercial agriculture create many costs with respect to the indirect and contingent values. These are very often not included in any calculations although they could be of very much greater local, national or international benefit than the financial profits from production of the commodity replacing the forest. It is also possible that the current value of the production and employment created is considered by the country to be of greater value than the costs for the environment and losses from the indirect benefits. This cannot be determined *a priori.* But it is essential that these costs and benefits are clearly articulated. It is also important that those who benefit and those who lose at each point are clearly defined. It is also possible that in the calculations only the direct values that reach markets are included in the analysis – those values that contribute to home food, medicine and other commodities and services need to be included or the conversion from forest to farm may result in a loss to direct income streams even without considering the effects on the environment and other values.

This raises the importance of governance issues, of transparency and of reducing the opportunities for the allocation of forest and land resources to result in the creation of economic or political rents[3] for those with allocatory power.

Institutional structures are needed in place to ensure good and transparent information and analysis systems giving all stakeholders a voice in policies developed

Countries all have different tenure systems and the forests are owned and used by a wide range of people from both within and outside a country. The control of whether forests are converted is not always clear. In

[1] *Opportunity costs refer to what society gives up when it uses resources for one thing instead of for something else. In this case what it gives up when it loses its forest*

[2] *This is where you would need to see what contributions may be important in terms of indirect and other values generated in addition to the financial production returns*

[3] *Economic rents refer to financial bribes. Political rents refer to increased support "bought" through the allocation of resources.*

most cases it is haphazard and in others it is the result of deliberate government policy.

As governments come under increasing pressure to provide land leases from multinational US and European corporations, from South Korean, Chinese and Arab state companies[1] and many others, there is an urgent need for good information systems that clearly articulate all that is at stake and that ensure a transparent process is put in place. Those most affected by the land use change need to be fully compensated and the full impacts on all the values need to be articulated even where all the costs and benefits cannot be quantified.

Unless this is done, Africa will lose her forests and her land without gaining the sustainable development and power on the world stage that these forests could help her to achieve.

[1] *E.g. rubber plantations Liberia, land in Madagascar, Ethiopia, Zimbabwe, DRC*

Articles

Oil palm in Cameroon: risks and opportunities

Laurène Feintrenie[1]

Summary

Oil palm is a native of the central African region, and has been cultivated in Cameroon since times immemorial to produce cooking oil, palm wine, and soap. In 2011, about 100 000 ha of oil palm were grown by small and medium holders and 70 000 ha were owned and exploited by agro-industries. This area is not productive enough to cover the domestic needs for oil, and the country imports about 50 000 tons of crude palm oil per year (CPO/year). As a consequence the government wants to develop the sector, and explore several possibilities, including foreign investment in oil palm plantations. A major concern of the civil society is the direct consequence of rapid expansion of oil palm plantations, which can impact on local people's access to land, induce the displacement of (other) food crop production, and directly or indirectly cause deforestation (indirectly where other crops are displaced and forests converted to new agricultural land). The paper questions the risks and opportunities of further oil palm development in Cameroon.

Introduction

Oil palm is the most oil producing crop. It produces an average of 3.66 t/ha/year, far ahead of rapeseed (with 0.6 t/ha/year), which is in second position (Jacquemard 2012). Suitable area for expansion of oil palm plantations are found in the equatorial climatic zone, which is also home to biodiversity-rich and partially untouched rainforests. This is the main reason for its low popularity among environmental NGOs and Western consumers. Oil palm plantations have been expanding quickly in recent decades, mainly in Indonesia and Malaysia. Nowadays, investors are looking for land for growing oil palm in other regions. International investors are attracted to Central African countries which have large areas of suitable lands for oil palm plantations. These countries often have insufficient law enforcement capacities (Karsenty and Ongolo 2012), and weak procedures to deal with foreign investments.

This paper is based on a literature review, interviews with oil palm cultivators, industries and experts in Cameroon, and the author's own experience with oil palm development in Indonesia. It discusses the risks and opportunities for future oil palm development in Cameroon.

Oil palm in Cameroon

Though oil palm occurs in natural palm groves in the Central African region, and has been exploited for domestic consumption since records began, Cameroon remains in the 13th position as a palm oil producing country, with a production estimated at around 210 000 tons of crude palm oil (CPO) in 2010 (Ngom, 2011). Three types of plantation are present in the country: agro-industrial estates, contracted small and medium growers, and independent smallholders. Oil palm is cultivated in the southern part of the country, with processing industries concentrated on the coastal strip. The location of all the palm oil mills close to the littoral, and far from the northern frontier of the oil palm cultivation area, illustrates the self-reliance of the farmers *vis à vis* agro-industrial mills (Cheyns and Rafflegeau 2005). There is a well-developed artisanal sector which produces red palm oil - a commonly used cooking oil -, palm wine – perhaps the most popular drink in the country -, and soap.

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The Ministry of Agriculture and Rural Development of Cameroon estimates that about 100 000 ha of oil palm plantations were cultivated by small and medium holders in 2011 and 70 000 ha were cultivated by industrial plantations (Figure 1). But these estimations are rough and a global census of producers of Fresh Fruit Bunches (FFB of oil palm) and palm oil is still to be made (Ngom, 2011). Smallholders with less than 5 ha of oil palm plantations represent more than 75% of all oil palm growers in the country (Figure 1). Most of these do not have access to good quality seedlings, use little inputs, and sell their fruits to artisanal millers. As a consequence, the economic returns of smallholders are quite low in Cameroon, amounting to about 300 €/ha/year at peak production time (Ngom 2011), against 800 to 2900 €/ha/year for an Indonesian smallholder (Feintrenie et al. 2010).

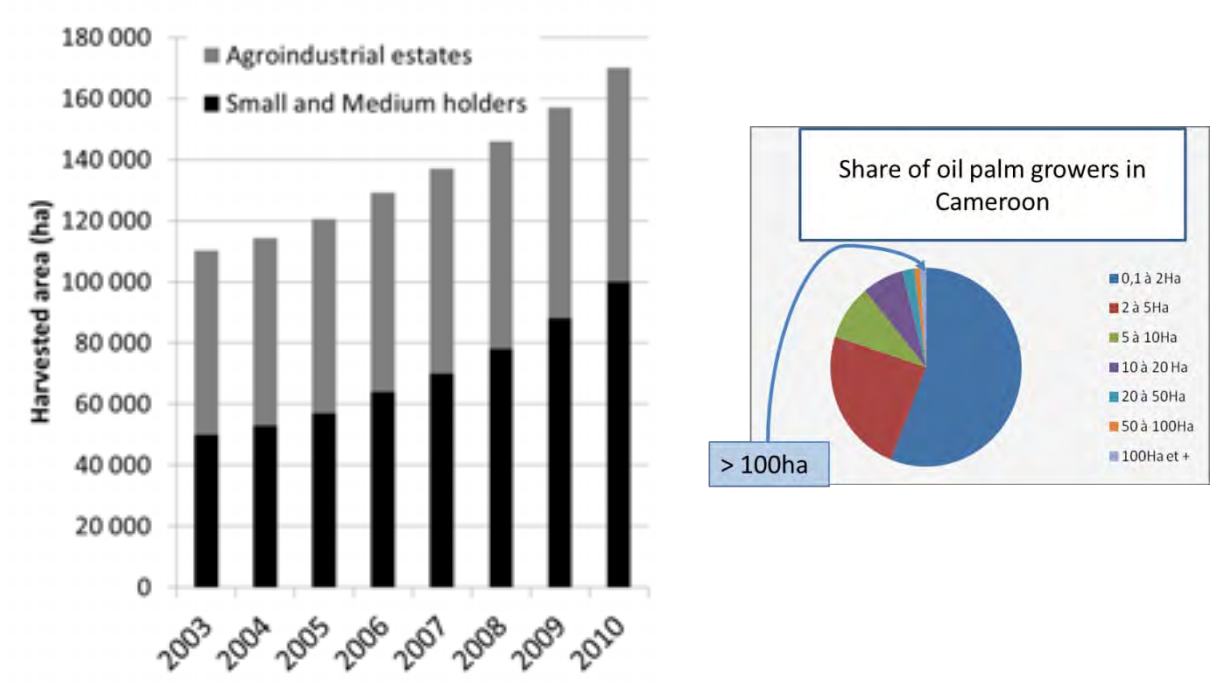

Figure 1: Areas of productive oil palm plantations in Cameroon, and share between agro-industrial estates (public and private), and small and medium sized growers (less than 100 ha). Based on Ngom, 2011.

There are a lot of job opportunities for women in the transformation of FFB into red oil and soaps, which are sold in local market places or on the road. The extraction of oil directly by farmers allow them to get an added value of about 150 €/ha/year (Ngom 2011), with no added production costs. In these conditions, it is more profitable for smallholders to sell red oil on the local market than to sell FFB to a mill. Often, men are responsible for the management of the plantations, and women are responsible for oil extraction, thus the production of oil on-farm allows household members to share work and income. The artisanal transformation of FFB and oil also provides an opportunity for income to widowers and single women, who have poor access to land.

Risks and opportunities in future development of oil palm plantations

At the present time, palm oil production in Cameroon does not meet the domestic consumption need; there is a yearly deficit in the commercial balance of palm oil, with yearly imports of 20 to 50 000 t refined oil (figure 2). The government considers that the development of the sector has potential as a source of employment and national revenue, and sees it as an opportunity to balance the import-export equilibrium.

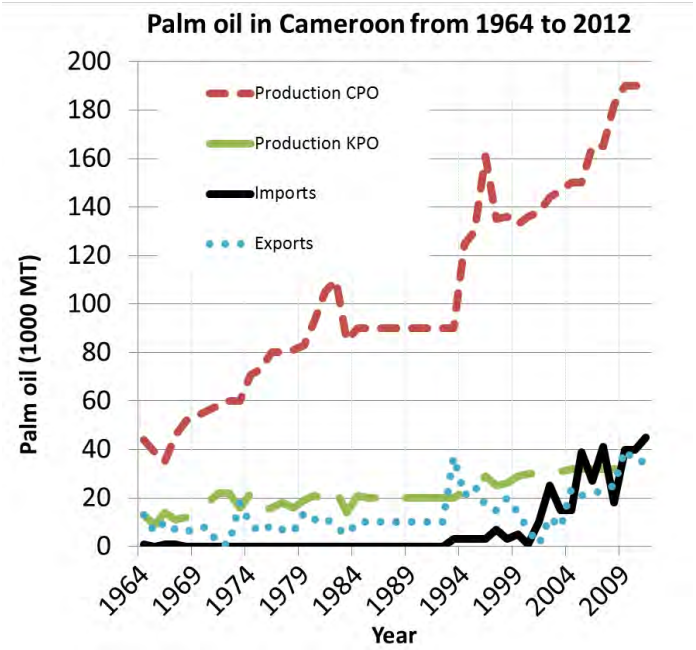

Figure 2: Palm oil production in Cameroon showing production, Imports and Exports of Crude Palm Oil (CPO) and production of Kernel Palm Oil (KPO) from 1964 - 2012 (source: Index Mundi 2012, see: http://www.indexmundi.com

Transnational palm oil companies and international groups are interested in getting involved in the sector in Cameroon (Figure 3). Currently more than 1 million ha are under negotiation between foreign investors and the Cameroon Government. The only sources of information regarding these negotiations are media and NGO reports. The lack of transparency concerning the deals being negotiated, including the size of the concessions, generate fears of corruption, deforestation, and negative impacts on local communities which may be under threat to lose access to land.

At the Land and poverty international conference organized in Washington DC (23-27 April 2012) by the World Bank (see http://www.landandpoverty.com), the representatives of the private sector who participated agreed that business plans considering agricultural development of more than 10 000 ha/year for oil palm development were not sound.

Enterprise	Company group	Homeland	Concession asked (ha)	Year	Region	Investment promissed	source
Sithe Global Sustainable Oils Company (SG SOC)	Herakles Farms[1]	USA	**100 000** (73 000 secured)	2009	South-West	350 Millions US$	Hoyle and Levang, 2012 http://e360.yale.edu/ http://af.reuters.com/
Goodhope Asia Holdings	GMG[2]	Singapore	**50 000**	2011	Ocean division, South	200 Millions US$	Hoyle and Levang, 2012 http://www.journalducameroun.com
Biopalm Energy	Siva	Indian owned, Indonesian registered	**200 000** (50 000 secured)	2011	Ocean division	1800 Millions US$	Hoyle and Levang, 2012 http://www.journalducameroun.com
	Sime Darby[3]	Malaysia	**600 000**	2011	Centre, South, Littoral, South-West		Hoyle and Levang, 2012
PalmCo			**100 000**	2012	Nkam and Littoral		Hoyle and Levang, 2012
Smart Holdings			**25 000**	2012			Hoyle and Levang, 2012

Figure 3: Concessions under discussion in 2011 for oil palm estates in Cameroon[123]

Land speculation is characterized by short-term objectives of economic benefits based on a rise in the price of land. It involves little or no plans for investment to add value to the land or produce. Speculators have been known to hide their actual objectives behind a business plan involving agricultural and infrastructure development which later do not materialize.

Conclusions

An improvement of oil palm Fresh Fruit Bunches production by smallholders would have direct economic benefits for the population of Cameroon, and would help develop employment in the artisanal processing sector. However, support to small-scale palm oil production might not be enough to balance the commercial deficit of the country in palm oil. Investments by private agro-industries are thus needed. Action in this field must be guided and monitored with much care by the government, to ensure that doors are opened to responsible investors interested in long-term benefits of investments, while at the same time being wary of land-speculation. A clear economic analysis of all the costs and benefits to small farmers, to the economy and to the environment needs to be undertaken and made public. Those who will benefit and those who will lose land and access to forests need to be made clear and any agreements with international

[1] Nurseries have been cultivated since 2010, to prepare 4 000 ha of plantations.

[2] GMG manages 64 000 ha of oil palm plantations in Malaysia and Indonesia, with expansion plans up to 157 000 ha (source : http://goodhopeasia.com/pages/default/root/our_company/0, consulted in July 2012)

[3] Sime Darby owns 521 000 ha of oil palm plantations in Indonesia and Malaysia and is also present in Liberia (source : http://www.simedarbyplantation.com/Upstream_Overview.aspx, consulted in July 2012)

agencies should require adequate compensation to the losers.

The government should thus be prepared to administer and manage related foreign investments. The land grab dimensions can, with correct policy, be attenuated through forcing co-cultivation of oil palms by large estates and smallholder out-growers. Appropriate laws and regulations must be instituted, which will give due attention to environmental and social impact assessments, environmental safeguards, effective public consultation (regarding the use and customary rights on the land involved), and proper technical review of business plans to assess their feasibility and sustainability in the long term. Foreign investments with no direct substantial benefit to the country and its population should not be allowed.

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Conceptual Structure for Climate-Smart Agriculture for enhanced Productivity in the Congo Basin

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Summary

In safeguarding food security, alleviating poverty and protecting the environment, agriculture will have to be intensified while minimising land expansion and conserving existing forest resources. This paper espouses a framework for climate-smart agriculture in the Congo Basin. It suggests sustainable farmland and water management under a polyculture of trees including for timber, crops and livestock. The effective integration of these components to achieve farmer welfare will require access to markets and value chain addition, as well as timely research, effective extension and adequate communication. This calls for political will to provide enabling conditions for the performance of eco-agriculture in the Congo Basin.

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Introduction

The Congo Basin has the second largest contiguous tract of humid tropical forest in the world after the Amazon and it is the largest in Africa covering almost 2 million sq. km. Between 1990 and 2010 the net annual rate of deforestation in the basin is estimated at 0.23% (FAO, 2011). However there are zones with much higher rates of deforestation. The highest rates are found in Cameroon and the Democratic Republic of Congo which also have large rural populations practicing slash-and-burn agriculture. New threats in the basin, such as climate change, human conflicts, industrial development and the potential development of large-scale plantations by foreign investors to produce biofuels, timbers and food crops, compound the challenges faced by interventions aimed at limiting deforestation. Arresting the encroachment of the forest margins for more farmland requires the sustainable intensification of agro-ecosystems with current land use.

The intensification of sustainable agriculture in the basin requires development and dissemination of alternative farming systems in place of the typical rainfed slash-and-burn shifting cultivation which is highly vulnerable to climate and environmental change (Thornton et al, 2011). Projections of temperature rise indicate that climate change may reduce crop yields by 20 percent by mid twenty-first century, with food prices of some grain staples like maize and rice rising between 30-100 percent (Nelson et al, 2010). Schlenker and Lobell (2010) project robust negative impacts of climate change on sub-Saharan African

agriculture by 2050, with the mean estimates of aggregate production changes estimated at −22, −17, −17, −18, and −8 percent for maize, sorghum, millet, groundnut, and cassava, respectively. In all cases except cassava, there is a 95 percent probability that damages exceed 7 percent and a 5 percent probability that they exceed 27 percent. This is a significant indictment of the continent's agriculture, particularly the rain-dependent farming systems in the Congo Basin, where increasing frequencies of heat stress, drought, floods, pests and diseases may exacerbate these impacts.

While agriculture is the sector most vulnerable to climate change, given its inherent relationship with climate, agricultue is also, in turn, a significant cause of global warming induced climate change. This sector directly accounts for about 14 percent of global greenhouse gas emissions and indirectly, through deforestation and land-use change, it is responsible for another 17 percent of global greenhouse gas emissions (IPCC, 2007).

For food security to be assured and poverty alleviated to meet the needs of a rapidly growing population in the Congo Basin, agriculture must be intensified to increase productivity. The question is how this can be done taking into account the environmental and socio-economic concerns of exploiting and conserving forests within the framework of sound farmland management. One answer lies in a model of agriculture now defined by FAO (2010) as climate-smart agriculture. The concept refers to agricultural practices which sustainably increase agricultural productivity, is resilient to environmental change (adaptation function), reduces or removes greenhouse gases (mitigation function), and enhances national food security and developmental goals. This paper defines and discusses a framework for climate-smart agriculture in the Congo Basin.

Conceptual framework for climate-smart agriculture

Agricultural efforts that address the related challenges of food security, environmental sustainability and climate change mitigation require the promotion of effective indigenous practices carried out in conjunction with newly proven agricultural practices which increase productivity and resilience and reduce greenhouse gas emissions. This means that efforts should meet global objectives as well as national food security concerns in a sustainable manner, while mitigating climate change through carbon sequestration, preserving biodiversity,supporting ecosystem resilience and protecting watersheds. Sonwa et al (2011) and Nkem et al (2010) have reviewed practices that sustainably increase agricultural productivity in the basin whilst addressing both food security concerns of local populations and the global common good.

Though the indigenous inhabitants of the basin have been practicing sustainable agriculture for generations through polyculture of perennials and annuals, which at times have been labelled as primitive, studies now indicate that the cultivation of single field crops or only of annuals is not a suitable strategy in tropical rain forest areas such as the Congo Basin. A mixture of the use of perennials and annuals has in fact been found to be "climate-smart" (FAO, 2010), as such a strategy can help protect soils and maintain soil fertility for decades. Growing a mixture of perennials and annuals often works best for resource poor small-scale farmers because such polyculture fields provide a diversified income, as well as an insurance against crop or market failures. The virtues of including trees in cropping strategies of smallholder systems hinge not only on their direct economic benefits but also on the environmental values they generate or maintain, particularly in terms of soil productivity. The further development of this system will require that researchers pay attention on the optimum combination of crops and trees, and of tree spacing,

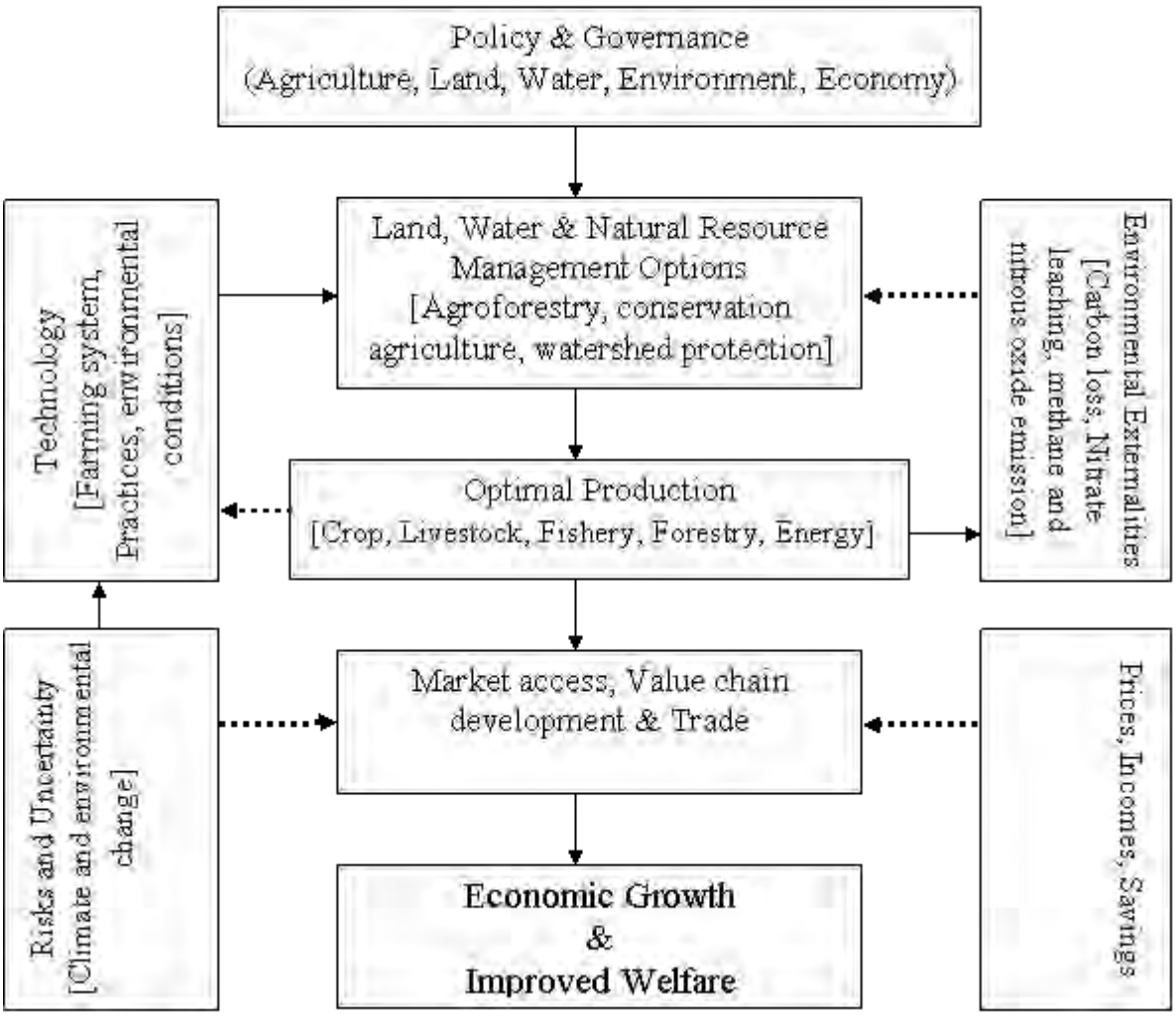
orientation to ensure the best physical conditions for vegetative growth. The role of research and extension are important instruments for current and future agricultural success, taking into account the increasing complexity of farming systems (Vignola et al, 2009).

Water bodies in the Congo Basin and the Congo Basin watershed also need to be proactively and vigorously protected, as forests along river margins provide valuable ecosystem services such as controlling erosion, protecting water quality and supporting aquatic organisms through litter fall and large woody debris which are important to the survival and regeneration of such organisms. "Forest buffers" also provide food and shelter for wildlife. They therefore contribute to carbon sequestration by conserving biodiversity and protecting watersheds and the organisms these support. In degraded landscapes such buffers should be established while in secondary and primary forests, they should be left during land clearing and managed as necessary.

As the farming systems and practices increase output, the issue of marketing becomes important. Access to market, trade support infrastructure (e.g. storage, packaging, retail facilities and information technology) and other interventions to improve trade are important for facilitating consumption and agricultural development. Currently, there is little value addition and transformation of agricultural produce within the region. Processing should be developed simultaneously with regional value chains for strategic forest and agricultural commodities within the polycultures, to enhance their agricultural transformation, global competitiveness and farmer welfare. Agricultural produce are currently only a small proportion of the value of the final product, meaning that farmers in the region receive less than optimal returns for their farming effort. Market power can be enhanced through reenergizing and promoting farmer market cooperatives that sell produce to middlemen and processors at rewarding prices. This could help uphold the perceived dignity of employment in the agricultural sector.

Figure 1 presents a framework for climate-smart optimal agriculture in the Congo Basin. The framework is regionalized at the Congo Basin country level, with the foundation being agricultural and forest management practices. The recommended farming system is one that integrates sustainable forests timber and non wood products development, agroforestry and conservation agriculture practices (Thiombiano and Malo, 2009). Environmental risks such as climate change and market uncertainty may influence the optimal production and welfare in the agricultural sector. However, timely implemented governmental policies including investments from timber products are required to influence agriculture and forest management to reduce any economic and environmental risks. Overall, effective agricultural land and water management are important for agriculture in the basin. This thus highlights the overarching role of governments to provide the enabling policy and conditions for the interaction of the constituent sub-sectors of agriculture, e.g. market infrastructure, land tenure policies, finance and credit facilities and agricultural extension (Vignola et al, 2009).

Figure 1: Congo Forest Agricultural Sector Optimization Model



Conclusion

The way forward for sustainable farming in the Congo Basin should be the employment of land use and farming systems which efficiently integrate land and water management, and captures synergies amongst agriculture's sub-sectors. Such integration should cater for necessary land cover change and balance the production of food, income, energy, forest products and environmental services. This means that agricultural policies will have to promote systems which are not only ecologically friendly and environmentally sustainable, but also economically viable. There is a need to ensure that such balanced systems which favour ecologically and climate-smart agricultural practices receive adequate support in research, extension and capacity building. Safeguarding the virtues of agroforestry, conservation agriculture and watershed protection at the farm-level will require optimal access to finance and markets. These are in turn possible determinants for technology adoption, adaptation and mitigation, which can help ensure that agriculture in the Congo Basin remain climate-smart whilst achieving its multiple objectives at local and national levels.

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Exploring the Potential of REDD Mechanism to Stabilize the Forest-Agriculture Interface Zone of Southern Ghana

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Summary

The concept of Reducing Emissions from Deforestation and Forest Degradation (REDD) is relatively new and its operating mechanism still remains under discussion. There is the need for developing countries to explore pragmatic ways that will turn drivers of deforestation and degradation into new opportunities for sustainable development using this new concept to support action in the field. The use of REDD is being explored in southern Ghana's off-reserve area where large forest-agricultural mosaic landscapes exists. The potential to stabilize this area for environmental, social and economic benefits are worthy of consideration.

Introduction

Forest and wildlife resources have long been major contributors to Ghana's economic development by providing formal and informal employment, support to livelihoods, and foreign exchange earnings. All these benefits have largely come from the forest zone in southern Ghana.

Government forest policies in Ghana began to evolve during the colonial administration of the late 1880s as concerns arose over degradation of natural renewable resources. Most of Ghana's forest reserves were established through negotiation with local chiefs and traditional authorities in the 1930s. Reservation was enacted either through the 1927 Forest Ordinance or the Native Authorities Ordinance, which enabled authorities to constitute forest reserves under their bylaws. The intent and purposes of forest reservation at that time were two-fold; protection of watersheds, hills and dry landscapes and the maintenance of climatic conditions necessary for agricultural production of especially cash crops such as cocoa. The first formal forest policy was prepared in 1948, and provided for conservation and protection of the forest reserve estate. It was foreseen that the off-reserve areas would ultimately be depleted and therefore no sustainable forest management systems were put in place for off-reserve areas. The more recent 1994 Ghana Forest and Wildlife policy aims at the conservation and sustainable development of the nation's forest and wildlife resources for the maintenance of environmental quality and the perpetual flow of optimum benefits to all segments of society.

The 1994 policy notwithstanding, there are no clear and comprehensive strategic directives for managing forest resources in off-reserves areas. However, it is on record that in the last two decades or so most of the supply for the timber industry has come from off-reserve areas (World Bank, 2007). Furthermore, the use and potential of off-reserve areas as a pool for non-timber forest products that provide important rural support for livelihoods are enormous (Falconer 1990; Abbiw 1990). In addition, a number of studies found in the literature have shown that the use of on-farm tree resources, through the up-scaling of agroforestry and tree domestication, could lead to a reduction of poverty, malnutrition, hunger and land degradation, as well as contributing to the mitigation of the effects of climate change (Leakey 2010; Attipoe et al. 2006; Leakey et al. 2005).

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In Ghana, forested areas (forest reserves and off-reserve areas) still remain under traditional forms of land management; around 85 percent of the land in Ghana is administered in this way. Traditional authorities (paramountcies) hold the allodial title to the land, and usufruct rights are held by sub-chiefs and families. Both traditional authorities and stool[1]chiefs have rights to a share of the benefits from timber and forest lands (World Bank, 2007). The area of the forest zone (forest reserves and off-reserve areas) in southern Ghana is about 82,000 km^2; representing 34 percent of the total area of Ghana. Forest and wildlife reserves occupy a total area of about 18,000 km^2, and thus cover 22 percent of the forest zone (Hall and Swaine, 1981). Potentially, an area of about 64,000 km^2 exists in southern Ghana as unreserved forests (off-reserve areas) and this is where deforestation and forest degradation is most evident. Several causal factors, including forest policy and governance failures, poor agricultural practices, unsustainable logging (legal and illegal) and wild fires can be cited.

Forest loss contributes to 12–17% of annual global carbon dioxide emissions, and the sustainable management of forests can thus play an important role in mitigating climate change. This has led to the initiative called *Reducing Emissions from Deforestation and Forest Degradation* (REDD), which is supported by the World Bank. The basic concept behind REDD was, originally, at least in theory, simple: governments, companies or forest owners in tropical forest countries should be rewarded for keeping their forests instead of cutting them down. In recent years, REDD has developed into a wider scheme called REDD+, the '+' indicating the inclusion of forest plantation establishement and management, sustainable natural forest management and conservation practices.

Moving ahead with REDD/REDD+ in Ghana will require important decisions on the design and national implementation of REDD. Hence available options for REDD implementation must be carefully assessed. According to Angelsen (2008), REDD will need to secure (i) actual emission reductions (be effective) at a minimum cost (be efficient), while (iii) reducing undesired social and ecological trade-offs (be equitable and provide co-benefits).

Therefore, the objective of this article is to relate Ghana's off-reserve area in the southern zone as a forest-agricultural mosaic landscape and explore the option of using REDD+ to stabilize this area in terms of environmental, social and economic functions.

Drivers of Deforestation and Forest Degradation

In Ghana, the problem in forestry is, essentially, one of gradual degradation rather than outright deforestation. Several drivers of deforestation and degradation work together and its effects are incremental rather than dramatic. The underlying causes are those typical of degradation in the more heavily populated countries of the tropics, and involve a complex of demographic, economic and policy influences (GoG, 2010). The main drivers for forest degradation in Ghana are summarised in Table 1 below.

[1] *Stool is a symbol of authority for traditional chiefs in most parts of southern Ghana and stools hold land in custody for people in a given community/clan/traditional area.*

Table 1 Summary of drivers of deforestation and forest degradation

Driver type	Elements of drivers
Policy	• Forest exploitation in favor of large-scale timber industry • Under-priced forest goods and services and inequitable distribution of economic income from timber sales • Weak regulatory mechanisms and unclear resource rights • Weak law enforcement • Ineffectiveness of sectoral institutions, weak inter-sectoral coordination particularly between agriculture and the forestry sector
Demographic	• Population growth and urban expansion demanding construction wood and energy • Slash and burn agricultural practices
Economic	• High international demand for primary products leading to dangers of over-exploitation • Low prices for timber on the domestic market
Natural forces	• Wildfires • To a lesser extent floods, pests and diseases

Off-reserve areas in Southern Ghana and the Effect of REDD Financing Mechanisms

Land use in off-reserve areas is mainly for agricultural rather than forestry purposes. Placing a substantial part of the southern one-third of Ghana under forest reservation is arguably out of proportion and has created what resembles "land hunger" in the south, where population growth is increasing and farming systems remain under-developed and unable to meet growing demands for food.

Forest-agricultural mosaic landscapes in off-reserve areas will affect financing needs of REDD initiatives. Pressures on forests vary across regions of Ghana and keep changing over time. Pressures on forests in southern Ghana, where fertile soils suitable for agriculture and the growing of food are available, are greater than in other areas of the country where soils are less fertile. Pressure to use forest resources is shaped by, among others things, market access, land use tenure and security of tenure (Angelsen, 2008).

Chomitz et al. (2006) provided a three stylized forest types of tropical forests which included features and policy needs of forest-agricultural mosaic lands. Table 2 presents typical features of forests and conceived policy needs potential for REDD financing in forest-agriculture mosaics in off-reserve forest areas in southern Ghana, plus outlines key actions required to meet identified policy needs.

Table 2.Features of forests, policy needs to meet REDD financing requirements and key actions required in forest-agriculture mosaic landscapes in southern Ghana

Features of off-reserve areas in southern Ghana	Policy needs	Key actions
1) Depleted fragmented forests 2) Small and isolated forests, confined to "sacred groves[1]" 3) Areas of high agricultural value 4) Areas with high population densities with a substantial portion of forest dwellers 5) Areas where the majority of communities are engaged in agricultural activities 6) Areas in which slash and burn agriculture is most prevalent	• Clarification and enforcement of property rights over forest resources	• Clarification, improvement and enforcement of land use and tree tenure issues, particularly as they relate to carbon offset reimbursement rights
	• Development of sustainable markets for forest goods and environmental services	• Creation of new market opportunities for diversified forest goods and services • Promotion of local enterprise • Encouragement to develop value added forest products
	• Forest restoration and proper valuation of forest goods and service	• Capacity enhancement and implementation of tree planting and forest conservation practices • Development of policy and legal frameworks for valuing forest services • Raising political awareness for properly evaluating forest goods and services • Establishment of infrastructures for monitoring emission reduction at various scales
	• Reform of regulations to encourage forestry and strengthening inter-sectoral cooperation	• Harmonization of presently conflicting laws and regulations (both intra- and inter sector) • Establishment of strong inter-sectoral coordination mechanisms between agriculture and forestry • Improvement of technologies in farming systems

[1] *Pockets of forests managed wholly by communities, but have no legal status and are extremely small in most instances*

Based on Table 2, two major needs for financing a REDD mechanism in Ghana can be identified. These are: (i) financing up-front capacity-building (readiness) in areas such as clarifying and improving land tenure systems, strengthening institutional capacity, policy coordination and law enforcement, and developing and implementing systems for monitoring emission reduction,; (ii) financing costs related to conservation and sustainable management of forests (i.e. costs of implementing coordinated forest and agriculture policies needed to mitigate forest related emissions) and opportunity costs (i.e. forgone profits from land use change from agriculture to forestry or the costs of adopting sustainable forest management practices. Opportunity costs are generally higher where markets are readily accessible and where expanding forest conservation practices such as REDD restricts land available for agriculture (Angelsen, 2008).

REDD Implementation Option

This paper suggests that REDD be implemented in Ghana thorugh the integration of trees in farming systems, through forest management and/or forest tree planting. The aim is to provide environmental services and /or forest products that are either traded or used locally to confer multiple livelihood benefits, especially for smallholder farmers living in deprived forest communities beset with poverty and malnutrition. The farmers will receive financial and other related rewards from financiers/beneficiaries of their products in cases in which these are traded. The proposed approach, design, governance and implementation considerations are outlined in the section below.

Approach and design

The proposed concept will follow typical agroforestry practices. The scale of implementation of the REDD scheme will be at sub-national (community) level, with the option of up-scaling to higher levels depending on success rate and acceptability of the overall concept.

Participation will initially be offered to the following farming groups:

- Farming communities in southern Ghana actively engaged in subsistence agriculture in off-reserve forest areas;
- Farmers who own or lease less than 5 ha of farmland;
- Farmers willing to incorporate tree crops in their farming systems in order to ensure provision of environmental services such as restoration of lost productive capacity in farm land; mitigation of climate change; diversified production; and the promotion of local enterprise through the provision of a range of products.
- Experienced farmers willing to share tacit knowledge on traditional agroforestry practices.

Participation will initially be offered to the following financier groups:

- Financiers/development partners willing to commit to sustained financing of the REDD related program for at least 10 years
- Financiers/development partners willing to facilitate the development of market opportunities for farm produce including research into new commercially tradable agroforestry products
- Financiers/development partners willing to promote carbon stock trading.

Governance

- A legal and regulatory framework will be established to govern the program through consultative stakeholder process
- A transparent benefit sharing arrangement will be established. The scheme will clearly define who benefits, and how, at different stages of development of the scheme. This will include a planned support system for farmers during inception, implementation and completion of program cycle

- Stakeholders will agree on a clearly defined action plan with binding targets
- Potential risks will be identified, and remedial measures planned in advance

Implementation Arrangements

- Government institutions such as the Ministry of Lands and Natural Resources and the Ministry of Food and Agriculture will collaborate and play lead roles in policy development and implementation
- Roles and responsibilities of all stakeholders will be identified and confirmed by those concerned
- A performance monitoring system will be put into place, including provision for feedback mechanisms and long-term monitoring of impacts.
- Capacities for program implementation will be strengthened or, where necessary, established
- Resources will be matched with set targets
- Provision will be made for possible scaling-up (enlargement) of the program
- Flexibility in program implementation will be provided for.

Challenges

Some envisaged challenges likely to confront this REDD implementation option are listed as follows:

- Carbon markets will have to agree to buy carbon from farmlands with relatively smaller sizes;
- Monitoring, reporting and verification system to be established in a forest-agricultural mosaic landscape will have to be effective and efficient
- The challenge of putting in place a sustained financing mechanism that will enable the tree development and/or conservation
- The challenge of anticipating the likely adaptations needed for farming and financier groups participating in the program

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Contribution of sacred forests to sustainable environmental management in the Agonlin region in the Republic of Benin

Roch A. Houngnihin[1], Adolphe Kpatchavi[2], Albert Tingbé-Azalou[3]

Summary

On the cultural geographic area of the Agonlin people in Central Benin, environmental issues involve depletion of the vegetation cover, inadequate exploitation of water bodies, strong pressures on protected areas and soil depletion to mention a few. This study aims at analyzing the contribution of sacred forests to sustainable environmental management in a context increasingly marked by inappropriate modernization by stakeholders at local level. Qualitative study methods (preservation and observation) were the basis for the collection of data on the practices, ideas, perceptions and arguments of the various types of actors, including medicine men and traditional cult chiefs, farmers, pastoralists and artisans among others. As a result, it should be noted that the labeling of forests as sacred and their dedication to ancestral deities have been an endogenous strategy to sustainably manage the environment. This arrangement has also favoured establishment of botanical and ecological gardens in which harvesting of forest products from the wild were done only for medicinal, nutritional and ritual purposes, thus integrating the synergy between forestry and agricultural systems.

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Introduction

In the Agonlin region, the importance of environmental problems is translated in significant extraction of forest products, especially to meet the urban demand of firewood . This situation has led to the destruction of numerous sacred and protected forest areas, thus encroaching on the balance of ecosystems vulnerable to the effects of wildfires, over harvesting of firewood, expansion of farmland and overgrazing. Hence, the study of sacred forests and their contribution to the sustainable management of ecosystems, need to be conducted in the cultural geographic area of the Agonlin communities, characterized by the survival of this endogeneity. The relevance of this investigation was attested by research conducted by other authors on these traditional environmental conservation mechanisms (Kokou and Soukpon 2006; Tchouamo 1998).

Materials and Methods

Framework

The Agonlin region is located in the Zou Department, about two hundred kilometers from Cotonou the economic Capital city of Benin. This region which includes the Covè, Zagnanado and Ouinhi communes, covers a surface area of 6,500 km^2 and hosts over 274,492 inhabitants according to the General Population and Habitat Census (RGPH, National Institute of Statistics and economic analysis, 2002). This translates into a density of 42 inhabitants per km^2. The region enjoys an equatorial transitional climate characterized by two rainy seasons (from March 21 to July 21 and from September 21 to December 21) and two dry seasons (from December 21 to March 21, and from July 21 to September 21). The spatial organization is characterized by the prevalence of cereal and cotton cultivation and strong human impact on soils. On the religious aspect, the endogenous cult (Voodoo) is practiced by over 60% of the population.

Data Collection

The methodological approach used is of the anthropological type, based on a theoretical approach and an intensive collection of empirical data. The collection involved a sample of 50 individuals including traditional healers and cult leaders, farmers, pastoralists and artisans. The size of the sample was determined using the 'rational choice' and 'itineraries' techniques, in order to appreciate the 'history' of individuals and communities and the detailed stories of the evolution of the forests, and to collect information on social values. The study was conducted in 2011 over a six-month period.

Results

Inventory of sacred forests in Benin

"The 'Sacred Forest' is a generic term used to define a forest area considered as having sacred attributes or qualities by the various indigenous religions and beliefs to which most of the rural communities adhere. For that reason, those areas have been preserved for generations by the local populations" (Kokou and Soukpon 2006). This definition fits the floristic reality described by Butare (2003), according to which about 2,940 sacred forests covering 18,360 hectares exist in Benin, representing approximately 0.2% of the total national surface area. Smaller sacred forests (about 1 hectare) represent 70% of the total number. The larger sacred forests are: Igbo Doléo (1,600 ha), Adjougni (1,200 ha), Ekpasso (800 ha), Igbo Lakou (600 ha), Félia (600 ha) in the Department of Zou, as well as Adakplamé (450 ha) in the Department of Ouémé.

Endogenous values crisis and degradation of the forest cover

In the Agonlin region, anthropogenic activities have led to a systematic clearing of land areas formerly covered by sacred forests, thus preventing them from fulfilling their ecological (protection of water sources and soils against erosion, animal habitat), socio-cultural (cemetery, initiation grounds), religious (home for deities) or economic (agricultural productivity, dead wood harvesting, medicinal or food plants) functions. Indeed, a great deal of the body of knowledge and practices transmitted from generation to generation that contributed to the rational use of forests has reduced with the emergence of 'modern' management/conservation techniques, and may finally disappear from the collective memory. A few authors have highlighted the coercive dimension of colonial and neo-colonial forms of power that have affected development projects and other nature conservation initiatives (Bayart 1989; Cooper 1994, Mbembe 1990).

The phenomenon has worsened following the so-called neo-colonial era, for example during the revolutionary period (1972-1989) during which a policy aiming at stripping traditional cults from their sacred status was undertaken with the consequence of destroying numerous sacred forests officially declared of public interest. To illustrate, in May 1978, Covè was upgraded to a District (Decree No. 78-350 of May 30, 1978 following the territorial division of the former Sub-Prefecture of Zagnanado), then in November 1978, the Naogon borough was created. In order to build the offices of this borough, the Iroko forest of Lozunkan was cleared in 1980. Similarly, after having been declared of public interest, the Adjina Huesu forest was destroyed (for protection purposes) by the followers of Sakpata (a deity) to avoid it being desecrated by public officials. Thus, sacred forests considerably declined while the authority of traditional chiefs and healers was eroded.

Photo 1: The Naogon borough offices are located on the site of an Iroko forest destroyed in 1980 (R. Houngnihin, 2011)

Restoring the endogenous models of forest and agricultural systems sustainable use

The dedication of forests to ancestral deities is one of the endogenous techniques to sustainably preserve natural and agricultural resources and establish them into botanical and ecological gardens in which harvesting and

extraction are only for nutritional, medicinal and ritual purposes and for the collection of deadwood. The establishment of sanctuaries and the rites conducted in these forests by the communities testify to their appropriation of these natural entities. As sacred places of libations and initiations, these forests are placed under the authority of a religious leader. Thus, in addition to the necessity for all to abide by the community prohibitions (for example the interdiction to fell trees), there are sanctions depending on the severity of the offense: simple warning, fine, spell or death.

Thus, the sustainable management of forests has been associated with religious practices because of which the ecosystems have enjoyed a long period a natural conservation.

Table: Inventory of sacred forests in the Agonlin region

N°	Name	Location	Situation
01	Lozunkan	Naogon	Former Iroko forest, entirely cleared in 1980 for the construction of offices for the Naogon borough.
02	Fionzun	Naogon	6 of the 10 hectares of this forest were destroyed resulting in conflicts between the local communities and the worshipers of the deities.
03	Dokunon	Toué	Covering 22 hectares and watered by a tributary of the Zou River, this forest is almost intact thanks to the rituals currently conducted there.
04	Huesu Ahosuhué	Naogon	This forest has been completely destroyed and invaded by farms, confining the guardian spirit it hosts to a reduced area under a baobab tree.

Survey results, 2011

Photo 2 : Dokunon Forest (Toué) (R. Houngnihin, 2011)

Photo 3 : Remnant of the Huesu Ahosuhué Forest (R. Houngnihin, 2011)

Discussion and conclusions

Sacred forests are of great ecological, socio-economic and cultural value. This importance is well understood by the communities who have put in place mechanisms to sustainably manage forest ecosystems. However, current decentralization policies in Africa marginalize communities and are a hindrance to the sustainable management of forests (Egbe 1997; Vabi 1998). In several countries, new and powerful international actors have emerged to exploit forests and these do not always guarantee protection against the excesses of the transboundary industry. "Thus, while participation is being promoted everywhere, local populations have less and less control over the access to their natural resources" (Lassagne 2005).

Today, implementing a policy that would ensure the balance of forest and agricultural ecosystems, requires strategic reorientation within the framework of combining ethnology and ecology (Gutelman 1989).

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Forest to farm to market interfaces for Non-Timber Forest Products in Central Africa

Verina Ingram[1]

Summary

Non-timber forest products provide multiple livelihood benefits. They are mainly harvested from the wild until their value increases and over-harvesting incentivises cultivation. Markets have driven cultivation, but are also frequently negatively associated with maintaining populations of wild species. A forest-to-farm transition can maintain and enhance sustainable livelihoods as well as help maintain genetic resources aided by species specific regulation, customary traditions and support from research and development initiatives.

Introduction: Forest products in Cameroon and Democratic Republic of Congo (DRC)

Central Africa has high forest cover, extraordinary biodiversity and persistently high levels of poverty (de Wasseige et al. 2012). Forests provide Non Timber Forest Products (NTFPs[2]) for food, medicine, fibre, tool, shelter, energy and cultural use, and act as a genetic reserve for the future. Many have long histories of consumption and trade, providing incomes for forest-dwelling, rural and urban based-people involved in their value chains[3]. Despite their common use, comprehensive knowledge on their origins and socio-economic value is lacking for many products, hindering their management[4] and governance[5]. Forest to farm to market chains are mainly informal and un-captured in statistics and policy for such products in these countries. This makes their contribution to livelihoods and economies difficult to evaluate. Policies for sustainable development based on their production, use and trade are consequently largely absent. This study aims to inform policy makers and practionners by presenting the values and interfaces between wild and farmed products and markets, and implications for the sustainable management and governance of NTFPs.

Methodology

From 2007 to 2010 high-value NTFP chains were tracked from harvesters in major production areas to consumers. Interviews were conducted in Cameroon and DRC with 4,108 people, representing 25% of actors at each stage of the chains, concerning use, trade, values, governance, livelihood and sustainability. Literature, regulatory and trade data were also collected and analysed.

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[2] *Products of biological origin from natural modified and managed forested landscapes.*

[3] *Processes involved in bringing a product from the forest, through processing and production, to delivery to consumers.*

[4] *Management is the act or art of managing, conducting or supervising something and judicious allocation of resources to achieve specific objectives and outputs. It involves decision-making processes related to resources and is carried out within boundaries by specific people (i.e. Farmers managing their land and crops), and can be planned and implemented.*

[5] *Governance sets the framework in which management can thrive. Forest governance refers to the process of implementing and monitoring the allocation of forest land and resources and relevant policy. It encompasses decisions on how and to what ends forests are managed, who is involved, and how laws and policies are enforced. It includes the regulatory and institutional frameworks for the conservation, use and trade of forest resources and principles guiding interactions between those involved in the design and implementation of arrangements. It includes governments, private and civic actors such as communities and non-governmental organisations (Ros-Tonen and Kusters 2011).*

Table 1: Characteristics of NTFPs studied

Product names	Species	Production Location	Consumption locations	Life form	Parts used	Uses
Gum arabic	*Acacia senegal, A. polyacantha, , A. seyal*	Cameroon	Local, Europe, USA	Tree	Resin, bark, leaves, timber	Cosmetic, food, ink, medicine, forage, timber
Eru, okok, koko	*Gnetum africanum G.buchholzianum*	Cameroon	Local, national, Nigeria, Europe	Vine	Leaves	Food, medicine
Fumbwa		DRC	Local & urban			
Apiproducts (honey, wax, propolis)	*Apis mellifera adansoni*	Cameroon	Local & urban Central African Republic, Nigeria, Europe, USA	Insect	By-products	Food, medicine, cosmetics, candles,, soaps, sealing agent
		DRC	Local &urban			
Pygeum	*Prunus africana*	Cameroon	Local & urban Europe, USA, China	tree	Bark, seeds, leaves, timber	Medicine, wood carving, timber, fuel
Cola nuts, abel, goro	*Cola acuminata, C. nitida, C. anomala*	Cameroon	Local & urban Chad, Nigeria	Tree	Seeds, bark	Stimulant, medicine, cultural
Bush mango, ndo'o, andok	*Irvingia gabonensis, I. wombulu*	Cameroon	Local & urban Equatorial Guinea, Nigeria, CAR, Gabon	tree	Fruit, seed, bark, timber	Food, medicine, dye, construction, fuel
Raffia, cane, Indian bamboo, mimbo	*Raphia farinifera, R. vinifera, R. hookeri, R. negalis*	Cameroon	Local & urban	Palm	Stems, sap, leaves, seeds	Weaving, construction, tools, crafts, wine, food
Bamboo, (Alpine, kok-ko, Chinese)	*Yushania alpina, Oxytenanthera abyssinica Bambusa vulgaris*	Cameroon	Local & urban	Grass	Stems	Construction, tools, crafts, musical instrument, timber, paper, fuel
Safou, plum	*Dacryodes edulis*	DRC	Local and urban	Tree	Fruits, leaves	Food, medicine

Results and discussion

In Cameroon an estimated 25,000 harvesters and 4,700 in DRC are engaged in the chains of the 11 NTFPs reviewed. They have diversified livelihoods, having on average of six (standard deviation 2) sources of household income. The majority (98%) are also farmers, with farming ranked as the primary source of livelihoods by 44% and harvesting of NTFPs as the main income source by 39%. On average 12 other NTFPs[1] were also collected by harvesters in the DRC and six in Cameroon. Trade is a major driver of harvesting: on average 78% (standard deviation 15) of all NTFPs were sold, 12% consumed and the remainder bartered, given as gifts or perished. The NTFPs contribute on average to 37% (standard deviation 14) of a harvester's average annual household revenue (Figure 1).

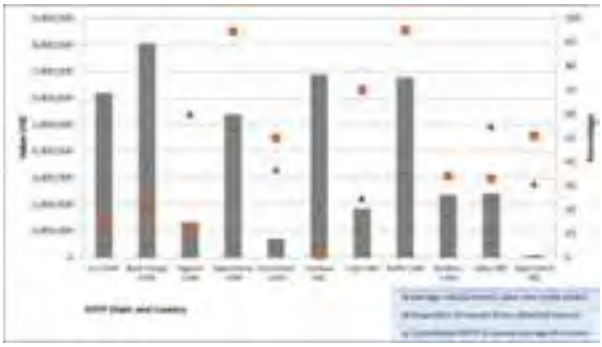

Figure 1: Average annual market value, livelihood contribution and cultivation levels in NTFP chains in DRC and Cameroon 2007-2009 hh= household income

The majority of NTFPs were gathered from primary and open-access forest (49%) where no governance is exercised and 30% from farms and fallows, 18% from customarily-controlled forest areas and 3% from community forests, with rates differing greatly by product and country (Figure 1). Over the three year period studied, a trend of increasing quantities harvested was noted for all products. Also in the longer term volumes sold increased for eru/fumbwa, safou, pygeum, honey, wax and bush mango. For example pygeum exports increased from 1995 to 2007 from 310 to 1,863 tons and in the last 25 years the fumbwa market in the DRC grew from an estimated 600 to 2,456 tons.

Diverse harvesting strategies have evolved for the different NTFPs. Unlike trees used for timber which are felled in fallows and preserved on cocoa farms (Robiglio et al. 2012), trees and plants producing NTFPs are often conserved on subsistence and cash-crop farms and in fallows. Medicinal, condiment and spice producing species are often planted around households. Other non-tree NTFPs are not extensively planted and few wild animals are domesticated. Strategies for harvesting and use vary according to species characteristics, commercial and cultural values, with the highest economic value products primarily sourced from the wild. Apiculture is an anomaly: although bees are domesticated, 78% of hives are located in forests. The NTFPs currently farmed generally have long trade histories. Harvesting and use of culturally-prized products such as cola and raffia are strongly customarily regulated, bamboo and honey less so. Eru, pygeum and gum arabic are customarily and formally regulated: these plural systems are largely incompatible and uncoordinated.

[1] *Not reported on in this study.*

Table 2: Harvester-farmer NTFP strategies

Strategy	NTFP	Features	Ownership and governance regimes
Domestication	Apiproducts	High economic and cultural value, multiple products, advanced domestication techniques	Individual harvester , unregulated or customary
	Safou	Easily domesticated, cultivation produces larger fruits	Family, customary
Small scale cultivation/farmed production	Eru	Cultivated since the 1990s in Cameroon, initially difficult to cultivate. Not farmed in DRC.	Household, trade regulated
Active planting	Gum arabic	High economic value. Around 30-40% sourced from small and large scale plantations	Community, government , trade regulated, customary harvesting rules
	Cola	High economic and cultural value	Household, customary regulation
	Pygeum	High economic value, multiple uses, grown on farm and in small scale plantations	Community, household, customary, national and international trade regulations
Historical planting	(Chinese)Bamboo	Planted during colonial period.	Individual harvester, household and community
Active management	Bamboo (Alpine & kok-ko)	Wild sources appropriated and managed, multiple uses	Individual harvester, household and open access, customary regulation
	Raffia	Wild sources ‘’owned’ and managed by individuals, high cultural value, multiple uses	Individual harvester, customary regulation
Preserved	Bush mango	Left during field clearance and in fallows	Household, customary regulation
	Cola	Left during field clearance, in fallows and cocoa and coffee farms	
	Safou	Left during field clearance and fallows, planted around compounds	
Spontaneous	Bush mango	Wild, left in fallows, spontaneous growth along paths to villages	Open access
	Chinese bamboo	Considered invasive species, widespread in clumps and groves	Open access
Wild harvest	Gum arabic	High value export trade, 60-70% harvested from wild	Open access, trade regulated, customary harvest rules
	Eru/Fumbwa	Own use and cash crop	Open access
	Apiproducts	Honey mainly hunted in humid forest areas Cameroon and DRC	

Shifts to planting and farmed production have been largely market driven. Increasing demand and scarcity has increased the prices of pygeum and eru, leading to further increases in harvesting. These shortages have stimulated farmed production. The pygeum trade and prices peaked in 2007, when international trade was suspended due to fears of unsustainable levels of harvest, a disincentive for some farmers. The growing fumbwa trade mirrors, with a three-decade time lag, the eru trade. Increasing scarcity started to really stimulate wider scale cultivation and government support in 2008, with decreasing abundance reported in all the traditional harvest areas (Ingram, Ndumbe et al. 2012).

The unsustainability of high volume trade in wild-sourced species has been increasingly realised (Ingram, Ndoye, et al. 2012). This has led to recommendations for their integration into perennial, biologically diverse cultivation systems (Leakey and Simons 1997). Guided by conservation or poverty-alleviating strategies, donor, research, civil society and government initiatives in the last two decades have supported bee domestication, safou, eru and pygeum cultivation. For the latter two, the study shows that scale of farmed production however is insufficient to keep pace with demand.

Formal regulation, forest and agricultural policy do not distinguish between wild and cultivated products for the species studied. With the exception of pygeum – they have hardly affected harvesting techniques or farmed production strategies. Incentives to reward cultivated, sustainable production or balance high market demand by stimulating farmed production are absent. This is despite sustainable harvesting[1] being critical to conserving the wild populations of

[1] *Where the parts or whole of a species can be harvested indefinitely from a defined area without detrimental impact on the structure and dynamics of harvested populations.*

species from which products are harvested (Schipmann et al. 2006). The relationship between the life form (i.e. perennial liana and tree) of a species and the parts of a species used was shown to be important to its vulnerability to harvesting. Eru and pygeum have limited resilience as significant proportions of their leaves and bark respectively are harvested, compared to safou fruit and bush mango nuts, which present a much lower threat to long-term survival at individual and population level. Lacunas in regulations in Cameroon and especially DRC exacerbate this vulnerability. Even when vulnerable species are regulated, harvesting techniques have not been specified, harvest quotas have been demand-led, instead of conservation led, quotas are largely exceeded and compliance unenforced. Although a conservation strategy has recently been developed for pygeum, none exists for eru, despite signs of its increasing vulnerability. Other threats to the forests within which these species grow (reported by the harvesters) were agricultural expansion and increasing timber concessions. Studies of land use changes in the Congo Basin confirm these major drivers of degradation and deforestation (de Wasseige et al. 2012)

Conclusions

Farmed production and conservation of wild populations of the species producing NTFPs discussed in this article are both essential for people active in their value chains. However sustainably managing and governing wild populations is extremely challenging given high market demand, fuelled by growing populations, urbanisation, the increasing ease of export, and threats of agricultural expansion and intensification of timber harvesting. Sourcing of products solely from natural forests risks their depletion, particularly given species-specific vulnerabilities. Tenure and access rights to forests, trees and their products can determine who benefits and how, with secure land ownership closely linked to better resource management and pro-poor outcomes (Alden Wily 2002). As nearly half of the NTFPs studied were harvested from open-access forest, this creates a "tragedy of the commons" situation. Farmed production of the species which produce NTFPs can play a critical role in creating sufficient supply to maintain a balance between short-term livelihood gains and long-term livelihood and environmental concerns.

The factors discussed above have direct consequences for NTFP supply and the livelihoods they sustain. Forest and agricultural policy, clear tenure, support to farmers and harvesters and regulation adapted to changing needs are needed to encourage the integration of NTFPs in agricultural systems and ensure their sustainable management and governance. The diversity of forest-farm interfaces highlights that species specific measures - conservation, management, planting and cultivation or a combination of these - are needed. Given the low level of state governance in Cameroonian and Congolese forests, recognising, using and maintaining sustainability-orientated customary and voluntary arrangements which support statutory frameworks is essential. If combined with well-designed demand-side incentives (Belcher and Schreckenberg 2007), this may help to fine tune management, increase the sustainability of production and contribute to poverty alleviation.

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Agriculture-Forest Interface for guaranteed food security and climate change adaptation

Cheikh Tidiane Touré[1]

Summary

In the eastern, northern and central regions of Senegal, shifting agriculture has led to severe land depletion through massive destruction of the plant cover. Populations find it difficult to ensure food self-sufficiency due to the lack of land suited for food production. Therefore, it is necessary to revisit the vision of ensuring food availability by promoting the protection of the Agriculture-Forest interface which guarantees the restoration of depleted land, good agricultural productivity and biodiversity preservation. The example of Assisted Natural Regeneration (ANR) is a perfect case in point.

Introduction

In Senegal, the overexploitation of natural resources to meet agricultural and pastoral production and household energy needs has led to the progressive degradation of the production base with the following consequences:

- At agricultural level, there has been a general decline in soil fertility which mainly resulted in reduced agricultural yields. This loss of fertility is due both to a chemical (nutrients depletion) and physical (water and wind erosion) degradation of soils.
- At forestry level, there has been a drastic reduction of natural forest formations and the disappearance of some plant and animal species.

Faced with this somber reality caused by the lack of significant yields from the capital invested by programmes in reforestation, it was found advisable to redefine the natural resources management policy. Thus was born the agroforestry technology dubbed 'Assisted Regeneration', an alternative to reforestation. In most regions of Senegal, populations reacted with the support of stakeholders by adopting en masse the improved clearing technique or Assisted Natural Regeneration (ANR). Today, local communities are offered the opportunity to develop and implement, in a participatory manner, and in consultation with technical departments, NGOs and populations, measures to manage natural resources in order to establish the foundations for food security. In other words, thanks to the transfer of skills in the area of environment and natural resources management, rural communities can be supported in developing and implementing a set of consensual rules to restore the environment. The mechanisms are consequently defined and supported by local conventions.

Methodology

The methodology involves preserving forest tree species in farming plots where crops are rotated and organic manure is used. Several reasons explain the safeguarding of trees in farms. About 20% of recorded species serve as food for humans and about 65% are used for other purposes: fertilization, feed, traditional medicine, roundwood and fuelwood. However, it is obvious that the food (human nutrition and fodder) and ecological reasons have precedence over the others. The species preserved for their economic relevance are mainly fruit trees (*Adansonia digitata, Zizyphus mauritiana, Balanites aegyptiaca, Cordyla pinnata, Sclerocarya birrea, Parkia biglobosa* and *Tamarindus indica). Acacia*

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albida, Celtis integrifolia, Guiera senegalensis and *Bauhinia reticulata* are among the species preserved in cropping plots in order to improve soil fertility and increase agricultural production with an average rainfall between 400 and 800 mm per year.

The trees and shrubs in the farms are managed in accordance with sometimes conflicting objectives, often leading to choices that involve the crops with which they are associated. Even if the techniques used by farmers in managing and preserving trees remain basic, it should however be noted that the actions conducted aim at avoiding any rivalry between trees and crops. The species preserved are managed by farmers for a sound exploitation producing fodder and wood for various services. This management is generally done at the beginning of the cropping season and involves pruning low branches to avoid direct shading on nearby crops. Large-canopy trees are pruned to reduce their adverse impact on crops. The period just before the rainy season is the most appropriate time for this activity because it corresponds to field preparation season. In order not to compromise fruit production, farmers prune only secondary branches of fruit tree. In most cases, however, many farmers do not carry out any pruning activities. For this methodology to yield more dividends, the issue of rural land tenure must be addressed; it is vital for the continued participation of the rural poor.

Natural Regeneration

Natural regeneration remains the main mode of propagation of tree species in farms. Farmers have observed that some identified species have a great regeneration capacity. The following performance of the tree species were recorded during a one-year period:

Trees species that regenerate and grow easily on the farms

Acacia albida, Guiera senegalensis, Balanites aegyptiaca, Moringa olejfera, Zizyphus mauritiana, Gardenia sp.

Trees species whose seeds germinate very poorly (these are rarely found in farms)

Aphania senegalensis, Sclerocarya birrea, Dyospyros mespiiformis, Ficus iteophylla, Parinari macrophylla.

Tree species that regenerate well during the rains but die after

Ximenia americana, Tamarindus indica, Anogeissus leiocarpus, Adansonia digitata

The tree species whose seeds germinate easily and their seedlings grow satisfactorily are maintained in the farm. Thus, regeneration is achieved almost exclusively by protecting seedlings from seeds that germinate in farmlands and fields. The main obstacles to tree species regeneration (as reported by farmers) include pressure from humans and animals, mechanization, rainfall constraints, and premature fruit harvesting. The proper germination of seeds is often hindered by the absence of rains, thus limiting growth.

Artificial regeneration of *Acacia alibida*

In order to boost agricultural production, farmers are encouraged to develop *Acacia albida* silviculture ('kadd' in local language) which highly contributes to rebuilding soil fertility. Moreover, its presence in farms reduces wind speed and consequently enables to stabilize the soil. To increase the efficiency of this practice while taking into account the slow germination of *Acacia albida* seeds, farmers develop partnership conventions with pastoralists, putting the animals in farms using a holding pen system and the owner of the farm contributes to feeding by providing a large quantity of Kadd seeds every morning. The seeds are thus scarified while in the paunch (stomach) of cattle and germinate in the farm.

Results

This technology has significantly improved agricultural production, conservation vegetation cover, food security and adaptation to climate change. The technology is easy to set up, and is consistent with the protection of young

seedlings. Moreover the technology strives to ensure that young plants grow in such a manner that they have straight boles and crowns that are trim. It requires human investment (enriched natural regeneration, spreading manure) and the procurement of simple and affordable equipment (rope, cutter, shovel). Only the renting costs for the transportation of the manure could be considered as relatively complex in areas where agricultural equipment is obsolete and sometimes inexistent.

Socio-economic aspects related to gender issues, land and production inputs, ownership and farmers' characterization referred to in the study, should be clarified in order to enrich the results of the study.In addition, it would be more relevant to illustrate the significant increase in agricultural productivity with figures with and without the new technology. Figures or scenarios showcasing the conservation of the vegetation cover, food security and the effects of climate change adaptation could undeniably contribute to enriching the results of the study.

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Managing forest resources to secure wood energy supply for urban centers: the case of Kinshasa, Democratic Republic of Congo

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Summary

The management of wood energy has become a major concern for the international community and is the focus of debates in Central Africa. The Makala Project, funded by the EU, fits within this context with the objective of securing the supply of wood energy to urban centers. Over the past three years, various forest resources management techniques have been designed and an assessment of the wood energy sector has been conducted in Kinshasa. Various technical itineraries have been proposed for the management of areas dedicated to the supply of wood energy at various levels, from the farming plot to the village land, and from the individual approach to the collective approach. This article provides a snapshot of the activities developed by the Makala Project to improve the management of periurban forest ecosystems and to secure the supply in wood energy.

Introduction

Forests in general and periurban forests in particular, play a vital role in supplying wood energy (Marien J.N., 2009). The demand in wood energy in the capital city was estimated at 490,000 tons of charcoal, approximately 4.8 million m³ of wood in 2010 (Schure J. *et al.*, 2011). The reliance of urban households on wood energy leads to the overexploitation of the remaining forest areas.

Forests remain a provider of goods and services indispensable for improving the living conditions of rural populations. However, these periurban areas which are characterized by overcrowding and a lack of management and development of economic activities, lead to the degradation and deforestation of natural forest ecosystems in the region (Vermeulen C. *et al.*, 2010).

What are the actions needed to improve the management of these ecosystems and to secure the supply in wood energy for the cities? This study suggests technical solutions varying from individual afforestation to the reconstitution of depleted natural forest areas through the development of Simple Management Plans (SMPs) for the production of wood energy.

The wood energy sector in Kinshasa

The area supplying wood energy in Kinshasa spreads from the south-west to the north-east over a distance of about 102 km for fuelwood, and 135 km for charcoal (Figure 1). About two-third of the wood energy produced originates from slash-and-burn agriculture, the remaining third comes from degraded forests.

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Photo 1 : Transportation of charcoal to Kinshasa (DRC) (Photo: R. Peltier, 2011)

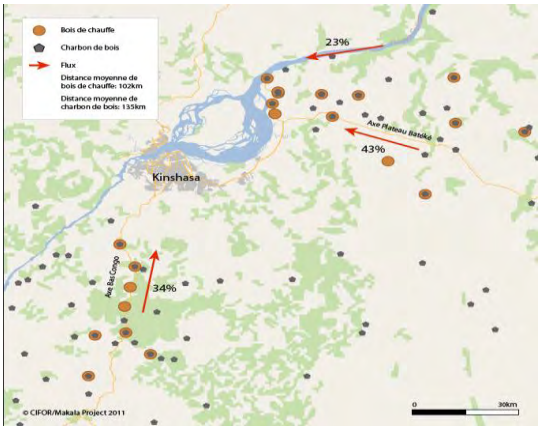

Figure 1: Movement of wood energy in Kinshasa (Schure et al., 2011)

The increase in the demand for wood energy in cities has exacerbated the pressure on forest resources in the region. This is of particular concern in view of the lack of incentives for the restoration or sustainable management of these resources. However, it ensures the livelihood of a large number of households. It was estimated that the total value of the wood energy market was worth 143 million dollars in 2010 (Schure J. *et al.*, 2011), 3.1 times the value of national roundwood exports of 46 million dollars in 2010 (FAO, 2011). Over 300,000 people are involved in this informal sector (Schure J. *et al.*, 2011), representing 20 times the number of persons (i.e. 15,000) working in the formal forest sector in the country (Eba'a Atyi R. and Bayol N., 2009). Most cash-generating opportunities exist at the level of production (the share of income generated varies from 47% for fuelwood harvesters to 75% for charcoal producers). Wood energy related incomes largely complete the average income of households. These incomes generated by wood energy contribute to their basic needs and provide households with an investment capital (mainly in agriculture and, to a lesser extent, in small-scale activities such as cattle rearing and fishing). Urban households rely heavily on woodfuel (87% in Kinshasa). Many businesses such as bakeries, breweries, restaurants, and brick and aluminum factories also rely on wood energy for their daily operations.

Managing periurban forest ecosystems

The management of tree resources was tackled around three main activities: the development of Simple Management Plans (SMPs), the dissemination of Assisted Natural Regeneration (ANR) techniques, and the reintroduction of trees in the cultural system.

Development of Simple Management Plans

An operational approach through the characterization of local landscapes toponymy was used to develop Simple Management Plans (SMPs). This process was built around five steps. The first involves the identification of endogenous groups to manage the area. The second aims at defining the area managed on a customary basis. The third aims at describing Landscape Units (LU) perceived by the communities in relation with the local spatial typology. Following the division of the area under study, management measures are identified in conjunction with the landscape units. The last step allows for the definition of future management modalities (rules, sanctions, profit sharing, type of contract) (Dubiez E. *et al.*, 2011). Various social communication tools were used in the participatory approach in order to maximize ownership (interactive model, participatory mapping, field trip, etc. see Larzillière A. *et al.*, 2011).

Photo 2 : Reproduction of Landscape Units using interactive models in the Kinduala village (Province of Bas Congo, DRC) (Photo : A. Larzillière, 2011)

Photo 3 : Assisted Natural Regeneration applied by a farmer in a farm located on the Batéké Plateau (Province of Kinshasa, RDC) (Photo : E. Dubiez, 2009)

Assisted Natural Regeneration (ANR) to enrich depleted fallow lands

The ANR technique was tested in the last shreds of gallery forests on the Batéké Plateau area. The technique is implemented in two phases. While clearing the underwood, the wood potential of the plot to be cleared is assessed by the farmer. He then selects the most interesting species based on their relevance (soil fertilization, charcoal production, caterpillar host plant, etc.). The species are preserved so as not to hinder crop growth with excessive shade and are protected from fire during the burning of the plot. The trees preserved are a source of seeds required for the reproduction and conservation of the most interesting species.

The second phase is conducted during the weeding of crops. The farmer chooses stump shoots based on their relevance. After the harvest, the preserved and spontaneous plants will grow during the fallow cycle (5-12 years in the area concerned). The farmer will use this space for plucking, beekeeping, etc. The ANR method enables to put in place an agroforestry system inspired by traditional shifting agriculture practices.

Reintroducing trees in the agricultural system

The development of *Acacia auriculiformis* farms contributes to (1) restoring soil fertility, and (2) providing wood energy after a period of 7-8 years. After cutting the wood and producing charcoal, the plot is reclaimed before being reforested again through natural seeding or farming. This technique was tested on a 8,000 ha block by the Mampu Project (Bisiaux F., Peltier R., Muliele J. C., 2010) and is currently disseminated in a large number of villages, in smaller plots scattered over the rural area. Coaching the farmers during the entire production cycle (from the nursery to the farm) empowers them for the implementation. Special attention should be given to securing land tenure, maintaining and protecting the farm against fire.

Photo 4 : *Acacia auriculiformis* nursery in one of the Project EU Makala villages (Photo: F. Bisiaux, 2010)

Discussion and conclusion

Interventions in the sector should take into account the reliance of a great number of people on wood energy production, its contribution to the energy security of urban populations, and the importance of trade as a profitable activity. Activities developed have led to technical itineraries that meet the challenges of managing wood energy. The activities should be timely monitored to observe the social appropriation of the suggested techniques (ANR, reforestation, agroforestry, simple management plan).

The management of village lands can not in itself account for the management of tree resources in the supply basin of Kinshasa. This approach should henceforth be integrated in the decentralization process, granting decentralized land entities (DLE) the necessary autonomy to manage their economic, human, financial and technical resources. Complementarity with the Congolese Law should also be discussed to secure village farms and incite producers to cultivate.

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Integrated Food-Energy Systems: Growing fuel wood on farm in Malawi

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Summary

Food security, access to energy, forest degradation and deforestation are closely interconnected. In Malawi, a country where a large part of the population is food insecure, where 97% of rural dwellers still rely on fuel wood for cooking, and where deforestation progresses rapidly with almost 1% per year, these links are especially evident. To respond to this triple challenge, rapid and practical solutions are needed. The authors present a simple, yet effective way of how to increase food security and energy access while ensuring the conservation and sustainable use of forests at the same time– by growing fuel wood on farm. Integrated Food-Energy Systems such as intercropping maize (Zea mays L.) and pigeon peas (Cajanus cajan L.) have shown that it is possible for households to burn woody biomass for fuel without leading to forest degradation or deforestation. On the contrary, if properly produced and managed, the intercropping with woody species can enhance food security and improve household income, on the one hand, and reduce pressure on forests for the provision of wood, on the other. This approach is a successful low-input intervention with a large impact, which deserves increased attention among decision makers at policy level.

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Introduction

"Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO, 1996, p. 1). In rural Africa, these objectives are often not met as evident in Malawi, a country which is still highly food insecure, ranking 171th from the end out of 187 countries on the Human Development Index. One of the underlying causes of food insecurity is the lack of energy. That is because the provision of safe and nutritious food, e.g. cooked meals and boiled drinking water, requires one crucial input: energy. Without access to energy there is no food security, and access to energy in Malawi is a serious constraint.

Most Malawians depend on biomass for cooking. Biomass contributes over 95% of Malawi's primary energy supply and meets over 90% of the total energy demand in the country, mainly in the form of firewood and charcoal (GTZ, 2009). Approximately 97% of the rural population uses fuel wood for cooking, and of all urban households approximately half use charcoal, the other half fuel wood or a mix of both. This does not only provide urban and rural dwellers with energy, but also with jobs (GTZ, 2009). According to estimations, over 93,000 people depend on the informal charcoal industry for employment (Kambewa, 2003). Affordable alternative clean energy sources are not available, and due to lack of adequate forest management practices wood fuels are unsustainably harvested from natural or planted forests or freestanding trees. This causes severe forest degradation and can subsequentially lead to deforestation. This process will also cause the release of carbon through greenhouse gas emissions.

The consequences are detrimental to both forests and the climate. As stated by FAO's latest Forest Resource Assessment (FAO, 2010), the world's forests store approximately 650 billion tons of carbon. Yet, deforestation and forest degradation

occur at an alarming rate; with an annual change rate of 0.99% between 2005 and 2010, Malawi ranks amongst the highest in Africa (FAO, 2010, FAO 2010a). Forest reserves declined from 47% to 28% of Malawi's land area in the past 25 years, mainly due to the growing demand for wood fuel, which exceeds the supply by 3.7 million tons per year (GTZ, 2009). Although fuelwood is no longer believed to be the main cause of de-forestation in Malawi, it remains an important contributory factor (Arnold et al., 2006, quoted in Orr et al., 2012). At the same time, the Climate Change Vulnerability Index rates Malawi as one of the top 10 countries at 'extreme risk,' (Maplecroft, 2011), which adds significant environmental risks such as droughts and floods to this vastly deforested nation.

To counteract environmental degradation, Malawi has been planting trees. Until 2011, Malawi had planted 360 million trees following the National Tree Planting Initiative. Yet, critics doubt that once planted the trees were taken care of and actually survived (Nyasa Times, 2012). This might be explained by the fact that that communities do not seriously engage in tree planting unless they have secure tenure over the trees they plant (Maqueen, 2011).

An alternative solution is the planting of woody crop species on agricultural land that can be privately managed, using trees or agricultural crops that produce woody biomass. We argue that pressure on forests for wood production can be significantly reduced if energy is deliberately produced on-farm in diversified production systems, in synergy with food production. Such Integrated Food-Energy Systems (IFES) (Bogdanski et al, 2010) can be part of a climate-smart solution to counter forest degradation, deforestation and food insecurity in Malawi.

Analysis

Over the past 15 years, a number of projects have promoted an alternative way of producing wood fuels to that of collecting fuelwood from natural forests, which involves producing biomass for fuel on-farm, together with food production. This will help satisfy the needs for energy while at the same time decreasing forest degradation and deforestation. For instance, the German Technical Cooperation (Deutsche Gesellschaft für Technische Zusammenarbeit, GTZ), implemented the *Integrated Food Security Programme (IFSP)* from 1997 through 2004, and introduced a variety of different measures in one of Malawi's poorest regions, to combat food insecurity (Webb 2011). One of the most successful innovations was the intercropping of Maize (*Zea mays* L) with improved varieties of pigeon-peas (*Cajanus cajan* L.), a nitrogen fixing multiple purpose plant, whose stalks provide significant quantities of fuel wood, while at the same time, providing fodder and fertilizer.

Depending on the variety, pigeonpea plants are usually one to two meters tall when harvested annually but when grown as a perennial plant, stems may reach a height of three to four meters – potentially a desirable trait for those who do not have easy access to fuelwood (Orr et al., 2012). Anecdotal evidence from the Mulanje district in Malawi showed that among those farmers who planted pigeon peas, the stalks served as cooking fuel for three to eight months per year. When complemented by other agricultural residues like sorghum stalks and maize cobs, some managed to cook with their home-grown fuel throughout the entire year using a simple cooking stove, thus reducing or even omitting the need to collect or purchase fuelwood (Roth, cited in Bogdanski et al., 2010).

The international development organization Concern Universal in a project funded by the European Union, took a similar approach in Balaka district, Malawi, promoting an IFES that combined the use of improved, energy-efficient stoves and the use of pigeonpea stems for fuel as part of their campaign *'ulimi wa nkhuni'* (grow your own firewood). During 2008 – 2010, 9,000 stoves were produced by groups of village artisans and

purchased by smallholders at a retail price of MK 300 (by 2011 equalling ca. USD $ 2). In addition, households that participated in project activities were rewarded with free pigeon pea seed to grow on their land (on average 0.6 acres). The project distributed a total of 24 tons of seed to 9,000 smallholder households, between two and three kg of seed for each household.

A household survey carried out jointly by FAO, Concern Universal Malawi and ICRISAT (International Crops Research Institute for the Semi-Arid Tropics, Nairobi, Kenya) evaluated the outcome of these measures to determine the impacts on demand for fuelwood, household food security, cash income, and on soil health and fertility (all subsequent figures from the survey in Malawi are quoted from Orr et al., draft report 2012). The survey of 150 households revealed that for 75% the main reason to grow pigeon peas is to obtain food. The average quantity consumed was 40 kg/household. Cash income and fuel received equal ranking in the decision making (53 % of households). The survey further showed that about 70 % of the pigeon pea harvested was kept by the farm household as food, while only 30 % was sold. Fifty-seven percent of households growing pigeon pea ranked it as their first or second-most important cash crop. The average value of pigeon pea sold ranged from 500-1,612 Mk/year (ca. USD $ 3 -10 in 2011).

Additional to the cash income generated through selling grain, the combination, energy-efficient stoves and pigeonpea reduced the *frequency* of fuelwood collection and purchase by 48 %, and hence allowed cash and time savings. On average, the use of pigeon pea stems for fuel saved households an estimated MK 3,000 per year (in 2011 USD $ 20). This figure also represents a significant saving of labour time. Using pigeon pea for fuel was estimated to save households 13 hours per month in travel time to collect fuel wood (Orr et al., 2012)..

Similar results were reported from Asia. A study in Myanmar found that those farms that plant pigeon peas can satisfy more than 25 percent of their solid energy needs with pigeon pea stalks (Kyaw, 2009).

The Malawi study further showed that such IFES can offer several co-benefits beyond food and energy alone (Orr et al., 2012). Regarding soil health and fertility, the study demonstrated that households that had grown pigeon pea over three seasons were significantly more likely to observe bigger cobs and higher yields for maize, and positive impacts on soil health such as improved water filtration and less compacted soils.

These findings correspond well to research findings from the World Agroforestry Centre (ICRAF). Under the term of "Evergreen Agriculture", ICRAF (e.g. Garrity et al., 2010) has been promoting intercropping maize with pigeon-peas and other leguminous woody crops such as *Gliricidia sepium, Tephrosia candida* and trees such as *Faidherbia albia* as a source for additional biomass on-farm, particularly stressing their *fertilizing effects* on soils. Garrity et al. (2010) report that several studies have shown that after a two to three year fallow, these plants provide 100–250 kg of nitrogen per hectare, enhancing the yields of the maize crops that follow.

A study conducted by Ngwira, Aune & Mcwind (2012) found that intercropping maize and pigeon pea under conservation agriculture presents a win-win scenario due to crop yield improvement and *attractive economic returns,* provided future prices of maize and pigeon pea grain remain favorable. Snapp et al. (2002) confirm this view showing that grain yields from legume-enriched systems were comparable to yields from continuous sole maize while they provided the added benefit of wood fuel. They concluded that intercropping with leguminous crops can lead to more productive plots, yielding as much maize as sole monocultures plus an additional yield in fuel wood and pigeon pea grains.

These results are also of uttermost importance regarding *climate change mitigation*. The fact that diverse production systems and ecosystems produce more biomass than monocultures (Tilman et al., 2001; Frison et al., 2011; Balde et al., 2011) means that opportunities for mitigation of climate change through carbon capture in biomass and soils can increase through such diversification.

Yet these results need to be interpreted with caution, as the advantages of integration of different crops will not always occur, as they will depend on the species intercropped and their specific physiology and synergies. For instance, a recent study on IFES in Australia (IEA, 2012) shows on the one hand that integrating mallee species (*Eucalyptus spp.*) on farms in low rainfall areas can be a win-win situation, producing biomass for energy and reducing soil salinity. Yet, on the other hand, the study also warns that woody species with deep roots may compete with food crops for water resources leading to decreasing crop yields, if the local hydrology is not carefully considered. The same may be true for nutrient competition.

Conclusions

Many developing countries, and particularly those in Africa, are facing a range of threats, all of which are closely linked to each other: food insecurity, insufficient access to energy, adverse effects from climate change and increasing land and forest degradation as well as deforestation. This multiple challenge requires a solution that goes beyond the green revolution of the past. Farming systems need to be locally adapted and, contrary to monoculture-based agriculture, should be functioning without dependence on external, energy-intensive and costly synthetic inputs to increase productivity. Such diversified agro-ecological farming systems are very knowledge-intensive, and require capacity building and strong financial and institutional support.

This can be perceived as a heavy financial burden in low-income countries such as Malawi, yet one might argue that the additional benefits of such integrated systems, such as increased resilience to climate risks, resource efficiency and improved livelihoods, make such an investment worthwhile. The planting of trees, as promoted by Malawi's National Tree Planting Initiative, is an important first step in the right direction. Yet, planting a tree does not, by itself, guarantee its survival nor benefits, unless farmers are sure to have tenure over the trees they plant.

Thus complementary measures to ensure the sustainable management of resulting IFES should be explored and implemented, aimed at halting forest degradation and deforestation and providing alternative sources of fuel. Various studies have shown that intercropping pigeon peas with maize can be an alternative which will supply fuel wood, food, fodder and fertilizer. Other options are the integration of other leguminous crops and trees, such as *Gliricidia sepium, Tephrosia candida* and *Faidherbia albia,* into existing farming systems. If tenure rights over planted trees cannot be assured, it may provide greater returns on investment by a government to promote intercropping on private land than to rely on nationwide tree planting initiatives because lack of tenure means the trees, even if planted, are not automatically cared for.

Despite documented success stories, one needs to carefully consider the hydrological and soil characteristics of the location considered, and the mix of species intercropped, to ensure that cumulative benefits are obtained, and that competition for water and nutrients are minimized. The intercropped species need to be selected in such a way that they do not compete for the same resources. They should occupy different ecological niches, for instance exhibit differences in canopy morphology, root system and phenology (Balde et al, 2011); and that, when intercropped, they provoke positive effects such as seen with pigeon peas or other leguminous crops that

enhance nutrient availability in the overall agricultural system.

Despite the large potential of IFES, the knowledge of potentially useful energy crops and trees and their site-specific interactions with food crops still remains scattered and scarce. Further research is needed to identify those food and energy species that can be successfully used in integrated systems. The cultivation of pigeon peas and maize is one of the successful cases which deserves increased attention also among decision makers at policy level.

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Opportunities and Challenges of Promoting Agroforestry for Climate Change Mitigation: A Case-Study of the Mitigation of Climate Change in Agriculture (MICCA) Pilot Project in Tanzania

Janie Rioux[1]

Summary

Agriculture can help mitigate climate change through reducing emissions from the agricultural sector and pressure on surrounding forests by investing in agroforestry systems that enhance carbon sequestration and provide fuel wood, thus reducing the need to deforest. In Africa, the main driver of deforestation remains subsistence agriculture, which stresses the need to develop climate-smart agriculture at field level with adequate support from district and national level policies. Agroforestry has been identified as a climate change mitigation practice for its potential to sequester carbon. Moreover, it provides multiple co-benefits to farmers, thus supporting adaptation to climate change. Farmer group discussions in the Uluguru Mountains in Tanzania suggest that 77% of trees found in the area provide them multiple benefits, mainly the provision of fire wood (79%) followed by fruits/food (51%). They also highlighted local adoption challenges, mainly the land tenure system and the common practice of slash and burn agriculture, which both impede tree planting and the wider promotion of agroforestry. This paper shows the importance for addressing land tenure while promoting agroforestry and connecting small scale farming with district and national policies on land tenure, agriculture and environmental conservation to ensure that climate change mitigation in agriculture is to be successful in Africa.

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Introduction

Direct emissions from agriculture and agricultural-induced land use change is responsible for more than 30% of yearly greenhouse gases (GHG) emissions (IPCC 2007). Agriculture through agricultural expansion is the main driver of deforestation followed by infrastructure development and wood extraction (Geist and Lambin 2002, FAO FRA 2010). With population growth, arable land expansion will likely continue in many regions, including Sub-Saharan Africa (FAO 2011). However, agriculture also provides the potential to mitigate between 5.5-6 Gt of CO2eqv/yr (IPCC 2007) and about 70% of this potential is in developing countries. This implies that agriculture and developing countries have to be part of the solution for mitigating climate change and for reducing land use change causing deforestation, while facing the challenge of enhancing agricultural productivity to meet the needs of growing human populations.

In contrast to Latin America and Asia where export markets drive agricultural intensification, which is now a leading driver of deforestation in those regions, in Africa it has remained small scale subsistence agriculture and poorly or totally un-managed wood harvesting for fuel, charcoal production and timber (DeFries and al. 2010, Palm and al. 2005, Burgess and al. 2002, FAO FRA 2012). Subsistence agriculture, often characterized by unsustainable agriculture practices such as slash and burn or shifting cultivation, is practiced by millions of small scale farmers, and is associated with complex development issues such as human population growth, urban demand for charcoal and animal protein, poverty, and food and land tenure

insecurity (FAO 2008, DeFries and al. 2010). Thus addressing climate change in agriculture in Africa will require a bottom up approach in which district and national policies are aligned with local level needs and advocacy on how best to support small scale farmers to help mitigate climate change and reduce deforestation without limiting livelihood opportunities.

Supporting adoption of climate-smart agricultural practices seems a promising pathway. Climate smart agriculture is an agriculture that sustainably increases productivity, resilience (adaptation to climate change), and reduces/removes greenhouse gases (mitigation of climate change) while enhancing the achievement of national food security and development goals (FAO 2010). Farmers aim at increasing their farm productivity and resilience to improve or at least maintain their livelihoods. Hence climate-smart agricultural practices, if they are to be adopted and up-scaled by small scale farmers, have to provide multiple benefits going beyond carbon sequestration and reduction of GHG emissions. Agroforestry systems, which are traditional and modern land-use systems in which trees are integrated with crops and/or livestock, have a good potential to be climate and livelihood smart practices (Verchot et al. 2007, ICRAF 2009). Considering its wide applicability, agroforestry has a high potential to mitigate climate change through carbon sequestration in soil and biomass (IPCC 2000) Average carbon storage by agroforestry system is estimated at 21 and 50 Megagrams C/ha/year in sub-humid and humid regions respectively (Schroeder 1994). Agroforestry also strengthens farmers' adaptive capacity to counter climate change impacts by building more resilient agricultural systems and diversifying income sources. Also importantly to farmers, agroforestry contributes to food security by providing multiple products and benefits to farmers such as food, fodder and shade for livestock, timber and renewable wood energy. It also supports enhanced agricultural production by improving soil conservation, soil water holding capacity, soil organic matter, soil fertility, and other ecosystem services. A key issue is to understand why agroforestry is not widely adopted and address the constraints.

The Mitigation of Climate Change in Agriculture (MICCA) programme, launched by FAO in 2010, is working to make agriculture more climate-smart. One component of the program are two pilot projects in Kenya and Tanzania where climate-smart agricultural practices are integrated into farming systems demonstrating that smallholders can be part of the solution to mitigate climate change in agriculture. This case study based on the MICCA pilot project in Tanzania looks at agroforestry as an opportunity to promote climate smart agriculture and reduce deforestation considering its multiple benefits, and explores project-specific challenges and barriers to adoption, mainly the prevailing land tenure system and the practice of slash and burn.

Methods and Site

The pilot project in Tanzania, a partnership between FAO, CARE International and the World Agroforestry Centre (ICRAF), aims to contribute to decrease the net GHG balance of agricultural systems in the project area through conservation agriculture, agroforestry, soil and water conservation, and the introduction of energy efficient cooking stoves. The MICCA pilot project in Tanzania is active in 15 villages in the locations (wards) of Kolero, Kasanga and Bungu in the Uluguru Mountain in the Morogoro district.

Map 1: The villages in the project's area in the Uluguru Mountains, Tanzania

A rapid appraisal on agroforestry, slash and burn agriculture and energy was conducted by MICCA- CARE International and ICRAF-Tanzania in December 2011 (unpublished data). The agriculture-deforestation interface was explored considering its relevance for climate change mitigation in the project area.

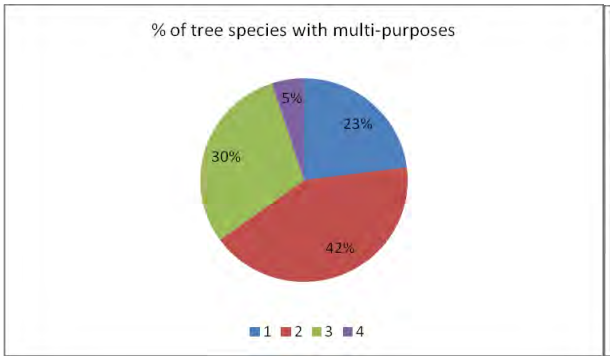
Seven focus group discussions (FGDs) were organized with a total of 63 farmers from the 14 villages located in the three sub-divisions (Table 1). Focus group discussion is a qualitative research method, in which a small group of participants discusses a specific topic under the guidance of a trained moderator.

Table 1: Number of participating villages and farmers by sub-division

Wards	Villages	FGD 1	FGD 2	FGD 3	Total
Kolero	5	6	6	8	20
Kasanga	5	8	11	-	19
Bungu	4	8	16	-	24

Results and Discussion

Trees provide natural, physical and financial assets. The FGDs were focused on the direct uses of trees and tree products as perceived by farmers; other ecosystem services provided or supported by trees were not discussed. Results from the FGDs showed that 43 tree species are important to farmers in the project area, and that 77% of these provided multiple benefits (Figure 1). The main uses mentioned were firewood (79%), fruits/food (51%), construction materials (30%) and timber (26%) (Figure 2). The results demonstrated the multifunctionality of trees in the project area and their contribution to farmers' livelihoods.



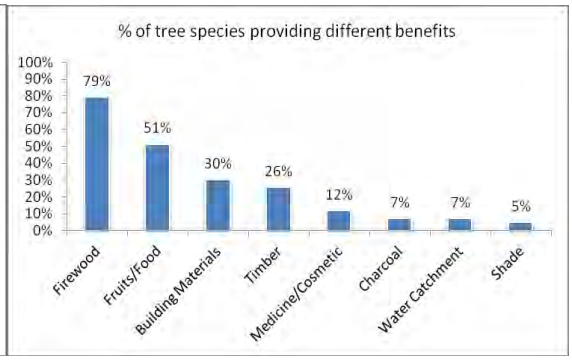


Figure 1(left): % of tree species with multi-purposes, and Figure 2 (right): % of tree species providing different benefits

It emerged from the FGDs that the main local drivers of forest degradation and deforestation in the project area were shifting cultivation through slash and burn practices, and the overexploitation of trees for timber, construction materials and firewood. Wood harvesting for brick making and removal of tree bark for storing crops were mentioned as reasons for forest degradation. Shifting cultivation and land clearing using slash and burn was perceived by farmers as being the main contributor to deforestation. It also impeded the subsequent regeneration of trees and the spread of wild fires. Slash and burn is the most common practice used in the project area for clearing and opening new lands for agriculture and for controlling weeds and pests posing a serious threat to forest edges, wood lands, and causing forest loss.

Challenges and barriers to agroforestry were discussed during the FGDs, and they could be grouped in three main categories (Table 2): land tenure system, land use and management, and capacity building and knowledge. Slash and burn is preferred by farmers as it is not time and labor consuming, and helps to control weed and pest. Thus, alternatives need to be provided to help address the issues of time availability, labor demand, and weed and pest management, in association with awareness on the impacts of slash and burn agriculture on climate change and environment conservation in general. There will be a trade-off between ease of agricultural production, and forest conservation and climate change mitigation.

Table 2: Challenges and barriers related to adoption of agroforestry in the project area

Challenges	Barriers to Agroforestry and tree planting
Land tenure system	- Small land plot size (mainly in upland villages) - Clan-owned land renting system - Absence of village land use plans
Land use and management	- Slash and burning practice which farmers mentioned is not time and labor consuming and allows to control weed and pest
Capacity and knowledge	- Lack of awareness by farmers of environmental benefits of trees and misconception about trees e.g. fear of tree shade negatively affecting crops, and fruit trees attracting monkeys - Lack of awareness of existing forest legislation - Lack of knowledge of tree seedling management, pest and disease control, and adequate seeds and germplasm supply

These results demonstrate that capacity development and awareness building is central to the expansion of agroforestry in the project area, and that the promotion of alternatives to slash and burn is a high priority. More importantly however, they highlighted the challenges related to improving the land tenure system in which a considerable proportion of farmers today rent clan-owned lands on a seasonal/annual basis. In most cases, land owners rented out the most unproductive land, and farmers believed that if the land owners noticed an improvement in production they would claim back the land. Moreover, changes in land use practices on rented lands were allowed only in regard to annual crops, not for perennial crops and long cycle crops such as cassava. Within such a land tenure system, planting trees raises several issues on tree and tree products ownership, land renting agreements and, more generally, on the social organization and power structures in the project area.

Conclusions and Recommendations

Agroforestry helps to sequester carbon and provides multiple benefits to the livelihood of farmers, and thus has a great potential to contribute to climate change mitigation; however at the local level, its implementation faces significant challenges. These include the prevailing land tenure systems, the common practice of slash and burn agriculture, as well as a lack of awareness and knowledge by farmers on alternative practices, which all together hinder tree planting and agroforestry. In this context, climate change mitigation will require field-based supportive policies and incentive mechanisms suitable for small scale farmers with the aim to promote agroforestry and the incorporation of trees in agricultural landscapes.

Based on the results obtained to date, the MICCA pilot project in collaboration with its partners will support the establishment and management of tree nurseries (individual, group and village levels), and provide trainings to raise awareness on the multi-functionalities and ecosystem services of agroforestry and the growing of trees on-farm. Moreover, the project and partners will support stakeholder consultations and contacts between local and district authorities, and clan land-owners and farmers to discuss solutions for farmers renting lands to engage in tree planting and agroforestry considering livelihood benefits while at the same time helping to mitigate climate change. Simultaneously, in collaboration with local and district authorities, incentive mechanisms and bye-laws will be identified and promoted for widespread adoption of agroforestry, as well as alternatives to slash and burn such as conservation agriculture. Changes also need to be introduced at district and national levels to promote policies supporting agroforestry and capacity building for climate-smart agriculture for smallholders and linking local deforestation dynamics with national initiative such as UN-REDD.

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COUNTRY FOCUS: Uganda

Community Watershed Management as a means of Enhancing Household Farm Income in Uganda

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Five years ago, the Government of Uganda with funding from the African Development Bank (ADB) and the Nordic Development Fund started implementation of a Community Watershed Management (CWM) restoration program under the Farm Income and Forest Conservation (FIEFOC) Project whose main objective is to improve income, rural livelihood and food security, through sustainable natural resources management and agricultural enterprise development. Under the Community Watershed Management (CWM) sub-component, the project (FIEFOC) assists local communities develop a culture of collectively working together to manage watersheds. It is implemented by Ministry of Water and Environment (MWE,) Ministry of Agriculture Animal Industry and Fisheries (MAAIF) and in 100 watersheds spread across 70 districts in close collaboration with local governments, research and academic institutions, private sector and faith based organizations. The Ministry of Water and Environment is the Executing Agency and the Chair of the Project Steering Committee. The Ministries role is mainly coordination, supervision, monitoring and evaluation, while implementation of the activities is by the Local governments of the participating districts.

The project having multi-sector components and complexity is coordinated at the national level by a small National Project Coordinating Unit (NPCU) housed in the Ministry of Water and Environment which is the executing Agency. The functions of the NPCU is limited to coordination, and liaison with the Development Partners and the two coordinating units in the two ministries (MWE and MAAIF), consolidation of project accounts and reports, facilitating supervision missions, arranging for annual audits, mid-term review and project completion report.

At Policy level is the Project Steering Committee (PSC) comprising of Permanent

Secretaries of relevant Ministries and organizations. The PSC provides an oversight function in managing the project on top of approving annual work-plans and budgets and training programmes and budgets. The PSC which is the highest decision making body of the project whose membership consist of Permanent Secretaries of the Ministries of Water and Environment; Agriculture Animal Industry and Fisheries; Local Government; Prime Minister's office; Gender, Labour and Social Development; Lands, Housing and Urban Development and Finance, Planning and Economic Development as well as a representative from Uganda National Farmers Federation.

The Government of Uganda made some reforms in the Public Sector in 1998 (Post-Constitutional Report, 1998) by changing the roles and mandates of Government Ministries (and Departments) to regulatory, facilitatory ensuring there is conducive environment for the private sector to operate effectively especially in the areas of agricultural services provision, production, marketing and output processing.

The joint ministerial coordination has enabled cross-sectoral planning, monitoring and supervision of project implementation while the private sector involvement in tree seedling production and distribution has made it possible for the project to provide and meet the seedling demand of target communities. Research and academic institutions like the National Forestry Resources Research Institute and Makerere University have provided professional expertise to identify and mitigate tree diseases/pests and manage project data through a GIS system respectively. At the grass root level, the project has facilitated establishment of 397 Community Watershed Management groups across 70 target districts whose core roles are to mobilize, plan, monitor, formulate and enforce bye laws and arbitrate conflicts among members/stakeholders. The multi stakeholder involvement has thus ensured efficiency, effectiveness and synergism in project implementation.

The design and implementation of the project is premised on the need to address a multiplicity of challenges (Social, environmental & livelihood) afflicting communities in watershed areas across the country. The project employs a community-based watershed management approach whose main objective is to protect and restore watershed functions that include minimizing soil and water loss and erosion. The approach enables individuals, groups, and institutions with a stake in management outcomes to participate in identifying and addressing local issues that affect or are affected by watershed functions. It entails coordinated implementation of activities such as contour hedgerow planting and stone embankment, water catchment trenches, agroforestry, tree planting and protection of natural forests/vegetation aimed at controlling, enhancing and restoring watershed functions.

Like anywhere else, communities living near forests in Uganda depend on forest resources for firewood, building materials and medicinal plants but are also faced with more immediate livelihood needs prompting over-exploitation. Forest ecosystems contribute tremendously to agricultural productivity, by protecting soil against degradation and erosion, maintaining river bodies, and assuring regular rainfall patterns. It's worth noting that only 30% of Uganda's forests are located inside protected areas while 70% are on customary and private land. While forest cover in the country reduced by 7% from 4,933,000 to 3,556,000 Ha between 1990 and 2005, forest cover outside protected areas declined by 34% during the same period (NFA, 2008[1]). The rapid decline is largely attributed to conversion of private forest estates to agriculture.

The high rate of deforestation coupled with poor farming practices has affected the

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ability of the soil to retain adequate moisture and soil nutrients required for crop farming. Through mobilization and sensitization, 40,000 Ha of Private Natural Forests in the watersheds (tropical rain forests and woodlands) are being managed and protected by private owners to minimize soil moisture and nutrient loss.

The same effort by the project has led to enrichment of 5,075.8 Ha of originally degraded Private natural forests with indigenous tree species. Additionally, the undertaking is helping to conserve biodiversity outside gazetted protected areas. For instance farmers around Nandere Private Natural Forest in Luwero district have been collecting wild coffee germplasm for planting on farm. Bee keeping has been supported by the project as an incentive to private owners to conserve their natural forest. In addition to providing income through sale of honey, the bees act as pollination agents for crops grown by farmers around the protected forests.

Fig 1: A protected privately owned forest in Bushenyi district in western Uganda

The project has also promoted contour hedges as a means of controlling water runoff and soil erosion. 4,227.5 km of contour hedges comprising hedgerows, stone embankments, grass strips and *FanyaJuu/Chiini* has so far been established and stabilized with *Calliandra colothythus* and Napier grass which also provide fodder for livestock (cattle and goats) as depicted in the Figure 2 below.

Fig2: A farmer in Rukungiri feeding an improved goat with Calliandra fodder

Information from beneficiaries who have adopted the technology indicates that there is an increase in milk yield of 1-2 liters per cow which is attributed to *Calliandra* supplement.

The key farm based livelihood opportunities created by the project include forest plantations, woodlots, fruit orchards and agroforestry (apiary). The achievements attained on these include the following:-

- So far 27,128 hectares of forest plantations and woodlots have been established by 38,939 farmers throughout the project area. At a 25 year's rotation, a pine forest plantation is expected to accrue a compounded return of between US $ 29,000-48,000 per hectare to the participating households. On the other hand some farmers have already started generating income through sale of firewood and poles from eucalyptus woodlots whose return is between US $ 2,000-3,000 per hectare on a four year rotation. In addition the enterprises are providing informal employment to the rural population.

Fig3 : Stake of firewood on sale from one of the beneficiary farmers in Nebbi district, Uganda

- Fruit tree orchards have been promoted by the project to provide food and household income. 5,477 Ha of mainly oranges and mangoes have been established. The investment return is between US $ 3,200-4,000 per hectare. The fruit trees, particularly mangoes have also provided safety nets during periods of hunger.

Fig 4: A project beneficiary in Kiruhura district displaying fruits from an improved mango tree

The long term nature of forest investment has been an impediment to project success as farmers with limited resources are in most cases un willing to invest in planting trees that will take 25 years to harvest in the case of timber. As a mitigation measure, farmers have been encouraged to integrate short term generating activities such as bee keeping and fruit growing into tree planting activities.

Lessons Learned

Supporting tree planting on small land holdings can be successful if thorough mobilization and sensitization is carried out. This is confirmed by the overwhelming demand for tree seedlings the project is facing now.

Forest fires are a big threat to tree planting efforts and so for any tree planting programme, management of forest fires should be integrated in the project support.

Public-private partnership in the implementation of the project has proved very effective and enhanced both employment opportunities and farm income. For example, the Ministry of Water and Environment contracted private seedlings suppliers to supply quality tree seedlings to project beneficiaries and this approach is being replicated in other government and private tree planting initiatives in the country, for example Sawlog Production Grant Scheme (Government Programme), Bujagali Hydro-electric Dam Forestry Rehabilitation Project.

The Project design promoted the strengthening of technical departments at all levels and further advanced multidisciplinary approach to planning, budgeting, monitoring and evaluation in watershed management. The Project design provided for the formation of Technical Committees at sub-county and district levels chaired by the Sub-county Chief and the Chief Administrative Officer respectively who are the Accounting Officers at those levels of administration. The technical committees comprise of relevant departments/disciplines.

Challenges

Some challenges to the project success have been the land tenure system that does not permit women to own land. This has affected their full participation in project implementation. The relatively longer time taken to establish grass-root implementation structures delayed

implementation during the initial stages of the project.

Inadaquate and inaffordable tree seed. The country doesn't have its own tree seed sources for some of the key species. For example Pines seeds are imported from Australia and Brazil. 1 kg of Pine seed is over US$ 800.

Soil and water conservation technologies were not readily taken up by farmers or households because it's mainly the woman's responsibility and this is an added workload

Being a multi-sectoral project, it's very difficult to ensure that the two ministries are moving at the same pace, e.g. planning and budgeting, monitoring and budgeting processes.

Conclusion

Integrated approach to land management is important but requires a holistic management approach. The involvement of multiple stakeholders in project implementation at both national and local levels has enabled the project to tap into the diverse technical expertise of other institutions. Continued engagement of communities in planning, implementation and monitoring of watershed restoration interventions are also important for sustainable management of watersheds.

FAO Activities and Results

Special Programme for Aquaculture Development in Africa: enhancing the supply of and access to farm-raised fish and other aquatic products through the sustainable development of aquaculture.

John Moehl[1]

The African aquaculture sub-sector is changing. It is redesigning itself to supply more food to the market while providing new opportunities for investors, especially women and youth. Initial results have been promising with a number of African countries now harvesting more than 5,000 MT/year from their aquaculture programmes. However, although investment in aquaculture is at an all time high, assistance is still needed to ensure results are sustainable and production continues to increase.

To this end, in 2008, the FAO Regional Office for Africa launched SPADA (the Special Programme for Aquaculture Development in Africa). SPADA is a response to the NEPAD Action Plan for the Development of African Fisheries and Aquaculture and Millennium Development Goals. SPADA is designed to build on the growing opportunities and emerging successes of aquaculture expansion in the region; identifying the key arenas and elements necessary to complement or catalyze country efforts. SPADA's goal is to assist African countries to reduce poverty and increase food security, whilst contributing to overall national and regional economic and rural development, by enhancing the supply of and access to farm-raised fish and other aquatic products through the sustainable development of aquaculture. SPADA's scope and strategy aim to cover all African countries; interventions taking place at national, sub-regional and regional levels. At national level the programme intends to work with public and private institutions, service providers, NGOs/CSOs and the private sector to establish sustainable and responsible aqua-businesses which will, in turn, increase employment, fish supply and investment opportunities. At sub-regional level SPADA will work with Regional Economic Communities (RECs) to develop protocols for managing shared resources, trans-boundary movement of aquatic products as well as intra-regional trade and markets. At regional level, the programme will assist NEPAD in implementing its Action Plan including assistance to the nascent Aquaculture Network for Africa (ANAF) as well as relevant aquaculture bodies including the Committee on Inland Fisheries for Africa and Aquaculture (CIFAA).

SPADA is founded on key lessons learnt over the past three decades. Chief among these is the principle that there are more commonalities than differences among aquaculture programmes across the Africa region, thereby promoting a high degree of transferability of technologies, solutions and successes. The relative newness of the sub-sector also provides considerable opportunities for south-south co-operation. The new principles ensconced in SPADA are now acknowledged as being the bases for sustainable and profitable aquaculture development. There has been a significant shift in paradigm based on the adoption of these principles. Profitable micro- , small- and medium-scale aqua-business are the core of the programme. Aquaculture development must be more focused to facilitate investment in these businesses and the service that support them: targeting high potential zones with an optimal mix of socio-economic and bio-physical characteristics where market-orientated clusters of producers, supported by innovative outreach mechanisms, can make a significant impact on food supply.

Practically, adopting SPADA methodologies involves interventions at both the macro and micro levels of a country's programme. The entry point is the crafting of a National

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Aquaculture Strategy. This document defines the roles and responsibilities of important stakeholder groups; the public and private sectors along with civil society. Previously national programmes relied heavily on public and donor support. The intent is to set the stage for a shift where much of the action and most of the services are attributed to the private sector.

The next step in the macro process is to elaborate a National Aquaculture Development Plan based on the strategy. Ideally this process is overseen by an Aquaculture Advisory Group; a formal assemblage led by the private sector but engaging all stakeholder groups. The advisory group assists in the drafting the plan to ensure ownership by and oversight from those most affected. To date approximately 20 countries have prepared National Aquaculture Strategies whilst five of these have continued the process to elucidate their corresponding National Aquaculture Development Plans. Of those countries with plans, three have set up official Aquaculture Advisory Groups.

Pragmatically, as is typical, overcoming inertia is a major issue. The first strategy was formulated in 2003. However, it was not until 2008 that there were sufficient examples and adequate understanding of the process to rapidly accelerate adoption, reaching today's level where a score of countries have prepared these instruments. Similarly, now with a critical mass of plans, the subsequent preparation of these companion documents will accelerate in the near future.
At the micro level, it is necessary to pilot the implementation of the approaches embedded in the national strategy and plan. The overall development of the country programme is an iterative process with results from the field feeding back to national level where the guiding instruments are revised and updated as results become available.

Piloting involves first developing the needed market and business planning and business management skills among operators. Analyses have concluded that the major knowledge gaps are not so much bio-technical as market- and business-related. Hence, investors need to bolster these capabilities and in the process identify critical benchmarks such as minimum economic size of an operation.

Guided by these baseline figures, it is possible to identify those firms that can be profitable by preparing a suitable business plan for operators; those having a positive bottom line being candidates to form market-orientated clusters where the whole becomes greater than the sum of the parts and where the smallholders can attract optimum prices whilst pulling down needed services. To date, six countries have initiated pilot work; building marketing and business skills whilst assisting operator to join forces in functional market-drive clusters.

It may well be the time to ask to what extent SPADA's goal of increasing investment in aquaculture and improving market access and profitability has been achieved. It has been projected that if SPADA's approach is fully adopted in 20 subsaharan African countries, the program could engage an estimated 28,800 direct beneficiaries, as well as create about 207,000 jobs and produce 259,200 tons of fish estimated at a value of $324,000,000. It is hoped adoption of SPADA's methodology will continue among countries and these ambitious goals will be achieved.

It is noteworthy that outside of its aquaculture context, SPADA may be perceived as an approach or methodology that can be applied to any area of development, including at the Forest-Agriculture interface. As has been described, this tried and tested approach is based on increasing investment predicated upon demonstrated profitability and structured so as to be accessible to small holders. Equity and inclusiveness, productivity and profitability are thus important elements in SPADA.

Links

TECA Beekeeping Exchange Group
The natural environment of many developing countries offers a real potential for beekeeping to contribute to the livelihood of rural dwellers. However, lack of access to information and technologies to sustainably improve production, product quality and increase income from beekeeping is an important obstacle in maximizing the benefits from beekeeping. Simple low-cost techniques such as the use of protective gear can allow honey gatherers and beekeepers to collect honey without using fire and killing the bees.

The TECA Beekeeping Exchange Group has been set up to make available applied technologies and good practices to rural beekeepers around the world and to link beekeepers, advisory services, extension workers, beekeepers' associations, NGOs, researchers, university students and anyone interested in beekeeping to enhance the sharing of practical knowledge and good practices that have been applied by beekeepers in rural areas.

To learn more about the TECA Beekeeping Exchange Group, visit the website: http://teca.fao.org/group/beekeeping-exchange-group.
Source: Charlotte Lietaer, Moderator, TECA Beekeeping Exchange Group

Farmlands and forests in globalization: from the temptation of land grabbing to model diversification? This is the title of an article published as part of the collective work "Agriculture et alimentation – Des champs politiques de confrontation au XXIe siècle" (Agriculture and Food – Political confrontation platforms in the 21st century) (Cahier DEMETER)

In sum, the article aims at showing that the expression "commercial pressure on lands" used by the International Land Coalition, reflects perfectly the diversity of practices and models being developed, both for the farmlands coveted by diversely motivated investors, and for the woodlands which are of interest for the carbon finance. The premise is that the model designated by "land grabbing" will rapidly reach its limits due to predictable resistance from farmers and local populations.

On the one part, these opposition movements will increase as the information contained in the contracts signed, often in complete opacity, between local governments and foreign investors will come to light. On the other part, the implementation of these contracts will force investors to justify to both national and international public opinions, practices that marginalize directly or indirectly poor populations that will be deprived, if not of their right to access land, at least, of their rights to pass on their land heritage to their offspring.

The need for new and massive investments in agriculture in the south being undeniable, contractualization production models based on keeping farmers on their lands, models practiced for a long time in some areas (for example cotton production in the Sahel) are being developed. If the contracts are equitable, they may lead to mutual gain for investors and farmers.

Transparency remains an indispensable requirement; all the contracts signed are not accessible to the public, and this is detrimental to the search for equity. There is, in the area of extractive industries, a programme for the transparency of incomes paid by companies to governments (ITIE) which could be summed up in the slogan suggested by some NGOs: "Publish what you pay". In the area of land acquisition, the world will need a programme with the slogan "Publish what you sign" and which will be pursued in a regular and independent evaluation of the implementation of commitments made by investors. In the future, a specific "responsible investment contract" may appear next to the existing labels on "responsible" palm oil, wood or soya.

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A book by James Clarke released July 2012. Web Links: www.jamesclarke.co.za
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Theme and Deadline for Next Issue

The year 2012 has been an important year for water resources management. Five major events have taken place, to *inter alia* assess the state of water resources, and promote their wise management. These five key events include: The World Water Forum in Marseilles, France – March 2012, The Land and Water Day in Rome – May 2012, The African Water Week in Cairo – May 2012, The 38th Special Session of the Committee on World Food Security (CFS) of the Food and Agriculture Organization of the United Nations (FAO), which adopted the 'Voluntary Guidelines on Responsible Governance of the Tenure of Land, Fisheries and Forests in the Context of National Food Security' – May 2012 , and The Rio+20 Conference on Sustainable Development in Rio de Janeiro – Brazil June 2012. The Stockholm Water Week is also due to take place during the last week of August 2012,

While the focus was beyond water issues alone at some of these events (CFS, Rio+20), the debates explored how water together with land, forestry and fishery resources could be managed in an integrated fashion towards food and nutrition security, and sustainable development in general, in a context of climate change, an increasing population and rapid urbanization.

In April 2012, the BBC reported on a cutting-edge story about groundwater potential in Africa. (http://iopscience.iop.org/1748-9326/7/2/024009/article

http://www.bgs.ac.uk/research/groundwater/international/africangroundwater/home.html

http://www.nytimes.com/2012/06/18/opinion/africas-hidden-water-wealth.html?emc=eta1)

Despite such reports of potential groundwater, coupled with the fact that Africa is blessed with abundant water resources including large water bodies such as the Congo, Nile, Zambezi, Niger and Lake Victoria, the continent still experiences an economic water scarcity, as a result of its inability to harness its abundant water resources. Agriculture water management in Africa remains sub optimal and inefficient, the hydropower potential of the continent is not fully exploited and most countries lag behind in the Millennium Development Goals such as for ending poverty and hunger and for environmental sustainability (with the target of halving by 2015, the number of people without access to safe drinking water and adequate sanitation).

According to the World Wide Fund for Nature (2002)[1], 14 countries in Africa are already experiencing water stress; another 11 are expected to join by 2025 at which time nearly 50 percent of Africa's predicted population of 1.45 billion people will face water stress or scarcity. Approximately 51 percent of people (i.e. 300 million) in sub-Saharan Africa lack access to a supply of safe water and 41 percent lack adequate sanitation (http://www.unep.org/themes/Freshwater/Regions/index.asp?case=roa). Over 80 of Africa's river and lake basins run through two or more countries and a majority of countries rely on water flowing from catchments largely outside their national boundaries.

A new study released by the UN Environment Program (UNEP) at the Rio+20 Conference shows that 40 African countries are making good progress with integrated approaches to water resources management. More than 75 percent of the

[1] *World Wide Fund. "The Facts on Water in Africa." Living Wasters: Conserving the Source of Life, July 2002.* Water in Africa *assets.panda.org/downloads/waterinafricaeng.pdf Africa appears blessed with abundant water resources: large rivers include the Congo, Nile, Zambezi and Niger and Lake Victoria is the world's second largest.*

member countries of the African Ministers' Council on Water (AMCOW) are enacting regulations on water, and nearly half (i.e. 40 percent) are carrying out national plans for Integrated Water Resources Management (IWRM) in line with the African Water Vision for 2025 (McMullen, 2012)[1].

Further integration calls for a holistic management of all natural resources including water, land, forestry and fisheries considering that they are intimately interlinked and that their respective - intrinsic and other - values are largely interdependent.

Therefore, as a sequel to these major key events, the next issue of *Nature & Faune* will be devoted to the integrated management of water, land, forestry and fishery resources.

The theme for the December 2012 edition of *Nature & Faune* is **"Managing Africa's water resources: integrating sustainable use of land, forests and fisheries"**. We seek papers that reflect the interface between water resources and land, forestry and in-land fisheries management in Africa, and a course of action that will conserve these to meet the needs of future generations. Content and subject matter of articles should contribute to the debate of evaluating best practices, and offer applicable measures to ensure a secured access to abundant water and quality land, forests and fisheries in Africa.

Deadline for submitting manuscript(s) and other contributions for the next issue of *Nature & Faune* is 1st November 2012.

[1] *McMullen, C (ed.). "Status Report on the Application of Integrated Approaches to Water Resources Management in Africa." Abuja: African Ministers' Council on Water (AMCOW). Available at: <http://bit.ly/KcwqMb>. Accessed 2 August 2012*

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