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Bouncing back

Forests, trees, and resilient households

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ABSTRACT

This paper examines some of the concepts surrounding the idea that forests and trees can contribute to making households more resilient to food insecurity. The paper begins with a discussion of the widely accepted definitions of food security, and the implications for our understanding of the role of forests and trees in contributing to food security. We discuss the origins of the idea of resilience, adaptability, and transformation as responses to food insecurity, and the conditions that increase the capacity of households to become resilient. The second part of the paper looks at some of the empirical evidence about the role of forests and trees as household safety nets, and examines some of the issues around the reliance on Non-Timber Forest Products (particularly woodfuel) to produce income. The paper closes with a discussion of evolving perspectives about landscape approaches, how these can contribute to building household resilience to food insecurity, and some of the policies that can support this goal.

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1. Introduction

This paper explores some of questions around how forests and trees contribute to the resilience of households to respond to various stresses – temporal, spatial, climatic, economic, and nutritional – and the relationship of that resilience to household food security.

It begins with a short definitional discussion of food security and resilience, and then examines different aspects of how households are able to rely on forests and trees to recover from temporary stressors, or to adapt to longer-term ones. We consider the particular case of woodfuel as an Non-Timber Forest Product (NTFP) that is sold to deal with food insecurity during times of stress.

The paper closes with a discussion about the emergence of "landscape approaches" to building resilience and how policies can strengthen the extent to which these are adopted.

2. Food security, forests and trees

Between the mid-1970s and the 1990s, there was a paradigm shift in thinking about how to address food security. Much of the initial thinking had focused on national food supplies, self-sufficiency, and price. But increasingly, the discussion began to acknowledge the complexities of livelihood strategies in difficult and uncertain environments, bolstered by a better understanding of how people actually respond to perceived risks and insecurities (Maxwell 1996; Weber et al. 1998). The evolving paradigm suggested that food security had to be addressed quite differently.

> "Flexibility, adaptability, diversification and resilience are key words. Perceptions matter. Intra-household issues are central. …(F)ood security must be treated as a multi-objective phenomenon, where the identification and weighting of objectives can only be decided by the food insecure themselves." (Maxwell and Smith 1992)

The most commonly accepted definition of food security was agreed on during the 1996 World Food Summit:

> "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)

There is also agreement that four particular criteria must be fulfilled simultaneously to meet food security objectives: food must be physically available, economically accessible, and usable (in the sense that it can be consumed in a way that makes the most of its nutritional value), and these three conditions must be relatively stable over time. Analysts also generally characterize two types of food insecurity: chronic or transitory (FAO 2008).

From this definition, a fairly extensive catalogue[1] can be assembled of how forests and trees fit directly into the food security picture: physically available food comes from forests and trees, valuable sources of wild and domesticated foods; rights of use and access to trees and forests mediate whether or not these resources are economically available; wild and domesticated foods from trees and forests have well-documented nutritional values; food from forests and trees have an important safety net function that can be jeopardized by forest loss and land conversion.

[1] Indeed, one of the most extensive efforts to describe these characteristics was compiled more than 20 years ago by Ian Scoones and his colleagues in *The Hidden Harvest* (Scoones, Melnyk, and Pretty1992). This comprehensive annotated bibliography provides a wealth of perspectives on forests, trees, and food security extracted from the literature to date.

There is also a catalogue of less direct but equally important links between forests, trees, and food security: forests and trees play an important role in regulating water supplies and in maintaining the health of watersheds, and so are a critical link in maintaining farming systems that depend on these; food security and access to firewood are closely linked, because the ability to cook food increases the extent to which it can be consumed in a way that improves its nutritional value; income from forests and trees can be significant and increases the capacity of households to buy food.[2]

All of these strands are woven into the narrative about why forests and trees contribute to food security. What is less clear is how forests and trees contribute to the resilience of households to respond to periods of food insecurity. But before discussing this, it would be important to be clear about what we mean by resilience.

Resilience to what?

The idea of "resilience" derives from the ecological literature, particularly Hollings (1973), who posited that resilience was a measure of the ability of ecological systems to respond to external forces, but still be able to persist. He distinguished this from stability, which he defined as the ability of a system to return to an equilibrium state after a temporary disturbance. The more rapidly it returns, and with the least fluctuation, the more stable it is. He pointed out that ecological systems can be very resilient and still fluctuate greatly.

Especially during the 1990s, the idea of resilience began to influence "sustainability science." Walker et al. (2004) described how the concept of resilience had evolved with respect to how it has been applied to social-ecological systems, noting that the stability of human and natural systems actually depends on three complementary attributes: resilience, adaptability, and transformability. These all factor into how we consider the response of households to food insecurity.

So if resilience refers to the ability of a system to respond to external forces and be able to persist, adaptability refers to the capacity to modify these systems in a way that increases the capacity for resilience. "Transformability" refers to the ability to make a radically significant change in the way the system operates when existing systems are no longer viable. These concepts are all relevant to how we consider the problem of food security, and the role of forests and trees in influencing the stability of household systems of resource allocation and use.

Shocks at the household level – whether from drought, illness, the loss of employment, crop losses from disease, fire, flooding, or other natural disaster – can undermine household food security, and compel households to adapt to change, often quickly, but seldom easily. Longer-term stressors, including climate change as well as other anthropogenic causes (such as population pressures), can similarly compel households to create adaptive strategies in response. Long-term stressors also interact with short-term stressors in ways that require responses to both. And sometimes, significant and more or less permanent transformations take place, particularly in response to chronic food insecurity.

Indeed, time scale is an important variable for assessing resilience as well as adaptability and transformation. Carpenter et al. (2001) suggest that resilience in one time period can negatively affect resilience in another. For

[2] Findings from the Center for International Forestry Research (CIFOR) Poverty-Environment Network (PEN) studies, for example, have shown that forests and trees can generate sometimes significant sources of environmental income. Their comparative analysis, derived from about 8,000 households in 24 developing countries, showed that forest income constituted about one-fifth of total household income, while environmental income (forest and nonforest) makes up more than one-fourth (CIFOR 2011). Income, of course, plays a central role in ensuring food security because it enables households to buy food.

example, chainsaws helped agricultural societies because they enabled them to clear forest for new agricultural land. But as the forest frontier became constrained, and fallowing was no longer tenable for maintaining soil fertility, the resilience of the system was compromised. And so resilience in one time period was gained at the expense of resilience in the second period.

Adaptability and transformation as responses to food insecurity

As we have suggested, adaptability is the capacity of actors in a system to influence resilience. Adaptation is an outcome, and though the language of adaptation has evolved to account for the scale and nature of responses to climate change, at a more parochial level it holds much relevance for how we consider household responses to stressors such as food insecurity.

Table 1 is a modification of a table from Russell et al. (2012) that describes various responses to climate change, modified here to capture similar responses to household food insecurity.

Table 1: Adaptation to Household Food Insecurity

Differentiating Concept	Response
Timing	• Anticipatory adaptation takes place before the impacts of household food insecurity are observed • Responsive adaptation takes place after the impacts of household food insecurity are observed
Temporal scope	• Short term • Long term
Spatial scope	• Localized • Widespread
Actors	• Initiated by individuals, households, or private companies as a response to self-interest • Initiated and implemented by governments, in the public interest
Functions or effects	• Migration, accommodation, mitigation, prevention, tolerance, expansion, restoration
Form of adaptation	• Structural, legal, institutional, regulatory, financial, technological

Source: Russell et al. (2012).

The table alludes to the capacity to undertake more systemic longer-term responses to food insecurity, and indeed, Walker et al. (2004) argued that the third possible trajectory after resilience and adaptability is transformability – the capacity to create a fundamentally new system when ecological, economic, or social structures make existing systems untenable. More typically, we find examples of this when grazing resources degrade over multiple generations, forcing pastoralists into more sedentary lifestyles that are more food secure. But there are other examples as well, where trees have featured prominently in the transformative process.

For example, during the colonial period in Kenya, landholdings in Central Province had become heavily fragmented as a result of systems of inheritance, and disputes over rights of tenure became increasingly common. In some areas, tree planting was seen as a way of maintaining tenure rights in the face of these uncertainties, and so there were significant incentives to plant trees on remote fragments of landholding in order to assert rights of land use (Dewees 1995). In conjunction with restrictions on the cultivation of other crops, black wattle (*Acacia mearnsii*) came to be widely planted as a cash crop, virtually transforming the landscape in the space of about 20 years, largely to provide supplies of bark for the tanning extract industry. In Murang'a District, for example, by 1937, black wattle had been established over nearly 18,000 hectare –having first been introduced into the district only around 1917 (Cowen

1978). These pre-independence patterns of land use resulted in outcomes that to this day influence how food security is ensured in the rural space in Kenya.

Households respond to the prospect of food insecurity in three closely linked ways: *increasing resilience* by managing existing stocks and flows of resources, *adapting* to the prospect of food insecurity through land use and other changes that enable them to return to their earlier food-secure status, and by totally *transforming* their farming systems and livelihood strategies in response to the prospect of food insecurity. The rest of this paper highlights cases where forests and trees have contributed to all three strategies for responding to food insecurity. It is certainly not meant to be exhaustive, but rather to highlight a few examples of where innovations and opportunities have been supported by policy change, both explicitly and implicitly.

3. Food security and tree-based innovations in land use

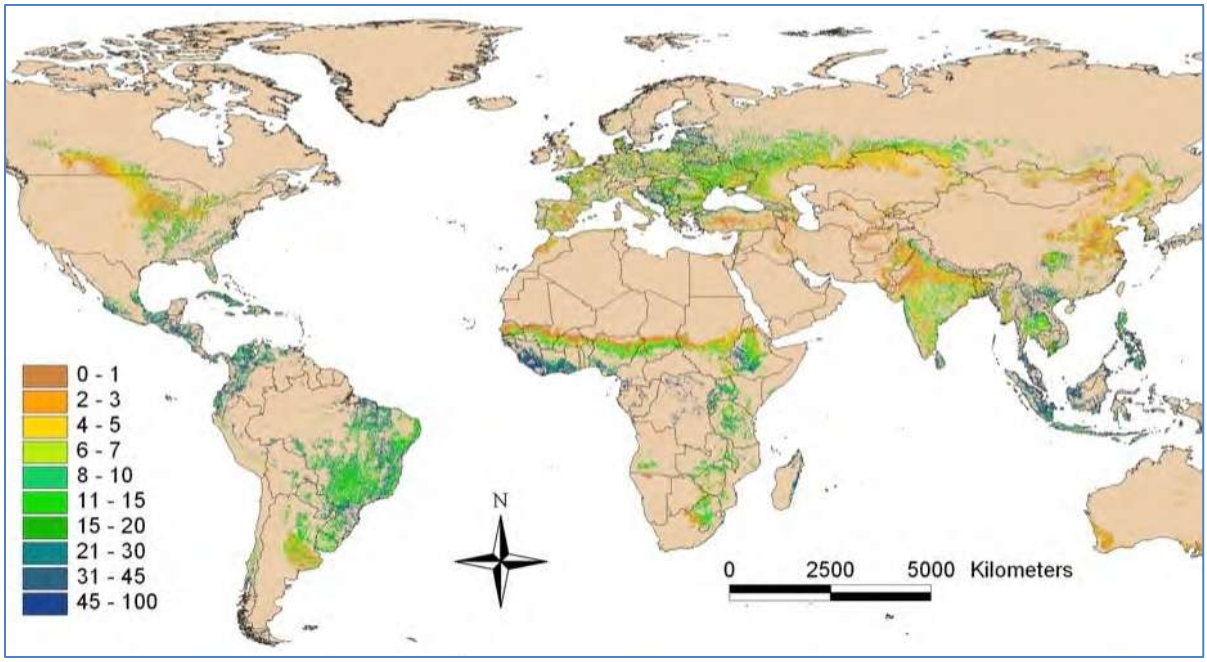
This section reviews some important land-use changes that are gaining increasing attention, the role of trees and forests as safety nets, the specific role of income generating strategies to smooth household consumption levels, and the role of economic and ecological diversification in building resilience to household food insecurity.

The emergence of trees in farming systems

One of the most profound trends that has been observed in the past 15 years has been the extent of forest loss and forest degradation, but also the increasing prominence of trees outside forests (Figure 1). The trend is nothing new – farmers have incorporated trees into their farming systems for thousands of years through intensive management strategies, such as in the sophisticated home gardens of Indonesia (Michon, Mary, and Bompard 1986), or through less explicit processes of land use change, for instance, ensuring that valuable indigenous trees are retained in farm fields as new agricultural lands are cleared (Wilson 1989). Trees outside forests are very well known to peasants, but tend to be poorly understood by technical specialists, planners, and policy makers, and have been mostly overlooked by national statistical and economic accounts (Bellefontaine et al. 2002). What has changed has been both an awareness of the extent of these practices, as well as their growing prominence as a feature of agricultural land uses.[3] Their potential impact on food security is profound and should be recognized, accounted for, and enhanced through targeted investments.The outcome of this trend has been that the boundaries between the forest and the farm have become increasingly obscured. The evolution of complex land-use systems has analogues in ecological science, where empirical evidence shows that complex systems are far more resilient, though arguably less productive (see Hollings and Goldberg 1971). This has implications for our understanding of the role complex land-use systems—incorporating the use and management of trees, forests, and woodlands—play in the challenges of food insecurity because they create greater resilience.

[3] For example, as of 2010, the Food and Agriculture Organization's National Forest Monitoring and Assessment Programme (NFMA) had provided direct support to more than 15 countries that had implemented national inventories including information on the extent of trees outside forests. The number of countries and territories that provided this information to the FAO Forest Resources Assessment increased from 61 in fiscal year (FY) 2005 to 77 in FY 2010. Despite measurable progress, hard data on trees outside forests remain scarce (de Foresta et al. 2013)

Figure 1: Global Extent of Tree Cover on Agricultural Land (% of agricultural land area)



Source: Zomer et al. (2009).

Trees and forests as safety nets

The view that trees and forests can provide important risk-reduction functions at the household level is well established in the literature. Looking at the problem of risk management, Delacote (2007) distinguished nontimber forest product extraction in two ways: as a *diversification strategy*, where households increase their participation in a wide range of possible welfare-improving activities; or as a *coping strategy*, where households increase their extraction of NTFPs to smooth out consumption levels when agricultural or other outputs fall. He noted that risk-diversification strategies are likely to conserve more forests and trees (by raising the value of NTFPs and increasing the incentive for sustainable management) than risk-coping strategies are, because of the more intermittent nature of demand over short periods of stress and the relatively low value of NTFPs in the market.

The point is relevant when we consider the risk that relying on forests and trees for NTFPs can become a poverty trap, providing short-term security but constraining households in the longer term (Wood 2003). Although forests may help reduce risk in the short term, more robust opportunities for poverty reduction may come from converting forests to other land uses.

NTFPs are also used on a regular basis, and not just as a risk-mitigating strategy, so the boundary between using NTFPs for direct household provisioning and using them as a safety net can become indistinct (Paumgarten 2005).

A number of studies have collected empirical evidence that examines NTFPs from a diversification perspective (addressing the question of the share of household income and consumption that is met by NTFPs), but relatively few have reported findings about how NTFPs contribute to smoothing consumption as a coping strategy. Paumgarten (2007) examined the safety net function of NTFPs in two rural villages in South Africa by looking at how households cope with both expected and unanticipated crises over a two-year period. The results from that fieldwork are shown in table 2.

Table 2: Coping Strategies Employed by Households in Response to Anticipated and Unanticipated Risk

Coping strategy	Total	Wealthy	Poor	X^2	Significance
Kinship	85	80	90	1.9	> 0.05
Reduced spending	74	84	64	5.2	< 0.05
Changed diet	72	84	60	7.1	< 0.05
Saving/budgeting	72	88	56	12.7	< 0.05
NTFPs	70	68	72	0.2	> 0.05
Selling livestock	44	58	30	7.9	< 0.05
Savings clubs	41	64	18	21.9	< 0.05

Source: Paumgarten (2007).

The most important coping strategy used by all classes of households in this study is a reliance on kinship groups and community support networks to help compensate for income losses. More generally, however, the study shows that differences in how wealthy and poor households respond to stress are very much a function of their access to assets. Wealthier households are more able to sell assets such as livestock or to rely on savings than are poor households. With respect to the use of NTFPs, the study also showed that while poor and wealthy households both relied on them, poorer households were more likely to sell them to generate income than wealthier households were (NTFPs are among the few assets they are able to sell). In other results, the study showed that wealthier households tended to use firewood to substitute for kerosene, while poor households both used firewood and sold it to generate income.

These findings are echoed elsewhere. Shackleton (2006), Kayambazinthu et al. (2005), FAO (2005), and Barany et al. (2004) point to the importance of dry forest resources and the sale of NTFPs to households afflicted by HIV/AIDS, and Tairo (2007) and Ngaga, Munyanziza, and Masalu (2006) point to Southern Africa's miombo woodland as the provider of "famine foods" and as natural insurance (see also Pattanayak and Sills 2001; Takasaki, Barham, and Coomes 2004; Dewees et al. 2010; and McSweeney 2002 for a discussion of the insurance values of forests). Using seasonal household data for rural Malawi, Fisher and Shively (2005) found that households experiencing an income boost (say, from remittances or from a good harvest) depended less on forest product extraction, compared with those not receiving such a boost. Hegde and Bull (2008) document the role that miombo resources play when shocks such as wildfires and illness hit household assets. They show that households with illness shocks increased their consumption of environmental resources (including the sale of NTFPs) by 42 percent. Volker and Waibel (2010), in their study of rates of forest extraction in mountainous parts of Vietnam, showed that households affected by idiosyncratic health shocks (by economically active household members) and severe weather shocks were more likely to extract forest products, especially fuelwood, than other households.

A common finding in many of these studies is that during times of stress, NTFPs are sold to generate income that can be used for purchasing food. This is, of course, not the only approach to dealing with food insecurity, but its ubiquity makes it worth exploring further.

Income, risk management, and woodfuel

The sale of woodfuel is a relatively common income-generating strategy in many parts of the world. Growing urban populations are driving the growth of markets for charcoal, and supply chains are increasingly responsive to this. What do we know about the extent to which this strategy is used to reduce food insecurity?

The reliance on woodfuel markets to generate income during periods of stress has been widely observed, but seldom well documented. In his assessment of household responses to food shortages in Malawi in 2003, Zulu (2010) identified a range of adaptation strategies (table 3). More than 40 percent of households surveyed responded that they used the generation of income from the sale of charcoal or woodfuel to purchase maize, in response to famine conditions.

Table 3: Strategies to Adapt to Famine in Southern Malawi in 2003

Strategy	Percent (*N*=381)
1. Reduced number of meals per day	48.0
2. Substituted maize with non-staple foods (e.g., pumpkins, potatoes, wild foods)	45.9
3. Engaged in piece work to earn income to buy food	39.1
4. Used food grants from the government and other agencies	32.8
5. Produced or sold charcoal to buy maize	29.7
6. Sold livestock to buy food or exchanged livestock for food	16.8
7. Sold other crops (e.g., vegetables, cassava, potatoes, etc.) to buy maize	16.0
8. Sold firewood to buy maize	11.8
Did not encounter a food deficit	14.2

Source: Zulu (2010).

Two questions emerge from observations about the role of woodfuel and food security: First, do woodfuel markets generate sufficient sources of income to mitigate food insecurity? Second, what is the impact of this on the resource base? In other words, is reliance on woodfuel markets one of those risk-reducing strategies that mitigate short-term risks at a longer-term cost?

Forest products in general are important sources of household income. The PEN studies (CIFOR 2011), for example, showed that income from unprocessed and processed forest products accounted for income shares of 16.3 percent and 5.4 percent, respectively. Fuelwood and charcoal is the most significant product in the mix, accounting for 37 percent of forest income, and representing about 7 percent of total household income.

In Africa, woodfuel markets have been estimated to employ about 7 million people, and are worth about $8 billion per year (World Bank 2011). The production, management, and marketing systems that deliver this volume of product to the market are hugely diverse, and the number varies significantly from market to market. But as an industry,

woodfuel markets generate substantial sources of income. And while added income can surely contribute to improving food security, it is not a sufficient condition for doing this.

Woodfuels are one of those products that fit both risk-management niches for rural households – as a diversification strategy some of the time and as a coping strategy during times of environmental or other stress. The impact and outcome of these markets on poverty and on the resource base have to be considered from both perspectives. If, as Delacote (2007) suggests, risk-diversification strategies are likely to be more forest- and tree-conserving (by raising the value of NTFPs), we would expect to find cases where woodfuel markets have stimulated the development of sustainable forest and tree management systems.

The better-known cases where woodfuel markets have created sustainable supplies tend to focus on higher-value production of an industrial feedstock, as in Brazil, where eucalyptus is grown on a large scale to provide charcoal for the steel industry. But there are other cases where charcoal markets have created new management opportunities. For example, in the Argentine province of Salta, in the plains of the Gran Chaco, management systems have been devised to bring large areas of degraded woodland back under production, with one objective being charcoal production (Bucher and Huszar 1999). The system relies on integrating livestock management with woody biomass management, over a 20-to-40-year cycle, with the objective of landscape restoration. In the longer term, however, the system will require balancing the interests of local farmers who continue to depend on agricultural land clearance to meet livelihood objectives.

The conventional wisdom in much of Africa seems to be that the charcoal market is a driver of deforestation and forest degradation. Mwampanda et al. (2013) point out that charcoal itself is seldom the culprit, that deforestation tends to be driven by agricultural expansion, of which charcoal is a byproduct rather than a driver. The capacity of dry woodlands to regenerate and recover is well known, and there are good examples of systems that have developed, for example in Senegal and Zambia, to take advantage of this trait (see Ribot 1999; and Chidumayo and Gumbo 2013; respectively). Wurster (2010), in his assessment of the extent of forest degradation in Senegal, pointed out that forests in areas managed for charcoal production were about equally as degraded as in other areas, and could distinguish no clear differences in forest structure and tree diversity.

It is important, though, to distinguish between these types of production systems that depend on a certain amount of ecological resilience in the system, and other systems that have much lower ecological resilience. The most vulnerable, who may depend on burning charcoal as a safety net during times of environmental stress, often live in areas that are ecologically the most fragile. It is this combination of stressors – low ecological resilience combined with high economic vulnerability – that can bring the temporal dimension of managing risk into play. Risk management as a coping strategy, which depends on clearing woodlands to produce charcoal, may simply shift the risk to a period in the future, before woodlands have had the chance to recover, and resilience in one time period may be gained at the expense of resilience in another.

It is important not to overplay the impact of household income from woodfuel or other NTFPs on food security because, in general, the association between increased levels of income and food security has been somewhat ambiguous. Increasingly, the view is that traditional income and poverty measures do not provide clear information about food security, even though food insecurity and hunger can stem from constrained financial resources (Bickel et al. 2000).

So why is this? Greater income does not necessarily lead to improved food security because of household consumption preferences. Household members could spend extra income in ways that do nothing to improve food security, such as on social events or clothing. Or it may be that there is a time lag between the moment when income gains are realized, and the time of year when food insecurity tends to occur. Markets for some NTFPs are seasonal and may coincide during peak food production periods when food insecurity is less of an issue. By the time of the next lean season, earlier income surpluses gained by the sale of NTFPs could have been disbursed across household members (Haglund et al 2011). These observations point to the importance of incorporating detailed seasonal and panel data into analyses of the extent to which using NTFPs forms part of a coping strategy at the household level.

What seems to be more significant than income by itself in determining food security outcomes is the ability of rural households to diversify their livelihood sources. As Nielsen, Pouliot, and Bakkegaard (2012) point out, households with income levels above the poverty line can be vulnerable if they lack the asset base to diversify their livelihoods or otherwise compensate for income shocks. Conversely, a household that has earnings below the poverty line, but that has access to environmental and other assets, may suffer fewer changes in living standards from a sudden income drop if it can compensate by drawing on these assets.

Diversification can be an ex ante risk-mitigation strategy, or it can be a response, ex post, to household shocks. Debela et al. (2012), for example, showed that among households living in forested areas of Uganda, average rates of livelihood diversification (in terms of the number and relative importance in total income) were larger for households that received proportionately larger income shocks in previous periods.

The analogues with ecological resilience are obvious: more diverse ecosystems are more resilient to environmental and other shocks. Greater economic diversity in terms of assets that can be used for income and consumption creates households that are more resilient to food insecurity. So the roles of forests and trees in building household resilience and increasing food security come from these two dimensions: they create more diverse and resilient farming ecosystems on the one hand, while on the other creating greater economic diversity in terms of assets that can be used for income and consumption.

4. Building resilient landscapes for improving food security

So how can farming ecosystems be made more robust, and how can diversification be used to do this? To start with, there is a clear need to step back and take a broader perspective about how trees and forests are part of the rural landscape. Increasingly, at the World Bank at least, we are taking a more considered view of how to support *landscape approaches* for sustainable development.

What do we mean when we talk about landscapes and landscape restoration?

The term “landscape” has increasingly permeated discussions regarding rural development during the past several years (see Rietbergen-McCracken, Maginnis, and Sarre 2007). A landscape is often defined as a geographical construct that not only includes biophysical features of an area but can include its cultural and institutional attributes. It describes a mosaic of land cover and land-use types relevant to the processes or services being considered or

managed,[4] a dynamic, complex patchwork of overlapping political, economic, social, and ecological systems that are individually relatively homogeneous.

At one end of the spectrum, trees in landscapes can occupy specialized niches at the farm level, producing commodities for sale or for home consumption, and/or increasing the resilience of crop production systems. They can help even out the household's use of seasonal labor, or create reserves of capital for new investment, and can contribute to clarifying who has tenure over land demarcated by trees.

At the other end of the spectrum, forest landscapes can range from contiguous and large tracts of forests used for multiple purposes (production; cultural, recreational, or environmental services; and the like) to mosaics of forests and blocks of trees within the rural landscape. They can be managed with varying degrees of intensity, and may become integrated into mixed farming agro-silvicultural systems. In drier parts of Africa, woodland and woodland mosaics produce valuable inputs into farming systems, including leaf litter for cropping systems and livestock browse and fodder. In Southeast Asia, forest landscapes are found spread throughout rural farming systems, and these enable people to exploit mountain slopes in ways that yield a diversity of crops, maintain soil fertility and watershed functions, and retain indigenous biodiversity.

It has been widely observed that forest landscapes go through a transition as populations increase, with increasingly anthropomorphic influences on forests and trees, resulting first in forest degradation and deforestation, but then eventually transitioning to landscapes where planted and managed trees and forest patches are fully integrated into productive farming systems and agricultural landscapes.

Increasingly, the term "landscape approach" has been used to describe a conceptual framework that allows for a structured way of viewing the broader effects of any major investment or intervention in the rural sector. It describes interventions at spatial scales that attempt to optimize spatial relations and interactions among a range of land cover types, institutions, and human activities in an area of interest. The ideas of landscape restoration, landscape planning, and ecoagriculture all build on landscape approaches and principles.

A tree-oriented approach to "landscape restoration" is meant to complement and enrich more narrowly defined approaches to afforestation, reforestation, and land and water conservation. Central to this approach is the need to improve both human livelihoods and ecological integrity. Landscape restoration aims to—

- restore a balance of environmental, social, and economic benefits from forests and trees within a broader pattern of land use;
- enhance the functionality of a landscape and the supply of environmental services across the range of land uses, not just maximizing new forest cover;
- have an impact on the whole landscape, and not just individual sites. This allows for trade-offs but also introduces particular challenges with respect to scaling-up; accordingly, site-level activities accommodate, or are nested in, landscape-level objectives;
- stimulate grassroots economic development that supports sustainable livelihoods and thus diminishes some of the drivers of landscape degradation;
- involve people as central elements of the landscape and, by doing so, enhance local stakeholder involvement in decision making and implementation; and

[4] This section is derived from Dewees et al. (2011).

- recognize that the dynamic nature of ecosystems and socioeconomic systems makes gathering complete information regarding any system basically unachievable (accordingly, explicit efforts are made to integrate and adapt plans, programs, and projects that are active in a landscape, including the sharing of new knowledge and information).

The approach can involve the use of a wide range of restoration options that may include active promotion of natural regeneration, for example, in the parkland forest/farm systems of West Africa (Sendzimir, Reij, and Magnuszewski 2011), as well as different types of tree planting and agricultural and sustainable land management strategies (Palm et al. 2010). The expectation is that these approaches would not lead to the conversion of natural forests or other ecologically important landscape features into tree plantations or ecologically degrading farming systems.

What are some examples of a landscape approach?

Some countries are already incorporating landscape strategies as a central part of national development policy. In February 2011, Rwanda announced a program of border-to-border landscape restoration. Ethiopia's new agriculture investment program encompasses numerous large landscape restoration initiatives, and the Fadama program in Nigeria with the same objective has generated billions of dollars in public and private investment.

The Great Green Wall is an initiative developed by the African Union to develop a green belt 15 kilometers wide stretching across Africa from Senegal to Djibouti, and is an excellent example of a transnational landscape approach. In terms of scale, this landscape initiative is meant to protect the land against desert encroachment and soil erosion.

In Rwanda, agriculture is challenged by uneven rainfall, production variability, small land holdings, limited commercialization, and land constraints due to population growth. The Land Husbandry, Water Harvesting and Hillside Irrigation Project, supported in part by the World Bank, addresses these challenges through a landscape approach by providing infrastructure for land husbandry (e.g., terracing, downstream reservoir protection), water harvesting (e.g., valley dams and reservoirs), and hillside irrigation (e.g., water distributions piping, fittings, and field application for basin and furrow irrigation), complementing a government program for border-to-border landscape restoration, rooted in an ecosystems approach.

In Albania, a project that integrates forest, pasture, and agriculture management shows that with strong involvement from local communities, whole landscapes can recover with dramatic results. Improved forest governance, local management, small-scale investments, and managed grazing measures have halted unsustainable land use, thereby reducing carbon emissions and protecting key watersheds. As a result, incomes from forest and agriculture activities have increased by 50 percent in targeted micro-catchment areas (World Bank 2012).

On Colombian hillsides, the landscape approach is integrating livestock, trees, and a range of crops, depending on the slope of the land and the direction of the streams, to increase incomes while conserving the landscape. In Ethiopia's Great Rift Valley, the landscape approach has included establishing forest cooperatives that sustainably manage and reforest the surrounding land using the farmer-managed natural forest regeneration technique, thus addressing deforestation that threatens groundwater reserves that provide potable water for 65,000 people. Ethiopia has also used its highly developed program for creating social safety nets to finance the restoration of extensive degraded landscapes, through tree planting, terracing, and other measures to improve the landscapes' capacity to provide environmental services (see Andersson, Mekonnen, and Sage 2011). In Niger, farmer-managed woodland regeneration is increasing fodder and fuelwood, providing shade for animals, increasing organic matter in the soil,

and enabling yield increases for cropped agriculture (see Haglund et al. 2011). The World Bank Loess Plateau Watershed rehabilitation project is an example of an integrated landscape approach from China.

What does it take for a landscape approach to work?

In general, a landscape approach works better if rights to land and trees are secure. This creates incentives for individual farmers, households, and communities to invest in improved land and water management and to protect trees and forests. Appropriate pricing regimes encourage rational use of scarce resources. Regulations are sometimes also needed (e.g., to control pollution runoff or avoid free grazing of animals), but these must be backed up by appropriate incentives for private farmers to invest in "public good" activities that may benefit others in the landscape in addition to strengthening the delivery of ecosystem services (Kline, Mazzotta, and Paatterson 2009).

Landscape management often also requires up-front investments that yield benefits in the longer run. This requires creating an enabling environment to access long-term finance, or to overcome the trade-offs between short-term costs and long-term benefits. Governments can support provision of, and investment in, public goods such as research in improved breeds and farming systems.

Communications and information infrastructure is also very helpful. If people do not have access to information they can understand, then they don't have an incentive to change behavior. Improved technologies also have a role, as does taking advantage of local knowledge. Creating an environment conducive to behavioral change is also important. Decentralized decision making facilitates locally adapted solutions and encourages local communities to participate. Access to information and long-term finance, as well as transparent and accountable institutions, are essential.

Policies for building resilient landscapes and resilient households

Various policy responses have been shown to create an improved climate for incorporating trees and forests more fully into managed and resilient rural landscapes.

Policies and institutions need to be reoriented to ensure that trees, forests, and landscape restoration are addressed in the decentralization agenda. The devolution of full control over land and other natural resources to local institutions and organizations is increasingly seen as a requirement for bringing about better natural resource management. While decentralization is not a guarantee of success, local control increases the chances for improved management and benefits. The challenges are to enhance the legitimacy of local management organizations, to ensure that these organizations can put in place effective management mechanisms, and to see that local organizations have the capacity to limit elite capture.

Improving value-addition at the local level can increase incentives for better management of landscapes and trees in farming systems. Local value-added can be enhanced through various policy and regulatory mechanisms; these include simplifying the regulatory regime to reduce transaction costs for poor producers, and developing a framework for improving support for producer organizations and user groups. In many ways, regulatory regimes have acted as a trade barrier, limiting competition, restricting market entry, and keeping producer margins low and consumer prices high. A simplified regulatory regime that favors the capacity of producers to manage trees could

contribute to expanding markets. Trade associations have shown that they can play a role in promoting market diversification, improving the prospects for niche market entry, and establishing product standards.

Payments for environmental services can help. Markets for environmental services from trees and from better managed farming landscapes are potentially quite important for carbon sequestration, biodiversity conservation, tourism, and watershed management. These markets could be more fully developed in line with the emergence of new financing instruments and international commitments. Experience so far has suggested that these types of initiatives are most successful when they are integrated with other rural development activities. Combined with direct benefits, such as productivity increases and improved climate resilience, payments for environmental services may provide additional incentives for local people to manage trees and landscapes more sustainably.

Forest organizations need to be revitalized. Forest organizations are generally underfunded and not aligned with the major thrusts of rural development efforts. These organizations often resist change, even though their failure to adapt increases their marginalization. Perhaps the biggest challenge for forest organizations is the need for a reorientation from their earlier roles, which were largely regulatory, to roles with a much stronger service-delivery orientation, aligned with the poverty mitigation agenda. The skill set that currently characterizes forest organizations, and the budget processes that allocate public resources for forest management, are largely irrelevant for meeting the challenges of managing trees and forests in farming systems. Similarly, with only a few exceptions, forest research institutions have demonstrated a limited understanding of the complexities of tree cultivation and management to meet local needs. It may be that responsibilities for service delivery should shift to other institutions with greater capacity for engaging local stakeholders in improving natural resource management.

Rural development efforts should work across sectors to encourage synergies. To increase investments in trees and forests to build resilient landscapes on a meaningful scale, government and donor-led initiatives must go beyond the forest sector and engage a wide range of public and private stakeholders including water, agriculture, livestock, energy, land, and environmental finance and planning authorities; producer groups; civil society organizations, including business associations; food companies; and private investors.

Policies that improve land, water, and tree governance can minimize the risks of large-scale land acquisitions. Large-scale land acquisitions are increasingly a reality in Africa and elsewhere, and present both risks and opportunities. Policies that strengthen information access and protect existing land rights can help ensure that land transfers are voluntary and beneficial to local people. A sound policy framework can help attract responsible agro-investors who respect a set of basic principles and can strengthen food security rather than putting it in jeopardy. At the individual farmer level, adequate legislation that recognizes farmers' rights to the trees on their farms can provide incentives for land restoration and sustainable land management practices.

REFERENCES

Andersson, C., A. Mekonnen, and J. Stage. 2011. "Impacts of the Productive Safety Net Program in Ethiopia on Livestock and Tree Holdings of Rural Households." *Journal of Development Economics* 94: 119–126.

Barany, M., A.L. Hammett, K. Stadler, and E. Kengni. 2004. "Non-Timber Forest Products in the Food Security and Nutrition of Smallholders Afflicted by HIV/AIDS in Sub-Saharan Africa." *Forests, Trees and Livelihoods* 14: 3–18.

Bellefontaine, R., S. Petit, M. Pain-Orcet, P. Deleporte, and J.G Bertault. 2002. *Trees Outside Forests: Towards Better Awareness*. FAO Conservation Guides 35, Rome: FAO.

Bickel, G., M. Nord, C. Price, W. Hamilton, and J. Cook. 2000. *Guide to Measuring Household Food Security*. Alexandria, VA: U.S. Department of Agriculture (Food and Nutrition Service).

Bucher, E.H., and P.C. Huszar. 1999. "Sustainable Management of the Gran Chaco of South America: Ecological Promise and Economic Constraints." *Journal of Environmental Management.* 57: 99–108.

Carpenter, S., B. Walker, J.M. Anderies, and N. Abel. 2001. "From Metaphor to Measurement: Resilience of What to What?" *Ecosystems* 4: 765–781.

Chidumayo, E.N., and D.J. Gumbo. 2013. "The Environmental Impacts of Charcoal Production in Tropical Ecosystems of the World: A Synthesis." *Energy for Sustainable Development* 17: 86–94.

CIFOR. 2011. PENews 2011-2 2011 (September-October). http://www.cifor.org/pen/news-events/penews-2011-2-2011-september-october.html

Cowen, M.P. 1978. "Capital and Household Production: The Case of Wattle in Kenya's Central Province, 1903–64." Ph.D. dissertation, University of Cambridge.

Debela, B., G. Shively, A. Angelsen, and M. Wik. 2012. "Economic Shocks, Diversification and Forest Use in Uganda." *Land Economics* 88 (1): 139–154.

de Foresta, H., E. Somarriba, A. Temu, D. Boulanger, H. Feuilly, and M. Gauthier. 2013. *Towards the Assessment of Trees Outside Forests*. Resources Assessment Working Paper 183. Rome: FAO.

Delacote, P. 2007. "Agricultural Expansion, Forest Products as Safety Nets, and Deforestation." *Environment and Development Economics* 12: 235–249.

Dewees, P.A. 1995. "Trees and Farm Boundaries: Farm Forestry, Land Tenure and Reform in Kenya." *Africa* 65 (2): 217–235.

Dewees, P., F. Place, S.J. Scherr, and C. Buss, C. 2011. *Investing in Trees and Landscape Restoration in Africa: What, Where, and How*. Washington, DC: PROFOR.

Dewees, P.A., B.M. Campbell, Y. Katerere, A. Sitoe, A.B. Cunningham, A. Angelsen, and S. Wunder. 2010. "Managing the Miombo Woodlands of Southern Africa: Policies, Incentives and Options for the Rural Poor." *Journal of Natural Resources Policy Research* 2 (1): 57–73.

FAO. 2008. *An Introduction the Basic Concepts of Food Security.* Rome: EC-FAO Food Security Program. http://www.foodsec.org/docs/concepts_guide.pdf

———. 2005. "Miombo Woodlands and HIV/AIDS Interactions—Mozambique Country Report." Forestry Policy and Institutions Working Paper 2, Food and Agriculture Organization of the United Nations, Rome. http://www.fao.org/docrep/008/j5251e/j5251e00.htm

———. 1996. *Declaration on World Food Security*. World Food Summit. Rome: FAO.

Fisher, M., and G.E. Shively. 2005. "Can Income Programs Reduce Tropical Forest Pressure? Income Shocks and Forest Use in Malawi?" *World Development* 37(7): 1115–1128.

Haglund, E., J. Ndjeunga, L. Snook, and D. Pasternak. 2011. "Dry Land Tree Management for Improved Household Livelihoods: Farmer Managed Natural Regeneration in Niger." *Journal of Environmental Management* 92: 1696-1705.

Hegde, R., and G. Bull. 2008. "Economic Shocks and Miombo Woodland Resource Use: A Household Level Study in Mozambique." In *Managing the Miombo Woodlands of Southern Africa*, ed. P. Dewees (Technical Annex 4). Washington, DC: World Bank.

Hollings, C.S. 1973. "Resilience and Stability of Ecological Systems." *Annual Review of Ecology and Systematics* 4: 1–23.

———, and M.A. Goldberg. 1971. "Ecology and Planning." *Journal of the American Institute of Planners* 37 (4): 221–230.

Kayambazinthu, D., M. Barany, R. Mumba, and C. Holding Anyonge. 2005. "Miombo Woodlands and HIV/AIDS Interactions: Malawi Country Report." Forestry Policy and Institutions Working Paper 6, Food and Agriculture Organization of the United Nations, Rome. http://www.fao.org/docrep/008/j6038e/j6038e00.htm

Kline, J.D., M.J. Mazzotta, and T.M. Patterson. 2009. "Toward a Rational Exuberance for Ecosystem Services Markets." *Journal of Forestry* (June): 204–212.

Maxwell, S. 1996. "Food Security: A Post-Modern Perspective." *Food Policy* 21 (2): 15–170.

———, and M. Smith. 1992. "Household Food Security: A Conceptual Review." In *Household Food Security: Concepts, Indicators, Measurements. A Technical Review,* ed. S. Maxwell and T. Frankenberger. New York and Rome: United Nations Children's Fund (UNICEF) and International Fund for Agricultural Development (IFAD)

McSweeney, K. 2002. "Who Is Forest Dependent? Capturing Local Variation in Forest-Product Sale, Eastern Honduras." *The Professional Geographer* 54: 158–174.

Michon, G., F. Mary, and J. Bompard. 1986. "Multistoried Agroforestry Garden System in West Sumatra, Indonesia." *Agroforestry Systems* 4 (4): 315-338.

Mwampanda, T.H., A. Ghilardi, K. Sander, and K.J. Chaix. 2013. "Dispelling Common Misperceptions to Improve Attitudes and Policy Outlook on Charcoal in Developing Countries." *Energy for Sustainable Development* 17: 75–85.

Ngaga, Y.M., E. Munyanziza, and H.E. Masalu. 2006. "The Role of Wild Mushrooms in the Livelihoods of Rural People in Kiwele Village, Iringa, Tanzania: Implications for Policy." *Discovery and Innovation* 18: 246–251.

Nielsen, M.R., M. Pouliot, and R.K. Bakkegaard. 2012. "Combining Income and Assets Measures to Include the Transitory Nature of Poverty in Assessments of Forest Dependence: Evidence from the Democratic Republic of Congo." *Ecological Economics* 78: 37–46.

Palm, C.A., S.M. Smukler, C. Sullivan, P. Mutuo, G. Nyadzi, and M.G. Walsh. 2010. "Identifying Potential Synergies and Trade-Offs for Meeting Food Security and Climate Change Objectives in Sub-Saharan Africa." *Proceedings of the National Academy of Sciences* 107 (46): 19661–19666.

Pattanayak, S.K., and E.O. Sills. 2001. "Do Tropical Forests Provide Natural Insurance? The Microeconomics of Non-Timber Forest Product Collection in the Brazilian Amazon." *Land Economics* 77: 595–612.

Paumgarten, F. 2007. *The Significance of the Safety Net Role of NTFPs in Rural Livelihoods, South Africa.* Rhodes University. Grahamstown (South Africa), (MSc thesis).

———, 2005. "The Role of Non-Timber Forest Products as Safety Nets: A Review of Evidence with a Focus on South Africa." *GeoJournal* 64: 189–197.

Ribot, J.C. 1999. "A History of Fear: Imagining Deforestation in the West African Dryland Forests." *Global Ecology and Biogeography* 8: 291–300.

Rietbergen-McCracken, J., S. Maginnis, and A. Sarre. 2007. *The Forest Landscape Restoration Handbook.* London: Earthscan.

Russell, A., B. Locatelli, E. Pramova, G.J. Alumai, and D. Chandrasekharan Behr. 2012. "Using Forests to Enhance Resilience to Climate Change: What Do We Know About How Forests Can Contribute to Adaptation?" Working Paper. Washington, DC: PROFOR.

Scoones, I., M. Melnyk, and J. Pretty. 1992. "The Hidden Harvest: Wild Foods and Agricultural Systems. A Literature Review and Annotated Bibliography." Report prepared for the Swedish International Development Authority and the World Wildlife Fund. London: International Institute for Environment and Development.

Sendzimir, J., C.P. Reij, and P. Magnuszewski, 2011. "Rebuilding Resilience in the Sahel: Regreening in the Maradi and Zinder Regions of Niger." *Ecology and Society* 16 (3):1.

Shackleton, S.E. 2006. "Forests as Safety Nets for Mitigating the Impacts of HIV/AIDS in Southern Africa." Forest Livelihood Brief 4, CIFOR, Bogor, Indonesia.

Takasaki, Y., B.L. Barham, and O.T. Coomes. 2004. "Risk Coping Strategies in Tropical Forests: Floods, Illnesses, and Resource Extraction." *Environment and Development Economics* 9: 203–224.

Tairo, V.E. 2007. "The Composition and Regeneration Status of Wild Food Plants in Chenene Miombo Woodland, Dodoma Rural District, Tanzania." *Discovery and Innovation* 19: 107–111.

Volker, M., and H. Waibe. 2010. "Do Rural Household Extract More Forest Products in Times of Crisis? Evidence from the Mountainous Uplands of Vietnam." *Forest Policy and Economics*. Doi:10.1016/j.forpol.2010.03.001.

Walker, B., C.S. Hollings, S.R. Carpenter, and A. Kinzing. 2004. "Resilience, Adaptability and Transformability in Social-Ecological Systems." *Ecology and Society* 9 (2): 5.

Weber, M.T., J.M. Staatz, J.S. Holtzman, E.W. Crawford, and R.H. Bernsten. 1998. "Informing Food Security Decisions in Africa: Empirical Analysis and Policy Dialogue." *American Journal of Agricultural Economics* 70 (5): 1044–1052.

Wilson., K.B. 1989. "Trees in Fields in Southern Zimbabwe." *Journal of Southern African Studies* 15 (2): 1–15.

Wood, G. 2003. "Staying Secure, Staying Poor: The 'Faustian Bargain.'" *World Development* 31: 455–471.

World Bank. 2012. "Albania Natural Resources Development Project." Implementation Completion and Results Report (ICR1859), Europe and Central Asia Department, Sustainable Development Department, World Bank, Washington, DC.

———. 2011. *Wood-Based Biomass Energy Development for Sub-Saharan Africa: Issues and Approaches.* Washington, DC: World Bank Africa, Renewable Energy Access Program.

Wurster, K.W. 2010. "Management Matter? Effects of Charcoal Production Management on Woodland Regeneration in Senegal." Ph.D. thesis, University of Maryland, College Park.

Zomer, R.J., A. Trabucco, R. Coe, and F. Place. 2009. "Trees on Farm: Analysis of Global Extent and Geographical Patterns of Agroforestry." World Agroforestry Centre Working Paper 89, World Agroforestry Centre, Nairobi, Kenya.

Zulu, L.C. 2010. "The Forbidden Fuel: Charcoal, Urban Woodfuel Demand and Supply Dynamics, Community Forest Management and Woodfuel Policy in Malawi." *Energy Policy* 38 (2010): 3717–3730.