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Dacryodes edulis, Irvingia gabonensis, Sclerocarya birrea, eco-agriculture, Green Revolution, domestication, agroforestry tree products (AFTPs)

Chapter 2

Trees and markets for agroforestry tree products: Targeting poverty reduction and enhanced livelihoods

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Abstract

Agroforestry tree domestication as a farmer-driven, market-led process emerged as an international initiative in the early 1990s, although a few studies pre-date this. A participatory approach now supplements the more traditional aspects of tree improvement, and is seen as an important strategy for meeting the Millennium Development Goals of eradicating poverty and hunger and promoting social equity. Considerable progress towards the domestication of indigenous fruits and nuts has been achieved in many villages in Cameroon and Nigeria that focuses on 'ideotypes', based on an understanding of the tree-to-tree variation in many commercially important traits. Vegetatively propagated cultivars are being developed by farmers for integration into their polycultural farming systems, especially cocoa agroforests. However, if agroforestry is to be adopted on a scale that has meaningful economic, social and environmental impacts, it is crucial that markets for agroforestry tree products (AFTPs) are expanded. Detailed studies of the commercialization of AFTPs, especially in southern Africa, provide support for the wider acceptance of the role of indigenous tree domestication in the enhancement of livelihoods for poor farmers in the tropics. Consequently, policy guidelines are presented in support of this new approach to sustainable rural development – an alternative to the biotechnology approaches being promoted by some development agencies.

Introduction

In the context of reducing poverty and enhancing the livelihoods of poor smallholder farmers, this chapter presents the evolution over the last 10–15 years of tree domestication strategies, approaches and techniques aimed at promoting the cultivation of trees and the development of markets for agroforestry tree products (AFTPs). It relates the domestication of agroforestry trees to the commercialization of their products and examines the important role that markets play in the adoption of agroforestry and in the achievement of some of the Millennium Development Goals (MDGs). Finally, it suggests that the domestication and commercialization of AFTPs represents a rural development paradigm that is appropriate for wider implementation in developing countries.

Trees

The origins of tropical tree domestication

The domestication of many species for food and other products has been carried out for thousands of years in almost every part of the world, often arising from extractive uses by indigenous people (Homma 1994). The concept of domesticating trees was first presented by Libby (1973), but at this time it was focused on timber trees and was virtually synonymous with tree improvement, including the emerging clonal approaches. In 1992, a conference was held in Edinburgh, entitled 'Domestication of Tropical Trees: The Rebuilding of Forest Resources' (Leakey and Newton 1994a; 1994b), which embraced tree cultivation within the concept of domestication. The recent interest in domestication is not restricted to tree species; a range of new herbaceous crops are also being studied (Smartt and Haq 1997). Many indigenous vegetables are candidates for domestication (Schippers 2000) and can be components of multistrata systems, where there is a need for new shade-tolerant crops.

These days, the World Agroforestry Centre's tree domestication activities fall within a Trees and Markets research theme that stresses the commercialization of AFTPs in the overall poverty alleviation strategy of the Centre. While the focus of this chapter is on the development of marketable products from agroforestry trees, interest in tree domestication encompasses trees for other purposes such as soil amelioration, fodder, fuelwood, timber, boundary demarcation, and so on.

The aim of tree domestication

The definition of tree domestication, established at the 1992 Edinburgh conference, encompasses the socioeconomic and biophysical processes involved in the identification and characterization of germplasm resources; the capture, selection and management of genetic resources; and the regeneration and sustainable cultivation of the species in managed ecosystems (Leakey and Newton 1994a; 1994b). This concept has subsequently been refined and expanded with emphasis on it being a *farmer-driven* and *market-led* process (Leakey and Simons 1998; Simons 1996; Simons and Leakey 2004) that takes a participatory approach to involve local communities (Leakey et al. 2003; Tchoundjeu et al. 1998). Furthermore, not just species but also whole landscapes can be domesticated as a result of changing plant exploitation practices (Wiersum 1996).

Since the mid-1990s, a growing number of donors have recognized the potential of tree domestication to achieving ICRAF's vision and mandate for agroforestry to contribute to both poverty alleviation and the provision of environmental services (see Figure 1). The rationale is that domestication and commercialization of indigenous trees through agroforestry will provide an incentive for subsistence farmers to plant trees in ways that will reduce poverty and enhance food and nutritional security, human health and environmental sustainability. In this way, agroforestry tree domestication is seen as an important component of strategies to achieve the Millennium Development Goals (Garrity 2004; also see Chapter 1 this volume, especially goals relating to environmental sustainability and food security (Goals 1 and 3–8: www.un.org/millennium-goals). It is important to note, however, that to bring about effective outcomes from this research the messages have to be clearly and widely disseminated to farmers, foresters and many relevant institutions.

The genetic improvement of trees has usually been the prerogative of national and international research institutes, but since the start of the Centre's Tree Domestication Programme (a forerunner to its Trees and Markets theme), the approach pursued has been a participatory one.

The Humid Lowlands of West and Central Africa (HULWA) was the first of the Centre's regions to develop participatory approaches that went beyond simply collecting germplasm. This started with the development of guidelines for species priority setting, derived by a partnership of international and national scientists with farmers and both non-governmental and community-based organizations (Franzel et al. 1996). This project has since evolved in several ways:

1. It now includes a range of different species.
2. It has used, disseminated and refined a simple low-technology system for the vegetative propagation of tropical trees, appropriate for use in small, low-cost village nurseries (Leakey et al. 1990; Mbile et al. 2004; Shiembo et al. 1997).
3. It has been quantitatively examining the tree-to-tree variation in a range of fruit and nut traits to determine the potential for highly productive and qualitatively superior cultivars (e.g. Anegbeh et al. 2005; Atangana et al. 2002; Leakey et al. 2005c; Ngo Mpeck et al. 2003; Waruhiu et al. 2004).
4. Perhaps most importantly, it has been successfully scaled-up to regional level (Tchoundjeu et al. 1998) and now encompasses 40 villages in southern Cameroon (about 2500 farmers) 11 villages in Nigeria (2000 farmers), 3 villages in Gabon (800 farmers) and 2 villages in Equatorial Guinea (500 farmers).

Together these developments result in a model participatory domestication strategy. This strategy is aligned with the United

Nations Environment Programme's Convention on Biological Diversity (Leakey et al. 2003; Simons and Leakey 2004; Tchoundjeu et al. 1998), by recognizing the rights of local people to their indigenous knowledge and traditional use of native plant species, and to benefit from commercial development of this knowledge.

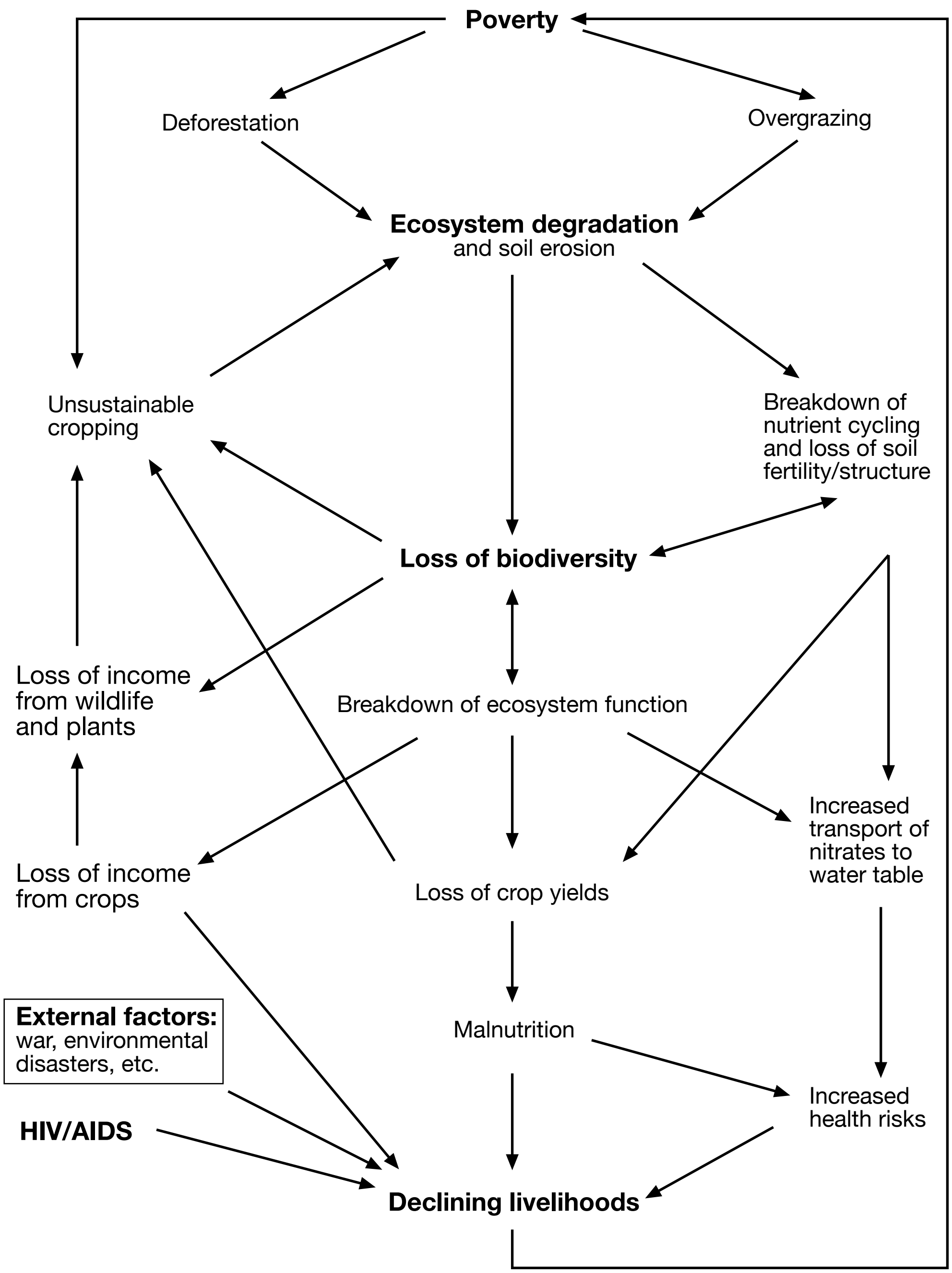

Figure 1. *The cycle of biophysical and socioeconomic processes causing ecosystem degradation, biodiversity loss, and the breakdown of ecosystem function, in agricultural land in many tropical countries.*

The extraction of fruits and medicinal products from indigenous trees by hunter-gatherers is a traditional practice in most tropical regions (Sullivan 1999). It has also been noted that farmers frequently maintain indigenous fruit and nut trees within their farming systems and sell the products locally. Yet despite these observations, and the findings of the species prioritization process, international donors were initially sceptical about investing in new crop species. This scepticism perhaps stemmed from a deep commitment to the Green Revolution, coupled with a top-down approach to rural development in the tropics – still evident in the on-going pursuit of new biotechnological solutions (Lipton 1999; McCalla and Brown 1999).

As proof, a study of the frequency distribution patterns of traditional species found that subsistence households are indeed committed to their traditional food species (Leakey et al. 2004). This conclusion has been corroborated by the quantification of the numbers of indigenous fruit trees in farmers' fields in Cameroon, especially on small farms (Degrande et al. in press; Schreckenberg et al. 2002). In Benin, relative densities of widely used species are typically higher in farmers' fields than in the natural savanna vegetation because of preferential retention by farmers (Schreckenberg 1999). Interestingly, evidence from South Africa indicates that the yield of marula (*Sclerocarya birrea*), a traditionally important indigenous fruit tree, is increased by 5- to 15-fold through cultivation in homestead plots and fields (Shackleton et al. 2003a). Mean fruit size is also greater from trees in these plots, again with some evidence for domestication by farmers (Leakey 2005; Leakey et al 2005a; 2005b).

Identification, capture, retention and protection of genetic diversity

Domestication has been defined as human-induced change in the genetics of a species to conform to human desires and agroecosystems (Harlan 1975). It is not surprising therefore, that much of the work to domesticate agroforestry trees has focused on both the identification of intraspecific genetic variability of the priority species and the vegetative propagation techniques to capture these superior combinations. However, one desirable trait is not necessarily correlated with another: thus large fruits are not necessarily sweet fruits, and do not necessarily contain large nuts or kernels. This multitrait variation, coupled with the variability of each individual trait, results in a considerable opportunity for selection of trees with good combinations of traits, but also makes it more unlikely that an ideal tree will be found. Thus, large numbers of trees have to be screened to find the rare combinations of traits. This rapidly becomes impractical and very expensive. Consequently, the practical approach is to search for trees that have particular market-oriented trait combinations (or ideotypes) – such as big, sweet fruits for the fresh fruit market (a fruit ideotype) or big, easily extracted kernels for the kernel market (kernel ideotype), etc.

Trees can also be selected for production traits such as yield, seasonality and regularity of production, reproductive biology, and reduction of susceptibility to pests and diseases (Kengue et al. 2002). High yield is obviously a desirable trait in any cultivar, but, within reason, may not be as important in the early stages of domestication as the quality attributes. Fruiting season time/length, ripening period and seedlessness are other important variables that could be selected for (Anegbeh et al. 2005).

Such great intraspecific genetic diversity needs to be preserved. Domestication is generally considered to reduce genetic diversity, a situation that may occur where the domesticated plant replaces or dominates the wild origin, but is probably not the case at the current level of domestication of agroforestry trees. For example, the range of fruit sizes in on-farm populations of *Dacryodes edulis* and *Irvingia gabonensis* has been increased by the early stages of domestication (Leakey et al. 2004). Nevertheless, the maintenance of genetic diversity is essential. Modern molecular techniques can identify the 'hot-spots' of intraspecific diversity (Lowe et al. 2000), which should, if possible, be protected for in situ genetic conservation, or be the source of germplasm collections if ex situ conservation is required. In addition, when developing cultivars, they should originate from unrelated populations with very different genetic structures.

Having identified the superior trees with the desired traits, the capture of tree-to-tree variation using techniques of vegetative propagation is relatively simple and well understood (Leakey 2004b; Leakey et al. 1996; Mudge and Brennan 1999). Cuttings from mature trees have a low rate of propagative success, and the number of people with the appropriate skills to carry it out may be a constraint to its widespread application in the future (Simons and Leakey 2004). However, propagation by juvenile leafy cuttings is very easy for almost all tree species and is currently the preferred option for participatory domestication in village nurseries (Mbile et al. 2004; Mialoundama et al. 2002; Shiembo et al. 1996; Tchoundjeu et al. 2002b).

Cultivation and the growth of cultivars

The final stage of the domestication process is the optimal integration of selected plants into the farming system (Leakey and Newton 1994a; 1994b). In African farmland, a wide range of densities and configurations are grown (Kindt 2002). In Cameroon, for example, cocoa agroforests have been reported to contain around 500 cocoa bushes growing with 15 other types of trees and shrubs (Gockowski and Dury 1999). Agroforestry is expected to provide positive environmental benefits on climate change and biodiversity (Millennium Development Goal 7). However, research is needed to determine the impacts of such diversity on agroecosystem function (Gliessman 1998; Leakey 1999b; Mbile et al. 2003); carbon sequestration (Gockowski et al. 2001) and trace gas fluxes; and on the sustainability of production and household livelihoods.

Markets

The term agroforestry tree products (AFTPs) is of very recent origin (Simons and Leakey 2004) and refers to timber and non-timber forest products (NTFPs) that are sourced from trees cultivated outside of forests, to distinguish them from NTFPs extracted from natural systems. However, some products will be marketed as both NTFPs and AFTPs during the period of transition from wild resources to newly domesticated crops. Consequently, both terms are used in the following sections.

Economic and social benefits from trading AFTPs

To be effective, there must be a link between tree domestication and product commercialization, which requires the involvement of food, pharmaceutical and other industries in the identification of the characteristics that will determine market acceptability (Leakey 1999a). In West and Central Africa, a number of indigenous fruits and nuts, mostly gathered from farm trees, contribute to regional trade (Ndoye et al. 1997). In Cameroon, the annual trade in products from five key species has been valued at US$7.5 million, including exports worth US$2.5 million (Awono et al. 2002). Women are often the beneficiaries of this trade; they have especially indicated their interest in marketing *D. edulis* fruits because the fruiting season coincides with the time to pay school fees and to buy school uniforms (Schreckenberg et al. 2002). It is also the women who are the main retailers of NTFPs (Awono et al. 2002). Marula (*Scleocarya birrea*) is another fruit with a harvesting season that coincides with the start of the school year, and therefore the greater involvement of women.

These tangible market benefits are supplemented by additional benefits such as the availability of products for domestic consumption, the use of household labour for harvesting/processing free of charge, and ease of access to informal markets, etc. Because the production and trading of AFTPs are based on traditional lifestyles, it is relatively easy for new producers to enter with minimal skills, little capital and with few needs for external inputs. Together these make this approach to intensifying production and enhancing household livelihoods very easy, and adoptable by poor people.

The linkages between domestication and commercialization of AFTPs

As already indicated, domestication that is market-orientated has the greatest likelihood of being adopted on a scale that has impact on the economic, social and environmental problems afflicting many tropical countries. This requires that agroforesters work closely with the companies processing and marketing the products (Leakey 1999a). However, in doing this it is important to remember that smallholder farmers are the clients of the research and development (R&D) work and that there needs to be a functional production–to–consumption chain; principles that were apparently forgotten during recent domestication of peach palm (*Bactris gasipaes*) in Amazonia, resulting in the underperformance of the market (Clement et al. 2004).

In many cases, the successful commercialization of AFTPs relies on domestication to ensure that supply can keep up with the growing demand of a developing market. Through cultivar development, domestication can also help to overcome another constraint to commercialization: variability of quality (taste, size and purity). Domestication can also lead to an extended season of production, as is being done in West Africa with *D. edulis*, making it easier to supply industries throughout the year. Kiwi fruit (*Actinidia chinensis*) and macadamia nuts (*Macadamia integrifolia*) are good examples of co-ordinated domestication and commercialization.

The important question here is whether agroforestry can prevent the negative impacts that result from domesticating crops in a monoculture system, which can cause environmental degradation through deforestation, soil erosion, nutrient mining and loss of biodiversity. These systems can also result in social inequity and the 'poverty trap' for small-scale producers who are unable to compete in international trade with large or multinational companies. In theory, agroforestry is beneficial to the environment and beneficial to the poor farmer.

However, if the domestication of AFTPs is so successful that the market demand for one of them reaches the point where monoculture plantations, either in the country of origin or in some overseas location, are viable, this could undermine the whole purpose of developing new crops. Without markets there will not be the opportunity for subsistence households to increase their standard of living, while expanded market opportunities could lead to their exploitation by unscrupulous entrepreneurs. Having said that, recognizing the traditional role of NTFPs/AFTPs in food security, health and income generation, it is clear that the potential benefits from domestication outweigh the risks, and that commercialization is both necessary and potentially harmful to small-scale farmers practising agroforestry (Leakey and Izac 1996). Important areas for further study include the complex issues surrounding commercialization of genetic resources and benefit sharing (ten Kate and Laird 1999) and traditional knowledge (Laird 2002) and ways in which smallholder farmers can secure their intellectual property rights on farmer-derived innovations.

One strategy that reduces risk is to domesticate a wide range of AFTP tree species, especially those with local and regional market potential. In this way, coupled with strong indigenous rights, it is very unlikely that the market demand will attract major companies and, even if products of a few species do become international commodities, there will be others that remain.

Not all interest from international companies in agroforestry is unwelcome. For example, Daimler-Benz has taken a smallholder, multistrata agroforestry approach to producing raw materials for its C-class Mercedes-Benz cars in Brazil, and in partnership with the International Finance Corporation has been developing this as a new paradigm for public–private sector partnerships (Mitschein and Miranda 1998; Panik 1998). Smallholder cocoa farmers in Africa and Asia are supported by chocolatier Masterfoods (formerly M&M Mars) as they diversify their cocoa farms into cocoa agroforests, integrating fruit trees (often indigenous species) into the cocoa farm so that the shade trees are also companion crops (Leakey and Tchoundjeu 2001). This has been done as a risk-aversion strategy to provide new sources of income, in response to fluctuating market prices. Interestingly, cocoa is not the only former plantation cash crop to now be an important agroforestry species. Rubber is perhaps the best example, especially in Southeast Asia (Tomich et al. 2001), while tea and coffee are moving in the same direction.

A somewhat different but interesting example of AFTP commercialization is the case of marula, a tree of dry Africa, which is starting to be marketed by subsistence farmers for traditional beer and for industrial processing as an internationally marketed liqueur, 'Amarula', by Distell Corporation. Marula kernel oil ('Maruline') is also breaking into international cosmetics markets. This species thus provides an opportunity to examine the impact of different commercialization strategies on the livelihoods of the producers, the sustainability of the resource and the economic and social institutions. In other words, who or what are the winners and losers arising from the commercialization of indigenous fruits and nuts?

Winners and losers: impacts on livelihoods

The Centre for Ecology and Hydrology,UK, in collaboration with a wide range of institutions, conducted a large, multidisciplinary, multi-institutional study to determine the 'winners and losers' of the various commercialization strategies for a number of different NTFP products from two tree species (*S. birrea* and *Carapa guianensis*) in different environments and in structurally and ethnically different communities (Shackleton et al. 2003a; Sullivan and O'Regan 2003). The study specifically examined the effects of commercialization on the five forms of livelihood capital (human, social, financial, natural and physical). In brief, the authors concluded that to improve the livelihood benefits from commercializing NTFPs it is important to improve:

- The quality and yield of the products through: domestication and the dissemination of germplasm; and enhancing the efficiency of post-harvest technology (extraction, processing, storage, and so on).
- The marketing and commercialization processes by: diversifying markets for existing and new products; investing in marketing initiatives and campaigns; and promoting the equitable distribution of benefits.

The following lessons were learnt for NTFP commercialization from the study of *S. birrea* (abridged from Shackleton et al. 2003b), that apply equally to AFTPs:

- NTFPs are most important for poor and marginalized people.
- NTFPs make up income shortfalls but do not significantly alleviate poverty. How domestication may change this still needs to be determined.
- Engagement in NTFP commercialization and the extent of benefits is variable even among the poorest households.
- Benefits of NTFP commercialization must be weighed against the negative social and cultural costs of commercialization.
- Land and usufruct rights must be clear, government intervention must be pitched at the appropriate level, and political support for the NTFP industry must be secured.
- NTFP commercialization can lead to improved management and conservation of the resource in certain circumstances.
- NTFP cultivation needs to be community-owned and driven.
- Benefits can be accrued at the local level.
- Intellectual property right (IPR) systems that promote poverty alleviation, food security and sustainable agriculture are urgently needed.
- Models of commercialization based on partnerships between producer communities, non-governmental organizations (NGOs) and the private sector are most likely to succeed.
- The diversification of species used, products produced, markets traded, and players involved, is an extremely important strategy to minimize the risks of NTFP commercialization for rural communities.
- Scaling up and introducing new technologies can shift benefits away from women and the most marginalized producers.
- NTFPs form only part of a far broader ecological, economic, social and political landscape. For example, continued land clearance, the need for biomass energy, and wood for woodcarvings can be a greater threat than the commercialization of a fruit product.
- NTFP trade and industries are dynamic in space and time. There are seldom permanent winners and losers.

The conclusion from this study was that NTFP commercialization can create both winners and losers, but positive outcomes can be maximized if external players promote community involvement, and if the communities themselves work together and use their own strengths to manage and use their resources effectively. This is supported by the findings of a study investigating the role of tree domestication in poverty alleviation (Poulton and Poole 2001). Nevertheless, to ensure that those engaged in participatory domestication are winners, the current difficulties facing farmers wishing to protect their rights to their cultivars need to be resolved.

Policy guidelines

Inevitably, in a new research area such as this, many questions remain unanswered; indeed they cannot be answered until the techniques and strategies outlined above have been in use for longer periods and on larger scales. Nevertheless, there seems to be growing confidence on the part of institutions like ICRAF, and their donors, that this approach to agroforestry and the alleviation of poverty has merit. This is emphasized by suggestions that these concepts have a role to play in the achievement of several of the Millennium Development Goals (Garrity 2004).

One clear policy message is that it is important to recognize the 'chicken and egg' relationship between domestication and commercialization (Leakey and Izac 1996) – and the folly of doing one without the other. However, it is clear that the relationship between domestication and commercialization is delicately balanced. Both the lack of a market and the excessive growth of a market pose a threat. Sound policy interventions will probably be needed to ensure that smallholder subsistence farmers are the beneficiaries of the domestication of AFTPs. Policy makers tend not to think much about the differences between a monocultural approach to growing a new crop versus an agroforestry approach. However, in the extreme 20 million trees can either be grown by four farmers planting 5 million apiece, or by 1 million farmers each growing only 20 trees. Each scenario will likely have very different social and economic outcomes.

Desirable policy interventions (from Tchoundjeu et al. 2004; Ndoye et al. 2004; Wynberg et al. 2003) may be to:

- Promote the participatory domestication of tree species fitting a variety of on-farm niches.
- Focus domestication activities on the capture and use of intraspecific variation existing in wild/semi-domesticated populations and utilize the relatively quick economic and social returns from participatory domestication.
- Promote local-level processing and marketing of indigenous fruits, nuts and other tree products in parallel with domestication .
- Recognize the considerable training and extension needs of rural communities that are required to achieve the scaling up necessary to meet the Millennium Development Goals.
- Clarify land and usufruct rights to facilitate the successful and effective commercial development of AFTPs, recognizing that Western approaches may not be appropriate for indigenous resource tenure systems.
- Develop and implement systems to protect community-based cultivars (through participatory domestication) as part of legislative reforms for biodiversity management, indigenous knowledge protection, and plant genetic resource conservation and use.
- Ensure the continued use of a wide range of NTFPs to support rural livelihoods.
- Establish basic management, financial and institutional capacities to ensure that local people capture a greater share of the benefits from commercialisation.

Features of this approach to rural development

Although this chapter has focused on the reduction of poverty and the enhancement of smallholder livelihoods, the problems of poverty, land degradation, loss of biodiversity, social deprivation, malnutrition, hunger, poor health and declining livelihoods are all inextricably linked and cyclical (Figure 1). Consequently any attempts to alleviate the problems have to target a number of different points within the cycle. Agroforestry is advocated as one of many

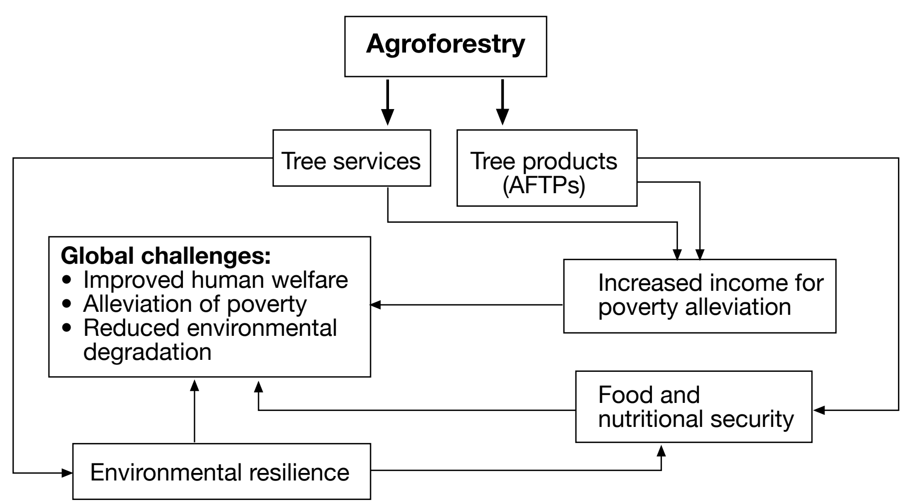

Figure 2. *The relationship between the two functions of agroforestry trees and their potential to mitigate global problems arising from unsustainable land use.*
Source: Leakey and Tomich (1999).

means of meeting these global challenges (Figure 2).

The potential of this approach of course comes with some risks (Figure 3). Furthermore, the domestication of AFTPs may reduce the market-share of wild-collected NTFPs, thereby disadvantaging landless rural people. However, the number of people benefiting from this domestication probably greatly outweighs those who are disadvantaged.

A number of studies imply that the income from AFTPs can contribute to meeting the Millennium Development Goal of halving the number of people living on less than US$1 per day. For example, in Cameroon, studies of farmers growing indigenous fruits have found that the net present value per hectare of cocoa is about US$500 greater when grown with indigenous fruits than when grown without (Gockowski and Dury 1999). To these benefits can also be added the AFTP products used in domestic consumption, which represent a saving on expenditure, and the cash earned from selling AFTPs that may be reinvested in the farms in the form of new and better inputs. It is clear therefore, that it is difficult to evaluate the total benefits obtained from marketable AFTPs.

Thus the challenge posed by the Millennium Development

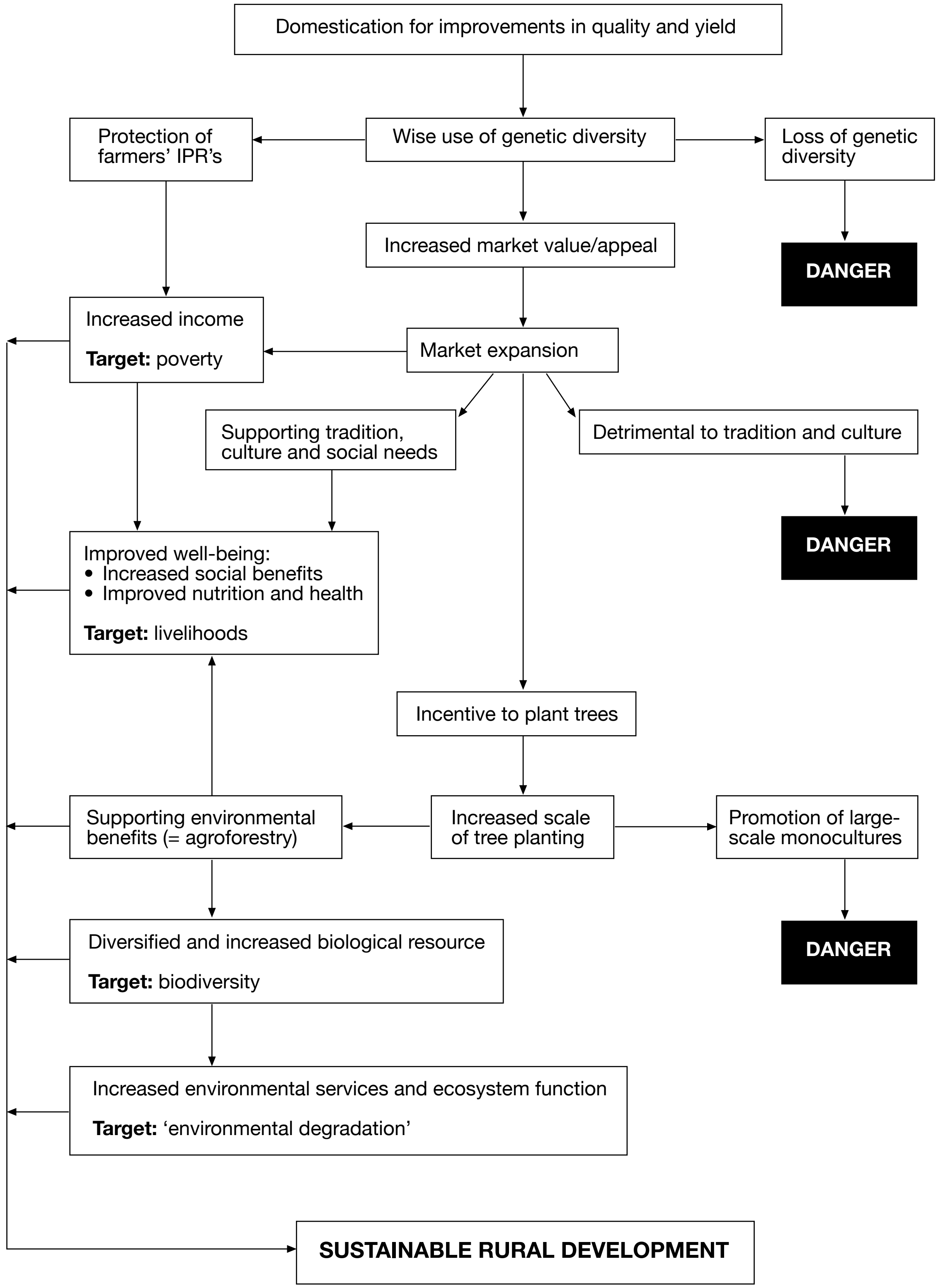

Figure 3. *Potential impacts on sustainability of domesticating agroforestry trees.*

Goals is not so much how to find a way to achieve them at the household level, but much more how to scale up AFTP production between now and 2015 to reach the millions of poor rural families (60 million in HULWA alone) for whom AFTPs might provide a step out of poverty. The AFTP approach could be thought of as a 'really green revolution' (Leakey 2001).

Development issues for the future

The scaling up of participatory domestication to tens of millions of new households across the developing world is probably the biggest challenge for agroforestry, both in terms of the logistics of training and supervision, and in the adaptation to new species, environments and markets. Techniques including vegetative propagation, and the acquisition and protection of 'community plant breeders rights' on the cultivars created by communities, are also areas where urgent action is needed. Failing to achieve this will discourage villagers from investing their time, effort and limited resources in a venture that could be taken away from them. Policy makers should realize that participatory domestication that enables community rights to be protected and realized represents a new and acceptable approach to biodiscovery – the antithesis of biopiracy.

As demand grows, markets will start to be more interested in quality rather than quantity. This will require refinements in the ideotypes for each particular market; necessitating, in turn, better market information than is currently available. Therefore, to avoid the potential pitfalls of domestication (Figure 3), strategies such as deliberate retention of intraspecific variation for pest and disease resistance, etc. will be important (Leakey 1991). In addition, as commercial interests increase, it will be important to maintain a focus on diversified agroforestry production that should promote integrated pest management (Leakey 1999b).

Around the world, agricultural R&D institutions must be helped to develop new skills in the domestication of indigenous species, the processing/storage of their products, market analysis and in developing market linkages (Garrity 2004). This level of expansion will also require high-level policy support to ensure a coordinated and coherent approach to the domestication and commercialization of AFTPs.

Conclusions

In the 9 years since agroforestry tree domestication was institutionalized at the Centre, great progress has been made. This review has focused on progress in the humid zone of West and Central Africa and in Southern Africa, but similar programmes are in progress in the Sahel, East Africa, Amazonia and Southeast Asia, as well as outside the Centre. Hopefully, the experiences reported here for agroforestry based on locally relevant tree species and markets will be of great benefit to other areas of the world embarking on similar people-centred concepts for rural development. We suggest that this approach offers a viable alternative to biotechnology-based advances in agricultural science for developing countries.

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