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DOMESTICATING INDIGENOUS FRUIT TREES AS A CONTRIBUTION TO POVERTY REDUCTION

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ABSTRACT

The contribution that domesticated indigenous fruit trees make to many farmers' livelihoods is often not acknowledged in either national- or international-level poverty reduction strategies. Current agricultural data tend to be restricted to a narrow range of exotic fruit (e.g. mango, avocado, citrus). Existing data on indigenous fruit are often not presented in the kinds of income-related terms used in the policy debate, nor are they linked to simple policy recommendations. Drawing predominantly on the examples of *Dacryodes edulis* and *Irvingia gabonensis* in Cameroon and Nigeria, this paper presents evidence for the contribution of these fruit trees to poverty reduction. Evidence on the numbers and types of people obtaining an income from indigenous fruit trees, the proportion and value of that income and whether the income acts as a safety-net or can help to move people out of poverty, is presented. Non-income related impacts on health and the environment are also discussed. Finally, key policy interventions required to sustain and increase the already valuable contribution of domesticated indigenous fruit trees are outlined.

Key words: Millennium Development Goals (MDGs), Poverty Reduction Strategy Papers (PRSPs), income generation, participatory domestication, gender, health, environmental sustainability, *Dacryodes edulis, Irvingia gabonensis.*

INTRODUCTION

The important contribution that indigenous fruit trees can make to poverty reduction has been recognised (Garrity 2004, Russell and Franzel 2004). Eradicating extreme poverty and hunger is the most important of the Millennium Development Goals (MDGs) that are currently the focus of the international development agenda. Other goals relate to improving education and health, empowering women and ensuring environmental sustainability. At a national level, the Poverty Reduction Strategy Papers (PRSPs), promoted by the World Bank and the International Monetary Fund, depict how governments may work with donors to attain the MDGs. However, even in forest-rich countries, the forestry sector gets little attention in PRSPs and the lack of examination of the links between poverty and the use of forest resources means that forest policy recommendations are rarely based on hard evidence (Bird and Dickson 2005).

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This reflects the traditional focus of the forest sector on timber production and trade, and conservation of wildlife and forests, rather than the links between forest trees and poverty.

Given the importance of PRSPs in determining national spending priorities, it is essential that appropriate data are available to allow for a more informed inclusion of forestry activities in national planning. Several international meetings in recent years have therefore addressed the links between forests and poverty, highlighting the potential of forest-based activities for income generation, as well as emphasizing the need to protect and promote the many safety-net functions of forests (Mayers and Vermeulen 2002, Oksanen *et al.* 2003, van Gardingen 2003). Arnold (2002) maintains that forestry's role in poverty alleviation is likely to be large (affecting substantial numbers of people) only if 'forestry' is defined to encompass sources of forest products both inside and outside forests, but this has been almost entirely overlooked in forest policy. Yet research into the poverty reducing role of non-timber forest products (NTFPs) has led to the recognition that many of these are no longer collected from the wild but are cultivated on farm (Ruiz-Pérez *et al.* 2004). Simons and Leakey (2004) suggest a new term 'Agroforestry Tree Product' (AFTP) to distinguish forest-collected NTFPs from the same products cultivated as crops on farms.

The important contribution that indigenous fruit trees make to many farmers' livelihoods (Poulton and Poole 2001) is often not acknowledged in national reporting. This reflects a lack of official and scientific interest in the many so-called "Cinderella species" which have provided poor people with a wide range of essential everyday products (Leakey and Newton 1994). Such national level information as is available refers predominantly to a narrow range of exotic fruit (e.g. mango, avocado, citrus) that have sufficiently large (and often international) markets to be captured in national statistics. This paper makes the case that, in addition to these conventional fruit, more attention – both at national and international level – should be paid to indigenous fruit crops. Drawing predominantly on research in the humid lowlands of Cameroon and Nigeria, with a special focus on *Dacryodes edulis* and *Irvingia gabonensis* (Leakey *et al.* 2003, Schreckenberg *et al.* 2002), the paper presents different kinds of evidence of the role indigenous fruit trees can play in poverty reduction and outlines some of the key policy interventions required to sustain and increase this contribution.

In spite of farmers' obvious interest in indigenous fruits for cash income and the range of food and medicinal products they provide, these species do not receive much attention from policy-makers, foresters or agriculturalists (Tchiegang-Megueni *et al.* 2001). A possible reason for this is concern over the lack of success of many of the tree-planting programmes of the 1970s and 80s having poverty alleviation as their primary objective. Many were implemented with little understanding of how specific trees contributed to meeting farmers' own goals (Arnold 1997). Also the evidence collected on the role of indigenous fruit trees fails to fit into the poverty reduction discussions that dominate the policy agenda. The evidence needs to be expressed in terms and concepts with

which the policy-makers are familiar, and must also be linked to recommendations that can be integrated easily into national-level planning processes. The use of the term NTFPs for products that are now routinely cultivated has not been conducive to attracting agricultural sector support; a clear distinction between NTFPs (which are within the forest policy domain) and AFTPs (which may more easily fall in the remit of agricultural policy) is needed.

Why the interest in indigenous fruit trees?

The role of exotic fruit trees in farmers' livelihoods was relatively well supported by research and extension during colonial times, ensuring that a range of high-yielding varieties is today available for different locations. These fruits may have local as well as international markets for income generation in addition to their consumption within the household. Increasingly, there is intense competition and imperatives for vertical integration in the major markets for conventional plantation-grown tropical tree fruit and commodity/cash crops. As yet, these pressures are less evident in the expanding markets for indigenous fruit and derived products, making indigenous fruits more suitable for smallholder farmers in developing countries (Poole 2004). Furthermore, the restricted number of usually exotic species promoted by extension services cannot meet the full range of farmers' needs. These include finding trees to fill a range of physical farm niches (hedgerows, shade trees, homegardens), as well as socio-economic niches (with labour inputs and benefit flows that complement those of other household activities).

The wide range of indigenous fruit trees available in many areas can enable farmers to meet their varied household needs for food, nutrition, medicines, etc. These species are often part of the traditional diet and culture and the subject of a body of indigenous knowledge regarding their management and use. Two well-documented cases of such species are the marula tree (*Sclerocarya birrea*) in southern Africa (Shackleton and Shackleton 2005) and the shea tree (*Vitellaria paradoxa*) in the West African parklands (Boffa 1999). While these two species both have wide ranges, many indigenous fruit trees have very localised importance. This is confirmed by the results of farm inventories in six sites in the humid lowlands of Cameroon and Nigeria, which found that 52% of all fruit trees are indigenous and that there is a high degree of site specificity of species distribution. While the set of exotic species is very similar from place to place, with nine out of 12 exotics occurring in all six villages, only three indigenous species (*Dacryodes edulis*, *Irvingia gabonensis* and *Cola acuminata*) occur in all six sites. Of the 28 indigenous species, 20 are found only in one or two of the villages (Degrande *et al.* in press).

The degree of farmer-driven domestication, in which farmers bring a species into a managed environment by planting or retention, revealed by a number of studies in Sub-Saharan Africa indicates that farmers are convinced that it is worth investing in indigenous fruit species. In southern Cameroon, farmers

describe how they and their parents have selected particular trees for their large fruit size as well as other characteristics such as taste and yield. This kind of selective planting by farmers has resulted in the fruits of *Dacryodes edulis* trees on farms being 66% larger than those in the forest. Farmers in south-eastern Nigeria have achieved similar successes with *Irvingia gabonensis* fruits, which are 44% larger on farm trees than on forest trees (Leakey *et al.* 2004). Evidence of domestication is not confined to humid regions. The shea butter tree (*Vitellaria paradoxa*) is in the early stages of domestication in northern Ghana (Lovett and Haq 2000) and widely protected throughout the West African Sahel region. In Benin, selective retention has increased its relative density in the fields to three times that in the savanna (Schreckenberg 1999). In South Africa, the mean fruit yield of marula (*Sclerocarya birrea* subsp. *caffra*) trees is significantly higher from village trees than protected area trees, and the fresh mass of individual fruits and mean kernel mass are also greater – suggesting some degree of historical selection of the trees in the homesteads and fields (Shackleton *et al.* 2003, Leakey *et al.* 2005a/b).

The right kind of evidence: focusing on 'income poverty'

Although poverty is recognised as a multi-faceted phenomenon, encompassing issues of security and safety-nets, self-esteem and belonging, power and control, as well as income and wealth considerations (Poulton and Poole 2001), it is most frequently measured in income terms using the 'dollar a day' measure (Maxwell 2005). Given the dominance of income-related evidence in the policy debate, this paper will focus on the following evidence:

- numbers and types of beneficiaries of income from indigenous fruit trees.
- proportion and value of income contributed by indigenous fruit trees.
- gap-filling or investment use of income from indigenous fruit trees.

In addition, some non-income evidence is presented of specific interest to the health and environment-related MDGs to demonstrate that indigenous fruit tree activities can contribute to poverty alleviation (in the sense of making poverty easier to endure) as well as to helping farmers actively reduce their levels of poverty (Arnold 2002). The aim of the paper is not to define an exhaustive list of useful evidence, but rather to use research results to illustrate different kinds of policy-friendly data linking domestication of indigenous fruit trees and poverty reduction.

Numbers and types of beneficiaries

The international development targets focus attention on initiatives to eradicate extreme poverty that will reach a large number of people rather than dramatically

improving the situation of a few (Poulton and Poole 2001). At the same time there is an argument for interventions that will lead to proportionately greater improvements in the situation of the poorest segments of society, including women. Information about just how many and what kinds of people might be helped out of poverty by domestication of indigenous fruit trees is needed to support decision-making.

Numbers of potential beneficiaries

West and Central Africa is a region of great poverty. In Nigeria, 70% of the population of 120 million is considered to be below the US $1 a day poverty line (Dickson and Bird 2004). The equivalent figure in Cameroon is 40% of the population of 15.5 million, rising to 55% in the forest region. Nationwide, farmers are the poorest occupational group, with 57% below the poverty line (GOC 2003) and are the most likely group to benefit from the domestication and commercialisation of indigenous trees. Although Cameroon's PRSP does not provide the absolute numbers of people concerned, it is clear that farmers in the forest zone are among the poorest in the country. In part this is due to the so-called 'crisis' of the late 1980s and early 90s caused by a combination of low cocoa and coffee prices, devaluation of the CFA franc and structural adjustment policies[1]. This led to reverse migration from towns to rural areas and subsequent clearing of forest for cultivation of food crops (Sunderlin *et al.* 2000). For the many poor farmers in the forest zone, domestication of indigenous fruit trees could be an important approach to reducing poverty, one that builds on rather than destroys their natural capital.

Types of beneficiaries

In addition to high numbers of potential beneficiaries, domestication of indigenous fruit trees has the advantage of bringing benefits to some of the most marginalised groups within communities. Evidence from four communities in southern Cameroon and two in southern Nigeria indicates that fruit tree density increases as farm size declines. The relationship is strongest in farms of less than 1 ha where 83% of variation in fruit tree density can be explained by changes in farm size. While this strong inverse relationship ($r = -0.85$) between plot size and fruit tree density is highly significant in homegardens, it is much weaker in food crop ($r = -0.38$) and cocoa fields ($r = -0.3$). This suggests that fruit trees are particularly important for poorer farmers, who typically have small farms and little to no land under cocoa (Degrande *et al.* in press). Even farmers with no more than a small homegarden around their house will plant fruit trees because of their contribution to domestic food security and their potential contribution to household cash income (Poulton and Poole 2001).

[1]Structural adjustment policies are economic policies that countries must follow to qualify for World Bank and International Monetary Fund loans.

Many indigenous fruit trees are particularly beneficial for women. While men may be the nominal owners of trees, women are often responsible for the marketing of fruit and are often able to decide on how the income is used. In southern Cameroon, 95% of the trade in *Dacryodes edulis* is dominated by women. Ndoye *et al.* (1997) estimated that trade of just four indigenous fruit products (*Dacryodes edulis*, *Irvingia gabonensis*, *Cola acuminata* and *Ricinodendron heudelotii*) within Cameroon and to neighbouring countries involves 1100 traders, mainly women. In Benin, the shea tree is considered 'a gift from God to enable women to survive' (Schreckenberg 2004) and, in southern Africa, the benefits of the trade in marula fruit and beer accrue primarily to women (Wynberg *et al.* 2003). Poulton and Poole (2001) propose that a focus on domestication of indigenous fruit that are traditionally seen as the women's domain, may be more advantageous to women than a focus on introduction of exotic fruit trees that will tend to appeal to men.

A particular attraction of tree crops is that they are less labour intensive than other crops and so are often planted where labour is a limiting factor (Arnold and Dewees 1998). Labour shortages are common at the end of a household's lifecycle, and are an increasingly frequent result of HIV/AIDS, when the elderly may be left to look after the very young. Migration of young adults may also reduce a family's labour resource. In Kenya, for example, tree crops are more likely to be established by aging households when family labour becomes scarce because young men migrate to cities to search for off-farm employment (Dewees 1993).

Proportion and value of income[2]

The information about the income from indigenous fruit trees must be related to the benchmark for poverty for it to be usable in national-level planning. The figure of US$1 per person per day is used in many countries, including Cameroon. Assuming an average family size of 6 people, this equates to an annual household income of over US$ 2,000. The estimated gross annual value of *Dacryodes edulis* production per household in the humid lowlands of Cameroon (on farms averaging 1.7ha in the Haut Nyong, Mvila and Lekié divisions) ranges from US$ 9 to US$ 80 using peak season prices, and up to US$160 for much higher early season prices (Ayuk *et al.* 1999a). Some 30–40% of this production is sold with the rest being used for household consumption. In the same area, farm level production of *Ricinodendron heudelotii* has been estimated at US$ 20 per annum (Ayuk *et al*. 1999b) while *Irvingia gabonensis* fruits and kernels are estimated to be worth US$ 90 and US$ 80 per annum respectively (Ayuk *et al*. 1999c). A combination of these and other species can therefore make a substantial contribution to a household's income. In the ASB Benchmark[3] site (the area from Yaoundé to Ebolowa), the inclusion of a range of fruit trees (both indigenous

[2]Editor's Note: In this section the authors' published data have been rounded to 1, or sometimes 2, significant figures.
[3]This is the Cameroon research site for the Alternatives to Slash-and-Burn project implemented by the International Institute of Tropical Agriculture.

and exotic) can add up to US$ 500 p.a. per ha to cocoa plantations (ASB 1998). This compares with average annual household expenditure in the region of only US$ 240 (Gockowski *et al*. 1998). The potential impact of greater uptake of participatory domestication techniques is indicated by the fact that an 'improved' *Dacryodes edulis* tree can yield fruit worth up to US$ 150 per annum compared with just US$ 20 for an unimproved one (Leakey and Tchoundjeu 2001). While the average number of *Dacryodes edulis* trees per farm in southern Cameroon is very variable (from only 19 per farm in some communities to an average of 100 trees per farm in a community specialised in *Dacryodes* production), these numbers suggest that even the unimproved trees can provide a household with a gross annual income of US$ 300–2000 (Schreckenberg *et al.* 2002).

Another useful measure of the importance of fruit-derived incomes is how well they compare with the local daily wage rate. *Dacryodes edulis* traders in Cameroon, for example, typically earn more than the minimum wage (Awono *et al.* 2002). The same finding is true for marula beer traders in South Africa (Shackleton 2004). A particular attraction of indigenous fruit trees is the fact that they provide regular and fairly low-risk returns (Schreckenberg *et al.* 2002). These can be further improved by participatory domestication activities, which can provide quick economic returns, with marcotted trees fruiting in 2–3 years, and farmers also able to generate incomes from selling their skills, cuttings and improved germplasm. One of the first group nurseries (involving 15–30 farmers) set up under ICRAF's participatory tree domestication programme in Cameroon is expected to produce an annual income of around US$ 10,000 in 2005 (Tchoundjeu *et al.* this volume).

In addition to local trade in fruits there is regional (Ndoye *et al.* 1997) and a small amount of international trade (Tabuna 1999). Exports may grow in future and highlight the potential importance of indigenous fruit for national poverty alleviation. In Cameroon, for example, the most important fruit crops (in terms of national production value) after banana are indigenous fruit: *Cola* spp. and *Dacryods edulis* (Temple 2001). The trade in four indigenous fruit (*Dacryodes edulis*, *Irvingia gabonensis*, *Cola acuminata* and *Ricinodendron heudelotii*) within Cameroon and to neighbouring countries was worth US$ 1.75 million in the first half of 1995 (Ndoye *et al.* 1997). In 1999, exports of *Dacryodes edulis* from Central Africa and Nigeria to France, Belgium and the UK were worth more than US$ 2 million p.a. (Awono *et al.* 2002).

Where it is difficult to obtain information on the absolute income contributed by indigenous fruit, an estimate of the proportion of household income obtained from fruit may also be a useful measure. In this case, it is important to distinguish between total income (which includes production for consumption and for sale) and cash income. While fruit trees may not provide a large proportion of total income, they can be an important source of cash income, particularly for women. In southern Cameroon, for example, 12% of households in 4 villages in different areas said indigenous fruit were their primary source of cash income (Degrande

et al. in press). Depending on local markets, in certain areas individual fruit tree species may be even more important to local livelihoods. Thus, in the case of one village in southern Nigeria that specialised in the sale of *Irvingia gabonensis* fruit (and, to a lesser extent, kernels), indigenous fruit were considered to be the primary cash income source for 30% of households and the secondary source of income for a further 55% of households (Degrande *et al.* in press). In south western Nigeria, sale of *Garcinia kola* nuts brings in about 8% of a household's average annual total income (Adebisi 2004). In the Sakpoba Forest Reserve in southern Nigeria, about 40% of households are involved in producing *Dacryodes edulis*, which contributes 5% of their annual household cash income (Adewusi 2004).

Use of income from indigenous fruit trees: safety-net or driver of change?

Evidence relating to the use of income is important because it can clarify whether domestication activities merely provide a safety-net when times are difficult or are sufficient to provide for a level of growth that can eventually help households or communities move out of poverty. Higher incomes may also contribute to achievement of the other MDGs, such as improvement of health and education levels and environmental sustainability. An important issue is to ascertain whether the income is spent within the community – and thereby has potential 'trickle-down' effects – or whether, as may be the case in the timber trade, it is taken outside by traders or elite (often city-based) members of the community.

Activities involving indigenous fruit trees can be located anywhere along the spectrum from safety net to driver of change depending on the circumstances. In fact their multiple uses are one of the attributes that farmers most appreciate. *Dacryodes edulis*, for example, is an important shade provider in the cocoa agroforests of Cameroon, as well as providing fruit that can be consumed or sold. Schreckenberg *et al.* (2002) found that for 28% of the *Dacryodes* trees inventoried on farms in southern Cameroon, farmers gave 'consumption' as the main reason for planting, but this figure ranged from 10-69% depending on the market access of the community. In one community, it was the arrival of traders from nearby markets that first interested farmers in planting *Dacryodes* for income generation.

The income obtained from indigenous fruit trees can be continuous throughout the year (e.g. for processed *Irvingia* spp. kernels or palm oil) or can be concentrated at one time of the year (e.g. fresh *Dacryodes* fruits). Evidence from Benin (Schreckenberg 2004) suggests that, for women at least, income that is obtained in regular small amounts is likely to be used to cover daily household expenditure, such as for sauce ingredients, soap or school meals. While this kind of expenditure is clearly essential to the survival of the household, it may not contribute directly to moving the household out of poverty. However, where income is obtained as a lump sum it may play an important role as start-up

capital for new activities. Thus women in Benin use money from the one-off sale of stored shea kernels to buy a goat or build a storage shed. They also use it to invest in social capital by buying presents for family and friends and covering the costs of family celebrations.

Very poor women have to sell shea kernels immediately after harvesting (in spite of low prices at this time) to help overcome the family financial shortfall at the start of the agricultural season. This highlights the important gap-filling role of income from indigenous fruit, the timing of which is often more important than its absolute value. In relation to poverty alleviation, perhaps the most important use of gap-filling income revealed by many studies is to cover the costs of school fees, uniforms and books. As outlined in the Cameroon PRSP, the higher an individual's level of education, the greater their chance of earning an income and escaping poverty (GOC 2003). In the humid lowlands of Cameroon, the timing of *Dacryodes edulis* income coincides with the start of the school year, a period when both men and women have few other income-generating activities (Schreckenberg *et al.* 2002). Income from *Garcinia kola* in southern Nigeria is similarly used to cover schooling costs as well as social obligations (Adebisi 2004). In southern Africa too, the timing of the *Sclerocarya birrea* harvest at the beginning of the school year makes this extra income extremely important for the payment of school fees and clothing (Wynberg *et al.* 2003).

Non-income related impacts on poverty

Health, nutrition and the environment are three MDG areas in which AFTPs such as domesticated indigenous fruit trees can have an important non-income related impact. While NTFPs are known to be important 'hungry season' foods when agricultural crops are not available or fail, many domesticated indigenous fruit are an essential part of household diets. *Dacryodes edulis*, for example, is a staple food for 3–4 months of the year, its oily fruit being quick and easy to cook at a time when labour is diverted to agricultural activities (Schreckenberg *et al.* 2002). In much of humid West and Central Africa palm oil (*Elaeis guineensis*) is the main cooking fat, being replaced by shea butter (*Vitellaria paradoxa*) in the drier Sahel region. Just as *Irvingia gabonensis* kernels are used throughout the year as an essential sauce ingredient in southern Cameroon, so the fermented seeds of *Parkia biglobosa* are used in the Sahel. Not only are these foods important components of the traditional diet, but many also make an often unrecognised contribution to people's nutritional status. Reducing the rates of malnutrition and the prevalence of underweight children are two of the key indicators of achievement of the MDGs. Raising awareness of the nutritional value of many indigenous fruit could help to attain these goals. *Dacryodes edulis* fruit, for example, contain 66% more fat than peanuts (recommended as a high fat food by FAO) and the seeds of *Irvingia gabonensis*, *Sclerocarya caffra* and *Ricinodendron rautenii* are all higher in fat content than peanuts (Barany *et al.* 2004). *Parkia biglobosa* seeds have a crude protein content higher than that of

beef as well as providing 42% of the recommended daily intake of zinc. The lack of data on micronutrient contents of other traditional foods means that it is likely that many more may be an important source of micronutrients. Improved nutrition through the consumption of these indigenous fruits can enhance the immune system and reduce the risks of disease, including HIV/AIDS (Barany *et al.* 2003, 2004). Lengkeek (2004) outlines the many ways in which the wise use of trees on farm, particularly high value fruit and nut trees, can help to mitigate the impacts of HIV/AIDS.

A key indicator of progress towards achieving the environmental MDGs is the proportion of land area covered by forest. There is very little quantitative information available about the contribution of indigenous fruit trees to forest conservation but there is mounting evidence that they can be important in the re-vegetation of agricultural land, potentially leading to an agro-ecological succession that increases biodiversity and delivers environmental services (Leakey 1999, Leakey *et al.* in press). This is particularly true in southern Cameroon where indigenous fruit trees are grown as shade-bearing companion crops for cocoa plantations (Leakey and Tchoundjeu 2001). In large areas of southern Cameroon, *Dacryodes edulis* is the dominant shade tree in the farming system, even though it is outside its natural range. This anthropogenic species distribution alone suggests that the tree is highly appreciated by local people. The resulting multi-strata cocoa agro-forests are among the most diversified and forest-like of all agricultural systems (Ruf and Schroth 2004). Fruit tree species diversity within them is significantly higher than in food crop fields and fallows (Degrande *et al.* in press). Investment in such agro-forests, which provide year-round incomes and make effective use of labour, can reduce the need for further forest clearance for extensive agriculture. Furthermore, unlike conventional domestication programmes, the high degree of intra-specific variation in fruit size found both within and between villages in the humid lowlands of Cameroon and Nigeria suggests that farmer-driven domestication of *Dacryodes edulis* and *Irvingia gabonensis* has not led to reduced diversity in these traits at least (Leakey *et al.* 2004). Participatory domestication, in which farmers are trained to use vegetative propagation techniques, would enable farmers in different locations to select cultivars for different (sets of) characteristics (Tchoundjeu *et al.* this issue, Akinnifesi *et al.* this issue), thus ensuring in the short-to-medium term that farm-level inter- and intra-specific diversity is maintained (Leakey *et al.* 2003).

Policies to improve the contribution of indigenous fruit trees to poverty reduction

Although there is a growing international and national policy-level interest in the domestication of indigenous fruit trees and other NTFPs/AFTPs as part of a process to diversify farming systems and reduce poverty, theoretical support still needs to be confirmed by policy action (Djombo 2004; Wynberg *et al.*

2003). In general, the kinds of policies required to support domestication of indigenous fruit trees are not complicated. They build on existing activities and many (e.g. improvement of market infrastructure) have the added bonus of providing simultaneous benefits for other sectors. However, the multifaceted nature of the support required for domestication of indigenous fruit demands a coherent and consistent policy approach. This section highlights some of the main policy recommendations that have come out of work on indigenous fruit tree domestication in the humid lowlands of West Africa (Ndoye *et al.* 2004; Tchoundjeu *et al.* 2004), many of which are also relevant for other regions[4]. They are broadly grouped into legislative and regulatory, marketing, extension and research issues although there is inevitably a degree of overlap between them.

Legislative and regulatory issues

The key issue at national policy level is for governments, in light of current evidence, to give greater recognition to the potential of indigenous fruit trees to contribute to poverty reduction as components of more diversified, sustainable and environmentally friendly livelihood options. This recognition would create a more favourable context within which a coherent set of government actions could be initiated. These might include:

- requiring statistical services to include production data for indigenous fruit products as a first step to valuing their contribution to the national economy.
- ensuring that legislation related to the exploitation, transport and import/export of indigenous fruit crops recognises that their on-farm exploitation does not pose a conservation threat and treats them like conventional farm-cultivated crops (AFTPs), rather than as wild-harvested NTFPs. Widespread awareness of such legislation would reduce the opportunities for rent-seeking (e.g. at road check-points on the way to market) thereby increasing the incentives for farmers to engage in trade of indigenous fruit crops.
- collaborating with other governments in the region to stimulate cross-border trade (which enables farmers to capitalise on the different growing seasons in neighbouring countries) by harmonising policies related to the exploitation, transport and import/export of indigenous tree crops.
- enacting legislation to ensure that the intellectual property rights of 'farmer-breeders' are protected so that the benefits of high-yielding cultivars produced by communities and individual farmers through participatory domestication are not unfairly exploited by large-scale commercial growers. As a first step, this may involve governments joining UPOV (International Union for the Protection of New Plant Varieties) or adopting the Organization of African Unity's New African Model Legislation for the 'Protection of the rights of local communities, farmers and breeders and the regulation of access to biological resources'.

[4]See, for example, similar recommendations made for southern Africa by Wynberg *et al.* (2003).

Marketing issues

In addition to providing a generally more positive policy environment for trade in indigenous fruit by reforming legislation, as outlined above, there are several main areas in which the marketing costs of poor farmers and small traders can be reduced:

- improving market infrastructure such as lighting, security and storage facilities. This would particularly benefit women traders by removing some of the key barriers that prevent them moving from retail into the more profitable wholesale business.
- improving road infrastructure to reduce the marketing costs of indigenous fruit (70% of which are typically transport-related), as well as benefiting trade in all other perishable products. Elimination of unnecessary road-checks and clarification of permit requirements for indigenous fruit would further reduce traders' costs with knock-on benefits for the producer.
- including indigenous fruit in existing market information systems (such as those supported by agriculture ministries) could enable farmers to increase their incomes through group marketing or by selection of different markets.
- promoting fruit tree activities as creditworthy enterprises would help farmers or communities obtain loans from government and NGO micro-credit schemes to establish indigenous fruit tree enterprises such as nurseries, small-scale plantations, processing and marketing activities.

Extension issues

In most sub-Saharan African countries, forestry extension is a recent and under-resourced activity with most staff resources located in Agriculture Ministries (Temu and Kowero 2001). It is here that retraining efforts need be focused to ensure that indigenous fruit trees become part of the basket of livelihood options supported by extension agents. In general, both government and NGO extension organisations are unprepared to support farmers in domestication activities. Their technical expertise is often restricted to a few commercial fruit species and they have limited marketing skills to pass on. Specific interventions in this area could include:

- promoting a more multidisciplinary extension approach to deal with farmers' fruit tree planting activities in an integrated manner, ranging from participatory domestication and horticulture to processing and marketing of the finished product.
- ensuring that extension activities address the constraints faced by farmers in their existing activities. This includes recognising that different groups within communities may have different interests (e.g. women may want trees that integrate well into homegardens and provide fruit for both consumption and sale, older people may need low trees to facilitate harvesting, while men may

be concerned about the shade characteristics of trees and how they combine with their cash crops).
- promoting indigenous fruit alongside conventional fruit.
- focusing on processes (i.e. empowering farmers with propagation skills or marketing techniques) that can be applied to many species, rather than inputs or information on individual species.
- training extension agents to promote the local-level processing and marketing of indigenous fruits, nuts and other tree products in parallel with domestication to ensure a balance between supply and demand.
- encouraging collaboration between health workers and agricultural extension agents to increase awareness of the nutritional benefits of indigenous fruit trees (Barany *et al.* 2004).
- identifying and promoting ways to scale up to the levels necessary to achieve the MDGs by 2015 (Leakey *et al.* submitted).

Research issues

Research issues relate primarily to production or use of indigenous fruit. Much of the necessary research needs to be carried out by researchers and/or extension services together with farmers, including:

- applying participatory domestication techniques to a greater range of species to enable farmers to create cultivars that meet a range of market requirements (e.g. fruit with specific size or taste characteristics, early- and late-season fruiting) and domestic needs (e.g. enhanced nutritional and health promoting properties).
- determining the nutritional content of indigenous fruit prepared in different ways as an input to nutritional programmes.
- developing post-harvest storage methods for indigenous fruit crops, many of which have a very short shelf-life (e.g. five days for *Dacryodes edulis*) and receive only minimal processing (e.g. drying) at local level.
- developing new products based on indigenous fruit (e.g. *Irvingia gabonensis* and *Dacryodes edulis* oils, pastes and biscuits) that can be produced by cottage industries for the benefit of small farmers, rather than large-scale entrepreneurs.

Conclusions

Clearly the domestication of indigenous fruit trees can play an important role in poverty reduction and deserves greater attention in national planning processes, such as PRSPs. To achieve this, relevant data need to be presented in a form that can be used by policy-makers. Given the current focus of the MDGs on income poverty, this means that evidence must, where possible, relate to the impacts of indigenous fruit trees on incomes. Drawing predominantly on research in

Cameroon and Nigeria on *Dacryodes edulis* and *Irvingia gabonensis*, this paper has presented evidence that domestication of indigenous fruit trees can contribute to raising incomes for some of the poorest people in the humid lowlands of West Africa, namely forest-zone farmers (particularly women). The incomes obtained can be sufficient to move households above the dollar a day poverty line. Further benefits of this approach include the potential for better nutrition, maintenance of biodiversity and environmentally sustainable agricultural systems.

Evidence of poverty impact needs to be linked to simple policy recommendations in order to integrate the promotion of indigenous fruits into national-level planning. This paper highlights some of the policies necessary to realise the full poverty reduction potential of participatory domestication and commercialisation of indigenous fruit trees. They include the need for national government recognition of the income contribution of indigenous fruit trees to create a more favourable market environment including less restrictive transport and market regulations, and provision of micro-credits for indigenous fruit tree-based enterprises. Multidisciplinary extension support should build on farmers' existing achievements and cover all aspects from production to commercialisation in an integrated manner. At the same time, a greater and more participatory research focus is needed to improve management practices, and identify new opportunities for adding value and commercialisation.

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