Building opportunities for smallholder farmers to commoditize indigenous fruit trees and products in southern Africa: 1. Participatory selection, propagation and cultivation

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Abstract
This paper presents the results of more than one decade of research-and-development work on indigenous fruit tree domestication in five countries in southern Africa. A participatory approach was used at all stages of domestication. Findings from multidisciplinary research on priority setting, nursery management and propagation research, post-harvest research, germplasm selection, genetic molecular analyses, clonal selection, pest and disease management, policy and land tenures show that developing priority miombo fruits into tree crop is feasible.

Keywords: Tree crop development, post-harvest, wild fruits, rural livelihoods,

Background
Indigenous fruit trees play vital roles in livelihood security for many rural community members, especially during periods of famine and food scarcity (Saka et al, 2004), and as important major food to supplement in better times. The food production capacity in the region is being pushed to the limit, with resulting over-cultivation of already exhausted lands. Recent assessment has shown that 65-80% of rural households in Malawi, Mozambique and Zambia lack food during 2-5 months (Akinnifesi et al., 2004). Indigenous fruit remains one of the major options for coping with hunger, nutritional deficiency in diets and poverty in the region. As the pressure on land intensifies, in the region, wild fruit trees are prone to extinction due to overexploitation and deforestation. This means that the livelihood of the poor rural people who are largely dependent on this natural resource is also threatened. This synthesis provides an overview of efforts to domesticate miombo priority indigenous fruit trees as tree crops in the southern Africa.
STRATEGY FOR COMMODITIZING IFTS

Commoditizing indigenous fruits from the miombo woodlands in southern Africa as tree crops, involves a long-term iterative and integrated strategy for tree selection and improvement, for the promotion, use and marketing of selected germplasm and its integration into agroforestry practices (Akinnifesi et al. 2004). The key components of this strategy are: 1) Verification of the importance and potential of indigenous fruits in the rural economy, 2) Initiation of a Tree Domestication Programme to select and improve germplasm, 3) Development and promotion of the indigenous fruit production with the new cultivars and 4) Commercialisation of the new products through a functional supply chain (fruit storage and processing, product quality assurance, value-adding, marketing research, rural revenue generation and enterprise development).

Ethno-botanical Characterisation and Species Prioritization
An Ethno-botanical survey was carried out as the first step to understand species diversity and role of trees on farms in Malawi, Tanzania, Zambia, Zimbabwe and Mozambique. The surveys were aimed at characterizing indigenous multipurpose trees and shrubs with respect to their diversity and richness, location and arrangement, establishment and management, uses, market opportunities, and uses and functions in farmer fields. Results of these surveys confirmed that 50 indigenous fruit trees are an important resource to rural communities, which they use for food in the form of leaves, fruits, pods, seeds and roots. The fruits are collected from the forests and consumed locally and also traded in local and roadside markets.

A second step was

Setting priority by assessing the farmers’ and user’s preference by interviewing 451 households in four countries in 20 districts (Malawi, Zambia, Tanzania and Zimbabwe) (Maghembe et al., 1998). *Uapaca kirkiana*, *Strychnos cocculoides*, *Parinari curatellifolia* and *Sclerocarya birrea* were identified as the top regional priority species. Country specific species were also identified. Additional species prioritization exercise was done for Mozambique in 2003. Farmers also identified the need for improvement of the tree precocity and fruit quality attributes such as variation in fruit sizes. However, due to the lack of knowledge in propagation techniques, seedlings production and tree husbandry skills, uncertain markets and low prices, skills and because of the free availability of the fruits from the forests, few farmers had planted indigenous fruits trees. Thus the need for research on domestication and commercialization became crucial.

Multilocational Provenance trials
To accelerate the delivery of quality germplasm of indigenous fruit trees of the miombo woodlands, research and development efforts started with establishment of a small arboretum of 24 species in 1990 at Makoka in Malawi. The fast growth, early flowering and even the fruiting of a few species within three years, encouraged ICRAF and partners to develop a strategy for domestication of indigenous fruit trees of the Miombo (Kwesiga et al., 2000).
ICRAF trained 30 germplasm collectors from Botswana, Malawi, Mozambique, Namibia, Swaziland, Tanzania, Zambia and Zimbabwe in October 1995, leading to the collection and exchange of 24 provenances of *Uapaca kirkiana* and 40 provenances of *Sclerocarya birrea* from the 8 countries in 1996; more than 10 tonnes of fruit were collected during the exercise. Genetic variations of within-stand in Uapaca and Sclerocarya trees were determined, and implications for developing germplasm collection guidelines suggested. In order to determine the genotype x environment interactions to isolate superior genotypes, sixteen provenances of *Uapaca kirkiana* and twenty of *Sclerocarya birrea* are being evaluated at four countries in the region since 1997. Analysis across sites showed that height growth of the provenances was better near the origin of mother trees than other sites. In addition, trees of *Uapaca* planted at the lower position in the soil catena seem to have performed poorly compared to those at the middle or upper slopes, suggesting that *Uapaca* is better adapted to well-drained soils. This explains why 93% of *Uapaca* is found in the mountains and hills.

*Participatory Identification of elite trees for clonal selection*

Using participatory approaches superior IFTs were identified from the wild, with communities and marketers. Tree-to-tree variation was measured from wild populations of *U. kirkiana* with communities. To supplement the information received from participatory workshops, elite trees were identified with communities and measurements were made on fruit size, fruit sweetness (sugar content), and pulp content (Akinnifesi *et al.* 2004). For example, in Dedza, Malawi, among the *U. kirkiana* trees identified as having high fruit yields (> 6000 fruits per tree), were trees with large (3-4cm diameter) and sweet fruit. In Zimbabwe, tree 40 at Mafa had the highest pulp content, largest fruit weight, but low sugar content (% brix), while tree 29 at Uranda had very sweet, small fruits and a high pulp content. Tree 9 at Chimani, on the other hand, despite having large fruits, was rejected as it had low pulp content, high shell weight and low sugar content. However, it is important to recognize that, as in *U. kirkiana* in Zambia, some fruit traits, including tree fruit load and pulp content per fruit, can be manipulated to a limited extent by management practices, such as thinning.

*Clonal Propagation*

Vegetative propagation is needed to rapidly multiply, test, select from and use the large genetic diversity in wild tree species. Most of the miombo fruit trees are not amenable to propagation by juvenile stem cuttings. Seed germination was generally good for most species, except for *Parinari* (< 10% regardless of scarification efforts). Grafting is the most efficient way to rapidly effect improvements in these fruit trees: *A. digitata* 85-100%, *M. indica* 97%, *U. kirkiana* 80%,
S. cocculoides 40-79%, S. birrea 52-80%, V. infausta, 100%, P. curatellifolia 71%, comparing favorably with exotics such as mango(90%), in the same trial. Airlayers was promising for Uapaca kirkiana (63%), but not successful for Parinari and Strychnos species. Interestingly, rooting hormone did not improve the rooting of Uapaca airlayers. The skill of grafters, timing of scion collection, and, to a lesser extent, storage method could affect the graft take in a dramatic way. Both grafting and air-layering set during November – December gave the best results. Top-wedge and whip methods were the most successful for grafting.

Tree orchards established in Makoka from grafted trees have started to fruit after two years, but fruit load only become stable after four years. Several thousands of farmers have been trained in the five countries on nursery establishment, propagation and tree management.

Conclusions and Lessons learned
One decade of research on indigenous fruit trees has started to yield dividends with new knowledge and skills on quality germplasm production, tree management and postharvest available to farmers and partners. The challenge remains on scaling up the technologies to new areas.

REFERENCES


