Indigenous knowledge, morphological variation and genetic diversity of *Blighia sapida* K.D. Koenig in Benin

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To

The memory of my beloved mother Afiavi

My dad Grégoire

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1. GENERAL INTRODUCTION

1.1. Importance and domestication of neglected and underutilized species in the Tropics

According to diverse estimates (Convention on Biological Diversity, 2002; Scotland and Wortley, 2003), about 270,000 plants species are known worldwide, some having the potential to feed us (Kermali *et al.*, 1997). Nearly 30,000 described plants species are edible, and about 7,000 have been cultivated or harvested from the wild for food at one time or another (Wilson, 1992). However, globally only 30 crops feed the world providing 95% of dietary energy or protein (Harlan, 1975). Over 50 percent of the global requirement for proteins and calories are met by maize, wheat and rice. Just 150 crops are traded on a significant global scale. But yet, the enormous amount of neglected and underutilized species (NUS) play a crucial role in the food security, nutrition, health, income generation and food culture of the rural poor. In addition, NUS are particularly well adapted to their natural environment, have the potential to withstand climate changes, and are contributing to ecosystem stability. Most of these species are collected not only in the wild, but some of them having a market value are also integrated and managed by local communities in various agroforestry systems (homegardens and compound farms, forest gardens, parklands, trees on farmlands etc.) (Atta-Krah *et al*., 2004). Lack of attention from research and development has meant that their potential value to human well-being and incomes is underexploited. This neglect places them in danger of continued genetic erosion and disappearance, further restricting development options for the poor. Research to increase the value of these species and to make them more widely available would broaden the agricultural resource base and increase the livelihood options for rural communities. Neglected and underutilized species are essential in our fight against hunger and poverty and are helping to achieve the United Nations Millennium Development Goals (http://www.un.org/millenniumgoals/index.shtml).

Recognizing the importance of NUS, the *Food and Agriculture Organization of the United Nations* **(**FAO) through the *Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture* (http://www.fao.org/ag/AGP/AGPS/GpaEN/GPATOC.HTM) has listed some priority activities to conserve and promote their use. Carrying on that, *Bioversity International* have elaborated its *Strategic Action Plan* to deal with NUS (http://www.bioversityinternational.org/publications/publications/publication/publication/n

eglected_and_underutilized_plant_speciesbrstrategic_action_plan_of_the_international_plant_gene.html), and the *World Agroforestry Centre* (ICRAF) has established a tree domestication programme with projects in six ecoregions of the tropics (Jaenicke *et al*., 1995; Weber *et al*., 2001).

NUS include different life forms (tree, shrub, liana, graminoid, forb and cactus) used for various purposes (food, fiber, fodder, oil, medicine etc.). Ackee is a tree species and since domestication strategy for individual species varies according to its uses, biology, target environments and management alternatives (Simons, 2003), the remaining part of this chapter is focused on agroforestry tree species.

Tree domestication in agroforestry is a farmer-driven and market-led process, which matches the intraspecific diversity of many locally important trees to the needs of subsistence farmers, the markets for a wide range of products and the diversity of agricultural environment. The products of such domesticated trees are called Agroforestry Tree Products (AFTPs) to distinguish them from the extractive tree resources commonly referred to as Non-Timber Forest Products (NTFPs) (Simons and Leakey, 2004). The steps of such a domestication process are: selection of priority species based on their expected products or services; definition of an appropriate domestication strategy considering the farmer-, market-, and landscape needs; sourcing, documentation and deployment of germplasm (seed, seedlings or clonal material); and tree improvement research (tree breeding or cultivar selection pathways). The research phase involves research institutions in participatory mode with the stakeholders such as farmers, households or communities. Working directly with the end-users is advantageous to achieve economic, social and environmental goals, especially in developing countries (Simons and Leakey, 2004). Participatory domestication thus empowers the farmers, allowing the outputs and benefits of domestication to remain with the community, as proposed by the Convention on Biological Diversity (Leakey et al. 2003). The idea behind participatory domestication is to provide a package of techniques to farmers and help them adopt and use the technologies provided that are most appropriate for their conditions, situation and environment (Tchoundjeu *et al*., 2006). Such tree domestication approaches are very challenging for several reasons: (a) hundreds of plants species are concerned, (b) they are exploited since centuries by millions of subsistence farmers (c) influenced by multiple stakeholders with sometimes contrasting interests (d); there is low availability of lands making impossible - even inappropriate - to establish a monoculture plantation.

Tree domestication is a powerful tool to: (1) improve livelihoods for the poor (nutrition, health, and increasing social benefits); (2) reduce poverty (by increasing income); conserve biodiversity (by diversifying and increasing biological resources); (4) improve environmental degradation (by increasing environmental services and ecosystem function) (Leakey et al. 2005). However, when tree domestication is not carefully planned, there can be possible disadvantages such as reduced intra-specific genetic diversity, lost of traditional and cultural values associated with indigenous species and lost of sustainability of production systems by promotion of large-scale monoculture and high input (McNeely, 2004; Leakey et al. 2005).

In Sub-Saharan Africa, many tree species such as *Prunus africana* (Tchoundjeu *et al*., 2002; Simons and Leakey, 2004), *Irvengia gabonensis* (Atangana *et al.*, 2001, 2002; Leakey *et al*., 2004), *Dacryodes edulis* (Leakey *et al*., 2002, 2004; Schreckenberg *et al.*, 2002) and *Sclerocarya birrea* subsp. *caffra* (Leakey, 2005) are now being domesticated in participative ways.

1.2. Ackee (*Blighia sapida*)

1.2.1. Taxonomy and botanic description

Blighia sapida K.D. Koenig (syn. *Cupania sapida* Voigt.) belongs to the soapberry family (Sapindaceae): it is a pantropical distribution family with many edible fruits species exploited commercially such as *Litchi chinensis* and *Dimocarpus longan*. *B. sapida* is commonly known in English as ackee, akee or akee apple. In German it is called Akibaum; in French it is known as arbre fricassé or arbre à fricasser (Haiti); yeux de crabe or ris de veau (Martinique). Spanish names are arbol de seso, palo de seso (Cuba); huevo vegetal and fruto de huevo (Guatemala and Panama); arbor del huevo and pera roja (Mexico); merey del diablo (Venezuela); bien me sabe or pan y quesito (Colombia); akí (Costa Rica). In Portuguese, it is called castanha or castanheiro de Africa. On the Ivory Coast of West Africa and Mali, it is called kaka or finzan and finza in the Sudan. In Benin, more than 20 local names are known for ackee, each given by different ethnic groups (Morton, 1987; ICRAF, 2009; Ekué *et al.*, 2004; Paper I of this thesis).

B. sapida is a large tree reaching up to 35 m in the wild (Fig. 1), densely branched and symmetrical, with smooth gray bark. It has a spreading crown and ribbed branchlets. Leaves are alternate, compound, 23-38 cm in length, with 3-5 pairs of glossy leaflets (Fig. 2). Flowers are greenish, small, staminate and hermaphroditic, in densely pubescent

axillary racemes, 5-20 cm long (Fig. 3). The fruit is capsule shaped, leather like pods contain a seed in each of usually three chambers or sections (Fig. 4). A thick fleshy stalk, rich in oil, holds the seeds. When ripe, the fruit sections split and the shiny black seeds become visible (Figs. 5 & 6). The fruit turns red on reaching maturity and splits open with continued exposure to the sun (Morton, 1987; ICRAF, 2009). The generic name *Blighia* honors Captain William Bligh who introduced the plant to the English scientific community at Kew in 1793 (ICRAF, 2009). The specific epithet is in reference to the presence of substances in its seeds which turn water soapy or frothy (ICRAF, 2009).