International Scholars Journals

Global Journal of Plant and Soil Sciences Vol. 5(1), pp. 001-006, June , 2021 . Available online at www.internationalscholarsjournals.org © International Scholars Journals

Review

Conservation of the indigenous leaf and fruits in Africa

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Accepted 2 June, 2021

The diversity of indigenous leaf vegetables and fruits of Africa is being seriously eroded as a result of multiplicity of environmental, political and socio-economic factors. This paper discusses some new development-related and crises factors that have interacted in concert to amplify the spate of loss of the indigenous leaf vegetables and fruits genetic resources in Africa. The paper also suggests urgent steps that nations individually and Africa in general can take to arrest the wave of loss of plant genetic resources and therefore ensure the conservation of our remaining indigenous leaf vegetables and fruits heritage.

Key words: Conservation, indigenous vegetables and fruits, Africa, genetic erosion.

INTRODUCTION

Of the 150 food-plants commonly consumed by man, 115 are indigenous African species and the world's major regions of crop diversity include Ethiopian highlands, the Sahelian transitional zone, the delta of Niger River and the humid forest zone of west and central Africa (Kiambi and Atta-krah, 2003).

Endemism, which is the proportion of species not found anywhere else in the world, is high in Africa (Kiambi and Atta-krah, 2003). Endemism in Tropical Africa at the general level has been estimated to be 45% (Sayer et al., 1992). The Food and Agricultural Organization (FAO) (1998) reported that countries of West and Central Africa sub-regions have identified a large number of under-utilized species that are important to the livelihoods of local population. On the list are 7 cereals, 8 legumes, 4 roots and tubers, 8 oil crops, 31 fruits and nuts, 17 vegetables and spices, 4 beverages, 38 medicinal plants and 44 genera of forages.

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This list is not exhaustive because Adebooye et al. (2003) reported an expanded list of twenty-four indigenous leaf vegetables that are eaten in southwest Nigeria only. Several other species have been listed by Okafor (1978, 1983) in Nigeria, Abbiw (1990) in Ghana, Chweya (1997) in Kenya, , Rubaihayo (1997) in Uganda, Seck et al. (1997) in Senegal and Okigbo (1977) for the entire tropical Africa. The Plant Resources of Tropical Africa (PROTA) (2004) reported an estimated 30,000 plant species for Tropical Africa and of these only 6,376 (21%) are used by man. The PROTA called this 21% the "Basic List". The 6,376 useful indigenous African plants is made up of 1,975 medicinal plants, 820 timbers, 611 forages, 533 ornamentals, 477 fruits, 397 vegetables, 377 fibers, 240 essential oil and exudates, 220 auxiliary plants, 176 carbohydrate plants, 130 spices and condiments, 129 dyes and tannins, 104 fuel plants, 80 cereals and pulses, 54 vegetable oils and 53 stimulants. The PROTA in 2004 published the contributions of 103 authors and 46 co-authors on detailed cultivation practices for 280 African indigenous leaf vegetables. A summary of the number of useful species and endemism

Table 1. Diversity of useful plants in 7 African countries.

Country	Size ($Km^{2)}$	Used Plants	Endemism
Cape Verde	4, 033	774	92
Gambia	11,300	974	3
Ghana	238,539	3,600	43
Guinea-Bissau	28,000	1,000	12
Liberia	111,370	2,200	Unknown
Nigeria	923, 768	4,614	205
Sierra-Leone	71, 620	2,090	74 and 1 genus

Sources: IUCN (1997), Okali and Fasheun (1997), Tuffour(1994) and Sayer et al. (1992).

in seven selected African countries is given below (Table 1).

Indigenous leaf vegetables and fruits are an integral part of agricultural systems in Africa. Unfortunately, most African countries governments have not given them priority in crop development. Adebooye et al. (2003) reported that of all mention of the status of food in Nigeria, indigenous leaf vegetables often disappear. Most studies on leaf vegetables and fruits in research institutes and universities have focused on the routinely cultivated species. Today the importance of African indigenous leaf vegetables and fruits to human nutrition, medicine and nature have been realized. Hence the United Nations in 1986 established the Institute for Natural Resources in Africa (INRA), an arm of the United Nations University in Accra Ghana, to build endogenous African capacity and strengthen national institutions to promote sustainable use of the continent's natural resources for development. The focus of INRA is research and training on conservation of African food plants diversity and soil conservation. Some other African governments have shown some form of interest in indigenous plants resources conservation, but the evaluation of their genetic variability for agronomically desirable traits is still in its infancy.

IMPORTANCE OF INDIGENOUS LEAF VEGETABLES AND FRUITS

Indigenous leaf vegetables and fruits play a key role in income generation and subsistence. For example, Adebooye (2004) reported that *Solanecio biafrae* (Olive and Heirne) C. Jeffery, an indigenous leaf vegetable in southwest Nigeria is several times more expensive than the routinely cultivated species especially during the dry season. Experience has also shown that other indigenous leaf vegetables such as *Telfairia occidentalis* f. Hook, *Celosia argentea* L., *Amaranthus cruentus* L and *Solanum macrocarpon* L. are also sold at high prices during the dry season in Southwest Nigeria. Also in Nigeria, Odiaka and Schippers (2004) reported that a fruit of *T. occidentalis* cost as much as US$0.70-1.00 each in the year 2002. In Kenya, the report of a survey conducted by Abukutsa-Onyago (2003) showed that indigenous leaf vegetables offer a significant opportunity for the poor people in western Kenya to earn a living because indigenous leaf vegetables production can be done with little capital investment. A direct effect of this is that these vegetables provide employment opportunities for those that are outside the formal sector.

Studies on chemical composition of indigenous leaf vegetables and fruits have shown that they contain appreciable amounts of crude protein, fat and oil, energy, vitamins and minerals (Adebooye, 1996; 2001; 2002; 2004; Adebooye and Bello, 1998; Chweya, 1997; USDA, 2002; 2003). They have also been known to make food more palatable and digestible.

In additional to serving as vegetables and fruits, some plants are also sources of traditional medicine in southwest Nigeria. Adebooye et al. (2003) documented the traditional medicinal uses of twenty-four indigenous leaf vegetables. Modern science has isolated many natural products with active principles of medicinal importance from many indigenous plants. For example, *Brassica* species have been shown to contain glucosinolates, which are highly effective against cancer and heart diseases.

The indigenous species are also adapted to many tropical conditions, pests and diseases. Therefore, they can be very good sources of genes for genetic improvement of cultivated species especially in the area of pests and diseases resistance. Also, the indigenous species can be improved by introducing desirable traits from cultivated species into them.

Despite these values, these vegetables have been neglected for many years by researchers, policy makers and funding agencies and are currently threatened with extinction. There is a great need not only to conserve their germplasm but also to improve their production (Abukutsa-Onyago, 2003).

PLACE OF PLANT CONSERVATION IN BIOTECHNOLOGY

Plant resources are basic ingredients for biotechnology research. Lewis (1985) stated that an adequate gene resource conservation programme is to genetic engineering as a library is to knowledge. Germplasm collection of indigenous leaf vegetables, fruits and spices, their wild relatives and landraces are essential if biotechnology is to move ahead (Witt, 1995). Perrino (1992) asserted that there were two reasons why biotechnologists need germplasm collections. First, they need models to synthesize genes because they cannot invent genes. Second, biotechnology will continue to depend heavily on naturally occurring genes in their experiments to influence the future. Gene banks are thus the home for gene hunters.

reserves in their natural ecosystem. In this way, landraces of the indigenous leaf vegetables, fruits and spices are protected in their natural habitat. This practice is as old as the beginning of live. In Nigeria among the Igbo and Yoruba there are traditional forests often called "evil forests or spirit forests" where the vegetation is left intact and tree felling is forbidden. These forests are indirectly serving plant conservation purposes. Therefore our interest as scientists should be in how many rare species we could find and collect in these forests. To ensure a successful conservation in natural ecosystem, there must be enabling laws and willing government in place to deal with illegal exploitation of the conserved species.

Cryopreservation

The best answer for long-term conservation of germplasm *in vitro* lies in cryopreservation i.e. the storage of frozen tissue cultures at very low temperatures in liquid nitrogen at –196 ^{0}C, which virtually stops all biological activity. This process puts the cells in suspended animation where they can retain their viability indefinitely. This method is also the best for handling the storage of recalcitrant seeds and is also suitable for species that do not form seed and those that are propagated from bulbs and rhizomes (Perrino, 1992). *Telfairia occidentalis*, a Nigerian indigenous leaf vegetable, with recalcitrant seed behaviour is now being successfully stored using cryopreservation technique (Ajayi et al., 2004). This method of plant conservation requires a lot investment in materials and human expertise to ensure success.

CONCLUSION AND SUGGESTIONS

The advent of scientific plant breeding this century and rapid spread of high-yielding varieties characterized by narrow genetic base had caused the displacement of traditional unimproved species that had large genetic base. Narrowness of the genetic base of a crop may lead to disasters, as shown by historical examples, especially on Irish potato (National Academy of Science, 1972). In Nigeria, there is awareness about the loss of indigenous leaf vegetables as a result of neglect by research and development, fast rate of forest destruction for industrial development and environmental degradation due to pollution as in the Niger Delta region (Adebooye et al., 2003). Most African countries are signatories to the Convention on Biological Diversity (CBD) (UNEP, 1994) which calls for effective organization, management and use of biodiversity information. Articles 6, 7 and 8 of the CBD require the ratifying countries to develop national strategies, plan and programmes for the conservation and rational use of biological resources.

We are joining our voices with that of the other stakeholders in Africa to call for an urgent government, institutional, groups and individual intervention to save what is left of our natural resources. To achieve this, the following suggestions are made:

Capacity building

Inadequate expertise in the science of plant genetic resources is at the moment posing serious problems for the ability of African countries to embark on serious plant conservation programme. For a well-organized plant conservation programme, there is the need for molecular geneticist, biochemist, horticulturist, physiologist, pathologist, entomologist, ecologist, statistician and ethno botanist. It is therefore an urgent task for African nations to strengthen the technical capacity for *in situ* and *ex situ* conservation and utilization of plant genetic resources at the sub-regional and national levels, with a special focus on human resources development and development of the necessary institutional conservation infrastructures. For conservation efforts to succeed there must be material/financial resources and human expertise. Therefore African countries, especially the West and Central Africa nations need to invest more in human resources development to be able to face the challenges of conservation of plant resources.

Facilities and infrastructure

Research in plant conservation and biotechnology is expensive. Simple form of biotechnology research, employing techniques such tissue culture to propagate a disease-free perennial, was estimated by Barker (1992) to cost a little less than US$1.0 million in 1992 while genetic engineering or gene transfer may require US$ 50 million-US$500 million and it may take 10-20 years to achieve the goal! The implications of this for African countries are clear. However, with a strong will and determination to succeed, African nations through the African Union (AU) and New Partnership for Africa's Development (NEPAD), can make arrangement for development of biotechnology in Africa by having regional centers (at least two centers) one in the south and one in the north, as the starting point for biotechnological development of Africa. This type of arrangement has been made to develop vegetable research in Asia with the establishment of the Asian Vegetable Research and Development Center (AVRDC).

Respect for international agreements

Most African countries are signatories to the CBD and GPA. However, it is rather unfortunate that they are not implementing to letters the provisions of the agreements. Few experts that have knowledge of plant conservation and biotechnology are in the Universities and national

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