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Review

Agricultural biodiversity for food and nutrient security: The Kenyan perspective

Ekesa Beatrice Nakhauka

Bioversity International, Plot 106, Katalima Road, P. O. Box 24384, Kampala, Uganda. E-mail: b.ekesa@cgiar.org. Tel: +256414286213, Fax: +256414286949.

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Agricultural biodiversity is the first link in the food chain, developed and safeguarded by indigenous people throughout the world and it makes an essential contribution to feeding the world. Kenya has an estimated 35,000 known animal, plant and micro-organism species. Ancient Kenyans participated in farming, hunting and gathering to acquire a variety of foods and they also utilized insects as sources of food. Due to population growth, urbanization, deforestation, pollution and intensive agriculture based on a few crops, species that now sustain humanity are very few. Local species that are not only numerous, fulfilling a variety of needs and adapted to different conditions, but also genetically variable, are being abandoned and lost forever. Changes in agricultural biodiversity have had negative impact on dietary diversity, nutrition and health. This paper first focuses on Kenya's ancient agricultural biodiversity, efforts by the government and other agencies to conserve it and its loss over time. The paper goes on to discuss the prevalence of food insecurity and malnutrition levels among rural households in Kenya. Lastly, recommendations that would help enhance agricultural biodiversity and food security to improve the nutrition status of Kenyans have been given.

Key words: Agricultural biodiversity, loss, conservation, hunger, Kenya.

INTRODUCTION

Agricultural biodiversity includes all components of biological diversity of relevance to food and agriculture. It also encompasses the variety and variability of animals, plants and micro-organisms which are necessary to sustain key functions of the agro-ecosystem, its structure and processes for, and in support of, food production and food security (FAO, 2004).

Since the dawn of agriculture 12,000 years ago, humans have nurtured plants and animals to provide food. Careful selection of the traits, tastes and textures that make good food resulted in an extensive diversity of genetic resources, varieties, breeds and sub-species of the relatively few plants and animals humans use for food and agriculture. These diverse varieties, breeds and systems underpin food security and provide insurance against future threats, ecological changes (Mulvany et al., 2002). Agricultural biodiversity is the first link in the food chain, developed and safeguarded by indigenous peoples, women and men farmers, forest dwellers, livestock keepers and fisher folk throughout the world. It has developed as result of the free-flow of genetic resources between food producers and it is fundamental to agriculture and food production, thus making an essential contribution to feeding the World (Gari, 2004; Mulvany et al., 2002).

In ancient times human beings obtained a great number of their foods from natural sources like; forests and bushes, which helped important contribution to household nutrition (FAO, 2004). Forest foods combined food from animal and plant origin. Plant foods were always classified into fruits and seeds, nectars and saps, stems and tubers and leaves and mushrooms. Animal foods were classified into invertebrates (insects and insect larvae) or vertebrates (Bush meat or fish) (FAO, 2004). These indigenous species were of unique and varied genetic make-up that made them survive even during harsh environmental conditions, thus enhancing food security. In addition studies have proved that apart from having the macronutrients necessary for good nutrition status, these indigenous species are rich in micronutrients like carotenes (precursor of Vitamin A), iron, zinc, and calcium that have profound effect on the immune system of an individual thus reducing the prevalence and severity of infections and cutting short the infection-malnutrition cycle (Gari, 2004; FAO, 2004). Since the advent of industrial agriculture and the increasing

Table 1. Nutrition composition per 100gram of edible portion of amaranths, spider plant and nightshade compared to cabbage (FAO).

Nutrient	Amaranths	Spider plant	Black nightshade	Cabbage
Iron	8.9	6.0	1.0	0.7
Protein (gm)	4.6	4.8	4.3	1.7
Water content (%)	84.0	86.6	87.2	91.4
Calories	42	34	38	26
Carbohydrates (gm)	8.2	5.2	5.7	6.0
Fiber (gm)	1.8	-	1.3	1.2
Ascorbic acid (m/g)	64	13	20	54
Calcium (m/g)	410	288	442	47
Phosphorus (m/g)	103	111	75	40
B-Carotene (mcg)	5716	-	3660	100
Thiamine (mg)	0.05	-	-	0.04
Riboflavin (mg)	0.42	-	0.59	0.10

globalization of markets, tastes and cultures, Although measuring the precise loss of agricultural biodiversity is, however, not an easy task, efforts are being made to develop reliable methods and indicators to this end (Scaffrin et al., 2006) much of this wealth of agricultural biodiversity is being lost both on-farm and in gene banks and increasingly the integrity of these resources is being compromised by genetically modified organisms (Mulvany et al, 2002). More than 90% of crop varieties have been lost from farmers' fields in the past century and livestock breeds are disappearing at the rate of 5% per year and aquatic life is similarly threatened. This loss of diversity is accelerating the slide down the slippery slope of food insecurity that today sends more than 1.2 billion people to bed, hungry (Mulvany et al., 2002).

The first part of this paper focuses on the ancient agricultural biodiversity of Kenya and how Kenyans utilized it. The loss of Kenya's agricultural biodiversity through modernization, population growth and intensive agriculture based on few modern breeds has been discussed. The paper goes on to discuss the efforts by the Kenyan government in preserving agricultural biodiversity and the extent of food insecurity in the country. Lastly recommendations that would help enhance agricultural biodiversity and food security with the objective of improving the nutrition status of Kenyans have been given.

KENYA'S ANCIENT AGRICULTURAL BIODIVERSITY

Kenya is rich in agricultural biodiversity. Though a country study to determine the status of Kenya's biodiversity, it was found that Kenya has an estimated number of 35,000 known species of animals, plants and micro-organisms (Government of Kenya, 2001). The ancient Kenyans took part in farming, hunting and gathering so as to acquire a great variety of foods. Indigenous vegetables like Amaranths (*Amaranthus blitum*), Rattle pod (*Crotalaria brevidens*), Cowpea leaves (V*igna unquiculata*), African nightshades (*Solanum scabrum*), spider plant (C*leome gynandra*), jute mallow (C*orchorus olitorius*), African kale (*Brassica carinata*) and pumpkin leaves (*Cucurbita maxima*) were a major part of meals (Abukutsa, 2003). The available limited research indicates that these indigenous vegetables have high nutritive value, they contain high levels of minerals especially calcium, phosphorus and iron, vitamins and proteins and in most cases the vitamin and mineral content supersedes that found in popular exotic vegetables (Table 1). According to Abukutsa (2003), spider herb constitutes of 35.8% protein, vitamin A, vitamin C, and minerals like calcium and iron while black nightshade constitutes of 29.3% protein, and is rich in vitamin A and C and minerals. Unpublished reports also indicate that milk was added to these indigenous vegetables to reduce the bitterness before being fed to children. In addition the Luo people of western Kenya say that the leafy vegetables that formed an important part of their traditional diet protected against gastro-intestinal disturbances: at least one of them *Solanum nigrum* was believed to be powerfully effective against the protozoan gut parasite *Giardia lamblia* (Emile, 2004).

Kenyans have also used insects like caterpillars, grasshoppers and white ants as a source of food (Aswani, 2004). Cultural history suggests that our forefathers fed on these insects raw, roasted or dried and were added to other foods as enrichment. In a study done by Attoley in 2003, it was found that insects are high in proteins, energy and various vitamins and minerals. It is also documented that mushrooms (a type of fungi) have been part of the cultural foods of Kenyans especially for people from the western part of the country. Mushrooms were considered an important source of food and relish.

Although low in carbohydrates and fats, research has proved mushrooms have 4 and 40% protein when fresh and when dry respectively, and are also rich in vitamin A, B2, B6, B12 and C, as well as calcium potassium, phosphorus, iron and zinc (Kavaisi and Magingo, 2003). A variety of rare meats were also obtained from forests and bushes. Hunting and trapping of animals like hare, giant rats, mole rats and birds like quills ('isindu') was widely practiced in Kenya (Were, 1989). These foods provided variety in the meals and also offered safety nets before harvest when the food supplies were low and during famine or natural disasters.

The Kenyan traditional staples were mainly; sorghum, millet and colored maize (Were. 1989). According to Kabuye and Ngugi (2001), finger millet constitutes 72% carbohydrates, 6 - 11% protein, 0.33% calcium, a good content of phosphorus, iron, and methionine an essential amino acid not found in maize. 100 gm of edible portion of sorghum have 10.7 g protein, 26 mg calcium, 4.5 mg iron, and 0.34 mg thiamine while the same quantity of Maize has 9.4 g protein, 3 mg calcium, 1.3 mg iron and 0.26 mg thiamine.

EFFORTS BY KENYA TO CONSERVE ITS AGRICULTURAL BIODIVERSITY

The recognition that conserving and using plant genetic diversity is vital to meeting the world's future development needs has led to establishment of a number of government and non governmental institutions with the aim of conserving our Agricultural biodiversity.

One of the government's major strides was the establishment of the National Gene Bank of Kenya (NGBK) (Kemei et al., 1995). NGBK was established in 1988 as the national institution for coordinating and implementation of all activities concerned with crop plant and forage genetic resources. These activities include: collecting, seed processing and conservation, multiplication, regeneration, characterization, preliminary evaluation and documentation. Among the priority species for action are the leafy vegetables. Establishment of NGBK and choice of priority crops was prompted by the realization that Kenya has many wild and weedy species of edible leafy vegetables that contribute significantly to the nutritional well-being of the rural population (Chweya, 1994). Also with increasing pressure on wild habitats and agricultural land, due to demographic and socioeconomic changes, the ecological niches of many leafy vegetables were fast disappearing. At the same time, the cultural status of these valuable food plants was declining as official policy continued to give priority to growing crops that suit urban tastes, or that offer a potential for export (FAO, 1988). As a result, the genetic resources base of food security has gradually being undermined (Juma, 1989; Kabuye, 1993).

As the national focal point NGBK has worked together with several research and academic institutions to help conserve agricultural biodiversity. Together with the University of Nairobi (Department of Crop Science) and Ben Gurion University in Israel, NGBK has organized and implemented various collecting missions for local vegetables and their wild/weedy relatives (Table 2). The objectives of this collaborative programme were both to undertake systematic countrywide collecting and to assess genetic erosion. The target groups were *Cucurbita, Crotalaria, Gynandropsis, Corchorus, Lagenaria, Cucumis, Luffa, Solanum* and *Vigna.* Areas selected for collecting were the ones where consumption of these traditional vegetables was believed to be still important culturally, and where species and genetic diversity were likely to be highest. These areas ranged from high-rainfall areas to semi-arid, from well-drained to swampy habitats and from hot lowlands (coastal region) to cool highlands (Rift Valley highlands and the Mt Kenya region). Collecting sites ranged from natural habitats to farmers' fields, backyards or home gardens, and occasionally included marketplaces. Mature fruits and seeds were targeted for collecting (Kemei JK, 1995).

With regards to seed conservation, the NGBK has facilities for seed processing and drying, viability testing, sealing, packaging and long-term storage. Germplasm of traditional vegetables has been distributed to various institutions collaborating with the gene bank, for research and improvement programmes. A number of accessions of indigenous vegetables conserved at NGBK have been characterized and evaluated (Kemei et al., 1995).

Through the Kenya Agricultural Research Institutes, Bioversity International (Former International Plant Genetic Research Institute) a renowned international research institution has also worked with NGBK. The vision of Bioversity International www.bioversity international.org is to harness the full potential of the earth's plant genetic diversity to eradicate poverty, achieve food security and protect the environment for the benefit of present and future generations. This has been done through the collective, concerted action of farmers, forest dwellers, pastoralists, scientists, development workers and political leaders (Kemei et al., 1995). Through its regional office in Nairobi, Bioversity International has worked with NGBK to help increase understanding of the role of African leafy vegetables in production systems. Bioversity International and NGBK have conducted surveys of 14 priority species. More than 1,000 accessions are currently documented and conserved in the gene bank. Together with farmers, Bioversity International and NGBK is characterizing six key species, which will be followed by participatory varietal selection and bulking of seed. A major outcome has been the discovery of two new species within the *Solanum nigrum* complex. One of these has exceptional characteristics: it is not bitter and therefore has great market potential (Kemei et al., 1995).

The Indigenous Food Plants Programme (IFPP) was initiated by the National Museums of Kenya in 1989, with the help of two NGOs and local communities in ten districts of Kenya. The IFPP has also set up an Indigenous

Table 2. Some of the valuable cultivated and wild/weedy relatives of vegetables collected by NGBK and collaborating institutions (1987 - 1994).

Genus	Altitude (m asl)	Regions	No. accessions
Amaranthus	60 - 2200	Coast, Eastern, Central, Rift Valley, Western, Nyanza	Landrace (40); weedy (33); wild (18); ? (7)
Citrullus	450 - 1025	Rift Valley, Eastern	landrace (1); weedy (2); wild (11)
Coccinia	686 - 1550	Eastern, Rift Valley, Coast	weedy (2); wild (13)
Corchorus	620 - 1350	Nyanza, Rift Valley, Western, Eastern	landrace (5); weedy (25); wild (5); IJO† (116)
Crotalaria brevidens	540 - 2200	Rift Valley, Western	landrace (18)
Cucumis	180 - 2130	Coast, Eastern, Rift Valley, Nyanza, Central	Landrace (6); weedy (4); wild (62); ? (13)
Cucurbita	20 - 2270	Coast, Eastern, Rift Valley, Central Nyanza, Western,	Landrace (160); wild (15)
Lagenaria	140 - 2440	Eastern, Rift Valley	Landrace (25); ? (17)
Luffa	5 - 1680	Coast, Eastern, Rift Valley, Nyanza	Landrace (14); weedy (3); wild (3); ? (3)
Gynandropsis gynandra	700 - 2300	Eastern, Nyanza, Rift Valley, Coast, Western	Landrace (28); weedy (7); wild (9); ? (1)
Solanum nigrum	620 - 2200	Nairobi, Nyanza, Western, Rift Valley, Eastern, Coast	Landrace (12); weedy (13); wild (9);? (9)
Vigna	560 - 2050	Nyanza, Eastern, Central, Coast, Western, Rift Valley	1312

† IJO = International Jute Organization.

Indigenous Food Plants Database, in the National Museum of Kenya (NMK), which has data on over 800 indigenous plant species used for food in one way or another. Of these, fruits form about 50%, leafy vegetable 25%, tubers and roots 12.5%, gums, resins, spices, herbs and those used for tea, and other minor food products making up the rest. The Kenyan government also set up The Centre for Biodiversity at the National Museums of Kenya (NMK) following a request by the United Nations Environment programme (UNEP). The decision was based on the existing facilities and expertise at NMK. The Centre's role was to coordinate country biodiversity studies and direct its subsequent operations in consultation with the relevant Government bodies. With Kenya's ratification of the Convention on Biological Diversity (CBD), demands on the centre intensified and its coordinating role of NMK's multidisciplinary biodiversity research departments and biological Conventions become more active. The centre also acts as an interface between biological science and their disciplines such as anthropology, sociology and economics. The mission of Centre for Biodiversity was to help fulfill the national obligation to biodiversity conservation by developing a research and action programme that will gather, store, analyze and disseminate the biodiversity information required for sustainable utilization of biological resources (National Museum of Kenya, 2009).

Through collaboration with Bioversity International, NMK has also been involved in a number of projects related to use of traditional African leafy vegetables to enhance dietary diversity and therefore improve nutrition. Partnerships have been established with farmers, training organizations and supermarkets. Campaigns to promote African leafy vegetables have also been carried out (National Museums of Kenya, 2009).

Other initiatives to conserve agricultural biodiversity have been the establishment of seed shows. In Tharaka, central province of Kenya, seed shows have been held annually since 1996. In 1998, displays were mounted by 29 women and 47 men, as well as some community groups. Every year during the show, a panel of judges evaluates the displays and the most diverse are awarded prizes. The total number of crop varieties displayed increased in 1998 to 149 from 134 in 1997. In 2001, 46 farmers displayed 206 varieties. Participants appreciate the seed show for many reasons: farmers can obtain rare crop varieties; they identify seed sources; it is a good forum for exchange of ideas on farming and exchange of seeds; farmers are exposed to national agricultural research work; the spirit of competition boosts farmer's morale and motivates farmers to diversify their crops indirectly enhancing food security; and it is a platform for interaction between farmers, students, researchers, extension staff and other development agents (Mulvany et al., 2002).

The Kenya Government has developed guidelines to integrate environmental concerns into agriculture development projects in relation to management of rangelands, forests, water quality, wildlife and conservation of genetic resources. The Kenyan national legislation restricts the transfer of productive arable land to other uses especially human settlement for commercial development, i.e. development of rental houses or commercial houses for industrial purposes. However, enforcement of this legislation has been rather wanting as population pressure on land has been increasing in the recent years (GOK, 2001).

The Kenyan Government is among the African countries that have ratified the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). The ITPGRFA came into force on the 29th June 2004. After seven years of negotiations to harmonize the International Undertaking (IU) on plant genetic resources and with the Convention on Biological Diversity (CBD), the ITPGRFA was adopted by the FAO conference in November 2001 and it came into force on the 29th June 2004. This legally binding Treaty covers all plant genetic resources relevant for food and agriculture. The Treaty is critical in ensuring the continued availability of the plant genetic resources that countries will need to feed their people and guarantee food security at national and global levels. It is of profound importance in the face of the current rate of genetic erosion and environmental change and to enhance *in situ* and *ex situ* conservation and sustainable use of genetic resources (Scaffrin et al., 2006).

The principal objectives of the ITPGRFA are the conservation and sustainable use of plant genetic resources for food and agriculture and the fair and equitable sharing of benefits derived from their use, in harmony with the Convention on Biological Diversity, for sustainable agriculture and food security. The beneficiaries of ITPGRFA include all sectors of society including farmers, scientists, international community etc. benefit from the Treaty in many ways. The farmers and their communities benefit through the recognition Farmers' Rights although it rests with national governments. The Treaty enhances food security through the promotion of a great variety of food, and of agricultural products. The scientific community will have constant supply of and access to an array of material and genetic resources crucial for research and breeding for increasing crop quality and productivity in crop improvement program. The Treaty provides for a safe and long-term legal framework for collection under the possession of the International Agricultural Research Centers. It enhances, at global level, the conservation and sustainable use of PGRFA without compromising the need of future generations (Scaffrin et al., 2006).

On 15 February, 2006 Kenya joined other 22 nations in signing the Agreement for the Establishment of the Global Crop Diversity Trust. The Global Crop Diversity Trust was established through a partnership between the United Nations Food and Agriculture Organisation (FAO) and the Consultative Group on International Agricultural Research (CGIAR).The sole goal of the Global Crop Diversity Trust is the conservation of the great worldwide diversity of agriculture housed in dozens of gene-banks across Africa and hundreds around the world. The mission of the Trust is to ensure the long-term conservation and availability of crop diversity for food security worldwide. It supports an endowment that will support in perpetuity the urgent and chronic shortages that face the world's most important collection of crop diversity. The Trust also supports priority up-grading and capacity building activities. The Trust addresses two of the Millennium Development Goals: Goal 1 to eradicate extreme poverty and hunger, and Goal 7 to ensure environmental sustainability (Global Crop Diversity Trust, 2007).

LOSS OF KENYA'S AGRICULTURAL BIODIVERSITY

During the World Food Day ceremony held at the FAO headquarter on 16th October 2004, the Director-General of the United Nations Food and Agricultural Organization (FAO), Mr. Jacques Diouf stated that biodiversity is vital to the productive use of the world's marginal land, but agricultural production has lost about three-quarters of its genetic diversity in the past century, leaving the world dependent on a dozen crops and a barely larger number of animal species (Europaworld, 2004). Mr. Diouf said FAO was raising the alarm about the situation in which "just 12 crops and 14 animal species now provide most of the world's food." He also suggested that, for many rural families, the sustainable use of local biodiversity is key to their survival. He further said that global food security depends not just on protecting the world's genetic resources, but also on ensuring that these resources remain available to all. Therefore preserving biodiversity should be a joint effort involving farmers, commercial plant breeders and the scientific community (Europaworld, 2004).

With the threat on locally diverse food production systems there is the accompanying threat on local knowledge, culture and skills of the food producers. Concomitantly, agricultural biodiversity is disappearing and the scale of loss is extensive. With the disappearance of harvested species, varieties and breeds goes a wide range of unharnessed species; more than 90% of crop varieties have disappeared from farmers' fields and half of the breeds of many domestic animals have been lost and in fisheries, the world's 17 main fishing grounds are now being fished at or above their sustainable limits, with many fish populations effectively becoming extinct (Mulvany et al., 2002). The FAO's Domestic Animal Diversity Information System (DAS-IS) had, in March 2005, records of over 6900 breeds in 35 species from 180 countries, including information on origin, population, risk status, performance and morphology. Of these, over 700 are already extinct and it is estimated that 30 percent of the world's breeds are at risk of extinction (Geerlings et al., 2002).

Despite the efforts employed by the government, Kenya's agricultural biodiversity is also under serious threat. The Kenya National Development Plan (KNDP) (2002 - 2008) states that because of population growth of 2.7%, urbanization, deforestation rates about 30 times greater that reforestation (Cunneyworth, 2001), pollution and intensive agricultural production based on cash crops like sugarcane, coffee, tea and three prime staples; maize, wheat and rice, the species that now sustain humanity in Kenya are very few. Breeders throughout the country just as in the whole world are engaged in developing better and higher-yielding breeds thus compromising the nutritive value obtained from a variety of foods (GOK, 2002). The local species that are not only numerous, fulfilling a variety of needs and adapted to different conditions, but also genetically variable, are being abandoned and lost forever in favor of fewer newly developed ones (Zedan, 1995).

A study carried out among rural agricultural-dependent households in Mumias district, a sugarcane-growing region in western Kenya, revealed that on average households grew three food crops, kept two animals for food and obtained two varieties of food items from natural sources (Ekesa et al, 2008). White maize was the most popular food crop with 97.2% of the interviewed households growing it. Although other findings have indicated that beans are the second popular crop in western Kenya, this study found that cassava was still popular with 59% of the households still cultivating it. Kenyan traditional pre-colonial staples like sorghum, finger millet were grown by less than 30% of the population. The findings of this study also showed that indigenous vegetables were not so popular, only 11.8% of the interviewed households grew indigenous vegetables (Ekesa et al, 2008). Chicken was being reared by majority of the households (70.1%) Cattle were being reared by 49.3% of the households. Only 5.6 and 0.7% of the household interviewed reared birds and fish respectively. Mushrooms were gathered by 43.1% of the households, while 30.1% and 11.1% of the households trapped termites and wild birds respectively. About 6.3% of the households gathered wild fruits. Although caterpillars, mole and giant rats were initially trapped and used as food, the findings of this study showed that only grasshoppers (1.4%) and white ants (30.1%) were trapped for food (Ekesa et al, 2008).

HUNGER IN KENYA

As stated earlier the Kenyan government is putting in effort to conserve its agricultural biodiversity and promote food security. Despite this, Kenya is a country constantly confronted with food shortfalls, and the rate of malnutrition is still high. According to Keino (2004), these food shortfalls are attributed to many factors including little emphasis, support and commitment from the government on traditional drought resistant food crops and animal breeds; and over dependence on a limited number of crops and animal breeds.

Kenya has been dealing with the accumulated effects of several years of drought that has affected a large number of people (IFRC, 2004). Most parts of the country experience dry weather as a result of poor rains This has led to acute food insecurity in several pastoral and agro-pastoral areas particularly in Garissa, Samburu, Mandera, parts of Malindi, Kilifi, Kwale, and Taita Taveta districts. Turkana, Marsabit, and parts of Kajiado, Narok, and Isiolo districts (IFRC, 2004).

One in every three people in drought-stricken areas of Kenya suffers from acute malnutrition, and worsening food shortages threaten millions in the East African nation, according to Timo Pakkala, deputy country director of the UN World Food Program, the lives and livelihoods of over 2.3 million Kenyans are at risk, and malnutrition rates are reaching alarming levels, endangering children's physical and intellectual development. Heimo Laakkonen of the UN children's agency, UNICEF states that acute malnutrition afflicts 35 per cent of the population in the hardest hit areas; and chronic malnutrition is as high as 45 per cent; and as many as 1.2 million children could drop out of school and 520,000 children need vaccinations and vitamins to cope with disease outbreaks related to food shortages (United Nations, 2004).

RECOMMENDATIONS

Emphasis should be put on re-establishing the knowledge transfer system that has been eroded due to modernization. This will enable community members to realize the high value of neglected and underutilized indigenous species of plants and animals.

Looking at the efforts of the Kenyan government, some emphasis has been put on plant varieties there is still more to be done for both the plant and animal varieties. The local breeds commonly possess valuable traits such as adaptation to harsh conditions, including tolerance of parasitic and infectious diseases, drought and poor quality feed. They are being replaced in both developed and developing countries by a few high production breeds which, to be successful, require high inputs, skilled management and comparatively benign environments, for instance the Red Masai sheep has proven to be genetically resistant, or less prone, to infestation with intestinal worms (Geerlings et al., 2002) Promoting the local breeds has worked in other area like Poland. The Polish Red cattle is an old local race that is very useful in some specific conditions especially in hilly and mountainous regions where controlled grazing protects slopes against erosion, to protect this local breed, Heifer International's office in Poland worked with the community of Zegocina to revitalize and increase the population of Polish Red Cattle in the region. Farmers appreciate these cattle, because of their high productivity and resistance to disease. As a result Zegocina has also retained its beautiful landscape that attracts many visitors, supporting agro-tourism development (Mulvany et al., 2002).

A Collective seed supply and husbandry should be developed through Community Seed Banks (CSBs). This can be through participatory approaches and it will further farmers' autonomy by timely provision of seeds and conservation of agricultural biodiversity. This will help solve the problems of government seed programmes where only a few commercial varieties are distributed. In Tanzania this has worked well local organizations have trained farmers who by 2000 had organised 220 CSBs, benefiting 6,920 families, storing over 80 tons seeds of the main crop varieties, including 67 varieties of three different bean species (Mulvany et al., 2002).

Policy makers are biased toward large-scale plans, whereas much of agricultural biodiversity is fine-scaled. Planners need to recognize and utilize traditional practices as a component of the knowledge system that support conservation and management of agricultural biodiversity (Gemmill, 2002).

Conclusion

As stated by the Director-General of the United Nations Food and Agricultural Organization (FAO), Mr. Diouf, biodiversity is vital to the productive use of the world's marginal land, and for many rural families, the sustainable use of local biodiversity is their key to survival since it allows them to exploit marginal lands and ensure a minimum level of food production even when faced with extremely harsh conditions (Europaworld, 2004). Therefore, conservation of agricultural biodiversity and reduction of hunger and malnutrition, will take political will and determination, since for every underfed child who makes news headlines, millions more are going unnoticed.

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