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Role of indigenous leafy vegetables in combating hunger and malnutrition

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Indigenous leafy vegetables can play an important part in alleviating hunger and malnutrition in sub-Saharan Africa, but they are often neglected in research. They are important sources of micronutrients including vitamins A and C, iron and other nutrients and are sometimes better nutritional sources than the modern vegetables. The leaves of cultivated plants, such as pumpkins, melons and cowpeas are used as a leafy vegetable, as well as leaves from wild and weedy species from farmers' fields and the veld. These wild and weedy species include amaranth species, C*orchorus* species and C*leome gynandra* amongst others, and all have the potential to be cultivated. The harvested leafy vegetables are perishable, but can be processed and preserved by partial cooking, blanching or drying. This paper provides ecogeographical information and some botanical descriptions; we discuss the importance of leafy vegetables in food security, the monetary value of some of these crops and report on some of the research carried out at ARC–Roodeplaat (Pretoria), South Africa.

Introduction

Despite the commitment made at the International Conference on Nutrition (ICN) in 1992 and at the World Food Summit in 1996 to eliminate or drastically reduce micronutrient malnutrition, unacceptably high rates of micronutrient malnutrition still persist. Hunger and malnutrition threaten millions of people in sub-Saharan Africa and it is estimated that in many countries in this region approximately 20% or more of the inhabitants experience food insecurity. Food security is defined as 'physical and economic access to sufficient, safe and nutritious food to meet the individual's dietary needs and food preferences for an active and healthy life' (FAO 1996). Malnutrition among preschool children is one of the manifestations of food insecurity.

Indigenous leafy vegetables are an important part of farming and consumption systems throughout Africa. They are important sources of micronutrients including vitamins A and C, iron and other nutrients (Van den Heever and Coertze 1996a, Schippers 2000). Indigenous leafy vegetables are crucial to food security, particularly during famine and natural disasters, two scourges that are currently prevalent in sub-Saharan Africa (SSA). Many plants grow in the wild or as weeds in cultivated areas, but have also been domesticated through semi-cultivation or cultivation. When domesticated, they require few inputs and tend to grow and produce in areas where cultivation of exotic vegetables is difficult. They have been known to compete effectively in markets with exotic vegetables, which require high inputs and yet are not always affordable by farmers and resource-poor consumers. Indigenous leafy vegetables are thus of great importance to SSA, but have been neglected as a result of inadequate research and development. Reasons for this neglect are varied but a major factor relates to their principal association with women, and a lack of appreciation of their nutritional and intrinsic value by researchers and development experts.

The need for research and baseline information

There are many different species of leafy vegetables in use in the SSA region, many of which are fairly localised. Many of these species are not readily amenable to conventional agronomy, often being grown in small patches in home gardens.

The leafy vegetables of Africa have been displaced in many areas, leading to a decline in production, use and diversity of the vegetables being grown. This trend will clearly have a detrimental impact on the nutritional status of households and the income particularly of the women farmers who constitute the primary producers, as well as consumers and sellers of these vegetables. The importance of leafy vegetables is underestimated. Lack of attention means that the potential value of these vegetables is under-exploited. The scenario thus far described encourages continuing genetic erosion, further restricting development options for the rural poor. These vegetables constitute a valuable intellectual and natural resource that needs to be preserved and that is crucial from a national and cultural point of view. Therefore, research on these crops should have high priority. First and foremost, it is necessary to understand what is happening at grassroots level, so as to establish which species are utilised.

ARC–Roodeplaat, in collaboration with the International Plant Genetic Resource Institute, Limpopo Department of Agriculture, African Christian Action Trust and various research institutions in Kenya, Cameroon, Senegal, Tanzania and Zambia are currently co-operating to fill the research gap and to establish a better scientific knowledge base. Baseline studies have been conducted in certain communities to enhance understanding of the existing utilisation pattern, including aspects relating to culture, beliefs, and taboos surrounding these species. The species utilised were identified and ranked in different communities. Information on the utilisation, cultivation and conservation of these species was gathered and research needs identified.

Local wild-cultivated species, as well as wild and weedy species, were collected in collaboration with the National Genebank of the National Department of Agriculture, and conserved as seed in the genebank. The specimen data from five genera (amaranth, cowpea, cleome and indigenous cucurbits) were acquired from the National Botanical Institute (National Herbarium Pretoria Computerized Information System). Distribution and prediction maps were drawn with DIVA and Flora Map diversity software packages (Hjimans *et al.* 2001, Jansen van Rensburg 2002, Van Zijl *et al.* 2002).

Leaves of the vegetables were harvested from species from the veld and from those grown in home gardens. Most of the species harvested from the veld have the potential to be cultivated; research on cultivation practices is needed. On-farm trials were conducted to assess the potential of the wild and weedy species under different production systems. Members of the community took part in the selection trials, thereby identifying those species and selections of the species favoured by the communities (Van Zijl *et al*. 2002).

The most important species belong to the *Amaranthus*, and *Corchorus* genera*,* and *Cleome gynandra*, but also include cowpeas, pumpkins and other cucurbits. The preference for these species differs, depending on age and gender of the consumer, the cultural background and geographical area.

Leafy Vegetable Crops

Amaranth (cheke, thepe, tepe, imbuya, pigweed, amaranth, misbredie)
Amaranth is one of the most common vegetables in Africa. All species of amaranth are used as leafy vegetables, with *Amaranthus hypochondriachus* (L.)*, A. tricolor* (L.), *A. hybridus* (L.) and *A. blitum* (L.) the most popular. Amaranth (Amaranthaceae) is an erect to spreading herbaceous herb. Height varies between 0.3m to 2m depending on the species and environment. Some species have distinct markings on their leaves. Terminal and auxiliary inflorescences occur. The small seeds of the leafy amaranthus are normally shiny and dark-brown to black. Amaranth is a C_4 plant with an optimal growth rate at higher temperatures, bright light and an adequate supply of water and minerals (Schippers 2000, Van den Heever and Coertze 1996a, Van Wyk and Gericke 2000, Van Zijl *et al*. 2002). Amaranth leaves and seedlings (Figure 1) are traditionally harvested from the veld, but the plant has a great potential for cultivation.

The various *Amaranthus* species are widespread in South Africa, except in the more arid southwestern areas as shown in Figure 2 (Jansen van Rensburg 2002, Van Zijl *et al*. 2002).

Cowpea (msoni, monawa, cowpea, akkerbone)
Cowpea (*Vigna unguiculata* L. Walp.), of the Fabaceae, is indigenous to several African countries, where it has been cultivated for a long time. Cowpeas are one the most important pulse crops in Africa. Different varieties exist, varying from prostate, indeterminate to erect, to determinate, low-branching types. The varieties mainly used as leafy vegetables are the spreading, prostrate varieties. It is often cultivated between taller crops such as maize. This leafy crop is especially important in the more arid regions since it is deep-rooted and tolerant to drought (Schippers 2000, Van Zijl *et al*. 2002). Flowers and leaves of cowpeas are shown in Figure 3.

Various subspecies are found in the wild in the eastern areas of KwaZulu-Natal, Mpumalanga and the Limpopo. These include *Vigna unguiculata* subsp. *dekindtiana* var. *dekindtiana, V. dekindtiana* var. *huillensis, V. protracta, V. stenophylla, V. tenuis* var. *ovata,* subsp*. unguiculata,* with *Vigna unguicalata* subsp*. unguiculata* the most common. The distribution of wild cowpeas is depicted in Figure 4 (Jansen van Rensburg 2002, Van Zijl *et al*. 2002).

Cleome (bangala, lerotho, spider flower, spider plant, african cabbage, cat's whiskers, oorpeultjie, snotterbelletjie)
Cleome gynandra L. belongs to the Capparaceae. It is an erect herbaceous herb, branched and rather stout. Height varies between 0.5m to 1.5m, depending on the environment. Leaves are compound and palmate with three to seven leaflets. Stems and leaves are covered with glandular trichomes. Variable pigmentation, from green to pink and purple is found on the stems. Terminal inflorescences have small white flowers, but pink and lilac flowers also occur. The fruit are small siliques (Chweya and Mnzava 1997, Van den Heever and Coertze 1996b, Van Wyk and Gericke 2000, Van Zijl *et al*. 2002).

In South Africa cleome is not cultivated, and leaves and young stems are traditionally harvested from the veld (Figure 5). However, it does have the potential to be cultivated. Cleome prefers deep well-drained soil, rich in organic matter but can thrive in a variety of soils. It is sensitive to cold and will not do well in temperatures below 15°C (Chweya and Mnzava 1997, Schippers 2000, Schippers *et al*. 2002a, Van den Heever and Coertze 1996b).

Cleome is a wild, weedy plant that grows in the veld and farmers' fields in the northern parts of South Africa. It is unknown in KwaZulu-Natal, although some plants were collected there (Figure 6) (Jansen van Rensburg 2002, Van Zijl *et al*. 2002).

Cucurbits — both indigenous and foreign (tinwembe, mophotse, intanga, pumpkin, pampoen)
The pumpkin family (Cucurbitaceae) is a large family found mainly in the warmer parts of all the continents. Species such as cucumbers, pumpkins and melons have considerable economic value. Leaves, fruits and flowers of the cultivated species are generally consumed by villagers throughout Africa. Leaves and fruit of some wild cucurbits are also harvested in the veld. The most popular cucurbit species are *Citrullus lanatus* (Thunb.) Mansf. (watermelon), *Cucumis melo* (melon), *Lagenaria siceraria* (bottle gourd or calabash), *Cucurbita pepo, C. maxima and C. moschata*

Figure 1: Amaranth seedlings ready for harvesting

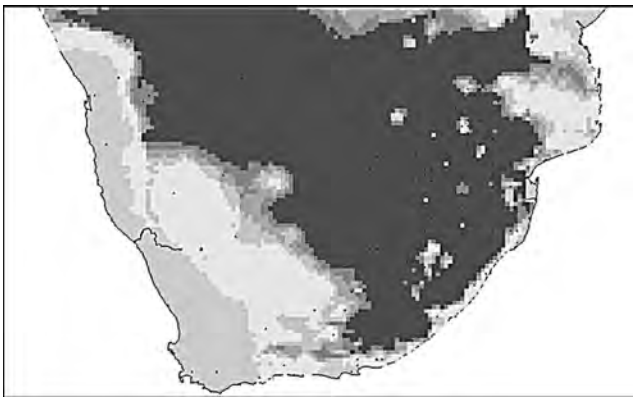

Figure 2: Possible distribution of the mentioned *Amaranthus* spp. in southern Africa

(pumpkins and squashes) (Bosch 1998, Coertze 1996, Schippers 2000). The leaves of *Momordica balsamina*, a local climber, form a popular vegetable in the eastern parts of South Africa (Figure 7).

Indigenous cucurbit species include *Citrullus lanatus* and *C. rehmii, Cucurbita pepo, Cucumis melo* and *C. anguria* and *Momordica balsamina*. Indigenous cucurbits prefer the more arid areas of western and central southern Africa (Figure 8) (Jansen van Rensburg 2002, Van Zijl *et al*. 2002).

Corchorus (guxe, ligusha, jute's mallow, wild jute, wildejute) Corchorus (Figure 9) is a very popular leafy vegetable in the northern and eastern regions of South Africa and could be used as a source of fibre. It is harvested from the veld as well as from farmers' fields. Different corchorus species are found throughout tropical Africa, namely *Corchorus asplenifolius*, *C. trilocularis* and *C. olitorius*. Corchorus is an erect annual herb, varying in height from 0.2m to approximately 1.5m. The hair-like teeth at the base of the leaves makes it easy to identify. The prepared leaves are mucilaginous, similar to okra, and are sometimes mixed with coarser vegetables to help soften their texture (Schippers *et al*. 2002a, Van Wyk and Gericke 2000).

Traditionally, corchorus is not cultivated but harvested from the wild. However, it has the potential to be cultivated. Corchorus prefers warm, humid conditions, and performs well in areas with higher rainfall (600–2 000mm). Higher temperatures favour the production of corchorus whereas temperatures below 15°C are detrimental to the crop. Corchorus grows in a wide range of soils, although it prefers rich, well-drained loam soil (Schippers *et al*. 2002a, Van den Heever and Coertze 1996a, 1996b).

Figure 3: Cowpeas in the field

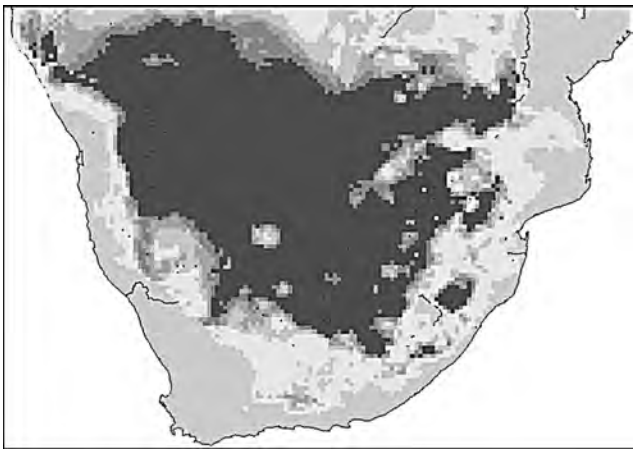

Figure 4: Possible distribution of the mentioned *Vigna unguiculata* subspecies in southern Africa

Figure 5: Harvesting the growth point of cleome

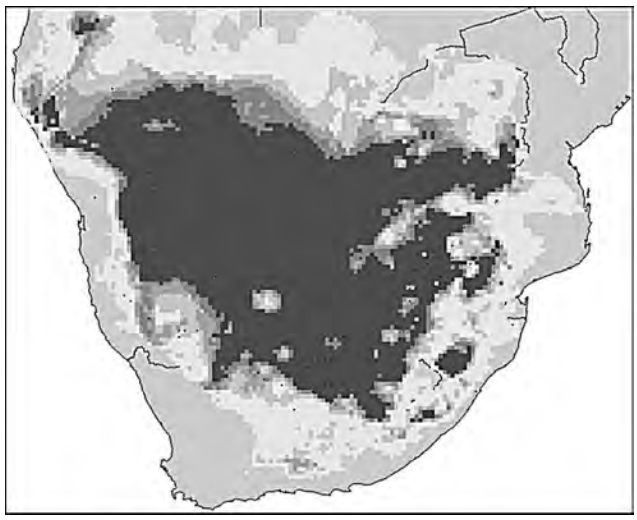

Figure 6: Possible distribution of *Cleome gynandra* in southern Africa

Figure 7: Various cucurbit species. (**a**) *Cucurbita maxima*; (**b**) *Cucumis melo* (phara); (**c**) *Momordica balsamina* (nkaka); and (**d**) *Citrullus lanatus* and *Cucumis melo* fruits

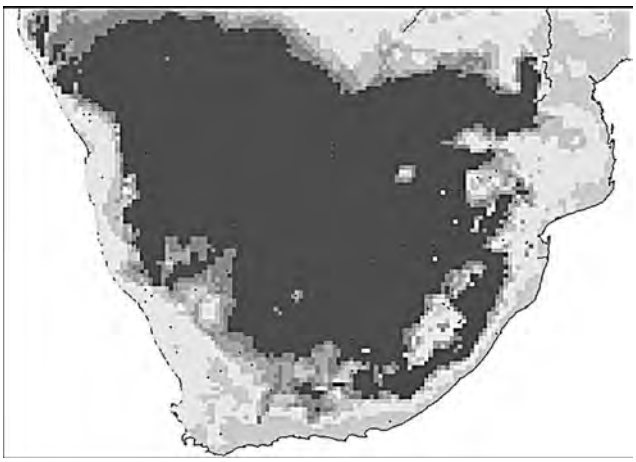

Figure 8: Possible distribution of the mentioned cucurbits in southern Africa

Figure 9: Young corchorus plants in a maize field

Other — Other leafy vegetable species include *Chenopodium album* L., *Bidens pilosa* L., *Portulalaca oleracea* L., nightshade (*Solanum americanum* Mill., *S. scabrum* Mill. and other species), sweet potato, and the indigenous kale species, *Brassica carinata* A. Br. Utilisation depends on season and cultural background of the consumers (Van Zijl *et al*. 2002).

Nutritional value

African leafy vegetables are usually inexpensive or free and are a rich source of nutrients, especially vitamins A and C, and minerals (calcium and iron). Boiling the leaves may reduce the vitamin C content by up to 80%, while drying reduces the vitamin content by about 95%. These vegetables are especially valuable in the diets of women and children. Some of these leafy vegetables also have medicinal value. It is believed that regular consumption of the leaves by pregnant women will ease childbirth, by reducing the length of labour, and aid recovery (Van Zijl *et al.* 2002).

As a vegetable, amaranthus is nutritionally more valuable than any of the other spring and summer leaf vegetables. It provides about 4 500 units of vitamins per 100g edible portion, compared with 600g for swiss chard and 280g for cabbage (Table 1). It also provides more energy, protein, miner-

Table 1: Composition per 100g of edible portion of amaranthus, spiderplant, black nightshade and corchorus compared to cabbage (FAO and Schippers 2000)

	Amaranthus *Amarahthus hybridus* (FAO)	Spiderplant *Cleome gynandra* (FAO)	Black Nightshade *Solanum nigrum* (FAO)$^{+}$ (Schippers 2000)$^{++}$	Corchorus *Corchorus olitorus* (Schippers 2000)	Cabbage (FAO)
Iron (milligrams)	8.9	6.0	1.0^{+} 1.0–4.2^{++}	7.7	0.7
Protein (grams)	4.6	4.8	4.3^{+} 2.8–5.8 (crude)$^{++}$	5.6	1.7
Moisture (%)	84.0	86.6	87.2^{+}		91.4
Calories	42	34	38^{+} 38^{++}	43.0	26
Carbohydrates (grams)	8.2	5.2	5.7^{+} 3.3–5.0^{++}	7.6	6.0
Fiber (grams)	1.8		1.3^{+} 0.6–1.4 (crude)$^{++}$	1.7	1.2
Ascorbic acid (milligrams)	64	13	20^{+} 20–158^{++}	53	54
Calcium (milligrams)	410	288	442^{+} 90–442^{++}	266	47
Phosphorus (micrograms)	103	111	75^{+} 75^{++}	122	40
B-Carotene (micrograms)	5 716		3 660^{+} 1 700–11 600^{++}	7 850	100
Thiamine (milligrams)	0.05			0.13	0.04
Riboflavin (milligrams)	0.42		0.59^{+}	0.26	0.10

Table 2: Nutritive value of *Amaranthus* leaves (Van der Heever and Coertze 1996a)

Variety	Protein (%)	Fat (%)	Fiber (%)	Fe	Ca	Vit. A (mg 100g^{-1})	Vit. C
A. hypochondriachus	27.6	2.2	7.6	24.3	3.9	41.9	13.6
A. tricolor	27.4	1.8	6.6	10.4	3.4	33.7	11.0
A. hybridus var. *cruentus*	26.0	2.0	9.1	61.3	3.3	43.8	6.3
A. hybridus	30.3	1.5	8.3	99.0	2.4	34.4	11.2
A. hybridus (Mayfords)	26.8	2.3	6.2	84.5	2.9	45.8	9.9
Recommended Daily Allowance (Males 14–18 years)	60.0g	–	–	18.0mg	1.4g	1.7mg	5.5mg

Table 3: The amounts of edible herbs consumed and their respective monetary value

Villages	Reference	Annually consumed edible herbs (kg capita^{-1})	Estimated value of a kilogram of herbs (ZAR kg^{-1})	Total annual value of consumed herbs (ZAR capita^{-1})
Mametja	(Twine *et al.* 2001)	8.9 (fresh herbs)	139.50	1 240
		1.2 (dry herbs)	96.00	115
Hlabisa	(Magasela *et al.* 2001)	2.3 (fresh herbs)	21.25	49
		0.9 (dry herbs)	11.44	10
Kat River Valley	(Shackleton *et al.* 2001)	26.6 (fresh and dry herbs)	0.67	18
Mogano	(Shackleton *et al.* 1999)	30.2 (fresh and dry herbs)	34.58	1 044
Ha-Gondo	(Shackleton *et al.* 1999)	4.1	33.94	139
KwaJobe	(Shackleton *et al.* 1999)	12.3	2.65	33

als and vitamins (especially vitamin C) than the other leafy vegetables (Table 2). The nutritional value is a function of the species and plant part used. Amaranthus is a good supplement for diets based on cereals and tubers as it is rich in lysine (Schippers 2000, Van den Heever and Coertze 1996a).

Cleome is known for its nutritional and medicinal value (Table 1). It is used to help mothers recuperate after giving birth and during breast-feeding; also for stomach ailments (Chweya and Mnzava 1997, Schippers 2000, Schippers *et al*. 2002a, Van den Heever and Coertze 1996b). Increased soil fertility results in increased crude protein, but a decrease in beta-carotene, ascorbic acid and iron content of the leaves. Increased soil fertility does not affect phenolic compounds or the calcium and sodium contents of the leaves. In *C. gynandra* the amount of ascorbic acid lost increases with cooking time, with up to 80% destroyed if cooked for 15min in 8 volumes of water (Van den Heever and Coertze 1996b).

Corchorus is rich in vitamins A and C, protein, calcium and folic acid (Table 1). In some species, the protein content of the young leaves can be as high as 25%. This vegetable eases indigestion and is also used as a laxative. Much of the healthy nutrients are lost due to overcooking, especially when the water, in which it was boiled is discarded (Schippers 2000, Schippers *et al*. 2002a).

Monetary values of edible herbs

The monetary values of woodland resources in South Africa are not adequately established, as there are too many variables across the various studies (Shackleton *et al*. 1999, Shackleton *et al*. 2001, Twine *et al*. 2001, Magasela *et al*. 2001). Shackleton *et al*. (1999, 2002) argue that understanding of such values would enable appropriate decisions to be made regarding policy frameworks and allocation of scarce resources. The main aim of evaluating edible herbs is to demonstrate the positive contributions of woodland resources to rural livelihoods and the local cash economy. The understanding of the importance of edible herbs, as well as the other woodland resources, may help to minimise the transformation of woodland to agricultural areas, industries and other land uses. This may also help establish appropriate ways to compensate the loss of such resources due to development.

A study was conducted in six villages, namely Ha-Gondo, Mametja and Mogano in Limpopo Province, KwaJobe and Hlabisa in KwaZulu-Natal, and Kat River Valley in Eastern Cape comprising: *Amaranthus hybridus*, *Bidens pilosa*, *B. biternata*, *Cleome gynandra*, *Corchorus tridens*, *Chenopodium album* and *Tribulus terrestris* were highly utilised in these six villages (Shackleton *et al*. 1999, Shackleton *et al*. 2001, Twine *et al*. 2001, Magasela *et al*. 2001).

The amounts of edible herbs consumed per person and the estimated value per kilogram of edible herbs vary considerably from one village to another (Table 3). Mogano and Kat River Valley villages appear to consume high amounts of the edible herbs at their disposal, whereas Hlabisa and Ha-Gondo consumed the least. These variations, which also affect the unit price, may be due to different parameters used for extrapolation of data from the different studies. As a result, the total monetary values estimated might be over- or underestimated. Although Mametja was one of the villages where the consumption of herbs was amongst the lowest, its total monetary value was one of the highest (Table 3). The reason for that was the likely over-pricing of 1kg of edible herbs (Table 3). However, such values in general give a rough guideline of how valuable edible herbs are to South African communities.

As shown in Table 3, a person in each household across the six villages consumes edible herbs worth approximately ZAR442 on average. If this value is extrapolated to a household comprising seven members, a common number in rural households, the total annual value of the amount of edible herbs eaten per household is approximately ZAR3 094. This figure gives a rough indication of the contribution edible herbs may make to the local and national economy. Sales of fresh edible herbs are particularly low, with only about 3% of the respondents making sales. However, the purchase of dry herbs was evident across the six villages. It appears that there is a need for reliable marketing and value-added activities (processing, drying, packaging, etc.) to help prevent surpluses from perishing. Once the market is established, *ex-situ* mass production should be considered to help improve yields and quality. Production trials are being conducted by ARC–Roodeplaat to develop these resources.

Processing

Throughout Africa, the tender leaves or young shoots, and often the flowers as well, are eaten boiled as a potherb, tasty relish, stew or side dish. The harvested leaves are normally washed and cooked in water, with or without salt, sometimes with the addition of bicarbonate of soda. Cooking times vary from a few minutes to up to 2h, depending on species and culture. The cooked leaves are eaten or are mixed into a relish, which is prepared by frying onions, tomatoes, minced peanuts or peanut butter together. The cooked leafy vegetables, morogo or imfino, are then eaten with a stiff porridge (Van Zijl *et al*. 2002). Fresh leaves are used as ingredients in other mashed foods, and dried leaves are ground and incorporated in weaning foods. The leaves of some species are rather bitter and for this reason are cooked with other leafy vegetables such as cowpea, amaranth and nightshade. To reduce bitterness, milk may be added to the boiled leaves, and the mixture preferably left overnight in the cooking pot (Van Zijl *et al*. 2002).

Indigenous or traditional vegetables are perishable, but consumers manage to lengthen the shelf life through partial cooking or drying. The indigenous inhabitants have a rich knowledge of these techniques. Drying and storing of vegetables are done to ensure ample supply during winter periods. The manner by which vegetables are processed may slightly vary from one culture to another and warrants further investigation.

Partial cooking or blanching

Vegetables are plainly and partially cooked without addition of salt or other ingredients. The women cook as much vegetables as they can during summer when it is still available in abundance (Van Zijl *et al*. 2002). Other cultures use different blanching methods. The blanching process plays a role in the retention of nutrients. Steam blanching, followed by dehydration is most effective in retaining ascorbic acid (Schippers 2000).

Drying

A number of drying techniques are used to lengthen shelf-life of vegetables. The most common methods of drying are the use of flat rocks and a flat zinc metal surface exposed to the sun. Fresh leaves or partially cooked leaves are formed into small balls and dried. It normally takes two to three days to dry vegetables completely. However, the vegetables may be subjected to dust and other impurities. Other technologies need to be developed to ensure quality products (Netshiluvhi pers. comm., Schippers 2000, Van Zijl *et al*. 2002).

Storage

Dried vegetables are stored either in a huge clay pot (*tshinkwana*) or sack (an empty maize meal bag). Vegetables are kept in the pot, with lid on, sealed with fresh cow dung. The pot is then exposed to the sun for two days to allow the dung to dry. After drying, the pot is then kept in the traditional kitchen (*tshitangani*) next to a fireplace. Smoke is believed to prevent the development of bread mould (*mugugumela*) on dry vegetables. If dry vegetables are kept in a sack, the sack is either hung by a string or kept on top of any object to prevent any close contact with the ground (Netshiluvhi pers. comm.). This is done to prevent vegetables from rotting or being infested by micro-organisms. Dried and stored vegetables have a shelf-life of about two to three years, when they retain good quality and taste.

Potential for Biotechnology

It is likely that agri-biotechnology will eventually take root in Africa. However, in Africa it is and will continue to be based on people's needs rather than being supply driven (Wambugu 2001). The greatest challenge is to raise crop yield rather than expand the area under cultivation. Yields can be raised through seed-based technologies, which are relatively easily disseminated and which farmers find easy to acquire and use. Where conventional selection and breeding techniques are difficult to apply, biotechnology may offer a way forward. Since biotechnology is indeed a logical response to the farmer's needs, it follows that the means of developing and delivering biotechnology solutions need to be in place, e.g. mutational breeding to increase drought tolerance. In South Africa mutational breeding is currently applied on amaranthus species, bambara groundnut and cowpea for enhanced drought tolerance.

Conclusion

South Africa faces increasing rural poverty, which leads to increased urbanisation, joblessness and levels of crime. Agriculture, one of the largest sectors in its economy is undergoing radical changes that are driven by major trends in the macro-economic, social and natural environments. These trends focus on the increasing importance of the market place and the rapid shifts in power along the food supply chain. The rate of these changes is accelerating due to the effects of global market integration and Africa has to deal with the economic shocks with few of the safety nets enjoyed by

agricultural workers in industrialised nations. For many African countries that rely on sales of raw materials, declining world commodity prices have led to rapidly falling terms of trade and the current recession has compounded the reduction in economic growth rates and shift in market power away from rural producers to urban retailers. Farmers are facing rapidly increasing production costs and falling prices for their produce. This decrease in income is compounding the difficulties associated with rural poverty and accelerating urbanisation of more people. However, whilst raw commodity prices are falling to record low levels, the agri-food sector is showing rising profits, with post-harvest components of the food systems increasing in number and importance. We can address these problems through promotion and use of our under-utilised indigenous resources. Leafy vegetables will benefit farmers across Africa, and help to improve the nutritional status of the vulnerable groups. It will also help to generate a better income for women farmers.

The international controversy over the bio-availability of pro-vitamin A from plant foods calls into question the nutritional contributions of indigenous leafy vegetables and underlines the need for research on this topic. Genetic diversity approaches can contribute to addressing the real contribution of these species to improved nutrition of vulnerable groups through inter- and intra-specific analyses of carotenoid composition and bioavailability. Plant diversity research may offer solutions through identification of synergistic food combinations or preparation methods that mediate pro-vitamin A absorption.

With urbanisation in sub-Saharan Africa projected to reach more than 50% of the population over the next 15 years, solutions to forestall the nutrition and health impact of this trend are needed. Potential ways in which indigenous leafy vegetables could contribute include scientific evaluation of plant properties, cultural support programs, dietary education, innovative processing and marketing.

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