The farmers' treasure trove

by **B. Mathieu**, **N. Perrot** and **S. Gonne***

Farmers own and cultivate their local varieties of transplanted sorghum (*Sorghum bicolor* (L.) Moench, *durra* or *durra-caudatum* varieties), which have become adapted to the different ecological and social conditions of the Lake Chad Basin. These dry season sorghums have different generic names according to the production area: *berbere* in Chad, *muskuwaari* in Cameroon and *masakwa* in Nigeria.

The production cycle on recessional land starts at the end of the rainy season and develops during the dry season with the use of soil-water reserves. This allows extra cereal production at a time when most other food reserves have already been exhausted (between December and March, depending on the variety). In Cameroon, transplanted sorghum was introduced during the Bornu Empire by the Kanuri. The nomadic Peul populations, who progressively settled in northern Cameroon, have contributed to the spread of *muskuwaari* since the sixteenth century [5.10]. Today, the production of transplanted sorghum ranges from 500 to 1 500 kg per ha.

Cultivation techniques vary widely from country to country, depending on labour availability, soil types, the growing period of the selected varieties – ranging from 90 to 150 days – and the dominant grass types that spring up during the rainy season, including *Loudetia togoensis*, *Setaria* spp., *Echinochloa* spp. and *Oryza* spp. [5.11]. The skills and knowledge of farmers are important, including the building of small dams so that rainwater is retained and infiltrates the soil; the coordination of the agricultural calendar by adjusting the production in nurseries to the transplantation period, which is governed by the predicted end of the rains and the withdrawal of water from the flooded lands; managing the clearing of grasses; and the use of low-cultivation density, not exceeding 10 000 holes per ha. For example, farmers from the Diamaré Plain (region of Maroua, Cameroon) have developed a technique for rehabilitating degraded soils that combines the development of a close network of small dams with the use of pioneer varieties well adapted to drought conditions. After a few years, the water retention capacity of the soil and the soil structure improve, thanks to the dams and to the action of the root systems, which enable water to infiltrate the soil. Many local sorghum varieties have adapted to the heterogeneity of the soil in cultivated environments. An inventory of these varieties, characterized according to the farmers, was carried out in 24 villages around Maroua and Kaélé in northern Cameroon. The existing transplanted sorghums were found to belong to the *durra*, *caudatum* and *durra-caudatum* varieties, based on the classification by Harlan and De Wet [5.11].

The ecotypes are *safraari*, *majeeri*, *burguuri* and *ajagamaari*. Each variety has a local name and has specific characteristics, such as the length and the compactness of the panicle, adaptability to different soil types, pest resistance, organoleptic and transformation characteristics, and suitability for different food preparations. Some 45 local varieties have been identified, and the farmers' main selection criteria have been productivity and food quality. *Safraari* varieties are grown in over 42 percent of the total cultivated areas, because they are highly productive on typical vertisols, the flour is of good quality, and the stovers are sweet and favoured as feed for livestock. Very rustic varieties, such as *yaawu*, are being increasingly grown on newly cultivated soils and in degraded areas. This is because they are early maturing varieties (a factor that lowers risks), are not very demanding and thrive in spite of the low water retention capacity of these soils. The *burguuri* varieties are preferred for their resistance to pests, particularly the red-billed quelea (*Quelea quelea*). *Burguuri* sorghum is cultivated either along tree and bush zones or on field borders in order to protect the better-quality varieties that are cultivated in these areas. Grains vary in colour from red to pink and have a brown layer under the pericarp with a high tannin concentration that is bitter and unpalatable to birds. Some varieties have hairs, which further discourage attacks by birds. The bitter taste remains after the grains have been processed, so the *burguuri* variety is only used as a means of protecting other crops. In the *yaéré* (floodplain) areas, short-cycle varieties are generally used because these lands are covered by water for long periods of the year. If long-cycle varieties were to be used, their late harvesting would make them a target for birds. Another advantage is that early-maturing varieties reach the market earlier and therefore command higher prices. In the 24 villages investigated, not one variety of sorghum has been abandoned in recent times. Farmers are reluctant to cast aside traditional varieties because, first, they have inherited them from their forefathers and, second, they are well aware of the benefits of each one. For this reason, varieties with limited food or agronomic qualities are still cultivated and transplanted on a small scale in order to maintain seed. Among these are *majeeri wojanyaande* and *nyaawri*. The main reasons why farmers grow transplanted sorghum are as follows.

- They use it for domestic consumption.
- It suits their tastes and their traditional recipes. Each variety is considered to have specific nutritional, taste, appeal and handling values. For example, *cuscus* cooked with the *safraari* variety provides energy, while the *majeeri* is more often used for *bouillie*. The *burguuri* varieties are hard to shell and mill, while the tegument of the *ajagamaari* variety is easy to remove.
- Local populations are ready to pay a higher price – up to 25 percent more – for local varieties of transplanted sorghum.
- Even urbanized populations tend to maintain their traditional tastes and habits, thus creating new market opportunities for these local varieties.

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>> RIGHT: FARMERS MAINTAIN AND CULTIVATE MANY DIFFERENT LOCAL VARIETIES OF SORGHUM ACCORDING TO THEIR DIFFERENT NEEDS. A TREASURE OF GENETIC RESOURCES FOR PRESENT AND FUTURE GENERATIONS

DORO LELEWA VILLAGE (N'GUIGMI), THE NIGER

Wild rice: a disappearing foodstuff

by **Van Nguu Nguyen** *

Oryza glaberrima is one of 21 species of wild rice found worldwide. Once common throughout West Africa, this valuable foodstuff is disappearing fast because of the introduction of cultivated rice plants from Asia. Left to its own devices, *O. glaberrima* grows spontaneously in many parts of the Lake Chad Basin, especially thriving on the marshy lands close to the lake and the rivers. It is an excellent source of food for both humans and animals and is traditionally harvested by local communities, who store it in leather sacks, baskets or calabashes.

However, increasingly, this precious wild rice is being ousted by the arrival of *Oryza sativa*, a cultivated species imported from Asia. Before planting the Asian rice in the paddy-fields, local farmers pull out the wild rice by its roots. The threat to biodiversity, and to the future of a species that has been used for generations, is one that urgently needs addressing. Some hope is offered by the launch of NERICA (New Rice for Africa), a hybrid strain developed by researchers from WARDA (West Africa Rice Development Association), from a cross between the newcomer *O. sativa* and the native *O. glaberrima*.

ORYZA GLABERRIMA [PLATE 21]

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NEAR DAMASSAK VILLAGE, NIGERIA

LOCAL WILD RICE IS BEING OUSTED BY A CULTIVATED SPECIES OF RICE IMPORTED FROM ASIA

Agricultural by-products

Traditional agricultural systems of the Lake Chad Basin, apart from providing food for human consumption, responded to two additional (and often conflicting) requirements: the need to provide feed for livestock during dry and cold periods of the year, when forage availability is scarce; and the need to maintain soil fertility and protect the soil against erosion. In order to meet these three requirements, traditional cereal varieties were selected that maximized not only cereal production but also the production of leaves and residues. Today, the need to intensify productivity per unit of land has resulted in increased competition between the needs for food, feed and soil fertility.

Traditional production schemes do not satisfy increasing production demands and therefore need to be integrated with additional technologies. Among these sustainable technologies: hay and silage production can increase the amount of feed reserves for livestock; harvesting of alternative food sources, such as *kreb*, can increase cereal availability by maintaining soil cover and providing good feed; and intercropping, the introduction of fodder trees and the use of green manure can contribute to the cover and protection of soils.

NEAR DIFFA, THE NIGER

NEAR LIWA, CHAD

TRADITIONAL VARIETIES WERE SELECTED IN ORDER TO PROVIDE FOOD AND FEED. INTENSIVE PRODUCTION SYSTEMS CONCENTRATE ONLY ON CROP PRODUCTION RATHER THAN ON MIXED CROP-LIVESTOCK SYSTEMS

THE FAINT BORDERS OF AGRICULTURE

Like wild grasses, many other plant species are harvested without being cultivated. For centuries people have developed techniques to protect, enhance and manage species in the wild in order to eat them. The livelihood of a population depends to a large extent on the many plants that provide medicine, food and feed, and materials for building dams, boats and houses, fuel, etc. A few of them will be described here, in order to give an overview of their importance, the range of their traditional uses, and their significance in the lake's ecosystem and in peoples' daily lives.

WILD OR DOMESTICATED?

The Gimbe and Duupa people, living in the mountain region of Poli in northern Cameroon, have an agricultural economy based on the cultivation of sorghum and millet. To fortify their diet, they use a sauce based on vegetables that are partly cultivated and partly collected from the wild. Some 70 plants that are used by the two populations have been identified. They have been divided into three main groups.

1. Plants that are sown at the beginning of the growing season (e.g. *Amaranthus* spp. and *Vigna unguiculata*) at the same time or after the cereals, but receive no additional inputs until they are harvested.
2. Plants that are simply protected or not weeded from fields (e.g. *Crotalaria ochroleuca*, *Solanum nigrum* and *Justicia insularis*).
3. Plants that are directly harvested from the wild without the intervention of any human management (*Merremia pterygocaulos*, *Psophocarpus palustris*, etc.).

DANDUWANE VILLAGE (N'GUIGMI), THE NIGER

FOR CENTURIES PEOPLE HAVE DEVELOPED TECHNIQUES TO PROTECT AND MANAGE WILD PLANT SPECIES IN ORDER TO EAT THEM

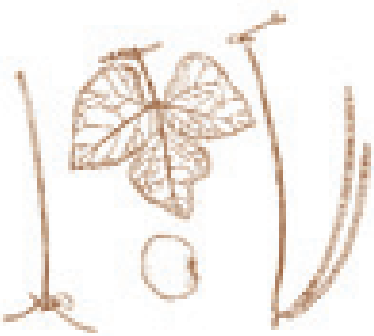
Most species from the second group, subject to a very limited human management, are collected from cultivated land and from domestic gardens (e.g. *Aspilia africana*, *Portulaca oleracea*, *Corchorus* spp. and *Crotalaria ochroleuca*), but only from land that is far away from the villages (because land that is closer is considered to be polluted with human waste). On the other hand, leaves from trees such as *Ficus* spp., *Tamarindus indica* and species of Bombacaceae are harvested both from trees close to the villages and from trees scattered in the savannah.

There is therefore a continuity between cropped and wild species because different plants are subject to different levels of human management. It is thus difficult to draw a line between domesticated (cultivated) species and wild species. This is yet another example of traditional knowledge enabling farmers to make a living in a difficult environment without jeopardizing its biodiversity [5.12].

FICUS BURKEI [PLATE 23]

PORTULACA OLERACEA [PLATE 26]

BOSCIA SENEGALENSIS [PLATE 24]



VIGNA UNGUICULATA [PLATE 27]

TAMARINDUS INDICA [PLATE 22]

CROTALARIA NATALITIA [PLATE 25]

SOLANUM NIGRUM [PLATE 28]

NEAR KOUSSERI, CAMEROON

EVEN *CALOTROPIS*, LIKE EVERY OTHER PLANT, HAS A FUNCTION IN ITS ECOSYSTEM. LOCAL PEOPLE KNOW HOW TO EXPLOIT IT

CALOTROPIS PROCERA

Another good example of a crop that is superbly adapted to the local arid conditions is *Calotropis procera*. This hardy, indigenous shrub has a wealth of uses, including fodder for goats and camels, medicine, building, and the manufacture of tools and other items that can be sold to generate income [5.13] [5.14].

Description

C. procera is an evergreen, softwood perennial shrub. It has one or few stems, few branches and relatively few leaves, most of which are concentrated near the growing tip. Its very deep taproot has few near-surface lateral roots. The opposite leaves are oblong-obovate to nearly orbicular and short-pointed to blunt at the apex, with a nearly clasping, heart-shaped base and very short petioles. The flowers take the form of umbelliform cymes that grow at, or near, the ends of shoots. The shrub flowers throughout the year and its seeds, which are dispersed by the wind, can travel for several hundred metres. It reaches an average 2 m in height.

Distribution and habitat

C. procera is native to West Africa as far south as Angola, and to East Africa, Madagascar, the Arabian Peninsula and southern Asia. More recently, it has become naturalized in Australia, the United Mexican States and the Pacific islands.

It grows best in an open habitat where there is little competition. Overgrazed pastures provide perfect conditions, but it also grows well in beach-front dunes, on roadsides and on disturbed urban lots. It thrives in dry areas with between 150 and 1 000 mm of rainfall per year, at elevations of up to 1 000 m, and on all types of soil.

FITINÉ ISLAND (BOL), CHAD

THE MANY USES OF *CALOTROPIS* INCLUDE FIREWOOD, TIMBER, TRADITIONAL MEDICINE, SILK PRODUCTION AND RENNET

An indicator of degraded soils

Calotropis has been regarded as an indicator plant of highly degraded soil and poor grassland conditions because it can be a serious weed in pastures, overgrazed grasslands and poorly managed fields. It is difficult to eliminate the stands by management, and some form of chemical control would seem to be the only practical solution. On the other hand, a wealth of traditional uses for this plant are known, reinforcing FAO's approach that, if resources are well used and well managed, their functions in the ecosystems will become evident and useful.

NEAR N'GUIGMI, THE NIGER

IF *CALOTROPIS* IS WELL USED AND MANAGED, ITS FUNCTION IN THE ECOSYSTEM WILL BECOME EVIDENT

Traditional uses

Pastoralists and farmers have long valued this plant precisely for its ability to proliferate on poor soils, its pioneer function and its wide variety of uses.

- *Calotropis* is a useful "nurse crop" for other, more valuable species.
- Sheep, goats and camels all readily eat the leaves in conditions of extreme drought. If the leaves are chopped and mixed with other leaves, the fodder can also be used at other times.
- Because of its resistance to termites and its flexibility, the wood of *Calotropis* is widely used throughout the region for building houses and for making fishing gear.
- The wood is a renewable source of hydrocarbons and is therefore a potential "petrocrop" [5.15], [5.16]. The wood is quite light and its smoke has a strong smell, but its use must be developed within the framework of cheaper and sustainable energy sources in view of the heavy population pressure on deteriorating and degraded vegetation.
- In the past, the silky hairs of *Calotropis* were used to stuff pillows and new research shows that the plant could be used to make textiles.
- *Calotropis* is also recommended as a host plant for butterflies [5.17], which play an important role in maintaining biodiversity because of their role as pollinators. *C. procera* is a favourite place for butterflies to settle and lay their eggs. In particular, it is a recognized food plant of the caterpillars of the plain tiger butterfly (*Danaus chrysippus*).
- In human health care, the tissues, and especially the bark, are used to treat a variety of illnesses, including leprosy, fever, menorrhagia, malaria and snake bite [5.18]. Extracts, chopped leaves and latex from the plant have shown great promise as a nematicide [5.19]. The latex, however, is toxic and can cause blisters.

Artificial silk

Seed fibre from *Calotropis procera* is being investigated as an alternative source of cellulose, for use in the production of textiles. Early results have produced a yarn that can be used to make a promising form of artificial silk. In order to make it appear more like cotton, the fibre has been modified, making it flat and ribboned rather than hollow.

Behind the research is Libyan scientist Dr Aisha Omran El Breki, head of the Textile and Leather Research Department at the Industrial Research Centre in Tripoli. She believes that yarns from *Calotropis* could prove a useful source of income for communities living where this hardy shrub grows, as well as being an environmentally sustainable method of making textiles [5.20].

THERE IS AN INCREASED WORLDWIDE INTEREST IN THE PRODUCTION OF TEXTILES FROM NATURAL FIBRES SUCH AS THOSE OBTAINED FROM *CALOTROPIS* SEEDS [5.36]

Making cheese with *Calotropis*

One good example of the use of *Calotropis* in food preparation comes from the Peul women in Benin. For more than a century they have been making cheese using a technique that is little known in the rest of West Africa but that could be introduced to the Peul women living in the Lake Chad Basin. It involves the use of a vegetable coagulant made from *Calotropis procera*. The cheese is first washed and boiled, before being eaten fried, a process that ensures the product's bacteriological quality. The cheese is highly prized, although it is not made outside Benin.

The production process is very simple. Fresh filtered milk is heated slowly in a pot. The vegetable coagulant, made from *Calotropis*, is then added through a strainer, and the milk and the coagulant are heated again gently for 15–30 minutes. It takes about 5 litres of milk to produce 1 kg of cheese. Generally, the women produce 0.5–5 kg of cheese at a time, depending on the availability of milk and their chances of selling the product. After they are made, the cheeses are either kept in their whey or dried and kept on the roof of the hut. No particular preservative measures are taken.

Before being sold, the cheeses are reddened. This is done to make them more attractive for market. The process involves cooking the cheese in water that has been coloured with sorghum cobs or stalks. For better preservation, the cheeses may also be cooked in water containing salt and potassium.

O'Connor and Bekele [5.21] carried out experiments (at the International Livestock Centre for Africa [ILCA], at Debre Birhan experimental station in Ethiopia) on the production of coagulant from different parts of the *Calotropis* plant. They confirmed that the leaves, which are the parts used by the Peul women, give the best results. More research on different varieties of cheeses is warranted, coupled with chemical, organoleptic and shelf-life tests.

The very low cost of producing coagulant from *Calotropis procera* confirms that traditional knowledge is a source of safe, cheap, socially and environmentally acceptable technologies that could be developed and promoted in the many other countries where *Calotropis* is widespread.

PHOTO: COURTESY OF N.SCHAREYKA

THE PRODUCTION OF CHEESE USING *CALOTROPIS* RENNET, ALREADY PRACTISED IN BENIN BY PEUL WOMEN, COULD BE INTRODUCED IN THE LAKE CHAD BASIN

Prosopis: friend or foe?

The presence in Africa of *Prosopis* spp., a leguminous tree from Latin America, was already documented in the nineteenth century. However, its dispersal started in the 1960s and 1970s, when it was introduced into several areas in order to fix mobile dunes and colonize very dry and sandy environments that were at risk of desertification. The trees, having a deep root system and good resistance to drought and to salinity, grew rapidly but they also spread towards the more fertile areas. Therefore many farmers started to see the tree as a dangerous weed.

In the Lake Chad Basin, in the Niger, a *Prosopis* forest 80 km in diameter has invaded the best recessional land. This has caused serious problems for the farmers, who have to burn and uproot the trees in order to plant their crops, and also for the fishermen, who can no longer move into the shallow waters of the lake because *Prosopis* and its roots are impeding the movement of boats. Chad reports some invasion of *Prosopis* around the lake, the extent of which is not known. Nigeria has not reported any *Prosopis* invasion of the lakeshore as yet. However, experts predict that, if the tree is not controlled, it might become invasive around the whole lake because it is advancing from the northern border southwards, mainly spread by animals that are eating the pods and dropping scarified seed.

The main problem with *Prosopis* is that, being a recently introduced species, local populations know very little about how to control it or how to utilize its products.

In 2001–2002 an FAO project based in N'Guigmi, on the Niger shore of the lake, promoted the sustainable use of the *Prosopis* tree by working with the local populations to demonstrate how to use the pods as food and feed, and the wood as construction material and for energy production. A total of 500 village women learned how to prepare *bouillie* (porridge), biscuits, syrup and coffee using *Prosopis* flour mixed in different proportions with local cereals, such as millet and wheat. As a result, they have been exposed to different cooking techniques, and local recipes have been developed with very satisfactory results. Kangar, a local non-governmental (NGO), is currently testing the effect of *Prosopis* feed with small ruminants. At the same time, the Institut national de la recherche agronomique du Niger (INRAN) prepared a map of the entire forest [5:22].

NEAR KOMADUGU RIVER, THE NIGER

PROSOPIS, INTRODUCED IN THE 1960s TO FIX DUNES, HAS FORMED THICK FORESTS THAT HAVE INVADED PRECIOUS RECESSIONAL LAND

PORT OF LELEWA (N'GUIGMI), THE NIGER

FISHING AND FARMING ACTIVITIES HAVE BEEN GREATLY DISTURBED BY THE RAPID SPREAD OF *PROSOPIS*. THE GOAL OF A RECENT FAO PROJECT WAS TO MAKE PEOPLE AWARE OF THE MANY USES OF THIS TREE

To summarize, *Prosopis* represents a clear example of the environmental risk brought about by introducing a new species into an ecosystem. Efforts must now be concentrated on the management and control of the tree, understanding its taxonomy and fully exploiting its potential in the fight against desertification; on its role as a source of firewood and good-quality food and feed; and, above all, on making the population aware of all this. Full responsibility lies with international institutions and national and local policy-makers to ensure that sufficient training and research support are given, within the framework of national and international strategies related to the sustainable use of introduced species.

NEAR DOUTHY VILLAGE (DAMASSAK), NIGERIA

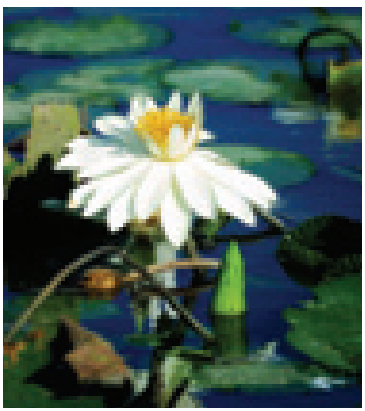
WATER LILIES PROVIDE GRAINS AND NUTS THAT ARE APPRECIATED AS FOOD AND SOLD AT MARKETS

WATER LILIES (*NYMPHAEA* SPP.)

Water lilies are found in many of the pools and inlets of the Lake Chad Basin. Their flowers are white or yellow and the plant can cover the whole expanse of a pool. Where there are fish, the lilies provide a suitable habitat beneath their leaves and on their stalks for the plankton and zooplankton on which fish can feed.

When the lilies ripen, their fruits burst and the grains they contain are eaten by the fish.

During times of severe famine, the fruits of the water lily are eaten by the people of the region. Entire families go in search of the fruits, which they dry before extracting the grains. These grains are milled and made into pasta. The nut, or tuber, which is formed at the root of the water lily, is greatly appreciated as a food. After being harvested and cooked, the nuts are sold in the market.



NEAR DOUTHY VILLAGE (DAMASSAK), NIGERIA

NEAR LIWA, CHAD

MANY DIFFERENT TREE SPECIES GROW IN THE ECOSYSTEMS OF THE LAKE CHAD BASIN

ACACIA SEYAL

Acacia seyal is one of over 60 African acacias. A thorny deciduous tree, it can reach a height of 6 or 7 m. It has a straight cylindrical trunk of about 60 cm in diameter and a smooth bark. It has spreading branches and flowers in the middle of the dry season, before, or at the same time as it produces leaves.

Its usual habitat is the clay soils of the lakeshores, as well as riverbanks and sandy promontories in rivers.

Pastoralists feed the leaves and pods to their livestock. The net energy contents of dry matter are high: 6–8 MJ per kg for foliage and 4–7 MJ per kg for fruits.

The digestible protein levels are also high: 100–150 g per kg for foliage and higher in fruits. Analyses of both foliage and fruits indicate a well-balanced mineral content and a very favourable quality in terms of proximate fractions (e.g. crude fibre 10–20 percent, ether extract <7 percent). Pods are sold for fattening sheep.

The dense wood is highly prized for fuel in areas where few other plants survive, and it is considered one of the best firewoods in Chad. It is also an excellent source of charcoal. Stands managed on a 10–15-year rotation yield 10–35 m^3 per ha of firewood.

The leaves are used in traditional medicine for the treatment of syphilis, conjunctivitis, diarrhoea and colds [5.23]. The tree is an important source of gum arabic [5.24], [5.25].