STANDING FAST
AGAINST THE DESERT

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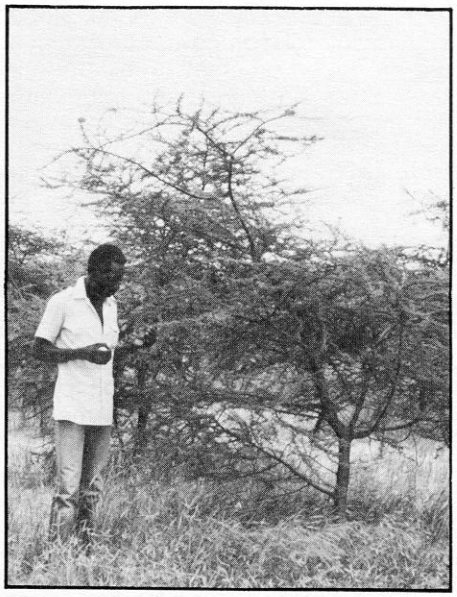
Mbiddi. When this small isolated hamlet of some 50 people in the North of Senegal is invaded during the dry season by thousands of cattle, the huts disappear behind the dust. The herders—Senegal's cowboys — know that here they will be able to water their herds. The well at Mbiddi is 250 metres deep and never dry.

The animals come for water, but the inhabitants stay because of the forestry station. "If it wasn't for the research station," says Oumar Tandia, technician with Senegal's Directorate of Water and Forests, "the drought would have emptied the village." Forestry work employs many heads of households.

In this region, typical of the Sahel, a good year will bring from 250 to 300 mm of erratic rains. El Hadji Sène, Director of Water and Forests, calls it "mosaic rain." "It rains enough to grow the crops in one village, yet in another barely 30 km away, there isn't a drop," he says. It is for this reason that many



deep wells have been bored. There are now more than 70 throughout Senegal's rangelands, spaced about 30 to 40 km from each other.

The environment around the boreholes suffers from the regular onslaught of large numbers of animals: some are more affected than others as brush fires and mosaic rains drive the animals toward certain sites. Between October and June, the leaves on the trees are the only green forage available. Toward the end of the dry season, leaves and edible pods make up about half the diet of the region's goats, camels, and cattle. The ligneous (woody) cover near the water holes is subjected to extremely intensive grazing.

The drought that came in 1972 delivered the final blow. The water table fell, slipping away under the roots. Overexploitation coupled with the drought to destroy 20 to 80 percent of the ligneous

Left: An Acacia tortilis *at first fruiting. The pods may be the only forage available during the dry season in northern Senegal. Above: A researcher examines an acacia in Mbiddi. The trees may become the centrepiece of a strategy for economic and environmental survival in the Sahel.*

cover, particularly around water holes.

The disappearance of the trees deprived the animals of the much-needed "aerial pastures." The nomadic herders also lost an important source of revenue. One of the trees, the *Acacia senegal*, secretes gum arabic, a precious hydrocolloid used as an emolient and binding agent in pharmaceuticals and food. Each year, beginning in November, the Peul and Moor herders strip bark from the trees to promote the exudation of balls of gum. The harvest continues until February, some trees producing many kilograms of gum. The nomads earn 150-200 francs CFA per kilogram ($ 1 Can. equals about 225 francs CFA) and Senegal has traditionally been one of the main exporters of gum arabic.

The drought caused exports to plumet from 6000 tonnes in 1971 to 500 tonnes in 1972. And because the trees were destroyed, Senegal's production has remained at 500 to 1000 tonnes a year.

Many of the Sahel's inhabitants left the stricken area. Yet, for centuries, cattleraising had provided a living for the Sahelians. The Sahel's grass cover and aerial pastures can feed large herds, at a density of one head of cattle per 4.5 hectares.

Because of the importance of cattleraising to the area, Senegal's forestry authorities decided to wage war against the desert. Reforestation, especially around water holes, became a priority in order to promote a better-planned development of the cattle industry and encourage the settlement of nomadic herders. Before large-scale reforestation was begun, however, the most productive gum and forage trees had to be identified and reforestation techniques developed.

Some research on gum and forage producing acacias had already been carried out in Senegal and elsewhere, but without follow-up. "It was back to square one," says El Hadji Sène. In 1972 discussions were undertaken with IDRC, which supported a research project on the reforestation of rangelands.

The Senegalese researchers and engineers have now succeeded in establishing an impressive collection of ligneous plant material at Mbiddi. The experimental plantations total 340 hectares, 75 of which are planted to gum trees, the rest to forage trees.

Planted in 1974, the gum trees stand proud — even though a mature *Acacia senegal* tree only grows to 2–5 metres. The survival rate has remained at 85 to 95 percent despite extremely difficult years. In 1976, for example, an army of rats gnawed all the young trees. The next year, the drought returned with a vengeance. Although only 130 mm of rain fell, the acacias survived nevertheless.

Thanks to the techniques developed at Mbiddi (*see box*), Senegal has reforested more than half-a-dozen water holes and settlement sites. Since 1975, 3000 hectares of gum trees have been planted, to which 2000 more will have been added in 1981. The cost per hectare, some 100 000 francs CFA, is too high to permit the reforestation of the region's 80 000 km², however. To reduce this cost, Mr Sène is relying on the participation of communities who quickly realize the advantages to be gained from gum orchards. In one department, for example, the Directorate planned to establish 600 hectares of community plantations in 1981. "They told us that 600 hectares was good, but 1000 would be a lot better," says El Hadji Sène. "We gave them the green light, and true to their word, when we carried out an inventory in this community, we counted 1018 reforested hectares," he adds.

Even if it takes seven years for the *Acacia senegal* to produce its maximum yields, the local people are anxious to have their own plantations. The future of gum arabic seems assured. "Its undeniable advantage is that it's a natural product," says one of the Directorate's engineers. New uses are constantly being found for the gum. One is the manufacture of timed release medications: The tablets are coated alternately with drug and gum; each time a layer of gum dissolves, the tablet delivers a dose of medication. The gum is also used in the same way in the manufacture of multi-stage fireworks.

Research on the forage trees confirmed the remarkable drought-resistance of the indigenous species. The *Acacia tortilis, nilotica,* and *senegal* displayed a surprising vigour, growing 60 to 70 cm a year. The species imported from Australia, however, were disappointing. For no apparent reason, the *Acacia holosericae* and *tumida* grew vigorously in the beginning, but withered suddenly after two or three years. The researchers have consoled themselves with the fact that the second and third generations — trees obtained from seed of trees grown in Senegal —seem more resistant. But if the luxurious Australian acacias suffer under the difficult Sahelian conditions, two species, *Acacia linaroides* and *pyrifolia*, seem hardier. One thing is certain: As soon as the new forage trees are available, they will need to prove their hardiness. Cattle and goats that have tasted the Australians' leaves didn't leave so much as a twig or stem behind them.

The solution to the adaptation problems of exotic acacia species could come from biotechnology. A young researcher at the National Centre for Forestry Research, Ibrahima Guèye, has just returned from Canada where he completed a masters' degree in plant symbiosis. At the University of Laval in Quebec, he studied the bacteria and fungi that promote the growth of acacias.

Rhizobium bacteria colonize the roots of leguminous plants such as acacia, enabling them to fix and use atmospheric nitrogen. In the same way, microscopic fungi of the phycomycete class, *mycorrhizae*, help the plants to assimilate phosphorus, the most important nutrient after nitrogen. "Tropical soils in West Africa are often rich in phosphorus," says Ibrahima Guèye, "but often in a form of phosphate that plants can't assimilate." The mycorrhizae transform the phosphate into a form usable by the plants. And so, in tropical countries, it is essential to inoculate orange trees and pine with mycorrhizal fungi to ensure their survival in plantations. In addition, the mycorrhizae increase the plant's resistance to drought because they also extend the root system beyond the root hairs, increasing the roots' water absorption capacity.

Both rhizobium and mycorrhizae are found on the roots of *Acacia senegal* and *tortilis*. The researchers hope to identify strains that will double the trees' initial growth rate in the nursery. These biological helpers will assist the trees to produce more protein-rich foliage and may also broaden the range of tree species that could be introduced in the Sahel's rangelands.

If the research seems increasingly specialized, the researchers have not forgotten the users. "Mbiddi will only reach its objective if we can translate the results into tools for the people of the region," says El Hadji Sène. And, in fact, some pioneering peasants have already started to plant gum trees from Mbiddi's nursery.

The research station each year distributes a growing number of kilograms of seed collected from the most promising candidates. Mbiddi may well become the ancestral home on the range of the Sahel's future orchards of gum and forage trees. □

TO PLANT A TREE

The Mbiddi researchers recommend the following procedures for planting trees, particularly acacias, in arid regions: †

Seeds, soaked for 12-24 hours in a small volume of hot water, are planted in polyethelene bags and germinated in the nursery. Planting should be done at the onset of the rainy season, before the seedlings become too large for transplanting.

Breaking up the soil with a subsoiler before planting has given excellent results at Mbiddi and is strongly recommended. The seedlings are then planted at the intersection of two rows: the bags are cut and removed, the tree is planted and watered. The area around the young tree must be kept completely free of other vegetation for the first 2-3 years.

According to the researchers, trees should be planted no closer than 6 metres from one another and the soil close to the tree should be banked to retain rainwater and catch any runoff.

† *Techniques de reboisement dans les zones subdésertiques d'Afrique,* by G.R. Ferlin (IDRC-169f).