The African tree — man's best friend

Gunnar Poulsen

Gunnar Poulsen is a citizen of Denmark. He studied forestry at the Royal College of Agriculture and Veterinary Science in Copenhagen and at Ecole Nationale des Eaux et Forêts, Nancy, France. Since 1956 he has worked in Africa, where he spent 10 years in the dry regions of Western Sudan and eight years on the mountains of Ethiopia. Before joining the IDRC as a Senior Research Advisor he was teaching forest biology and forest protection at the University of Dar es Salaam, Tanzania.

This article is based on the first of three papers on African forestry written by Gunnar Poulsen, soon to be published in collected form in the IDRC monograph series.

Over large areas of the African continent, the trees that grow outside the plant communities we call forests are about as important as the trees that grow inside them. This article is an attempt to describe the ways in which trees may be useful to man — useful in the broadest sense of the word.

First, a definition of what we mean by a 'tree' and a 'forest' may be useful. By tree, we mean any self-supporting woody plant that, when fully grown, exceeds a height of a couple of metres; really, anything from a straggling desert shrub to the 70-metre king of the rain forest. A forest is any area on which trees, in closed stands or more or less evenly scattered, constitute a conspicuous part of the growing plant community (but not including orchards).

Trees are useful to man in two distinct ways: as producers of a wide variety of goods, commonly called 'forest produce', and as custodians of favourable environmental conditions. It would not make sense to try to qualify one of these functions as more important than the other. Both are indisputably essential to the well-being — indeed to the survival of man. We shall look at these two types of 'tree-roles' separately, beginning with the production aspect.

Trees in Africa as elsewhere are naturally first of all producers of wood. There are many kinds of wood, however, and their uses are almost innumerable. Wood, in one form or another, enters into practically every sphere of human activity. It is characteristic of almost all African countries, however, that by far the most important utilization of wood is in the form of fuel, principally firewood and charcoal.

Tropical Africa covers approximately twenty million square kilometres. Of this huge area, probably about half can be described as forest-covered: from the open scrub vegetation at the edge of the desert to the impenetrable rain forest of the Congo basin. Really dense forests account for less than two percent of the forest area, however, the rest consists of various types of 'bush'. The area covered by artificial, and often highly productive, plantations is an infinitesimally small fraction of the total forest area.

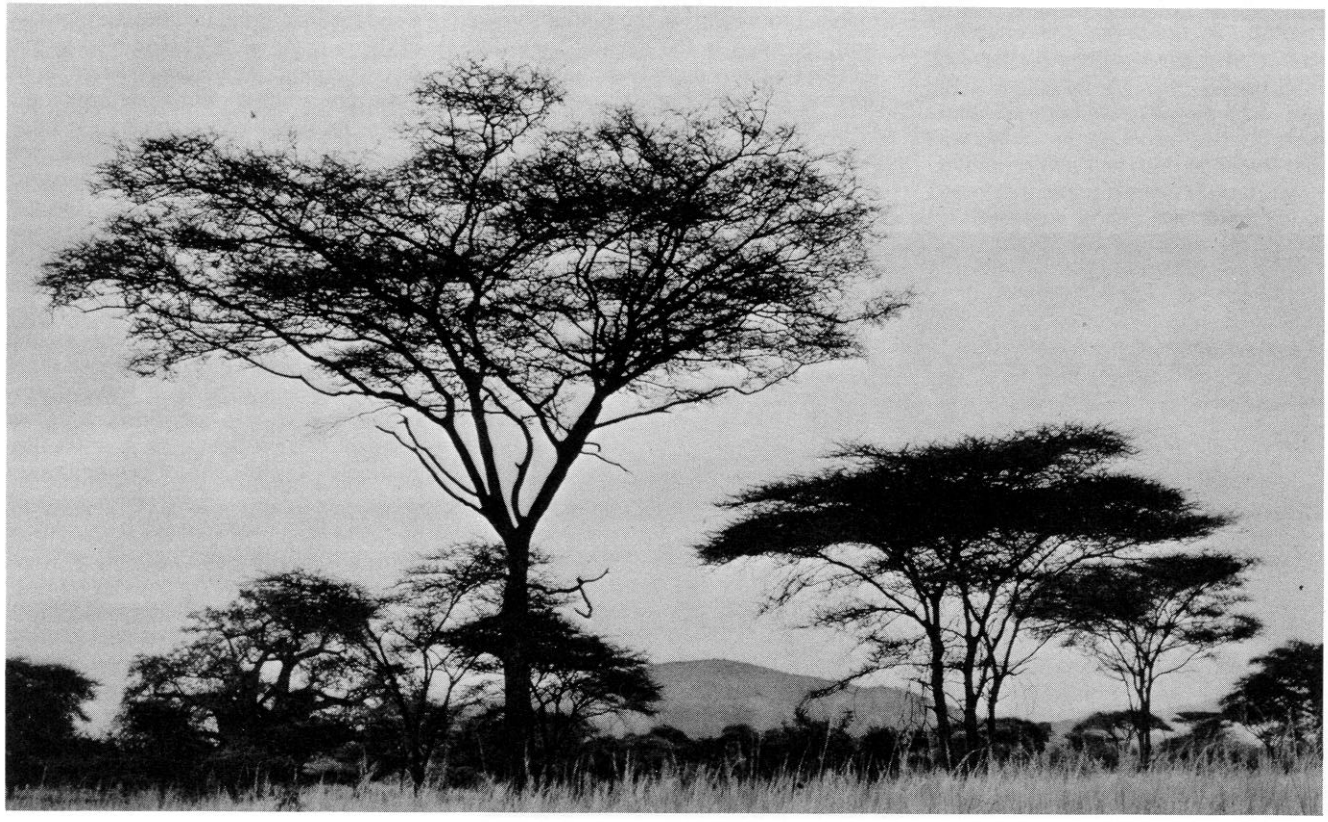

Photo: Marshall Laird

In terms of wood, the productivity of the natural African forest is not high. Annual yields vary from a fraction of a cubic metre per hectare to about five cubic metres per hectare. A considerable output is also obtained from scattered trees on farmland.

Of the total increment of the African tree vegetation, probably less than one fifth, or an estimated 300 million cubic metres, are at present being utilized. Despite this seemingly favourable relationship between production and consumption, the wood supply situation is far from rosy. The forest resources are in fact dwindling at a frightening pace as a result of the combined onslaught of firewood and timber exploitation, the clearing of land for farming, and last but not least, annual bush fires. Over large areas of Africa, a severe shortage of firewood and timber is already making life difficult for millions of people.

Photo: Clyde Sanger

A severe shortage of firewood often means carrying heavy loads over long distances.

There are, however, many products other than wood produced by African trees. Both the leaves and the fruit of the Baobab are used for human consumption in West Africa. From the bark of the same tree a cord is made that is utilized for stringing beds in the Sudan. From the bark of *Acacia nilotica,* on the other hand, the Masai of East Africa make a stimulating tea-like beverage. In some parts of Somalia the nut of a desert shrub *Cordeauxia edulis* is an important source of protein. Elsewhere in Africa, the young seedlings of the *Borassus* palm are cooked and eaten. A refreshing drink is made from the pods of a large savanna tree, *Tamarindus indica*. In Mali this drink is even produced industrially in tins. The fluff, or kapok, of trees of the *Bombax* family is used for upholstery. An infusion of the female flowers of *Hagenia abyssinica* is used as a vermifuge, just to mention one of many medicinal uses of trees. In a few areas arrow poison is still in use on a small scale; a common component is the latex of the Desert Rose, *Adenium honghel*. Industrially important extractives are obtained from the wood, bark, leaves and fruits of many species, for example tanning extractive from Wattle, and Shea-butter from the Shea-butter nut tree of the West African savannas. Some trees produce valuable exudates, the most important being the Gum Arabic that is tapped from various acacias in the Sahel Zone.

Of extreme importance, especially in the drier parts of the continent, is the production of cattle feed. Over large parts of Africa livestock obtain a considerable proportion of their nourishment from the trees in the form of fruits and leaves. Probably more than one hundred species are useful in this respect, the most notable being *Acacia albida*. In some areas, the South American tree, *Leucaenea glauca,* is being planted for commercial production of cattle and poultry feed.

In some regions of Africa, however, there is a conflict between trees and cattle ranching. Tsetse flies thrive only within woodland, and are often controlled by deforestation. The systematic cropping of wildlife to produce meat in tsetse-infested areas is an alternative favoured by some scientists, but serious doubt must still be expressed about its practicability. On the subject of wildlife, it should be stressed that a well-wooded environment is also a necessity for the survival of many of the species that comprise the extremely rich fauna of this continent.

The last non-wood forest product to be mentioned is honey. Many African trees, especially of the leguminose order, are excellent nectar producers, and offer an enormous potential for honey production. So far, however, this potential has been only marginally realized.

Beside being producers of a variety of useful goods, African trees play an extremely important role in maintaining a favourable environment. They exercise a useful, often indispensable, role in the cycling of plant nutrients, soil and water conservation, the maintenance of favourable macro and micro-climatic conditions, and last but not least, the creation of shelter, shade and beauty around dwellings.

The importance of trees for the cycling of plant nutrients is often overlooked, to the detriment of the soil fertility on which farming, animal husbandry and plantation forestry depend.

In the tropics, particularly the humid tropics, a considerable proportion (frequently more than 75 percent) of the soluble plant nutrients that are present in a certain area, is held within the biomass of the growing plant community. In this respect conditions are very different from those prevailing in temperate countries, where most nutrients normally are present within the upper layers of the mineral soil. In Africa, nutrients released from decaying organic matter do not seep down into the soil as in temperate countries. They are to a very large extent intercepted by a dense web of roots that the trees maintain just under the surface, a web made almost impenetrable by the additional presence of mycorrhizal fungi (the subterranean parts of some mushrooms that live in symbiosis with the roots of certain trees). As a result, the nutrients 'cycle' almost continuously

Photo: Neill McKee

Making cord from the bark of the Baobab — the leaves and the fruit are edible too.

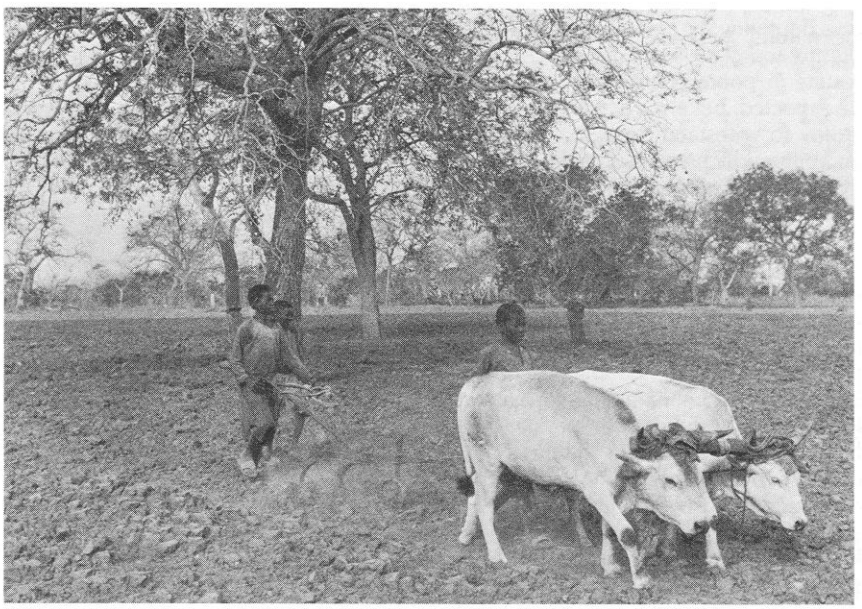

Photo: Jean Steckle

Trees, crops and animals in the right combinations can be mutually beneficial.

within the biomass, only a small proportion entering the mineral soil. In this way the vegetation has adapted extremely well, in the course of a long evolution, to the environment. Under hot, humid conditions any soluble nutrient element in the soil is, in fact, exposed to loss by leaching.

In cases where most of the biomass, including the subterranean part, is destroyed by cutting down the forest, usually to provide land for farming, this protective system breaks down. Soluble plant nutrients are released into the mineral soil, with no 'safety net' of roots and mycorrhiza to intercept them and prevent their being leached. A high humus content and a granular soil structure may slow down leaching for a few years but, as the humus decomposes and the soil loses its original favourable structure, the leaching process will accelerate.

The initial release of a large amount of nutrients into the soil will naturally result in great, if transitory, fertility. The farmer will reap excellent harvests during the first years after forest clearing. However, as leaching increases, yields will decline and eventually the farmer will be forced to abandon a completely exhausted soil — either to a long period of bush-fallow or, in the most severe cases, permanently. Some farmers may be able to halt the deterioration of the soil by the application of fertilizer, preferably combined with some kind of mulching, but many lack the resources to do so.

In some areas of Africa farmers have adapted extremely well to the imperatives imposed by the pattern of nutrient cycling. By mixing perennial crops, such as coffee, bananas and sometimes even large trees, with short-cycled crops such as maize, cassava and beans, they ensure that the amount of growing biomass never descends below a critical level. Alternatively, soil fertility may be maintained by the frequent application of mulch. This may be achieved by maintaining a certain proportion of each farm, preferably steep slopes and other erosion-prone areas, under tree cover. Branches lopped off the trees can be used to mulch the nearby fields.

The *Acacia albida* tree deserves special mention in the context of nutrient cycling. This large savanna tree occurs mainly on sandy soils in some of the drier parts of Africa. In general, the land where it grows is farmed and valued for its high fertility. *Acacia albida* has in fact a remarkable farm-improving influence. Contrary to all normal 'tree-behaviour', it drops all its leaves just at the onset of the rainy season. In the hot humid weather then prevailing, the leaves decay rapidly releasing nutrients into the soil just when the agricultural crops need them most. In the dry season, on the other hand, the tree is covered by a dense foliage and its cool shade is then much favoured by cattle. Towards the end of the dry season, cattle are even more strongly attracted by the huge amounts of protein-rich pods that drop to the ground under the trees. This continuous presence of cattle near the trees assists enormously in the upkeep of soil fertility. Finally the large crowns of the *Acacia albida* provide an excellent protection against wind-erosion.

The role of trees in soil and water conservation is no less important, especially in hilly and mountainous country. Better than any other ground cover, forest will ensure that the soil layer indispensable for water-catchment is maintained and not carried away by erosion. At the same time, the soils under the forest develop an open granular structure, that permits rain water to infiltrate quickly, to percolate to deeper soil layers from where it gradually may be released in springs and water courses.

Conversely it is known that large scale deforestation of steep slopes may lead to complete environmental degradation. The soil is carried away from the slopes leaving these bare and useless to man. In the valleys below, a formerly regular water supply becomes spasmodic and unreliable. During heavy rain-storms flood waters thunder down from the hills burying valley soils under gravel and stones, destroying crops and silting dam sites.

All slopes cannot normally be maintained under forest of course, but the steepest slopes and important catchment areas should never be deforested. On less vulnerable sites good farming practices, combined with the upkeep of some tree rows along contour lines, may provide sufficient protection against environmental deterioration.

Erosion is not caused by water alone but also by wind, particularly in the drier regions. Wind erosion may carry away the most fertile soil particles from farmland. In other places, crops may be damaged or even killed by wind-blown sand particles, or just buried under a layer of sand.

In all cases the best remedy against wind erosion is the maintenance or planting of trees, either in the form of shelterbelts or more or less evenly distributed tree vegetation. Where there are many trees, there will be no wind erosion.

A dense tree vegetation, or a system of artificially established shelterbelts, exercises a beneficial effect on microclimatic conditions in several other ways. The rapid expansion of desert conditions that has been observed these past years along the southern fringe of the Sahelian zone, has been caused partly by a succession of years with exceptionally low rainfall and partly by man's own destruction of the environment. The combined effect of overgrazing, overexploitation of the already scanty tree vegetation, and in some regions the introduction of mechanical farming in low rainfall areas, have resulted in the denudation of large tracts of land. Within these areas, the microclimatic conditions, coupled with the wind erosion problem, have made conditions for animal husbandry and crop farming unfavourable even in years of above average rainfall. But what may be even more serious, from these man-made desert areas hot scorching winds blow into the farmland further south, reducing yields and destroying crops.

The desertification process is frequently compounded by people, deprived of forest resources, being forced to

burn animal manure and crop-residues, thus depriving the soil of these sources of humus and plant-nutrients. This not only results in poorer crop-yields, as would be expected, but also reduces the plants' ability to withstand drought conditions, an ability which is closely related to the availability of nutrients in the soil. So in a marginal climate a drop in soil fertility will often lead to complete crop failure.

While there is no doubt that vegetation ground cover, especially trees, favourably influence the micro-climate, little exact information is available about possible effects on the macro-climate. Do such phenomena as higher day and lower night temperatures on denuded land, and an increase in the amount of dust in the higher atmosphere over overgrazed and overcultivated land, result in reduced rainfall? We really do not know in a scientific way. We only suspect that it is so. Not knowing for sure, we give the trees the benefit of the doubt and advocate the afforestation of dry areas. It may lead to better rainfall, or it may not. It will at least improve the micro-climate, and that in itself would be very valuable.

We have considered the importance of trees for the physical environment, the environment on which our supply of food and many other material goods depend. However, man does not live by bread alone. Human fulfilment also depends on a less tangible quality in our environment which we call beauty. Trees with attractive foliage and fragrant flowers around dwellings enrich the lives of those living in them and at the same time protect them against sun, wind and dust. Green belts around towns serve a similar purpose and provide leisure areas where people can escape the hustle and bustle, and fumes and stress, of modern urban life.

Trees may thus provide not only some of man's most basic physical requirements, but for some of his mental needs as well. The role of the tree in Africa is to contribute to the maintenance of an environment that is friendly to both man and beast. □

Elephant grass is good for cows . . .

Alexander Dorozynski

Although Egypt has some of the most productive agricultural land in the world, the country is suffering from an acute shortage of meat and animal products. The reason is a corresponding shortage of cattle feed, particularly during the dry summer months. This has resulted in the diet of the average Egyptian being among the lowest in the world in terms of animal protein.

A major effort is now underway, however, to remedy the situation, and three research projects appear to be particularly promising. Two of these projects are geared to the utilization of by-products that are at present either under-utilized or completely wasted.

The country's four main crops — cotton, corn, rice and sugar — yield more than 8 million tons of by-products: some 2.5 million tons of corn stover, 2.1 million tons of cotton stalks, 1.5 million tons of rice straw, as well as cotton seed hulls, corn cobs, rice hulls, sugar cane bagasse and molasses.

At present none of these is used in the production of pelleted feed, which relies principally on the limited availability of one major ingredient, cottonseed cake. Yet, these by-products are potential sources of feed — provided they are processed, and introduced, in the right proportion, in feed formulas.

This is the goal of a research project now underway at the Faculty of Agriculture of the University of Alexandria. The project is being carried out by the Department of Animal Production, with the support of IDRC.

In a series of laboratory experiments the researchers have developed physical, chemical and microbiological processes to improve the digestibility and nutritive value of the by-products. Feeding trials have indicated that the processed by-products can be used as components of pelleted food in proportions of about one-third, perhaps even more.

Dr Khaled El-Shazly, project leader and head of the Department's animal nutrition unit, and Dr A.R. Abou Akkada, principal investigator, are both members of the eight-man Animal Production Commission, responsible for government policy on livestock. They work in collaboration with the High Commission on Animal Feed, with the aim of devising feed formulas for specific requirements such as milk production, beef, sheep, and poultry, that can be adapted to make best use of local availability of by-products.

The nutritive value of several feed formulas has been tested in the laboratory. Feeding trials have given good results and work is now underway to establish a semi-industrial pilot plant capable of producing about one ton of pelleted food per hour. This plant is expected to be operating by the end of the year. The ultimate goal is the establishment of a number of small-scale local plants, down to the scale of cooperative farms, some of which are participating in the project.

Experiments are continuing at a small research station near Alexandria to improve the quality of by-products. Processing methods include chopping, milling and steam treatment, chemical delignification, and microbiological treatment. The latter involves ensilage, use of lignin-dissolving bacteria, and