REFORESTATION IN THE SAHEL: PROBLEMS AND STRATEGIES

An analysis of the problem of deforestation, and a review of the results of forestry projects in Upper Volta

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This paper is divided into three sections. This first deals with the context of reforestation and natural resource conservation projects in the Sahel region of West Africa. Background information on the cost of firewood, the problem of deforestation, and necessary responses to the problem is presented.

The second section discusses the impact of a number of forestry projects undertaken in Upper Volta within the past decade. Information related to the project's apparent success or failure is highlighted. The third section analyzes what we can learn from the past efforts in the forestry/ecology sector, and concludes with several guidelines for the design of future forestry projects.

I. OVERVIEW AND BACKGROUND

The Cost of Firewood

To be a forester in the Sahel today is to be confronted with enormous challenges. The problems one faces are immense, the means available, minimal, and people's needs are immediate.

Forests shrink constantly and become less dense as land is cleared for farming and wood cut for household uses at ever increasing rates. People harvest firewood faster than natural regeneration and regrowth can replenish the "woodstock." Once the vegetative cover has been removed, improper farming practices impoverished and erode soils. Growing herds of livestock steadily intensify grazing pressure on less and less productive rangelands. Overcutting, overfarming, and over-grazing all relentlessly lower productive potentials of Sahelian renewable natural resources.

Quantitative data on overfarming and overgrazing are difficult to obtain. Statistics on both crop yields and land use, and on livestock and rangeland condition are incomplete and unreliable. In addition, changes in net productivity of arable land are obscured by modifications in farming practices, including use of selected crop varieties, improved cultivation techniques, fertilizers and pesticides. One can nonetheless get a feel for present trends in resource productivity by talking to people whose livelihoods depend intimately on the condition of the land. Herders complain about the difficulty of finding enough water and pasture, especially during the dry season. More wells have been opened, but rangeland is diminishing in size and in productivity. Farmers often point to a condition of declining soil fertility; they assert that a farmer must cultivate more land to produce the same amount of grain as he grew 10 or 15 years ago.
Beyond dwindling availability and inadequacy of food and water supplies, the average Sahelian usually worries about firewood supplies. Firewood, the primary source of energy consumed by Sahelians, meets roughly ninety percent of the typical household's total energy requirements. Data on firewood costs in urban areas of western Upper Volta is spotty. Nonetheless, these data reflect dramatic changes in firewood availability over the past 10-15 years.

Table 1. COST OF FIREWOOD IN WESTERN UPPER VOLTA

<table>
<thead>
<tr>
<th>Community</th>
<th>Year</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tougan</td>
<td>1968</td>
<td>400 CFA/ donkey cartload</td>
</tr>
<tr>
<td></td>
<td>1980</td>
<td>1250 CFA/ dcl from 15-20 km away</td>
</tr>
<tr>
<td>Ouahigouya</td>
<td>1970</td>
<td>350 CFA/ dcl</td>
</tr>
<tr>
<td></td>
<td>1975</td>
<td>1000 CFA/ dcl</td>
</tr>
<tr>
<td></td>
<td>1979</td>
<td>1750 CFA/ dcl</td>
</tr>
<tr>
<td>Koudougou</td>
<td>1979</td>
<td>2000-2500 CFA/ dcl</td>
</tr>
<tr>
<td>Solenzo</td>
<td>1975</td>
<td>250 CFA/ dcl</td>
</tr>
<tr>
<td></td>
<td>1980</td>
<td>600 CFA/ dcl</td>
</tr>
<tr>
<td>N'Dorola</td>
<td>1970</td>
<td>firewood was not sold; deadwood easily found in close proximity</td>
</tr>
<tr>
<td></td>
<td>1980</td>
<td>1750 CFA/ dcl from 5-6 km away</td>
</tr>
<tr>
<td>Leo</td>
<td>1979</td>
<td>750 CFA/ dcl</td>
</tr>
<tr>
<td>Soumousso</td>
<td>1976</td>
<td>5 large pieces for 25 CFA</td>
</tr>
<tr>
<td></td>
<td>1980</td>
<td>3 split pieces for 25 CFA</td>
</tr>
<tr>
<td>Orodara</td>
<td>1976</td>
<td>50 CPA per bundle</td>
</tr>
<tr>
<td></td>
<td>1980</td>
<td>200 CFA per bundle</td>
</tr>
</tbody>
</table>

In contemporary Upper Volta, wood prices vary by location as follows:

- 2000-4000 CFA/ donkey cart load (dcl) -- largest cities
- 1000-2000 CFA/ dcl -- larger towns, and drier or more densely settled rural areas
- 500-1000 CFA/ dcl -- smaller towns, and wetter or less densely settled rural areas
- less than 500 CFA/ dcl -- small villages in well wooded regions, and remote rural areas
In many localities prices have doubled over the past five years. Prices are increasing everywhere. Increasing percentages of family income go to cook daily meals. Small families spend 50 CFA or more a day on firewood; larger families use more than a donkeycart a month, at costs of up to 4000 CFA per unit. Experts argue 20-30 percent of urban families' average annual income is spent on firewood, leaving less for other basic household expenditures, education, and health care.

In smaller towns and rural areas, women walk ever greater distances and spend even more time gathering and transporting firewood. It is not unusual for a woman to devote 4-6 hours, three times a week to the task of collecting firewood. If one assumes a woman works ten hours a day, seven days a week in the Sahel, she may spend a quarter of her time hunting firewood at distances up to ten kilometers from her home.

As the fact of deforestation and declining firewood supplies has become clearer, so has understanding of the reasons behind it. The root causes are changing man/land relationships.

### Firewood Supply and Demand

Reasonably accurate demographic data exist, and a number of studies of firewood consumption rates have been completed in recent years. Total areas devoted to different land uses (farm, pasture, fallow, forest) and the productivity of each category of land are less certain. Wood production varies as a function of stand density (density of woody plant cover), rainfall, and soil type, but for much of the Sahel receiving 700-900 mm of rainfall annually, average production can be estimated as follows:

<table>
<thead>
<tr>
<th>Land type</th>
<th>Wood Production (m³/ha/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>bush fallow</td>
<td>0.1-0.5</td>
</tr>
<tr>
<td>dense natural forests</td>
<td>0.5-1.0</td>
</tr>
<tr>
<td>woodlots</td>
<td>3-5</td>
</tr>
<tr>
<td>high yield plantations</td>
<td>5-10</td>
</tr>
</tbody>
</table>

Consumption ranges from less than 1 m³/person/yr to 1.5 m³/person/yr. It appears higher in urban areas, where people tend to prepare more hot meals, use fewer substitutes for wood (such as millet stalks, dung), and burn more charcoal (which
requires more firewood to yield a given amount of energy. Urban families also consume more wood indirectly in the form of baked bread, grilled meats, ironed clothes, and other such uses.

Historically, supply has exceeded demand by a large margin: the annual production of wood from the forested areas adjacent to most settled areas was greater than the total requirements of the community. According to rough estimates for the region as a whole, productive potential of the Sahel's woodlands is still slightly greater than total needs of the region's population. However, serious "shortages" have developed where demand exceeds locally available supplies:

-- in and around urban areas
-- in intensively farmed or densely settled areas
-- in heavily grazed areas
-- in ecologically harsh areas, having low rainfall, poor soils, or little natural cover.

For most of Upper Volta, population density has reached or soon will reach a point where total annual consumption of firewood will exceed average annual production. Population density now averages about 22 persons per km². In an area of 25,000 km², equivalent to about one-tenth the country's total area and about the size of an average ORD, one can assume a total population of roughly 550,000 persons. Assuming a consumption rate of 1 m³/person/yr., total wood demand would be 550,000 m³/yr. Given present land use patterns, total production of the typical region's forestland might attain 680,000 m³ of wood per year.

Table 3. TOTAL WOOD PRODUCTION FROM A TYPICAL VOLTAIC O.R.D.

<table>
<thead>
<tr>
<th>Land Type</th>
<th>% Total Land Area</th>
<th>Area km²</th>
<th>Production m³/ha/yr</th>
<th>Total Production x 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmed</td>
<td>10%</td>
<td>2,500</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Fallowed/open woodland</td>
<td>40%</td>
<td>10,000</td>
<td>0.2</td>
<td>200,000</td>
</tr>
<tr>
<td>Pasture/lightly wooded</td>
<td>35%</td>
<td>8,750</td>
<td>0.3</td>
<td>262,500</td>
</tr>
<tr>
<td>Densely wooded</td>
<td>15%</td>
<td>3,750</td>
<td>0.6</td>
<td>225,000</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100%</td>
<td>25,000</td>
<td>--</td>
<td>687,500</td>
</tr>
</tbody>
</table>
With average total annual production exceeding total demand by 25 percent, there is less likelihood of shortages in some areas (where demand is above average) or of over exploitation during dry years (when production falls below average).

Unfortunately, new conditions threaten to upset this historical equilibrium situation in Upper Volta and elsewhere in the Sahel.

1. Even moderate increases in population density can rapidly tip the balance and cause demand to outstrip supply. In the case of an ORD in Upper Volta, an increase beyond 27.5 persons/km² will cause demand to exceed average annual production of 687,500 m³ of wood.

2. A reduction in the area of forested land or in the density of the woody plant cover exerts the same disruptive pressure on the firewood supply/demand situation. Introduction of cash crops, and promotion of animal traction has caused more land to be cleared and cultivated. Unless countered by adequate improvements in traditional farming practices, mounting pressure on the land forces peasants to curtail traditional fallow periods. Soils are eventually depleted beyond the point of easy regeneration. More land is cultivated before woody cover has regenerated. Increasingly, fields are worked to exhaustion, abandoned and lost from the farming cycle. Less and less forested land remains as farmers move on into wooded areas to clear and plant new fields.

3. Whenever forest cover becomes less productive, demand for firewood may again outdistance supply. This happens when density of woody plant cover is reduced by bush fires, overgrazing, excessive lopping of branches, or localized overharvesting of wood, as well as by widespread overcutting of firewood for urban markets. It also happens as part of the whole desertification process.

4. Drought, or lower than average rainfall, stunts growth of natural vegetation, and causes net primary productivity to fall off. The "carrying capacity" or ability of land to indefinitely support a population or sustain a given use, is impaired. A level of use tolerable in "wet" years automatically becomes overuse in drought periods, leading to degradation or destruction of plant cover in "dry" years.

5. Once vegetation has been overused, soil is more exposed to erosion. The organic matter content of the soil and its moisture holding capacity decline. Water infiltration rates decrease. More rainfall is lost through runoff. A general decrease in the effectiveness of rainfall ensues. Less
rainfall remains in the soil available for plant growth. Crop, pasture, and woodland productivity can only suffer as this process proceeds.

**Shrinking Capital and Lowered Interest**

The situation deteriorates at an accelerating rate, through "negative feedback." As long as one harvests only the "interest" produced by woodland "capital," the natural resource base remains intact, and forest resources are renewed from year to year. Carrying capacity is stable and will sustain a predictable level of use determined by the rains of a given year. However, once people's needs can no longer be satisfied by the limited interest produced each year, pressure mounts to consume capital as well. Livewood is collected as well as deadwood; whole trees are cut instead of just smaller branches; grasses are grazed repeatedly, to the point where nothing remains to provide new growth in the next rainy season.

As forest or rangeland capital begins to shrink, so does the interest generated each year; more capital is required to meet total needs in subsequent years. As more forestland is lost, or as forestland becomes less productive, remaining resources are increasingly susceptible to overuse. This in turn reduces carrying capacity, generating further short-term incentives to overuse.

Trees play a major role in maintaining the productivity of Sahelian ecosystems. Loss of woody plant cover represents a significant environmental problem. It also confounds economic development efforts, especially in the agriculture, livestock, fisheries, and health sectors.

As a consequence of the soil-plant-water relationships discussed above, the disappearance of tree cover triggers drops in soil fertility, declines in crop production, and tends to increase dependence on imported chemical fertilizers. Without a healthy cover of trees and shrubs, livestock have difficulty finding dry season forage. They also need more water when shade is scarce. Once the trees are gone, groundwater resources are less likely to be recharged, and wells must be deepened. Runoff volume and velocity grow, intensifying soil erosion. Top soils end in watercourses, reducing reservoir capacity by siltation. Lowlands are more likely to be flooded by excessive peak runoff. Floodplains may suffer erosion and sedimentation. In sum, Sahelian deforestation cuts resource productivity, and the environment becomes less habitable. Basic human needs may go unmet as supplies of food, water, fuelwood, livestock forage, medicinal plants, wild foods, and
other raw materials for living in rural areas dwindle under the impact of excessive deforestation.

Responses to the Problem of Deforestation

All parties concerned concur that the Sahel in the years ahead must benefit from effective measures controlling deforestation and conserving renewable natural resources. As responses to the "firewood crisis," the following programs seem especially worthy of attention.

1. Increase woodfuel production by:
   a. conserving areas of remaining forestland;
   b. managing forest reserves more intensively;
   c. establishing fuelwood plantations, for intensive production of wood in areas of concentrated demand; and,
   d. promoting agroforestry and woodlots in rural areas.

2. Reduce woodfuel consumption by:
   a. development and dissemination of appropriate, improved woodstoves, i.e., different types adapted to different physical and social settings; and
   b. promoting development of alternative renewable energy sources (solar, wind, hydro, biogas), particularly in urban areas, with stress on intermediate technology.

3. Increase the capacity of Sahelians to deal effectively with the problem, by:
   a. supporting and expanding training institutions;
   b. reinforcing administrative and management capabilities; and
   c. developing basic capacities to identify and monitor environmental problem areas, to plan and program development assistance in the forestry/ecology sector, and to track and evaluate programs.

The magnitude of the problem requires action in all three major areas: increased production, reduced consumption, and strengthening of institutional capabilities. A multidimensional strategy offers the best approach to resolving this seemingly intractable problem. For example, in the typical Voltaic ORD, if every family of 10 persons could plant and care for 0.5 ha of trees every two years, they would in just
ten years creates a 2.5 ha woodlot capable of producing ten m3 of wood annually (2.5 m3/ha/yr times 4 ha), or enough to completely satisfy their fuelwood needs. Even if only half the families successfully established woodlots, pressure on natural forests would still be significantly relieved— to a point below that of overexploitation.

Alternatively, if ten percent of the land was designated as forest reserves (as is already the case in many Sahelien regions) and managed as a renewable resource on a sustained yield, multiple use basis, wood production could be increased to an average of 2 m3/ha/yr. Establishing high yield plantations on better sites, and more intensively protecting and managing natural forest elsewhere would achieve this target. In a typical ORD, these forest reserves could produce 500,000 m3/yr (2 m3/ha/yr times 2500 km2) or ninety percent of total wood requirements for a population of 550,000 (22 persons/km2).

Development and dissemination of improved woodstoves could theoretically reduce wood consumption by 50-60 percent, curtailing the temptation to overexploit existing forest resources while new plantations and woodlots reach maturity. In Upper Volta, an improved woodstove costing less than 5000 CFA ($25) can effectively reduce a family's firewood needs from twelve donkeycart loads to six per year. This savings is roughly equivalent to annual production from one hectare of a woodfuel plantation. Such plantations currently cost about 150,000 CFA to plant and maintain to maturity, and require six to eight years to produce the first harvest of wood. Clearly, more trees must be planted, but potential gains from more efficient use of wood should not be overlooked; they appear to be less costly and have a more immediate impact.

Much has been said about the need for community participation in reforestation, and of the need to reorient and strengthen forestry extension services. Given the fundamental importance of modifying people's approach to land use and resource control, lasting solutions must envisage training, conservation education and other programs to develop human resources and to promote a conservation ethic. However, few projects of this nature have been supported in the past.

Improving the Past Record

It is widely acknowledged that reforestation projects must be more broadly promoted and supported. The international donor community is becoming more aware of the
seriousness and significance of deforestation--of the links between the firewood crisis, desertification, stagnant agricultural production, and underdevelopment. Sahelians too, recognize the importance of reforestation and environmental conservation programs. Their priorities are clear: enough food and water; a habitable, productive environment; and progress in education and health care. Their development strategy calls for achievement of food self-sufficiency, development of water resources, and "restoration of the ecological equilibrium," as prerequisites for reduced vulnerability to drought and sustained socio-economic development of the region.

Sahelians and donors alike agree more should be done in coming years to conserve and develop natural resources than has been done in the past. Less than one percent of the past total development assistance to the Sahel has been allocated to the forestry/ecology sector. Obviously, more resources must be committed to this vitally important aspect of development, in order to deal effectively with the problem. It is also clear that resources must be utilized more efficiently and in more diverse ways. In the period 1977-79, approximately $66 million was allocated to forestry projects in the eight member-states of CILSS, yet this investment is expected to produce only enough wood to meet less than two percent of the total wood requirements of the Sahel. Most projects supported to date have been in retrospect:

1. very expensive for the amount of wood produced, or other benefits which may have resulted from the project;

2. implemented without the prescribed involvement of local communities; as local constraints and expressed needs of the community were overlooked, projects often lacked committed support of the local population;

3. difficult to maintain or to replicate; recurrent costs have proved unmanageable, and trained local personnel are still in short supply and unable to continue operations once project support has been terminated; and

4. focused on production of fuelwood with little attention to soil conservation, watershed management and forage production aspects; forestry projects were rarely integrated into rural development programs.

Unfortunately, inadequate design, low survival, and deficient aftercare and follow-up, singly or in combination, will prevent most projects from having much direct and lasting impact on the well-being of the poorest Sahelians.
II. FORESTRY PROJECTS IN UPPER VOLTA

A number of reforestation projects carried out in Upper Volta over the past decade are reviewed below. Included are those implemented in the Ouahigouya, Koudougou, Dedougou, Bobo-Dioulasso, Dinderesso, and Ouagadougou regions. A description of the ongoing and innovative village plantation program, now functioning in five Voltaic Regional Development Organization (ORD) jurisdictions appears below.

Woodlots in Yatenga

Prior to 1972, the reforestation program in Yatenga ORD (Ouahigouya) amounted to little more than organization of Arbor Day ceremonies once a year. Usually in late August, the Forest Service distributed seedlings for planting around marketplaces, along roadsides, in school courtyards, and wherever else villagers cared to plant trees. Perhaps 10,000-15,000 seedlings were distributed each year—in a region of 500,000 inhabitants. Late plantings and insufficient after-care markedly depressed survival rates.

Beginning in 1972, Yatenga ORD began to take a lead role in increased production and distribution of seedlings. As part of their rural development program, the ORD launched a wide-ranging "educational" effort to encourage villagers to plant trees at home, in their fields, and in collective plantations. These plantations were generally 0.5 to 1 hectare in size, and were established with the assistance of the ORD extension agents and Peace Corps volunteers. The program was supervised by a Forest Service field agent assigned to the ORD for that purpose.

As small amounts of outside funding became available, the ORD provided more material support and closer supervision of planting activities. A steadily increasing number of plantations were initiated through organized village groups, such as youth clubs, and pre-cooperatives. These groups tended to plant blocks of 0.5 ha or less (150-300 trees) each year. Hand tools were provided, wells were deepened or dug in some villages to provide water for seedlings and for adjacent vegetable gardens, and a large number of plantations were fenced with barbed wire and/or chicken wire. Donkey carts and oil drums were sometimes provided to facilitate watering of the plantations.

By 1975, the ORD "reforestation section" was helping to plant fifty to sixty ha of village woodlots annually.
The increasing level of reforestation activity in the Yatenga ORD is reflected in the number of seedlings distributed from the central nursery in Quahigoutya: 9,410 in 1972, 42,015 in 1974, and 76,600 seedlings in 1976.

Eight plantations totalling 5.7 ha were established in 1973. Only three had better than 50 percent survival in 1977, after four growing seasons. In 1974, twenty-three plantations totalling 13.0 ha were planted. More than 75 percent of the trees were alive in three plantations, and eight plantations had 50-75 percent survival in late 1977. Survival was, however, less than 50 percent in twelve of the plantations, just three years after they were planted. (For more detailed data, see CILSS/DSE seminar paper, 1978, "Plantation villageoises: l'expérience de 5 ans au Yatenga."

Major problems encountered were:

1. shortage of field agents with technical backstopping abilities;

2. inadequate support for ORD extension agents (training, means and incentives to monitor plantations, encourage after-care, etc.);

3. shortage of vehicles and other means to transport seedlings and visit sites on a frequent, regular basis;

4. ineffectiveness of barbed wire fences, which often were not cared for, and of little use in controlling goats even when well constructed and maintained;

5. lack of rainfall within one week after planting and inability to water seedlings (or to encourage watering) in the dry season; and

6. difficulty in obtaining good quality land where trees could be planted with standard techniques, and have a good chance of survival.

The most successful plantations were characterized by:

1. involvement of village chief and elders and/or commitment to the project by a youth group or pre-cooperative closely supported by an ORD agent;

2. sufficient water and food resources in the village;

3. a small-scale endeavor, or of less than one hectare in size; and

4. fencing around the perimeter of the plantation.
Several of the successful plantations were also associated with a cool dry season garden, located either within the plantation or adjacent to it. In these cases, fences were maintained primarily to keep animals out of the gardens, and sites were of better quality: deeper soils and higher water tables. The groups with gardens also tended to be better organized and well supervised by the extension agent.

Proximity to wells seemed to have little direct influence on plantation successes. Villages were rarely motivated to water trees on a regular basis. Some plantations showed good survival without watering, even when planted on relatively poor sites (shallow, lateritic soil). Survival was generally much better however where soils were deeper and more fertile. Such sites were available only in villages where:

1. people (and former user of the field) were convinced they had a reasonable chance of benefiting from planting trees—and would not just lose a plot of arable land to the government; and

2. pressure on good quality farmland was not severe.

In general, experience in Yatenga demonstrates chances of success are better if village-level efforts are small-scale at the outset, in keeping with desires of villagers unwilling to commit a large amount of arable land, time and energy to plant and care for woodlots. In addition, it appears villages can rarely initiate and successfully execute such a novel activity without a minimum of outside support and encouragement. They appreciate the rationale of reforestation and are anxious to obtain benefits of a successful project. But they need to be guided to the point of actually growing and harvesting wood from a woodlot. Until that point is reached, they remain interested but hesitant, and unwilling to make major sacrifices. (This is perfectly understandable given harsh milieu and people's preoccupation with their own well being and survival from one year to the next).

To provide necessary support, the ORD and Forest Service must field a group of agents trained in nursery operations, extension forestry (i.e., choice of species, and sites, advice on planting, soil conservation techniques and harvesting methods, etc.) and in evaluation, reporting and analysis. The latter aspects are particularly important, in order to justify a continued flow of outside assistance in the early stages. It also became clear that a single forestry agent could initiate, supervise, and monitor unassisted no more than 60 hectares/year of new plantations a year.
In an area such as Yatenga (average rainfall of 600 mm, high density of free-ranging livestock, and scarcity of fertile soils), long term survival rates of tree plantations will be low unless a program covers more than nursery and planting activities. A complete program must be supported, including:

1. training at all levels, involving village leaders, extension personnel, and managers in practical workshops and periodic seminars;

2. transportation and other costs for extension, seedling distribution and aftercare;

3. fencing materials, adequate to provide protection from goats for at least three years;

4. a sustained effort in education and extension, to organize and assist the village groups;

5. follow-up visits to maintain interest and encourage aftercare;

6. guidance in harvesting and demonstration of benefits of tree planting; and

7. analysis of past results and testing of new approaches and other potential improvements in the program.

Village Reforestation - Koudougou

A village reforestation project for the region around Koudougou, financed by the Rural Development Fund in 1976, was renewed annually through 1979. A project-supported central nursery, managed by the Forest Service, produced seedlings. The Forest Service distributed seedlings and provided technical support at a cost of about 136,000 CFA ha. Villagers contributed their labor (105-160 man-days per hectare). A program evaluation undertaken in June, 1979, revealed:
TABLE 4. KOUDOUGOU ORD

<table>
<thead>
<tr>
<th>Year</th>
<th>Proposed Planting</th>
<th>Area planted</th>
<th>Average survival</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Collective</td>
<td>Family</td>
</tr>
<tr>
<td>1977</td>
<td>46 ha.</td>
<td>62</td>
<td>19</td>
</tr>
<tr>
<td>1978</td>
<td>296 ha.</td>
<td>84</td>
<td>114</td>
</tr>
<tr>
<td>1979</td>
<td>200 ha.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In early 1978, thirty-six collective plantations and twenty family plantations were visited by project staff. Twelve collective plantations (33 percent) and six family plantations (30 percent) showed better than 50 percent survival after six months. In early 1979, survival rates in both types of new plantations were tabulated (see Table 4, above and Annex 1). Collective plantations showed 39 percent average survival, individual (or family) ones, 46 percent average survival.

Review of prospects for a large-scale reforestation program in the region indicate major constraints to be:

1. limited number of good planting sites close to villages,
2. shortage of water during the dry season,
3. limited time and energy of villagers involved in projects,
4. grazing pressures sufficient to make protecting seedlings from browsing livestock indispensable. These factors tend to limit program size and increase costs. However, a different set of factors appeared largely responsible for low plantation survival rates, namely:

1. late delivery of seedlings, as a result of poor planning and organization, and shortage of funds;
2. poor condition of seedlings by the time they were planted;
3. late planting, often carried out with little supervision; and
4. program success may have also been compromised by failure to control termites, fire and livestock damage.

Although family enterprises appear relatively more successful than collective plantations, success of both types reflected above all quality of extension support provided. In most cases Forestry agents visited villages only rarely. Their attitudes frequently discouraged popular involvement. Field staff did not emphasize to villagers potential benefits of planting trees. Instead they "advised" villager participation in a program conceived with skimpy input from those concerned.
Dedougou Forestry Center

In 1975, French development assistance (FAC) funded a three-year forestry project in Dedougou. Objectives were to establish a forestry center which would help to create 300 ha of industrial plantations and 600 ha of village woodlots over a period of several years. With project funds totalling 45 million CFA, only ninety ha of "industrial" plantations (all hand labor) were planted in two locations, in addition to approximately sixty ha of village plantations. Survival was fair to good in industrial plantations, but little trace remains of village projects.

The project constructed housing, office space and storage facilities for the Forestry Service in Dedougou, and financed equipment for the nursery as well as vehicles, operating costs, and workers' wages. Unfortunately, field agents received little technical and material support, especially after the first two years of the project. It was neither well managed nor capably supervised, and the Dedougou Forestry Service office received little assistance from the central administration once project funds ran out. As a result, the project had little impact beyond 1977.

In 1979, when the Netherlands became interested in funding a forestry project in the region, their appraisal mission determined it was necessary to expand/complete infrastructure investments, replace service vehicles, restore the nursery operation, and launch another reforestation program in the region.

Village Reforestation--Bobo-Dioulasso and Houndé

In 1978, the Bobo-Dioulasso ORD decided to incorporate village reforestation into their rural development program. ORD extension agents were urged to organize village groups to start small woodlots. However, they received no specialized training in conservation education or forestry. In response to village requests, the ORD purchased and delivered seedlings. No fencing or other materials were provided. However, the region receives more rainfall (1000+ mm) and experiences less grazing pressure than most other Voltaic regions. Adverse impacts of immigration and population growth have heightened still further local awareness of environmental degradation resulting from land clearing and overcutting of forests. However, land availability still permits long fallows and crop yields are good.
Approximately thirteen ha were planted in two sectors of the ORD in 1978, with only moderate survival (less than 65%) in spite of favorable soil and rainfall conditions. In 1979, the ORD again encouraged its agents to organize woodlot plantings, but required villagers to reimburse the ORD for seeding costs (20 CFA/plant). Very few villages decided to buy more seedlings to extend their woodlots. Some however requested grafted fruit tree seedlings available at higher cost (125 CFA/plant). In 1980, a number of villages agreed to purchase seedlings, but the ORD could not deliver sufficient quantities of desired species before the rainy season ended. It appears factors most responsible for poor success of the woodlots are those beyond villagers' control: late arrival of seedlings, poor quality of seedlings, no rain immediately after planting.

Results were considerably better and interest much higher in Houndé sector, where a rural development project funded by West Germany has recently included reforestation in its program. The project provides additional vehicles to transport seedlings, and considerable education/extension efforts promote woodlots as village group activities. Seedlings, however, are still paid for by the villagers themselves. The combination of more logistical support, regular contacts with villagers, and a continuing interest in success of the plantations has promoted higher survival rates and more local participation there. (In 1979, nineteen villages purchased 24,562 seedlings, and in 1980, twenty-three villages purchased 21,200 seedlings. In other sectors between two and four villages requested 1,000-2,000 seedlings.) Promoting tree-planting through an integrated community development project may also have contributed to the plantations' success.

FAO/UNDP Forestry Resource Development

In 1976-1977 a FAP/UNDP funded forestry project established 562 ha of industrial plantations within Dinderesso forest reserve, close to Bobo-Dioulasso. The project formed part of a larger effort to establish 3,000 ha of industrial plantations, 250 ha of village plantations, and 6,500 ha of managed forestland.

The industrial-type plantations at Dinderesso and along the P8 road south from Ouagadougou were established with the aid of heavy machinery on fair to good soils, in an area receiving 800-1,000 mm of rainfall. These types of plantations have demonstrated the rapid growth potential of certain
exotic species, especially when planted on good sites and carefully tended. Only 1,660 ha of industrial plantations were established, although 3,000 ha were targeted and funded. Costs ran between 125,000 and 150,000 CFA/ha. (Costs include site preparation, planting and aftercare for two years.) Village plantations achieved moderate successes in some areas, but not more than 100 ha were planted. This part of the program seems to have had less long term impact than expected. Little was ever accomplished concerning more intensive management of natural forests. It is not clear whether this aspect was dropped because of a shortage of funds, or through reluctance to try new techniques and silviculture experiments.

In spite of rapid growth of planted trees (especially in the first 2-3 years) it is not clear what ultimate benefits of the project will be. However, several problems have become apparent already.

1. Long delays in implementing large-scale operations dispersed over several regions of the country. The project was identified and designed in 1972, funded in 1973-74, and the first trees planted in 1975. The Dinderesso plantations were established in 1976-77, but many project objectives were still unmet when funding ran out in 1977.

2. Difficulties of introducing new plantation or forest management. FAO relied on French forestry research and accepted techniques of mechanized land clearing, soil preparation, use of exotics and paid labor. Only recently has more effort been made to evaluate local species' potentials and possibilities of alternative establishment techniques (taungya). Most foresters still prefer clearing natural forest to establish "high-yield" plantations, to more intensive management of natural forests.

3. Shortage of qualified, local personnel competent to assume project management and other responsibilities without additional training. The project relied on FAO technicians as well as Peace Corps volunteers. Counterpart assignments and in-service training were so deficient project activities often collapsed after expatriates' departure and exhaustion of project funds.

4. Voltaic government inability to cover recurrent costs for such projects. The planting program terminated in 1977. The government will probably not continue planting with national budget funds. Funds are apparently unavailable to operate nurseries or meet minimum requirements for plantation aftercare. Firebreaks have not been well maintained, and fire has damaged some plantations. Uncontrolled weeds
have significantly retarded tree growth. No thinning, cleaning or harvesting operations are envisioned or seem feasible without outside assistance and funding.

5. Forest Service's limited ability to intervene in firewood marketing, still tightly controlled by the private sector. The Forest Service apparently lacks political muscle necessary to retain control over receipts from sale of forest products and enter forest products marketplace. It should be possible to organize thinning and harvesting of plantations and to cover operation costs through wood but this has yet to be accomplished.

German Forestry Mission

In 1976, the German Forestry Mission in Upper Volta was organized to support a number of forestry activities, eventually including expansion of the central Forest Service nursery, establishment of a 3,000 ha fuelwood plantation, a green-belt, and associated small-scale village reforestation and forest management programs outside of Ouagadougou. Experiments with sylvopastoral plantings in the northern part of Upper Volta, and promotion of improved woodstoves have also been undertaken by the Mission.

The largest fraction of the budget (about $4 million since 1976) has been committed to the mechanized planting operations (nursery, green-belt, fuelwood plantations). The mission has recognized that expatriate staff of two foresters and several volunteer have difficulty supervising planting of more than 400-500 ha/yr. Total average costs for site preparation, seedlings, labor and maintenance for two years exceeded 240,000 CFA/ha in 1978-79. (About $1,208/ha, or $476/acre).

This project has confronted many problems encountered by the FAO/UNDP project:

1. shortage of qualified local personnel to assume counterpart assignments;

2. difficulty of managing recurrent costs (a forestry fund established with receipts from wood sales and nursery operations does not work as smoothly as anticipated);

3. lack of experience and knowledge concerning improved management of natural forests.
4. Forest Service's limited ability to manage fuelwood production and marketing operations; and

5. lower than expected yields occasioned by heterogeneous soils, delayed aftercare operations, low rainfall, and minor but poorly understood insect and disease problems.

As a result, this major effort to assure Ouagadougou a continuing supply of fuelwood will at best provide 10 percent of the capital city's needs—estimated at over 350 tons of wood per day, or more than 240,000 m³/year.

Village Woodlots - An Agroforestry Project

In 1977-78 a village reforestation program in the Kombissiri area initiated with FAO/UNDP project funds, was extended under Swiss financing. Attitudes of local populations involved in the project were surveyed and analysed by a team from CESAO (Centre d'Etudes Economiques et Sociales de l'Afrique Occidentale). The CESAO report and several CILSS papers compiled for a regional seminar on reforestation techniques, led the Swiss to propose in late 1978 a new "Bois de Village" program. The program was launched in three Voltaic ORD's: Yatenga, Center, and Eastern.

The woodlot project envisaged three principal objectives:

1. creation of woodlots, to meet rural populations' forest product needs;

2. promotion of environmental rehabilitation and conservation, to safeguard rural milieu; and

3. development of village-level capacity to initiate and implement reforestation and other natural resource conservation activities.

Program strategy advocated establishing a village reforestation coordinating unit within the Ministry of Environment and Tourism, to provide technical support, funds and accounting assistance, as well as planning and management support. Each ORD provided support in the form of training, vehicles, equipment, indemnities, operating costs, and workers' salaries. Participating villagers received fencing, seedlings, handtools, and technical supervision. Fertilizers for intercropped fields, wells/well-digging equipment, and materials required to set up "mini-nurseries" were also supplied to selected villages.
Basic principles in the project design are:

1. Training of field agents in survey and extension methods so they may assist villages in formulating a planting program adapted to local needs and constraints. These "retraining" seminars insisted agents elicit and consolidate villagers' long term interest and support.

2. Provision of means required at all levels: seedlings, tools and fencing at the village level, support necessary for ORD and Forest Service to function in an extension capacity, and assistance needed for planning, management, and project evaluation.

3. Donor agency's long term commitment to a phased program extending over 10 years; before the end of project financing, the first villages involved will have become autonomous and will have gone beyond tree-planting, to include other activities such as management of adjacent natural forests, establishment of windbreaks, local production of seedlings, and incorporation of soil conservation practices into traditional farming practices.

4. Replication of program activities in space and in time, so as to exert significant impact on deforested zones in each region where the program is funded. Priority zones are identified, on the basis of the severity of deforestation in the area. The project begins with a manageable number of villages in these zones, and gradually contacts most villages located in less densely wooded areas, by doubling the number of villages brought into the program each year.

In 1979, the Netherlands funded a village woodlot program in Dedougou and Kaya regions, with the objective of planting 360 ha in the first two years (1980-81). The following budget was proposed, and is representative of costs involved in such programs.
TABLE 5. NETHERLANDS WOODLOT PROJECT

<table>
<thead>
<tr>
<th>Project Activity</th>
<th>CFA/ha</th>
<th>$/ha</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coordinating unit: vehicles, office equipment, personnel, CESAO evaluations</td>
<td>42,500</td>
<td>212</td>
<td>14</td>
</tr>
<tr>
<td>Support to Forest Service and ORD: nursery materials, laborers, housing, office</td>
<td>98,528</td>
<td>492</td>
<td>33</td>
</tr>
<tr>
<td>space, vehicles, operating costs, indemnities, government personnel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Village investments: fencing seedling sites, fertilizers, tools, insecticides</td>
<td>159,902</td>
<td>800</td>
<td>53</td>
</tr>
</tbody>
</table>
| Total program costs, or 108.4 million CFA over 2 years                           | 300,930| $1,504| 100%

These programs have been difficult to implement as conceived. The Voltaic administration remains anxious to post record totals of hectares planted and shows less concern about plantations' long term viability and villagers' ability to continue operations on their own. "Extension" services often discount the value of dialogue with villagers, CESAO training to the contrary. In some cases, they supervise planting activity as if it were little different from a small-scale "industrial type" plantation, and treat villagers as paid laborers.

Villagers appreciate the considerable assistance provided, the opportunity to plant crops in plantations and the possibility of creating a combined nursery/garden. However, most villages have not yet received significant benefits from trees planted.

Many problems frequently encountered in other types of reforestation projects persist, though they may diminish with time as training programs progress. For example, a given field agent cannot cover more than ten to twenty villages, so the project has been limited, not by inadequate funds, but by numbers of ORD and Forest Service personnel willing to guide villages and extend the program into new areas.

Another potential problem is the increasing cost of operations and indemnities. The government probably cannot shoulder these costs when outside funding ceases. Also, project personnel ability to organize and coordinate project activities, and field agents' mastery of technical (practical) aspects is still weak. Contact with participating villages remains infrequent in some cases.
Finally, project personnel attitudes sometimes discourage local involvement. Many field agents do not feel project success is tied to local participation. Distribution of goods produced by the project is not adequately discussed and understood by villagers. Many remain unconvinced they stand to gain significantly from the planted trees. But, attitudes gradually improve as people learn from experience.

III. LEARNING FROM PAST EXPERIENCES

The contemporary Sahel confronts a problem too dangerous to ignore: imbalance between supplies of natural resources and demands people and animals make on them. The resource base is at once resilient and fragile. Natural regeneration after a drought or period of overuse has sometimes been remarkable. Yet overall, the resource base now deteriorates steadily and becomes less productive as a consequence of too many people and animals pressing too hard, for too long, in ways no longer appropriate. Dramatically rising costs, firewood for instance, indicate overuse of the renewable woodstock.

The Sahelian ecological crisis admittedly involves more than mere imbalance between farmers, herders, and the land. Forces originated in the colonial period, forces diversified and intensified in the post-independence "development" decades, have played a role in upsetting ecological equilibria in the Sahel. These include introduction of cash crops and animal traction, intensified development of irrigated agriculture, vaccination programs, well-digging, urbanization, health care, and other aspects of modernization and development assistance programs. The role of "drought" itself should not be overlooked. Present trends suggest the Sahel will continue to face difficulties in sustaining its livestock, feeding its populations, and insuring reasonable living conditions, even in years of good rainfall, unless development efforts focused on natural resource conservation are both intensified and redirected.

Currently, various programs are needed to simultaneously increase wood production, decrease wood consumption, and strengthen Sahelian institutions supporting forestry and resource conservation activities. More resources must be committed to the forestry/ecology sector, and to improving design and effectiveness of forestry programs.

A significant number of reforestation projects were initiated during the 1970s. Participants and observers have gained experience in reforestation, and have learned much from the occasional analysis or evaluation of these projects. Common problems encountered are summarized in one column of Table 6 below, key elements of successful projects in the other.
<table>
<thead>
<tr>
<th>Problems Encountered</th>
<th>Elements of Successful Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shortage of well-trained personnel</td>
<td>Community participation facilitated</td>
</tr>
<tr>
<td>Inadequate funds for operating costs, vehicles, fencing</td>
<td>Small-scale initiatives, tailored to local constraints</td>
</tr>
<tr>
<td>materials, etc.</td>
<td></td>
</tr>
<tr>
<td>Incomplete program: no provision for training, harvesting,</td>
<td>Local populations aware of and sensitive to environmental degradation</td>
</tr>
<tr>
<td>or evaluation</td>
<td></td>
</tr>
<tr>
<td>Inadequate protection from animals</td>
<td>Planting program integrated into rural development efforts</td>
</tr>
<tr>
<td>Shortage of water; drought stress</td>
<td>Careful selection of project areas excluding villages preoccupied with food, water shortages</td>
</tr>
<tr>
<td>Inadequate technical oversight and thus poor survival</td>
<td>Provision of long term support to Forest Service and extension personnel, vehicles, nursery equipment, tools, operational budget, training</td>
</tr>
<tr>
<td>Inadequate extension effort; little follow-up support to</td>
<td>Appropriate personnel incentives training, promotions, indemnities for Forest Service employees and others</td>
</tr>
<tr>
<td>villagers</td>
<td></td>
</tr>
<tr>
<td>Overemphasis on costly inputs, mechanisation, or paid</td>
<td>Built-in periodic evaluations</td>
</tr>
<tr>
<td>labor</td>
<td></td>
</tr>
<tr>
<td>Inability to absorb recurrent costs of nurseries and</td>
<td>Political commitment to project success; high level of interest and concern</td>
</tr>
<tr>
<td>plantations</td>
<td></td>
</tr>
<tr>
<td>Inexperience with non-industrial plantation techniques</td>
<td></td>
</tr>
<tr>
<td>Lack of expertise in management of natural forest</td>
<td></td>
</tr>
<tr>
<td>Absence of sustained yield management, with regular</td>
<td></td>
</tr>
<tr>
<td>thinning, harvesting and regeneration</td>
<td></td>
</tr>
<tr>
<td>Inadequate review, evaluation and fiscal control</td>
<td></td>
</tr>
</tbody>
</table>
Implications for the Role of the Forest Service

A key problem in past projects has been failure to generate a village-level reforestation capability; projects neither envisaged nor fostered autonomous village tree-planting and resource conservation activities. A large percentage of project funds were often sucked up by government "sponges." As a result many villagers never received much assistance. More importantly, top heavy designs of projects curtailed their impact beyond the life of the project.

As a rule, one cannot completely bypass the government in development assistance projects, but projects can be designed to redefine government agencies' roles. In fact, the Swiss/Dutch village woodlot project in Upper Volta has created a new role for the Forest Service: in addition to reforestation and resource protection activities, it has begun to develop support and extension capabilities. The agency now focuses on providing technical information and practical guidance in the field, to directly assist village resource conservation efforts. In principle, local people are the ones deciding on scale of operations, species to be planted, work organization and allocation of the benefits.

In this way, responsibility for reforestation efforts gradually shifts. Previously the sole prerogative of the Forest Service, they are becoming the responsibility of villagers. Government agencies now play a cooperative role, providing support and investment. Civil servants can then respond to expressed needs and desires of rural populations in a manner allowing villagers to accomplish what they decide to do in ways villagers feel most appropriate and promising.

Previously the Forest Service played an all but negative role: they were unable to supply seedlings or distribute them as effectively as other agencies, and rarely took the lead in tree-planting programs (unlike the ORD's or the Volta Valleys Authority). Most damaging of all, they failed to practice sustained-yield, multiple use management in forest reserves, and never convincingly demonstrated benefits of growing and managing trees. In the eyes of most villagers, the "tissnaaba" (Forest Service agent) remains someone to avoid when collecting firewood or hunting, especially in areas earlier expropriated from village lands to create forest reserves. Even today, the Forest Service rarely assists villagers but can cause problems. On the other hand, the "kouabnaaba" (ORD agricultural extension agent) might provide you with seedlings, works with the local cooperative, and frequently assists village and villagers. He understands local problems and promotes local interest.
When Forest Service technicians go into the field to work on reforestation projects, some lose sight of basic issues and questions. As technicians, they assume they must know what to do, how to do it, and when to do it. They forget (or consider it pointless to ask) why? for whom? at what gain and at what loss to whom? They don't take as a point of departure villagers' needs and constraints. They are only slowly redefining their mission from "protection and administration" to service--and assistance at the local level in order to promote resource conservation in appropriate ways.

Guidelines for the Future

Understanding of "what went wrong" in some past projects should point the way to the design of new programs having much better chances for success and for a significant, positive long term impact. Experience shows universally applicable designs and single approaches amenable to routine replication do not exist. Each project proposal must make sense in a particular ecological, cultural, and socio-economic setting. Reviewing those factors, and putting them into perspective, is the indispensable first step (though many projects design teams apparently overlooked it).

The following additional suggestions might prove helpful in designing Sahelian forestry projects.

1. Consider whether all proposed participants in the project will be sufficiently motivated and able to participate as planned. There must be clear rewards for their efforts; they must stand to gain something, and must understand and appreciate what they might gain. They should be confident they can succeed, as a consequence of support provided by the project. Customs, patterns, and rules of land tenure, resource allocation and other sociopolitical considerations must be reviewed as potential barriers or facilitators of reforestation.

2. Adequate numbers of well trained persons must be available at each level, or training for them should be provided. Other aspects related to their motivation should be analyzed and appropriate support provided. Ideally, salary, advancement, and retraining opportunities should be adjusted to reflect experience and achievement on the job.

3. The short and long term objectives of the project must be clearly stated and related to needs of people involved and affected by the project. Guidance should be provided for technical and organizational aspects of the project, but the
proposed design should be flexible and include several alternative approaches. Mechanisms should be built in to review the project during implementation, in order to modify its activities as seems advisable. New approaches and innovative, more effective techniques should be sought in the course of project implementation.

To date, there have been too few detailed evaluations and analyses of results of past efforts. Many projects were poorly conceived and rigidly implemented, and results have never been reviewed. Project evaluations could seek out design failures, understand them, and work around them imaginatively to design more effective projects.

4. Avoid the temptation to quickly plant as many trees as possible, and give more attention to how trees are planted. Consider how tree planting efforts can be carried on and extended in the future. Be wary of proposing inappropriate, unnecessary materials. Project inputs should be guided by analysis of constraints on tree planting: what is needed to remove obstacles that frustrated earlier initiatives? How can locally managed, autonomous efforts be encouraged in a lasting manner?

Survival rates can be increased and costs held down by closer attention to certain technical aspects (planting early, associating soil conservation practices or techniques, matching species and site.) and to organization and management aspects (use of vehicles and support materials, grouping and choice of villages, distribution of tools and equipment).

5. Avoid focusing on one aspect of a problem (e.g. firewood supply) to the point of limiting chances of achieving a lasting solution to an interconnected set of problems. Consider the potential for incorporating activities related to soil fertility maintenance, groundwater recharge, production of non-wood "minor" forest products and conservation of natural vegetation. Do whatever appears feasible to help resolve the bigger issues and contributing causes, including controls on land clearing, improved farming practices, and more efficient use of wood.

6. Take care in selecting project villages. Chances for success are greater in villages where food and water supplies are adequate, land pressure is not excessive, increasing scarcity of wood is being noticed, where community organization permits any collective action which may be required and favors an equitable distribution of the expected benefits of the project.
7. Recognize that a long term, multi-dimensional effort is needed. It will include training, conservation education and extension activities, provision of materials, equipment and operating funds, administrative and planning assistance, evaluations, experimentation and applied research and technical assistance for the non-traditional aspects of the program (e.g., woodstove development management practices and forest management).

The Forest Service could be much more aggressive in its efforts to integrate forestry into rural development programs. Forestry can do more than produce wood; it can also be a means to conserve water resources, protect and increase food production, and increase production of forage and a variety of other products of importance to rural households.
Results of Collective and Family Reforestation Project in 1978,
Koudougou Regional Development Organization

(Data presented below on all plantations and survival rates
derived from lists furnished by the Forest Service; the final
report and woodlot program analysis are not available for
Koudougou forestry jurisdiction.)

<table>
<thead>
<tr>
<th>Type of plantation</th>
<th>Number of plantations</th>
<th>Total (in ha)</th>
<th>Average area</th>
<th>Survival rate (Jan. 1979)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collective Plantations</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Village Group</td>
<td>36</td>
<td>45</td>
<td>1.25</td>
<td>33%</td>
</tr>
<tr>
<td>Youth Group</td>
<td>15</td>
<td>17.5</td>
<td>1.17</td>
<td>50%</td>
</tr>
<tr>
<td>Young Farmer Training Centers</td>
<td>12</td>
<td>13.5</td>
<td>1.13</td>
<td>51%</td>
</tr>
<tr>
<td>Schools</td>
<td>3</td>
<td>3.5</td>
<td>0.83</td>
<td>33%</td>
</tr>
<tr>
<td>Others</td>
<td>4</td>
<td>5</td>
<td>1.25</td>
<td>25%</td>
</tr>
<tr>
<td>Individual Plantations</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family</td>
<td>125</td>
<td>91</td>
<td>0.73</td>
<td>49%</td>
</tr>
<tr>
<td>Village Chief</td>
<td>18</td>
<td>23</td>
<td>1.27</td>
<td>34%</td>
</tr>
<tr>
<td>Subtotal: Collective plantations</td>
<td>70</td>
<td>83.5</td>
<td>1.2</td>
<td>39%</td>
</tr>
<tr>
<td>Subtotal: Individual plantations</td>
<td>143</td>
<td>114</td>
<td>0.8</td>
<td>46%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>213</td>
<td>197.5</td>
<td>0.9</td>
<td>43%</td>
</tr>
</tbody>
</table>

Administrative Circumscriptions

1. Town of Koudougou (above all family plantations)
   | 32 | 27.5 | 0.86 | 57% |
2. Koudougou-Central Arrondissement (above all family plantations)
   | 45 | 33   | 0.73 | 40% |
3. Sabou Arrondissement (above all collective plantations)
   | 19 | 23   | 1.21 | 54% |
4. Kindi Arrondissement (collective plantations)
   | 27 | 17.5 | 0.65 | 54% |
5. Kokologo Arrondissement 7 (family plantations)
   | 6  | 0.86 |      | 32% |
6. Nanoro Arrondissement (above all collective plantations)
   | 41 | 37.5 | 0.91 | 42% |
7. Other regions: Tenado, Reo, Yako, Leo
   | 52.5 | 1.25 |      |      |
| TOTAL                       | 125 | 91   | 0.73 | 49% |

ENDNOTES

1. In this paper, the Sahel refers to a sub-saharan region of West Africa, which includes the eight member-states of CILSS (Permanent Interstate Committee for Drought Control in the Sahel). From west to east, those countries are: Cape Verde, The Gambia, Senegal, Mauritania, Mali, Upper Volta, Niger and Chad.


3. 200 CFA = $1.00; 1 donkeycart (charrette) load = 1 m³ = 1.6 stere = 400 kg.

4. Cubic meters per hectare per year = m³/ha/yr; 1 square kilometer = km² = 100 ha.

5. See CILSS Ecology and Forestry Team report, 1979, "Programme revisé de satisfaction des besoins en produits forestiers et de lutte contre la désertification."

6. ORD = Organisme Régional de Développement, Regional Development Organization, a special service jurisdiction charged with overseeing and coordinating development efforts in its region.

BIBLIOGRAPHY


