Forestry Support Program

Forestry and Forestry Research in the Sahel
An Overview

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PREFACE

This report has been prepared at the request of USAID, Bureau for Science Technology, Office of Forestry, Environment and Natural Resources for the Forestry Support Program. The Forestry Support Program (FSP) was established to bring the knowledge and experience of the professional forestry community to bear on forestry development activities of the U.S. Agency for International Development (AID). FSP provides technical assistance to AID in identifying, designing, managing and evaluating field projects and country strategies in forestry and related natural resources. This AID-funded program (ST/FNR) is managed jointly by the Forest Service and the Office of International Cooperation and Development (OICD) of the U.S. Department of Agriculture.

The report was requested as a background document to support the Fuelwood Research Implementation Plan. The plan proposed a concerted Agency effort in fuelwood research in two categories of concentration, which are production plus conversion and utilization. This report was designed to examine the status of fuelwood/production research in the Sahel region of West Africa and the USAID forestry portfolio. This report makes a preliminary examination of the appropriateness for that region of four designated research topic areas applicable for Africa. These topics are as follows: 1) Multi-purpose fuelwood species assessment and trails; 2) Soil-site relationships of fuelwood species; 3) Fuelwood species biotechnology; 4) Bioenergy market system analysis; 4) On farm-forestry management.

The report consists of two sections. The first is an overview of the forest research situation in the Sahel of West Africa and its prospects. The second section provides synopses of the forest, forestry, and forestry research situations in four West African countries -- Mali, Niger, Senegal and Upper Volta. The allowed time for writing this paper was extremely limited and it can only be considered a partial and superficial introduction to the subject. Extensive use has been made of other reports which, in the interest of time, have frequently been used verbatim and footnoted. Especially important were J. K. Jackson's report on natural forest management in the Sahel[1] and the summary country profiles prepared by Frances Gulick.[2] Also drawn heavily upon was R. Catinot's overview of the research situation in the Sahel.[3]

Because this report is primarily concerned with research in the arid and semi-arid areas of West Africa, little attention has been given to forestry research in the more humid coastal countries. At some point such a broader look may be desirable, given the institutional and technical problems the coastal countries may share with the Sahelian, the complementarities between the ecological zones involved and the desirability of strengthening professional communications between the anglophone and francophone states.

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1 Jackson, J. K. et al. 1983. Natural Forest Management in the Sahel Countries. CILSS/Club du Sahel/FSP, Ouagadougou/Paris

2 Gulick, Frances A. and Kevin Mullally, 1981. CADA Forestry and Fuelwood Production Initiatives in Selected African Countries, Bureau for Africa, USAID, Washington. Gulick, Frances A., 1983. Possible Additional countries for the CDA Forestry Initiative. Bureau for Africa, USAID, Washington.

3 Catinot, R., 1982. Situation de la Recherche Forestiere dans les Pays du Sahel Membres du CILSS. (Provisoire) CILSS/Club du Sahel, Ouagadougou/ Paris.

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The report is in response to growing needs within USAID, both the bureaus of Science and Technology and of Africa, to better understand forestry research activities past, present and future in the Sahel.

The report consists of two sections. The first is an overview of the forest research situation in the Sahel of West Africa and its prospects. The second section provides synopses of the forest, forestry, and forestry research situations in four West African countries -- Mali, Niger, Senegal and Upper Volta. The allowed time for writing this paper was extremely limited and it can only be considered a partial and superficial introduction to the subject. Extensive use has been made of other reports which, in the interest of time, have frequently been used verbatim and footnoted. Especially important were J. K. Jackson's report on natural forest management in the Sahel[1] and the summary country profiles prepared by Frances Gulick.[2] Also drawn heavily upon was R. Catinot's overview of the research situation in the Sahel.[3]

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I. Introduction

A review of some of the more recent literature on Sahelian forestry and forestry research brings home the fact that these subjects are at this time very much in ferment. After six to eight years of experience in various approaches on reforestation and afforestation at varying scales of effort, and after the investment of nearly $200 million in external assistance in the forestry sector in the Sahel, a searching and high level reappraisal of that uneven experience is currently in progress. Indeed, if one defines research as "gaining of knowledge through empirical methods" much of the entire Sahelian forestry program could be considered "research".

Certainly a lot has been learned. Earlier assumptions and approaches have been called into question by the Africans and donors alike. Traditional forest service attitudes, laws and regulations are being reappraised. An active search is now going on for better ways by which Africa's forest and other natural resources can be managed to meet the needs of growing populations. The changes in emphasis and directions that are growing out of this reappraisal will have strong implications for forestry research. For in the future, as now, research will continue to be a critical means for acquiring the technical and social science understanding necessary to support the redirection of West African forestry. Thus AID's decision to give increased priority to forestry research with special emphasis on fuelwood comes at a particularly opportune time.

II. Forestry Research in Sahelian West Africa

A. Present Situation

Forestry research in Sahelian West Africa reflects, in an exagerated form, the problems of West African research generally. Local forestry research institutes suffer from acute lack of finances, staff and prestige. For example, in Senegal the CNRF budget for 1978/79 represented but 3% of ISRA's total budget. What financing is available is mostly devoted to salaries and administration with little left over for direct research costs. Long delays are often experienced between the time budgets are approved and funding is in hand.

Thus, Sahelian forestry research is heavily dependent on foreign assistance for financing and technical talent. In most cases, foreign financing exceeds the small amounts made available locally and the same situation applies for vehicles, equipment and supplies. As Catinot observes, without continued donor financing forestry research in the Sahel cannot survive, much less grow.

Perhaps the most disturbing aspects of the forestry research situation is its paucity of human resources. With the possible exception of Senegal, the forestry research centers lack adequate national talent for conducting research. The preponderence of the research being conducted is carried out by expatriates. Also, with the exception of Senegal, little in the way of advanced research training appears to be in progress. Here is obviously an area where more needs to be done.

Finally, the location, in all cases, of forestry research within a larger research institution, and its organizational separation from the forest service, results in an institutional lack of communication between the producers and ultimate consumers of research and lack of participation by the consumers in setting research priorities. Efforts have been made to surmount this barrier, such as the forest service, SRST consultative meetings in Senegal but the institutional problem persists. It is a problem which is quite separate from the lack of resources and deserves further examination in the context of an expanded research assistance effort.

B. Research Accomplishments

A number of observers point out that, in comparison with other developing areas, relatively little forestry research has been carried out in the Sahel and most of this is of fairly recent origin. What has been accomplished has largely been carried out by the CTFT prior to independence and by CTFT experts seconded to local research centers thereafter. More recently, other donors have begun to support forestry studies and surveys, often as part of larger forestry projects, and the scope of research has begun to broaden beyond the study of technical matters. Yet, having said that, forestry research in the Sahel remains today largely a French influenced and executed enterprise and continues to be concentrated on technical topics.

According to Catinot, the subjects which require the most attention are the following:

1. Identification of national forest stands, qualitatively by ecological zone and quantitatively by land unit. More has been done on the former (Mali, Senegal) than the latter.

2. Natural or artifical regeneration of local forest species. Previously neglected, interest has increased on this topic as a result of the energy crisis, problems of desertification and disappointing results from plantings of exotics for fuelwood. However much remains to be learned including how to deal with problems caused by fire and livestock. Most of the work existing has been done in Senegal, Upper Volta and Mali.

3. Management of natural forest stands. Here emphasis should be on different kinds of management models. There have been ecouraging trials in Senegal and Mali.

4. Reforestation techniques. Much work has been done by CTFT on choice of species. Good work on soils/species relationships has been done in Mali and Niger. Knowledge of nursery practices is almost adequate in relation to need except as appropriate to 3 above.

5. In regard to "special situation forestry", some research has been conducted in Senegal on salty soils (especially in mangroves) and on dune fixation. Irrigated forestry research is most advanced in Niger (under an IBRD project) but findings are not yet clear, especially economic viability. Little research has been done in agroforestry.

Catinot notes that of all research areas identification and classification of vegetation is the most advanced and least of need of further work.

It should also be noted that a number of non-forestry studies undertaken in the past few years have major implications for Sahelian forestry. Among these are the following:

1. Fuelwood imports from humid countries. FAO has conducted three studies on the economic and organizational feasibility of importing wood chips or briquettes from wood surplus areas (Ivory Coast, Amazon Basin, Borneo) to meet the fuel energy needs of the Sahel's urban areas, all with negative results.

2. Improved stoves and kilns. A great deal of research and development has taken place on improved stove design, heat efficiency testing and wood savings calculations but the efficacy of this approach, particularly for widespread rural household use, is still uncertain due to problems of quality control, durability, wood savings realized, and hence user acceptance. On the other hand, improvements in traditional charcoal kilns have yielded important energy conversion savings. Fee structures have hindered adoption of these techniques.

3. Fuelwood substitutes. None of the technologies tested to date i.e. butane gas (conventional) or solar cookers and biogas systems (renewable) appear to offer much promise due to social and economic constraints.

Forestry experts therefore conclude that the Sahel's forestry problems must be addressed within the context of what can be done on the ground within the region.

In regard to the collection and organization of research documents and the circulation and sharing of research findings, Catinot argues that the situation has declined since the establishment of national research centers, and that the existing documentation centers in the Sahel virtually ignore forestry. Weber indicates that an informal, ad hoc, and irregular communications network among expatriate forestry technicians has grown up. While important, this does not address the problem of intra-African research communications. On the other hand, CILSS and the Club du Sahel are commended for their contributions toward furthering communications among the Sahelians in forestry. Jackson notes the encouraging fact that a Sahel Documentation Network (Reseau Sahelian de Documentation or RESADOC) has been established and that the Environmental Unit of the Sahel Institute has already undertaken the compilation and publishing of an inventory of forestry research.

C. Research Priorities

There is some lack of agreement among the experts on where the emphasis should be placed for future forestry research. Weber suggests that the necessary technical packages for reforestation are already in place and, therefore, of low priority. He contends the limiting factor to forestry success is not

research but addressing socio-political problems. There are also differing views as to which technical subject should be given priority as well as the relative importance of socio/economic vs. technical research.

However, given the kinds of research that have already been carried out in the Sahel, and given the need for additional research as perceived by forestry experts on the ground, it is not clear whether the topics recommended for Africa in the May/June draft of the Fuelwood Research Implementation Plan (FRIP) would be the most useful to pursue or whether modification should be made. This may be judged, perhaps, by summarizing the priorities for research recommended by European and U.S. foresters with experience in West Africa.

1. Technical Research

There appears to be a concensus that research related to natural forest management, including studies on the present productivity of natural forests and means for increasing their productivity (rotation, protection, cultivation techniques) are topics of highest priority.

Second priorities are research relating to the regeneration (both natural and artificial) of tropical forest species and research on the genetic improvement of forest species to assist reforestation programs. These are closer to the FRIP's Topic A (multipurpose fuelwood species assessments and trials) and B (Soil-site relationship of fuelwood species) since, although the FRIP topics are primarily aimed at research to aid planting programs, it is concerned with multipurpose species and therefore could have the broader application that is favored by foresters with West African experience.

Additional recommendations for technical research include, in roughly the following orders of priority, agroforestry, sand dune fixation and irrigated forestry (economic feasibility being key issue for the latter). Opinions differ on the value of research in wood technology, some arguing that this could best be done with existing facilities in Europe or the United States.

Other than that noted above, not a great deal of need for additional research was detected on FRIP topic B (soil/site relationships of fuelwood species) although Catinot notes the need for research related to salty areas, especially mangroves. In regard to Topic D, conversion and utilization, there is a broad concensus on the need for further work on fuel efficient cookstoves with growing interest in portable wood and charcoal designs for urban populations. Traditional charcoal conversion technology is reportedly already as efficient as imported kilns, once some improvements are made in production systems and management.

2. Social Research

Many Sahelian foresters believe this field has a priority equal to technical research. Much of this research would be directed toward a better understanding of the conditions and incentives necessary for

popular participation in forest and land use management which is regarded as a key to the forestry and resource management question in the Sahel. Of similar importance is the knowledge necessary on how to go about changing the policies, laws, regulations and behavior patterns of the Sahelian forestry services toward an extension-oriented (as opposed to a regulatory) approach.

Topics for social forestry research include the following:

a. Research on land and tree tenure and their implications for natural forest management.
b. Investigations on what local conditions must exist to warrant decodification of forestry regulations to provide incentives for local management.
c. Studies on what extension systems work best in what particular types of local environment. Studies on forest service incentive systems (positive and negative) and other institutional changes to encourage an extension-oriented approach.
d. Field studies to identify local perceptions as to barriers to reforestation.
e. Studies on the role of fire in Sahelian agriculture and pastoral systems, traditional fire strategies and changes that may be feasible.

3. Economic Research

There is a concensus among a number of foresters with experience in the Sahel as to the need for studies on the consumption, distribution and marketing of fuelwood and charcoal (as well as other forest products) and the effect of price fluctuations on supply and demand. Such research is necessary for determining more rational government policies on taxes, licensing, cutting fees, and the establishment of forestry revolving funds. Research has also been recommended on uses made of non-wood forest products (leaves, fruit, fiber, gums, medicinal plants) and their economic and nutritional importance.

D. Research Support Priorities

Almost without exception, observers of the Sahelian forestry research scene make the point that the place to begin for supporting forestry research is by assisting the national research institutions that already exist. This would include technical assistance, material support, the training of African researchers and funding for research costs. Problems that would need to be addressed have been described as follows: "...(a) recurrent cost ramifications, (b) the ability of financially strapped governments to both make effective use of and hold on to trained research personnel, and (c) the additional financial and human resource commitments that are implied in the development of research infrastructures i.e. demonstration programs, an extension network, etc."[1]

[1]Taylor, G. F., Forests and Forestry in the Sahel: An Issues Paper. USAID, Proceedings of Workshop on Energy, Forestry and the Environment. Vol II, p. 115. April 1982.

There is similarly a concensus that it would be wasteful for each African country to study the same subjects and that some specialization of technical research by ecological zone and a sharing of results is necessary. Both Catinot and Jackson have suggestions as to which countries might take the lead in which zones and Catinot suggests various organizational arrangements to make this work. It is fully recognized, however, that such an approach will require a cooperative spirit among the countries involved and a leadership role by the CILSS and INSAH.

The latter point leads to a third area of near-unanimity, namely, the importance of a mechanism for disseminating research findings, sharing results and serving as a repository and bibliographic center for Sahelian forestry research. Related to this would be the need for conferences, seminars and workshops on forestry research topics. It is some believe that the former functions would be a logical role for INSAH and REDSADOC while the forestry/ecology team of the CILSS might pursue the latter. A start has already begun with the publication by INSAH of a bibliography on Sahelian Forestry research.

III. Country Synopses

A. Mali

1. General Forestry Situation

Mali has an area of 1,240,000 km^2. Of the 470,000 km^2 of land with a rainfall of over 400 mm, 21,000 km^2 are under fallow; thus 335,000 km^2 are under the aegis of the forest service, either in the 'domaine forestièr classè' or the 'domaine protègè'. The natural forest area is estimated at 6 million hectares. The forests under a rainfall of less than 400 mm can be considered as virtually unproductive, as they should be preserved on environmental grounds with only dead wood being collected.

The vegetation ranges from a vast expanse of desert in the north, with open wooded steppe of Acacia tortilis subsp. raddiana on its southern fringe, to open forest with Isoberlinia and Pterocarpus in the south east.

The population was 6,309,000 at the latest census in 1976, and is expected to rise to 11,520,000 by 2000. One estimate of domestic fuelwood consumption is 3,030,000 tons in 1981 rising to 4,954,000 tons in 2000, but these figures are considered too low by some authorities. The volume equivalents of these weights are about 3,600,000 and 5,900,000 m^3 respectively. Potential production is estimated at 6,900,000 m^3 in 1976, falling to 5,035,000 m^3 in 2000, as the result of additional areas being cleared for cultivation. However these overall figures conceal considerable local

deficiencies; the regions of Segou, Mopti, Gao and Tombouctou are already deficient in fuelwood, and all other regions, with the exception of Kayes, are expected to be in deficit by the year 2000. There are also the problems of supplying the capital, Bamako, with a population of 404,000 in 1976, expected to reach 887,000 in 2000.

The area of 'forêts classées' is 11,307 km^2, to which must be added 29,454 km^2 of ex-partial game reserves, and 3,500 km^2 of National Park. However much of this areas is quasiabandoned.[1]

2. Current Donor Involvement

Canada — Kaarta rural development project includes provision for establishment of forest tree nurseries (CIDA, 1978, $1,000,000). Savannah timber project (IDRC, 1976, $200,000); irrigated plantations species and provenance trials (IDRC, 1981, $200,000).

France — Improved management and reforestation around Bamako. (1979-84, $3.3 million). Village reforestation, 500 ha, (1980-83, 2.8 million francs, about $241,000).

Germany — Afforestation in the GAO region (ongoing, 3 million DM, about $1.1 million); Afforestation in the Tombouctou region (on-going, 3 million DM, about $1.1 million); support for the Mali forest service (on-going, 4.4 million DM, about $1.6 million).

US — Village afforestation (1980-85, $500,000); forest inventory in land use project (1977-81, $200,000).

IBRD — Fuelwood and poles in livestock project (1975-80, $100,000); fuelwood and poles plantation project (1979-84, $4,500,000).

WFP — Forestry subprojects include contributions for local currency costs of IBRD projects, Sikasso Forest Project (1,000 ha of plantations); Kayes region forestry, establishment of 10 nurseries (1979-83, $3,536,000). [2]

3. Related AID Activities

Land Use Inventory (688-0205), FY '78 - 11/30/84, LOP funding, $5.2 million. Project involves (1) a reconnaisance-level (1:200,000) resource inventory and evaluation including soils, vegetation, water resources and land use, and (2) training to develop Malian capability

[1] Jackson, ibid p. 20.
[2] Gulick, 1983, ibid, pp. A-10 and A-11.

to continue and update inventory work. Major outputs include land use maps of various agroecological zones with detailed descriptions of soil and vegetative characteristics shown on each map. Descriptions include estimates of crop and range potential.

Village Reforestation, AIP (625-0937) FY '81 - 9/30/85, LOP Funding $495,000. Involves reforestation activities in two cercles of the Fifth Region, Bandiagara and Mopti. Activities include the establishment of tree nurseries in each cercle, strengthening of forest service extension capabilities, promoting pilot activities in woodlots, windbreaks, fruit and shade trees and establishing a project monitoring system in the Water and Forest Service. An in-depth evaluation has recently been completed.

Mali World Food Program, Food For Work # 2231, 1983-86, WFP cost $31.2 of which U.S. contribution (through 7/83) was $1.6 million. This is a multipurpose rural and natural resources development project which includes a forestry sub-project being implemented in areas near Bamako, Mopti and Segou. The project involves planting 1,750 ha for fuelwood, charcoal and building poles and the management and construction of firebreaks on an additional 1,700 ha

CARE Renewable Natural Resources project (938-0216) funded by AID/PVC and CARE for $2.7 million each (1981-84). Project includes reforestation and has activities in Niger, Mali, Cameroon and Uganda. The Mali forestry component involves the initiation in November 1983 of a three year reforestation project in the Fifth Region which includes village woodlots, nurseries, greenbelts, live fencing and agroforestry (see also section on Niger, below).

A Forestry Sector Development project (688-0235) is presently under consideration in USAID/Mali. Research would be included as a component of the proposed project. If it materializes it could play an important role in an AID-financed African forestry research initiative.

4. Forestry Research

Bamako is the site of the l'Institut du Sahel (INSAH) which has been established as a regional research, training and documentation center for the eight Sahelian countries grouped within the CILSS regional organization.* INSAH is noted by Catinot as the logical organization to serve as a West African center for forestry documentation and the dissemination of forestry knowledge, functions which all observers consider of vital importance and which are not being presently addressed.

*The countries are Cape Verde, Chad, Gambia, Mali, Mauritania, Niger, Senegal and Upper Volta. CILSS (Comite Permanent Inter-Etat de Lutte Contre la Secheresse Dans le Sahel) was established in 1973 to strengthen cooperation for the development of the Sahel countries in the wake of the 1968-74 drought and to encourage international assistance.

The national forestry research center is located as a division (or department) in INRZEH (Institut National de la Recherch Zootechnique, Forestiere et Hydrobiologique) which was only set up in 1981. In 1982 its annual forestry budget was estimated at 19.4 million CFA (about $45,000) of which 16.5 (about $38,500)was for personnel (25 professionals and 7 assistants) and foreign assistance at 2-3 million. As with all the other West African forestry research entities, it is not part of the forest service but plays a subordinate role within a generally impoverished research institute.

Very little forestry research has been reported on Mali. Some trials in freeing seedlings of valuable natural species begun in the 1950's have not been followed up. The Mali forestry sector analysis, prepared for the Banjul October 1982 ecology/forestry meeting of the CILSS, is credited by Weber as having the most complete and thoughtful section on the lessons learned from Malian reforestation efforts to date (although these lessons are apparently not used to guide the report's request for 20 additional forestry projects).

The major AID-financial research carried out in Mali bearing on forestry is the Land Use Inventory noted above. Jackson indicates the inventory "...should form a useful basis for general forestry planning. The scale, however, is too small to be of much value in management of individual forests."* A Swiss-financed project "Project Forestier de la Region de Sikasso" begun in 1980 included a detailed inventory of 16,000 hectares and is being used for the planning of plantations and possibly the management of natural forests.

B. Niger

1. General Forestry Situation

The area of the country is 1,267,000 km^2 with a forest area of 140,000 km^2. Of this area it is estimated that 21,000 km^2 could be relatively easily brought under management. The forest type ranges from thorn steppe at the margin of the Sahara, to open wooded savanna of the Sahelo-Sudan type, with patches of gallery forest, in the south west.

The population was 5,697,000 in 1981, and is expected to rise to 10 million by 2000. In 1981 consumption of wood fuel (mostly firewood, as charcoal is little used in Niger), was estimated at 1.5 steres per head of population or a total of 8.5 million steres, which at 240 kg per stere is equivalent to approximately 2 m tons. Annual increment from 90,000 ha of natural forest, at 0.5 steres/ha/yr, is estimated at about 1 million tons. The Forest Service of Niger estimates that by the year 2000, 2.1 million hectares of natural forest could be brought under management, with yields ranging from 1 to 3 steres/ha/yr according to the ecological type of the forest, giving a total of 4.8 million steres or 1.15 million tons. To this would be added 650,000

*Jackson, ibid. p. 22.

steres from 135,000 ha of non-irrigated plantation, and 320,000 steres from 8000 ha of irrigated plantation, giving total of 5.8 million steres, or 1.4 million tons. By this time annual requirements will have increased to 2.5 million tonnes. Thus at present demand for firewood exceeds the increment from the forests, and even if the ambitious Forest Service program is realized, there will still be a serious deficiency in 2000.

The needs for building poles are estimated at 5 to 10 percent of the needs for firewood. Split Borassus stems provide an important proportion of timber used in roofing. The area of "forets classees" is 2,118 km^2.[1].

2. Current Donor Involvement

Canada	Village woodlots, including species trials (IDRC, 1980, $2,000,000)
France	Improved management of 2700 ha of, ronoraie (1978-81, 2.5 million francs, about $215,000); reintroduction of Acacia albida in 30,800 ha in the Dosso area (1980-85, 2 million francs, about $172,000).
Germany	Technical assistance and logistic support to the National Forestry Service (on-going, 1.7 million DM, about $600,000).
US	Forestry and land use planning (1980-84, $3,500,000); small forestry component in rural development projects including improved wood stoves (1979-86).
IBRD	Fuelwood in rural development project (1975-80, $100,000); fuelwood and poles plantations (1978-83, $4,500,000).
FED	Reforestation activities (details not available at time of writing).
Switzerland	Reforestation activities (details not available at time of writing)[2].

3. Related AID Activities

Forestry and Land Use Planning, 683-0230, FY'80 - 3/86, LOP funding $3.9 million. The purpose of this project is to strengthen the planning and managerial capability of the Nigerien Forestry Service and, as a result, to assist the government's capability for comprehensive natural resource planning. Principal elements of the project are technical assistance to a technical planning unit (BTF) in the forest service, a natural resource inventory function, preparation of model sites and management plans for reserve forests, and

[1]Jackson, ibid, p. 24.
[2]Gulick 1983, ibid, pp. A-12 and A-13.

social studies necessary to encourage local participation in resource management. The project was recently evaluated and major changes in emphasis and organization recommended. Research aspects of the project are noted below.

Niamey Department Development, 683-0204, FY'81- 84, LOP funding $13.6 million. Major emphasis is on increased food production but training in reforestation is included at project's farmer/couple training centers and increased forestry extension and community forestry are cited as among project's outputs.

Niger World Food Program. Food For Work 2646, 1983-84, WFP cost, one year $2.1 million, U. S. contribution $0.8 million. Includes planting green belts, regeneration of natural vegetation, 20 kilometers of windbreaks in Bouza district, community reforestation 30 ha and 1,400 km of firebreaks.

CARE Renewable Natural Resources project (see entry for Mali). Niger component includes continuation of Maggia Valley windbreak program, Yegalalane Valley dune stabilization project, Bona Riverbank protection project. Includes planting of trees for windbreaks, woodlots and for distribution and the initiation of Tera reforestration program with approximately 500 km of windbreaks, 1,500 ha of acacia and stabilization of 45 ha of dunes.

4. Forestry Research

A CTFT (Centre Technique Forestier Tropical) station was established in Niger in 1963 to serve both Niger and Upper Volta. In 1975 it was folded into INRAN (Institut National de la Recherch Agronomique au Niger) as its Forestry Research Division. It consists of two field stations near Niamey and Dounga and five smaller test plots (points d'appuis) with a staff in 1982 of two technical and two paratechnical personnel and several service people. The French staff of two left in 1980 because of the paucity of local resources. Its annual budget in 1982 was estimated at 1.5 million CFA (about $3500) supplemented by 3-4 million in foreign assistance, mostly from Projet Forestier of the World Bank. Most of its work has been concerned with the improvement of eucalyptus, with trials of some 100 species, as well as some with acacia. In addition, studies by the French in the mid-70's investigated various treatments of natural forest.

AID's Forestry and Land Use Planning (FLUP) project was started in 1980 with a focus on indigenous species in Niger's natural forests. Technical research initiated to date includes (a) investigations on optimum timing for coppicing cuts, (b) experimenting with various sampling techniques to determine volume/area of natural vegetation for fuelwood, (c) soil erosion control research (in cooperation with INRAN), (d) direct seeding techniques.

The model sites component of the project has provided information (maps, boundary markers, vegetative typing, etc.) for the first real management plans for the reserved forests of the country. A broad ranging natural resources inventory was initiated. The social studies component of the project has undertaken assessments of options for participatory management of the Guesselbode and Tanda forests and a social survey has been initiated to assess utilization attitudes and expectations of people toward their natural resources. A study of the energy potential of native Nigerien brushland was financed by AID's Office of Energy.

Future technical research activities recommended by USAID include (a) the effects of phosphate fertilizer on indigenous species growth (in cooperation with INRAN), (b) effects of acacia windbreaks on soil conditions and crop production, (c) direct seeding trials, (d) farm level agroforestry interventions.

The FLUP evaluation team recommended that the resource inventory and the social study be scaled down and focus on the Departments of Niamey and Dosso with emphasis on the forest and foresty and brushwood reserves near urban centers. In addition, the team recommended that a studies section be established within a greatly strengthened technical planning unit which would be responsible for supervising future technical, economic and social research, cooperating with INRAN on the former. Among the tasks recommended for the studies section are (a) a wood marketing study and its implications for forestry products pricing policy, (b) an investigation of tertiary and minor forest products, (c) a study of long term planning needs (in conjunction with a MDR/FED study).

C. Senegal

1. General Forestry Situation

The area of Senegal is 201,513 km^2; of this 33,000 km^2 are forests and wooded land, 88,000 km^2 uncultivated grazing, 15,000 km^2 sylvo-pastoral reserves, and 22,000 km^2 national parks, game reserves and hunting preserves. The forests range from tree steppe in the north, to savanna woodland, open forest, and small areas of closed forest and gallery forest in the south. The area includes' 'forêts classées' covering 13,550 km^2 of which 1550 km^2 are to be managed for fuel production while 12,000 km^2 consists of national parks and unmanaged 'forêts classées' in which exploitation is legally prohibited.

The theoretical annual yield of fuelwood from exploitable forests is estimated at 7.1 million m^3, and that of saw-timber about 1.2 million m^3. The present demand for fuelwood is estimated at 4,098,000 m^3 per annum, which is less than the potential annual increment. However resources are badly distributed, and in fact there is a fuelwood deficiency everywhere except in the southern (Casamance)

and Eastern Regions of the country. These regions can therefore be regarded as the forestry "storehouse" of the country, and a capital which must be conserved; however the soils of the Eastern Region are very erodible and the forests there are likely to play a protective rather than a productive role.

Fuelwood consumption is rising with the increasing population, though there are hopes of reducing it by increased use of bottled gas, by improving stoves, and by improved methods of charcoal production. It is estimated that by 2000 AD the demand will be for about 6,540,000 m^3 roundwood equivalent.

The drought caused heavy mortality of several species, in the Acacia nilotica forests along the Senegal River, and the natural forests continue to suffer from fire, overgrazing of domestic animals, and clearance land for cultivation; thus there is little hope of natural regeneration under present conditions. It is estimated that 40,000 ha of forest are being lost each year, mainly through cultivation clearance, and this area is likely to increase through colonization projects aimed at relieving congestion in the "groundnut basin" of central and east Senegal. In addition, over-exploitation of wood for fuel and building poles is estimated to be reducing the forest resources by 1 to 2 percent yearly, especially in the mixed formations of trees and grasses which constitute 90 percent of the forest resources of the country. Thus, by the year 2000 AD it is estimated that the area of natural forest will be reduced to 112,000 km^2 if present trends continue. The area of plantations is expected to reach 30,000 ha by the end of 1982, and there is a further program of 10,000 ha annually. This will mean a total area by the year 2000 of about 100,000 ha of plantation. If yields of 5 m^3/ha/yr are obtained, and all the produce is used for fuelwood, this will produce about a million m^3 of wood per annum, or about 15 percent of the country's needs.*

2. Current Donor Involvement

France — Experimental reforestation projects using irrigation: 40 hectares (1980-82, 2.5 MF or about $561,000). Assistance to the master plan for forestry for the nation (1980-81, $438,000, contributions from both FAC and CCCE). And also, Reforestation in the Centre-Est of an area of 1,2000 hectares (three-year program, 1978-81, $1,143,000, provided by both FAC and CCCE as part of the IBRD program).

Canada — Gum arabic production and rural forestry: four years, 1980-84, C$ 332,600 (about $416,000), GOS contributing $259,700. Objective: to establish a Sahelian zone of economic forest plantations of gum arabic for the foreign market and tree forage availability to support the food needs of livestock in the dry season, especially in years of drought and scarcity. In the long run, to

*Jackson, ibid, pp. 15-16.

achieve a woods/forage system taking account of the biologic potential and ecologic conditions of the Sahel.

CIDA-supported projects include: Senegal Forest Protection: Provide forest and brush fire protection in Casamance area. Six years, 1975-81, C$ 1,600,000, about $2,000,000.

Senegal Dune Stabilization: Brake the advance of the desert along the coast of Senegal to preserve the agricultural production of the region (three years, 1980-82, C$ 900,000, about $1,100,000).

US — Bandia Fuelwood Production, Phase I (Obligated through 1981, $2.8 million, life of project costs estimated at $3,434,000). Village and community woodlots (several projects totaling $888,000 for life of projects). Secondary wood product production, rural gum arabic reforestation (obligated through 1980 and life of project, $497,000). Proposed reforestation and dune fixation project (3-year, $6.9 million project to plant 3,700 hectares of trees along NW coast funding through Food for Development Program). Well-point plantings, a component of the SODESP livestock production project. (Through 1981, forestry component only, $830,000). National plan for land use, including identification of areas for forestry (obligated in 1981, $1 million, life of project estimated at $2 million)).

World Bank/ France — This project was initiated in 1981 with $9.3 million provided by IDA, $1.8 by FAC, $3.4 by CCCE and $1.8 by Senegal. The five year project is intended to strengthen the forestry department's capability to handle more comprehensive programs and includes studies of better uses of wood and substitutes, benefits of rural afforestation and feasibility of a follow-up project, in addition to several quite large planting and other forest management programs: establishment of 2,000 ha of rain-fed plantations, experimental management of 2,000 ha of natural forests, 1,500 ha of family plantations and 1.500 ha of rural community plantations.

FAO/UNDP — Training assistance.

Switzerland — Training assistance.*

3. Related AID Programs

*Gulick, 1981, ibid, pp. 7-9.

Fuelwood Production (685-0219), FY'79-'84, LOP funding $3.4 million. The project involved the development of a 3,000 ha plantation of "fast growing" trees (Eucalyptus and Prosopis) to help meet the charcoal needs of Dakar. Other features included a central nursery, use of harvesting contracts and a series of applied research interventions. The project was evaluated in early 1983 and, on the basis of three years experience, judged to be not technically nor economically feasible due to a number of factors, principally located in too dry a climatic zone, and termination of the project in 1984 was decided upon. It was agreed, however, that the research component would be continued until 1986.

National Plan for Land Use and Development (685-0233), FY'81-'84, LOP funding $2 million. The project involves the preparation of a national land management plan through a resource inventory using satellite imagery, aerial photography and ground surveys. Technical assistance in this field is being provided to the Directorate of Land Management (Amenagement du Territoire) and to the Remote Sensing Center at the University of Dakar.

Village Woodlots Fuelwood Production (685-0247), OPG with Africare, FY'80, $211,000. Project aims at planting fuelwood trees in 40 villages.

Renewable Energy, AIP, 1980-83, LOP funding $600,000. The project is funding efforts to design, develop and disseminate fuel efficient stoves for rural utilization, improved charcoal kilns and solar fish driers. The kiln component is coordinated with a UNDP/FAO project in the Cassamance.

PL 480 Title III Program in Senegal included a major sand dune stabilization activity (funded for the equivalent of about $6 million) to assist the forest service to plant 3,700 ha on 73 km of sand dunes between St. Louis and Dakar. The FY '83 tranch of the Title III program ($7 million) will include additional support for the dune stabilization project as well as funding for the following activities: community reforestation, village woodlots, Bandia forest, improved wood stoves and improved charcoal production.

World Food Program, Senegal 2236, Conservation and Development of Natural Vegetation, total funding $6.1 million of which U.S. contribution as of 7/83 was $624,000. Program funds planting programs involving Acacia albida (200 ha) windbreaks (1,000), village woodlots (700), nursery cultivation (2,000), dune fixation (90) and soil regeneration (600).

World Food Program, Senegal 2230, Integrated Development of Sine Saloum, 1975-83, U.S. contribution $624,000. The project includes windbreaks, eucalyptus tree planting, an estimated 10,000 ha of woodlots, soil replenishment, and the construction of village seed storage.

4. Forestry Research

Although suffering from acute financial and staffing problems, the forestry research situation in Senegal is by comparison an improvement over those in the other three countries included in this report. Starting with CTFT in 1966, forestry research became Senegalized in 1974 with the establishment of CNRF (Centre National de la Researche Forestiere) as a part of ISRA (l'Institut nationalized des Recherchs Agricoles) which in turn is a part of the government's research organization SRST (Secretariat d'Etat a la Recherche Scientifique et Technique) having quasi-ministerial status. CNRF is located in the Hann suburb of Dakar and has minor facilities at Ziguinchor (Casamance) and Bandia.

ISRA's budget runs at about 60 million CFA/year (about $140,000), most of it for salaries, administrative and for follow up research, while the proportion available for new research has fallen steadily (9% in 1980/81). France finances the salaries of the CTFT researchers stationed at CNRF in accordance with a French/Senegalese agreement while France and other donors help on additional projects -- the total of such assistance amounting to another 60 million. As of 1980/81 CTFT was providing four researchers while the CNRF staff consisted of six technical persons (including an expatriate) and three paratechnicians. Seven training grants had been awarded between 1977 and 1980.

A major assessment of the Senegalese forestry sector was carried out in 1981-82 (Plan Directeur de Developpement Forestier) with French funding and technical assistance; the assessment includes an overview of the research situation. The overview document* cites the two major aims of forestry research in Senegal as being protection and production. The first includes anti-desertification, erosion control and rural land management including the maintenance of forest stands in mixed agro/pastoral systems. The second includes meeting the needs of the population for wood for energy and other purposes. These broad aims are amplified into three national priorities which, in turn, are oriented regionally in accordance with conditions in Senegal's seven ecological systems and detailed in Senegal's 1979-84 research plan.

Major forestry research projects pursued with help from the CTFT include (1) study of reforestation in the south/center (Sine-Saloum), (2) genetic and production improvement of Eucalyptus in the Sudano/Sahel regions, (3) improvement of natural and periurban forests in the Thies region and (4) a study of reforestation and natural forests in the lower Casamance. Programs being assisted by additional external financing include (1) irrigated forest plantations along the Senegal valley (France), (2) changes in Sahelian forestry ecology (France), (3) symbiotic influences in the establishment, growth and drought resistance of woody species in the dryland tropics (France), and (4) research related to the Bandia forest project (U.S.).

*Senegal. n.d. Plan Directeur de Developpement Forestier-Diagnostic: Les Recherches Forestieres. Secretariat d'Etat aux Eaux et Forets.

A considerable amount of technical data is being generated by the foregoing research activities. Its usefulness and the extent to which it is being utilized for forestry development is less easy to evaluate. As with other Sahelian forestry research institutions, CNRF is not structurally part of the forest service, although efforts have been made to improve communications and planning between SRST and the forest and water service. The research volume of the Plan Directeur implies that good results have been obtained from research on the following topics: (1) increased knowledge of native species, (2) selection of species for reforestation, (3) nursery techniques, (4) methods of dune fixation, (5) improvement of natural and periurban forests in the Thies and Casamance regions. On the other hand, Jackson refers to the meagerness of research results in Senegal on natural forests and the insufficient use of those available.

The evaluation of the AID-financed Fuelwood Production project noted that the research carried out over the preceding two years had produced results of importance. Topics included (1) stump production techniques (refined and applied elsewhere), (2) chemical weeding trials, (3) intercropping with food crops (feasibility shown in initial years), (4) windbreak trials, (5) dynamics of soil and water components in exotic eucalyptus and indigenous natural forest, (6) species trials (initiated at eight sites through out the country). The evaluation recommended that research continue until the end of 1986, particularly on the last two topics. In addition, the report noted that the project itself had been a learning experience which showed the importance of training in equipment operation and maintenance, workshop organization and operation, plantation manpower organization, record keeping and analysis, financial analysis and management, and budgeting.

D. Upper Volta

1. General Forestry Situation

The area of the country is 274,000 km^2, of which 93,200 km^2 is 'available' forest (excluding national parks where exploitation is forbidden, and also excluding fallows and parkland of Vietellaria and Parkia). This forest is estimated to have a standing volume of 228 million m^3 of timber.

The forests range from Acacia-dominated formations in the Sahel zone, to open forests with Isoberlinia and patches of gallery forest, in the Sudano-Guinea zone.

The annual requirements for fuelwood are estimated at 6.25 million m^2 for a population of 6.5 million. The population is expected to be about 9.6 million in 2000, with a fuelwood consumption of 9.285,000 m^2.

By 2000 it is estimated that the forest area will be reduced by 10,000 km^2, and forest fallow by 45,000 km^2, leaving about 50,000 km^2 of forest for firewood production, against the 65,000 km^2 needed, at the high yield of 1.5 m^3/ha/yr, to meet anticipated fuelwood demands. These countrywide figures, however, conceal considerable variations from place to place, and it is considered that transport of considerable quantities of fuelwood from the south to the north of the country will eventually be needed.

Consumption of sawn timber is about 20,000 m^3 sawn volume, of which 18,000 m^3 are imported from the Ivory Coast, the rest being produced at small sawmills at Banfora. 'Forêts classées' cover 7,270 km^2 and there are about 125 km^2 of plantations.*

2. Current Donor Involvement

France — France is financing the establishment of four regional bases of reforestation, with special attention to distribution of nursery seedlings to rural areas. (A four-year program, costing 2.5 MF or about $516,000); a research project in which local and of eucalyptus will be crossed and multiplied for a seedling production program (2 years, $740,000, financed jointly by FAC and CCCE); eucalyptus plantations in the Wayen forests 7,000 hectares (a five year program, 1977-82, 14 MF or about $3,140,000, financed by CCCE).

Germany — Germany has a very substantial afforestation program underway, including introduction of improved wood stove (1974-1981, estimated cost, $5.5 million). The project includes the establishment of 5,000 hectares in six years in the forest reserve area of Gonse, 25 kilometers from Ouagadougou.

Canada — Canada has completed an overall appraisal of the forestry sector and key issues in the Sahel, including a separate study on Upper Volta. Canada has completed pre-project planning for several new forestry projects. Among them are three Bois de Village projects, a forest and wildlife reserve project and decentralized seedling services in 20 sub-prefectures.

US — The U. S. has a major training project and several small village level pilot projects underway: aid to the Dinderesso Training Center for lower level forestry agents, and the development of a model management plan for the

*Jackson, ibid, pp 22-23.

national forest, in 6,000 hectares adjoining the training center (5 years, 1979-1983, life of project $4,469,000). Small pilot projects include planting windbreaks and micro-catchment constructions, fuel conserving wood stoves, village nursery and woodlot projects, in which Peace Corps volunteers and local villagers are cooperating. A community forestry project is financed as a component of a larger integrated rural development project at Seguenega (Overall project, life of project, $5 million, forestry $170,000).

World Bank The World Bank initiated in 1980 a comprehensive first phase, five year, $14.5 million forestry project with the primary objective of strengthening an expanded forestry administration. Local professional and technical staff in Ouagadougou would be increased from 2 to 35, including 20 senior professionals. In addition, the project will establish 1,600 ha of rainfed plantations, conduct management experiments on 1,000 ha of natural forests, test methods of maintenance of 1,650 ha of rainfed plantations and establish 325 ha of rural woodlots. It includes a number of special studies and training.

FAO/UNDP Technical assistance to the Water and Forest Service

Netherlands, Switzerland, European Development Fund — Plantations and village woodlots.

World Council of Churches, Catholic Relief Service, OXFAM, Africare — Social forestry; village woodlots.*

3. Related AID Activities

Forestry Education and Development, 686-0235, FY'79-'84, LOP funding $6 million. The project is providing assistance to the Dinderesso Training Center of the Voltaic forestry service near Bobo-Dioulasso with the objective of giving junior level forestry agents forestry skills and an extension-oriented approach to their jobs. A second objective is to prepare a management plan for an adjoining national forest (using resource inventory maps, vegetative analyses, etc.) to serve as a model for natural forest management. The project was evaluated in early 1983 and found to be conceptually sound but having problems in implementation and adequate support and cooperation from the Voltaics, including the provision of counterparts. A redesign exercise was completed. The Mission is also considering (a) the inclusion of applied research in the redesign and (b) a series of studies in collaboration with CNRST (see below) to define the personnel and funding requirements for forestry research to be included in a possible new Forestry Resource Management project.

*Gulick, 1981, ibid, pp. 12-14.

Remote Sensing/West Africa (698-0420), LOP $4.3 million. Project involves AID participation with France and Canada in establishing a remote sensing training and user assistance center at Ouagadougou. Project has been operational since 1978 and as of 1/1/82 107 students trained and a number of West African agencies and institutions have been provided data and resource interpretations including forest inventories and the monitoring of ecological change.

4. Forestry Research

As of mid-1982 the forestry research situation was organizationally in flux with CTFT/Upper Volta carrying out most activities as part of IRBET (Institut de Recherche en Biologie et Ecologie Tropicales) and some, mostly in natural forests, under the sponsorship of CNRST (Centre National de la Recherche Scientique et Technique), both being within the Ministry of Higher Education. At that time Voltaic research staffing consisted of one professional and one para professional. Financing from (about $52,500) the national budget amounted to 22.5 million CFA annually, supplemented by 40 million (about $93,000) from foreign assistance. Research stations are located at Gonse and Dinderesso.

CTFT research in Upper Volta has emphasized the following topics (1) species trials on eucalypts, especially for fuelwood plantations, (2) species trials on other exotics, (3) research on local species (this effort has gained in importance recently as interest has grown in natural resource management) and (4) regeneration of natural tree cover. In addition, an FAO/UNDP project has among its objectives the evaluation of forest resources through the use of Landsat images and ground samples in order to identify potentially productive areas.

List of Acronyms Used

AID - Agency for International Development

AIP - Accelerated Impact Project

CCCE - Caisse Centrale de Cooperation Economique

CIDA - Canadian International Development Agency

CILSS - Comite Permanent Inter-etats de Lutle Contre la Secheresse an Sahel

CNRF - Centre Nationale de la Recherche Forestiere (Senegal)

CNRST - Centre National de la Recheche Scientique et Technique

CTFT - Centre Technique Forestier Tropical

FAC - Fonds d'Aide et Cooperation (France)

FAO - Food and Agriculture Organization (of the United Nations)

FED - Fonds Europeen de Developpement

FRIP - Fuelwood Research Implementation Plan

FSP - Forestry Support Program

IBRD - International Bank for Reconstruction and Development (World Bank)

IDA - International Development Association

IDRC - International Development Research Cooperation (Canada)

INRAN - Institut National de la Recherche Agronomique au Niger

INRZEH - Institut National de la Recherche Zootechnique, Forestiere et Hydrobiologique

INSAH - Institut du Sahel

ISRA - Institut Senegalais de Recherche Agricoles

LOP - Life of Project

RESADOC - Reseau Sahelian de Documentation

SRST - Secretariat d'Etat a la Recherche Scientific et Technique (Senegal)

UNDP - United Nations Development Program

WFP - World Food Program