CONSULTANTS IN DEVELOPMENT
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MIDPOINT EVALUATION

CHAD REFORESTATION PROJECT

Prepared for

CARE, Inc.

April, 1978

Fred R. Weber
Maryanne Dulansey

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BACKGROUND

Purpose and Methodology

CARE, with the assistance of Consultants in Development, has gathered data and analyzed it with the purpose of monitoring the progress of the project at its 20-month point, in terms of planned/achieved performance in the context of operating conditions and constraints. CARE has taken advantage of this to include a broader look by

1. Evaluating the impact of project activity on farmer and Forest Service attitudes and behavior regarding improved land use and increased food production;

2. Recommending ways to improve project performance and impact;

3. Identifying and commenting on the feasibility of new project interventions, by broadening the scope of the present project and/or applying a similar approach in other parts of the Sahel;

4. Relating this project to the current knowledge (research and field experience) about Acacia albida.

The main purposes of this look at the project may be restated in simple terms. CARE wishes to improve the implementation and impact of this project, and to consider the implications of this experience for future development programs in Chad and in other areas of the Sahel.

The methodology of looking at project progress, impact, and broader program implications has been, to th e extent possible, collaborative. Consultants in Development held extensive discussions with CARE headquarters and field personnel to develop the approach. The field work was done by a team of CARE project technicians, Chadian Forest Service personnel, and Consultants in Development. Discussions were held with the major parties involved, the farmers themselves, Chad national and local government personnel (technical/ administrative and traditional), USAID and Peace Corps. Consultations on the broader implications were held with CILSS (Comite Permanent Interetats de Lutte contre la Secheresse dans le Sahel), and Forest Service personnel in Niger, Upper Volta, and Senegal. Contact was made on research questions with the University of California at Riverside, the National Academy of Sciences, and the U.S. Department of Agriculture. The draft report is available for review by headquarters and field personnel.

Briefly, the methodology consisted of field visits to nurseries and planting sites, talks with farmers, representatives of the local power structure, meetings with government representatives, both in the field and on ministry levels; technical discussions with a literature review, and analysis of data. More details may be found in Appendix A,Methodology and Field Schedule.

Project History and Description

CARE's presence in Chad dates back to its 1974 response to the Sahel Drought Emergency, providing food and transport for

distribution of the food. Food for Work projects were begun, and a number of clinics and schools were built. These projects were broadened to encompass the rehabilitation of agriculture, particularly the food production activities of small farmers. Food, both P.L. 480 and private donations through CARE, was made available together with hand tools, to those participating in a range of activities, including planting of trees, which contribute to the improvement of the critical natural resource situation.

CARE and AID funds have been invested in this three-year project, the purpose of which is "to establish the Acacia albida tree on farmers' fields as a recognized low-cost improved technology and as a means of increasing the farmers' capacity to improve his (sic) agricultural output and to establish the concept of cultivating firewood as a domestic crop with concommitant protection of the environment." (Program Description, Grant No. AID/afr-G-1251) The project has been running longer, but AID Grant supports runs from July 1, 1976 through June 30, 1979.

Project activities are listed in the program description as follows:

IMPLEMENTATION

" For the planting of Acacia and Neem trees, the Grantee will be responsible+ for establishing and operating nurseries in the following locations in Chad: Bongor, Guelengdeng, Mai Lao,

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+ Chad Forest Service contends they should be in charge.

Mandelia, Massakory, Masseguet,Moussoro and Mogroum. The Grantee's field representatives will be responsible for the following duties:

1. Orientation/training of Government of Chad (GOC) counterpart forestry personnel in the objectives, approach, and methodology of this project which is conceptually new to the Forestry Service.

2. Selection of farmers in collaboration with the counterparts to include an evaluation of their potential to participate in the project on an individual basis.

3. Training of farmers to include development and execution of a methodology appropriate to meet the requirements of stimulating interest and effectively imparting knowledge to a traditional, rural illiterate population.

4. Preparation of a field manual to set forth all pertinent aspects of the project activity and to serve as an operational document for expanded and/or similar activites.

5. Preparation of educational materials in improved agricultural practices to include such items as posters, film strips and radio broadcasts.

6. Direction and supervision of all operational elements of the project to include such specific items and steps as:

a. Administration and reporting;

b. Local procurement of material and equipment;

c. Arranging and coordinating logistics and transportation;

d. Village and field surveys and subsequent surveillance of field operations on an on-going basis;

e. Establishment of nursery operations to include preparation of access roads, construction of work sheds and huts, seed gathering, separation and storage, fence construction, pot bed lay out, picket treatment, potting soil preparation, pot filling, provision of water supply, nursery watering, scarification, seeding, thinning, reseeding, weeding, shading, pruning, and protection;

f. Transfer of seedlings to sites to include transport of seedlings to villages and field perimeters and watering;

g. The technicians will be responsible for setting up 8 nurseries (2 in interim quarter and 2 each in Fiscal Years 77-79) and the planting of Acacia, Commiphora and Neem trees in 3,500 hectares of land. Approximately 2,000 rural farmers and 10,500 dependents will be project beneficiaries; and

h. Field work to include planting-out and erection of fencing stakes, cleaning tree area and fencing, treatment of plants and fencing, and the continued surveillance and counseling.

7. Internal evaluation of project activities."

Please see Appendix B for the Logical Framework for this project.

This evaluation report is a background, preparatory document for CARE's use in complying with the grant reporting requirement:

REPORTS

"At the end of 20 months the Grantee shall conduct a project evaluation and submit the evaluation report in 15 copies to CDO/Chad. This report shall indicate but not be limited to the following:

a. Actual as compared to projected progress toward achieving the project purpose as stated in Logical Framework Matrix.

b. Financial Report of project activities.

c. The establishment and operation of four nurseries for Acacia, Commiphora, and Neem trees.

d. Whether small farmers from areas where nurseries have been established are actively partic'pating in project, i.e planting, tending and protecting trees.

At the completion of services under this Grant, the Grantee shall submit a final report in fifteen (15) copies to the CDO/Chad. The final report shall set forth, in detail, the results of the project."

(Material on Project Activities and Reporting Requirements is taken from (1), See Bibliography, Appendix C.

Current Knowledge and Concepts about Acacia albida

Literature

An extensive amount of literature available on acacias covers different parts of the world (e.g., Australia, Africa and Israel). Perhaps the most comprehensive abstract is that by G.E. Wickens (7). (Refer to Bibliography, Appendix C). He has also written another document in English which provides an excellent

introduction to the subject (27). Most work on acacias in the Sahel has been done by French researchers and foresters; the principal works are cited in the bibliography: (6), (8), (10), (11), (13), (24), (25). French and African research institutes studying Acacia albida include: the Agricultural Research Station at Bambey, Senegal; CNRF (Centre National de Recherche Forestiere) Dakar/Hann, Senegal; ORSTOM (Office de la Recherche Scientifique et Technique Outre-Mer) Paris, France; and above all others, CTFT (Centre Technique Forestier Tropical), Paris, France.

Literature on extensive field trials carried out by British and Nigerian foresters (Fishwick, Jackson, and others) is available through Ahmadu Bello University in Zaria, Nigeria. Relatively little has been written on the subject by United States sources. The Agency for International Development has a paper on file (5) and some background information has been compiled by others (14), (15), and (16). A revised version of the unpublished Notes on Acacia albida by Fred R. Weber is found in Appendix D . The Bibliography contains references to works pertinent to this project. For additional references see the texts cited, the Office of Arid Land Studies/University of Arizona, or the Africa Section of the Northwestern University Library. The CARE office in Ndjamena has a collection of most of the principal references cited here.

Description

Acacia albida (Del.) is a large tree, growing as tall as 15 m with a large spread-out crown. The bark is dull grey, fissured and scaly. Branchlets are white; spines are thick, white, straight and point downward. Leaves are grey-green 3-10 pairs pinnules and 6-23 pairs leaflets. Acacia albida flowers with creamy white blossoms. Seeds are dark brown inside orange pods which are 8-15 cm long. Acacia albida is highly valued in conservation efforts and much appreciated by local people. It is the only species which loses its leaves during the rainy season; therefore, farming under these trees is not only possible but profitable.

Uses

- Good soil conservation tree (can lead to higher yields of crops planted underneath).
- Pods good food for cattle and other domestic animals .
- Branches useful for fences.
- Leaves used for animal feed.
- Wood for implements and carving
- Bark contains tannin (though another acacia: nilotica is a more popular source for natural tanning material)

Special Notes

- Introduction of Acacia albida is considered important and worthwile by many farmers, a fact which helps gain acceptance of a project using this tree.

- Acacia albida trees have reached heights of 2 to 4 m after only three and four years of growth (Niger and Upper Volta).

- How much Acacia albida does enrich the ground around the tree and what factors are involved has not yet been fully investigated.

- Young trees are hard to protect against stray grazing pressure. It is usually necessary to protect these trees for 5-8 years depending upon area and site conditions. The young branches and leaves are enjoyed by animals. Also young trees in farm fields are small and hard to see and may be lost during hoeing if not marked.

- Acacia albida until recently was able to regenerate naturally (seeds are eaten by and passed through animals). Now land and grazing pressures have increased so much that the young trees are being destroyed by browsing animals and clearing operations.

- The benefits of planting Acacia albida, in terms of initial investment, are not yet fully defined. Thus, it is difficult to fully justify a tree planting project to donor agencies. However, it is more costly to reduce grazing to a level where a tree can regenerate than to raise plants in nurseries, set them out in the fields, and protect them individually.

The Wickens abstract (7) indicated that Acacia albida is found all over Africa: from the Nile Valley to Southern Africa, and from Senegal to Ethiopia.The author reports two fruiting

seasons in some areas. In the very dry part of the desert, Acacia albida is restricted to the bottom of the wadi or kori, that is, to alluvial plains where occasional flooding occurs.

Wickens indicates that Acacia albida protects the soil and provides forage for animals in the form of leaves as well as pods. 1/ Porteres (8) and Bourke (9) specifically point to the enriching influence of Acacia albida in farm fields. They and others attribute increased soil fertility in farm fields to the accumulation of leaves and other organic matter beneath the trees.

Studies in various parts of Africa and the Near East are consistent as to the beneficial influence of Acacia albida on the soil. Papers by Aloni on Acacia albida in Israel (26) and Karshon in Jordan(22) make nearly identical statements, similar to experience reported in East and West Africa, (24) and (10).

Field Experience, Chad

In general, the basic nursery and planting techniques are now well established. Manuals (3) and (4) exist on the subject and are used by project technicians. Nursery, planting and protection techniques have been worked out in sufficient detail to ensure the successful and effective establishment of Acacia

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1/ 1 kg of Acacia albida pods have a forage value (V.F. as defined in (23) of 0.98.

albida in farm fields in the entire project area or others where similar physical and social conditions exist.

There are, however, a number of technical questions which the existing literature does not satisfactorily address: removal of pots on planting; direct seeding vs. planted stock; artificial vs. natural reproduction; vegetative propagation; effects on the water table. Additional information on these questions would increase the efficiency of the project and shed additional light on the extent and nature of Acacia albida's usefulness in farm fields. See the section Data on Current Status for further discussion.

Effects of Acacia Albida

While it was not the purpose of this evaluation to gather additional insight into soil fertility-crop production relations the following observations explain field viewpoints.

A significant amount of nitrogen fixation of Acacia albida (a member of the leguminous family of plants) is not readily apparent from observations in nursery beds or during the first years the trees are planted in the field. Nodulation in young trees is not pronounced. It may well be that other factors are responsible for the more vigorous growth, healthier color of leaves, and greater number and better quality of heads observed in millet and sorghum grown under Acacia albida. These factors are listed here in apparent order of importance, and

further discussed in Appendix D :

Animal manure. Animals are attracted to Acacia albida trees during the hot season for two reasons:

Acacia albida produces pods of excellent feed value (0.98) and palatability to animals in the early part of the dry season. Animals therefore congregate under the trees looking for freshly fallen fruit. To hasten the process, herders knock down pods with long poles (See Photos 4, 5) for their animals.

Acacia albida are often the largest trees found in the area. They produce a steady and dense shade during the hot part of the year. As a result, animals spend long periods of time resting beneath the trees. More manure therefore accumulates beneath Acacia albida than out in the open or under other trees or bushes. This manure quite likely has a beneficial influence on soil fertility, especially in the topsoil where it is more important to farm crops as opposed to natural vegetation .

Leaves. Acacia albida drops its leaves annually, at the beginning of the rainy season . Organic material is thus added to the soil, in the form of leaf litter which, as it decomposes and gets worked into the soil also contributes to fertility and water retention capability of the soil.

Birds. A certain amount of organic matter is also provided by birds nesting in Acacia albida trees. Since Acacia

albida provides excellent habitat especially for larger birds, their droppings also contribute to the enrichment of the soil.

Micro climatic improvement. The physical environment is dry and hot, too hostile for many plants unless protected. Further North, for example, it can easily be observed that grasses grow only under the protection of bushes and trees (e.g. Acacia raddiana). Similarly, the shade provided by Acacia albida in its mid and advanced age has a protective effect, resulting in increased biologic activities.

Acacia albida is well accepted in Chad by many farmers, as discussed in the following section. Appreciation by those who live in a hostile climate and work with minimum resources may well be the most important indicator of value.

STATUS OF PROJECT
(Monitoring of Project Progress)

Targeted Outputs

The project plan (See Appendix B for Log Frame) lists the following outputs which are to be achieved by the end of the project (June 30, 1979):

1) 3,500 hectares planted in Acacia albida, 10m x 10m, or 350,000 trees field planted;
2) 122,500 meters of Commiphora fencing planted with 735,000 trees;
3) 105,000 meters of Neem trees for windbreaks and firewood involving 52,500 trees field planted and producing;
4) 3,500 hectares planted producing a total of 1,312 additional tons of food (50% gain);
5) 1,725 farmers reached.

Monitoring Methods

In accordance with the agreement between Consultants in Development and CARE, CARE/Chad provided the basic facts and figures on:

-- number of trees planted and surviving

-- number of surface areas "worked"

-- number of villages and farmers involved

The data was spot-checked during the site visits, and found to be realistic. Successive results are listed in the Progress Reports, which are compiled each trimester (4).

Data on Current Status

The first trees planted on a pilot basis are now three years old. (Note: AID funding was made available a year after project inception in 1975). The 1975 summer planting was 5,000 trees on 50 hectares.

In regard to (1) above (3,500 hectares/350,000 Acacia albida trees), Table I recaps the situation to date. For location of "zones" see Map 1, Appendix E. It should be noted that although the targeted outputs specify only the number of trees planted and the amount of hectares planted by the end of the project, June 30, 1979, this evaluation also discusses the number of trees surviving.

TABLE 1

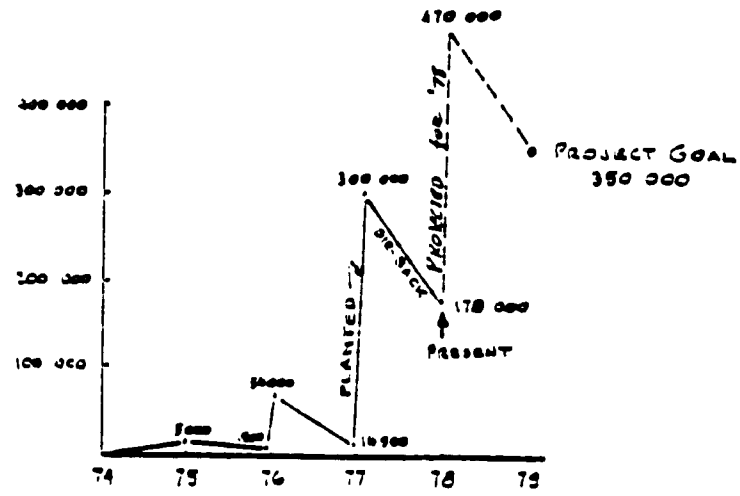
ACACIA ALBIDA PLANTED (LIVING)
AT THE END OF RESPECTIVE PLANTING SEASON
BY ZONES

Season	Zone A		Zone B		North		All Zones	
	Planted	Living	Planted	Living	Planted	Living	Planted	Living
1975	5,000	(1,500)	0	(0)	0	(0)	5,000	(1,500)
1976	52,500	(13,000)	0	(0)	0	(0)	52,500	(13,000)
1977	100,000	(45,000)	144,000	(100,000)	49,000	(15,000)	293,000	(161,000)
Total	157,500	(59,500)	144,000	(100,000)	49,000	(15,000)	350,500	(175,500)

Survival counts in Table 1 were taken immediately after each planting, and have been revised over time. While some trees appeared dead but sebsequently resprouted, others died later on.

The project managers decided to plant more Acacia albida than originally planned in order to allow for these losses. Thus, at the time of this 20-month evaluation, 350,500 trees have been planted (equalling the output targeted by June 30, 1979). The total number of live trees at the time of evaluation was estimated to be 178,000, or about 60% of the final goal of 350,000. Figure 1 shows the cumulative progression of planting-attrition-planting.

Figure 1. Number of Acacia albida Trees Planted and Surviving

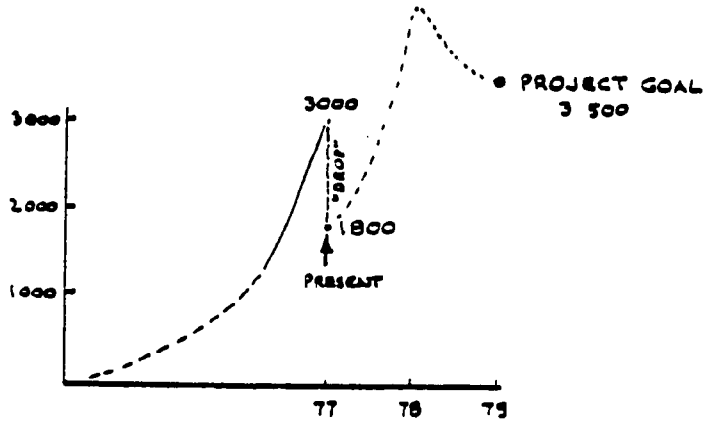


Since some of the unsuccessful or sub-marginal areas planted are being eliminated as experimental losses, the general statement can be made that the over-all,effective survival rate presently is 70%.

With regard to hectares planted to Acacia albida , approximately 56% of the goal (3,500 ha) has been reached. At the time of

this evaluation 178,000 2-3 year old trees have been planted which at an estimated average density of 90 per hectare, represents a total of about 2,000 hectares.

Figure 2. Number of Hectares Planted to A. albida



The 10m by 10m spacing used provides 100 trees per hectare at the start. At maturity, 40 to 60 trees per hectare is considered optimum. Therefore a certain loss can be accepted during the years during which the stands are becoming established.

Progress toward target (2), 122,500 meters of commiphora, fencing planted with 735,000 trees is less spectacular than for Acacia albida, which is receiving the major emphasis in this project. To date 45,000 meters have been planted. Most of the live fencing planted is Parkinsonia, although other species were also used (Prosopis, Ziziphus, Balanites).

Table 2 shows meters of live fencing planted and living at the end of the 1976 and 1977 planting seasons, while Figure 3 graphs the meters planted against meters projected.

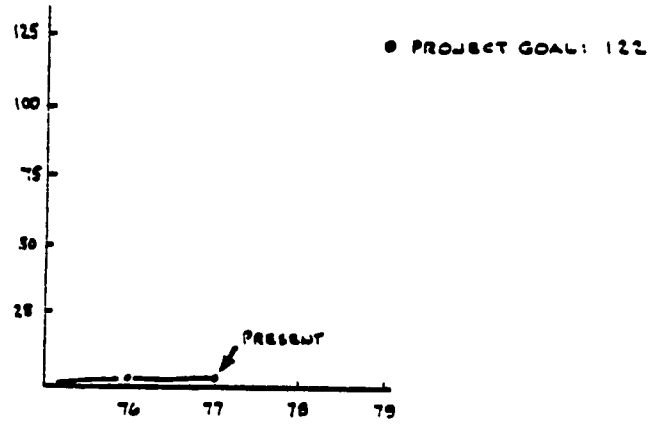
TABLE 2

LIVE FENCING PLANTED (LIVING) AT THE END OF THE RESPECTIVE PLANTING SEASON

Season	Meters Planted	Meters Living
1976	15,000	1,000
1977	30,000	2,900
Total	45,000	3,900

Figure 3

Meters of Live Fencing Planted



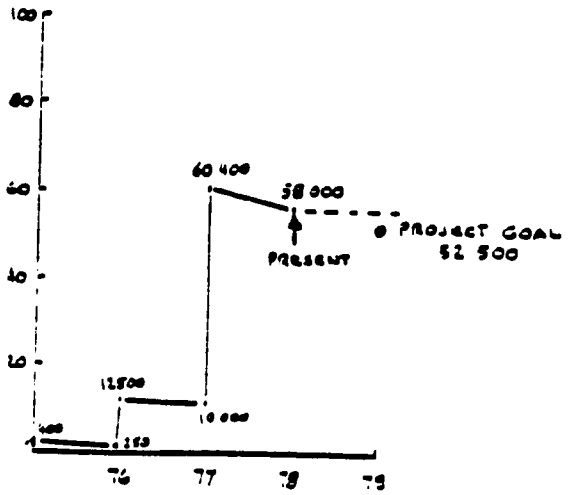
Planting of trees for windbreaks and woodlots for firewood was targeted at 105,000 meters of Neem trees involving 52,500 trees field planted and producing (3). Table 3 gives data on Neem, Eucalyptus, fruit trees planted as windbreaks and woodlots. Note that current living trees exceed the end of the project goal. Figure 4 graphs the progress.

TABLE 3

TREES FOR WIND BREAKS (FIPT) WOODLOTS
PLANTED (LIVING) AT THE END OF SEASON

Season		Planted	Living
1975	All areas	400	(250)
1976		12,200	(10,000)
1977		50,400	(48,000)
Total		62,000	(58,250)

Figure 4
Trees for Windbreaks and Woodlots
Living/Projected



Targeted output (4) has not been dealt with in the monitoring of project progress, as it is more properly a goal level indicator, which requires time for the trees to mature before it will be operable.

The number of farmers projected for participation in the project, 1,725, has been exceeded. A total of approximately 3,000 farmers so far have been reached, of which 1,850 were considered participants in the project at the time of this evaluation. These are heads of household; thus household members estimated at 10 per household, are also affected by the project in that they participate in the work and in the Food for Work incentive.

TECHNICAL QUESTIONS

The following points have been discussed at length with project forestry technicians as well as with Chad Forest Service personnel, and measures to improve, streamline and reduce certain costs are described here.

Planting Techniques

When the trees are planted, should all the plastic pots be removed or not? The Chadians and their expatriate experts adamantly advocate the removal of the entire plastic nursery shell once the tree isplanted, but experience in Nigeria and Niger has shown that nursery mix-the earth inside the pot which contains the root system of the young tree-cannot be properly quality-controlled.

A visit by the project technicians to Northern Nigeria is suggested as a means of comparing methods.

The quality of mix is often a question of available soil, add-on, screens, water, etc. There is a risk that when the plastic wall is removed, the mix will be disturbed by the removal operation, especially if not done with care, to such an extent that the roots are exposed and/or damaged. Survival is noticeably lower than in areas where the pot wall is imbedded and left at the planting site with the tree.

Obviously the bottom of the pot must be removed so that the roots can grow downward without being obstructed. This is normally done by cutting off a half inch "cookie" with a sharp knife. For further details on planting techniques, see (14).

This issue cannot be resolved by proclaiming one method is correct and the other is not. Without proper care in planting and quality control of the pot mix, the soil surrounding the roots will be damaged. An obvious alternative to leaving the pot wall intact and in place is to be more cautious and careful during the planting operation. This may require more supervision and fewer trees planted.

Quality of Plastic Bags

A large percentage of the plastic bags used during the first phases of the project appeared to be on inferior quality; the above-ground portion becomes brittle after the first few months of use in the nurseries. Severe cracking and splitting subsequently is encountered during the transport phase.

In addition, many pots, when shaken or tapped against the ground in order to achieve a minimal desired amount of compaction of the fresly filled nursery-mix, crack or split along the bottom seams.

It was thought that perhaps their wall thickness was less than pots used in other areas. Three samples were analysed (as reported in Appendix F) but it was found that wall thickness is not responsible for the unsatisfactory performance when

compared to samples of tubing used elsewhere (Niger, source: Abidjan).

We are unable to identify the causes of these failures at this time. Nevertheless it is obvious that the materials do not perform as well as similar material used elsewhere. In spite of the uncertainties involved, the following recommendations will minimize the extent of the problem:

1) Consider purchasing plastic bags in the U.S. under tighter quality control specifications and airshipping them to Chad.

Alternate:

Purchase of bags in Abidjan, using a proven source of generally satisfactory performance in other Sahelian countries.

2) Place a berm of dirt against the outside lines of pot beds in order to minimize exposure to open air of the pots along the outside rows.

3) Locate the necessary quality-control specifications, test procedures, to ensure delivery of material that is satisfactory for the purpose.

Direct Seeding vs. Planted Stock

This point is seriously contended. Obviously plastic pot stock has a definite advantage over freshly germinated trees sown in place. Plants which had a three to four months headstart in a nursery can grow with more vigor and survice a series of dry spells better than much smaller seedlings which are only a few weeks old.

However, though planting trees by direct seeding is a lot cheaper than using planted stock, the problems are more difficult. During the first year especially, direct seeded trees are less well established and are difficult to protect.

Often these points are debated with great perseverance. It seems that much valuable time could be saved by simply trying different techniques, and comparing field results. Often actual field experience answers the questions quite fully and to the satisfaction of everybody. Whether to direct seed Parkinsonia acculeata or not seems well suited for this kind of field-test approach.

Direct seeding should be tried wherever possible to reduce tree-unit cost. Small-scale trials should be conducted with live fence and woodlot species also to determine the extent to which direct seeding might replace nursery stock and thereby eliminate transport to planting sites.

Water Table and Hydrologic Balance

Except for the "North" (See Map 4), water tables in the entire project area are relatively high. Local wells seldom are more than 10 meters deep. In addition, project sites are located in the plains between the Chari and Logone, the area's two principal rivers. Ground water tables here fluctuate in accordance with the general hydrologic regime of these two major river systems.

Trees, whether in closed stands or as individuals, will to some degree affect the water table but where well supplied ground water reservoirs are available, they will hardly be affected by the growing of Acacia albida in farm fields.

In addition, before present land clearing and cutting activities took their toll, vegetation was more profuse and thus more water was consumed by bushes and trees. Large (native) Acacia albida, such as the ones encountered on the West bank of the Logone in Cameroon, prove that farming operations are not adversely affected by the dominant presence of this species.

As has been shown in Northern Nigeria, Acacia albida roots can easily reach depths of 30 feet within the first three or four year's growth whereas field crops such as millet and sorghum draw their moisture from levels much closer to the surface (infiltrated rainwater). Thus competition for water between larger trees (including Acacia albida) and field crops is not as direct as it appears at first.

In addition, the benefit from larger trees in terms of improved micro climate in their vicinity may more than offset a water table that may be somewhat lower, especially when the first "free" water occurs at levels far below those that can be reached by the root systems of agricultural crops.

Dr. Felker, in his preliminary report to AID on the value of Acacia albida (5) has raised the question of the trees

influence on the water table. Several of the sites visited seem suitable to studies on this subject and AID could use this project to conduct studies/research in this field, if found necessary.

Vegetative Reproduction

The same report also raises the need for a practical method to establish Acacia albida vegetatively (that is from cuttings rather than seeds). This would have some advantage in that it would produce a more uniform growing material. CARE project technicians should have the opportunity to experiment in order to find practical, relatively simple propagation techniques that could be adapted to standard field operations.

A partial practical answer to making planting material more uniform and one that certainly would not require additional inputs from the outside, would be to increase efforts to collect high quality seeds from specifically selected, well formed, vigorous and tall trees. Though this would not result in genetically uniform plants, past experience elsewhere has shown that by selecting seeds carefully, a high degree of uniformity can be obtained.

Artificial vs. Natural Reproduction

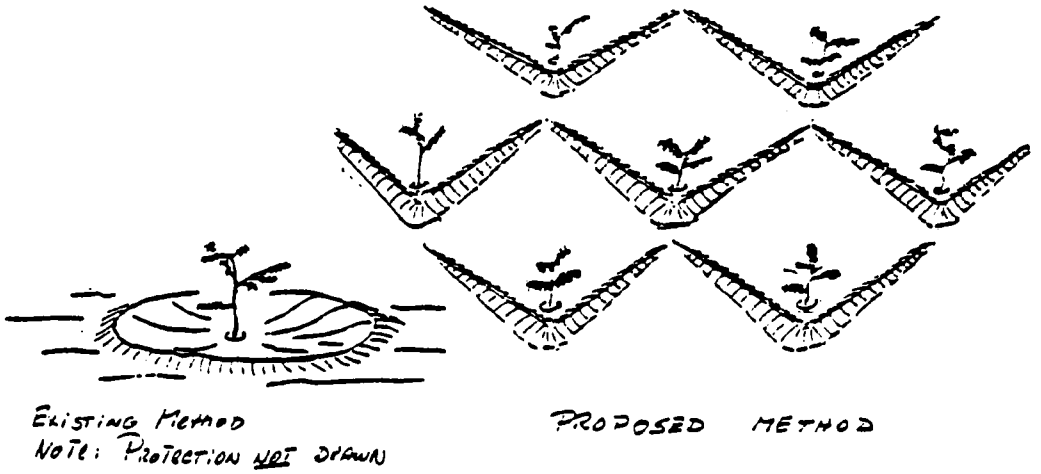
Where adequate natural reproduction occurs it does not make sense to plant nursery stock of the same species unless, of course, specific varieties or stock of other special characteristics are needed which is not the case here.

Any fields selected for the project should be carefully examined for evidence of existing natural regeneration of Acacia albida. Where possible, at appropriate densities and alignment, existing A. albida should be marked and protected. A good case can be made that where natural reproduction is found, rather than producing trees in a nursery and hauling them to the planting site (often the major cost factor), more effort could go into protecting what is naturally available on-site.

Rainwater Harvesting

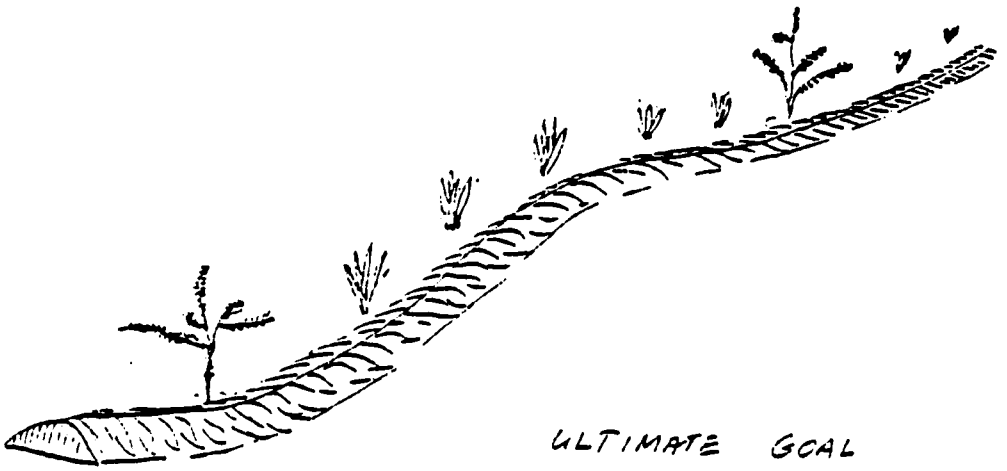
A small basin is now formed around each planted tree as a method to catch rainwater. Such "microcatchments" are being used in various parts of the world with success. Other methods to collect rainwater are possible and should be tried. Many farm fields have sufficient slope so that small herringbone dikes could extend the perimeter of the "watersheds" in order to trap more rain water yet. Figure 5 shows existing and proposed methods.

Figure 5. Rainwater Harvesting Methods, Existing and Proposed



In addition, these herringbone dikes could, in due time and after several yearly evolutions, be "flattened" so they ultimately could be run together. Actual contour berms would result. This in turn would introduce a new concept--contour farming--which would not only conserve water for the planted tree but also further contribute to increasing crop yields, the ultimate goal of the project.

Figure 6. Rainwater Harvesting Methods, Ultimate Goal: Contour Berm



Tree Growth Rates

Generally, tree growth rates seem quite satisfactory, especially as compared to similar operations elsewhere in the Sahel. Poor planting stock reduces both "take" and growth rate as compared with healthy well cared-for nursery stock.

Proper nursery care will assure good planting stock and growth rates will be satisfactory and relatively constant.

Growth rates can also be increased by improving the quality of the potting mix. This will require(in addition to close supervision) greater cost for better mix ingredients, more extensive mix preparation, more deliberate watering, and more careful transportation.

Containerized Transportation of Plants

Transporting plastic pot stock is expensive. Each pot has to be handled, stacked in the truck, unloaded and re-stacked. It would be most advantageous to develop some kind of a metal (or other lasting,strong material) rack containing 12 or 15 trees each. These crates or frames should be constructed so that they could be stacked (at least two high) to make transportation more efficient. The individual pots would be handled in a similar manner as soft drink or beer bottles which are moved, stacked and re-deposited. Pots could be carried to the field in these crates or "frames". Developing such containers would provide quite a breakthrough in handling ease would reduce transport costs, eventually throughout the entire Sahel.

Choice of Species for Live Fencing

So far the only species used for live fencing has been Parkinsonia acculeata. Rapid growth, easy pruning are the main advantages. However, the species does not have much value other than as physical barrier. Some branches when trimmed can be used to reinforce the hedge, plugging the holes between plants. But since no secondary products are derived from Parkinsonia it would be interesting to see if other species could also be used which would provide some additional values: firewood, forage, fruit, thorn branches for fencing, or whatever. It would be ideal if a species could be found that would produce the thorn branches necessary to place around the Acacia albida for continued protection. A list of possible other species was discussed by the experts in the field. See Photo 14, Appendix G.

Protection Against Animals and Diseases

Causes of trees loss were analysed with the following results:

Domestic animals 25%

Sparcity of rainfall 25%

Poor planting techniques..... 20%
(includes poor planting stock)

Elephant damage 15%

Caterpillars 10%

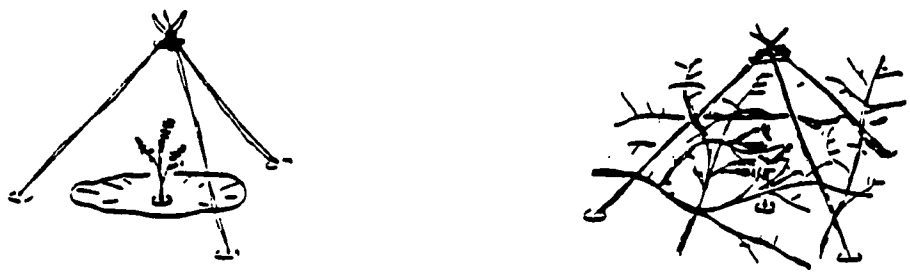
Fires 5%

Termites ..... trace

Elephants

The project area contains a considerable elephant population; therefore trees have to be protected individually, rather than fencing entire farm fields. Several methods to protect the trees have been used throughout the project site and interesting comparisons can be made of each method, but the system of a three-legged pyramid of sticks against which thorn branches are placed (and should be held together) seems to constitute the more effective way of using what is available. See Figure 7 and Photos 7 through 11.

Figure 7
Protection of A. albida with
Local Materials: Stick Pyramid
with Thorn Branches



Locally available materials are used and preferred over imported metal stakes and wire. Pyramids should be tall enough to accommodate one year's growth or more.

Elephants use young Acacia albidas to scratch their foreheads with obviously disastrous results. As natural vegetation dissapears, the more elephants seem to rely on Acacia albida to meet their needs. It is impossible to protect a young tree against this kind of intervention. Different forms of repellents should be tried; perhaps one can be found that repulses even elephants, but hope for success is tempered by the fact that not much is known about this subject and the size of the animals involved is rather overwhelming.

Grazing Animals

The protective methods discussed earlier, using local materials, seem to be both practical and effective, provided the "teepee" can be solidly built so that it is relatively maintenance-free. It could be made somewhat larger in order to provide more than one season's protection. This may encourage the local farmers some by saving effort and labor.

Vigilance against free-roaming domestic animals could be increased, by the affected farmers as well as the local administrative offices, in order to create a different sense of responsibility on the part of the animal owners. Laws exist which protect planted trees. But basic, traditional values are involved which change only slowly and not without causing friction and discontent among farmers, transientherders and government agencies as well.

Termites

Chemical treatment is possible and effective, but it is relatively costly and outside the economic reach of the individual farmer.

Termites are attracted to the dead plant material used for protection. Branches, sticks, and also mulch around the young trees create a food source for termites and indeed entice them to also attack the plants that are being protected or supported in this way.

One consolation exists. Often termites attack only plants that are stunned, diseased or otherwise handicapped. What is seen as "termite damage", often is the result of other causes of plant damage; the termintes merely finish the job.

Termites continue to be a serious problem. Existing approaches and techniques should be continued while experimenting with other lower-cost methods to bring termite control within the reach of farmers.

Caterpillars

Chemical protection is used. In the long run it seems that there are years in which caterpillar attacks are more pronounced than in others. The over-all problem is not that great except for the Northern areas where, as experience in Niger has shown, caterpillars can kill up to 70% of the planted trees in one year.

North - South

There is a definite drop in the meaningful "good" the project can do for farmers as one travels from the relatively fertile South to the northern areas near Lake Chad. The closer toward the real Sahel one gets (limited along its Southern Boundary by the 500 mm mean annual rainfall line), the more seasonal "farming" becomes. Large areas are under sub-marginal cultivation and

"farmers" are transient, working their fields during the three or four months when rains are falling but moving South after harvest with their livestock in search of other pasture areas.

Under these circumstances, it is extremely difficult to expect seasonal farmers to stay during the dry months to protect their trees when grazing pressure is greatest. Unfortunately, it is exactly this grazing pressure that poses the greatest threat to the young trees. It is during this off-season when they need attention to be able to survive. What is more, it is also this type of grazing pressure that increases as one moves North.

Therefore, there is a cut-off line North of which efforts to introduce Acacia albida simply become prohibitively expensive and at the same time less successful. This is unfortunate because the tree's beneficial influence is more urgently needed as one penetrates into the drier zones of the Sahel.

But, North of the cut-off line, other tree planting activities, primarily for soil conservation purposes, could and should be undertaken. General pasture conditions should be improved and trees especially appreciated for forage and protection values, as well as firewood production, could be introduced and protected. Perhaps this could be done in connection with a herder participation scheme although such efforts of course must address major and basic conceptual and attitudinal problems on the part of the local people that are responsible for the

deteriorating trends that exist today. If it is difficult working with farmers, cooperation from herders is even more elusive to solicit.

From this discussion, the project sites north of Massaguet, namely Bacham, Massakory, Tourba (which time did not permit to visit during the evaluation) are simply, in the opinion of Consultants in Development, too far North to be viable for the introduction of Acacia Albida. Conservation and restoration efforts should be directed more toward tree forage and conservation species.

In the other direction, Acacia albida planting efforts also begin to lose their essential value South of the 800 mm line, at least where soil conservation and fertility are the main purposes. General soil productivity as well as re-growth potential farther South is such that other conservation and protection measures bring faster and more effective results for example, animal traction, green manure, cover crops, crop rotation. Though Acacia albida trees are appreciated in areas far enough South to permit cultivation of commercial cotton, the primary project goals "to increase food production and protection of the soil" obviously are no longer of the same importance as farther North. A visit to Fianga to observe the Acacia albida component of the FAC project confirmed this view. There, in relatively intensive farm operations, Acacia albida are introduced while other, more appropriate measures could bring similar results. The Acacia albida planting efforts have been rather unsuccessful because adequate protection was not provided.

Therefore, there remains a "belt" in which Acacia albida efforts should be concentrated. Although locating the exact position of a cut-off line is somewhat arbitrary the following parameters help in setting the limit:

Mean annual rainfall (generally not lower than 400 mm)

Land use patterns (generally not farther North than where at least some "farmers" remain in place during 12 months of the year.

It is possible to apply the same criteria to Acacia albida projects in other parts of the Sahel. In fact, Acacia albida projects in other Sahelian countries presently fall within the limits described above.

FINDINGS

Conclusions of the Mid-Point Evaluation

The report required by AID under the grant at the 20-month point is to address the following four points:

1. actual as compared to projected progress toward achieving the project purpose as stated in the Logical Framework Matrix.
2. Financial Report of project activities.
3. The establishment and operation of four nurseries each for Acacia, Commiphora and Neem trees.
4. Whether small farmers from areas where nurseries have been established are actively participating in project, i.e. planting, tending and protecting trees.

The project purpose as stated in the Log Frame is to:

-- establish the Acacia albida tree as a recognized low-cost technology which will produce increased food supply for subsistence farmers;

-- establish the concept of cultivating firewood as a domestic crop with concomitant protection of the environment.

It is respectfully suggested that a mid-point evaluation is more usefully centered on the monitoring of project activites (targeted outputs) than on their effect in reaching the End of Project Status.

The CARE Acacia albida project is an outstanding success in terms of progress toward the projected output goals, as outlined in the previous section. With the exception of live fencing, actual progress is well ahead of target. Only the quantity of live fencing planted thus far is lagging behind the amounts specified in the log frame. This, however, under the circumstances, is not a great deficiency since the available species (mainly Parkinsonia) has not contributed to any great degree in providing a completely satisfactory answer to the problem. Furthermore, the concept of a live fence is not that well known to the farmers. Therefore, though pilot efforts should continue in order to demonstrate what is possible with live fencing, widespread enthusiastic acceptance can be expected to lag several years.

Now that planting targets have been achieved, more attention must be given to survival rates and protection of the trees, at least until they are five years old. Although targets did not specify the number of trees surviving, this is obviously an important factor in the success of the project. Based on the experience to date, it is most likely that survival rates can be kept above those of the past. Losses not exceeding the order of

fifteen percent can be realistically expected, in which case only an additional 160,000 trees will have to be planted in order to reach the goal of 350,000 trees planted and living at the end of the project. Since past experience indicated that young trees need continued protection, it is desirable to plant as many of the remaining trees as possible during the coming (1978) planting season. In that way, the trees will have a better chance of surviving. Consultants in Development recommends the continuation of project support for protection activities until the trees are five years old, and can make it on their own.

Financial reporting has been left to CARE, but it can be noted that as of October 1977 a total of approximately $1,500,000 has been spent, in the form of funds, food and tools given as incentives, and other inputs. This cost averages out at about $500 per hectare planted. The cost accounting system should be improved so that accurate unit costs of tree planting and protection activities can be recorded.

Nine nurseries have been established. Field visits were made to nurseries at Koundoul, Mailao, Mogroum, Guelengdeng, Moulkou, Bongor and Massaguet. All of these sites are now operating satisfactorily. Seven field nurseries have been established specifically for this project. They amply demonstrate the advantages of saving transport cost and time by descentralizing their location. Cheaper and better stock is provided for planting sites, and a number of local centers for operations and on-site training of agency personnel and farmers are thus created.

There has been a high degree of participation by farmers in the project. Interest has been such that project managers are able to select those who show the greatest willingness to cooperate, and to retain those who better results. While it is planned to eliminate some areas, farmers and/or fields from the project, it should be noted that factors other than willingness have been affecting project success. There have been problems with bad soil, excessive and continual termite damage. Trees were planted in areas used for stock drive ways It does not make good sense to continue against such physical odds. More farmers than targeted for the final project goal have already been involved, and the quality of their participation is improving. In one area, project managers face problems due to the wide dispersal of participating farmers, but the policy of accepting any farmer willing to plant has resulted in some outstanding cooperation. In this case it was found that the best participants were those farmers located farthest from the road.

Generally, acceptance of Acacia albida has been high; farmers will not plant any other trees in their fields. Local people also value shade and environmental improvement trees, fruit trees, then woodlots and finally windbreaks. The poorest acceptance has been of live fencing, as discussed above.

It should be pointed out here that virtually all work carried out by local farmers in the execution of the project is paid for

with food rations, both P. L. 480 and CARE foodstuffs. There are seven operations for which standard rations are given: field preparation; planting; fencing; hoeing and cleaning; cutting and carrying thorns for protection; attaching thorns; fire cleaning and fence repair. In addition, tools had been provided to some participants. Food provided in this manner is called encouragement in French, and has the connotation of an incentive. The rations in this project provide a substantial portion of the family food requirements.

The rationale for food "incentives" is based on the fact that food supplies available to the farm population are at such critically low levels that people, as much as they would like to work, simply cannot do so unless the necessary extra energy is made available in one form or another. This conflicts with the concept of fundamental self help. The case can be made that farmers are simply being paid for planting and protecting trees. The implication of this view is that these operations will cease the moment the project comes to an end. Another case can be argued. It is, that under the circumstances of severe lack of resources, an activity which will yield benefits at a (distant) future time cannot compete successfully for priority with other (more immediate) concerns. Eating comes first; if the food needs of the family can be guaranteed, other activities can then be considered.

As it stands now, food incentives are not given in such a way as to encourage and reward increased cooperation and performance. If possible, the system should be revised to permit such distribution.

Other Considerations

The Training Function

In this project, as under similar conditions in the Sahel, outside donors sometimes assume at the onset that the host country agents know little, if anything. More often than not this turns out to be false, and becomes a source of embarrassment. The reason for this apparent lack of knowledge is simply that without a project, host country agents do not have the necessary means to apply their knowledge and exercise their skills---no way to get around, no money for labor, no equipment, no tools, no direction for their work. Once the money, equipment, vehicles and the authorization to begin have been obtained, they generally display good, solid attitudes as well as some rather significant know-how, dexterity, initiative and commitments. They get a job done under often difficult conditions and against rather formidable odds. A failure on the part of outside donors to appreciate this is counterproductive to close and fruitful cooperation between the donor and the host country agency.

The same holds true for the "target population". Farmers might be hard pressed to grow enough to eat from one season to the next; the country's resources (and its rains) may be marginal at best to guarantee everyone fulfillment of basic human needs. Existence and "poverty" levels in the project villages may be among the lowest in the world. Yet that does not mean that

"the people" do not know how to plant a tree or how to poke some sticks in the ground and lay some thorn branches around them for protection against the goats. Then why are'nt they doing it on their own? Because it costs money to raise trees in nurseries and to haul them to the fields. Besides it takes some basic energy for someone to go out, collect sticks and branches and then place them in accordance with specified (common sense) procedures. If people are half-starved, perhaps sick, and it is 120 degrees in the shade, it should not be surprising that they do not undertake these efforts with vigor, confidence in the future and a healthy, basic belief that hard work will pay off in the long run.

Basic activities such as building a fence, filling plastic pots with dirt, planting a tree in a farm field are, by their nature, not so complicated that a great deal of academic, conceptual "learning" is necessary, especially as the "students" know the country, the farmers, and the existing land use practices far better than someone fresh off the plane. Where new "technologies"are tried out and found feasible, the basic approach simply consists of the "do like this/don't do like this" model.

Thus, it is somewhat presumptuous to speak of training. It is rather a situation in which all concerned learn together. When extensive outside financing is available, newer, perhaps more expensive material and equipment can be "deployed" in which case the host country personnel face the task of learning how to

use them effectively. Introduction of modern nursery and transplanting techniques during the course of this project has been a challenge to the Chadian technicians involved. They observed and learned to use the newly available resources simply by imitating the pilot efforts made by the CARE project technicians. During their frequent visits to the nursery and job sites, they answer questions, talk with people, and encourage them to try new ideas on a small scale and to compare them with older, established methods. This is the "methodology" used to help the local people find out themselves, by experience, what works better and what new procedures can be applied practically in social and cultural context.

Peace Corps volunteers assigned to the project learn alongside their Chadian friends and counterparts to do the job better, faster, more effectively. It is much more a learning-together scene than it is "transfer of technology", technical assistance as believed to be needed by outsiders who are not aware of how much intrinsic know-how already exists in the field.

Field Manual

CID reviewed the field manual prepared in English by CARE technicians. It is quite detailed and gives a series of step-by-step how-to instructions covering all aspects of Acacia albida introduction into farm fields in accordance with the terms of the project. Also contains many practical points covering secondary tree planting and reforestation operations pertaining

to shade trees, establishment of woodlots and live fencing. As such it meets basic needs and will, once it is available in French, provide a useful training and field text for any agent involved in these types of operations. Before it is translated, it should be revised. It is too long, and requires technical editing. In some instances it is based on "zero" knowledge of the local situation, often covering aspects that Forest Service agents, even in their formative years, are already familiar with.

Consultants in Development has had experience with a similar work (14) and wishes to observe that such editing is time-consuming, and is a specialized job. Should CARE wish assistance in any of the tasks necessary to finalizing and translating the manual, CID would be available.

Since similar physical conditions in other Sahelian countries do not vary that much from this project site, such a graining and field manual could easily be used in other countries where similar activities are planned. In fact, it can well become a basic text for these types of operations for CILSS projects dealing with tree planting in general and introduction of A. albida in particular.

Educational Materials

CARE technicians have prepared a series of 8 mm sound films documenting the project activities. They show the fields, and the technicians talking with farmers. Once edited, these will be suitable for both the local population and outside donors. Other educational materials such as pamphlets, or any type of written

handouts are of lesser importance since the great majority of affected or prospective farmers do not yet read.

Operational Management

Project implementation gives a well-rounded, effective appearance. The nurseries are established in accordance with practical, modern principles. Water supplies (often the critical factor in running successful nurseries in the Sahel) are well thought-out and efficiently designed. Most nurseries are large enough to allow expansion. Of particular interest was the wise and practical use of sofar unused terrain or areas that during some portions of the year are empty: vegetable gardens and some fruit trees are neatly dove-tailed into the primary Acacia albida operations. This multi-purpose use of facilities is of terrific demonstration value. It shows how given resources can be used to supply a multitude of needs to the people no matter which technical service may nominally be in charge.

Host Country Personnel

A total of 12 Chadians working for the Forest Service are assigned practically full time to this project. Their participation marks an important involvement of the Chad Forest Service in the project's activity. All except two (lower level) agents are mid-level service personnel who during the last two years have proven that they are "field directed" and more than willing to work with the small farmers.

The attitude of middle and lower level Forest Service Personnel working in the project is impressive. They are dedicated, hard working, hustling and straight-shooting people who take their work seriously, and are trying to do as good a job as the situation permits. They provide hope for the future in the face of generally discouraging conditions.

On the other hand, certain specific problems are encountered by CARE's project executing staff in their relations with two of the top level Forestry Agents. Both the service chief as well as his officer in charge of reforestation come down hard on a number of administrative and contractual as well as technical details.

It is clear that those responsible in GOG simply are not completely aware of the pertinent agreement language. However, it seems that gray areas exist in the basic written agreements, which now can and need to be talked over and defined.

The reason why this has not been done before is because the CARE project technicians, carrying out their day to day production oriented activities, can not-- in addition to their assigned operational tasks--play the role of representing "project management" at the same time. The CARE director should/ will have to (himself or through his assistant) begin a series of issue-clearing discussions with the members of the GOC involved. This includes not only personnel in the Ministry of Rural Development but also includes the Ministry of Foreign Affairs and the Ministry of Planning. Someone inside the GOC (above the

Forest Chief level) must be made to understand the intent of the basic agreement and issue the necessary directions to the Forest Service about what is involved and--above all--that a problem exists that must be straightened out. AID must be supportive of this redefinition and facilitate any changes that may be needed in the Operational Program Grant as a result.

Recommendations

The following are ways in which the on-going project might be improved. Some are already on the way to implementation; with others, it is not clear how they can be implemented at this point. Obviously the recommendations are a notation for the participants in the project as to where the project is, and where it might go. It remains to them to shape and implement these ideas. The number in parentheses refers to the page on which the topic is discussed.

1) Raise and plant 300,000 Acacia albida. This is planned for 1978, and would more than suffice to meet the project goal. More importantly, this means additional surfaces (approximately 1500 hectares) can be added to the project effort. The remaining plants would be used to fill in; some losses are included in this figure. (16)

2) Drop up to 1,200 hectares of sub-marginal fields from the project. (16)

3) Raise and plant 150,000 other trees, with emphasis on Parkinsonia. This is also planned for 1978, and will step up the live fencing portion of the project, the only component that is behind schedule. Hopefully this will establish as much as 70 km of live fencing, which should, if well distributed, provide adequate pilot and demonstration areas of live fencing for the local people. No further live fencing should be undertaken unless requested by the people. It will most likely take some time for the idea to "catch on," and when it does, it will be relatively easy to provide farmers with seed or planting stock. (17 and 38)

4) Shift project emphasis from planting to protection; formulate a long-term protection strategy; explore the possibility of continuing project support for protection activities until the trees are five years old. (39)

5) Experiment with:

a) planting techniques: how much, if any, portion of plastic pots should be removed; (22)

b) vegetative propagation; (26)

c) species other than Parkinsonia for live fencing;(30)

d) lower cost termite control methods; (33)

e) repellants for domestic animals and for elephants(32)

6) Gather data on direct seeding, so it can be compared for cost effectiveness against the planting of nursery stock. (24)

7) Buy better plastic bags; check specifications for quality control and testing; minimize exposure to air. (23)

8) Develop rack for pot transport. (29)

9) Improve pot mix where practical to give more "structure," increase the water retention capacity, improve surface to prevent crusting. (29)

10) Check fields for natural A. albida reproduction and plant accordingly; include naturally occuring A. albida in the protection scheme. (27)

11) Continue using local materials for protection; consider making "teepees" larger to accommodate a full year's growth or more. (31)

12) Introduce herringbone dikes in conjunction with microcatchments; develop the concept with farmers, moving toward contour farming. (27)

13) Increase vigilance and control of roaming animals by farmers and local authorities; step up educational program. (32)

14) Maintain awareness of optimum North-South zone for A. albida; select other reforestation and production/conservation strategies outside the zone. (33-6)

15) Technicians should visit A. albida sites in Northern Nigeria to observe work and compare experiences. (22)

16) Review and refine field manual; translate into French, omitting basics superfluous for African technicians. (45)

17) Keep better track of the cost of different operations in terms of CFA, outside and local inputs. (39)

13) Explore the feasibility of giving incentives in such a way that increased cooperation and performance are rewarded. (41)

19) Facilitate communications between CARE and Forest Service personnel at the highest level. (47-8)

20) Revise the Logical Framework Matrix or CARE internal planning documents to improve their effectiveness as on-going monitoring and evaluation tools. (38)

APPENDIX

APPENDIX A

Methodology

In the United States

Developed purposes of the evaluation with CARE

Contacted sources of data about Acacia albida: University of California/ Riverside, U.S. Department of Agriculture, National Academy of Sciences, Agency for International Development.

Read basic documents in CARE N.Y. file.

Developed basic field methodology.

In Chad

Reviewed and revised methodology with CARE/Chad; modified proposed trip schedule and visit sites to give more attention to non-field aspects of the project within the time limit (10 days)

Reviewed CARE/Chad project records and reference library

Reviewed CARE/Chad field manual and educational material for this project.

Interviewed CARE administrative personnel, project technicians, monitors; Forest Service personnel at all levels, as well as two expatriate experts; USAID and American Embassy personnel; Peace Corps staff and volunteers; local authorities: village chiefs, sultans, sous-prefets; villagers/project participants (both men and women). Made field visits to:

Koundoul Nursery	Koundoul Village project	
	Kalam-Kalam project	
Mailao nursery	Kournari project	Kournari warehouse
	Ali-Garga	
Mogroum nursery	Mogroum project	Garden project/nursery
Guelengdeng nursery	Guelengdeng project	Fianga FAC project
Moulkou nursery		
Bongor nursery	Bongor project	
	Matassi project	
	Koutmoussiri Pacha proj.	Mandelai/sultan
Massaguet nursery	Naala project	
1976 planting site	Am-guiffel	

Note: site visits served purposes of seeing representative project operations, verifying monitoring data, discussing operational and technical problems with project CARE and Forest Service staff; interviewing farmers and local authorities for their perception of project impact.

Photographs taken. (See Appendix G)
Discussed findings with CARE/Chad staff, Peace Corps personnel.

In other Sahelian countries:

Contacts were made with Forest Service directorates in Niger, Upper Volta and Senegal; the CILSS Environmental/Ecology Work Group and CILSS Non-Governmental Organization representative; and CTFT personnel in Upper Volta and Niger.

Field Schedule

The following itinerary of the evaluation field trips has been prepared by Mike McGahuey, CARE/Chad.

3 Feb, Friday

Met with Radcliff, Kirmse, and McGahuey

Met with Baba Diguera, Dimkinbayel, and McGahuey

Ate McGahueys with Kirmse

Reception at Radcliffs; Dimkimbayel, Parkan, Trann, Cavanaugh, Judy Collins, Mrs. Angie Kazaks, Radcliffs, Jack Morris, Rudi and Danna Griego, Tony Dalsimar (DCM) and McGahueys.

4 Feb., Saturday

Weber, Kirmse, and McGahuey depart from N'djmena.

Koundoul Nursery: visited with Nantour, a forestry agent who is Nursery supervisor.

Koundoul Village; visisted with David, Forestry agent who is responsible for village of Koundoul Acacia albida project. Also went with chef du village to visit fields.

Kalam-Kalam: Arrival of Dimkimbayel. Met by Timothe, project monitor for village. Visited fields and talked with farmers.

Kournari-visisted fields and observed circular enclosures(3). Met with Boubacar, magasinier who explained distribution of tools and food. Saw a food magasin.

Ali-Garga. Saw results of trees having been planted in plastic pots.

Visited Mai Lao nursery and 1975 plantings; observed elephant damage and discussed using animal repellants.

Returned to Ndjamena and visited with Volunteers.

5 Feb., Sunday

Breakfast at McGahueys with Kirmse and Volunteers Blaine, Robertson, George Branson.

Met with Inger Hvoslip (USAID) about Women in Development.

6 Feb., Monday

Depart from Ndjamena with Weber, Kirmse, Dimkimbayel, Blaine, Robertson and McGahuey.

Mogroun and Guelengdeng. Spoke with 20 farmers in both places.
Saw nurseries in Mogroum and Guelengdeng.
Garden project in Mogroup nursery.
Live fencing with Parkinsonia with ONDR irrigation project in Guelengdeng.
Two Acacia albida trees that were protected by the village chief near Guelengdeng. 15-20 years old.
Jack Morris at night. Bruce Robinson, PCV Guelengdeng.

7 Feb., Tuesday

Guelengdeng, Moulkou, Bongor, Fianga. Saw nursery in Moulkou.
Saw fields in Moulkou, 10 farmers. Night in Fianga.
Conversation with Sous Prefet of Fianga.

8 Feb., Wednesday

Fianga, Bongor, Guelengdeng, Mogroum. Saw the FAC Acacia albida project in Fianga with Forest Agent Dacsalla. Saw fields of A. albida trees and nursery in Bongor. David Blaine, PCV Bongor.
Conversation with Sous Prefet of Bongor; Sultan of Mogroum.

9 Feb., Thursday

Departed from Mogroum for zone Madiago.

Visited Matassi with chef du village, monitor Boukari, and the representant du Sultan.

Saw three fields of different quality.

9 Feb., Thursday (cont.)

Talked with the two chefs du village of Matassi, the representant du Sultan and six villagers.

Visited the forestry agent Pascal at Loumia. Went with Pascal to see fields in village of Joutmoussiri Pacha. Talked with chef du village.

Went to Mai-Lao nursery to talk with Chris.

Continued to Mandelai for discussion with Sultan.

Kirmse, Weber, and McGahuey met in afternoon at office for discussion.

Kirmse, Weber, Collins, and McGahueys to dinner.

10 Feb., Friday

Departed for Massaguet with Weber, Kirmse, Dimkimbayel and McGahuey. Visisted fields at Naala and Am-guiffel. Talked to project monitor and agent of Forest Service (Abdermane) at Naala. Take rate something around 60%. Noted that this areacommunal and not individual.

Visited nursery site in Massaguet with Bouba, the agent assigned to the project. Noted the water depth. Visited the 1976 planting site and discussed possiblity of diversion of barriers with guards instead of individual fences or four-sided fence. Visited the Secretary of Chef de PIA as the Chef de PIA was in N'Djamena. Returned to N'Djamena. Ate at Kirmses.

Met with Syan in late p.m.

Dinner at Jack Morris.

11 Feb., Saturday

N'Djamena. Meeting with Baba Diguera, Dimkimbayel, Parkan, Trann, Weber, and Cavenaugh about Acacia albida project.

Worked at the office the entire day.

Lunch with Bill Booth, Peace Corps Director.

Dinner at McGahuey's.

Other Countries

On the way back from N'Djamena stopped in Niger, Upper Volta and Senegal. Contacts in each country were made with the respective directors of Forest Services. In addition while in Ougadougou, I did have a chance to talk to people of CILSS's environmental/ecology work group (Stebler, Winterbottom, De Smets) as well as the CILSS representative of ONG's, a Nigerien, Abba Moussa Issoufou, who apparently is familiar with CARE's operation in Niger, having been involved in Niger's GAP organization .

Niger: Abdou Daoure, Assistant Chief Forest Service. Chief was out of country.

Moussa Salley (former head Acacia albida programs, now director of AID's Niamey Productivity Project.

Upper Volta:

J. Barry, Chief Upper Volta Forest Service, in addition Forest Service field personnel in Ouga and Bobo area.

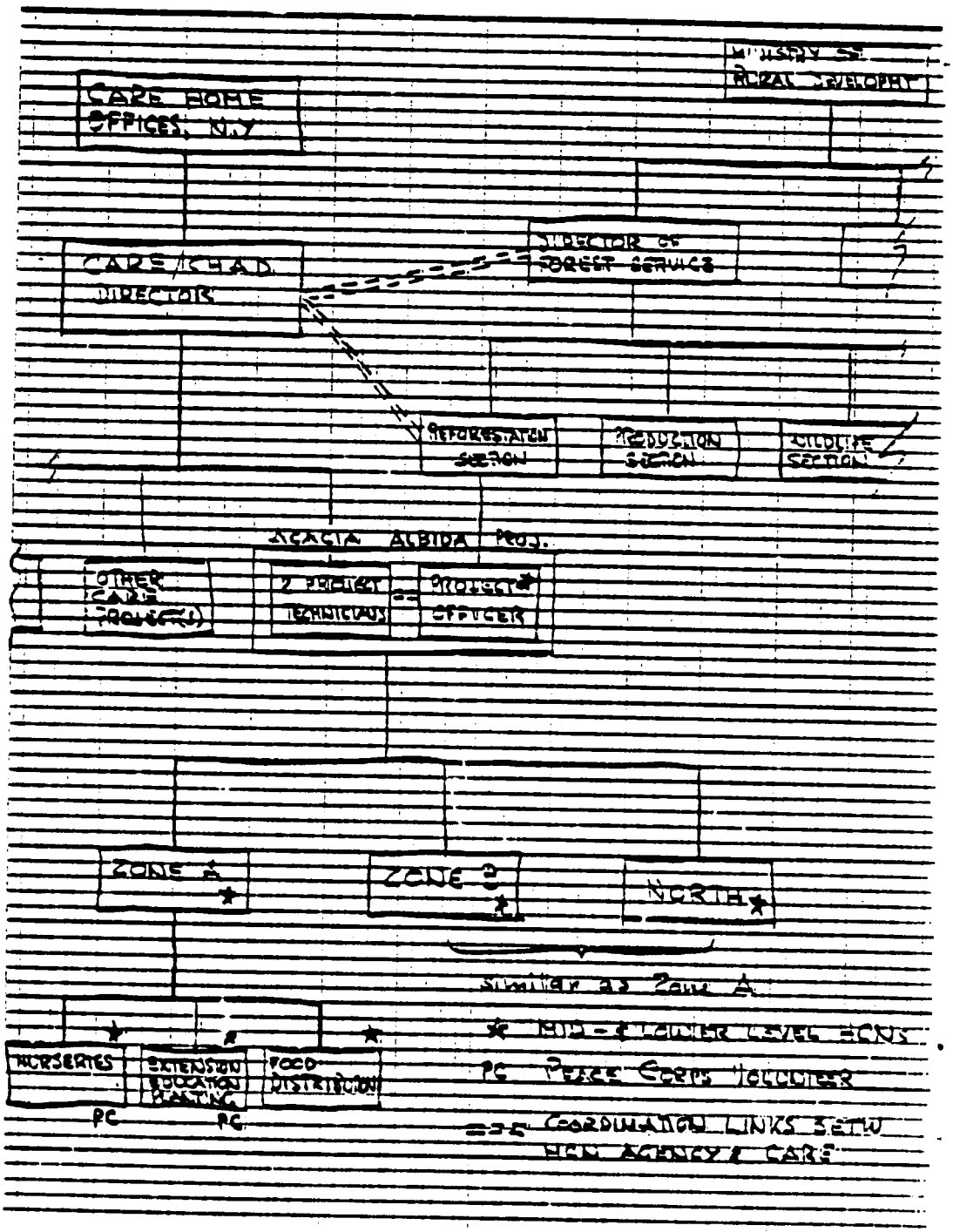
Senegal: El Hadji Sene, Chief, Senegal Forest Service (Also met with Tom Greathouse, USFS on TDY to re-write an AID forestry conservation project.

LOGICAL FRAMEWORK MATRIX

SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	IMPORTANT ASSUMPTIONS
A.1. GOAL - Increase food supply and protection of the soil.	A.2. - There will be an increase in the available food supply in those areas where the project is located.	A.3. - The Chadian Government policy will continue to be directed toward these goals
B.1. PURPOSE - Establish the Acacia Albida tree as a recognized low-cost technology which will produce increased food supply for subsistence farmers. - Establish the concept of cultivating firewood as a domestic crop with concomitant protection of the environment.	B.2. **At the end of this project there will be a lag of 5 years before all of the trees will be fully grown and production indicators can be measured. - Farmers have understood the concept and show willingness to duplicate it on their own. - Forestry Division personnel are becoming field-directed and are willing to work with the small farmers.	B.3. - An integrated low-cost technological package can be adapted to increase the food supply and protect the soil. - Farmers are able and willing to make a minimal immediate investment in anticipation of benefits 5 or 6 years in the future. - The Acacia Albida tree is able to produce the results described.
C.1. OUTPUTS - The number of seedlings produced, both Neem and Acacia Albida - The number of hectars field planted. - The number of meters of Comiphora planted. - The number of farmers reached.	C.2. - 3,500 hectars planted in Acacia Albida, 10m x 10m or 350,000 trees field planted. - 122,500 meters of comiphora fencing have been planted with 735,000 trees. - 105,000 meters of Neem trees for wind breaks and firewood involving 52,500 trees have been field planted and are producing. - 3,500 hectars planted will produce a total of 1,312 additional tons of food (50% gain). - 1,725 farmers reached.	C.3. - Fuel and materials will be available as required. - Vehicles will arrive in Chad on time. - Agreed upon working arrangements with Forestry Division are not altered. - Farmer interest at high level can be maintained until trees are established.
D.1. INPUTS - USAID - Materials and Equipment as well as Personnel & Operations funding and PL 480 (if available) - CARE-Hand tools and other general support as well as	D.2. - See Section V. D.1. continued privately donated food commodities. - Forestry Division - Nursery facilities, Personnel, vehicles, support.	D.3. - PL 480 Support can be integrated into this project.

Appendix B

PROJECT ORGANIZATIONAL CHART



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Appendix C

(1) Executed copy of Grant AID/afr.G-1251

with: A Program description
B Standard Provisions
C Payment Provisions

(2) Project proposal: (Acacia albida expansion project (no date)

CARE N.Y. (note: contains applicable log frame)

(3) Acacia Albida Expansion Project, 1977 CARE-Chad

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Appendix D

NOTES ON ACACIA ALBIDA

By Fred R. Weber

(NB: In original form, these notes were written specifically for AID/Senegal. They have been edited for inclusion in this report.)

In view of some uncertainities about Acacia albida and its value to farmers, it may be useful to discuss the following points:

Acacia albida projects are neither new nor untested. "Operation Cadde" in Senegal has been going on with varying intensity over the last thirty years and is now in Phase Three. Government and individual farmers efforts to introduce this tree into farm fields are by no means unknown.

This species, like so many others indigenous to the Sahel, grows deep roots to survive the dry season. Within several months after planting, the tree roots grow quickly and deeply; after the first rainy season, tap roots of 10 to 20 feet are possible. British foresters in Northern Nigeria about fifteen years ago excavated a three-year old Acacia albida tree to measure the root. They broke off the root at a depth of 33 feet and found it very, very fine, like a tough thread. Obviously it was longer than 33 feet.

Acacia albida seedlings are usually grown in the nursery, normally about two to four months before planting in July. Generally, they are grown in containers 8 cm in diameter and 30 cm high. Plastic is used because it is relatively light, cheap, easy to ship and durable. Material other than plastic can be used but it is essential that it be featherlight, absolutely waterproof (except for the holes in the bottom of the container) and sturdy.

Seed treatment, root pruning and insect protection are important to raise healthy Acacia albida seedlings successfully. Senegalese foresters and crews as well as our own foresters are well aware of the technical details involved. It would go beyond the scope of this paper to go into all the details since several excellent reference texts are available such as the Niger Forestry Manual (Peace Corps, 1972) and its newer edition Reforestation in Arid Lands (VITA, 1977). Additional information is available also from the various Sahelian Forest Services, the C.T.F.T. (French Tropical Forest Research Institute), the Sahelian Information Center in Niamey (Niger Forest Service), the Forest Research Stations in Nigeria, and the Amadu Bello University Forestry Division.

Acacia albida seedlings have been produced throughout the Sahel and Savanna for years. There are no technical operational problems in raising and making them available to the farmers. The average cost is 75 CFA per tree f.o.b. nursery for the first 20,000, decreasing beyond that quantity.

There are obvious advantages to growing Acacia albida in the Sahel. Though it is apparently not sufficiently clear yet precisely why subsistence crops such as millet and sorghum grow better under the canopy of an Acacia albida the following reasons all seem to contribute.

Advantages of Acacia albida

1) Acacia albida trees grow taller and have stronger branches than other species (in the Sahel) and large birds such

as vultures and crows prefer their branches for nesting. When Acacia albida happens to be the largest tree around, the area underneath reaps an extra harvest from the droppings of the large birds. The extent to which this factor contributes to the special value of Acacia albida to farmers, however, is not accurately established at present.

2) During the hot months, livestock may well gather under the tree for shade. It is known that Acacia albida pods are well liked by livestock. The pods also are collected by farmers and sold on the market as supplemental feed. The timing of their ripening is ideal; the pods fall to the ground from January to April, when other natural feed for the animals is difficult to find. In areas where these pods are not collected and thus fall to the ground, animals eagerly devour them. Other species lose their fruits or seeds at about the same time of the year, but they are neither as plentiful nor as tasty and nutritious as those of Acacia albida. It is fair to state that Acacia albida bean pods attract livestock more than other species.

3) Falling leaves add organic matter to the soil. Acacia albida leaflets are fine and small and probably enter the top soil quickly. In itself, this does not give Acacia albida any special distinction, yet the leaves contribute to the enrichment of the topsoil underneath the trees.

4) The shade from the tree alone reduces the surface temperature of the soil. The smallness of the leaves perhaps

lets more sunlight through than a Colorado Blue Spruce or a Weeping Willow would. However, what little shade is available does help improve the soil and creates a microclimate that enhances biologic activities in the soil.

5) Acacia albida is classified as a leguminous plant and thus may fix nitrogen increasing soil fertility. Although commonly accepted, this point does not seem to be established well enough to satisfy. Considerable field research on this and other seemingly beneficial effects of Acacia albida on soil fertility have been done. However some of the methods used seem to be questioned; more important, the results of these efforts have been interpreted differently by various reviewers and project analysts, so that the question of how Acacia albida helps is still not completely answered.

From this discussion, it may seen that Acacia albida is no better than other trees around. However, there is one feature of the tree that is of the greatest importance to people in the Sahel. Acacia albida losses its leaves during the rainy season and since that is the time of the year when millet and sorghum are grown throughout this area, it makes it a good tree under which to grow crops. Crops planted under other trees, such as beech, mango or maple, which do not lose their leaves during the growing season, for reasons not elaborated here, do not do very well.

According to Senegalese and foreign experts alike, Acacia albida is the only species in Senegal that loses its leaves during the rainy season.

Finally, it must be said that by tradition, Acacia albida is considered by the farmers as one of the most valuable trees in the area. In some areas farmers, on their own initiative, have begun to protect even the smallest Acacia albida trees. Where closed stands of mature trees exist, cropping is continuous (no fallow) and has been for years.

Disadvantages

Acacia albida has some specific disadvantages.

- It grows relatively slowly, only at a few places are heights of up to 12 feet recorded in four years or less (as reported in Upper Volta by C.T.F.T. and Madarounfa, Niger, by Peace Corps and Niger Forest. Service). Acacia albida trees planted as part of a USAID project in Niger as early as 1966 only showed heights of 15 to 20 feet ten years later, although in that time crowns began to form, beginning to provide some ground cover.
- In some areas farmers complain that Acacia albida (or any tree for that matter) attracts birds that cause damage to the harvest. Not surprisingly these complaints come from areas of heavy bird population (as the Lake Chad vicinity) where birds are a major factor in harvest losses.

Questions/Answers

Some of the more frequently asked question about the tree:

Q. How soon will a farmer have higher yiedls in a field planted with Acacia albida?

A. Since the tree grows slowly, millet and sorghum yields probably will not significantly increase for the first ten to fifteen years. Afterwards, however, consistently higher production will be a matter of statistical proof. This depends on the spacing of the tree; 10 x 10 m is average, but other spacing patterns are acceptable.

Q. Why is it necessary to plant these trees? What has happened to natural regeneration?

A. Acacia albida, like any other part of the vegetation here, is under constant pressure. Natural reproduction forces are present, as always, but population pressures today are much greater than ever before. Formerly, the animal and human population was such that a certain number of young trees survived inspite of hungry goats, sheep, cattle, and in spite of people farming and weeding their fields. Now, suddenly, there is less fallow, andmore animals concentrated on uncultivated land. Also, people cultivate using less discriminate animal traction. All these are activities which make it that much harder for a small tree to survive.

Q. Is it necessary to plant the trees from a nursery or stock? Why can't we just protect natural reproduction?

A. Good idea, except that reproduction often does not come at the time we want it. If we look at the bare field, just

weeded and harvested, a new batch of Acacia albida would not germinate until the next rainy season; then we would have to have a good seed year, adequate rains, etc. --and even then the young trees would be relatively small. Instead, if we plant now, we will have larger, healthy trees at the beginning of the rains.

There is another important factor. When we plant, we place the trees in a pattern, along lines. This way the farmer can use animal or tractor drawn equipment. If we were to use natural reproduction we would probably have most trees grown where we do not really want them, that is, in a random pattern .

Q. What about direct seeding?

A. Absolutely, this should be tried, by all means. It has worked well in other places and is very cheap, in comparison to raising each tree in the nursery. It does take, however, much more seed than required in a nursery-based operation, and can only be carried out as long as the necessary seed quantities are available.

Q. What about treating the seeds before planting?

A. Nature takes care of that. Animals do the job for us by digesting the pods. When the seeds go through the stomach tracts of the animals, the acids, etc. seem to do the trick However,we can do this "artificially".

Q. How?

A. There are several quick methods involving sulfuric acid or other dangerous substances. But a simple, reliable procedure

of immersing the seeds in water which has just been boiled and leaving them to soak overnight has been found continually reliable. The following morning the seeds are sown either in nursery pots or in the ground for direct seeding. This process avoids the risk of battery acids and of overcooking the seeds. Another approach also works well. Cutting a hole in the outer shell of the seed or filing a small chunk of it practically guarantees germination within two or three days. But, this is obviously a bit expensive and slow, even if labor costs are not high.

Q. What is the nutrient value?

A. Questions about the fruit nutrient value of Acacia albida pods for domestic animals can be answered by Senegal's livestock laboratory. Records indicate the following values:

Complete fruit (March):	M.S. p 100.....	93
	N.....	10.7 MS p 100
	Cellulose.....	16.8 MS p 100
	Ashes.....	4.6 MS p 100
	U.F./kg	0.98 (the same as (1 kg.of oats;
	M.A.	60 (per kg as is (-not dry

Additional details can be furnished by the Livestock Sector's well equipped laboratory (in Dakar) or other institutions with similar, extensive research and data background in the general area of livestock and range management in the Sahel and Savanna Region of Africa.

Soil Conservation Package (A package that USAID considered in Senegal at one time)

The planting of Acacia albida is by no means the only activity that will help attain the oversall purpose of this sub project: to retain and enhance the fertility of the farm soil.

The big draw-backs resulting from over-use of the farm soil, peanut monoculture and depletion of nutrients due to continuous repeated croppings, are:

- wind exposure, with resulting loss of "fines" and organic material.
- high surface temperatures due to extensive solar exposure, which in turn inhibits beneficial soil forming processes.
- over-use

These misuses can be mitigated to some extent by planting Acacia albida in the fields. Additional measures are available which may further contribute to better conservation of the available resources.

For more effective farm management, several activities such as applying manure, growing cover crops, chemical fertilizer, rotational cropping practices, mixed farmings, etc. can be utilized each with its own range and limitation as to feasibility and practicability.

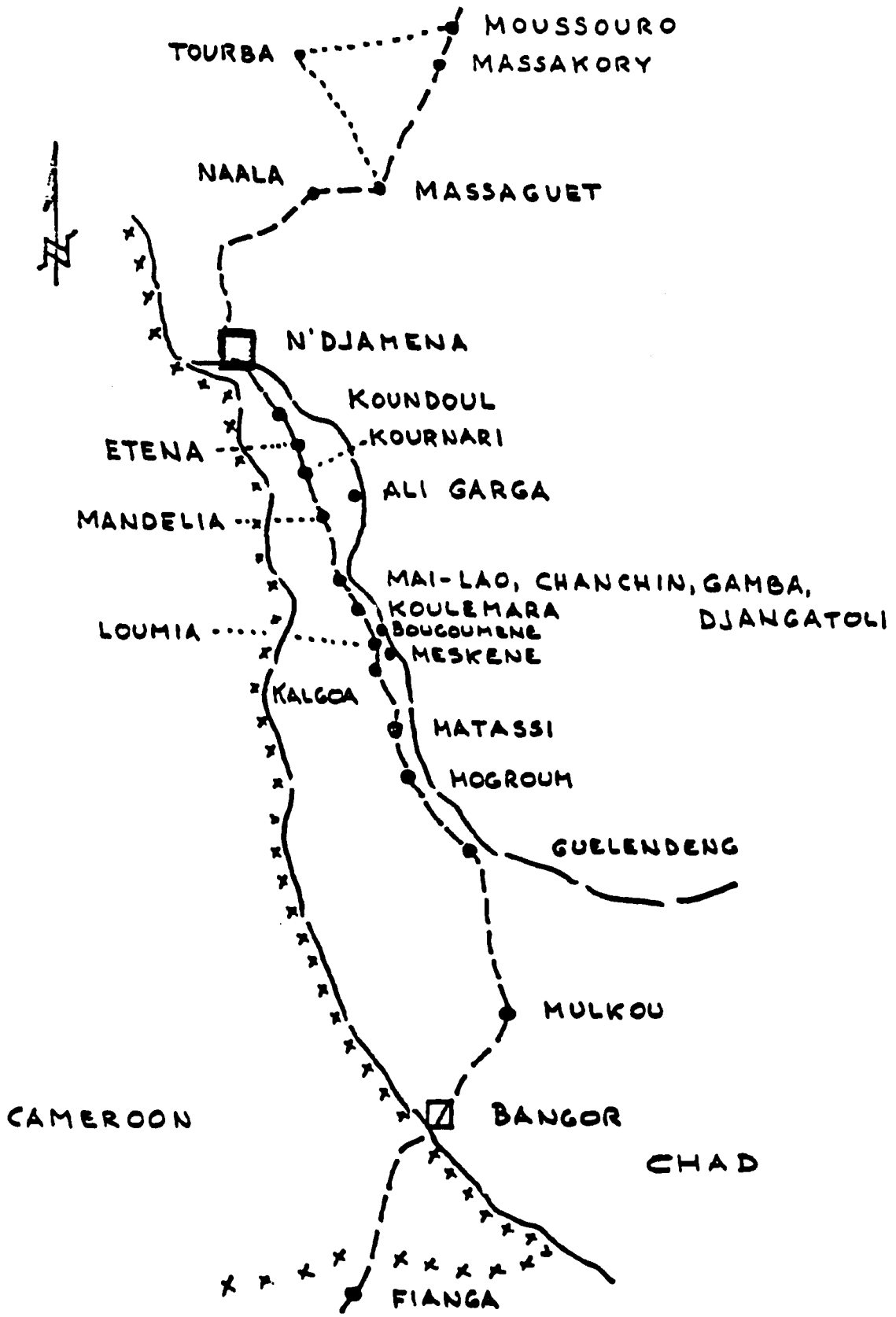
The introduction (or better re-introduction) of Acacia albida is only one of several conservation-oriented activities that have been found possible and practical here. The Acacia albida introduction effort can be combined with other conservation

measures, designed to make a combined impact to preserve productivity of soil:

1. Windbreaks
2. Woodlots (Small service needs)
3. Live fencing
4. Tree and forest products (and other benefits)
5. Firebreaks can also be included when needed and feasible.
6. Watershed Development
7. Low lands (Bas fonds)
8. Depressions. Drainage centers, dikes
9. Contour farming.

Appendix E

M A P S



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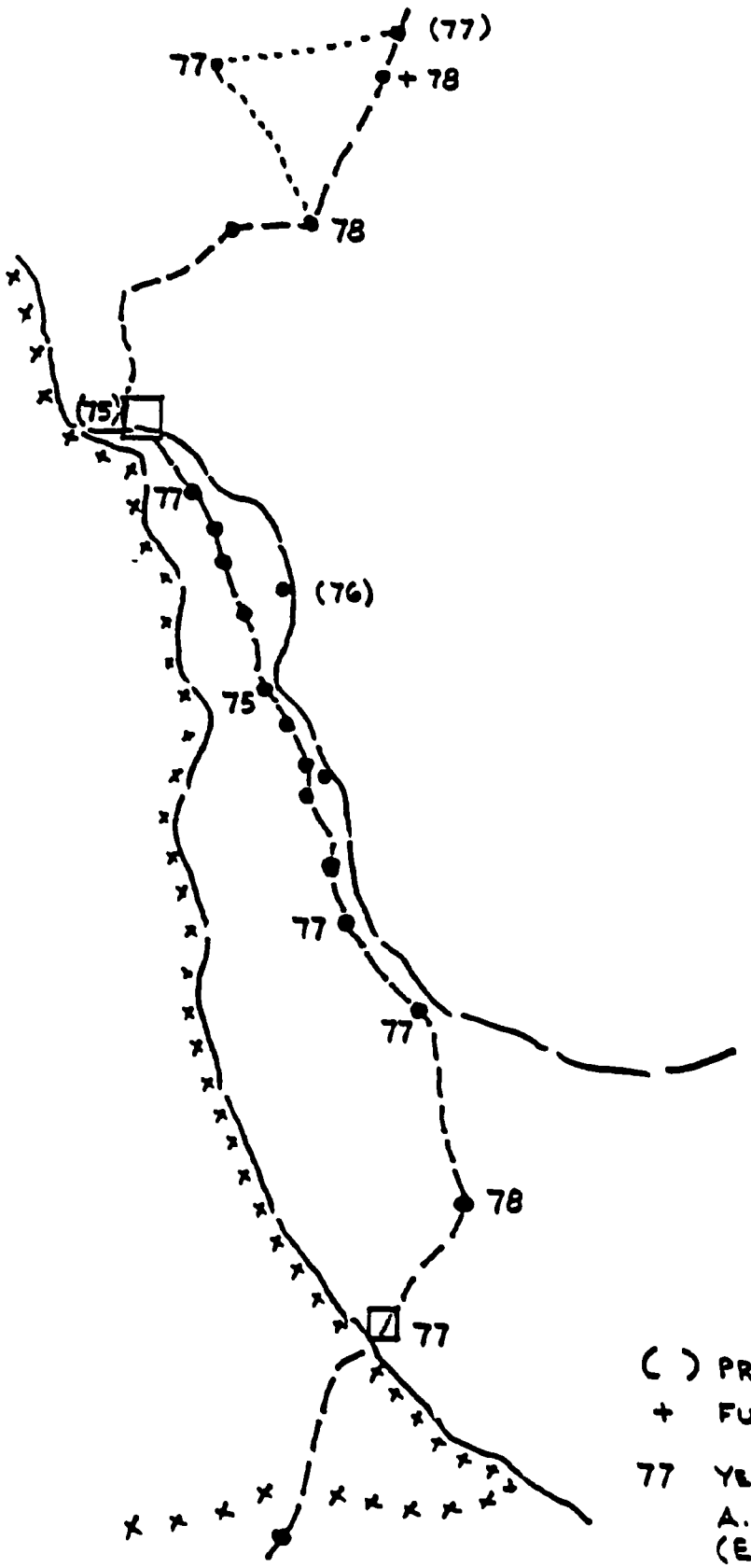
GENERAL

MAP 1



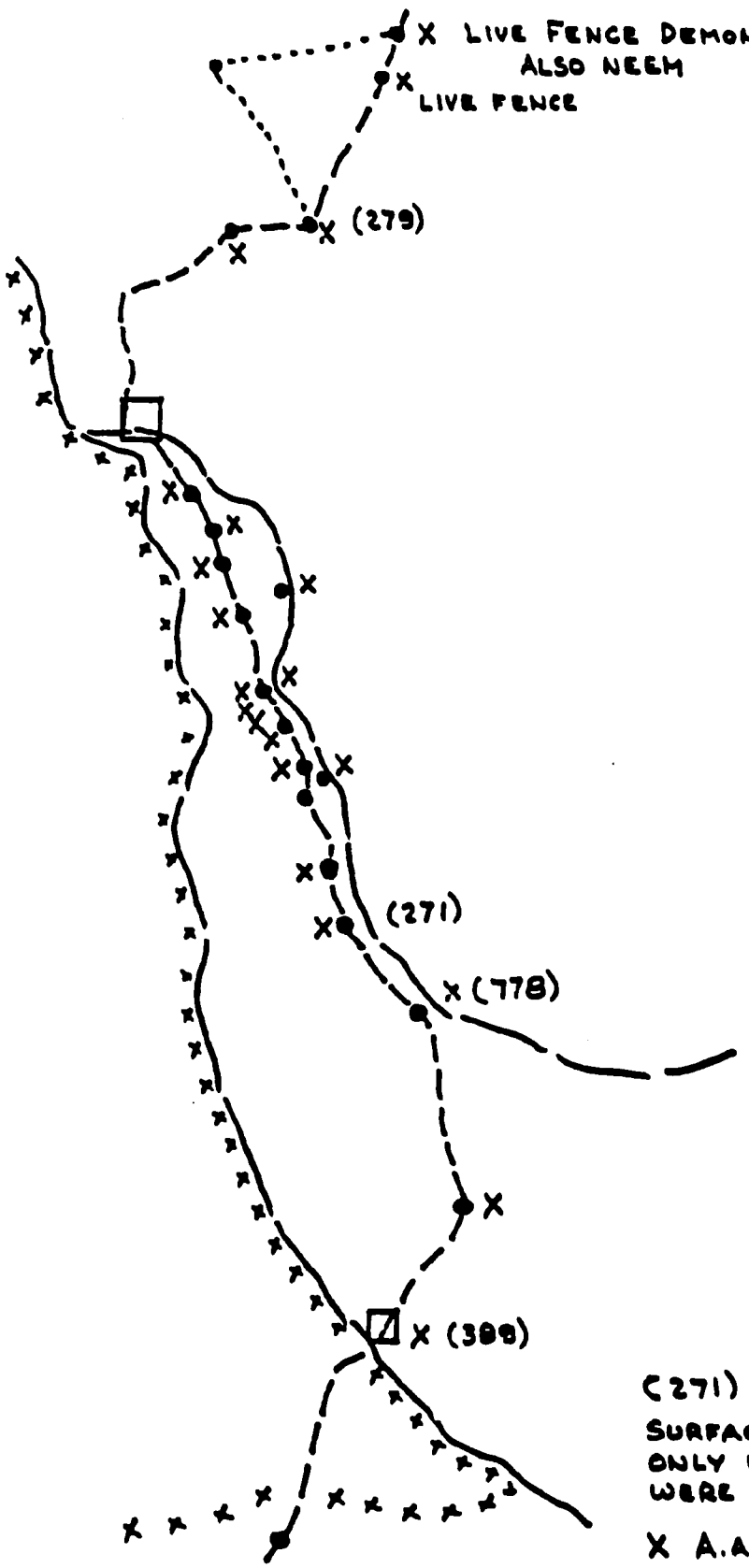
( ) PREVIOUS SITES

\+ FUTURE LOCATION

77 YEAR IN WHICH FIRST A. ALBIDAS PRODUCED (EXISTING PROJECT NURSERIES)

MAP 2

NURSERIES

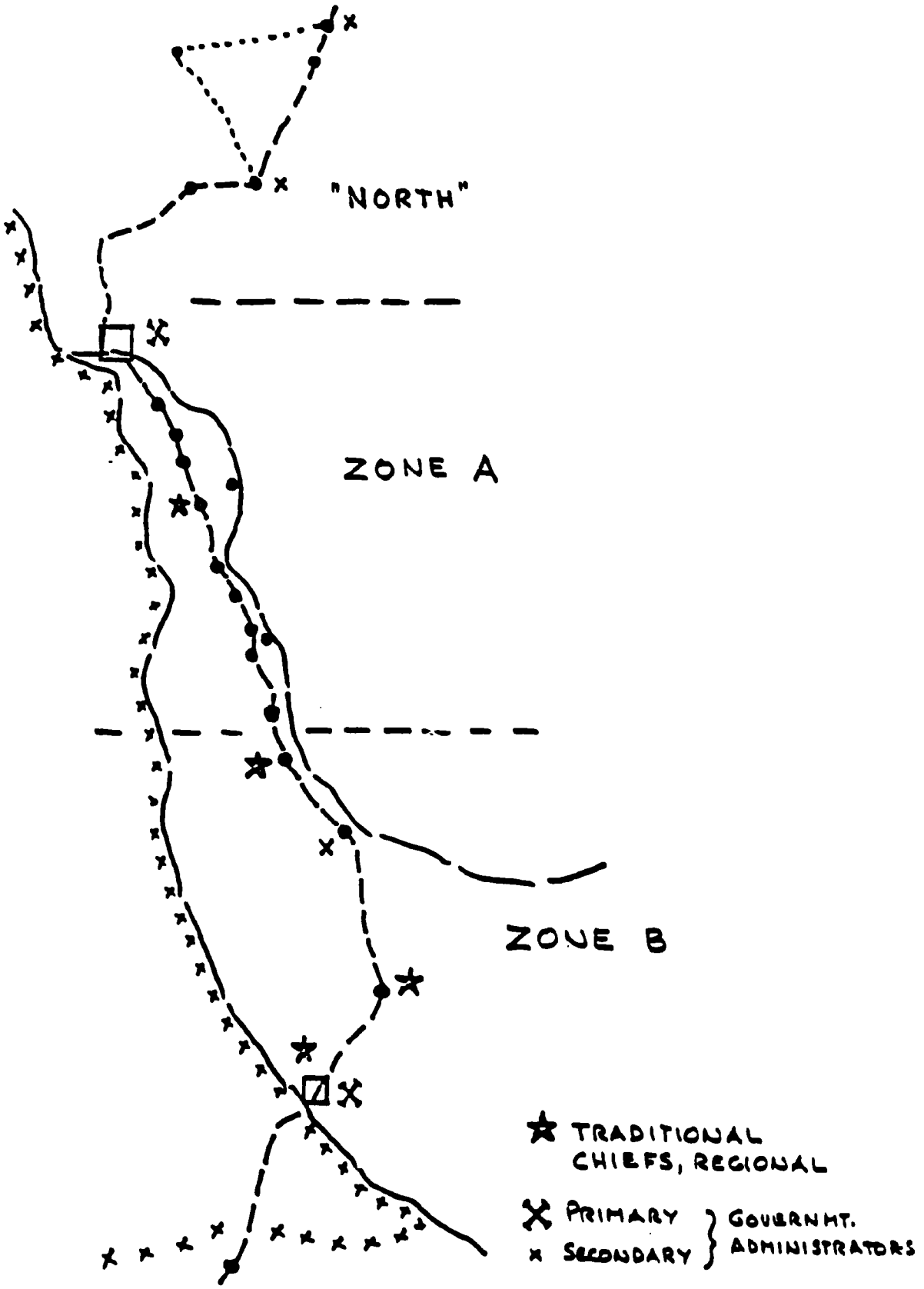


(271) ha PLANTED SURFACE AREAS SHOWN ONLY WHERE FIGURES WERE AVAILABLE

X A. ALBIDA PLANTING SITES

PLANTING ACTIVITIES

MAP 3



MAP 4

BACKGROUND

Appendix F

Measurements of Wall Thickness of
Plastic Bags

Date April 4, 1978
Job Number 78-03
Sheet 1 of 1

Report to: International Resources Development
& Conservation Services
5797 Bogart
Boise, Idaho 83702
Attn: Mr. Fred R. Weber, P.E.

Sample Identification

On March 31, 1978, your personnel delivered to our laboratory four (4) samples of plastic bags reported to be from various international sources. At your request, we performed measurements to determine the wall thickness of the plastic bags.

The test results are summarized as follows:

Test Results

Sample No.	71466	71467	71468	71469
Source	----------	Cameroon	----------	Ivory Coast
Color	Red	Red	Blue	Black
Average Wall Thickness, in.	.0031	.0030	.0022	.0022

Certified_

Appendix G

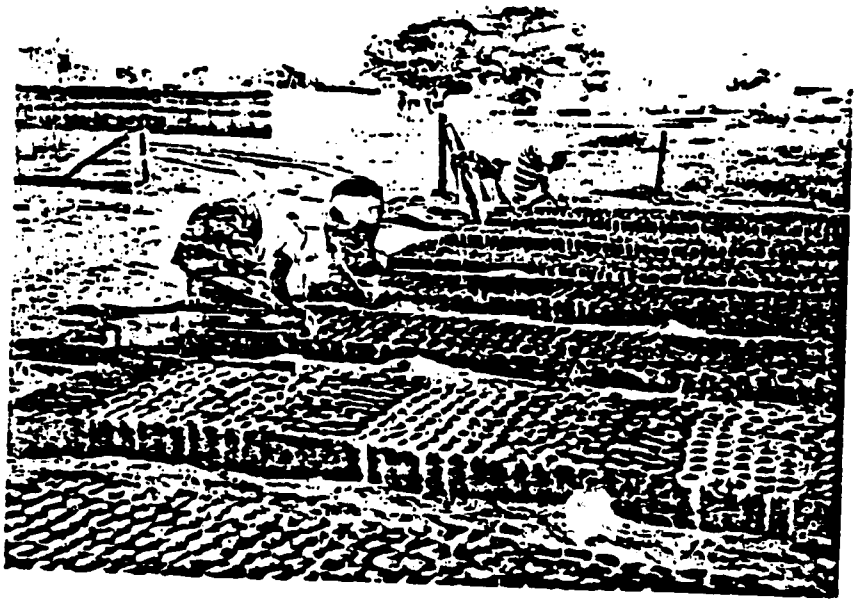
PHOTOGRAPHS

(1) A. albida park-like landscape. All ground visible is farmed on year after year basis. (N. Cameroun)

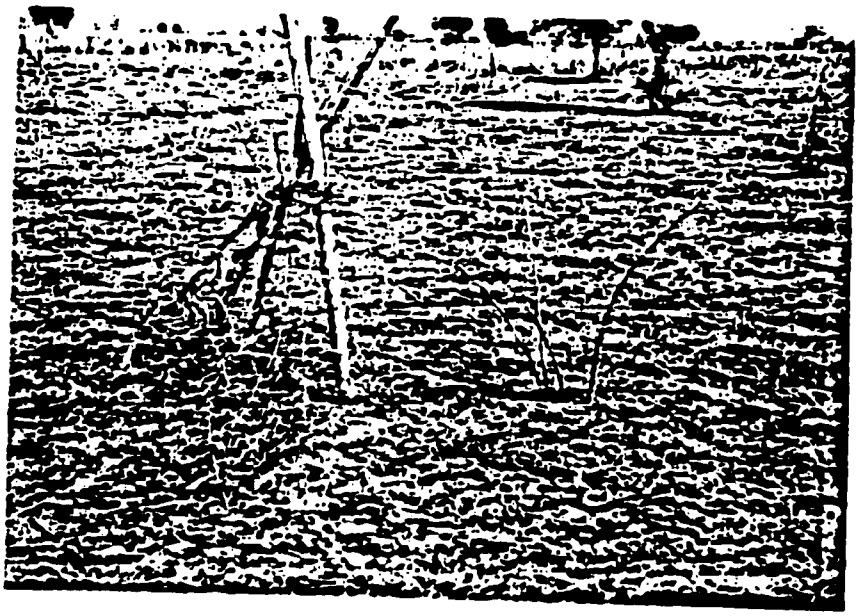
(2) Individual A. albida in millet field. As pods become ripe in February, livestock is attracted to feed. (Upper Volta)

(3) Group of A. albida in Chad. Foreground farm field; background a field kept in fallow. Rotation is common.

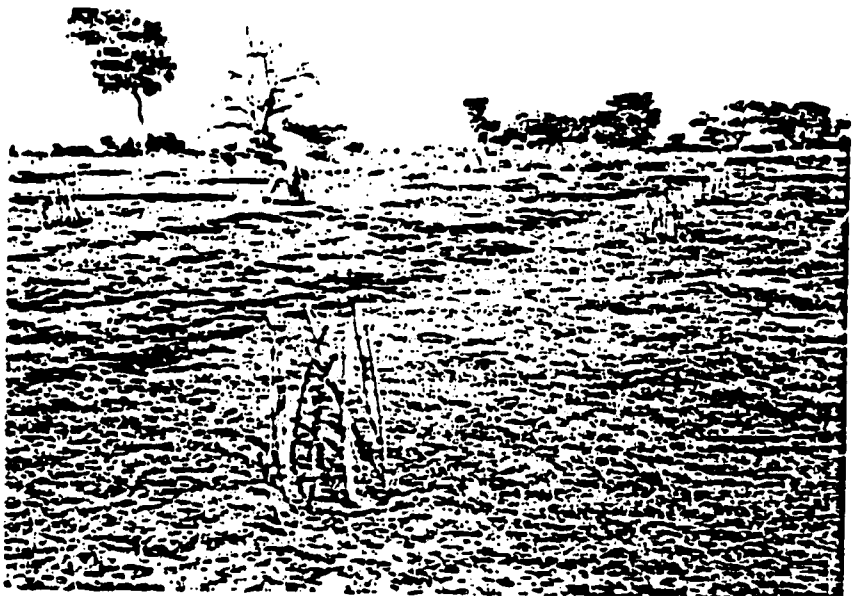
(4) and (5) Long sticks are used by herders to knock down A. albida seed pods to provide food for animals. According to [illegible]NT studies one pound of pods equal the feed value of one pound of oats.



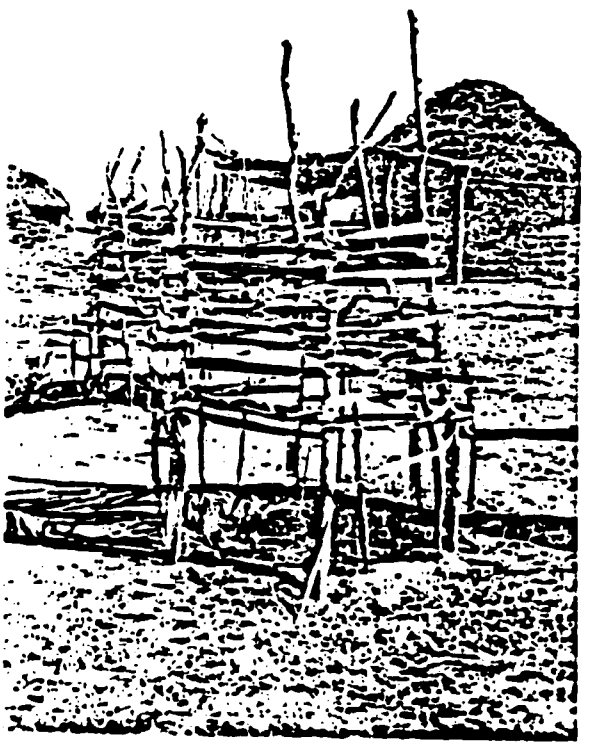
(6) Typical nursery way-out scene. Plastic pots of different colors are stacked and prepared for seeding. Note women workers.



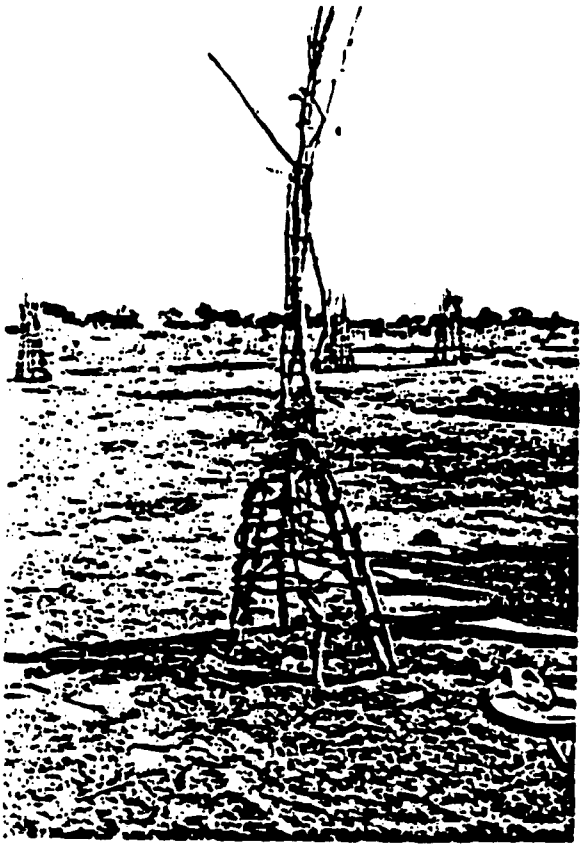
(7) Protecting trees by using local materials. Note the different styles, photos (7) through (11).

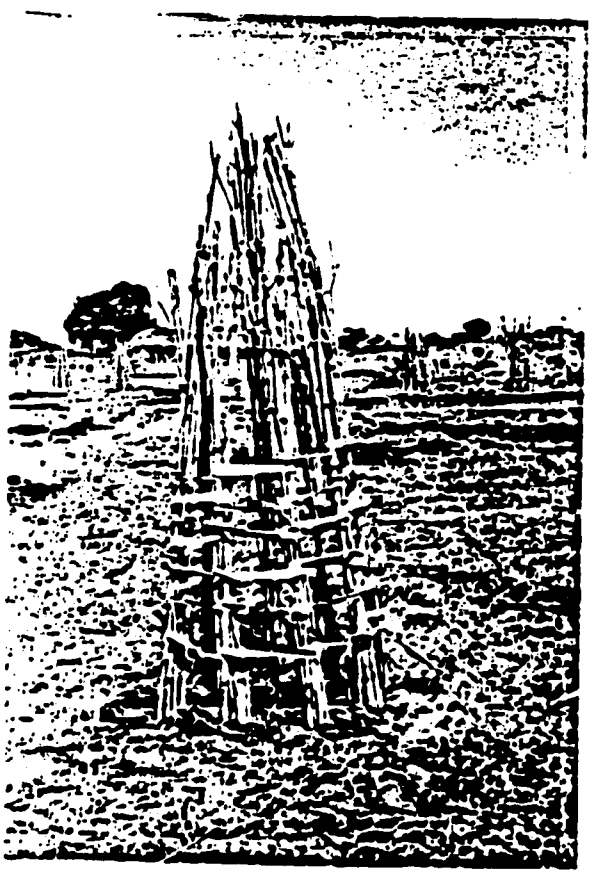


(8) Different methods of protecting trees, using local materials.



(9) The strips used to tie sticks together can be rags or and other material, but palm fronds are used most often.

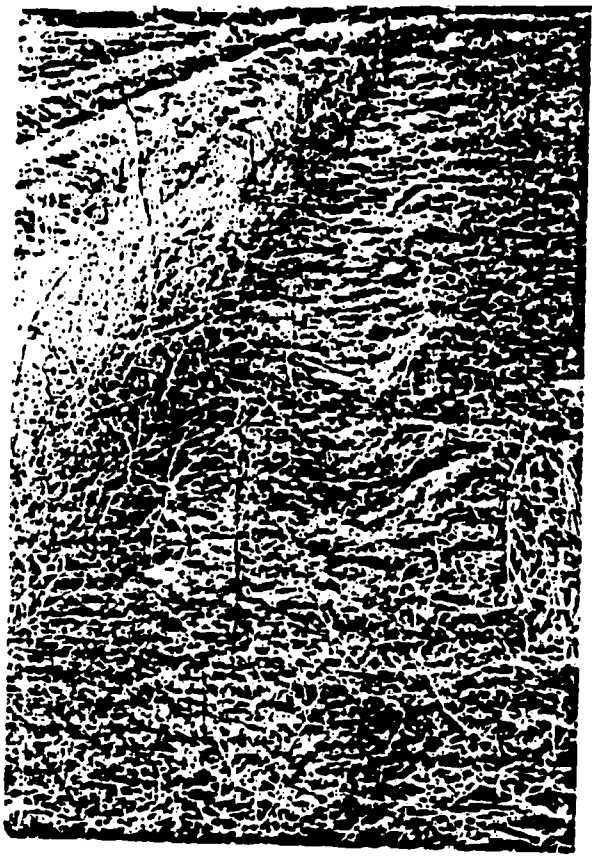




(10) and (11) Different methods of protection with locally-available materials.

(12) Here an entire field has been enclosed and trees are protected on an area rather than individual basis. Trees in foreground were planted nine months ago and are doing well. Note that here, north of Ndjamena, the vegetation is relatively sparse and unimpressive

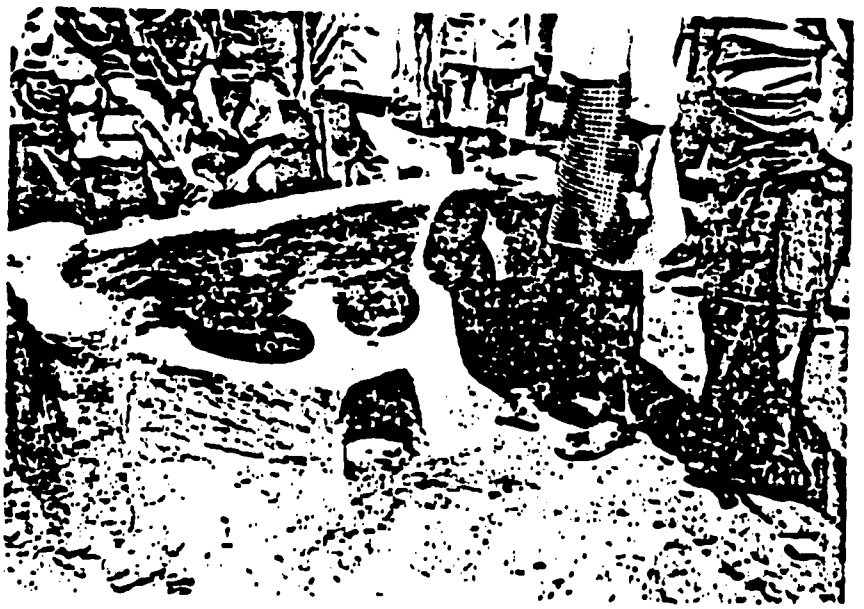
(13) Live fencing. See also (14).



(14) Live fencing. Parkinsonia and other species are planted at 50 cm internals, as shown here behind a traditional, temporary fence of dead, thorny branches. Once the trees take, thorns and trims from the live tree can be used to plug holes between the live fence posts.

(15) Abuse of A. albida. During our visit, we caught the farmer living in these houses chopping a large branch off this tree, in clear violation of the law. Although he knew it was not in his best interest, and against the law, he needed fuel to feed relatives attending a funeral in his family. No other wood or source of fuel was available. People will usually not cut A. albida unless they have no alternative.

(16) Classic example of herder use of acacia trees (especially A. seyal and A. senegal, also others including A. albida) Limbs are lopped off so that small animals can eat the fine leaves and also the pods. A seyal pod for instance is as much appreciated by small animals as A. albida pods



(17) An outside oven designed to use firewood more effectively. The firewood keeps the heat in the oven. The two hole structure meets customary requirements for cooking a cereal and a meat sauce at the same time.