AN ABSTRACT OF THE THESIS OF

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Reforestation projects in Senegal are often the vehicles which administer and implement social forestry activities. Their objectives are to help people solve their wood supply problems, enhance the environment by planting trees on farms and in villages, and introduce reforestation as a self-sustaining practice in village culture. Many projects establish village-based tree nurseries where community members grow seedlings to supplement or replace those supplied by government-owned regional nurseries. Village-based nurseries are promoted by the Division for Conservation of Soil and Reforestation and other Senegalese government agencies.

This study, based on a survey of 32 villages, contained within four different projects: 1) investigates village-based tree nurseries in the Peanut Basin of Senegal by evaluating performance in terms of seedling survival and village nursery manager's intention-to-continue,

2) compares the structure of four reforestation projects descriptively and quantitatively. Finally, it presents recommendations for future implementation of nursery projects.

Results indicate that village participation is a significant predictor for survival success. Three factors were significant predictors of intention-to-continue: previous nursery experience, water availability in the village, and the commercial sale of seedlings by nursery managers. Analysis of these success factors provides insight into project organization.

Project extension strategies range from very structured methods to informal approaches. Awareness campaigns, field trips, and group training were variations found among projects in various mixes. Projects were similar in organizational structure, financial incentives, and encouragement of self-sustaining activities.

Project design should include: 1) village participation from goal setting through evaluating results, 2) economic incentives that are based on encouraging the sale of seedlings, and 3) financing to improve water sources. Projects could also benefit from well-planned awareness campaigns, practical group training, and the application of more structured extension methods. Future studies are needed on villagers' behavior towards practice, adoption, and continuance.

Evaluating Village-Based Tree Nurseries in Senegal: A Comparative Study of Four Projects

by

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Dr. Jerry Sesco, Deputy Chief of the USFS also provided financial support.

I dedicate my thesis to my mother for her confidence in me, to the PSPs, and to my sister Margaret, for waiting.

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I. INTRODUCTION

Problem of Deforestation

Desertification

Desertification, or desert encroachment, can be defined as movement of a mesic ecosystem towards a more xeric condition caused by cyclic drought and the removal of vegetation through human activity. Desertification accelerates when population densities increase, fallow time is shortened and agricultural intensification leads to the faster removal of tree crops (Boserup, 1965; Byron, 1985). Desertification forms and expands desert-like patches around cities, villages, wells and other centers of concentrated activity and on a larger scale, the southern encroachment of the Sahara Desert into savanna regions (NCR, 1984). A contributing factor to desertification is deforestation. Trees and other woody perennials are cut for fuelwood, fodder, food, fencing, construction material and agricultural land clearing.

Sahelian deforestation was first noticed forty years ago when Auberville predicted ecological and social collapse (Shepherd, 1986). The disappearance of dry, wooded and shrub savanna forests was predicted to affect soil fertility and influence the climate. Numerous studies have confirmed the destructive influences of

desertification (Anderson, 1987; Eckholm, 1979; ICRAF, 1985; USAID, 1987).

Fuelwood Scarcity

Environmental degradation is coupled with wood scarcity. More than 100 million people in 26 countries of the world are currently facing an acute wood shortage. They are found mostly in arid and semi-arid regions, including the Sahel. Projections suggest that if present trends continue, nearly 2,400 million rural dwellers will experience acute wood scarcity or deficit by the year 2000. The rapid emergence of dangerous imbalances in the wood supply systems is expected in the developing world (Foley and Barnard, 1984).

In Africa, approximately 90 percent of the population use wood for cooking. Current annual wood consumption is estimated to exceed the mean annual growth of local tree stocks and forest reserves in many Sahelian countries (Anderson, 1987). Improved economic welfare in some countries has thus far proven ineffective at shifting fuel preferences to non-wood sources.

Forest Cover in Senegal

Senegal (description in Appendix B) has 13.8 million hectares of natural forest land, 30 percent less than 30 years ago (Joyce and Burwell, 1985). The current rate of

deforestation is 50,000 hectares/year, while reforestation is only 2,000 hectares/year (World Resources, 1988). If this trend continues, the natural forest will decline another 20% by the year 2000 (Joyce and Burwell, 1985).

The need for regulatory action and forestry education of the rural communities has been widely recognized by the Government of Senegal (GOS)[1] and international aid agencies. Appropriate resource management and resource conservation measures are being pursued in an attempt to improve the standard of living and quality of life of the local people.

Senegal Forestry Development

Forest Service

A forest regulatory system became established under colonial rule in the territory known as the French Soudan. In 1935, a Forest Service, Eaux et Forets, (EF) was created to enforce the Forestry Code (Lai and Khan, 1986). The focus of early forestry was the creation of state forests to protect natural forests, and establishment of government-owned plantations and roadside plantings.

In the period following independence, from 1961 through 1977, approximately 22,500 hectares were reforested, 334 kilometers of roadsides were planted with a

[1] Acronyms are listed in Appendix A

single row of trees, and over 4 million seedlings weredistributed to individuals or groups. In the years between 1977 and 1982, 27,350 hectares were reforested and 2.35 million seedlings were distributed (DCSR, 1988).

Transition to Current Reforestation Efforts

Traditionally, the role of foresters has been limited to establishing reserves and plantations, policing, and revenue collection. Early plantation programs met with criticism by international development agencies for their lack of involvement with local people. Villagers did not understand the goals of government plantations and viewed them as benefiting only the government. Failures of these reforestation schemes can be traced back to outsider misassessments of village cooperation (Shepherd, 1985). Villagers' interests were not openly considered and foresters became alienated from the local farmers. In the mid 1970s, a call for change in reforestation policy was heard and attempts to implement social forestry began (Shepherd, 1985). Social forestry is defined here as "a broad range of tree and forest activities undertaken by rural land-owners and community groups to provide products for their own use and for generating local income" (Gregerson, 1988).

The 1980s marked a shift from government-operated plantations to reforestation through social forestry. The

GOS, under the Ministry of the Protection of Nature, EF, made reforestation a national priority (DCSR, 1988). EF was subdivided to create a branch specifically for conservation activities, the Division of Conservation of Soil and Reforestation, (DCSR) (Figure 1).

By 1987, only one-sixth of the annual reforestation activity was in government plantations (Figure 2). The balance was achieved by villagers planting woodlots, field intercropping, orchards, windbreaks, shelterbelts and live fences.

Reforestation projects in Senegal are often the catalysts that encourage social forestry. Their objectives are to help people solve their wood supply problems, to preserve the environment by planting trees on farms and in villages (Foley and Barnard, 1984), and to introduce reforestation as a self-sustaining practice in village culture. For example, reforestation projects promote agroforestry (a form of social forestry), an integrated land use approach that increases total productivity and income by combining forestry with agriculture, while maintaining the productive capacity of the natural resource base (Winterbottom and Hazelwood, 1987). In land-scarce environments such as Senegal, social forestry provides sustenance and tree products to meet the local needs.

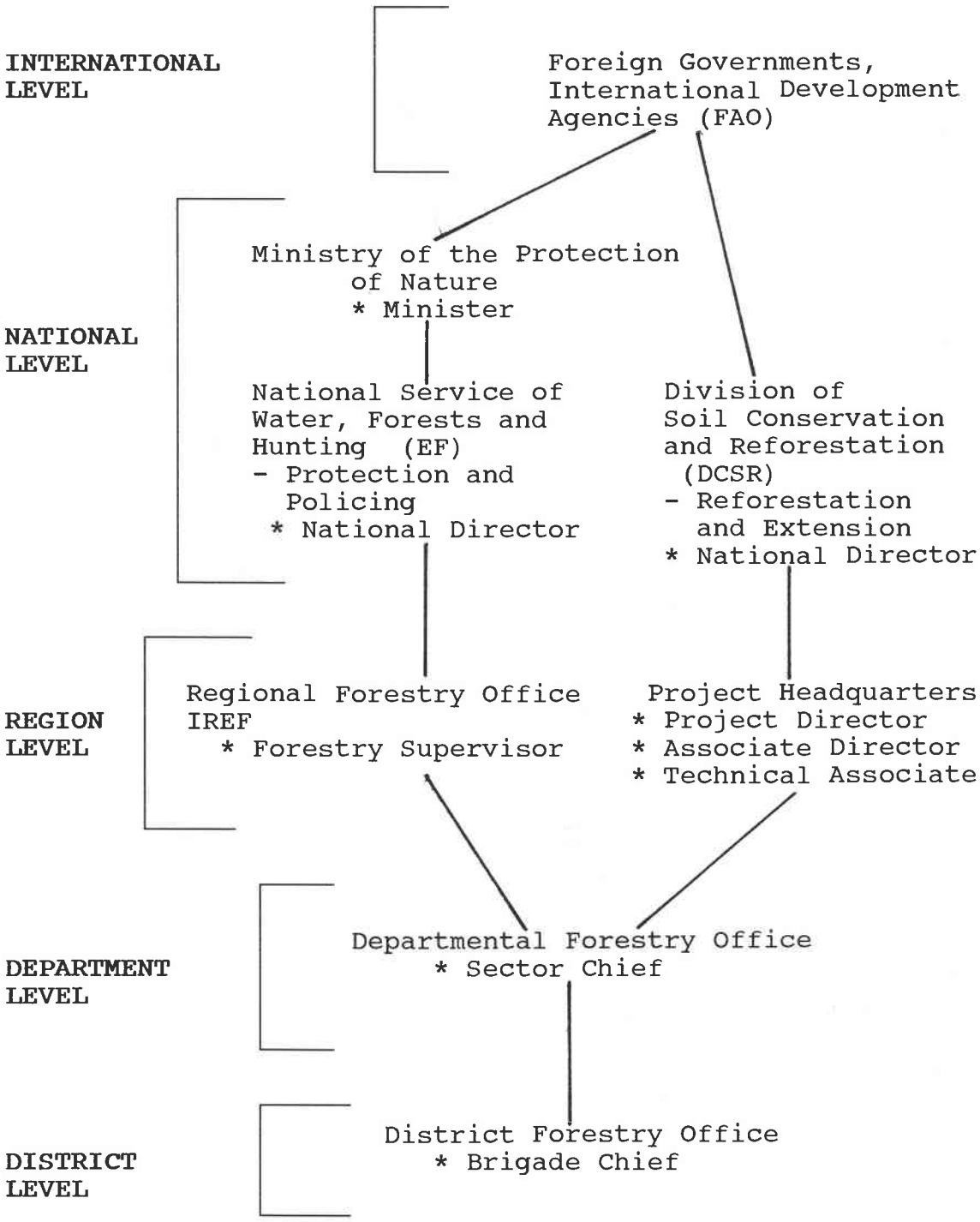

Figure 1. Administrative and financial flowchart of the Forest Service and Forestry Projects associated with DCSR in Senegal (DCSR, 1988).

* Title of civil servant

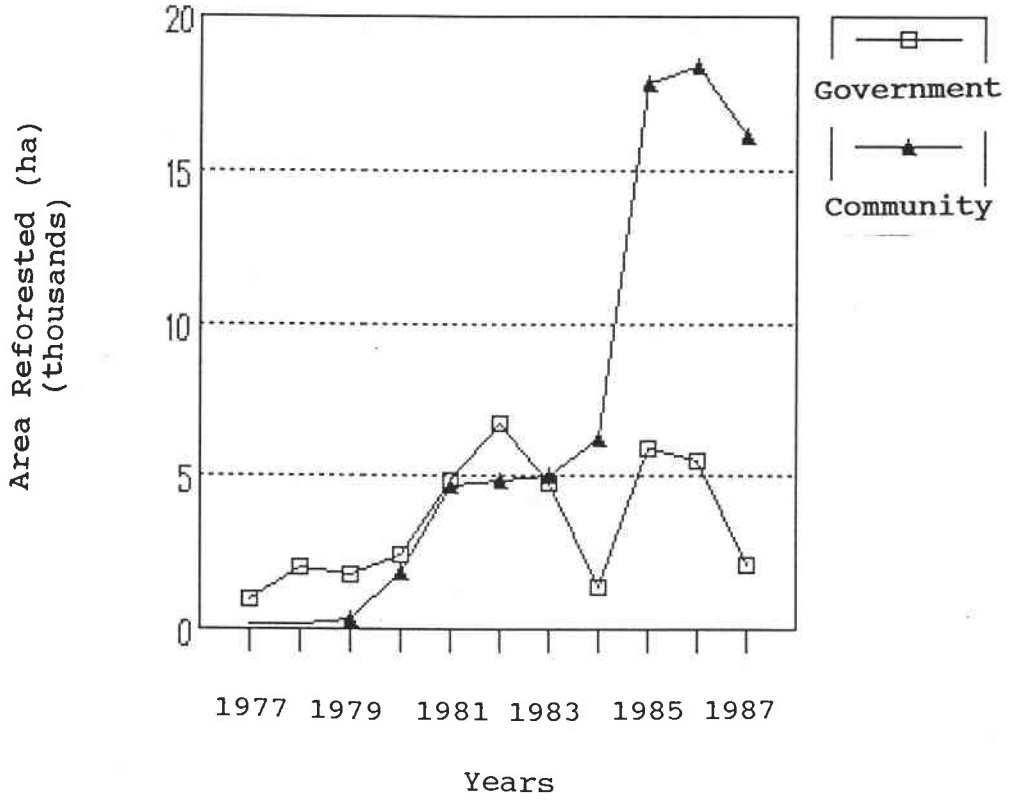

Figure 2. Area reforested by government and community reforestation projects in Senegal (DCSR).

Village-Based Tree Nurseries

A key to fostering tree planting efforts is the establishment of a highly decentralized nursery and seedling distribution system (Anderson, 1987). In addition to providing seedlings, community nurseries could have a valuable demonstration effect for private investors. Many projects establish village-based tree nurseries where community members grow seedlings to supplement or replace those supplied by government-owned regional nurseries.

Village-based tree nurseries first appeared in Senegal seven years ago under the supervision of the Inspection Regional des Eaux et Forets, (IREF), the regional division of EF, in Diourbel, and Projet de Reboisement Communautaire dans le Bassin Arachider du Senegal (PRECOBA), in Fatick (Figure 3). The nurseries offer an alternative to government seedling production and have been promoted by DCSR (DCSR, 1988). Today, there are approximately 690 village nurseries associated with DCSR in 10 regions, 461 of which were established under 16 reforestation projects (Table 1).

The minimum support from a project for a village includes pots and seeds, and technical assistance in the form of personal consultations with forestry extension agents. Some projects supply tools, watering cans, pesticides, fertilizers, and organized group technical training. Still other projects include the financing for well construction or repair.

Village-based nurseries are managed by women's or men's groups or by individuals. Cooperative farming or social groups are commonly used as vehicles for development activities where work and benefits are shared by the members. The benefits of establishing village nurseries can be viewed in social as well as economic terms.

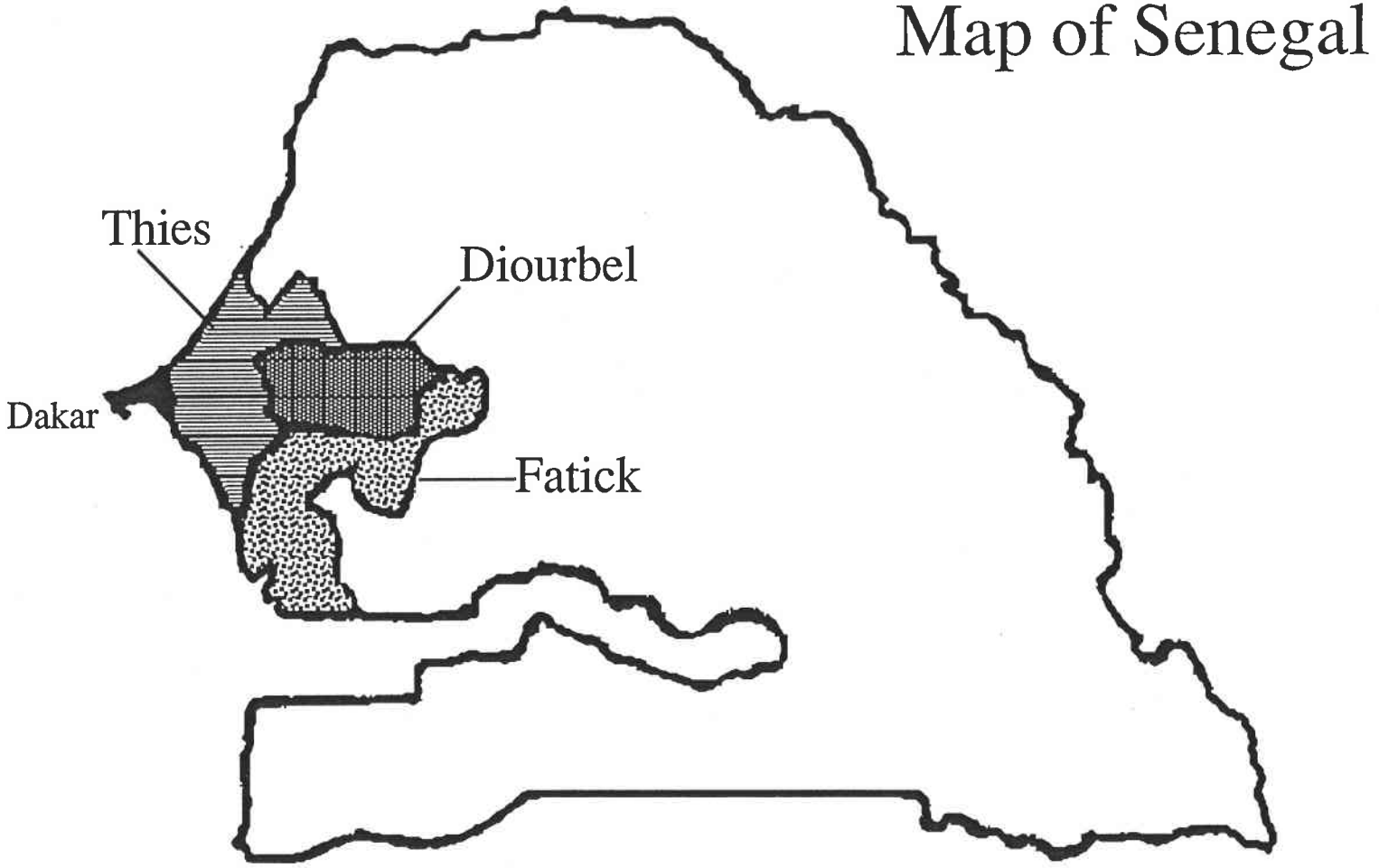

Figure 3. Map of Senegal: three regions in the Peanut Basin

Table 1. a) Reforestation activities in Senegal by region, 1988 (DCSR, 1988).

REGION	Total Seedling Production	Village Plantations (hectares)	Government Plantations (hectares)	Number of Nurseries	
				Gov.	Vill.
St. Louis	963,000	1,495	86	11	61
Louga	2,059,000	798	437	9	136
Diourbel	289,000	229	0	4	24
Thies	1,061,000	795	182	9	85
Dakar	121,000	15	0	2	0
Fatick	443,000	1,066	17	2	72
Kaolack	794,000	786	14	6	191
Tambacounda	770,000	826	98	2	102
Kolda	357,000	848	0	3	7
Ziguinchor	121,000	691	5	6	12
TOTAL	6,982,000	7,550	840	54	690

b) Reforestation projects in Senegal currently working with DCSR.

Project	Number of Villages	Number of Village Nurseries	Number of Project Nurseries
CTL Nord	30	3	2
Kebemer	63	12	2
PROBOVILL	105	65	2
PROBOVILB	41	-	-
P R M N	44	0	4
PROGONA	52	52	3
NGAOULE	-	0	1
ZONE NORD	27	7	-
P R C	30	-	2
PREVINOBA	89	24	3
CTL Sud	9	2	3
PRECOBA	207	(47*) 10	0
PASA	355	19	1
PARCE	360	230	3
P R P T	103	-	-
P R S	-	-	-
TOTAL	1513	461	26

* Private nurseries initiated by PRECOBA

Advantages of Village-Based Tree Nurseries

Government nurseries require large financial outlays for water, labor, and administrative services. Village nurseries provide cheaper labor. One study estimated the cost per seedling in government nurseries to be 43 CFA (West African currency equal to 12 cents U.S.), as opposed to 26 CFA (7 cents) in village-based nurseries (DCSR, 1988), about 60 percent more. Costs of government or village nursery production may be covered in part or whole by donor agency contributions, by GOS forestry funds, or by revenues from fines for illegal cutting.

Lack of funds for fuel and vehicles often inhibit timely seedling delivery from government nurseries (Gaye, 1988). Village nurseries significantly reduce transportation costs and mortality losses because seedlings are grown closer to the planting sites. The savings thus realized mean more funds and seedlings available for other reforestation activities.

In their review of development projects, Cohen and Upoff (1977) highlight the importance of local participation in planning as a crucial component for development projects (UNDP, 1984). Direct involvement of community members in the formulation of goals, in project maintenance and in the distribution of benefits, is imperative (Sen and Das, 1987). Program adjustments, such as transferring the responsibility

of growing and transporting seedlings to villagers encourages villager participation (FAO, 1978).

Disadvantages of Village-Based Tree Nurseries

Disadvantages of village nurseries include the lack of quality control, unpredictable production associated with poor silvicultural practices, and prevalence of pests. Access to appropriate and timely expertise is often difficult in rural settings. In addition, many villages have an unstable labor force, particularly during the nursery season. Finally, water sources are often insufficient to maintain a village nursery.

Reforestation projects are catalysts for change and villagers are the beneficiaries of the trees thus planted (Gueye, personal communication). However, in some villages, confusion over tree ownership occurs because the project requires villagers to produce a specified number and species of seedlings, with predetermined distribution of a portion of the seedlings to other villages or government projects. In these cases, villagers often think they are producing seedlings for the government, not for themselves, and thus are discouraged from participating in nursery operations.

Importance of Extension

Successful establishment and continuation of nurseries depends on the organization of the extension agency, the

extension agent him/herself, and the creative use of extension methods. The extension agent or agency attempts to influence adoption decisions in a direction he/she feels is desirable (Rogers, 1962). The extension agent coordinates awareness campaigns and organizes practical hands-on education using a variety of methods. Follow-up and continued cooperation is important as is monitoring and evaluation (FAO, 1986). Many methods are employed by these projects, some structured and others informal.

The Projects

Seventy-five percent of reforestation activities in Senegal are managed by projects not directly controlled by the forest service, yet working closely with it. The term "project" here is defined as an administrative organization and its approach to reforestation activities.

There are currently 16 reforestation projects throughout the ten regions of Senegal (Table 1b). These projects receive financing from foreign donor countries, are administered at the international level by development organizations such as Food and Agriculture Organization of the United Nations (FAO), and are administered and implemented at the national and local level by DCSR and other governmental agencies (Figure 1).

Non-Governmental Organizations (NGOs), working directly with villagers or cooperating with DCSR, have also

undertaken reforestation projects. In 1987, there were 34 NGOs working in the forestry sector in Senegal (Melamed-Gonzalez and Giasson, 1987). These range from small local cooperatives or village development groups, to large international NGOs based in developed countries. Their strengths include close communication with local communities, low administrative costs, and the ability to integrate forestry activities with related agriculture, water supply, health, and energy concerns within a broader rural development context. Organizational problems may inhibit some NGOs from participating in government and aid agency funded projects. Cooperation among NGOs, governments and aid agencies is generally poor. The grass-roots approach to forestry by NGOs is their major contribution (Hazelwood, 1987). However, NGO projects were not examined in this study because they represent a small portion of village nurseries in Senegal and were beyond my capacity to examine at this time.

For the study hereafter described, I selected four projects which most closely represented those found in the 16 reforestation projects in Senegal. These projects have the following common characteristics: 1) establishes village-based nurseries to produce seedlings for village woodlots, agroforestry, and household planting, 2) is administered by a governmental agency (EF or Societie de Developpement et Vulgarisation Agricole (SODEVA), an

agricultural extension agency, 3) offers variety in financing, extension method approach and organizational structure, and 4) is located in similar climatic and vegetative zones (the peanut basin of Senegal) (Figure 4). Furthermore, I was able only to survey the selected projects with the available time and funds.

Three projects: PRECOBA, IREF, and Project de Reboisement Villageois dans le Nord-Ouest Bassin Arachidier (PREVINOBA), are administered at the national level by DCSR, and implemented at the field level by IREF. The fourth, Projet de l'Agroforesterie et du Conservation des Sols et des Eaux (PAFOCSE), is administered and implemented nationally and locally by SODEVA, which has its own extension agents. The four projects are further described in Table 2. I will elaborate on the four projects in the discussion section when I compare the performance among them.

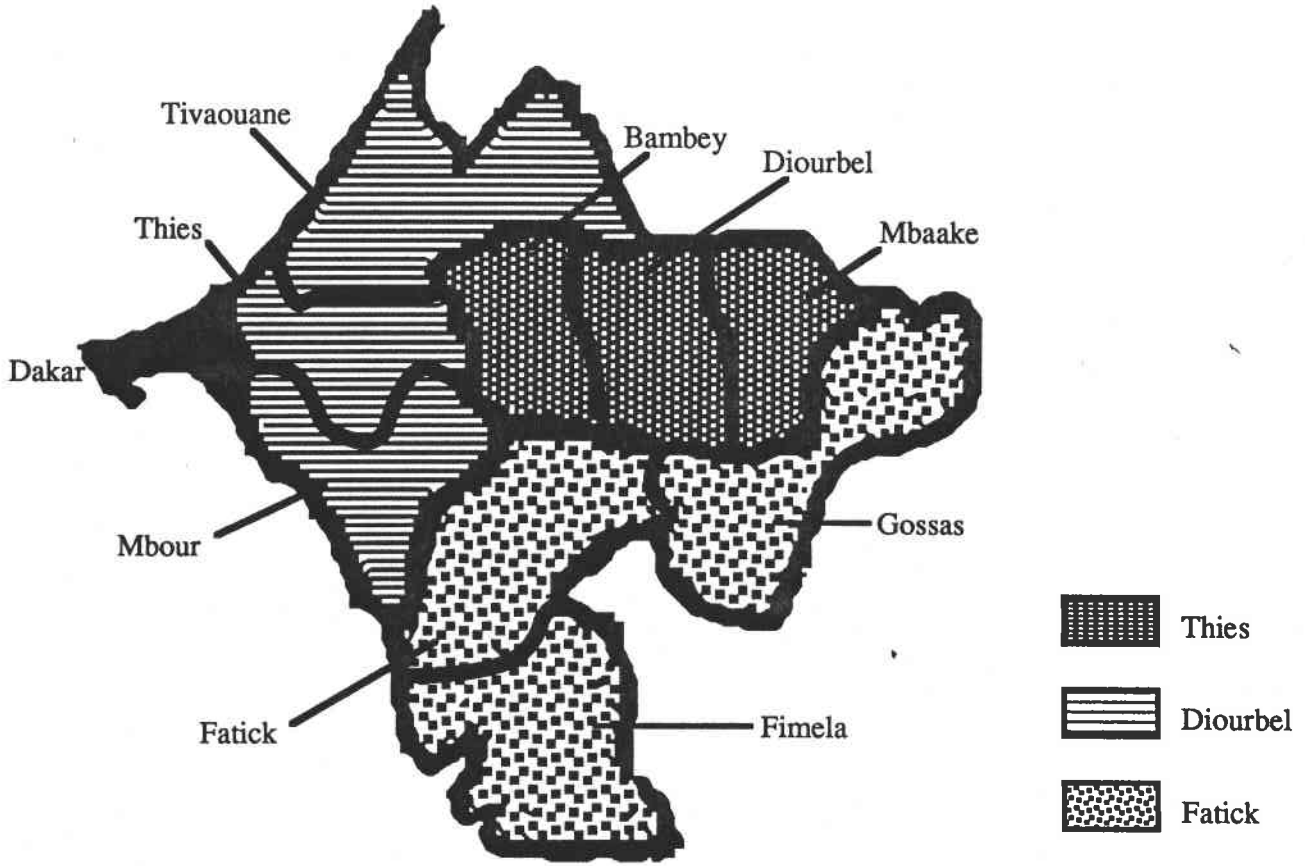

Figure 4. Map of Thies, Diourbel and Fatick, three regions in the Peanut Basin, with departmental subdivisions, location of four reforestation projects, 1988

Table 2. Characteristics of four village-based tree nursery projects in Senegal, 1988: History, size, financing, and administrative characteristics (FAO, 1988; Gaye, 1988; Linehan, 1987; Saware, 1987).

	PRECOBA	IREF	PREVINOBA	PAFOCSE
1. Project History a. Commencement of Project	1982	1982	1987	1985
b. Status of project	on going	on going	on going	com-pleted
2. Number of Villages in the project	207	205	89	60
3. Number of Village-Based Tree Nurseries	10	24	24	25
4. Source of Financing a. International Donor	Holland	None	Finland	USAID
b. Government of Senegal	DCSR	DCSR	DCSR	SODEVA
c. International Admin.	FAO	None	FAO	None
5. Total Annual Financing US $ (1987)	615,000	N/A	578,000	1,000,000

II. OBJECTIVES

With the preceding introduction to village-based tree nurseries in Senegal and background on the four projects, I now examine the three specific objectives in this study. They are:

1. To investigate village-based tree nurseries in the Peanut Basin of Senegal
   a. To describe nursery characteristics
   b. To evaluate existing nurseries, determining success in terms of seedling survival and manager's intention-to-continue
2. To compare four village-based nursery projects
   a. To compare descriptively the following:
      1. Project goals
      2. Organization
      3. Extension methods
      4. Technical expertise
      5. Incentives
   b. To compare project performance and evaluate factors influencing nursery success in terms of the measures in 1.b.
3. To develop recommendations for future implementation of village nurseries

To meet these objectives, in the following sections I discuss: 1) methods I used for data collection, 2) data analysis and results, 3) discussion of results, and 4) recommendations.

III. METHODS

Design

I conducted surveys of villages in three regions of Senegal; Thies, Diourbel and Fatick, during November and December, 1988 (Figure 4). My analysis is augmented by observations in Senegal and Mali during four years as a Peace Corps Volunteer and trainer between 1983 and 1988. The survey was largely based on a design by Cernea and Tepping (1978), the Rapid Rural Appraisal process (Beebe, 1985), and personal consultation with Dr. David Cleaves.

Meetings were held with administrators of each of the four projects to secure their logistical support and cooperation and to determine a strategy for conducting the survey.

The study covered eight villages in each of the four projects. Each project covered a region which is subdivided into departments (Figure 4). Villages were randomly selected from within each department in proportion to the total number of nurseries in that department. A total of thirty-two villages were selected. Although stratification of the data into projects made statistical inferences less valid, time and transportation constraints precluded larger samples. The smallest project had only ten village-based tree nurseries, the remaining three had more than 20, so that from 33 percent to 80 percent of the nurseries were examined.

Questionnaires

Two interview questionnaires were developed, an Organizational Questionnaire and a Village Nursery Manager Questionnaire (Appendix C & D respectively). Both surveyed perceptions, attitudes, practices and knowledge on a variety of topics (Livingston, 1988).

The Organizational Questionnaire was administered to two or three representatives from each project, either departmental or project level extension coordinators for a total of ten responses. It was used to collect data regarding the material and financial inputs of each project, the extension method or strategy used, the frequency of interaction between extension workers and villagers, problems encountered and recommendations for changes.

The Village Nursery Manager Questionnaire contained questions about the village, the ownership of nursery land and seedlings, and the position of the interviewee (usually the nursery manager).

In this study, seedling survival rate was used as an indicator of success. Survival can be influenced by village knowledge, by physical/environmental conditions, by interference from other agricultural activities, and by cultural barriers. I selected survival rate because reforestation efforts depend on the survival of trees once they are outplanted, thus a higher nursery seedling

survival rate is essential. Survival also represents how well the village members put their training to use.

Survival is calculated as a percent by:

seedlings survived/# pots planted x 100 = % survival

Remaining sections of the questionnaire included open-ended questions concerning who was involved in species selection, whether or not they participated in a nursery training, what materials were provided (including financing for wells), and whether they intended to continue the nursery next year, with and without project financing. Intention-to-continue is an important variable because it provides a measure of performance related to self-sustaining reforestation practices.

Execution of the Survey

The questionnaires were translated into French and Wolof (the local language), with the assistance of Mr. Salif Gueye, a forest engineer from DCSR. I conducted the survey by interviewing the manager or assistant manager of each nursery. Mr. Gueye accompanied me on these survey visits to help translate and verify responses. A local representative of the project also accompanied us to help find the villages, identify the nursery manager, and formally present us to each village Chief.

IV. ANALYSIS AND RESULTS

Village-Based Tree Nurseries

Factors Affecting Seedling Survival

I examined 12 variables that could conceivably affect seedling survival (Table 3).

I used a multiple regression model to determine which variables or combinations of variables were predictors of seedling survival (Appendix E). Only one of the variables was significant.

Residuals were approximately normally distributed. Examination of the correlation matrix showed no collinearity, however, there was non-constant variance (heteroscadasticity). To adjust for this, I used the weighted least square estimates of the dependent variable, with weights equal to:

$$(p \times (1-p)/n)$$

where: p = percent survival
n = number of observations (32)

With this model, the variance was only slightly improved, but the estimated regression coefficients were still unbiased and consistent (Neter, Wasserman, and Kutner, 1989).

Table 3. Variables used in multiple regression analysis for village nursery success.

Variable		Question	Response
Y_1		Seedling survival	number
X_1	*	Who chose the species that you grew?	multiple choice
X_2		Have you or another member of this village ever participated in a nursery training?	Y/N
X_3	*	From your experiences, what were the biggest problems in the nursery?	multiple choice
X_4	*	Who owns the nursery?	multiple choice
X_5		How many pots did you fill this year?	number
X_6		Did you ever have in a nursery before the beginning of this project?	Y/N
X_7	*	How often did your extension agent visit your village during the nursery season?	multiple choice
X_8	*	How often since you have planted your trees has the agent been to visit?	multiple choice
X_9		Did your extension agent teach you seeding techniques?	Y/N
X_{10}	*	What was your water source for the nursery?	multiple choice
X_{11}		Was the quantity of water sufficient?	Y/N
X_{12}		Was anyone compensated for their work in the nursery?	Y/N

* variables were recoded as indicator variables (one of two responses)

T-test results (Appendix E) indicated that only choice in species selection, or "Participation", X_1, was a potential predictor. None of the interactions among variables was significant.

I used the simple regression model to determine if "Participation" alone helped predict seedling survival (Appendix F). There was significant predictive value with a regression equation of:

$$Y_1 = .362 + .327(X_1)$$

where: Y_1 = Percent survival, X_1 = Participation

The coefficient of determination (R^2) indicated that 32 percent of the variation in seedling survival was attributed to "Participation". Interpretation of these results will be discussed further in the Chapter V.

Factors Affecting Intention-to-Continue

The nursery manager's intention-to-continue was elicited under two scenarios: 1) with continued project financing, and 2) without project financing. Financing is defined as money and supplies provided by the project including pots, seeds, tools, and/or water improvements. Possible responses were yes, conditional yes, or no. For the conditional yes, the manager specified under what circumstances he/she would continue, for example, if the well were deepened, or if pesticides were provided.

Conditional responses added insight to the study, but because the stipulations could rarely be met, conditional responses were considered as "no" for analysis purposes.

The data were analyzed in two ways. To determine if differences exist among villagers, I used the chi-square test for categorical data. It showed a significant decrease in manager's intention-to-continue if project financing was discontinued.

Secondly, I investigated combinations of 18 variables (Table 4) to evaluate their influence on nursery manager's intention-to-continue using the multiple logistic regression model, or logit. Logit analysis was selected over a normal regression model because it is suitable for binary dependent variables (Neter, Wasserman, and Kutner, 1989).

Table 4. Variables considered for intention-to-continue among village nurseries.

Variable		Question	Response
Intention-to-Continue			
Y_1.		What do you plan on doing next year if the project financing continues?	Continue/ discontinue
Y_2.		If there is no financing from the project, what will you do?	Continue/ discontinue
Previous Experience			
X_1.	*	In what years did you have a nursery?	years
X_2.	**	Categorical division of years	years
X_3.		Did you ever have a nursery before the beginning of this project?	Y/N
X_4.		Before you began this nursery, had you ever bought trees for outplanting?	Y/N
X_5.		Before you began this nursery, had you ever receive trees free for outplanting?	Y/N
Nursery Ownership			
X_6.	**	Who owns the nursery?	multiple choice
Water Problems			
X_7.	**	From your experience, what were the biggest problems in the nursery?	multiple choice
X_8.	**	What was your water source for the nursery?	multiple choice
X_9.		Was the quality of the water good?	Y/N
X_{10}.		Was the quantity of the water sufficient?	Y/N
X_{11}.		Did you receive financing for improving your water source?	Y/N

Table 4. con't

Extension Methods			
X_{13}.	**	Who chose the species that you grew?	multiple choice
X_{14}.		Have you ever participated in a nursery training?	Y/N
X_{15}.	**	How often did your extension agent visit your nursery?	multiple choice
Incentives			
X_{12}.		Was anyone compensated for their work in the nursery?	Y/N
X_{16}.		Have you ever thought of selling seedlings from your nursery?	Y/N
X_{17}.		Did you donate the seedlings from your nursery free to groups or individuals in your village or elsewhere?	Y/N
X_{18}.		Did you sell any seedlings from your nursery?	Y/N

* variable was continuous
** variables were recoded as indicator variables (one of two responses)

Responses to the questions "What will you do (with your nursery) next year (with or without project financing)?" were fit to the logit regression model. The data was run on the Shazam (1987) statistical program. The model (Appendix G) yields a fitted value (π) that estimates the probability that a manager will intend-to-continue depending on the variables that are significant in Table 4. The logit function, $g(\pi) = (\pi/(1-\pi))$, is the logarithm of the odds ratio, the difference between the estimated odds when the variable = 1 and the estimated odds when the variable = 0 (Neter, Wasserman, and Kutner, 1989). It is capable of approximately describing the relation between changes in the factors in Table 4 and the changes in (McCullagh and Nelder, 1985).

Independent variables were subjectively divided into categories corresponding to past experience, nursery ownership, water problems, extension methods and incentives. A logit regression was estimated for each set and the most significant variables from these groups were selected for further analysis.

Intention-to-continue with project financing was not correlated with any of the independent variables because it was uniformly high. Without financing, however, manager's intentions showed interesting trends. Five variables were identified as potential predictors of intention and were combined in a final logit model.

Three variables were significant predictors: 1) previous experience, 2) water problems, and 3) commercial sale of seedlings from their nursery (Appendix H).

The logit equation indicates that, for example, the estimated probability is 80 percent that a respondent who had never had a nursery ($X_1 = 0$), did not list water as their biggest problem ($X_2 = 1$), and had sold seedlings from his/her nursery ($X_3 = 1$), will intend to continue the nursery if project financing is eliminated. The logit regression model is:

$$\pi = \frac{\exp(-1.5593 + 1.8163(X_1) + 1.1630(X_2) + 1.7806(X_3))}{1 + \exp(-1.5593 + 1.8163(X_1) + 1.1630(X_2) + 1.7806(X_3))}$$

Further discussion follows in Chapter V.

Role of Women: Knowledge about women's roles in forestry projects is important because it ensures that extension efforts are directed at women as an appropriate target group. As a sidelight to the study, I compared women's responsibilities in all nursery tasks with women's responsibilities in the two most time consuming tasks: filling pots and pulling water daily (Table 5). Women participated in 35 percent of all tasks, but their participation increased to 65 percent in the two most time consuming tasks (Appendix I).

Table 5. Women's responsibilities in village nurseries; Number of villages that included women in specific tasks in Senegal, 1988.

Nursery Task	Included Women	Did not Include women
Nursery site selection	6	26
Filling pots	21	11
Soil mixture	13	19
Species selection	8	24
Seeding	8	24
Pulling water	21	11
Watering	9	23
Shading/mulching	5	27
Protection	7	25

Comparison of Four Projects

To compare the four projects, I discuss their goals and activities (Chapter V). I also analyze: percent survival and intention to continue, in relation to water shortages, well financing, number of pots filled, provision of tools and other materials, degrees of participation, and training in the four projects (Table 6). I used the analysis of variance (ANOVA) and chi-square statistical tests for these comparisons.

Table 6. Variables tested for differences between four nursery projects in Senegal, 1988.

Question	Response
How many pots did you fill?	number
How many seedlings did you have at the end of the nursery season?	number
What do you plan on doing next year if the project financing continues?	continue/ discontinue
If there is no financing from the project, what will you do?	continue/ discontinue
Who chose the species that you grew?	multiple choice*
From your experience, what were the biggest problems in the nursery?	multiple choice*
Did you receive financing for improving your water source?	Y/N
How many pots did you fill this year?	number
What materials were provided by the project? (Tools, fertilizers and pesticides)	multiple choice*
Have you or another member of this village ever participated in a nursery training?	Y/N

* variables were recoded as indicator variables (one of two responses)

PREVINOBA and IREF had 83 percent and 82 percent survival, and PAFOCSE and PRECOBA had 62 percent and 56 percent. Grouped together, PREVINOBA and IREF had significantly higher seedling survival than the other two. PREVINOBA and IREF also included villagers in the selection of species more often (Appendix J).

There were no significant differences in intention-to-continue or in perceived water problems.

The material support provided by each project was significantly different except for the provision of plastic pots and seeds (Table 7). However, these differences were not correlated with the measures of nursery performance: seedling survival or villagers intention. Participation or other unmeasured factors must be influencing performance as is discussed in the following chapter. Statistical comparisons are found in Appendix J.

Table 7. Differences in material support provided to villages in four nursery projects in the Peanut Basin in Senegal, 1988. Columns 1,2 and 3, indicate the percentage of villages receiving materials, column 4 is the average number of pots.

PROJECTS	POTS & SEEDS %	TOOLS, FERT PESTICIDES ETC. %	WELL FINANCING %	NUMBER POTS FILLED
PRECOBA	94	48	50	3050
EF	94	***27	37.5	3050
PREVINOBA	100	58	* 100	4200
PAFOCSE	100	73	62.5	***850
CHI-SQUARE RESULTS	No Difference	10.29 p =.001	7.47 p =.05	20.25 p =.0002

* = significant at .05, ** = sign. @ .01, *** = sign. @ .001

V. DISCUSSION

Village-Based Nurseries in Senegal

Characteristics

Community ownership by men's groups, women's groups, or both, accounts for over 80 percent of the village nurseries (Figure 5). The rest are owned by individual farmers. More than 75 percent of the nursery land is owned by private individuals. Divided ownership between nurseries on one hand and land on the other, seldom seems to cause problems, and no evidence was found that conflict influences intentions.

Seedling production techniques in Senegal are typical of those used in many West African countries. Plastic pots are filled with a mixture of soil and manure and set in beds approximately one meter wide and of variable length. Tree seeds are sown one per pot and require between six and 24 weeks in the nursery prior to outplanting. Pots are seeded between March and May to have trees for outplanting when the rains begin in June or July (Weber, 1982). A tree nursery requires at least one watering daily. Seedlings that are outplanted early in the rainy season can survive the nine-month drought period without regular watering.

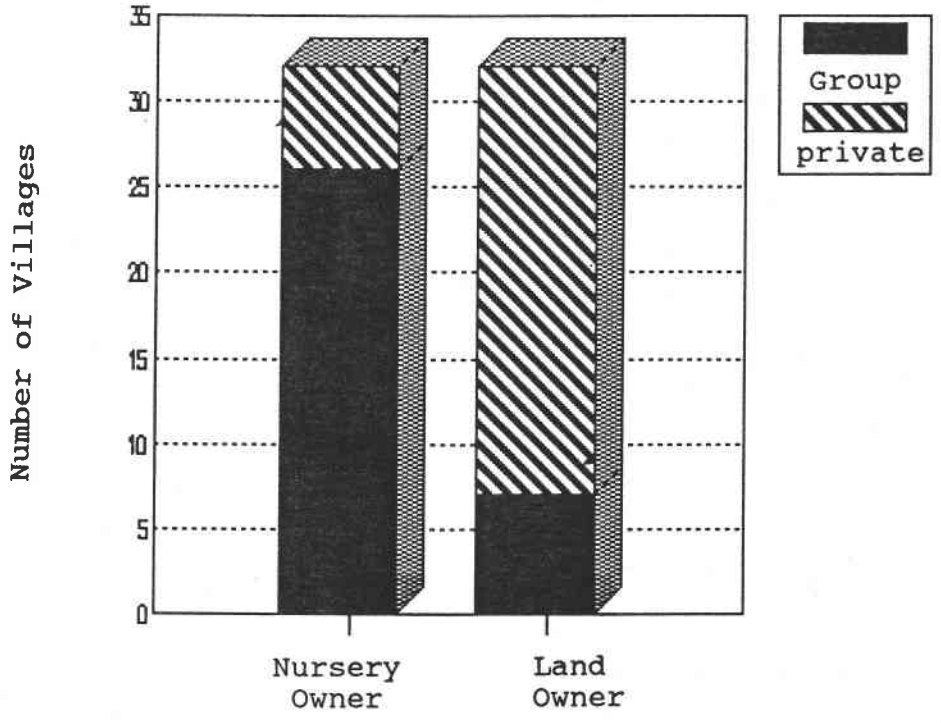

Figure 5. Nursery Ownership: Group versus private ownership of tree nurseries and land in four village-based tree nursery projects in Senegal, 1988.

Most seedlings (69 percent) are outplanted in village woodlots (Figure 6). Agroforestry practices, such as windbreaks and field plantings, account for the second largest use. Shade tree planting in courtyards and around the village ranks third. Multiple purpose species that serve, for example, as windbreaks and fodder, or provide shade and fruit, are preferred by villagers.

Most seedlings remain in the village that produced them and are given free to village groups and individual farmers. Nursery managers sometimes distribute free seedlings to neighboring villages. Less than twenty percent of the nursery managers had ever sold seedlings.

Eighty-five percent of the nurseries depend on hand-dug, cement-lined wells for water. Deep bore-hole wells and piped water from a reservoir are less common water sources.

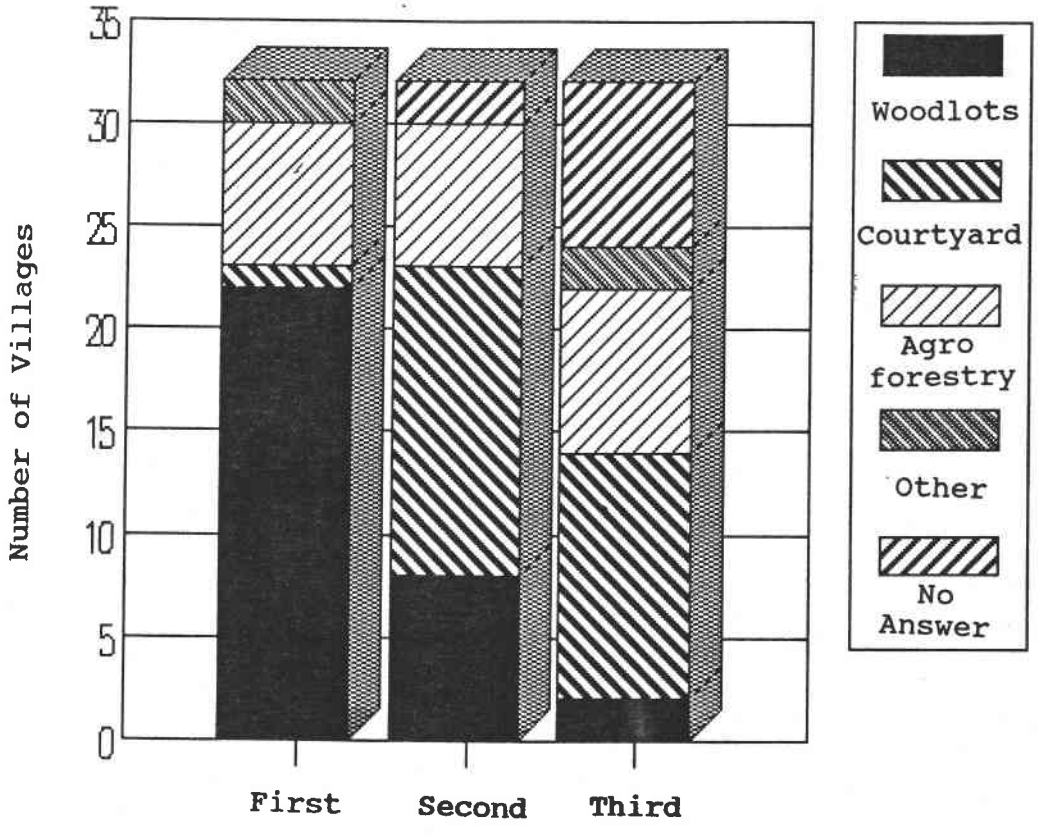

Figure 6. Uses of seedlings produced in village-based tree nurseries in Senegal, 1988 (listed as villagers' three most important uses).

Barriers to Nursery Implementation

Water quantity heads the list of nursery problems, with pests, water quality, lack of pots, seeds and tools, and poor germination also influencing success (Figure 7). Access to technical and diagnostic services is rarely available; for example, villagers are unable to accurately identify insect or disease problems. Seedling protection from grazing animals, both in the nursery and after outplanting, is also a major problem in reforestation efforts (Weber, 1982).

Less evident are problems associated with the effectiveness of extension strategies, including mixes of activities such as village participation, training, and incentives affecting the success of the nurseries.

To be effective in diffusing new ideas, the extension agent must secure linkage with the clientele (Rogers, 1962). This requires communication between extension agents and villagers, under social and cultural constraints. Therefore, an extension agency should try to match target groups with extension agents of similar cultural and social background who have appropriate communication skills.

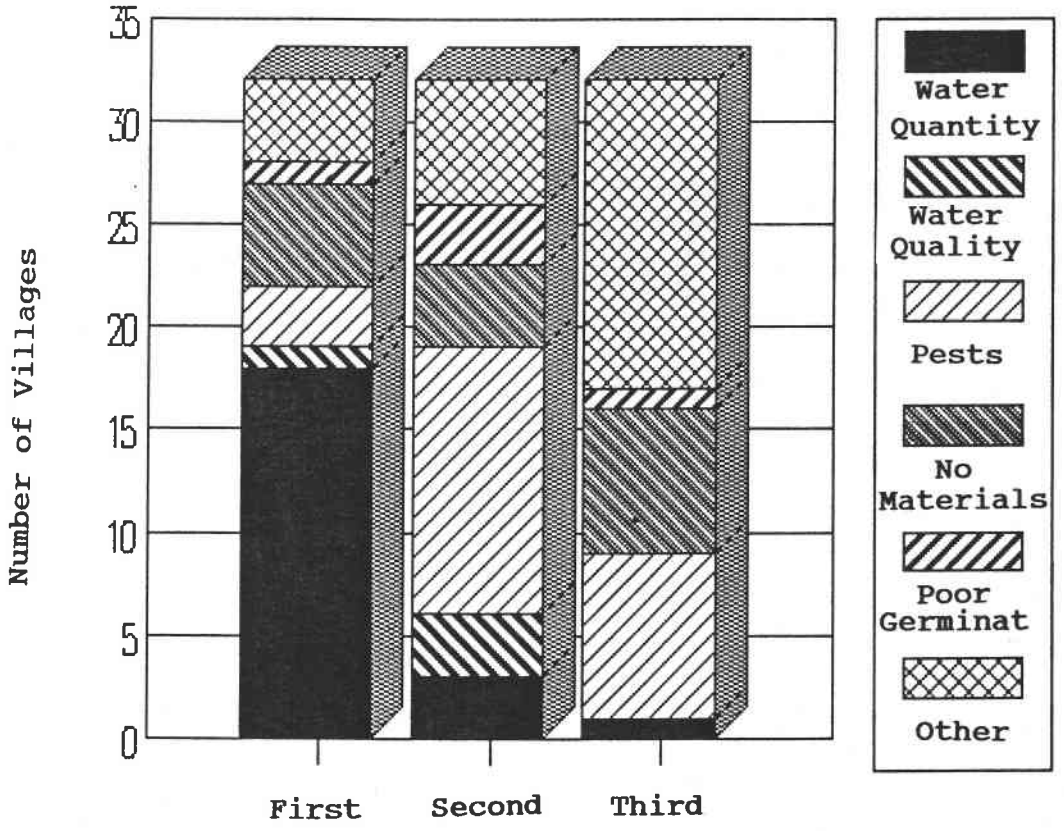

Figure 7. Nursery managers' perceived problems in village-based tree nurseries in Senegal, 1988 (listed as managers' three most important problems).

In African agriculture, women account for 60-80 percent of the labor force (Kandiyoti, 1985). This study showed that women play a significant role in nursery production in Senegal, participating in 65 percent of the most time consuming tasks. Communication with women farmers might suggest the effectiveness of having women foresters and extension agents (FAO, 1978). Women are the primary collectors of fuelwood, often have a detailed knowledge of the growing properties and uses of trees (Shepherd, 1985), and are more permanent residents in villages than the men who might migrate to urban areas for jobs. Unfortunately, women are under-represented as forestry extension workers in Senegal (Gueye, personal communication).

Another subtle, yet real problem is the village dependence for material or financial support from the project. Under many projects, equipment and supplies are temporarily furnished, but villagers fail to perceive this as a temporary service. There is neither explicit agreement to encourage self-sustained production, information about availability of supplies, or programs to encourage the villagers to sell seedlings. Villagers' intention-to-continue declines by 32 percent if financing were not provided.

Predictors of Success

Seedling Survival: The regression model indicates that participation is a significant predictor of seedling survival (Appendix F). The results are reasonable for a model based on observed survey results, recognizing that many other factors could not be measured, such as interest of the extension agent, political problems within the village, and pest losses.

The model reinforces the concept that social forestry must accurately and obviously reflect the needs, aspirations and problems of the people, and should be based on open consultation with them (UNDP, 1984). When villagers produce seedlings that generate perceived benefits, they better care for the nursery.

Intention to Continue: There was a significant impact of the presence of financing on the nursery manager's intention (Figure 8). Three of the four projects' goals state that villagers should be responsible for the management of their wood resources, however, the data indicates that this goal is not being realized. Villagers depend on continued financial support.

Without financing only 43 percent intended to continue. Fifty-six percent would not continue or would continue only under specified conditions. This raises the question of whether the projects are fulfilling their stated goal of self-sustained production.

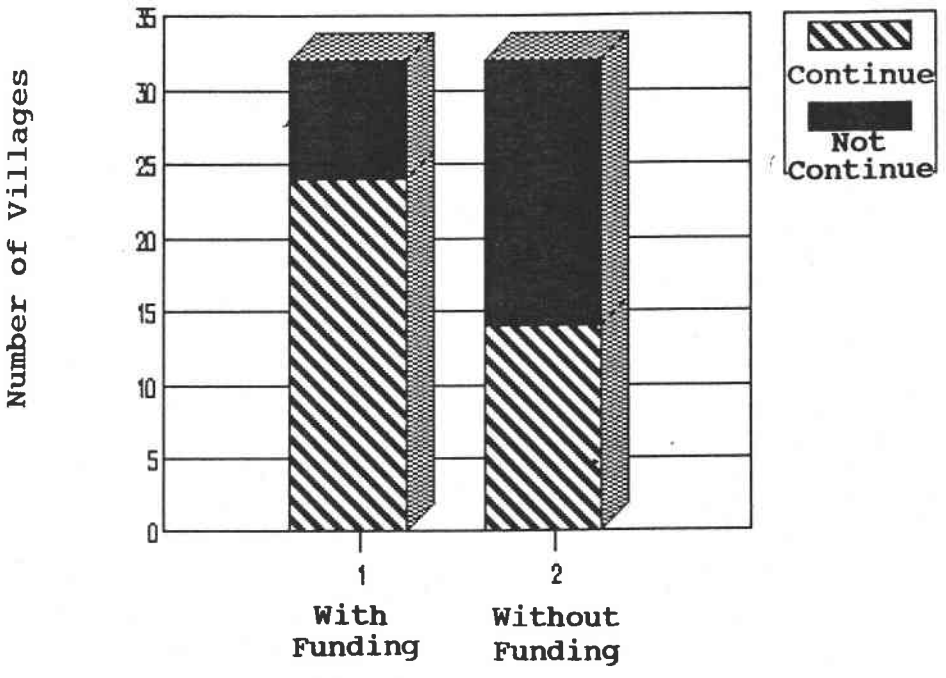

Figure 8. Intention to continue village-based nurseries with and without continued funding, Senegal, 1988.

Results indicate that managers' intention was most positively correlated with their previous experience. Villagers with previous nursery experience, even if unsuccessful, have a higher probability of intending to continue their present nursery. This suggests that villagers who have established nurseries in the past, with other projects or on their own, should be targeted for sustained adoption.

The fact that villages without water problems are more likely to continue is not surprising. This suggests that projects promoting self-sustaining nurseries should concentrate financial incentives and technical assistance on securing a water source. This may be more important than the supplies and equipment normally provided.

Villagers who have sold seedlings from their nursery are more likely to continue. Sixteen percent of the nursery managers had sold seedlings. This supports Anderson's (1987) idea that charges for seedlings, perhaps sufficient to cover operating costs, would financially support the project (or village) and discourage waste. Markets for trees and tree products from the village woodlots would also encourage greater seedling demand.

Comparison Among the Four Projects

Table 8 is a comparison of the four project's goals. All projects defined their goals clearly and outlined steps needed to achieve them. Similarity in stated goals indicated that reforestation efforts in Senegal are agreeing on what technical and social aspects are important. Individual project goals are described in detail in Appendix K.

Comparison of Stated Goals

Administrative goals in all four projects encourage village participation and self-sustaining activities (Linehan, 1987; Saware, 1987; FAO, 1988; and DCSR 1988). In addition, PRECOBA and PREVINOBA and IREF identify local participation and popularizing forestry as either their first or second goal (FAO, 1988; DCSR, 1988). These three projects state that village self-management is the ultimate goal.

Table 8. Goals of four reforestation projects in Senegal, 1988, listed as they appear in project documents (FAO, 1988; Gaye, 1988; Linehan, 1987; Saware, 1987).

PROJECT	GOALS			
	First	Second	Third	Fourth
PRECOBA	Increase Awareness	Establish Woodlots	Provide Technical Supervision	Village Management of Agro-Forestry
IREF	Follow National Forestry Code*	Encourage Villagers as Producers/ Protectors of Forests	Stop Desertifi-cation	
PREVINOBA	Increase Awareness/ Encourage Village Forestry Management	Encourage Agroforestry Activities	Improve Technical Forestry Knowledge/ Skills	
PAFOCSE	Initiate Agroforestry in 60 villages	Adaptive Technical Agroforestry Research	Research Environmental Social Economic Agroforestry	

* The National Forestry Code is a set of rules regulating public access, harvesting and protection of natural forests and the management of these woodlands and savannas including reforestation.

PAFOCSE did not implicitly state local participation in its goals but discussed it throughout the planning document. This may be attributed to the fact that SODEVA, the GOS administrative body in PAFOCSE, is an extension agency, thus local participation and awareness building are inherent in all of their projects. The planning document stresses actual production goals such as creation of 60 woodlots (Linehan, 1987). Village groups had to agree to meet minimum requirements including size of woodlots and windbreaks. PAFOCSE maintained a "top down" approach and failed to involve the rural community in the initial stages.

Agroforestry is emphasized in the goals of all four projects. PAFOCSE, with much experience in agroforestry, required villagers to plant windbreaks and distributed beans for cultivation in woodlots. SODEVA, PAFOCSE's administrative agency, initiated agroforestry in the 1970s in a protection program for Acacia albida in cultivated fields; therefore agroforestry practices continue in PAFOCSE today. All four projects promote species that have multiple-use benefits for agroforestry in their nursery production.

PAFOCSE is distinctive in that it includes research as a goal. Agroforestry experiments with components of biological and sociological research are high priorities (Linehan, 1987). However, only one of these research

projects has produced results due to lack of funds and lack of cooperation with the Institute Senegalaise de Recherche Agricole (ISRA), the national agricultural research institute (Linehan, 1987). I explore research further in the section on Organization (page 48).

IREF, under the direction of EF, the national forest service, differs from the other projects because the National Forestry Code determines its goals. IREF, as a regulatory agency, controls harvesting and protects natural forests or specified tree species with a system of permits and fines outlined. This code is strict, therefore, it has been suggested that villagers may be apprehensive about working with IREF.

I investigated project activities in four categories: 1) organization, 2) extension education, 3) technical assistance, and 4) incentives. The subdivisions in each category highlight the qualities of an ideal extension program (Anderson, 1989; FAO, 1986). Figure 9 displays some distinguishing characteristics of the four projects.

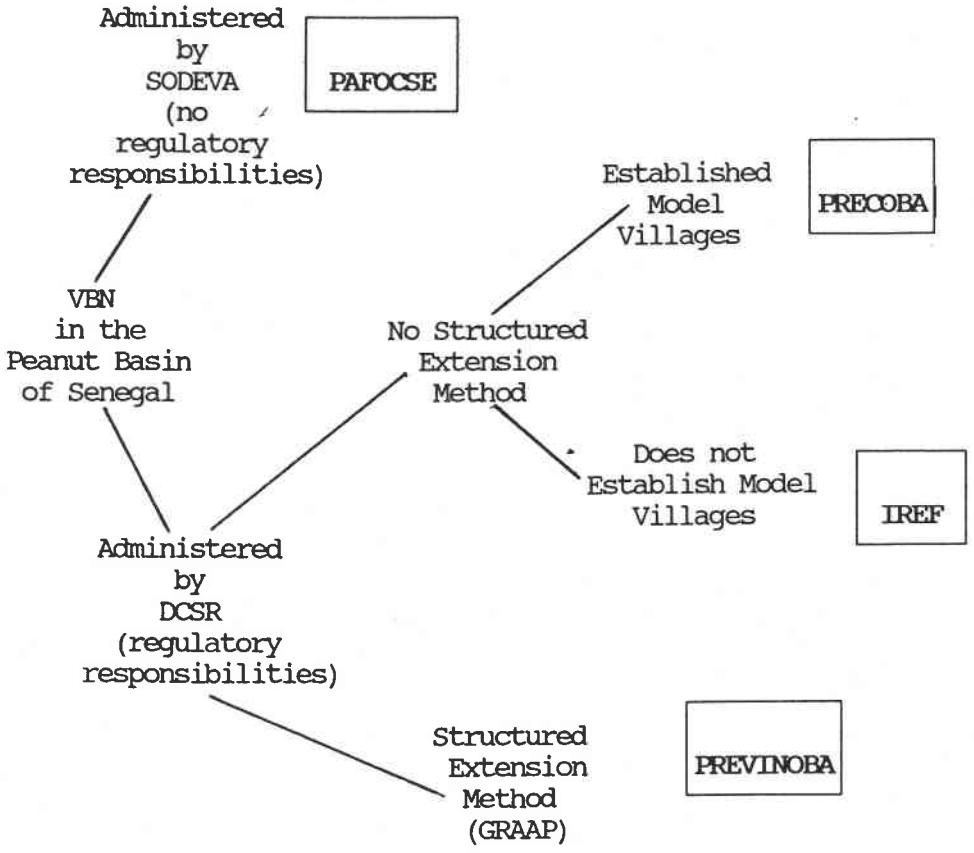

Figure 9. Distinguishing characteristics of four village-based nursery projects in Senegal.

Organization

Table 9 compares the organizational components of the four projects. Three of the projects use trained foresters or Chef de Brigades (CB) from EF as their extension agents (Figure 10). While they are technically qualified, in most cases, they have little or no extension training. In addition to EF, these agents are responsible to the Centre d'Education Rural (CER) which integrates government development activities throughout each district. This is advantageous because the agents can coordinate nursery activities with other activities such as the agricultural production cooperatives or improved gardening and water projects. This helps avoid overlapping forestry projects, keeps the GOS informed of reforestation activities, and integrates nursery management with other activities.

Research: While research cooperation between forestry projects and research institutions, such as joint funding, identifying research goals and establishing sites for village field trials, is well defined in the planning documents in three of the four projects, there is little evidence of its fruition (Linehan, 1987; FAO, 1988; and Saware, 1987).

Table 9. Comparisons of the organization of four extension projects.*

COMPONENTS	PROJECT			
	PRECOBA	IREF	PREVINOBA	PAFOCSE
1. Integrates activities with other agencies				
a. Int'l Development	yes	no	yes	yes
b. Research	yes	no	no	yes
c. Local rural development agency	yes	yes	yes	yes
2. Program emphasis				
a. Awareness	good	fair	excellent	good
b. Training	good	good	very good	poor
c. Production	good	good	good	fair
d. Research	fair	poor	poor	fair
3. Provides training for extension agents				
a. Technical training	very good	very good	very good	fair
b. Extension training (communication and instruction)	fair	poor	excellent	fair
4. Regulatory responsibilities	negative effect	negative effect	negative effect	neutral
5. Conducts evaluations yearly (levels)				
a. National	good	good	good	good
b. Project	good	N/A	good	good
c. Departmental	good	good	good	good
d. Village	good	poor	fair	fair

* qualitative assessments provided by the author based on organizational interview and work experience in West Africa.

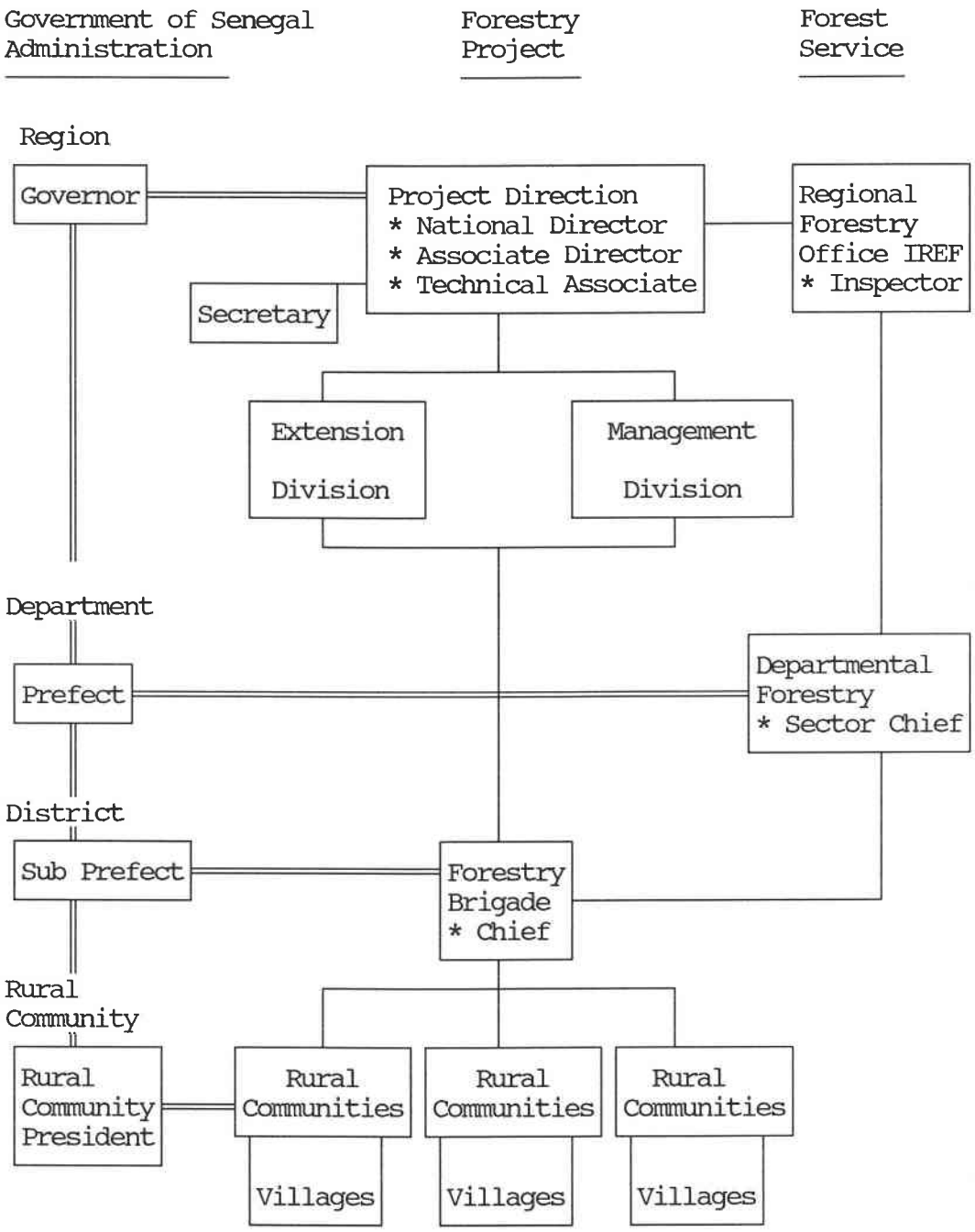

Figure 10. Organizational diagram of the interactions between the government of Senegal, the Forest Service and donor-financed Forestry Projects in Senegal.

* Title of the civil servant
— Interaction within the Forest Service or Project
= Interactions between Government Officials

In the final technical report of PAFOCSE, the proposed research to be conducted by the Division de Research de Produit Forestier (DRPF), the forest products branch of ISRA, included controlled experiments of agroforestry activities, follow-up field studies, soil surveys and others. DRPF was unable to carry out these activities; however, an independent contractor conducted one soil survey whose results were submitted to USAID. Future studies addressing the sociological implications of the agroforestry projects and the silviculture of various tree species were proposed in the 1987 report, but no projects were initiated because of a lack of funding.

PRECOBA had a research program which included mapping forested areas of the region using aerial photographs and studying the harvest activities of established woodlots. To date, these tests have not been published. The aerial photographs and satellite images are currently being used, and Species Elimination Tests (SETs) for saline soils are also being conducted (Lischi, personal communication).

This proposed research would directly and indirectly support village nursery programs. Directly, with SETs and agroforestry experiments that investigate the production potential of species on specific soils and in combination with agricultural crops, the extension agencies will be better equipped to advise villagers on species selection for their nurseries. In the sociological context, the

extension agency would benefit from investigating villagers' motivation to establish and continue village-based tree nurseries. By understanding villagers' motivation, the extension agency can modify its extension approach for future village nurseries.

Indirectly, research on wood volume yields, harvesting techniques, and the marketability of species will help extension agents advise villagers on these subjects and on potential economic benefits.

Training for Extension Agents: Concrete guidelines for extension staff training are limited, although Benor, et al. (1984), clearly define the important considerations in training agents. Orientation to the principles, functions, and working procedures, as well as an awareness of the social-economic benefits of forestry to the community and other rural activities, is essential (FAO, 1984). Updating technical knowledge, possibly through short courses, is necessary. Staff involved in supervisory and management positions should also have appropriate training (Benor, et al., 1984).

One complaint expressed by IREF agents was the lack of opportunities to update their technical and extension skills. DCSR supported periodic training on selected topics, but enrollment was limited to agents in managerial positions. Individual projects such as PREVINOBA funded

other training, but IREF agents working in regions without projects had little opportunity to participate.

PREVINOBA held regular training for the CBs and Sector Chiefs, who work at the district level. These seminars are specifically designed to train agents in the Research and Support Group for Rural Self-Promotion, (Groupe de Recherche et d'Appui pour l'Autopromotion Paysanne, GRAAP) method (Dieme, 1988). This is a structured approach to awareness building and goal setting for rural forestry development projects that was developed in Burkina Faso and is currently being used in other countries in West Africa.

PAFOCSE agents were trained in agriculture methods and in village extension methods. Most had gained their forestry skills through hands-on experience with SODEVA (Linehan, 1987). A two-day introductory workshop in nursery management for the agents had been conducted in the first year of the project. Other staff training included field trips to two forestry projects outside the region and to villages participating in the project (Linehan, 1987). The lack of financial support limited more structured, frequent, and appropriate in-service training.

Regulatory responsibility interaction: The ideal extension program is not regulatory in nature (Niederfrank, 1967). This is not the case in three of the projects: PRECOBA, PREVINOBA, and IREF; because they use EF foresters

in the field. The para-military organization of EF requires CBs to play duel roles as both "police" and extension agent. This factor influences the rapport between project staff and villagers.

As police, they fine farmers for illegal tree cutting, bush fires, and illegal charcoal production, and administer fuelwood cutting permits. A portion of these fines and fees are deposited in the National Forestry Fund to be used for reforestation activities. The remaining portion is paid as commission to the agent levying the fines. This incentive to collect fines perpetuates an antagonistic relationship with rural populations (Lai and Khan, 1986) and complicates the agent's role in extension.

Most EF agents feel that there is little conflict in this duel role (Gueye, personal communication), but villagers' opinions are often contradictory. Some villagers have accepted participation in reforestation projects specifically to avoid punitive action by the forest service (Gueye, personal communication). Villager goals are subordinated in order to remain in favorable standing with forestry agents. This detracts from self-sustainability because villagers' motives are avoidance of negative repercussions resulting from a refusal to participate, not self-sustaining village nurseries. It also may account for reluctance to continue the practice in the absence of contact with agents.

Successful participation in these projects requires honest communication between villagers and extension agents. Perceptions of the extension agent's motives and enthusiasm by clientele affects his/her success in securing change (Rogers, 1962). More successful agents favor the expectations of the local client system over those of the extension agency (Preiss, 1954). Enforcement duty creates a perception that the agent is more closely tied to the institution. Projects that separate the regulatory from the extension function would reduce perceptual confusion.

PAFOCSE does not levy fines but it can provide links to financial assistance. This incentive may also sway villagers to participate in projects despite personal reservations or lack of interest.

Rogers (1962) also discusses the need for the agent to be on the same social level as the clientele. The military uniform worn by many EF agents appears to distinguish them from the rural population. Educated agents coming from an urban background and higher social class are often mistrusted by villagers. Literate people learn, and supposedly teach, in different ways than illiterate people. More than 80 percent of the villagers are illiterate, so a natural communication barrier is established. Some extension agents choose not to wear uniforms when visiting villages and have worked hard to

build a friendly rapport with them. These agents appear to be the most effective.

Project Evaluations: All four projects have yearly evaluations and planning sessions for the next year's campaigns. Regional supervisors and project directors synthesize the evaluations from departmental and district extension agents. Personal performance appraisals are not conducted for extension agents.

Agents in the projects report seedling production from all village nurseries in their district (for EF) and department (for PAFOCSE). This is one of three elements listed by Foley and Barnard (1984) as the basic purpose of program monitoring and evaluation, "monitoring physical progress". Two other elements, impact and client feedback, are also necessary, but in three of the projects surveyed, villagers were not interviewed about the problems encountered. Evaluations instead focus on seedling production and distribution compared to production goals. This narrow focus limits the effectiveness of the evaluation. Individual village evaluations are conducted in PRECOBA, problems are discussed and alternative goals are set.

Identifying strengths and weaknesses in the administrative or support services should also be a part of evaluations (FAO, 1986), but it was difficult to investigate these evaluations without further study.

Extension Education Activities

Qualitative comparisons of each project's extension education activities are found in Table 10.

Designated Extension Method: The Research and Support Group for Rural Self-Promotion (GRAAP) is rigorously used by PREVINOBA to increase villagers' awareness of the problems and opportunities in rural forestry (Saware, 1987). Besides other benefits, this reassures the villagers that the project will address their perceived needs. The GRAAP method applies client involvement, has been widely accepted by the villagers, and is economically efficient (GRAAP, 1982).

In the GRAAP method, the agent leads a village meeting where she/he introduces topics, for example deforestation, and encourages the villagers to express their personal views. As the agent summarizes the points the villagers have made, she/he displays pictures of related activities such as collecting fuelwood. For illiterates, this creates mental pictures and reinforces important points. In this same manner, each aspect of the problem is discussed: causes, consequences, solutions and plans of action (GRAAP, 1982).

Table 10. Comparisons of extension activities included in each project.***

ACTIVITY	PROJECT			
	PRECOBA	IREF	PREVINOBA	PAFOCSE
1. Designated extension method				
a. GRAAP	no	no	yes**	no
b. Training & Visit	no	no	no	yes
c. Community meetings	yes*	yes	yes	yes
2. Awareness campaign media				
a. Radio	good	fair	good	good
b. T-Shirt/hats	none	good	none	very good
c. Calendars	good	good	excellent	none
d. Printed material	none	none	good	good
e. Video/slides	very good	none	good	none
f. Others, posters, etc.	good	very good	very good	good
3. Use of demonstration model plots in villages	yes	no	no	no
4. Use of village training workshops	yes	yes	yes	no
5. Field trips for village nursery managers	no	no	no	yes
6. Includes women managers				
a. Extension agents (agency)	yes	no	no	no
b. Nursery managers (village)	2 of 8	none	1 of 8	1 of 8
7. Allows villagers to select species	4 of 8	8 of 8	7 of 8	6 of 8

* Good contribution
** Excellent contribution
*** qualitative assessments provided by the author based on organizational interview and work experience in West Africa.

PAFOCSE loosely employs the Training and Visit system of extension (Feder, et al., 1985). The agents are trained in the nursery techniques and are expected to diffuse techniques within and among the villages. Agents often live in small villages for closer access to clientele. Frequent visits build a rapport, contribute to the confidence in and respect for the extension agent, and create an environment favorable for change (Rogers, 1962).

Local Leadership: Use of local leadership is exemplified by PRECOBA. This project donates materials to an individual farmer to establish a nursery his/her first year. The farmer is usually an innovator (Rogers, 1962) and an opinion leader of the community. The Communaute Rural (county seat), using 10-15 percent of local tax revenues, buys the seedlings from this private nursery and distributes them to rural residents. Through income gains of the individual nursery manager and guaranteed distribution by the Communaute Rural, PRECOBA is providing a temporary service and encouraging independence in production (FAO, 1988). This system operates independently of PRECOBA after the first year and can continue indefinitely.

Awareness Campaign Strategy: Promotional measures selected depend on the project objectives, local perceptions about growing trees, local farmers' literacy,

their economic status, technical abilities, and access to resources such as water (Foley and Barnard, 1984).

PREVINOBA has the most complete awareness campaign. First year's activities include radio advertisements, illustrated calenders, brochures and video tapes (PREVINOBA, 1988). An intended benefit is to create a strong community spirit that supports decisions to adopt and maintain nurseries. Community cohesion is important in Senegalese society.

The other three projects' awareness strategies include village meetings and the distribution of T-shirts, hats, or posters for villagers participating in the project. However, the emphasis is on establishing nurseries immediately, rather than building an understanding by the villagers about the purpose and methods for producing trees.

Increasing villagers' interest could be accomplished by prepatory field trips to existing village nurseries. None of the projects used nursery visits in their awareness campaign. Yet forty-five percent of the managers interviewed said that visiting a nursery was the most influential activity for encouraging them (Figure 11). Talking with an extension agent was the second most influential factor.

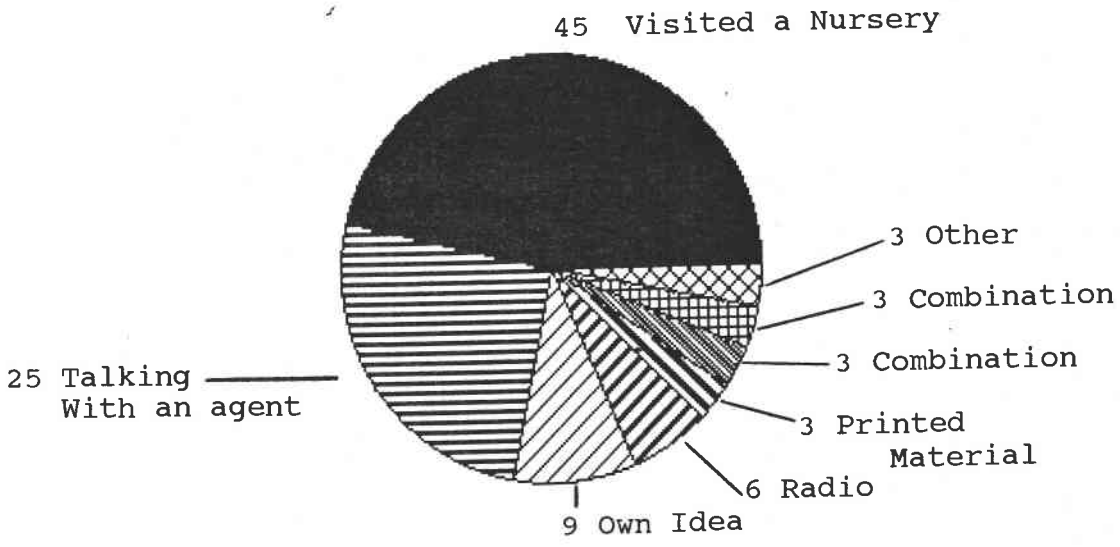

Figure 11. Factors that encouraged nursery managers to establish village-based tree nurseries in Senegal, 1988.

Demonstration Nurseries: Axinn (1978) recognizes demonstration nurseries as a key to success, but they do not exist in three of the four projects. These nurseries could be established with help from research organizations who pioneer improved nursery and reforestation practices. Researchers currently concentrate their efforts at experimental stations and extension agents work in the field. Organizational rewards and funding could be

directed at encouraging mixing of these groups. But evidence points to a reverse trend. For example, PAFOCSE eliminated demonstration models before reducing other activities (Linehan, 1987).

PRECOBA is the one exception. It has a "managed villages" program where water supply development, woodlots, agroforestry, and tree nurseries are integrated in exemplary villages. These villages also serves as demonstration sites for hands-on training of neighboring villagers (Turakka and Diaw, 1986).

Villager Training: Training is an integral part of all extension work (FAO, 1978). Eighty-one percent of the nursery managers surveyed had participated in workshops on how to construct a tree nursery. Three to five-day workshops for 10-30 participants, one or two from each village, were conducted in a village or training center. These workshops provide practical, hands-on training. It offers participants opportunities to temporarily leave the village, to gain respect and prestige in their own villages, and to exchange ideas with managers from different villages, regions, ethnic groups, and levels of experience.

PAFOCSE is the only project that did not mandate this type of training. Each of the other projects had organized its own training. Some villagers participated in an

additional Peace Corps sponsored three-day workshop. All classes taught similar techniques.

The survey participants' most common response about training was it was "too short". The response to the question "did they apply the skills to their nursery?" was overwhelmingly "Yes" with only minor exceptions. The trained villagers were most often "opinion leaders" and played an important role in the adoption of innovations (Rogers, 1962). This method of introducing techniques was seen by the villagers themselves as a highlight of the projects.

Field Trips: Transporting villagers from one region to another to see village nurseries has benefits similar to those of villager training. PAFOCSE is the only project that included field trips (Linehan, 1987). In this project, a healthy competition emerged that encouraged the villagers to produce trees of highest quality. This was particularly true when villagers knew their nurseries would be on display.

Role of Women: Women are viewed by the administrators in all projects as target audiences. One question in my study investigated the role of women in village-based nurseries. I compared the division of labor between men and women in the nurseries. Men have a greater share of responsibility (65 percent) than women (35 percent) when all nursery tasks are considered. However,

for the specific tasks that are most time consuming (filling the pots and pulling water), women are responsible for 65 percent. This supports other findings (Tripp, 1985) that women's contribution in agriculture production is usually underestimated. Women were important contributors in these nursery projects, thus important targets for encouraging self-sustaining nursery production. Failing to consider the role women play in rural society has at times resulted in the failure of projects (Edgren, 1982 in Foley and Barnard, 1984). Also, women were nursery managers in only four of the thirty-two villages I studied.

In addition to securing women in the work force, PRECOBA and PREVINOBA also propose to involve more women as extension agents (Saware, 1987; FAO 1988). In this culture, women agents communicate more effectively with village women than most men agents. However, evidence of including women extension agents was not apparent in any of the projects and there was a noticeable lack of women in DCSR and EF administrative positions (Gueye, personal communication). Women from other governmental agencies, for example, Social Development, are now being considered to serve as forestry extension agents.

Program effectiveness demands expanded efforts to eliminate the sex-bias in agricultural extension (Kandiyoti, 1985). In addition, inequality of women's access to agricultural (and forestry) inputs, such as

financial support, must be countered with direct efforts to promote the women in village-based nursery projects.

Participation in Species Selection: As was seen in the statistical analysis of the seedling survival (page 40), village participation in the selection of species appears to play an important role.

Technical Assistance

Table 11 shows qualitative comparisons of the four projects technical expertise and assistance, and Table 12 compares project incentives to villagers.

Silvicultural Assistance: Many villagers had problems with germination, water quality, pests and disease (Figure 7). Education and advice about advanced nursery management was desired by the villagers but was minimal in all four projects. Insufficient information, lack of money for pesticides, and improper pesticide use by the villagers complicate the situation. This reinforces the need for applied research in nursery production, and communication between researchers, extension agents and nursery managers to identify the problems and investigate solutions.

Table 11. Comparison of the technical assistance provided to villagers in four nursery projects in Senegal, 1988.*

ACTIVITY	PROJECT			
	PRECOBA	IREF	PREVINOBA	PAFOCSE
1. Provides regular on-the-ground silviculture expertise	yes	yes	yes	no
2. Provides "On Farm" Research	yes	no	no	no
3. Collaborates with Local Ag/Forestry Research Centers	yes	no	no	yes

Table 12. Comparisons of incentives to villagers working in four nursery projects in Senegal, 1988.*

ACTIVITY	PROJECT			
	PRECOBA	IREF	PREVINOBA	PAFOCSE
1. Provides financial support for materials				
a. Pots and seeds	yes	yes	yes	yes
b. Tools	yes	no	yes	yes
c. Fencing	no	no	no	yes
d. Pesticides	yes	no	yes	yes
e. Fertilizer	no	no	no	yes
2. Provides a water source	sometimes	no	yes	sometimes
3. Encourages sale of seedlings through agents/education	no	no	no	no
4. Promotes self-sustaining activities	yes	yes	yes	yes

* qualitative assessments provided by the author based on organizational interview and work experience in West Africa.

"On Farm" Research: This research, also know as farm trials, provides a testing ground for research findings before results are recommended by extension on a large scale. It differs from demonstration models because the trials are used to collect data, not necessarily to directly aid diffusion of proven technologies. Trials are simple but duplicated on many farms. They facilitate close working relationships between research workers, extension staff, and villagers (Benor, et al., 1984). PRECOBA is the only project that conducts "On Farm" research in the villages.

Incentives

This was discussed in the statistical analysis section, however, the subject warrants further attention here. A water source (construction or deepening of a well), or plastic pots for seedlings, were provided in all four projects.

A difficult area is the provision of plastic pots. Sanders (Anderson, 1989) maintains that the role of extension is to provide temporary services when necessary. The question is: How long should the program provide this support without discouraging villagers to be independent? None of the projects try to reduce dependency by informing the villagers of container availability, or encouraging villagers to save money to buy them. Therefore, villagers

continue to expect support indefinitely. Sale of seedlings and increased education in marketing could help increase revenue but the villagers would have to be trained to manage nursery finances to allow for annual investments.

Water is the most expensive input and is often required before a village can start a nursery. Interestingly, PREVINOBA had constructed or repaired wells in all eight villages surveyed, but water was insufficient to provide for the nursery in seven of them. These hand-dug wells are difficult to construct, and in the dry season when the water table drops, they often run dry. Their effectiveness as an incentive is debatable. Better supervision at the well site and sufficient funding for the well diggers would improve well construction and repair.

The sale of seedlings is not encouraged in any of the projects. However, in PRECOBA, five of the nurseries surveyed sold trees to other villages. This enterprise was villager initiated but not yet self-sustaining. Marketing education could capitalize on this trend.

Food aid often accompanies development projects as a means of payment for work. Food aid has generally proven to be less than successful (Joyce and Burwell, 1985). In three of the four projects, food aid was minimal, sometimes as little as one half a kilogram of grain per person per year, and erratically distributed. The impact of such an

incentive was negligible. The fourth project did not provide food aid.

Additional Comparison Among Projects

PREVINOBA and IREF had significantly higher seedling survival than PAFOCSE and PRECOBA (page 31). PREVINOBA and IREF also included villagers in the selection of species more often (six and eight of eight villages) than PAFOCSE and PRECOBA (five and four of eight villages). This difference in the approach of the extension program reaffirms the earlier conclusions regarding "Participation".

Projects differ in the inclusion of extension training workshops for nursery managers. All nursery managers in three of the four projects participated in a training. PAFOCSE did not provide these structured workshops, thus, lack of training might be an influencing factor in the low survival rate in PAFOCSE nurseries.

All four projects provided containers and seeds for the participating villages. However, the number of pots filled per village in the PAFOCSE project was significantly smaller. Seven out of the eight nurseries had less than 1000 containers compared with 3500-4000 for other projects, presumably because the reduced financing of the project this year.

The projects differed in the amount of "secondary" materials (tools, watering cans, fertilizer and pesticides) they supplied to each nursery in the program. IREF provided the smallest amount of secondary inputs, possibly because IREF does not receive funding from any donor agencies or countries. However, IREF had one of the higher seedling survival rates. This suggests that these additional materials are not necessary for establishing a successful nursery. Project funds might have been invested more effectively in marketing education, water improvements, or other areas as indicated in the earlier analysis of villagers intention-to-continue (page 40).

There were no significant differences among projects perception about the shortage of water as their primary problem. Financing for well construction was significantly different among the four. IREF and PRECOBA did not provide financial assistance for well construction and repair as frequently as PREVINOBA and PAFOCSE. Three projects: PRECOBA, PREVINOBA and PAFOCSE, had designated financial assistance for well repairs, however, some villages in each project (including IREF) had repairs financed by other sources.

PREVINOBA contributed to well construction or repair in six of the eight villages surveyed, and all six still had an insufficient water supply for the nursery because the wells were not deep enough. An evaluation of the

factors influencing well effectiveness is beyond the scope of this study but may be an area where increased support could pay dividends.

There were no significant differences among projects in nursery managers intention-to-continue the nursery, but few degrees of freedom may limit the effectiveness of this statistical test.

Summary of Differences Among Projects

Village participation is an important component of an extension program. Projects that include villagers in decision making, such as PREVINOBA and IREF also have higher success. Other features that may contribute in PREVINOBA's nurseries are the emphasis on awareness and the rigorous adherence to the GRAAP extension method. Villagers worked with agents discussing reforestation and planting seedlings during the first year, then started a nursery the second year. Other contributing factors include field agents with exclusively extension responsibilities (Chef de Zones), nursery manager training, and training of the extension agents.

In addition to villager participation, IREFs high seedling survival may be attributable to their awareness campaign (although different from PREVINOBA) and long standing, high project visibility in the region.

Problems associated with low survival in PRECOBA and PAFOCSE are difficult to pinpoint. Lack of a highly structured extension approach and village participation are two possibilities, as well as the fact that most nursery managers in PAFOCSE did not attend a nursery training.

VI. CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Factors Influencing Performance

Two measures of performance in Senegalese village-based nurseries were studied: survival of seedlings and nursery manager's intention-to-continue (with the nursery). Of the 12 factors that were hypothesized to influence seedling survival, only village participation in species selection was a significant predictor. Of the 18 factors considered in intention-to-continue, three factors were significant predictors: 1) manager's previous experience, 2) presence of water shortages, and 3) commercial sale of seedlings.

These results reinforce other studies that suggest village participation positively influences how well and how completely an innovation is adopted.

Village nursery manager's intention-to-continue even if the project financing is discontinued is an attitude assumed to be prerequisite for actual continuation. Despite the well noted methodological discrepancies between attitude and behavior, we felt that actual continuance of nursery practice was not likely without positive intentions. When an extension project's goal is to establish self-sustaining nurseries, manager's intention-to-continue could be an interim measure of project success.

Results indicate that managers who had previous nursery experience were more likely to continue, therefore, when projects are selecting new villages, it is beneficial to choose individuals with previous experience. Nursery managers whose village had ample water were more inclined to continue. Projects could encourage sustainability by establishing secure water sources. Finally, nursery managers who had sold seedlings from their nursery were more likely to continue. Projects could promote continuation of nurseries by encouraging and training managers about marketing their seedlings.

Despite the usefulness of these results, the limits of both the data collected and the statistical methods used must be considered. The measures of success (dependent variables) used are two of many that could indicate nursery practice success. Others could be: outplanting success, diffusion of nursery practices to other villages, acceptance by the villagers.

Intentions do not always result in behavior, so follow-up studies of these villages would confirm whether villagers act on the intentions expressed in this study. This study only investigated villages that currently have nurseries. A study that compares villages that have discontinued their nursery with those who continue would be beneficial. In addition, seedling survival is influenced by many factors beyond those studied here, thus may not be

a true indication of nursery success. Villagers with strong interest and motivation may nevertheless be at the mercy of weather, insects, disease, or livestock damage.

Many factors that could influence both survival and intention-to-continue are difficult to measure and were not studied here. These might include social goals of villagers, their attitudes towards project staff, and villager innovativeness. Differences in biological capacity between villages and projects were not investigated because the focus of this study was social dimension.

The statistical analysis also had limitations. A larger sample size would have increased the accuracy of the results. If more villages from each project had been surveyed, chi-square and logit analysis would have been more complete. The results and discussion of nursery adoption success must be viewed with these constraints in mind.

Project Differences

Qualitative comparison of the extension projects indicates that all four have strong points, but strategies used in some projects were substantially different from the others. PREVINOBA's method of village awareness building and education, GRAAP, has been very well received by both villagers and agents. Their campaign includes use of

printed material and other media which reaches beyond the villagers with nurseries. PREVINOBA is the leading project in staff training for extension methods.

PRECOBA was innovative in using local leadership, establishing demonstration villages, and encouraging the sale of trees.

PAFOCSE's function as a non-regulatory organization was advantageous and distinguished it from the other projects. Agents were specialized in extension thus more qualified in the informal education process.

IREF, which had no financial support from outside Senegal, appeared to be the least innovative in extension methods. However, this was not reflected in the village nursery production figures. This particular project has been at the forefront of establishing village nurseries for seven years, thus awareness in this region is already very high. Lack of funding and materials prohibit expansion of the extension program. With financial support, the project would have excellent potential for success.

Group training as a means of skills transfer and motivation should be further studied to determine if this technique is more effective than one-on-one skills transfer. Also of interest would be a benefit/cost analysis of the agent's time for each of these activities.

Quantitative comparisons of the projects indicated two levels of seedling survival. IREF and PREVINOBA had

significantly higher seedling survival than PAFOCSE and PRECOBA. These two projects had: 1) villagers participate in species selection more often, 2) a structured extension method (PREVINOBA), and 3) a high visibility in the area (IREF). These could account for the higher seedling survival.

PAFOCSE did not organize group training for nursery managers and had significantly smaller nurseries than the other three projects. This may account for its low seedling survival.

Projects with complete, effective extension programs can influence village nursery success. Project policies that could increase the performance of village nurseries include: 1) mandating village participation, 2) designating funds for well improvements, 3) working with experienced managers, and 4) encouraging seedling sale.

Recommendations

Village participation in every aspect, from setting goals to evaluating results, is essential. Effective extension agents should confer with villagers and elicit agreement on work requirements, the division of labor, nursery size, location, species, and the distribution of seedlings and other benefits. Extension agents should visit villages regularly to build rapport, listen to their

needs and objectives and to accurately relay these to project decision makers.

Villagers who have previous nursery experience should be high priorities when selecting villages for nursery establishment. They should not be viewed as unsuccessful and poor risks. Their previous experience is an indication that they are more willing to continue their nurseries.

Projects should designate money for improving well water sources for village-based nurseries. In addition to its positive support for nursery continuance, it provides water for villagers' other needs. Capital investment in water sources could be more important than short term purchases like hoses, wheel barrels, and other tools for nursery maintenance. Proper timing and supervision for construction at the well site is important because it ensures quality construction and a secure water source.

Financial incentives are motivating factors in many nurseries. The majority of managers intended to continue if funding were provided and most were interested in prospects of seedling sales. Seedling sales could lead to more self-sustaining village nurseries, and should be promoted by projects. Education about marketing seedlings is necessary because villagers are not familiar with sales procedures for these products. Receipts could compensate nursery workers or support the purchase of materials for the next year.

Further research is needed on the sociological aspects of nursery continuation, correlating individual characteristics and elements of village social structure with continuance. Research is also needed on the impact of economic incentives on nursery budgets and adoption. Information is especially needed on: 1) seedling sale potential, 2) price levels acceptable in rural communities, and 3) procedures for efficiently marketing seedlings. Comparisons between the continuation of nurseries that have sold seedlings with those that have freely distributed them could suggest interesting policy directives. Although not addressed in this study, the marketing of seedlings could create opportunities for further commitment on the part of villages purchasing the seedlings and promote inter-village trade. The GOS should reconsider free seedling distribution from centralized nurseries in favor of seedling sale from village nurseries. Benefit/Cost analysis would be needed to determine if village based nurseries promote more efficient and permanent diffusion of nursery production than regional or central project nurseries.

Village based nurseries in Senegal offer an alternative to government seedling production. The key to successful establishment and continuation lies with the creative use of extension methods, incentives, technical assistance and organization. By combining the strong

aspects of the four projects and the key success factors studied here, forestry extension programs could create even more positive changes in the attitudes and behaviors of villagers in rural Senegal.

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A P P E N D I C E S

Appendix A

Glossary of Acronyms and French Terms

CB - Chef de Brigade (Extension agent at the community level, forestry department)

CER - Centre d'Education Rurale (Rural Education Center, governmental agency for rural development, located at the district level)

CFA - Currence Francs African (Central African Currency, Francs)

DCSR - Division de Conservation de Sol et Reboisement (Division of the Conservation of Soil and Reforestation, functions under the Ministry of the Protection of Nature in collaboration with IREF)

DRPF - Division de Recherche des Produit Forestiere (Forestry products branch of ISRA, the Senegalese Institute for Agricultural Research)

EF - Eaux et Forets (Forest Service, National Level)

FAO - Food and Agricultural Organization of the United Nations

GRAAP - Groupe de Recherche et d'Appui pour l'Autopromotion Paysanne (Research and Support Group for Self Motivated Rural Development), an extension method approach developed in Burkina Faso.

GOS - Government of Senegal

IREF - Inspection Regional des Eaux et Forets (Regional Forest Service)

ITEF - Ingenieur Technique des Eaux et Forets (Forest Engineer)

ISRA - Institute Senegalese de Recherche Agricole (Senegalese Agricultural Research Institute)

NGOs - Non-Governmental Organizations

PAFOCSE - Projet de l'Agroforesterie et du Conservation des Sols et des Eaux (Agroforestry Project for Soil and Water Conservation)

PRECOBA - Projet de Reboisement Communautaire dans le Bassin Arachider du Senegal (Community Reforestation Project in the Peanut Basin of Senegal)

PREVINOBA - Projet de Reboisement Villageois dans le Nord-Ouest du Bassin Arachidier (Village Reforestation Project in the North West Peanut Basin in Senegal)

SODEVA - Societie de Developpement et Vulgarisation Agricole (An agricultural extension agency of the Government of Senegal)

VBN - Village-Based Nurseries

Appendix B
Description of Senegal

Senegal is a West African country with a population of seven million. Sixty-four percent work in the agricultural sector (World Bank, 1988).

Senegal stretches across a transition zone between the Sahara Desert to the North and the humid tropics to the South. The country is classified as Southern Sahel/Sudano-Guinean vegetation type, commonly known as wooded and shrub savanna (Weber, 1982). Rainfall distribution ranges from less than eight inches (200 mm) in the North, to greater than 40 inches (1000 mm) in the South (Weber 1982). The rainy season lasts from June through September. Wide diurnal temperature fluctuations, low relative humidity, and dry northeasterly winds contribute to high evaporation rates. Water deficiency is the key limiting factor for life (NRC, 1984).

Lateritic and sandy soils, when subjected to intensive farming, overgrazing and vegetation removal, are highly susceptible to wind and water erosion. Traditional Senegalese farming systems include subsistence/cash crop farming and migratory herding. Larger herds and the settlement of many herders has increased pressure on forest resources.

Trees and shrubs, often nitrogen fixing species, are grown intraspatially with annual crops such as millet, sorghum and maize. Trees and shrubs provide products such as fuelwood, fodder, food, fruit, and medicine. They also provide construction wood and shade, and have cultural and religious significance. Woody perennials are important for fertilizing and improving organic matter, soil structure, water holding capacity and soil microbiological activity (Felker 1978 in NRC, 1984). For example, Acacia albida in Senegal has been shown to increase peanut yields from 100

pounds/acre (500 (+/- 200) kilograms/hectare) to 175 pounds/acre (900 (+/- 200) kilograms/hectare) (Felker 1978 in NRC, 1984).

Appendix C

Organization Questionnaire

1. Name of Organization

PRECOBA	1
EAUX ET FORET	2
PREVINOBA.....	3
SODEVA	4

2. What is/was the duration of the project?

1YR	2YRS	3YRS	4YRS	5YRS	6YRS	>6YRS
1	2	3	4	5	6	7

2. Number of villages in the project_____

3. Number of villages with tree nurseries_____

4. Did any of the villages already have nurseries?

5. Nursery size (%).

<100 trees	_____
100 - 500	_____
501 - 1000	_____
1 - 2000	_____
> 2000	_____

6. Did the project receive funding?

Y	N	NA
1	2	9

7. Who supplied the funding?

	Y	N	NA
USAID	1	2	9
HOLLAND	1	2	9
FAO	1	2	9
AFRICARE	1	2	9
FINLAND	1	2	9
OTHER	1	2	9

8. Was funding used to purchase village tree nursery materials?

Y	N	NA
1	2	9

9. How were these materials delivered to the village?

TRANSPORTED TO VILLAGES	1
VILLAGERS PICKED THEM UP	2
BOTH	3
NA	4

10. What materials were transported or picked up ?

	Y	N	# Quantity	NA
SACKS	1	2		9
SEEDS	1	2		9
WATERING CANS	1	2		9
HAND TOOLS	1	2		9
PESTICIDE	1	2		9
FENCING				
BARBED WIRE	1	2		9
SACKET	1	2		9
CRINTING	1	2		9
OTHER	1	2		9

11. When were the materials delivered to the village?

A1	A2	M1	M2	J1	J2	>J
1	2	3	4	5	6	7

12. What was the approximate distance from the village?

SHORTEST	_____
LONGEST	_____
AVERAGE	_____

13. How many years did the funding for these materials last?

1	1
2 - 3	2
4 - 5	3
>5	4

14. What materials were purchased?

	Y	N	# Quantity	NA
SACKS	1	2		9
SEEDS	1	2		9
WATERING CANS	1	2		9
HAND TOOLS	1	2		9
PESTICIDE	1	2		9
FENCING				
BARBED WIRE	1	2		9
SACKET	1	2		9
CRINTING	1	2		9
OTHER	1	2		9

15. Did the financing purchase new wells or material for improving existing water sources?	New	IE	None	NA
	1	2	3	4

15a. If yes, cost/well

EXTENSION METHODS

1. What extension method was used in this project?	Y	N	NA
a. VILLAGE VISITS	1	2	9
WEEKLY	1	2	9
BIWEEKLY	1	2	9
MONTHLY	1	2	9
LESS THAN MONTHLY	1	2	9
b. TRAINING WORKSHOPS	1	2	9
IN VILLAGE	1	2	9
IN REGIONAL CAPITAL	1	2	9
AT A TRAINING CENTER	1	2	9
c. GRAAP	1	2	9
d. OTHER	1	2	9

2. Describe the extension method approach used? (GIVE AN EXAMPLE OR REFER TO THE LAST QUESTION)

3. Why did you choose this approach?

4. What changes have been made in the approach since the conception of the project?

5. Was there any formal extension training for the extension agents?

TRAINING WORKSHOPS	
HELD AT A TRAINING CENTER	1
HELD AT THE OFFICE	2
HELD IN A VILLAGE	3
OTHER	4

6. From your experience in this project, what have you learned?

7. If you were to redesign the project today, what would you change?

8. What are the three most important elements you look for in a village for starting a nursery?

9. Do you think villagers are genuinely interested in developing village tree nurseries?

Y	N	NA
1	2	3

10. Overall, what are the biggest barriers to getting villagers to begin and continue village nurseries?

Appendix D

Village Nursery Manager Questionnaire

Date:
Surveyor:

1. Organization

PRECOBA	1
Eaux et Forets	2
PREVINOBA	3
PAFOCSE	4

2. Farmer's name_____
3. Village_____
4. Community Rural_____
5. Arrondisement_____
6. Department_____
7. Region_____
8. Ethnic Group_____
9. Village population_____
10. Village Personnel:

    Village Chief_____
    President of Men's Group_____
    President of Women's Group_____
    President of Youth Group_____
    Other_____

NURSERY DESCRIPTIONS

11. Nursery Site Description

12. Who owns the nursery? (DON'T READ THE RESPONSES)

    1. INDIVIDUAL
    2. CHIEF OF THE VILLAGE
    3. COMMUNITY
    4. GOVERNMENT
    5. OTHER
    6. NA

13. Who owns the land the nursery is on? (DON'T READ THE RESPONSES)

    1. INDIVIDUAL
    2. CHIEF OF THE VILLAGE
    3. COMMUNITY
    4. GOVERNMENT
    5. OTHER
    6. NA

14. What is your position in the nursery? (DON'T READ THE RESPONSES)

    1. OWNER
    2. CHIEF OF THE NURSERY
    3. PRESIDENT OF GROUP
    4. GUARDIAN
    5. CHIEF OF THE VILLAGE
    6. OTHER
    7. NA

15. In what years did you have a tree nursery?

    1. 88
    2. 87
    3. 86
    4. 85
    5. 84
    6. 83
    7. <83

16. (IF THEY STOPPED DOING A NURSERY FOR ANY YEARS, ASK WHY?)

NURSERY TABULATIONS

17. How many pots were filled this year? _____

18. How many trees were produced in your nursery this year?

    _____

19. What species did you produce?

	Y	N	#	NA
1. Prosopis juliflora - Nebbnebb-u-toubab	1	2		9
2. Eucalyptus camaldulensis - Hotubotil	1	2		9
3. Parkinsonia aculeata - Parkinsonia	1	2		9
4. Mangifera indica - Mango	1	2		9
5. Acacia albida - Kadd	1	2		9
6. Acacia holoceracea - Acacia holo	1	2		9
7. Acacia nilotica - Nebbnebb	1	2		9
8. Azadirachta indica - Neem	1	2		9
9. Citronier sp. - Limon	1	2		9
10. Papaya - Papay	1	2		9
11. Anacardium occidental - Dakaasee	1	2		9
12. Leuceana leucocephela - Leuceana	1	2		9
13. OTHER	1	2		9

20. Who chose the species that you grew?
(DON'T READ THE RESPONSE)

1. YOU
2. VILLAGE GROUP
3. VILLAGE CHIEF
4. EXTENSION AGENT
5. OTHER
6. NA

21. How many trees did you outplant this year?

1. <100
2. 1-500
3. 5-1000
4. 1-2000
5. >2000
6. NONE
7. NA/DK

22. Were all of these trees produced in your nursery?

1. YES 2. NO 9. NA

23. (IF NOT, WHERE DID THEY COME FROM)

		Y	N	NA
BOUGHT				
	PRIVATE	1	2	9
	GOVERN'T	1	2	9
DONNATED				
	PRIVATE	1	2	9
	DONATED	1	2	9
	OTHER	1	2	9

24. Did you donate or sell the trees in your nursery?
To whom?

	FREE	SOLD	#	COST/TREE
YOU				
OTHERS IN YOUR VILLAGE				
INDIVIDUALS IN OTHER VILLAGES				
VILLAGE GROUP IN YOUR VILLAGE				
VILLAGE GROUP IN OTHER VILLAGES				
OTHER				
NA				

25. (IF THEY HAVE NEVER SOLD TREES, ASK "HAVE YOU EVER THOUGHT OF SELLING YOUR TREES?")

    1. YES 2. NO 9. NA

    WHY OR WHY NOT?

26. What were the trees used for? (DON'T READ THE RESPONSES, HAVE THEM RANK THE TOP THREE USES)

    1. VILLAGE WOODLOTS
    2. WINDBREAKS COMPOUND
    3. FRUIT TREES
    4. SHADE
    5. ROADSIDE PLANTING
    6. AGROFORESTY
    7. OTHER

27. From your experiences, what were the biggest problems in the nursery? (DO NOT READ THE RESPONSES, HAVE THEM RANK THE TOP THREE PROBLEMS)

    1. LACK OF WATER
    2. SALTY WATER
    3. LACK OF MATERIALS
    4. MAINTENANCE
    5. POOR GERMINATION
    6. BIRDS
    7. INSECTS/DISEASE
    8. OTHER

28. What could you do to remedy these problems?

EXTENSION METHOD FACTORS

NOTE: The next seven questions concern the time before you started your nursery.

29. Did you ever have in a nursery before the beginning of this project?

    1. HAD A NURSERY
    2. WORKED IN A NURSERY
    3. NO
    4. NA

30. Before you began this nursery, did you ever buy or receive trees free for outplanting?

BOUGHT
1. PRIVATE NURSERY
2. GOVERNMENT NURSERY

RECEIVED FREE
3. PRIVATE NURSERY
4. GOVERNMENT NURSERY
5. OTHER

6. NO
7. NA

31. How often had you heard advertisements on the radio about reforestation activities?

1. 1/WEEK
2. 2/MONTH
3. 1/MONTH
4. <1/MONTH
5. NEVER
6. NA

32. How often did you discuss reforestation with your friends and neighbors?

1. 1/WEEK
2. 2/MONTH
3. 1/MONTH
4. <1/MONTH
5. NEVER
6. NA

33. How often did you talk to an extension agent about reforestation?

1. 1/WEEK
2. 2/MONTH
3. 1/MONTH
4. <1/MONTH
5. NEVER
6. NA

EXPLAIN:

34. Had you ever seen any information in the local language about reforestation activities?

1. YES 2. NO 9. NA

35. Did you ever visit a nursery before you began yours?

1. YES 2. NO 9. NA

36. (IF YES, ASK THEM WHAT KIND OF NURSERY IT WAS.)

1. GOVERNMENTAL
2. PRIVATE
3. COMMUNITY
4. OTHER

37. Of the previous seven questions, which one do you think was the most influencial in getting you to start a nursery?

1. RADIO
2. DISCUSSION WITH FRIENDS
3. EXTENSION AGENT
4. WRITTEN MATERIAL
5. VISITING A NURSERY
6. RECEIVING/PLANTING TREES
7. OTHER
8. NA

38. Is there an extension agent working in this village?

1.YES 2. NO 9. NA

39. What is your extension agent's name?

_____

40. How often did your extension agent visit your village during the nursery season?

1. 1/wk
2. 2/mth
3. 1/mth
4. less than 1/mth
5. never
9. NA

41. How interested and involved in your nursery do you think your agent was?

    1. Very interested
    2. Interested
    3. A little interested
    4. Not interested at all
    9. NA

    WHY?

42. How often since you have planted your trees has the agent been to visit?

    1. 1/wk
    2. 2/mth
    3. 1/mth
    4. less than 1/mth
    5. never
    9. NA

43. How interested in your project was your agent after you outplanted?

    1. Very interested
    2. A little interested
    3. Not interested at all
    9. NA

    WHY?

44. What practices did the extension agent introduce to you? Did you use the techniques?

		INTRODUCED			USED		
		Y	N	NA	Y	N	NA
1.	NURSERY SITE SELECTION.....	1	2	9	1	2	9
2.	FILLING POTS.....	1	2	9	1	2	9
3.	SOIL MIXTURE.....	1	2	9	1	2	9
4.	SPECIES SELECTION.....	1	2	9	1	2	9
5.	SEEDING METHODS.....	1	2	9	1	2	9
6.	WATERING.....	1	2	9	1	2	9
7.	SHADING/MULCHING.....	1	2	9	1	2	9
8.	PROTECTION.....	1	2	9	1	2	9
9.	OTHER (specify).....	1	2	9	1	2	9

45. (IF THERE ARE ANY TECHNIQUES THAT WERE NOT USED, ASK "WHY DIDN'T YOU USE THESE TECHNIQUES".)

46. Have you or another member of this village ever participated in a nursery training?

    1. YES 2. NO 9. NA

47. (IF YES, WHO ORGANIZED IT, WHAT DID IT INCLUDE, AND WHERE WAS IT HELP?)

FINANCIAL INPUTS

48. Where did the materials that you used come from? Did you receive them free or did you purchase them?

	FREE		PURCHASED		#	COST/UNIT	NA
	GOS	OTHER	GOS	OTHER			
1. SACKS	1	2	3	4			9
2. SEEDS	1	2	3	4			9
3. WATERING CANS	1	2	3	4			9
4. HAND TOOLS	1	2	3	4			9
5. FENCING	1	2	3	4			9
6. FERTILIZER	1	2	3	4			9
7. PESTICIDES	1	2	3	4			9
8. OTHER	1	2	3	4			9
9. NONE	1	2	3	4			9

49. What was your water source for the nursery? (DO NOT READ THE RESPONSES)

    1. OPEN WELL
    2. DEEP BOREHOLE WELL
    3. FAUCET
    4. WIND MILL PUMP
    5. OTHER

50. Was the quality of water sufficient?

    1. YES 2. NO 9. NA

51. Was the quantity of the water sufficient?

    1. YES 2. NO 9. NA

EXPLAIN

52. Did you receive financing for improving your water source?

    1. YES 2. NO 9. NA

53. (IF YES, WHO PROVIDED THE FINANCING?)

    1. GOVERNMENT SERVICE
    2. VILLAGE CONTRIBUTIONS
    3. NON-GOVERNMENTAL ORGANIZATION
    4. OTHER

54. Do you think you would have started a nursery without outside support?

    1. YES 2. NO 9. NA

EXPLAIN:

WORK RESPONSIBILITIES

55. Who was responsible for the work in the nursery? (YOU, THE WOMEN, THE MEN)

		Y	W	M	C	NA
1.	NURSERY SITE SELECTION.....	1	2	3	4	9
2.	FILLING POTS.....	1	2	3	4	9
3.	SOIL MIXTURE.....	1	2	3	4	9
4.	SPECIES SELECTION.....	1	2	3	4	9
5.	SEEDING METHODS.....	1	2	3	4	9
6.	PULLING WATER.....	1	2	3	4	9
7.	WATERING.....	1	2	3	4	9
8.	SHADING/MULCHING.....	1	2	3	4	9
9.	PROTECTION.....	1	2	3	4	9
10.	OTHER (specify).....	1	2	3	4	9

56. Was anyone compensated for their work in the nursery?

    1. YES 2. NO 9 NA

57. (IF YES, WHO WAS COMPENSATED, WHAT WAS THE COMPENSATION?)

WHO WAS COMPENSATED	COMPENSATION			
	CASH	FOOD AID	OTHER	NONE
INDIVIDUAL				
VILLAGE GROUP				
NURSERY CHIEF				
GUARDIAN				

58. Who provided the compensation?

59. What do you plan on doing next year? (DON'T READ THE RESPONSES)

1. CONTINUING NURSERY
2. DISCONTINUING NURSERY
9. NA

60. (IF THE ANSWER IS CONTINUE, ASK "WILL YOU INCREASE OR DECREASE PRODUCTION?")
1. INCREASE
2. DECREASE

61. (IF THE ANSWER IS INCREASE/DECREASE PRODUCTION, ASK "HOW MUCH WILL YOU INCREASE/DECREASE PRODUCTION ?")

_____

62. If there was no financing for the project next year, what would you do?

1. CONTINUE THE NURSERY
2. DISCONTINUE THE NURSERY
9. NA

Appendix E (1)

Regression Analysis and Analysis of Variance for the Full Regression Model for Village Nursery Success
Y = Percent Survival

1) Variables

Question	Variable Name
X_1 Who chose the species that you grew?	newchoice
X_2 Have you or another member of this village ever participated in a nursery training?	newtrain
X_3 From your experiences, what were the biggest problems in the nursery?	newprob1
X_4 Who owns the nursery?	newowner
X_5 How many pots did you fill this year?	Pots
X_6 Did you ever have in a nursery before the beginning of this project?	Had Prev
X_7 How often did your extension agent visit your village during the nursery season?	Visits
X_8 How often since you have planted your trees has the agent been to visit?	Visitsaft
X_9 Did your extension agent teach you seeding techniques?	Seeding
X_{10} What was your water source for the nursery?	WSource
X_{11} Was the quantity of water sufficient?	Quantity
X_{12} Was anyone compensated for their work in the nursery?	Comp

2) Multiple Regression Model and ANOVA

Model fitting results for: PERCENT.newpercent

Independent variable	coefficient	std. error	t-value	sig.level
CONSTANT	-0.522099	0.5064	-1.0310	0.3155
newchoice	0.381758	0.114132	3.3449	0.0034
newtrain	0.268189	0.167843	1.5979	0.1266
newprobl	0.186793	0.13855	1.3482	0.1934
newowner	0.162503	0.125906	1.2907	0.2123
Pots	-0.032891	0.032797	-1.0029	0.3285
Had_Prev	0.172411	0.130464	1.3215	0.2020
Visits	0.044519	0.091485	0.4866	0.6321
Visitsaft	-0.022289	0.087087	-0.2559	0.8007
Seeding	-0.022846	0.157965	-0.1446	0.8865
WSource	0.133261	0.103835	1.2834	0.2148
Quantity	-0.276034	0.227293	-1.2144	0.2395
Comp	0.194317	0.172556	1.1261	0.2741

R-SQ. (ADJ.) = 0.2499 SE= 0.012278 MAE= 0.007298 DurbWat= 1.697
Previously: 0.3941 0.227431 0.137028 1.543
32 observations fitted, forecast(s) computed for 0 missing val. of dep. var.

Analysis of Variance for the Full Regression

Source	Sum of Squares	DF	Mean Square	F-Ratio	P-value
Model	0.00336551	12	0.000280459	1.86053	.1095
Error	0.00286408	19	0.000150741		
Total (Corr.)	0.00622959	31			

R-squared = 0.540246 Stnd. error of est. = 0.0122777
R-squared (Adj. for d.f.) = 0.249874 Durbin-Watson statistic = 1.69732

Appendix E (2)

Correlation Matrix for the multiple regression analysis for Village Nursery Success (Y = Percent Survival)

Correlation matrix for coefficient estimates

	CONSTANT	newchoice	newtrain	newprobl
CONSTANT	1.0000	-.1950	-.4583	-.1911
newchoice	-.1950	1.0000	.3255	.0932
newtrain	-.4583	.3255	1.0000	.2473
newprobl	-.1911	.0932	.2473	1.0000
newowner	-.0216	.3741	.1661	-.0960
Pots	.1677	-.4806	-.6233	-.4352
Had_Prev	-.7374	.0900	.1826	.1561
Visits	-.5055	.0700	.1013	.1809
Visitsaft	.2696	.0872	-.0664	-.0785
Seeding	-.4086	-.0630	.0312	.2994
WSource	-.2682	.1598	.0782	.1224
Quantity	.5035	.0894	-.4190	-.5151
Comp	-.6244	-.1951	.4211	-.1136

	newowner	Pots	Had_Prev	Visits
CONSTANT	-.0216	.1677	-.7374	-.5055
newchoice	.3741	-.4806	.0900	.0700
newtrain	.1661	-.6233	.1826	.1013
newprobl	-.0960	-.4352	.1561	.1809
newowner	1.0000	-.2990	.1978	-.2368
Pots	-.2990	1.0000	-.2592	-.1067
Had_Prev	.1978	-.2592	1.0000	.5154
Visits	-.2368	-.1067	.5154	1.0000
Visitsaft	.2560	.0675	-.4334	-.8619
Seeding	-.4267	-.0414	.0985	.4324
WSource	.1046	-.1534	.0077	-.3168
Quantity	.2430	.1281	-.1105	.0426
Comp	-.0828	.0750	.4693	.2668

	Visitsaft	Seeding	WSource	Quantity
CONSTANT	.2696	-.4086	-.2682	.5035
newchoice	.0872	-.0630	.1598	.0894
newtrain	-.0664	.0312	.0782	-.4190
newprobl	-.0785	.2994	.1224	-.5151
newowner	.2560	-.4267	.1046	.2430
Pots	.0675	-.0414	-.1534	.1281
Had_Prev	-.4334	.0985	.0077	-.1105
Visits	-.8619	.4324	-.3168	.0426
Visitsaft	1.0000	-.3058	.4124	-.1466
Seeding	-.3058	1.0000	.2528	-.3382
WSource	.4124	.2528	1.0000	-.5245
Quantity	-.1466	-.3382	-.5245	1.0000
Comp	-.2653	-.1338	-.1736	-.3709

	Comp
CONSTANT	-.6244
newchoice	-.1951
newtrain	.4211
newprobl	-.1136
newowner	-.0828
Pots	.0750
Had_Prev	.4693
Visits	.2668
Visitsaft	-.2653
Seeding	-.1338
WSource	-.1736
Quantity	-.3709
Comp	1.0000

Appendix F

Simple Linear Regression Model for Village Nursery Success

Variables

Y_1 = Percent Survival

X_1 = newchoice (village participation in species selection)

Regression Equation

$$Y_1 = .36 + .33(X_1)$$

t value = 3.96 (significant at .001)

Variable	Coefficient	Standard Deviation	t-value	sign. level
Constant	0.36	0.07	4.99	0.00
newchoice	0.33	0.08	3.96	0.00

R-squared = .32

Annalysis of Variance (ANOVA)

F-Ratio = 15.65 P-value = .0004

R-squared = .34

Correlation matrix for coefficient estimates

	Constant	newchoice
Constant	1.0000	-.8776
newchoice	-.8776	1.0000

Appendix G

Logit Regression for Nursery Manager's Intention-to-Continue

1) Variables

Question	Variable Name Response Y/N
Intention to Continue	
Y_1. What do you plan on doing next year if the project financing continues?	newfin
Y_2. If there is no financing from the project, what will you do?	newnofin
Previous Experience	
X_1. In what years did you have a nursery?	Years*
X_2. Categorical division of years	newyears
X_3. Did you ever have a nursery before the beginning of this project?	had one
X_4. Before you began this nursery, had you ever bought trees for outplanting?	bought
X_5. Before you began this nursery, had you ever receive trees free for outplanting?	received
Nursery Ownership	
X_6. Who owns the nursery?	newowner
Water Problems	
X_7. From your experience, what were the biggest problems in the nursery?	newprob1
X_8. What was your water source for the nursery?	WSource
X_9. Was the quality of the water good?	Quality
X_{10}. Was the quantity of the water sufficient?	Quantity
X_{11}. Did you receive financing for improving your water source?	newwellf
Extension Methods	
X_{13}. Who chose the species that you grew?	newchoic
X_{14}. Have you ever participated in a nursery training?	newtrain
X_{15}. How often did your extension agent visit your nursery?	newvisit
Incentives	
X_{12}. Was anyone compensated for their work in the nursery?	newcomp
X_{16}. Have you ever thought of selling seedlings from your nursery?	TofSell
X_{17}. Did you donate the seedlings from your nursery free to groups or individuals in your village or elsewhere?	free
X_{18}. Did you sell any seedlings from your nursery?	sold

*this variable was continuous

2) Correlation Matrix

Correlation matrix for coefficient estimates

	CONSTANT	Years	newyears	hadone
CONSTANT	1.0000	-.2432	.1006	.0508
Years	-.2432	1.0000	-.8193	.2590
newyears	.1006	-.8193	1.0000	-.4674
hadone	.0508	.2590	-.4674	1.0000
bought	-.2299	-.3205	.1980	-.1123
received	-.2040	.0388	-.0412	.1603
newowner	-.1442	-.4286	.3911	-.3152
newprobl	.1230	-.4396	.1946	-.1129
WSource	-.2699	-.1469	.2353	-.4079
Quality	-.4613	-.0493	.1146	-.1809
Quantity	-.1336	.3708	-.1820	.2172
newwells	-.2722	-.1207	.2188	-.3215
newcomp	-.3809	-.0917	.0739	.3317
newchoice	-.0974	.2135	-.3561	.1293

	WSource	Quality	Quantity	newwells
CONSTANT	-.2699	-.4613	-.1336	-.2722
Years	-.1469	-.0493	.3708	-.1207
newyears	.2353	.1146	-.1820	.2188
hadone	-.4079	-.1809	.2172	-.3215
bought	.1238	.1133	-.5496	.4306
received	-.2851	.0925	-.1679	.1963
newowner	.1565	.0047	-.2421	.3334
newprobl	-.1042	.1764	-.5673	.0473
WSource	1.0000	-.1753	-.2712	-.0034
Quality	-.1753	1.0000	-.0273	.3211
Quantity	-.2712	-.0273	1.0000	-.3694
newwells	-.0034	.3211	-.3694	1.0000
newcomp	-.1749	.1579	.4832	-.1827
newchoice	.1807	-.4855	.2063	-.4425

	bought	received	newowner	newprobl
CONSTANT	-.2299	-.2040	-.1442	.1230
Years	-.3205	.0388	-.4286	-.4396
newyears	.1980	-.0412	.3911	.1946
hadone	-.1123	.1603	-.3152	-.1129
bought	1.0000	.4551	.3053	.1212
received	.4551	1.0000	.2686	-.0452
newowner	.3053	.2686	1.0000	.1801
newprobl	.1212	-.0452	.1801	1.0000
WSource	.1238	-.2851	.1565	-.1042
Quality	.1133	.0925	.0047	.1764
Quantity	-.5496	-.1679	-.2421	-.5673
newwells	.4306	.1963	.3334	.0473
newcomp	-.1648	-.0797	.0033	.0089
newchoice	-.1529	-.2542	-.1987	-.1915

	WSource	Quality	Quantity	newwells
CONSTANT	-.2699	-.4613	-.1336	-.2722
Years	-.1469	-.0493	.3708	-.1207
newyears	.2353	.1146	-.1820	.2188
hadone	-.4079	-.1809	.2172	-.3215
bought	.1238	.1133	-.5496	.4306
received	-.2851	.0925	-.1679	.1963
newowner	.1565	.0047	-.2421	.3334
newprobl	-.1042	.1764	-.5673	.0473
WSource	1.0000	-.1753	-.2712	-.0034
Quality	-.1753	1.0000	-.0273	.3211
Quantity	-.2712	-.0273	1.0000	-.3694
newwells	-.0034	.3211	-.3694	1.0000
newcomp	-.1749	.1579	.4832	-.1827
newchoice	.1807	-.4855	.2063	-.4425

	newcomp	newchoice
CONSTANT	-.3809	-.0974
Years	-.0917	.2135
newyears	.0739	-.3561
hadone	.3317	.1293
bought	-.1648	-.1529
received	-.0797	-.2542
newowner	.0033	-.1987
newprobl	.0089	-.1915
WSource	-.1749	.1807
Quality	.1579	-.4855
Quantity	.4832	.2063
newwells	-.1827	-.4425
newcomp	1.0000	-.0250
newchoice	-.0250	1.0000

Correlation matrix for coefficient estimates

	CONSTANT	newtrain	newvisits	TofSell
CONSTANT	1.0000	.2227	-.3500	-.5948
newtrain	.2227	1.0000	.0896	-.1962
newvisits	-.3500	.0896	1.0000	.2391
TofSell	-.5948	-.1962	.2391	1.0000
free	-.0049	-.2418	-.0810	.0595
sold	-.4091	.0048	.3339	.3179
newowner	-.1023	-.0487	-.0541	.0875
newprobl	-.2317	-.2105	.0527	.2419
WSource	-.3255	.2198	.3298	.0531
Quality	-.3364	-.4899	-.2620	.0472
Quantity	-.0399	-.7171	-.2821	-.0532
newwells	-.1871	-.0015	-.1163	.1364
newcomp	-.2978	-.8136	-.1332	.0477
newchoice	-.0922	.1984	.1153	-.1586

	free	sold	newowner	newprobl
CONSTANT	-.0049	-.4091	-.1023	-.2317
newtrain	-.2418	.0048	-.0487	-.2105
newvisits	-.0810	.3339	-.0541	.0527
TofSell	.0595	.3179	.0875	.2419
free	1.0000	.2273	.3322	-.1729
sold	.2273	1.0000	-.1953	.0534
newowner	.3322	-.1953	1.0000	-.0845
newprobl	-.1729	.0534	-.0845	1.0000
WSource	-.0802	.2767	.0089	-.1786
Quality	-.1754	-.0416	-.1860	.3253
Quantity	.2766	-.3517	.1808	-.2021
newwells	.0710	.2198	.1398	.0837
newcomp	-.0740	-.2615	.0487	.2166
newchoice	.0116	.2099	-.0974	-.3082

	WSource	Quality	Quantity	newwells
CONSTANT	-.3255	-.3364	-.0399	-.1871
newtrain	.2198	-.4899	-.7171	-.0015
newvisits	.3298	-.2620	-.2821	-.1163
TofSell	.0531	.0472	-.0532	.1364
free	-.0802	-.1754	.2766	.0710
sold	.2767	-.0416	-.3517	.2198
newowner	.0089	-.1860	.1808	.1398
newprobl	-.1786	.3253	-.2021	.0837
WSource	1.0000	-.3455	-.4044	-.1798
Quality	-.3455	1.0000	.3525	.2258
Quantity	-.4044	.3525	1.0000	-.1765
newwells	-.1798	.2258	-.1765	1.0000
newcomp	-.2629	.5754	.7667	-.0792
newchoice	.3288	-.4602	-.0812	-.3447

	newcomp	newchoice
CONSTANT	-.2978	-.0922
newtrain	-.8136	.1984
newvisits	-.1332	.1153
TofSell	.0477	-.1586
free	-.0740	.0116
sold	-.2615	.2099
newowner	.0487	-.0974
newprobl	.2166	-.3082
WSource	-.2629	.3288
Quality	.5754	-.4602
Quantity	.7667	-.0812
newwells	-.0792	-.3447
newcomp	1.0000	-.2152
newchoice	-.2152	1.0000

Correlation matrix for coefficient estimates

	CONSTANT	newtrain	newvisits	TofSell
CONSTANT	1.0000	-.3636	-.4946	-.7477
newtrain	-.3636	1.0000	.0296	.0503
newvisits	-.4946	.0296	1.0000	.3388
TofSell	-.7477	.0503	.3388	1.0000
free	.1928	-.5024	-.0963	-.2136
sold	-.4032	-.2093	.3870	.4348
Years	-.3627	.0897	.0971	.0879
newyears	.0078	.1900	.0036	.1607
hadone	-.0403	-.1428	-.0557	-.1382
bought	.3848	-.4540	-.3460	-.4034
received	-.2740	-.0634	-.1053	.0596

	free	sold	Years	newyears
CONSTANT	.1928	-.4032	-.3627	.0078
newtrain	-.5024	-.2093	.0897	.1900
newvisits	-.0963	.3870	.0971	.0036
TofSell	-.2136	.4348	.0879	.1607
free	1.0000	.2302	-.3127	-.0149
sold	.2302	1.0000	-.0329	.1453
Years	-.3127	-.0329	1.0000	-.7632
newyears	-.0149	.1453	-.7632	1.0000
hadone	.4532	-.0529	.0306	-.3484
bought	.4470	-.2639	-.2751	-.0519
received	-.2030	-.0484	.2289	-.1304

	hadone	bought	received
CONSTANT	-.0403	.3848	-.2740
newtrain	-.1428	-.4540	-.0634
newvisits	-.0557	-.3460	-.1053
TofSell	-.1382	-.4034	.0596
free	.4532	.4470	-.2030
sold	-.0529	-.2639	-.0484
Years	.0306	-.2751	.2289
newyears	-.3484	-.0519	-.1304
hadone	1.0000	.2105	-.0078
bought	.2105	1.0000	.2373
received	-.0078	.2373	1.0000

Appendix H

Final Logit Regression Model for Intention to Continue Without Project Financing

Assumptions

The assumptions for logit models were met: no correlation, no interactions, normal distribution and equal variance of the residuals.

General Logit Regression Model

$$\pi = \frac{\exp(B_0 + B_1(X1_) + B_2(X_2) + B_3(X_3))}{1 + \exp(B_0 + B_1(X1_) + B_2(X_2) + B_3(X_3))}$$

Logit Multiple Regression Model

$$\pi = \frac{\exp(-1.56 + {}_1.82(X_1) + 1.16(X_2) + {}_1.78(X_3)}{1 + \exp(-1.56 + {}_1.82(X_1) + 1.16(X_2) + {}_1.78(X_3)}$$

Where: = Log odds of the proportion of respondents who intend to continue their nursery if project financing is discontinued.

X_1 = hadone - Village nursery managers who had previously had a nursery

X_2 = newprob1 - Village nursery managers who stated water as their biggest nursery problem

X_3 = sold - Village nursery managers who had sold seedling from their nursery

Maximum likelihood estimates of the logistic regression function - Intention to continue without project financing. Estimated Coefficients, Standard Deviations and Odds Ratios

Regression Coefficient	Estimated Regression Coefficient	Estimated Standard Deviation	Estimated Odds Ratio
B_0	-1.56	.65	
B_1	1.82	.99	6.15
B_2	1.16	.87	3.20
B_3	1.78	1.28	5.93

Likelihood Ratio Test = 10.75 with 3 D.F.
Significant at p = .05.

where the coefficients are:

B_0 - intention-to-continue
B_1 - previous experience
B_2 - water problems
B_3 - sale of seedling

Test Statistic:

Logit regression models have a likelihood ratio test statistic for an associated degrees of freedom compared to a p-value (Neter, Wasserman, and Kutner, 1989).

Appendix I

Chi-square Analysis of Women's Participation in Nursery Work

Comparison of women's participation in all nursery tasks and women's participation in the most time consuming tasks.

Row 1 = all tasks combined
Row 2 = most time consuming tasks

		Included Women	Did not Include Women	Total
All tasks	(expected)	115	173	
	(observed)	98	190	288
Most time consuming	(expected)	25	39	
	(observed)	42	22	64
Total		140	212	352

$$X^2 = \sum \frac{(\text{Observed} - \text{Expected})^2}{\text{Expected}}$$

$X^2 = 22.97$, with 3 degrees of freedom, significant at .000

Appendix J

Differences Among Four Village-Based Nursery Projects in the Peanut Basin in Senegal, 1988

1) **Seedling Survival** (and participation in species selection)

Summary Statistics

	PRECOBA	IREF	PREVINOBA	PAFOCSE
Sample Size	8	8	8	8
Average	56	83	82	62
Standard Deviation	34	21	15	36

ANOVA: Difference in seedling survival between two groups of projects

Group 1 = PREVINOBA and IREF
Group 2 = PAFOCSE and PRECOBA

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F-Ratio	sig. Level
Between Groups	4255.03	1	4255.03	5.75	.02
Within Groups	22210.18	30	740.34		
Total	26465.22	31			

ANOVA: Difference in villgers participation in seedling survival between two groups of projects

Group 1 = PREVINOBA and IREF
Group 2 = PAFOCSE and PRECOBA

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F-Ratio	sig. Level
Between Groups	.78	1	.78	5.00	.03
Within Groups	4.69	30	.15		
Total	5.47	31			

2) Intention-to-Continue, (and independent variables tested for differences among the four nursery projects)

Chi-square analysis:

Variable	Chi-square	P-value	df
Intention to Continue with project	no significant difference	-	-
Intention to Continue with out project	no significant difference	-	-
Seedling Survival	unable to test +	-	-
Water Quantity Problems	no significant difference	-	-
Well Financing	7.4	.058	3
Number of Pots/Nursery	20.25	.00015	3
Tools, Fertilize Pesticides	10.29	.001	3
Participation	no sign difference	-	-
Training	unable to test +	-	-

+ Observations were too few to test using chi-square analysis.

Appendix K

Goals of four reforestation projects in Senegal, 1988

I.CRP (PRECOBA) * - Community Reforestation Project in the Peanut Basin of Senegal (Projet de Reboisement Communautaire dans le Bassin Arachider du Senegal) (FAO, 1988).

Goals:

1. To encourage equal participation of local populations in reforestation activities by increasing public awareness of the problems in forestry.
2. To provide technical supervision to aid in site selection, plantation establishment and tree protection.
3. To establish 10 ha woodlots/year at the community level in 10 villages in the project zone.
4. To integrate silviculture and agriculture, and sustain self-management of these systems.

II. FD (IREF) - Forestry Department, Regional Inspection of Diourbel (Inspection Forestiere de Diourbel, Direction des Eaux, Forets, et Chasses).

This reforestation project does not receive any outside financing. FD (IREF) encourages local organizations to be village production groups, creating and maintaining forest cover in Senegal.

Goals:

1. To follow the national forestry code, creating and protecting the forest resources of Senegal, and guaranteeing the revenues of forestry activities to the population.
2. To initiate forestry exploitation reform enlisting village groups as producers and protectors, with emphasis on: encouraging villagers to take charge of their forest resources; active and responsible participation of rural populations beginning with the planning stage; striving for

concrete and immediate results; promoting education which emphasize the value of forest resources villagers themselves use; integrating diverse activities of the rural population (i.e. agro-silvo-pastoralism).

3. To stop desertification, provide wood needs for the population, rebuild and protect the natural forests, save fragile ecosystems and to promote the conservation and reduction of total wood consumption in Senegal.

III. VRP (PREVINOBA) * - Villager Reforestation Project in the Northwest Peanut Basin (Projet de Reboisement Villageois dans le Nord-Ouest du Bassin Arachidier) (Saware, 1987).

Goals:

1. To increase the awareness of rural populations of forestry problems, training the villagers in appropriate techniques, and putting villagers in charge of essential forestry actions necessary for reconstructing and managing their environment.

2. To encourage the rational utilization and support the harmonious integration of agricultural and forestry.

3. To improve technical forestry knowledge/skills by institutional reenforcement of the forests service and through training forestry extension agents to become "development" agents.

IV. AP (PAFOCSE) * - Agroforestry Project for Soil and Water Conservation (Projet de l'Agroforesterie et du Conservation des Sols et des Eaux) (Linehan, 1987).

The SODEVA, the agricultural extension agency, coordinated participation of all contributing agencies, DCSR provided technical assistance, the Institute Senegalese de Recherche Agricole (ISRA), the Senegalese agricultural research institute was to provide research assistance and Peace Corps provided six volunteers in rural villages as technical agents.

Goals:

1. To initiate a series of agroforestry activities in 60 villages in the Thies and Diourbel regions to: reintroduce trees into the production system; demonstrate the role and importance of tree planting; demonstrate the beneficial use of agricultural sub-products (i.e. compost, animal waste, livestock fodder) in connection with forestry.
2. To test and validate agroforestry techniques by conducting adaptive research of tree species, plantation techniques, use of animal wastes and crop residue.
3. To obtain adequate information on the degree of environmental degradation, the interest of villagers, and the economic feasibility of project interventions to permit the elaboration of a long-term, large-scale agroforestry projects.