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DIAGNOSTIC SURVEYS AND MANAGEMENT INFORMATION SYSTEMS IN AGROFORESTRY PROJECT IMPLEMENTATION

A case study from Rwanda

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Prefatory Note

ICRAF's Working Papers series is intended to bring relevant work in progress to the attention of the wider community of agroforestry researchers and development workers. Most of the papers in this series are written by ICRAF staff; however, it has been the editorial policy of the series that papers by non-ICRAF staff may be published from time to time providing that they report on work that makes an exceptionally relevant and timely contribution to ICRAF's own programme of work.

The present paper is an example of such work, representing the adaptation and extention of diagnostic and design (D&D) concepts and procedures into new territory--the development and use of a diagnostically-based information management system in the implementation of an agroforestry extension project. As such, the paper illustrates the "iterative" nature of the diagnostic and design process and presents one example of the kind of microcomputer-based information management system that can facilitate the use of the D&D process as part of a project's "internal guidance system." Future papers in the Working Papers series will report on other examples of such systems, inasmuch as the whole question of information management in agroforestry projects has become an important new area of emphasis in ICRAF's methodology development effort. We are grateful to the authors and to CARE-International for the opportunity to open up this topic with the present contribution to the Working Papers series.

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ABSTRACT

A diagnostic survey was used to develop the agroforestry extension strategy of the CARE Gituza Forestry Project in Rwanda. In addition to providing valuable information about the pre-project state of farming systems and land-use, the survey identified the local issues around which the extension program was constructed and periodically monitored. Based on the survey results, an information management system for project monitoring was developed, which supplied critical information about the extension service's ability to respond, in a sustainable way, to farmer-identified needs and interests. The findings of the diagnostic and follow-up surveys were thus translated directly into agroforestry extension training as well as day-to-day management decisions. Preliminary evidence gained from one year's use of the monitoring system suggests that the project has a significant and positive impact on farming practices and that the described methodology is a practical way of assuring continuous participation from the project beneficiaries.

TABLE OF CONTENTS

	PAGE
ABSTRACT	0
1.0 INTRODUCTION	1
1.1 Specific Objectives of the Diagnostic Survey	1
1.2 Background of Gituza Commune	2
2.0 METHODS	3
2.1 Survey Questionnaire Design	3
2.2 Sample Selection	4
2.3 Training of Enumerators	4
2.4 Data Collection	5
2.5 Data Entry	5
2.6 Data Analysis Procedure	6
2.7 Problems	6
3.0. DISCUSSION OF RESULTS	7
3.1 Commune-Wide Results	7
3.1.1 Respondent Characteristics	7
3.1.2 Institutional Affiliation	8
3.1.3 Land Use History	8
3.1.4 Landholding Patterns	9
3.1.5 On-Farm Labor	9
3.1.6 Food Production	10
3.1.7 Livestock	10
3.1.8 Water Sources	10
3.1.9 Household Energy	11
3.1.10 Woody Raw Materials	12

PAGE

3.1.11 Industrial/Artisanal Wood Uses 12

3.1.12 Previous Tree Planting Practices 12

3.1.13 Indigenous Tree Species and Uses 13

3.1.14 Future Tree Planting 13

3.1.15 Willingness to Purchase Seedlings 14

3.2 Sector Results 14

3.2.1 Sector Nyakayaga 15

3.2.2 Sector Nyagisozi 16

3.2.3 Sector Mugera 16

3.2.4 Sector Nyabiheke 17

3.2.5 Sector Gitebwe 17

3.2.6 Sector Gitoki 17

3.2.7 Sector Gituza 18

3.2.8 Sector Mukarange 18

4.0 MANAGEMENT IMPLICATIONS 25

4.1 Management Information System for Extension Monitoring and Evaluation 32

4.1.1 Diagnostic Baseline Survey 32

4.1.2 Extension Course Diplomas 34

4.1.3 Seedling Distribution Lists 35

4.1.4 Post-Planting Follow-Up Extension Visit Forms 36

4.1.5 Agroforestry Monitoring Trials 37

4.2 Initial Management Information System Results 39

4.2.1 Seedling Survival 39

4.2.2 Changes in Species Preference 40

PAGE

4.2.3 Participation in Agroforestry Extension Courses 46

4.2.4 Frequency and Type of Extension Advice Given to Farmers and Frequency of Extension Problems Encountered 46

4.2.5 Initial Changes in Agroforestry Practices 48

5.0 CONCLUSIONS 49

6.0 BIBLIOGRAPHY 51

APPENDICES

Appendix I: Survey Questionnaire Form 52

Appendix II: Interview Response Form 63

Appendix III: Tabulated Results of Commune-Wide Frequencies 64

Appendix IV: Results of Crosstabulations of Key Variables 75

Appendix V: Average Price for Seedlings Farmers Are Willing to Pay 81

TABLES AND FIGURES

Figure 1 Map of Gituza Commune 15

Figure 2 Information Acquisition, Flow and Management Importance Within the Agroforestry Extension System 33

Figure 3 Picture of Extension Training With Feltboard 35

Figure 4 Picture of Agroforestry/Soil Conservation Trial Plot 38

Figure 5 Picture of Avocado Grafting Training 43

Figure 6 Picture of Markhamia Platycalyx With Sorghum and Bananas 43

		PAGE
Table 1	General Sector Information	19
Table 2	Social Characteristics and Landownership Patterns	20
Table 3	Resources	21
Table 4	Frequency of Tree Species Planted by Sector	22
Table 5	Numbers of Trees Planted by Sector	23
Table 6	Frequency of Trees Farmers Would Like to Plant in the Future and Willingness to Purchase Seedlings by Sector	24
Table 7	Implications of Survey Results for Extension Program Development and Monitoring	25
Table 8	Survival Rates of Trees Planted During the First Two Project Seasons	41
Table 9	Tree Species Planted Before the Project and After the Project's First and Second Planting Seasons	44
Table 10	Tree Species Desired for Future Planting Before the Project and After the Project's First and Second Planting Seasons	45
Table 11	Percentage of Farmers Who Have Taken Agroforestry Extension Courses During the First Two Project Seasons	46
Table 12	Frequency of Extension Advice Given to Farmers During the First Two Seasons	47
Table 13	Frequency of Agroforestry Related Problems Noted by Extension Agents During Follow-Up Visits	47
Table 14	Change in Frequency of Forestry/ Agroforestry Practices in the Gituza Forestry Project	47

1.0 INTRODUCTION

In July 1984 CARE International fielded a team to design a forestry and energy conservation project in the northeastern region of Rwanda. Responding to requests from the Government of Rwanda, the team identified a project-based strategy to reduce the fuelwood consumption of 23,000 Ugandan refugees living in a camp in the area. Project funding by USAID was approved in September 1984 and project operations began after an agreement was signed with the Rwandan government in April 1985.

In addition to addressing the energy problem in the refugee camp, the project was to reforest several thousand hectares of degraded hillsides in the adjacent Gituza Commune and address Gituza farmers' needs for forest products through agroforestry extension.

The object of this paper is to describe how the project developed its agroforestry extension strategy and identified specific interventions using a diagnostic survey methodology. In addition to providing information about survey design, implementation and analysis, the paper seeks to illustrate, through a case-history approach, how such information can be used throughout the project implementation cycle. The reader is provided with a description of the monitoring tools developed by the project, intermediate results as they relate to day-to-day extension management, and quantified impacts on farming practices realized during the first year of operations.

The paper is aimed at a target audience comprised primarily of practicing project managers, designers and evaluators. Although the diagnostic survey described bears some resemblance to the ICRAF Diagnosis and Design (D&D) methodology, it does not include all of the steps used by the D&D model and is part of a management information system designed to fit the context of the Gituza Forestry Project.

1.1 Specific Objectives of the Diagnostic Survey

The diagnostic survey was implemented with the intent to provide project management with guidelines for the implementation of the agroforestry component. Specifically the survey was designed with the following objectives:

1. To systematically assess local farmers' present land-use practices and develop a solid, quantitative information base of their expressed needs, interests and concerns with the intent to identify those local issues upon which an agroforestry strategy and specific interventions could be built;

2. To establish baseline information on as many facets of agroforestry activities as existed prior to project implementation to be used as a benchmark against which

the success of project-promulgated technologies could be periodically monitored and evaluated;

3. To determine quantifiable indicators for the monitoring of agroforestry extension activities and to develop a management information system (M.I.S.) to provide continuous feedback from farmers, to monitor and evaluate evolving agroforestry knowledge, attitudes and practices, and to assure maximum participation by farmers; and

4. To serve as a training tool to the Extension Agents for a "client-oriented" extension approach. Although understated within this case study the practical training in communication skills and interviewing techniques were invaluable to the Extension Agents' subsequent effectiveness.

1.2 Background of Gituza Commune

The Gituza Forestry Project is located in Gituza Commune in northeastern Rwanda. The 336 square kilometer Commune is contiguous with Akagera National Park and is geographically classified as a transition zone between the hilly Eastern Plateau and Eastern Plains of Rwanda. Roughly half of the Commune lies in each of these two distinct agro-ecological zones.

The average annual rainfall in the area is approximately 1000 millimeters distributed in a distinctly bimodal pattern. Elevations range from 1450 meters in the lowest valley bottoms in the northeast to 1890 meters on the hilltops in the southwest.

Soils are extremely diverse. Vertisols are typical in the permanently wet bottomlands where raised-bed and irrigated agriculture is practiced. Ultisols are found on gentle sideslopes formed by alluvial deposition and are perhaps the most important soil class present. On the steeper slopes Inceptisols and Entisols are common, primarily due to erosion induced by fire and overgrazing.

Gituza Commune has a population of about 32,000 and represents one of Rwanda's least populated areas. The Commune is currently experiencing population increases in excess of the national average due to immigration from more crowded regions of the country. Residents in Gituza are almost exclusively farmers who live on well-dispersed homesteads. The economy can be classified as agrarian subsistence although most families produce one or more crops for cash or barter income. The major crops are beans, corn, sorghum, sweet potatoes, cassava and bananas.

Gituza Commune is divided into eight administrative Sectors headed by an elected advisor who reports to the appointed Commune's mayor ("Bourgmestre"). Individual Sectors are further disaggregated into Cells, usually determined as geographic entities (hills), which are headed by a Cell leader.

According to the 1962 Constitution and subsequent legislation, all land in Rwanda theoretically belongs to the State but is actually held in escrow by the Communes. Land is subsequently allocated to individuals who, in practice and legislated theory, have exclusive usufruct rights rather than outright ownership. Areas out of private or communal use revert back to the central government but can be ceded to either the Commune or individuals upon request.

According to Commune estimates (Commune de Gituza 1984), 9591 hectares of land are actively cultivated, 3462 hectares lie in fallow, and 498 hectares are held in private or public forest woodlots. The remainder is classified as either Commune-owned pasture and swampland or State-owned and severely degraded forestland.

2.0 METHODS

2.1 Survey Questionnaire Design

Two of the stated objectives of the survey were to identify resource constraints and opportunities of Gituza Commune farmers which could be addressed through agroforestry and to acquire baseline information against which project interventions could be measured. The questionnaire (see Appendix I) represents a composite sketch of several existing survey tools with particular emphasis on ICRAF's Agroforestry Diagnosis and Design method (ICRAF 1983). It is divided into fourteen sections dealing with existing resources and patterns of resource use:

- general information on the respondent (address, name, sex, age);
- land use history and evidence of soil degradation;
- landownership;
- land use type;
- farm labor (gender, employment status, numbers);
- institutional affiliation;
- food production (crops produced for sale and/or consumption);
- livestock (type, quantity, fodder sources and sufficiency);
- water (source, distance in dry and rainy season);
- household energy (type, source, sufficiency);
- raw materials (type, source, sufficiency);
- past tree planting practices (species, number, purpose, source of seedlings);
- natural woody vegetation on farm (species, purpose);
- trees desired to plant in the future and willingness to pay for seedlings.

Direct questions concerning cash income were avoided since this seemed to be a sensitive subject about which people did not wish to speak. The questions were written in French and Kinyarwanda and were headed by a code number to facilitate data entry into the computer.

2.2 Sample Selection

According to the latest census the total population of Gituza Commune in January 1985 consisted of 32,014 people in eight Sectors with an average of 4,000 people per Sector. Assuming an average familiy size of six persons (Service Des Statistiques Agricoles 1985) each Sector consists of approximately 660 families, thirty of which were randomly chosen to be interviewed. This 4.5 % sample was considered to be statistically adequate, particularly in view of the need for timely results to serve as an accurate baseline for the project's agroforestry interventions.

Commune records proved to be inadequate for selection of the sample as recent immigrants, newly married couples and non-legal marriages were not yet registered. If Commune records had been used the sample would have been skewed towards older and more established farm families. A new census of all farmers was therefore carried out from which the names of thirty heads of families were randomly selected for each Sector.

2.3 Training of Enumerators

The survey enumerators were eight "Moniteurs Forestiers" (Monifors) trained by project staff to work as Agroforestry Extension Agents in their respective Sectors. Due to the generally low education level in the Commune it was extremely difficult to find qualified candidates for extension workers. The project's attempt to recruit fifty percent female extension workers failed because no sufficiently qualified candidates applied. On the average the Monifors had less than two years of secondary education and no professional training. Prior to the interviews they underwent one month of intensive training in communication skills and interviewing techniques. The purpose of the survey was explained to them at length, particularly with respect to their own future work in the Sectors. The survey was equally important as an extension training exercise for the Monifors to help them identify the needs and concerns of their future "clients", as well as learning how to approach and communicate with farmers.

The pre-survey training of the Monifors was implemented by the head of the agroforestry program, an agronomist and former teacher, with guidance from the Project Manager. Training exercises included instruction and role plays on how to approach farmers, as well as individual and group test interviews under supervision of the instructor. Each Monifor then independently carried out one test interview in his Sector, the results of which were discussed with the training group.

At this point the questionnaire was slightly modified in response to problems encountered with some questions during the test interviews. A rural sociologist reviewed the questionnaires after approximately one third of the surveys had been completed. She provided useful input on questions requiring better resolution by the enumerators (Barnes 1985). A sample of respondents who were later re-interviewed indicated that no fraudulent surveys had entered into the data.

2.4 Data Collection

Prior to the survey, communal authorities were informed of its purpose and content to assure their assistance and cooperation. Consequently all sample farm families were willing to participate in the survey which was implemented during the months of August and September, a low activity period for farmers.

Due to its length, the questionnaire was divided into two parts and the Monifors were instructed to complete only one part at a time if the interview took more than 90 minutes. As the Monifors became more experienced, interviews took progressively less time and the average duration of a complete interview was 80 minutes. If the Monifor did not encounter the head of the family during the first visit, an appointment was made for a second visit. In case of repeated absence of the family head another name was randomly chosen.

During and after each interview the Monifor filled out an interview response form (see Appendix II) which provided information on duration of the interview, problematic questions, attitude of the respondent, and comments by the Monifor. The response forms were periodically reviewed by project staff to keep track of the progress of the survey which was discussed during the weekly in-service training sessions for the Monifors.

2.5 Data Entry

After completion of the interviews the questionnaire form was encoded and the data entered into an IBM-XT Personal Computer using the "Knowledgeman Integrated Information Management System" software package. This program has the advantage of allowing the user to store, retrieve and manipulate large amounts of information including limited statistical facilities, while compiling the data in a form which is easily converted to the ASCII format for use with other statistical software packages. "Knowledgeman" was chosen because of its integrated approach to information management and its availablity, but other data management packages such as "Dbase III" would have been appropriate as well. It took an average of ten minutes to enter the data of one questionnaire and a total of seven person-days to complete the data entry for 240 surveys.

2.6 Data Analysis Procedure

Most of the statistical data analysis was done on the IBM-XT using the "SPSS Statistical Software Package". Due to its size, the original data file was subdivided into seven separate files, each consisting of different questionnaire sections and key variables for analysis.

The statistical analysis was divided into two parts corresponding to different levels of information sought:

1. Commune level: Frequency analysis and crosstabulation were the main analysis procedures used to obtain a socio-economic profile of the Commune as well as information on patterns and trends of landownership, resource use and tree planting practices. While the frequency analysis gives a descriptive picture of farming practices and trends in the Commune, crosstabluation provides information on underlying causes and factors which influence farmers' decisions and behavior, particularly with respect to tree planting practices on which the project is focused. Chi-square tests and measures of association (Cramer's V, lambda) were used to test the statistical significance and strength of relationships between variables.

2. Sector level: Each Sector has an agroforestry nursery staffed with an Extension Agent. Thus, the eight administrative Sectors of the Commune form the basic operational level for the project's agroforestry extension efforts. Due to the size of the Commune and the resulting geographic, climatic and demographic differences between the Sectors, it was to be expected that resource constraints and opportunities also differ considerably, i.e. agroforestry interventions would have to be adjusted accordingly in each Sector. The second analysis level therefore aimed at identifying these differences through crosstabulation of the Sector variable with all other variables and the above mentioned significance tests.

In an effort to explain intra-Sector differences, a third level of analysis was attempted whereby the key variables were crosstabulated separately for each Sector. However the sample size proved to be too small to obtain significant results at this level.

2.7 Problems

During the analysis procedure it became apparent that some questions should have been formulated differently in order to yield valid or more useful results. Others proved to be too complicated in view of the limited educational level of both the Monifors and the farmers.

For the questions about the number of years the interviewed person had farmed in the area and the price he/she was willing to pay for tree seedlings, number intervals were given on the questionnaire form. These intervals proved to be inappropriate in both cases and

should have been replaced by a blank space on the questionnaire form to be filled with a specific number. If necessary, intervals could be created retrospectively during analysis with SPSS.

Both questions on land use type and on-farm firewood sources required percentage proportions as answers. Farmers were unable to adequately estimate proportions while the Monifors had difficulties to convert proportions into percent adding up to 100 % total. Farmers also had difficulties estimating the number of trees of a given tree species they had planted on their farms and particularly the number of trees that had died. The only exception were fruit trees which are generally planted in small numbers. Therefore only broad categories were used to evaluate numbers of trees planted against other variables.

3.0. DISCUSSION OF RESULTS

3.1 Commune-Wide Results

The results of the frequency analysis for the entire Commune are tabulated in Appendix III and are discussed by subject below.

3.1.1 Respondent Characteristics:

The majority of survey respondents were men as they are normatively the heads of families. Some of the 12.5 % women interviewed are wives of absent farmers while the rest head their own families. Compared to a national average of 21.7 % woman-headed households in Rwanda (Service Des Statistiques Agricoles 1985), survey results indicate a lower percentage for Gituza Commune. The majority of woman-headed households is headed by widows (Williams 1986) and the lower percentage may be explained by the generally younger population of the Commune. Due to the small sample size of woman-headed households, differences of needs and interests between men and women could not be adequately assessed through the survey. This task was carried out by a social scientist at a later stage who was hired to fine-tune the survey results.

The age distribution of the respondents is somewhat skewed toward younger ages as compared to national figures, possibly reflecting the general growth of the Commune due to immigration from other parts of the country. The average family size of six persons found in the survey corresponds with national statistics (Service Des Statistiques Agricoles 1985).

More than half of the respondents are illiterate while most of the remaining 42 % have only primary school education. However, education levels seem to be increasing among younger family members: while 45 % of the farmers who are 30 years old and less

are still illiterate, a follow-up survey with 38 randomly chosen farm families shows that 79 % have at least one family member with a minimum of three years of primary education (Williams 1986).

3.1.2 Institutional Affiliation

Local organizations that are not government-affiliated do not seem to play an important role in the social structure of the Commune. The only form of organization with substantial participation is the "ikibina", a very informal credit association among small groups of farmers to buy construction materials or tools. The few cooperatives that exist are concentrated in the Mugera and Nyagisozi Sectors, the commercial centers of the Commune.

The predominant religious denomination is catholic (59%), but animistic beliefs are fairly common (24%).

3.1.3 Land Use History

Twenty percent of the respondents have been farming in the area for less than five years and most likely represent young people from the Commune and those who recently immigrated from the more crowded parts of the country. More adequate information on immigration patterns may have been obtained if time intervals had been chosen differently in the questionnaire.

A major concern of 73 % of the farmers interviewed, with important implications for the agroforestry program, are declining crop yields and the main expressed causes are decreased soil fertility and loss of topsoil. The most common measures taken against soil degradation are crop rotation, increased fallow, clearing of new land and composting. However, composting was the President's National Theme for 1985 and it is to be suspected that many respondents wanted to give the impression they were following national guidelines.

Surprisingly the recognition of soil degradation problems does not differ significantly between farmers who are new to the area and those who have been farming for more than five years (see Appendix IV). This may be due to the fact that the new farms are on less fertile land where productivity decreases faster than that of the more fertile soils of older farms.

Fallowing and clearing new land are fairly common in Gituza Commune where landholdings are relatively large and new land is still available for cultivation. However, in view of Rwanda's current population growth rate of 3.8 % (World Bank 1984) and increasing immigration into the Gituza area, landholdings are likely to become smaller in the future with less unoccupied land available. Therefore, agricultural intensification with sound soil management practices will become vital to sustain agricultural productivity.

3.1.4 Landholding Patterns

The enumerators were trained in simple land surveying techniques to determine the approximate surface area of the farms and to indicate the location and species of woody perennials. According to the survey, the average size of landholdings in Gituza Commune is 2.1 hectares. This is within ten percent of the latest Commune statistics which indicate an average of 1.9 hectares (Commune de Gituza, 1984). Gituza residents thus own almost twice as much land as the national average of 1.2 hectares (Service Des Statistiques Agricoles 1985). This is primarily due to a lower population density, less fertile soils, and the fact that the remote Gituza area was inhabited relatively late. More than 50% of the farmers hold more than one plot, the overall average being 2.1 plots per farmer.

Farming practices are extensive with land often lying fallow due to lack of farm labor. Crosstabulations however show that landownership patterns in Gituza Commune follow trends apparent in all of Rwanda (see Appendix IV). Older farmers with larger families, who have spent more time in the area, have larger landholdings, more labor, grow more cashcrops and own more livestock. Younger farmers with smaller families and less labor, who have farmed in the area for five years and less own less land. While there is still more land available in Gituza than elsewhere in the country, landholdings are nevertheless becoming smaller in the present generation, a trend which is likely to continue if the population growth rate is not reduced.

The majority of farmers (83%) hold title to their land while most of the remaining 17 % have customary use rights. Unlike many West African countries, local land tenure and national legislation do not show large divergencies and thus do not pose a serious problem for on-farm tree planting. Farmers have traditionally planted trees on their land and seem to recognize tree planting as a productive land-use function which strengthens title to land.

3.1.5 On-Farm Labor

While the mean number of people working on the farm is 6.3, this figure may present an incorrect picture of the actual labor situation in the Commune. On 74 % of the farms the labor force consists exclusively of family members with an average of less than four persons working. Only five percent have full time hired labor and 25 % have seasonal hired labor. In view of the comparatively large landholdings this points to a shortage of farm labor and, again, to relatively extensive farming practices. Labor intensiveness is thus an important factor to be considered when promulgating agroforestry practices and agricultural intensification. Indeed, seasonal labor shortages within the project's reforestation component have been directly attributed to competition for on-farm labor.

3.1.6 Food Production

The principal food crops grown by more than 90 % of the farmers are beans, sorghum, corn, sweet potatoes, bananas and cassava. In addition approximately 25 % of the respondents grow vegetables, soybeans, peas, taro, tobacco, peanuts or fruits. In general crops are grown for home consumption with surpluses sold or exchanged for other goods. Coffee and bananas are the only exceptions: coffee, grown by 42 % of farmers, is the only exclusive cashcrop while a portion of the banana crop is most often sold in form of banana beer. Pure subsistence farming hardly exists as 95 % of the farmers sell at least one product.

3.1.7 Livestock

Historically livestock raising has been an important activity in the Gituza area. Ten years ago the Commune counted 15,000 head of cattle (Mashavu, pers. com. 1986). Numbers have been greatly reduced in recent years due to an outbreak of hoof and mouth disease and pasture degradation caused by historical overgrazing combined with periodic burning.

Commune records show that livestock presently consists primarily of goats (14,640), with only 2,019 head of cattle left in the Commune (Commune de Gituza 1984). According to the survey 16 % of Gituza's farmers own cattle, the mean number being 2.1 head per owner. Cattle are grazed collectively on Commune pastures and State owned land mainly in the Sectors Nyakayaga, Nyabiheke and Mukarange. Since the average number of goats (4) and sheep (2.2) owned is small, these animals are left to roam free. Stable feeding and the use of aerial fodder are uncommon. According to the Commune's Agronomist there are currently only 29 stable feeding operations in the Commune (Mashavu, pers. com. 1986). Like landholding size and labor availability, livestock raising practices point to extensive farming systems. However, 28 % of the respondents complain about fodder insufficiency, mainly due to seasonal inavailability of fodder grasses and insufficiency of quality pasture land. This shortage almost certainly applies to goat feed as the average farmer is quite removed from day-to-day cattle management.

3.1.8 Water Sources

Gituza Commune does not have a Commune-wide water system and the main water sources are springs, brooks and wells. In the rainy season rainwater and ponds are used to a limited extent as well. Most people walk 1 km or less to the closest water source and the mean distance of 0.73 km during the rainy season increases to 0.83 km during the dry season. However, in the Rwandan context time spent on a specific task is a better indicator than distances as many people live on upper hill slopes. Therefore, time spent on daily water collection may be a more serious constraint than the distance to the water source indicates. Future surveys should thus try to gauge time versus linear distances.

3.1.9 Household Energy

Expectedly the main source of household energy is firewood, which is used by 97.5 % of the respondents. It may be supplemented and/or substituted seasonally by agricultural residues. In addition to cooking, firewood is used for brewing sorghum beer, space heating, and, to a limited extent, for lighting and ironing. Agricultural residues are also frequently used for beer brewing and space heating despite a national effort to encourage farmers to compost residues rather than burn them. It is difficult to determine whether residues are burned due to a lack of firewood or because they are more convenient to collect and are therefore seasonally used as a substitute.

Unlike in many other African countries where fuelwood gathering is exclusively the women's task, the responsiblity seems to be equally shared here by men, women and children. While men cut and split trees, women and children collect dead wood or cut branches off trees. Men's interest in planting fuelwood trees should therefore be equally as high as women's, particularly where most of the firewood is obtained by cutting down trees on the own farm.

Only 28 % of the survey respondents claim difficulties in obtaining sufficient firewood as natural vegetation is relatively abundant in the Commune and the adjacent National Park. However, while 60 % of respondents collect dead wood and 30 % obtain firewood from uninhabited land, 67 % also cut down trees for fuel and 69 % obtain firewood from their own farms. The fact that only 28 % of farmers claim firewood scarcity may also be a result of the way scarcity is perceived. It is common practice to substitute or supplement firewood with agricultural residues and the importance of residues for sustaining soil fertility and agricultural production are not well understood. Thus, as long as crop residues are available as fuel, the farmers may not perceive a scarcity even if firewood is in short supply.

Fuelwood scarcity differs greatly between Sectors (see Table 3, Page 20). Gituza, Gitebwe and Mugera have the highest percentage of people experiencing difficulties in procuring sufficient firewood. Gitebwe and Mugera are both located in the center of the Commune, have been inhabited for a long time and have the highest population densities (see Table 1, Page 18). Gituza is also one of the Sectors which have been inhabited early.

In order to determine what causes perceived firewood scarcity, several key variables were crosstabulated with the firewood scarcity variable (see Appendix IV). While the Sector differences may overshadow correlations to some extent, it became, nevertheless, apparent that the source and the means of procuring firewood have an influence on perceived scarcity. In general those farmers who have to cut down trees and obtain firewood from their own farm tend to recognize a firewood problem while farmers who collect dead wood and obtain it from uninhabited land are less likely to do so. As men usually cut trees while women collect dead wood and the majority of interviewed farmers were men this finding was to be expected.

Somewhat surprisingly the 10 % of farmers who have to buy firewood do not seem to perceive insufficiency. In addition older farmers who have been in the area for longer than five years more often claim firewood problems which could be an indication for decreased availability over the years.

3.1.10 Woody Raw Materials

Trees and shrubs provide raw materials mainly for construction, tools and enclosures/windbreaks. While most woody materials are collected or produced on-farm, materials for construction and tools are often insufficient (50 %) and have to be purchased, indicating a definite need for tree species that can provide these materials.

3.1.11 Industrial and Artisanal Wood Uses

Small industries which use wood include brick making, pottery, charcoal making, light carpentry and various crafts. They occupy only about five percent of the interviewed farmers. Brick making is probably the most predominant in terms of wood consumption during the dry season, and a large percentage of privately owned woodlots is sold to brick makers as a form of income generation.

3.1.12 Previous Tree Planting Practices

Gituza farmers have traditionally planted trees on their land: 95 % of the survey respondents claim to have planted trees, the majority for more than five years. In addition the Government encourages tree planting through a yearly National Arbor Day, when Rwandan citizens are expected to plant at least one tree on their farms or on communal land. Although it is difficult to ascertain figures, it is quite likely that the majority of the 95 % have planted trees exclusively on National Arbor Day as a civic obligation. Survival of these trees is estimated to be less than 20 % (DGF, pers. com. 1985). On-farm trees are mostly planted on farm boundaries, around homesteads and in the fields. Woodlots are planted on hillsides and some planting takes place on agricultural land lying fallow.

In terms of frequency and numbers *Eucalyptus* spp. and *Euphorbia tirucalli* are the most commonly planted species, followed by avocado, *Ficus* spp., *Markhamia platycalyx*, papaya, *Grevillea robusta*, *Cupressus lusitanica* and *Erythrina abyssinica* in descending order of frequency. *Euphorbia* and *Ficus* are usually planted as enclosure/windbreak around the compound, while the others, with the exception of fruit trees, provide firewood, construction or carpentry wood and tool handles. The seeds for indigenous trees are generally collected or propagation is left to natural regeneration. Seedlings for exotic species such as *Eucalyptus*, cypress and *Grevillea*, as well as avocado and guava originate in nurseries operated by the Sector with "umuganda"

(voluntary labor) and are given to farmers free of charge. As elsewhere in the country, the species selection offered by these nurseries was extremely limited prior to project implementation.

In order to get a better understanding of the factors which influence tree planting, crosstabulations were carried out for farmers who have planted relatively few trees (< 50) and many trees (>300) (see Appendix IV, Table 3.5). It appears that younger farmers, smaller households, farmers with little land and/or only one plot, without title to land, and those who have been farming in the area for five years and less, have generally planted less trees. Large numbers of trees have been planted by farmers with large landholdings and more than one plot. Most of these are in the form of Eucalyptus woodlots. Recognized firewood scarcity seems to have no effect on the decision to plant trees, not even in the Sectors Mugera, Gitebwe and Gituza, where fuelwood problems are prominent. However, those farmers who obtain firewood from their own farms or have to cut trees for firewood have planted more trees than those who collect dead wood or get firewood from uninhabited land. This reflects the fact that men generally plant as well as cut trees. Therefore, those farmers who have to cut trees for firewood have probably a larger interest in planting trees than farmers whose wives collect firewood.

3.1.13 Indigenous Tree Species and Uses

78 % of the respondents have a total of 52 different indigenous trees and shrubs on their farms, many of which are extremely difficult to identify because of local variations in vernacular names. The most common species are Erythrina abyssinica, Vernonia amygdalina, Acacia sieberiana, Rhizinus sp. and Ficus sp., all of which are used for firewood. In addition Erythrina and Ficus are used for tools while Vernonia and Erythrina are medicinal plants. Traditional uses of indigenous trees and shrubs are found to be much more limited than in Sahelian West Africa, where people depend on them for food, medicine and fiber due to harsher climatical conditions, and where each species was found to have at least five different uses (Muller 1982).

3.1.14 Future Tree Planting

The majority (87 %) of respondents would like to plant more trees while the rest claim insufficient land or old age as reasons for not wanting any more trees. Crosstabulation with other variables yielded little more information on factors influencing the desire for more trees. The majority of farmers seem to want trees irregardless of the amount of land they own, whether they have title or not or whether they experience fuelwood problems. They only significant factors are the age of the farmer, indigenous trees on the farm, having to cut trees for firewood and having previously planted firewood species. However, even these correlations are not very strong.

A comparison between the previously planted tree species and the species farmers would like to plant shows a trend toward fruit trees such as avocado, papaya, guava, lemon, orange, mango and soursop (Annona reticulata). On the non-fruit tree side, the farmers are still interested in introduced, fast-growing trees, namely Eucalyptus, Grevillea and cypress, but there appears to be little interest in further planting of indigenous trees. In terms of the purpose for which these trees are desired, there is a slight increase in the interest in selling trees, particularly for less common fruit trees such as guava, citrus, mango and soursop. Some enterprising farmers seem to sense a potential for income generation by selling these fruits. Climatically the Mutara valley, to which part of Gituza Commune belongs, is very well suited for commercial fruit production and has potential to become Rwanda's "fruit basket" in the future.

3.1.15 Willingness to Purchase Seedlings

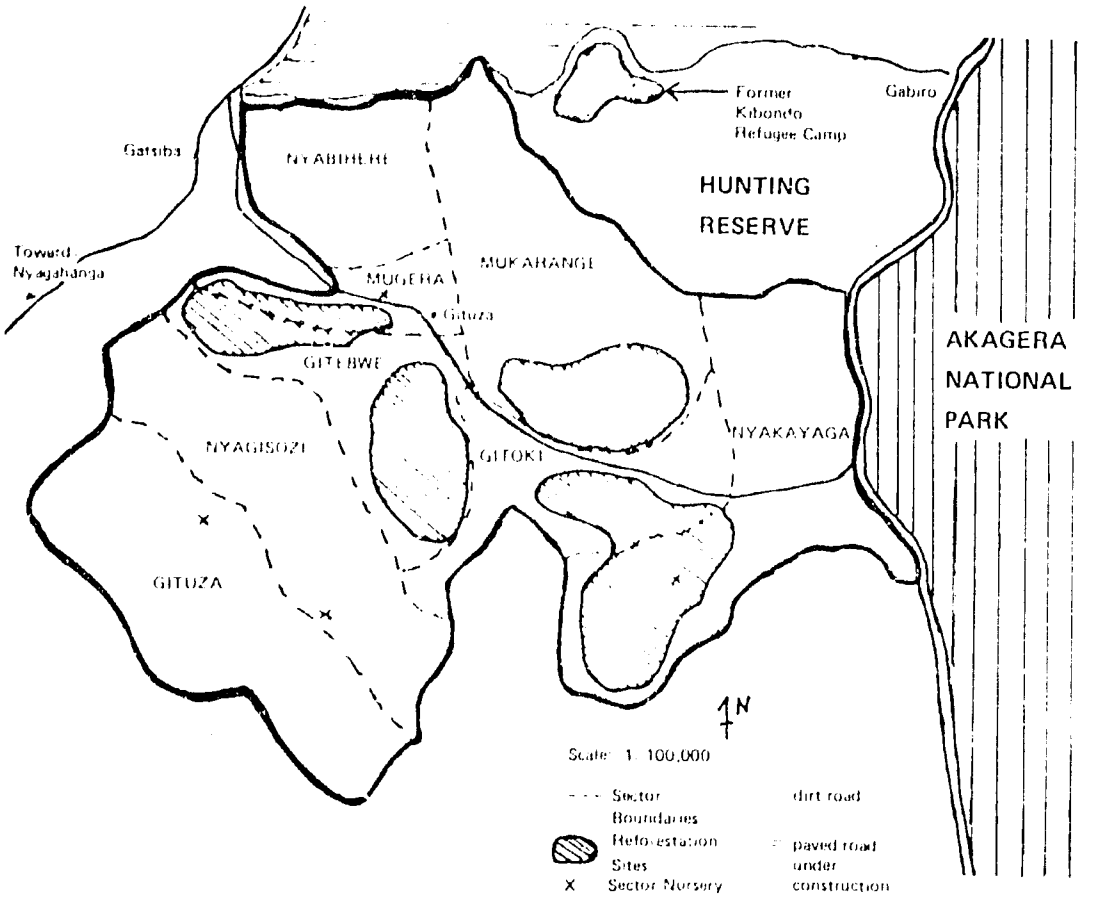
As mentioned earlier trees have been traditionally given to farmers free of charge in an effort to encourage widespread tree planting. However, survival rates have been generally poor under this system - less than 20 % of the trees planted on National Arbor Day survive (DGF, pers. com. 1985). In order to increase tree survival and to better address the problem of recurrent costs in the Sector nurseries, the project considered the possibility of selling seedlings to farmers in the future. When asked if they are willing to pay for seedlings, 76 % of the farmers responded positively while the rest claimed not to have enough money (17%) and/or were unwilling because it is customary to receive trees free of charge (9%). Proposed prices range from 1 to 10 FRW (0.01 to 0.1 US $) for most species, with the exception of fruit trees for which 20 % of farmers would pay a higher price. Unfortunately the formulation of the question in the survey did not allow for more exact information on actual prices. The same question was therefore included in follow-up extension interviews carried out by the Monifors after the first planting season, in which they asked for the exact amount the farmer would be willing to pay for each species (see Appendix V).

Several key variables were crosstabulated to get an idea of what influences the willingness to purchase seedlings and more specifically, if wealth, as indicated by the size of landholdings, cashcrops, number of livestock and cattle, is a determining factor. However, none of the variables proved to be significant and unwillingness to buy seedlings is based mainly on a perceived cash shortage and the traditional custom of receiving seedlings free of charge.

3.2 Sector Results

Gituza is a large and geographically diverse Commune which spreads from the Eastern Plateau area with steep hills to the Tanzanian plain (Fig. I). Subsequently the Commune's eight administrative Sectors

Figure I. Map of Gituza Commune with Sectors



differ ecologically as well as demographically and socio-economically (Table 1). Through crosstabulation, significant differences between Sectors were also found which are related to landownership, resources and tree planting practices (Tables 2 to 6). A brief profile of each Sector highlights the major differences and points out specific needs and concerns which may be addressed through the project's Sector-based agroforestry extension service. Only the most salient inter-Sector differences are highlighted.

3.2.1 Sector Nyakayaga

Nyakayaga is located in the Eastern part of the Commune and borders the Akagera National Park to the North and East. Ecologically it is part of Rwanda's Eastern Savanna region. With 3,800 hectares, Nyakayaga is almost twice as large as most of the other Sectors and

has the lowest population density (108 persons/sq km). Landholdings are the largest in the Commune with an average of 2.74 hectares per farmer. 96% of the residents have title to their land. Nyakayaga is a pastoral Sector: 30 % of farmers own cattle and there are 200 hectares of Sector-owned pasture. Coffee production plays a minor role as only 20% of the farmers grow coffee. Farmers in this Sector have planted less trees in the past than in most other Sectors, but there seems to be a particularly high interest in fruit trees for future planting.

3.2.2 Sector Nyagisozi

This Sector, located in the Southwest of the Commune, is part of the steep, hilly Eastern Plateau. 97% of the farmers have been in the area for more than five years which indicates population saturation and a low immigration rate. Farm sizes are slightly below average with 2.02 hectares per farmer, but most farms consist of several plots. Farm labor appears to be scarce compared to the other Sectors and consists of family members on 90% of farms. Nyagisozi is a coffee-producing Sector while only 6 % of farmers own cattle. Major concerns appear to be soil degradation, which is recognized as a problem by 90% of farmers, and insufficiency of fodder for livestock as there is no open pasture. A high percentage of farmers has been planting fruit trees, particularly avocados, and interest in fruit trees continues to be high, especially for papaya, guava and mango. However, the percentage of farmers who are willing to buy seedlings is lower than in the other Sectors (60%).

3.2.3 Sector Mugera

Mugera is the smallest Sector and has the highest population density (338 persons/sqkm). Located in the center of the Commune, it is the seat of the Commune administration as well as its commercial center. Geographically it is a transition zone with steep degraded hillslopes covering the southern half while the rest are fertile valleys and gentle hill slopes. Farm sizes are the second smallest in the Commune with 1.74 hectares per farmer, but all farmers hold title to land. The main cashcrops are coffee and bananas. Resource problems include long distances to water sources and difficulties in obtaining sufficient firewood. The highest percentage of farmers who buy firewood is found in this Sector. All the farmers interviewed have planted trees in the past, mostly Eucalyptus and avocado with comparatively high numbers of Grevillea, papaya and guava. Farmers would like to plant a larger variety of species in the future than in other Sectors and there is a significant interest in less common fruit trees such as soursop, lemon and orange. Mugera also has the highest percentage of farmers willing to buy seedlings (83%), probably because residents in this Sector generally dispose of more cash income than in the rest of the Commune.

3.2.4 Sector Nyabiheke

Located in the northern part of Gituza Commune and bordering on the Akagera National Park, Nyabiheke is part of the Eastern Savanna region. Although few people own cattle, Nyabiheke is a pastoral Sector because much of the Commune's cattle is collectively grazed on Sector pastures. Landholdings are average in size with 2.13 hectares per farmer but, surprisingly, many farmers have hired labor. Nyabiheke is the only Sector which does not produce coffee. Due to an abundance of natural vegetation, tree planting seems to have had low priority in the past as farmers in Nyabiheke have on the average planted ten times less trees than in other Sectors. However, interest appears to be increasing and is equally divided between fruit trees and non-fruit trees.

3.2.5 Sector Gitebwe

Gitebwe is centrally located and forms a transition zone between the Plateau and the Eastern Plains. A major part of the Sector is covered by extremely degraded hills while the rest is fertile agricultural bottomland. The population density is the second highest in the Commune (228 persons/ha) and landholdings are the smallest with an average of 1.3 ha per farmer. They consist mostly of several plots and only 58 % of the farmers hold title to their land. Labor is scarce and consists mostly of family members. Coffee and bananas are grown as cash crops.

Major concerns are soil degradation which is recognized by 74% of the farmers and firewood scarcity, although no one apparently buys firewood. In the past farmers in Gitebwe have planted large numbers of eucalypts. While the interst in eucalypts and other non-fruit trees seems to be declining, it is slightly increasing for fruit trees.

3.2.6 Sector Gitoki

Gitoki is surrounded on three sides by steep hills but the Sector itself is part of the Eastern Savanna region with bottomlands and gently sloping hillsides. Population density (160 persons/ha) and farm sizes (2.00 ha/farmer) are average. However, only 43% of farmers hold title to their land and 30% have been in the area for five years and less. This indicates a high rate of immigration either from other Sectors or from the more densely populated regions of the country. Coffee and bananas are the main cashcrops and 17% of farmers own cattle. There seems to be an abundance of natural vegetation as only 7% of farmers claim difficulties in obtaining sufficient firewood and 87% collect dead wood.

Concerns are soil degradation, which is recognized by 83% of the farmers and long distances to water sources which increase by 30% during the dry season. In terms of numbers of trees planted in the past, Gitoki lies below the Commune average. In contrast to other Sectors, there seems to be more interest in non-fruit trees than in fruit trees.

3.2.7 Sector Gituza

Gituza is the southwestern-most Sector and consists of the steep hills and narrow valleys characteristic of the Eastern Plateau region. With a surface area of 2,600 hectares the Sector is comparatively large and the population density is below average (168 persons/ha). Landholdings are the second largest in the Commune (2.69 ha/farmer). However, the mean farm size is somewhat misleading as only a few farmers have landholdings of more than five hectares while the majority has farms of 2-3 ha and less. 97% of farms consist of two plots or more and the same percentage of farmers holds a title to the land. However, labor is not abundant as the labor force on 87% of the farms consists exclusively of family members. Gituza is the biggest coffee producer in the Commune with 90% of farmers growing coffee as a cash crop.

Concerns are soil degradation, which is recognized as a problem by 93% of farmers, and firewood scarcity (88%). No one appears to buy wood, but all farmers cut down trees for firewood and obtain it from their own farm. This partly explains their concern because it involves time and effort by the farmer himself. It is possible that firewood problems have led to widespread tree planting. Farmers in Gituza have planted the largest amount of trees in the past, the majority being eucalypts. For future planting there appears to be less interest in non-fruit trees (57%), while 80% would like to plant more fruit trees and 73% are willing to purchase seedlings.

3.2.8 Sector Mukarange

Located in the northern part of the Commune and bordering on the Akagera National Park, Mukarange is part of the Eastern Savanna region. The terrain is gently rolling with the exception of some steep hills in the southern part. Population density is the second lowest in the Commune (157 persons/sq km) and 37% of farmers have been in living in the Sector for five years and less. Like Gitoki, Mukarange is a target area for immigration from other Sectors or other parts of the country. Farm sizes are above average with 2.29 hectares per farmer and 83% hold title to their land. Although no one appears to own cattle, the Sector is nevertheless pastoral as much of the Commune's cattle is grazed here. Only 10% of the farmers grow coffee as a cash crop and the Sector is still fairly undeveloped and at subsistence level. Natural vegetation is abundant and 80% of farmers collect dead wood. Thus, firewood does not appear to be a problem.

Planting of Eucalyptus, which is generally the most common tree in terms of numbers and frequency, has played a minor role in the past. Farmers in Mukarange have planted five times less than the average of the other Sectors. Although interest in tree planting seems to be increasing, only 60 % of farmers are willing to buy seedlings which may be partly due to a lack of cash income in the Sector.

Table 1. General Sector information

	Nyakayaga	Nyagisozi	Mugera	Nyabiheke	Gitebwe	Gitoki	Gituza	Mukarange
Size (ha)	3,800	1,800	1,000	1,700	1,700	2,600	2,700	2,700
Ecological Zone	Eastern Savanna	Eastern Plateau	transition zone	Eastern Savanna	transition zone	Eastern Savanna	Eastern Plateau	Eastern Savanna
Total Population (1984)	4,085	3,986	3,482	3,452	4,044	4,171	4,547	4,249
Population Density (persons/km2)	108	221	348	203	238	160	168	157
Main Resources	cattle bananas	coffee	bananas	cattle, bananas, fertile soils	coffee, bananas, fertile soils	cattle bananas fertile soils	coffee	fertile soils
Schools	Primary School since 1950, CERAI since 1982	Primary School since 1933	Primary School since 1949	Primary School since 1962	2 Primary Schools since 1949 and 1956, CERAI since 1985	2 Primary Schools 1955 and 1982	Primary School since 1982	
Sector Owned Pasture	+- 200 ha	10 ha	28 ha	91 ha	+- 70 ha	+- 120 ha		50 ha

Table 2. Social characteristics and landownership patterns

	Nyakayaga	Nyagisozi	Mugera	Nyabiheke	Gitebwe	Gitoki	Gituza	Mukarange	Commune
Mean Family Size	6.9	5.2	6.4	6.0	5.1	5.7	6.4	6.9	6.0
Mean Age of Farmer	40	36	44	45	43	39	46	40	41
Mean No. of Workers	6.3	4.7	6.3	12.5	3.0	6.6	4.8	6.1	6.3
Only Family Labor	70%	90%	60%	57%	83%	73%	87%	70%	74%
Some Education	60%	43%	40%	37%	40%	60%	33%	60%	43%
Religion	47% catholic 20% animist	73% catholic 20% animist	70% catholic 13% animist	24% catholic 52% animist	61% catholic 32% animist	56% catholic 15% animist	70% catholic 11% animist	67% catholic 30% animist	59% catholic 24% animist
Mean farm size	2.74 ha	2.02 ha	1.74 ha	2.13 ha	1.30 ha	2.00 ha	2.69 ha	2.29 ha	2.11 ha
More Than 1 Plot	30%	97%	47%	28%	73%	57%	97%	87%	43%
Title to Land	96%	97%	100%	89%	58%	43%	97%	87%	83%
<= 5 Years in Area	13%	3%	13%	21%	23%	30%	3%	37%	20%
Recognized Soil Degradation	50%	90%	50%	69%	74%	83%	93%	70%	73%

Table 3. Resources

	Nyakayaga	Nyagisozi	Mugera	Nyabiheke	Gitebwe	Gitoki	Gituza	Mukarange	Commune
Cashcrop Coffee	20%	67%	53%	0%	74%	30%	90%	10%	43%
Cattle Owned	30.0%	6.7%	3.3%	3.4%	6.5%	16.7%	10.0%	0%	9.6%
Livestock Owned	93%	80%	77%	76%	74%	77%	83%	63%	78%
Fodder Insufficient	21%	54%	35%	22%	13%	32%	8%	39%	27%
Firewood Scarcity	18%	17%	30%	10%	52%	7%	88%	7%	28%
Firewood Purchased	3%	21%	27%	14%	3%	7%	0%	7%	10%
Cutting Down Trees	83%	66%	63%	55%	60%	60%	100%	53%	[illegible]%
Collecting Dead Wood	24%	48%	60%	79%	60%	87%	39%	80%	60%
Wood From Own Farm	74%	79%	63%	55%	58%	63%	100%	63%	69%
Wood From Uninhabited Land	19%	7%	47%	59%	36%	30%	17%	27%	30%
Distance to Water Source Rainy Season	0.58 km	0.46 km	1.24 km	0.53 km	0.49 km	0.93 km	0.81 km	0.78 km	0.73 km
Distance to Water Source Dry Season	0.95 km	0.74 km	1.28 km	0.53 km	0.57 km	1.26 km	0.89 km	0.89 km	0.89 km

Table 4. Frequency of tree species planted by Sector

Species	Nyakayaga	Nyagisozi	Mugera	Nyabiheke	Gitebwe	Gitoki	Gituza	Mukarange	Commune
Eucalyptus	93%	80%	97%	76%	84%	77%	93%	57%	82%
Cypress	23%	43%	33%	24%	16%	10%	50%	33%	29%
Grevillea	20%	30%	47%	45%	36%	43%	40%	30%	36%
Avocado	60%	90%	97%	48%	48%	70%	80%	33%	66%
Papaya	57%	10%	63%	41%	42%	57%	3%	40%	39%
Black Wattle	10%	23%	0%	3%	3%	0%	30%	3%	9%
Ficus	47%	53%	77%	79%	65%	67%	90%	30%	63%
Markhamia	50%	23%	40%	41%	45%	30%	50%	27%	38%
Erythrina	3%	10%	20%	59%	39%	3%	43%	27%	25%
Guava	7%	7%	40%	7%	10%	3%	17%	0%	11%
Fruit trees	70%	90%	100%	72%	65%	87%	87%	5[illegible]%	78%
Non-fruit trees	97%	87%	100%	93%	87%	90%	97%	73%	90%

Table 5. Average numbers of trees planted by Sector

Species	Nyakayaga	Nyagisozi	Mugera	Nyabiheke	Gitebwe	Gitoki	Gituza	Mukarange	Commune
Eucalyptus	116.7	212.2	213.4	28.9	572.3	147.9	652.3	46.8	251.1
Cypress	2.6	4.8	16.1	1.3	1.5	0.1	4.8	1.5	4.1
Grevillea	0.8	1.6	2.1	3.9	1.6	2.8	2.2	1.7	2.1
Avocado	1.7	2.7	6.8	2.6	2.5	2.2	3.8	1.1	2.9
Papaya	1.5	0.3	2.7	1.9	1.4	2.2	0.1	1.3	1.4
Black Wattle	3.6	3.5	0	0.7	0	0	20.7	0	3.6
Ficus	10.4	11.6	16.7	5.0	9.0	6.7	33.9	0.9	13.0
Markhamia	6.6	8.7	3.0	3.9	18.6	1.3	5.7	1.2	6.2
Erythrina	0.1	0.2	0.4	1.4	2.1	0	6.4	2.1	1,6
Guava	0.1	0.2	1.5	0.2	0.3	0	0.5	0	0.4

Table 6. Frequency of trees farmers would like to plant in the future and willingness to purchase seedlings by Sector

Species	Nyakayaga	Nyagisozi	Mugera	Nyabineke	Gitebwe	Gitoki	Gituza	Mukarange	Commune
Avocado	87%	97%	80%	76%	68%	73%	73%	87%	80%
Eucalyptus	83%	60%	77%	76%	65%	80%	50%	73%	70%
Papaya	63%	80%	37%	24%	39%	23%	53%	57%	57%
Grevillea	37%	13%	43%	41%	16%	55%	7%	40%	47%
Guava	37%	43%	23%	10%	6%	13%	30%	40%	25%
Cypress	40%	3%	27%	10%	16%	27%	3%	13%	18%
Citrus	13%	7%	20%	14%	19%	10%	0%	13%	12%
Mango	3%	17%	7%	14%	10%	7%	3%	13%	9%
Markhamia	3%	3%	17%	7%	0%	13%	3%	7%	7%
Annona	3%	3%	13%	7%	13%	0%	0%	10%	6%
Maesopsis	3%	0%	10%	7%	6%	7%	3%	0%	5%
Fruit trees	90%	97%	87%	76%	71%	73%	80%	87%	83%
Non-fruit trees	87%	70%	93%	76%	71%	87%	57%	77%	77%
Willing to purchase seedlings	77%	60%	83%	72%	68%	67%	73%	60%	76%

4.0 MANAGEMENT IMPLICATIONS

The survey findings offer statistical information about the present state of knowledge, attitudes and practices of Gituza's residents, particularly regarding farming systems. This information served as guideline for the development of an agroforestry extension strategy and as a monitoring and evaluation tool by which the project could objectively assess its effectiveness and impact.

The diagnostic parameters and survey findings are illustrated in light of functional extension management in Table 7 below. Although the analysis of the findings and their practical implications for extension management is far from exhaustive, it offers a good starting point and provides definite direction to the agroforestry extension program.

Table 7. Implications of survey results for extension program development and monitoring

Diagnostic Parameter	Extension Implications	Follow-Up Measurement Parameters
3.1.1 Respondent Characteristics		
Gender	Given the small number of women-headed households, extension activities should be aimed at family as a group providing equal weight to all members. Nutrition Centers and family planners provide access point for more intensive women-oriented extension activities.	Monitor participation in extension courses, seedling distribution and post-planting follow-up extension visits by gender. Track frequency and participation in extension courses given at maternity clinics/nutrition centers and in courses organized by the Social Workers.
Age	Farmers likely to be less experienced in agriculture and forestry, particularly when combined with 3.1.3 below.	
Family Size	When considered in light of age and landownership patterns (3.1.4), this indicates labor shortage leading to extensive farming systems with which all agroforestry interventions must be tempered. Less than 4 of 6 family members working indicates many children in school.	
Education	Extension efforts must be developed for illiterates (audio-visual media such as felt-boards and posters) and written materials must use Kinyarwanda as French taught only in last two years of Primary School.	Monitor frequency of extension courses given in Primary Schools and attendance of informal felt board sessions by gender.

Diagnostic Parameter	Management Implications	Follow-up Measurement Parameters
	Increased emphasis needs to be placed on extension for Primary and Secondary Schools as median age of farmer will soon fall below 30 and literacy of younger generations increases.	Monitor student planting activities, tree survival rates and prefered species.
3.1.2 Institutional Affiliation		
General Remarks	Political structure and use of churches are the best presently available extension vehicles as few institutional alternatives exist.	Monitor frequency and quality of support of extension activities by local authorities and their participation in extension courses.
Cooperatives	Possible extension vehicle if supported and strengthened but increased awareness of general population must occur first.	
Informal Sector	Because of their small size and informal organization, credit associations offer limited immediate extension potential, but their sizes and present activities could lend themselves to seedling production if a value and market structure for seedlings can be created.	Monitor willingness to purchase seedlings and prices farmers will pay for different species through the post-planting follow-up visits. After establishing theoretical prices track response to actual seedling sales (average numbers by species and family), changing perceptions of the value of trees, and emerging interest in private nurseries.
Religion	Harness the Catholic Parishes as a mechanism for raising awareness of agro-forestry and tree planting. Sermons, catechism and church-related planting activities provide good opportunities. Develop program of short extension messages.	
3.1.3 Land-Use History		
Farming Duration	Extension Agents need solid technical skills in agronomy and soil conservation as well as forestry to be effective and credible with farmers. All indications point to agricultural concerns as the major thrust of all extension activities and not forestry or agroforestry per se.	Track Agents' understanding of soil management, crop propagation techniques and forestry through periodic examinations, either on-farm practical tests, technical note quizzes or correspondence courses with homework assignments.
Farm Productivity	The present types of low-input farming systems are evidently not sustainable. Specific agroforestry interventions such as alley cropping along contours, tree fallows, intercropping with nitrogen fixing trees and other appropriate soil	Quantify adoption of various strategies to determine socio-economic (time/labor/land) appropriateness of technologies. Benchmarks such as kilometers of grass/tree terraces, numbers of NFTs planted and hectares of improved pasture or tree fallow are useful measures of active participation.

Diagnostic Parameter	Management Implications	Follow-up Measurement Parameters
Farm Productivity	management techniques which are consistent with 3.1.1, 3.1.2 and 3.1.4, can help alleviate apparent problems.	Develop research and on-farm trials to provide presently lacking, quantified information for more effective agroforestry extension. Monitor inputs and outputs to find technical solutions which approximate land opportunities while minimizing labor constraints.
3.1.4 Landownership Patterns		
Total Area & Number of Parcels	Average landholdings and labor statistics confirm extensive farming systems with labor as a limiting factor for farm input. Means tend to hide skewed patterns that point to predominance of either large, older and well-established farms or younger farmers with smaller landholdings. Risk and adoption strategies of these classes likely to be divergent. Extensionists' communication and skill training has to be fine-tuned to take these differences into account. More importantly increasing land pressure requires that promoted technologies be adaptive to land-use dynamics.	Adoption rates measured periodically against Diagnostic Survey findings. Stratify adoption rates of various technologies with regard to total area and number of parcels to identify different adoption strategies for major land/labor classifications.
Land Tenure	Tenure provides little/no constraint to tree planting. Given extensive farming practices with a large proportion of the land lying fallow, tree fallow systems and fruit trees can reinforce usufruct title when no crops are grown.	Use post-planting follow-up extension visits to track the farmers' reason for practicing either tree fallows or boundary plantings. Requires objectivity of Extension Agents so as not to second guess farmers' respon[illegible].
	Landholders with small and more numerous parcels could benefit from boundary plantings to better define parcels.	Monitor possible correlations between farm size, number of plots and frequency of boundary plantings.
3.1.5 Farm Labor		
Numbers	Apparent labor constraints require consideration of land-labor associations throughout development of extension strategy for agroforestry interventions.	Closely track labor inputs into research trials to develop agroforestry strategies which optimize productivity while minimizing labor requirements.

Diagnostic Parameter	Management Implications	Follow-up Measurement Parameters
3.1.6 Food Production	Extension Agents must be capable of providing basic agronomic advice for credibility and effectiveness. Implies broader vocational training for Extension Agents.	Periodic in-service examinations and results from correspondence classes should be used to measure Extension Agents' improved understanding of agronomy and their ability to promulgate sound agricultural techniques.
Legume Rotation	Importance of rotating legumes with cereals and pulses is poorly understood by farmers. Extension Agents' knowledge of nitrogen fixation, impact on soil properties and crop yields, and intercropping techniques with nitrogen fixing trees is required for effective farmer education.	Same as above.
Coffee Crops	Although coffee growers have track record of planting more trees than average farmer, these trees are not intercropped with coffee as Rwandan law presently prohibits this practice. Development of coffee intercropping techniques should help change national policy in favor of soil conservation.	Establish coffee intercropping trials to determine best tree species, spacings and management techniques. After reversal of existing law, monitor adoption rates of coffee intercropping.
Bananas	Emphasis on intercropping bananas with traditional species (Markhamia) and promotion of other appropriate species should be major extension thrust. Through applied research the project should attempt to identify optimal tree-banana intercropping strategy.	Through follow-up visits determine number of farmers starting to incorporate trees with bananas as measured against baseline information. Measure biomass production on trial plots for banana and forest product maximization.
3.1.7 Livestock Production	Both goats and cattle managed in very extensive systems with little incentive to intensify management. Promulgated agroforestry interventions should be broad-based and flexible to include eventual intensification of livestock management as land pressure increases. Emphasize livestock management in extension training for pastoral Sectors with landholdings > 2.5 ha/family. Emphasis in extension training and extension visits should be on use of fodder producing trees (Leucaena, Sesbania, Calliandra etc.) to alleviate seasonal fodder shortages.	Track farmers' understanding of livestock management intensification through follow-up visits. Monitor number of farmers practicing cut-and-carry and stable feeding. Erosion control systems (Sesbania, Leucaena, Calliandra with Setaria or Tripsicum) should eventually show signs of multi-purpose management. Use quantitative results from agroforestry/erosion control trials with grass strips. Monitor extension effectiveness through adoption rates of agroforestry systems for fodder production measured against baseline statistics. Monitor types of trees planted by number and type of livestock managed.

Diagnostic Parameter	Management Implications	Follow-up Measurement Parameters
3.1.8 Water Resources	Any decrease in time spent on this task could be theoretically used for agroforestry/erosion control. Expansion of CARE's Water Project into Gituza Commune should be considered.	
3.1.9 Household Energy	Fuelwood/energy procurement not a women's issue per se, but firewood type and diameter provided through agroforestry interventions may change existing roles and responsibilities, increasing women's contribution to energy procurement.	Post-planting follow-up visits should monitor species preference by gender and seek trends in changing energy procurement roles between men, women and children.
	The apparent lack of understanding of the impact of burning crop residues on soil fertility and agricultural production should be addressed by the extension program.	Successful farmer education about loss of organic matter in soil and subsequent impact on yields can be measured through numbers of farmers practicing composting and green manuring versus farmers who continue to burn crop residues. A good corroborating measure will be the number of improved stoves purchased by Commune farmers which should be tracked through sales receipts.
	Extension Agents must receive individual training which allows them to identify and cope with the Sector-specific energy problems. As species supply and demand respond to inter-Sector differences the Agent must see his Sector and its clients as the operational environment for his interventions.	Inter-Sector dynamics in species preference should be evaluated semi-annually through post-planting extension visits where farmers will be canvassed about the numbers and types of trees desired for the following season.
3.1.10 Woody Raw Materials	Promotion of traditional and new tree species which provide raw materials through extension courses, demonstration plots and on-farm visits. Intercropping pole timbers (Cedrella, Markhamia and Acrocarpus) with bananas or use of trees/shrubs for live fencing which are more productive than the traditional Euphorbia hedge should be promoted as good, labor-extensive alternatives.	Monitor changing species preference and number of families using recommended live-fence species around compounds through follow-up extension visits.
3.1.12 Industrial Wood Uses	Promotion of intercropping as a low-risk strategy to increase area allotted for industrial/commercial wood production while shoring-up crop yields: offer alternatives to Eucalyptus such as Grevillea, Leucaena, Cedrella and tree fallow opportunities.	Follow-up visits to measure adoption rates against baseline data. Effort should be made to allow the farmer to define her/his reasons for adopting given configuration in order to learn from farmers' risk strategy and to better gauge extension effectiveness.

Diagnostic Parameter	Management Implications	Follow-up Measurement Parameters
3.1.12 Previous Tree Planting Practices Numbers Timing Species	Extension Agents must emphasize that tree planting, like agriculture, is an activity which must be done timely with benefits accruing directly to the farmer and not only "National Patrimony". Decrease emphasis on civics and aim at increasing farmers' understanding of the benefits of trees for their own wellbeing.	By using plant distribution lists track the dates and numbers of different species to identify timing of seedling removal from nurseries as indication of extension effectiveness and understanding of personal benefits from trees.
Correlation with Farm/Family Size Age & Length of Time in Area	Woodlots are the predominant form of tree planting while intercropping, tree fallows and fruit tree orchards are relatively unknown. Initial extension effort should emphasize alternative types of forestry activities and the diversity of products and on-farm locations for these alternatives. Begin with basic farmer education, then introduce new configurations and species as alternatives to woodlots.	Measure the adoption of new agroforestry strategies through the numbers and species of plants removed from the nursery and the reason for planting in a given configuration as expressed by the farmer during a follow-up extension visit. Evolution of species preference and on-farm planting configurations should indicate acceptable alternatives to classic woodlot formula and subsequently illustrate level of participation of those farmers presently planting few or no trees.
Trends in Participation by Gender	In households where fuelwood is traditionally cut from family-operated woodlots on-farm agroforestry is less likely to be accepted and if so, the role of women in wood energy might increase. On smaller, less well established farms the extension message should emphasize the reduced time spent on energy procurement and increased agricultural production benefits.	Species preference by gender should be monitored during seedling distribution and follow-up visits. Adoption of agroforestry in women-headed households should be measured against male-headed households to develop gender specific extension strategies.
3.1.13 Use of Indigenous On-Farm Trees	Use of indigenous species likely to decrease with increasing land pressure. "Protection and maintenance" extension course should emphasize proper management/propagation for sustained yield while accenting the multi-purpose value of indigenous trees. Alternative agroforestry configurations using local species and similar introduced species should try to emulate present practices.	Measure preference for various indigenous species during plant distribution and through evaluation of proceeding season's species demand. Select several farmers who manage existing indigenous species to better understand traditional management practices. Track disappearance of indigenous species from the farm as well as the species which tend to replace them.
3.1.14 Future Tree Planting	Farmers must be periodically canvassed to determine which species they wish to plant so that nurseries respond to expressed farmers' needs and not propagation simplicity or Extension Agent's preference.	Seedling distribution lists and follow-up on-farm extension visits should be used as tool to steer nursery production to reflect explicit farmers' needs. Any move toward commercialized seedling production is entirely dependent on this.

Diagnostic Parameter	Management Implications	Follow-up Measurement Parameters
	Intercropping with trees should be stressed through extension courses, particularly for those farmers claiming insufficient land. Fruit trees and cash income from fruit sales should be emphasized among women as they are traditionally responsible for fruit collection and household nutrition.	Monitor participation in intercropping ("site & species selection") courses by total numbers and gender and then randomly select participants to measure adoption rates. Track the frequency and price of fruit sales in local markets to gauge production and overall appreciation for fruit trees.
	For older farmers claiming old age and slow tree growth as a reason for not planting trees fast growing species and long-term investment value of trees for the benefit of descendants should be emphasized.	Monitor adoption rates during on-farm extension visits and post-planting survival evaluation. Try to quantify inter-cohort disparities.
3.1.16 Willingness to Purchase Seedlings	In order to try and institutionalize tree-planting activities as a sustained and meaningful activity, efforts must be made to increase the perceived value of trees and agroforestry. Survival rates of trees, upon which successful adoption of all agroforestry strategies depends, must be based on perceived value of the various components. The project should attempt to develop a commercial seedling production strategy with the explicit aim of increasing tree survival through enhanced maintenance and protection practices induced by requirement of a financial and/or human investment for seedlings. In addition the commercial format should be viewed as a strategy to institutionalize seedling production and to create jobs.	Monitor the development of an imprest communal forestry fund with several incremental price increases of seedlings until they approximate seedling production costs. Closely track species and numbers of seedlings requested (follow-up visit) versus those taken from the nurseries (sales receipts, distribution lists) to determine desired species. Nurseries have to produce quality seedlings of desired species to make a commercial production system feasible.

4.1 Management Information System for Extension Monitoring and Evaluation

Table 7 outlines the extension strategy based on findings from the diagnostic baseline survey and identifies parameters to periodically measure progress toward the stated extension goals. In addition the monitoring instruments conceived were intended to provide continuous feedback from participants so that the dynamics of changing agroforestry practices could be incorporated into extension activities. This required the development of an management information system with the purpose of collecting appropriate and adequate data to monitor and evaluate extension progress. The management information system is illustrated in Figure 2 and has the following components:

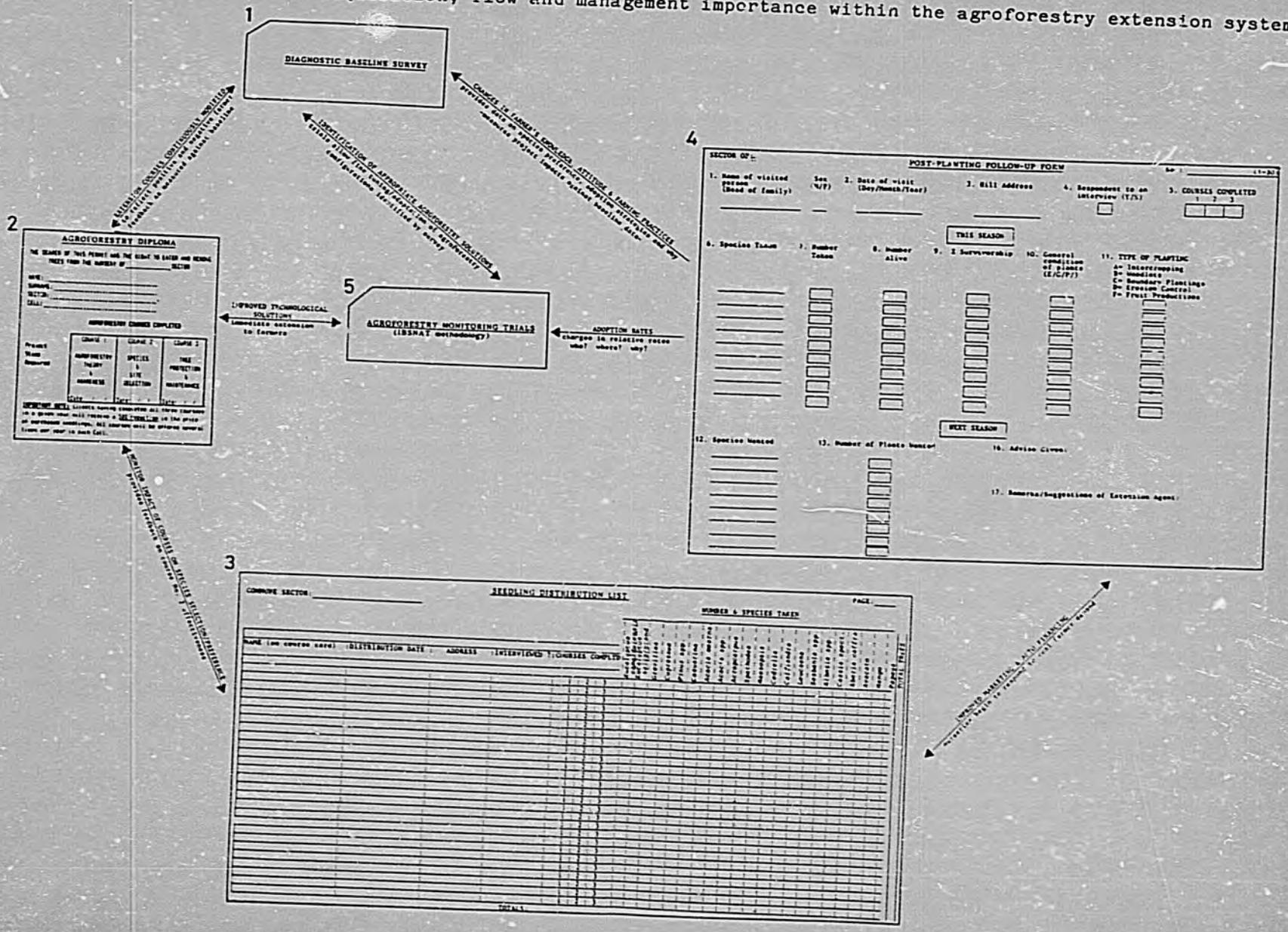
INFORMATION MANAGEMENT TOOL	TIME FRAME
1. Diagnostic Baseline Survey	Once prior to project implementation
2. Extension Course Diplomas	Given to farmers after participation in extension courses; four different courses offered several times per year
3. Plant Distribution Lists	Prepared during each planting season
4. Post-Planting Follow-Up Extension Visit Forms	15 families per Sector randomly selected after each planting season (twice per year)
5. Agroforestry Monitoring Trials	Run continuously in Gituza's two major agro-ecological zones

Brief descriptions of the functional relationships between the components of the management information system are offered below. Initial results from the first year's application of the system for project monitoring are presented in Section 4.2 as a demonstration of the value of any similar methodology.

4.1.1 Diagnostic Baseline Survey

The purpose and development of this component are adequately explained on pages 1 through 5 and will not be reiterated here.

FIGURE 2. Information acquisition, flow and management importance within the agroforestry extension system.



4.1.2 Extension Course Diplomas

Farmers are encouraged to participate in a variety of informal educational modules developed by the General Directorate of Forests and offered by project Extension Agents. The modules are essentially instruction courses based on a dialogue between farmers and Extension Agents and take place in "under the tree" settings. A feltboard complete with cardboard figurines that can be attached to it is used as a conceptual aid to help visualize the subjects discussed (see Fig. 3). Farmers who have actively participated in a course receive a "diploma", i.e. a small card on which the date and course number are stamped (see Fig. 2). Four extension courses are currently offered on the following subjects:

1. "Awareness raising ": This is an introductory course with the objective of increasing awareness of the importance and value of trees on the farm through discussions about the negative impacts of deforested hillsides on farm productivity, water sources and the general wellbeing of farmers, as well as the role trees can play to reverse or alleviate these effects.

2. "Site and species selection": Identification of the benefits farmers expect from trees and of tree species which provide these benefits, as well as instruction on appropriate planting sites for different species, agroforestry configurations and planting techniques. This course is used to introduce and familiarize farmers with alternative species to the traditionally planted eucalypts and cypress.

3. "Protection and maintenance": This course is usually offered after the planting seasons. Its main objective it to increase tree survival through instruction on techniques for individual tree protection against grazing and maintenance techniques such as weeding and pruning. The course is supplemented with practical demonstrations and exercises on farmers' fields.

4. "Soil conservation": The course is intended to support and strengthen the current national soil conservation campaign by creating awareness of the need for soil conservation and instructing farmers on proper techniques using contour plantings of grasstrips backed up by hedges of trees (see Fig. 4).

The purpose of the courses and diplomas is threefold. First, and most importantly, they present an informal setting where, through animated dialogue guided be the Extension Agent, farmers discuss their needs and problems. They are encouraged to develop their own solutions with technical assistance from the Extension Agent.

Secondly, the time required to finish each module (approximately one hour) is theoretically perceived as a time investment by the farmers. During the first and second seedling distribution periods the diplomas were used as "Nursery Entry Permits" which gave farmers the right to remove seedlings from the nurseries. Farmers began to realize the benefits of investing time in courses and learned to

better value the trees they obtained from the nurseries. Marked increases in course participation occured as the project began collecting nominal fees for seedlings during the second year. Based on results from the baseline survey, the follow-up extension visits (see Appendix V) and an economic analysis of nursery production, initial price levels were established for different species as a first step toward commercial seedling production. Farmers holding diplomas for at least three of the four courses were offered a 50 percent reduction in the per unit price as an incentive for course participation.

Finally the diplomas carry the farmers' address which, combined with course information, allows to compare tree species and configurations planted by farmers prior to project implementation (Diagnostic Baseline Survey) and to monitor changing species preferences (Seedling Distribution List) and adoption rates of agroforestry technologies (Follow-Up Extension Visit Forms).

Figure 3. The feltboards which are part of the extension courses were also used to train Extension Agents.

4.1.3 Seedling Distribution Lists

The Seedling Distribution Lists (see Fig. 2), supplemented with sales receipts in the second year, are permanent nursery records completed by the Extension Agents. The Distribution Lists include names and addresses of the farmers who removed seedlings from the Sector nurseries. In addition dates of distribution, courses completed and whether or not the farmer was an interview respondent of the Diagnostic Baseline Survey are entered on the form.

A sample of 15 farmers from each Sector's Seedling Distribution List is randomly chosen after every planting season for post-planting follow-up to determine tree survival, adoption rates and species preferences as described below. Thus the Seedling Distribution Lists form the third critical link in providing participatory feedback from "clients" through cyclical information management.

In addition the Distribution Lists permit a rigorous analysis of the average number of trees taken for households, schools, churches or government-sponsored tree planting activities. Thus they provide project management with measures of the relative ability of individuals, households and institutions to participate in tree planting and agroforestry activities and plan for future seedling production requirements. As many of the institutions are focal points for extension activities there is a clear need to determine the effectiveness of extension messages and correct or reinforce certain topics.

4.1.4 Post-Planting Follow-Up Extension Visit Forms

Post-planting extension visits represent the last segment in the information cycle that helps determine the actual performance of the agroforestry component over a given period. It is the final yardstick for measuring the to-date adoption of specific agroforestry configurations and to guide the following season's seedling production and extension emphasis.

As previously mentioned 15 farm families are randomly chosen from Seedling Distribution Lists. The selected families are stratified into three classes dependent on the total number of trees taken.

The information originally recorded on Course Diplomas, which is then added to the Seedling Distribution Lists, is entered on the Follow-Up Form (see Fig. 2) prior to the Extension Agent's arrival at the farmer's home. Thus the form includes all data gathered about the farm family as well as numbers and species of seedlings taken from nurseries.

During the follow-up visit, the Extension Agent is often accompanied by one of the Extension Officers to assure that the Agent fully understands the purpose of the visit and obtains the most objective information possible from the farmer. The additional data collected during the visit and later analyzed under the same procedures as described in 2.5 and 2.6 includes:

1. Survival of out-planted nursery stock;

2. General condition of surviving trees;

3. The type of agroforestry configuration used according to the farmer;

4. The numbers and types of trees the farmer would like for the next season;

5. General agroforestry/agronomy advice given to the farmer by the Extension Agent;

6. Observations by the Agent about farming and agroforestry practices and conditions on the farm.

4.1.5 Agroforestry Monitoring Trials

After reviewing all agroforestry-related documentation for projects in Rwanda and similar bimodal tropical highlands in Africa, it became apparent that little quantified information was available to guide project extension training and implementation as to which agroforestry configurations yield the most appropriate and sustainable results.

Subsequently, the project management decided to add a research component to monitor the impact of various agroforestry interventions on soil fertility and crop yields. The long-term goal is to provide a better understanding of tree-crop-soil interactions based on empirical data gathered in systematic and replicable fashion, and to select those agroforestry interventions which maximize productivity while minimizing labor input.

Two experimental fields were established in the main agro-ecological zones of the project area. Experiments include alley cropping/erosion control systems using grass strips and hedges of four different tree species with various inter-hedge spacings and hedge management techniques, as well as banana/tree intercropping trials with various tree densities and controls. Data is collected of grass and tree biomass production, tree growth, crop yields, soil properties and soil loss/accumulation. Each field is equipped with a weather station from which metecrological data is collected on a regular basis. In addition labor inputs are monitored for the individual experiments to be evaluated against the controls.

In order to assure timely collection of all required data, and to produce comparable results that can be shared with extension staff and farmers as well as other institutions and projects, the methodology developed by the International Benchmark Sites Network for Agrotechnology Transfer (IBSNAT) is used for data collection (IBSNAT 1985). It consists of a standard minimum data set for agricultural research which assures completeness of site characterization, optimal number and size of experimental plots and optimal number of growth observations. The data set further allows researchers and project managers to use computer simulated models of crop performance and management systems to find appropriate solutions. While the IBSNAT methodology was originally developed for agricultural research, it has been found to be suitable for agroforestry research as well with minor changes in emphasis of data collection. Using a standardized data set also assures replicability of experiments and use of the data elsewhere.

As information is gained through the monitoring trials, which place explicit emphasis on approximation of present land-use, labor and agro-ecological conditions in Gituza, it is fed into the Extension Agents' training program. Subsequently, it becomes available to farmers through either extension courses or on-farm extension visits. An important point here is that there is only a short "lag time" between research and on-farm adoption as both occur simultaneously. In addition the findings from the experiments will be made available to Government counterparts and other interested projects and institutions in Rwanda, as well as internationally through collaboration with IBSNAT and with the International Council for Research in Agroforestry (ICRAF).

Figure 4. Agroforestry/soil conservation trial plot with contour planting of Setaria grassstrips, Leucaena leucocephala and sorghum. The catchment, which is the recommended erosion control measure of the national soil conservation campaign, collects any soil that may penetrate the grass/tree barrier. The project also emphasises less labor intensive erosion control systems without catchments.

This final information tool completes the feedback loop necessary to monitor and evaluate the impact of project-induced changes in agroforestry and the project's overall effectiveness. Through monitoring of the physical impact of agroforestry interventions and adoption rates by local farmers, project management will be able to approximate real socio-economic and agro-ecological impacts of the agroforestry component in a systematic and continuous way.

4.2 Initial Management Information System Results

Based on the findings of the diagnostic survey and the management implications described in Table 7, the project developed a monitoring and evaluation system which has been used for two planting seasons or approximately one year. Thus far the initial results indicate that the system is effective in monitoring project performance and impact and in guiding future extension and seedling production activities. The results reviewed below serve as illustrative examples of the system's effectiveness but are not an exhaustive listing of useful information gathered to date.

4.2.1 Seedling Survival

Most foresters, agronomists and social scientists would agree that survival and growth of trees planted in agroforestry configurations are good indicators of appreciation and adoption of agroforestry technologies. In fact survival is the expression of early satisfaction or understanding of the worth of a given species. Needless to say, subsequent mortality could be due to dissatisfaction or poor comprehension of the trees' long-term benefits. But at present, particularly within a project cycle, initial survival gives a good indication of farmers' interest and extension effectiveness. Ultimately adoption must be gauged over periods which normally exceed project lives.

Table 8 shows survival rates for different tree species determined through post-planting extension visits. The Table provides useful information about ecological conditions conducive to planting of different species during the project's first two planting seasons and indicates early trends in acceptance and adoption rates.

Firstly, and not surprisingly, survival is generally higher for trees planted during the October-December rainy season. The trees take advantage of two rainy seasons at close intervals before they are exposed to the long May-September dry season during which often no rain falls at all. Fruit trees planted during the March-April rainy season generally fared better than non-fruit trees. The implications of these findings for the extension program are to teach farmers to plant most non-fruit species during the October-December period and emphasize appropriate nursery production.

In terms of species preference, fruit trees, by numbers and survival rate, are most appreciated and deserve a larger emphasis in nursery

production. The composite inter-seasonal mortality rates among various fruit tree species differ by only eleven percent suggesting that maintenance of fruit trees is generally better than of other species. It also indicates that seedling production, given nursery capacity restrictions, should probably emphasize fruit trees for distribution during the March-April planting season. Conversely it appears that lesser valued and drought intolerant forest and agroforestry species should be produced for distribution during the October-December rains.

Survival rates for most of the newly introduced species were around fifty percent (Cedrella odorata, Acrocarpus fraxinifolium, Acacia melanoxylon). However survival for Leucaena leucocephala and Sesbania sesban (a "reintroduced" indigenous species) was above eighty percent after both seasons. This fact could attest to their hardiness but it could also indicate that farmers are beginning to better understand site-species relationships. Both species are recommended for intercropping on agricultural soils and it appears that farmers are following the recommendations.

Survival rates for the better known species such as Grevillea robusta, Markhamia platycalyx and Maesopsis eminii were generally quite high, which is most likely due to appropriate planting sites. All three species require fertile, sandy, loam soils for good growth which means they are best planted on agricultural soils. This is emphasized in the "site and species selection" course which implies some success resulting from the extension course message and format.

4.2.2 Changes in Species Preference

Measured against baseline findings, trends in species preference obtained from the Follow-Up Forms show the effectiveness of extension efforts and are extremely useful in guiding nursery production. Table 9 tabulates the frequency of species planted prior to project inception against those planted during the first two project seasons. Table 10 demonstrates the evolution in species preference as expressed by the farmers' desire for particular species. In Gituza, where species diversity of trees planted on-farm has traditionally been extremely low, species demand is probably a better indicator of agroforestry extension success than numbers of trees planted as the latter often only reflect nursery supply and/or seedling transport constraints.

1. Fruit tree species continue to dominate demand and planting statistics, particularly avocado and papaya. In view of the survival information there is a clear need to place renewed production emphasis on fruit trees. An increased interest in mango also indicates expanded familiarity with the species and should press project management to begin grafting mango for higher and faster yields. The citrus blight has had a negative impact on planting of lemon and orange and demand has responded accordingly. Planting of guava has dropped off most likely due to saturation of demand for this species as the project produced and distributed nearly 60,000 guava seedlings during the first two seasons. Soursop, jackfruit and passion fruit seedling demand and planting remain low, the first two still being fairly unknown.

Table 8. Survival rates of trees planted during the first two project seasons (October '85 to April '86)*

SPECIES	FIRST SEASON SURVIVAL RATE* (JAN.-MARCH'86)		SECOND SEASON SURVIVAL RATE* (JUNE-SEPT.'86)		OVERALL SURVIVAL RATE	
Avocado	91.5%	(107)	72.5%	(39)	86.4%	(146)
Guava	83.3%	(53)	86.0%	(14)	83.9%	(53)
Papaya	73.8%	(16)	59.9%	(20)	66.0%	(36)
Annona	90.0%	(15)	73.3%	(33)	87.1%	(18)
Mango	100.0%	(2)	90.0%	(5)	92.6%	(7)
Leucaena	80.2%	(39)	85.8%	(4)	80.7%	(43)
Sesbania	80.4%	(17)	85.0%	(2)	80.8%	(19)
Grevillea	85.0%	(59)	82.2%	(51)	83.7%	(110)
Markhamia	63.7%	(15)	88.9%	(11)	74.3%	(26)
Maesopsis	77.8%	(13)	54.0%	(5)	71.2%	(18)
Pine	71.5%	(15)	8.0%	(1)	67.5%	(16)
Eucalyptus	86.3%	(57)	78.3%	(4)	85.8%	(61)
Cedrella	-		47.0%	(50)	47.0%	(50)
Cypress	72.6%	(28)	80.3%	(3)	73.4%	(31)
Cassia	40.0%	(5)	100.0%	(2)	57.1%	(7)
Acrocarpus	-		51.4%	(5)	51.4%	(5)
Callitris	68.6%	(10)	-		68.6%	(10)
Acacia melanoxylon	-		51.3%	(20)	51.3%	(20)
Acacia mearnsii	-		100.0%	(3)	100.0%	(3)
Average survival rate	77.6%		71.9%		74.1%	

* The October-December rainy season is the main season for planting trees because it is followed by a short dry season with intermittant rains, while the March-April rainy season is followed by four dry months.

2. Trends for agroforestry species are more subtle but nevertheless significant. While Grevillea continues to lead demand, Leucaena and Sesbania are becoming increasingly popular. These two species together with Calliandra calothyrsus, which was just recently introduced in small numbers, are recommended for alley cropping in association with erosion control. The growing demand indicates that extension messages are being adopted.

Markhamia presents an interesting case where a traditional, indigenous agroforestry system is slowly making a come back. Intercropping Markhamia with bananas is practiced frequently in Rwanda but in Gituza relatively few farmers have been using this species. However, presumably responding to its availablity in nurseries, farmers are slowly starting to plant it. A similar trend for Maesopsis, another indigenous intercropping and shade species, is also apparent for the same reasons.

3. Forestation species are beginning to show some positive trends toward adoption of alternatives to the limited number of traditionally planted species. Demand as well as numbers of trees planted for previously unknown species such as Pinus oocarpa, Casuarina equisetifolia, Cedrella and Acrocarpus are increasing. Conversely, demand for eucalypts and cypress, traditionally the only seedlings available in Commune nurseries, is slowly declining. This could be in direct response to extension courses on site and species selection, decreased availability of land for woodlots, and availability of alternative species in the nurseries.

Other trends indicate a slow acceptance of exotic acacias and a continuing disregard or lack of understanding for the use of indigenous species. While Erythrina and Ficus were planted frequently prior to project implementation, there is no interest in procuring seedlings of these species. This is probably due to the fact that they are traditionally propagated through cuttings or natural regeneration and farmers do not perceive them as "nursery" stock. The free availability of fast-growing exotic trees from Commune nurseries to farmers, combined with an increasing fuelwood demand of Gituza's growing population, has led to a gradual disappearance of many indigenous species and partial replacement by exotics. There is a need for more attenion to local species, their management and multipurpose aspects. The project should therefore consider a new extension course on proper propagation and management techniques of indigenous trees. In addition live fences of local species planted in project nurseries can be used for demonstration and as a source of rooting stock.

Figure 5. Improved varieties of avocado are in high demand with farmers. The Extension Agents were therefore trained in avocado grafting techniques.

Figure 6. Markhamia platycalyx, an indigenous agroforestry species, is here intercropped with sorghum and bananas.

Table 9. Tree species planted before the project and after the project's first and second planting seasons (percent of surveyed farmers)

SPECIES	PLANTED BEFORE PROJECT START (BEFORE 10/85)*	PLANTED DURING FIRST PROJECT SEASON (10/85)**	PLANTED DURING SECOND PROJECT SEASON (3/86)**
Avocado	61.7%	69.9%	50.0%
Guava	9.6%	34.6%	16.7%
Papaya	38.8%	10.5%	25.6%
Annona	0%	10.5%	3.8%
Mango	5.6%	1.3%	6.4%
Citrus	<5.0%	0%	0%
Jackfruit	<5.0%	0%	0%
Leucaena	0%	25.5%	5.1%
Sesbania	0%	11.8%	2.6%
Calliandra	0%	0%	1.3%
Grevillea	34.2%	39.9%	65.4%
Markhamia	38.8%	11.1%	14.1%
Maesopsis	0%	8.5%	6.4%
Pine	<5.0%	9.8%	1.3%
Eucalyptus	80.0%	37.9%	5.1%
Cedrella	0%	0%	64.1%
Cypress	26.7%	18.3%	3.8%
Cassia	0%	3.3%	2.6%
Acrocarpus	0%	0%	6.4%
Callitris	<5.0%	6.5%	0%
Acacia melanoxylon	0%	0%	25.6%
Acacia mearnsii	10.8%	0%	3.8%
Ficus	56.3%	0%	0%
Erythrina	23.3%	0%	0%

* From diagnostic baseline survey with 240 farmers. Percentages represent all farmers who planted tree species before October '85

** From follow-up surveys with 231 farmers (January to September '86)

Table 10. Tree species desired for future planting before the project and after the project's first and second planting seasons (percent of surveyed farmers)

SPECIES	WANTED BEFORE PROJECT START	WANTED AFTER FIRST SEASON	WANTED AFTER SECOND SEASON
Avocado	69.2%	49.0%	60.3%
Guava	22.1%	10.5%	6.4%
Papaya	40.8%	35.3%	33.3%
Annona	5.4%	6.5%	2.6%
Mango	7.9%	17.6%	21.8%
Citrus	10.4%	7.8%	3.8%
Passion Fruit	0%	2.6%	1.3%
Jackfruit	0%	1.3%	0%
Leucaena	0%	15.0%	11.5%
Sesbania	0%	5.9%	15.4%
Calliandra	0%	0%	1.3%
Grevillea	27.5%	50.3%	64.1%
Markhamia	5.8%	6.5%	10.3%
Maesopsis	2.4%	5.2%	9.0%
Pine	0%	3.3%	6.4%
Eucalyptus	60.8%	52.9%	57.7%
Cedrella	0%	11.1%	41.0%
Cypress	15.0%	14.4%	9.0%
Cassia	0%	0.7%	2.6%
Casuarina	0%	0.7%	3.8%
Acrocarpus	0%	0.7%	3.8%
Callitris	0%	2.0%	1.3%
Acacia melanoxylon	0%	3.9%	2.6%
Acacia mearnsii	<2.0%	0%	3.8%
Aberia caffra	0%	0%	2.6%
Spathodea	0%	0%	1.3%

4.2.3 Participation in Agroforestry Extension Courses

Another measure of interest and participation in agroforestry and tree planting activities is the voluntary attendance of extension courses. Table 11 summarizes the course participation by the 231 families visited during post-planting follow-up in the first year.

Table 11. Percentage of farmers who have taken agroforestry extension courses during the first two project seasons

COURSE	PERCENT OF FARMERS	
1. Frequency of individual course attendance:		
"Agroforestry awareness" course taken (Course 1)	72.7 %	(168)
"Site and species choice" course taken (Course 2)	64.1 %	(148)
"Protection and maintenance" course taken (Course 3)	12.6 %	(29)
No courses taken	28.1 %	(65)
2. Composite frequency of courses attendance:		
Only Course 1 taken	9.1 %	(21)
Courses 1 and 2 taken	51.3 %	(119)
Courses 1, 2 and 3 taken	11.3 %	(26)

The overall attendance was satisfactory with 51 % having taken the first two courses while 11 % took courses one, two and three. The fourth course had not yet been offered at the time of the follow-up visits.

In addition course attendance, monitored by total number of participants and by gender, increased the second time the courses were offered during the low-work season in August and September 1986. According to monthly reports from the Extension Agents, attendance ranged from 12 to 120 participants with an average of 34 men and 20 women per session. This period also coincided with the announcement that seedlings were to be sold for the first time in the upcoming season with price reductions given to farmers who had taken extension courses. It appears that this was a successful incentive and subsequent seedling sales reconfirmed the appreciation of courses as a way of reducing seedling prices.

4.2.4 Frequency and Type of Extension Advice Given to Farmers and Type and Frequency of Extension Problems Encountered

The effectiveness of extension messages offered in the courses can be monitored through the extension advice given to farmers and problems noted by the Extension Agent during the post-planting follow-up

visits. This excercise, the results of which are summarized in Tables 12 and 13, not only illustrates the level of farmer comprehension of the various subjects, but also provides information about the competence and perception of the Agent himself. Logically there should be a strong correlation between the problems or the remarks noted on the form by the Agent and the advice offered to the farmer.

Table 12. Frequency of extension advice given to farmers during the first two seasons

EXTENSION ADVICE	PERCENT OF FARMERS	
Better post-planting maintenance	59.3 %	(137)
More appropriate agroforestry site/species choice	49.4 %	(114)
Better protection of fruit trees	33.3 %	(77)
Should take extension courses	12.6 %	(29)
Should practice soil conservation	10.0 %	(23)
Correct planting methods and timing	9.1 %	(21)
Practical demonstration was given	8.2 %	(19)
Should replace dead trees	5.2 %	(12)
Should provide agroforestry model for others	1.7 %	(4)
General agronomy advise	0.4 %	(1)

In light of the data in Table 12 several functional inferences about the effectiveness of Extension Agent training and courses can be drawn. Sixty three percent of farmers were advised to either improve site-species selection and/or participate in the appropriate extension module. This advise corresponded to the fact that some 24 percent of farmers had a "poor understanding of tree intercroppping" which translates into inadequate participation in the site-species module or poor instruction on the part of the Agent. Further data will give better indications about causitive factors on a Sector basis. However, the current information suggests the need for a more concentrated effort in this area.

Table 13. Frequency of agroforestry-related problems/remarks noted by the Extension Agents during the follow-up visits

REMARKS	PERCENT OF FARMS	
Lack of protection and/or maintenance	48.1 %	(111)
Poor understanding of intercropping	24.1 %	(56)
Numbers of trees taken (plant distribution list) and found on farm do not correspond	13.9 %	(32)
No courses taken or no time or insufficient land	12.6 %	(29)
Trees from other nurseries	8.2 %	(19)
Trees were stolen from farm	4.8 %	(11)
Pest/disease problems	3.0 %	(7)
Farmer afraid/reluctant/lying	3.0 %	(7)
Farmer grows his/her own seedlings	2.2 %	(5)

Other advice given concerned better land-use management, i.e. the need for soil conservation practices, improvement on tree planting methods and timing of planting efforts. The balance of the remarks noted by the Agent identified some reasons for reluctance to plant additonal trees (no land, no time for courses, seedlings stolen from farm). Other valuable information included disease problems, possible sale of trees taken from nurseries to other farmers for profit, and the beginnings of on-farm seedling production. Again, additional information gathered during upcoming seasons will strengthen or weaken these associations. The main point is that continuous monitoring allows the project to directly incorporate trends in farmer participation and understanding of agroforestry into the extension program through modifications of extension training and implementation emphasis.

4.2.5 Initial Changes in Agroforestry Practices

The utility of the information system in guiding extension training and monitoring project impact is illustrated in Table 14 as it quantifies project progress toward stated goals.

Table 14. Change in frequency of forestry/agroforestry practices in the Gituza Forestry Project

PLANTING PURPOSE/ LOCATION	BEFORE PROJECT (FROM BASELINE SURVEY) (224 cases)	AFTER SECOND PROJECT SEASON (FROM FOLLOW-UP SURVEY) (231 cases)
Agroforestry Intercropping	41.8 % (92)	83.1 % (192)
Boundary Planting	60.5 % (133)	81.8 % (189)
Woodlot	48.1 % (154)	35.9 % (83)
Fruit trees planted around homestead	67.3 % (86)	76.6 % (177)
Erosion control	---	40.3 % (93)

Intercropping (alley cropping, interspersed multipurpose trees) frequencies have more than doubled when measured against baseline results. Some of this increase can be attributed to the project's emphasis on soil conservation and promotion of contour plantings. This effectively means that some of the alley cropping is also included in the erosion control category. However, no soil

conservation was practiced in the Commune until the project began. Therefore it is almost irrelevant whether the farmer's reason for alley cropping along contours is recognized as intercropping or erosion control.

Boundary plantings, as well as fruit trees planted around homesteads have markedly increased both of which can be attributed to the availability of a wider variety of tree species as well as the response of farmers to extension messages received through courses or on-farm visits.

The decrease in woodlots, the traditional type of forestry in Gituza, is interesting to note, particularly in view of apparent increases in agroforestry practices. This may be a result of an increasing awareness of alternative on-farm planting and crop-tree associations and thus point to extension effectiveness. However, it may also be due to the fact that farmers are responding to a perceived reduction in woodlot potential caused by the reforestation component which makes large tracts of public land unavailable for private woodlot development.

5.0 CONCLUSIONS

Most of the functional implications of the extension development and monitoring design described have been treated under Sections 3.0 "Discussion of Results" and 4.0 "Management Implications". Initial results from the first two planting seasons suggest that the management information system developed is successful in providing adequate and relevant information to guide agroforestry extension development and implementation. In addition the first two years' results are already indicating changes in knowledge, attitudes and practices of Gituza farmers with respect to agroforestry. More importantly the information feedback loops of the monitoring system are providing continuous input and feedback from farmers to guide extension activities as farming practices evolve with changing land-use and increasing land pressure.

It must be emphasized that the usefulness of the system lies in the direct translation of the data gathered through the various components of the information system into project management activities. The objective is a reduction in lag time between learning from the farmer, developing appropriate solutions, and extending the solutions in a way to which the farmer readily responds.

It should also be stressed that the management information system described in this paper was specifically developed for the Gituza Forestry Project. It involves not only an elaborate computer system, but requires at least six person months per year of staff time for data management, statistical analysis and monitoring of experimental fields, whereby the person charged with this task must possess the necessary skills and training. This case study is not intended to provide the ultimate solution to information management for agroforestry project development, monitoring and evaluation. Obviously the scope of information acquisition and assessment must be

project-specific and tuned to the knowledge required to adequately gauge extension effectiveness.

In general terms, it is in most cases desirable to carry out a diagnostic survey before or at the beginning of an agroforestry extension project in order to assure participation of farmers at all stages of project development and implementation, and to obtain baseline information against which project progress can be measured Project monitoring should include extension performance, i.e. seedling production, distribution and survival, as well as project impact on farm productivity and the general wellbeing of the target population. However, the methods used to acquire the necessary information must be tailored to a given project's objectives as well as material and personnel resources. Before embarking on time consuming data collection a strict review of the information necessary and the means put at the project's disposal are therefore critical. Staffing levels, financial resources for survey design, implementation and analysis, and the ability to maintain the system must be carefully weighed so that information remains a useful instrument and not an administrative burden or the driving force.

Another point this case study tries to demonstrate is the importance of timeliness in information flow to assure genuine participation from the people the project seeks to serve. Extension development for the Gituza Forestry Project occured simultaneously with information acquisition: the diagnostic survey was an integral part of extension training as well as the source of baseline information. The project had the time and luxury of putting the farmer, extension workers, and technicians together in a way which allowed all parties, particularly project management, to grow and learn simultaneously. Unfortunately this is not often the case and rarely is information gathered early enough to either serve as a baseline or understand the farmer's needs and interests.

The sustainability of post-project efforts depends on identifying the determining factors of land-use dynamics in a way which incorporates them in a "client-oriented" extension system. All the data and statistics are useless unless they address the sustainability question through the farmer's perspective. The project implementation strategy which has evolved from the findings of the baseline survey explicitly aims at sustainability of promulgated agroforestry interventions at the local level. However, with only two years of the project completed it is too early to tell whether the described system has put into motion all of the pieces and players in a way which guarantees this objective.

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APPENDIX I

AGROFORESTRY FARM SURVEY

PART I

Enumerator:_____

Date:_____

Sector:_____

Farmer's Name:_____

Sex: Male ( ) Female ( )

Age:_____ years

A. LAND-USE HISTORY

A.1 Since when have you been farming in this area?

1 Less than 1 year ( )
2 1-2 years ( )
3 2-5 years ( )
4 More than 5 years ( )

A.2 Have you experienced any soil degradation since you began farming here?

Yes ( ) No ( )

A.3 If yes, please describe the symptoms:

1 Decreased fertility/productivity ( )
2 Loss of topsoil ( )
3 Increase of pests/diseases ( )
4 Other (specify)_____

A.4 What have you done about it?

1 Terracing ( )
2 Increased fallow ( )
3 Cleared more land ( )
4 Changed crops ( )
5 Contour planting ( )
6 Left the area ( )
7 Applied fertilizer/compost ( )
8 Introduced pesticides/fungicides ( )
9 Other (specify)_____

B. LAND TENURE

B.1 How many parcels do you have?

_____

B.2 What is the approximate size of each parcel?

B.2.1 Parcel no. 1 _____ ha
B.2.2 Parcel no. 2 _____ ha
B.2.3 Parcel no. 3 _____ ha
B.2.4 Parcel no. 4 _____ ha
B.2.5 Parcel no. 5 _____ ha
B.2.6 Parcel no. 6 _____ ha
B.2.7 Others _____ ha

B.3 Do you or your family hold title to your land?

Yes ( ) No ( )

B.4 If not, why?

1 Land is Commune property ( )
2 Tenant farming ( )
3 Title is in process ( )
4 Traditional, but no legal title ( )
5 Other (specify)_____

C. LAND-USE TYPE

C.1 Which proportion of your land is used for the following purposes:

Land-use Type	Percent of Total					
	0	1-15	16-30	31-50	51-75	75-100
C.1.1 Area surrounding house	( )	( )	( )	( )	( )	( )
C.1.2 Non-irrigated agriculture	( )	( )	( )	( )	( )	( )
C.1.3 Irrigated agriculture	( )	( )	( )	( )	( )	( )
C.1.4 Natural pasture	( )	( )	( )	( )	( )	( )
C.1.5 Improved pasture	( )	( )	( )	( )	( )	( )
C.1.6 Orchards	( )	( )	( )	( )	( )	( )
C.1.7 Firewood/windbreaks	( )	( )	( )	( )	( )	( )
C.1.8 Fallow	( )	( )	( )	( )	( )	( )

D. LABOR

D.1 How many people belong to your household?

D.1.1 Male adults (> 15 years) _____
D.1.2 Female adults (> 15 years) _____
D.1.3 Male children (5-14 years) _____
D.1.4 Female children (5-14 years) _____
D.1.5 Male infants (< 5 years) _____
D.1.6 Female infants (< 5 years) _____

D.2 Who works on your farm?

	Number
D.2.1 Male adult family members	_____
D.2.2 Female adult family members	_____
D.2.3 Children full time	_____
D.2.4 Children part time	_____
D.2.5 Full time hired men	_____
D.2.6 Full time hired women	_____
D.2.7 Part time hired labor for planting	_____
D.2.8 Part time hired labor for weeding	_____
D.2.9 Part time hired labor for harvesting	_____

D.3 What is your highest level of education?

1 Illiterate ( )
2 Primary School ( )
3 Tronc Commun ( )
4 Secondary School ( )
5 University ( )
6 Professional training ( )

E. COMMUNE

E.1 Which groups/organizations do you belong to?

1 Commission Technique ( )
2 Conseil Communal ( )
3 Conseil de Dveloppement ( )
4 Services Administratifs ( )
5 Services Techniques ( )
7 Local cooperatives ( )
8 Religious groups ( )
9 Political groups ( )
10 Women's groups ( )
11 Sportsclubs ( )
12 Other (specify)_____

E.2 What is your religion?

1 Catholic ( )
2 Seventh Day Adventist ( )
3 Protestant ( )
4 Baptist ( )
5 Moslem ( )
6 Animist ( )

F. FOOD PRODUCTION

F.1 Agricultural Crops

F.1.1 Which of the following crops do you grow for consumption and/or sale?

	consumption	sale
F.1.1.1 Beans	( )	( )
F.1.1.2 Corn	( )	( )
F.1.1.3 Sorghum	( )	( )
F.1.1.4 Sweet potatoes	( )	( )
F.1.1.5 Cassava	( )	( )
F.1.1.6 Vegetables	( )	( )
F.1.1.7 Coffee	( )	( )
F.1.1.8 Tee	( )	( )
F.1.1.9 Bananas	( )	( )
F.1.1.10 Tobacco	( )	( )
F.1.1.11 Fruits	( )	( )
F.1.1.12 Other (specify)_____	( )	( )

F.2 Domestic Animals

F.2.1 How many of the following domestic animals do you have?

F.2.1.1 Cows _____
F.2.1.2 Bulls _____
F.2.1.3 Oxen _____
F.2.1.4 Goats _____
F.2.1.5 Sheep _____
F.2.1.6 Pigs _____
F.2.1.7 Chicken _____

F.2.2 How do you feed your livestock?

1 On-farm pasture ( )
2 Off-farm pasture ( )
3 Fodder produced on-farm ( )
4 Fodder produced off-farm ( )
5 Fodder bought ( )

F.2.3 Do you find sufficient fodder all year round?

Yes ( ) No ( )

F.2.4 If not, why?

1 Seasonal fluctuations in availability ( )
2 Insufficient land ( )
3 Pasture quality ( )
4 Other (specify)_____ ( )

AGROFORESTRY FARM SURVEY

PART II

G. WATER SOURCES

G.1 Which are your principal water sources during the rainy season and the dry season?

		Rainy Season	Dry Season
1	Rainwater	( )	( )
2	Springs	( )	( )
3	Rivers/brooks	( )	( )
4	Wells	( )	( )
5	Cisterns/piped water	( )	( )
6	Ponds	( )	( )

G.2 What is the distance of your primary water source during the rainy season?

1 Less than 500 m ( )
2 500 m - 1 km ( )
3 1 - 2 km ( )
4 3 - 5 km ( )
5 More than 5 km ( )

G.3 What is the distance of your principal water source during the dry season?

1 Less than 500 m ( )
2 500 m - 1 km ( )
3 1 - 2 km ( )
4 3 - 5 km ( )
5 More than 5 km ( )

H. ENERGY

H.1 What is your main source of household energy for cooking?

1 Firewood ( )
2 Charcoal ( )
3 Agricultural residues ( )
4 Dung ( )
5 Kerosene ( )
6 Gas ( )

H.2 For which other purposes apart from cooking do you use the following types of fuel in your household?

		Firewood	Agr. Residues	Charcoal
1	Ironing	( )	( )	( )
2	Beer brewing	( )	( )	( )
3	Lighting	( )	( )	( )

		Firewood	Agr. Residues	Charcoal
4	Space heating	( )	( )	( )
5	Washing	( )	( )	( )
6	Other (specify)_____	( )	( )	( )

H.3 Who is responsible for firewood collection in your household?

1 The male household head ( )
2 The female household head/wife ( )
3 Male children ( )
4 Female children ( )
5 Other (specify)_____

H.4 How do you usually obtain firewood?

1 Collection of dead wood ( )
2 Cutting branches from trees ( )
3 Cutting down trees ( )
4 Purchase ( )
5 Other (specify)_____

H.5 Where does your firewood usually come from?

1 Own farm ( )
2 Other farms ( )
3 Communal woodlots ( )
4 Roadsides ( )
5 Uninhabited land/National Park ( )
6 Other (specify)_____

H.6 If you obtain firewood from your own farm, which part of the farm does it come from? Please give percentages.

1 Woodlot _____
2 Live fences _____
3 Trees in the field _____
4 Windbreaks _____
5 Fruit trees _____

H.7 Do you experience difficulties in finding enough firewood?

Yes ( ) No ( )

I. WOODY RAW MATERIALS

I.1 For which of the following purposes do you use trees and shrubs as raw materials?

		Trees	Shrubs
1	Enclosures	( )	( )
2	Shade	( )	( )
3	Construction	( )	( )
4	Mats	( )	( )
5	Windbreaks	( )	( )
6	Tools and household utensils	( )	( )

I.2 How do you obtain these raw materials?

		Collection	Production	Purchase
1	Enclosures	( )	( )	( )
2	Shade	( )	( )	( )
3	Construction	( )	( )	( )
4	Mats	( )	( )	( )
5	Windbreaks			
6	Tools and household utensils	( )	( )	( )

I.3 Can you obtain enough of these raw materials?

		Yes	No
1	Enclosures	( )	( )
2	Shade	( )	( )
3	Construction	( )	( )
4	Mats	( )	( )
5	Windbreaks	( )	( )
6	Tools and household utensils	( )	( )

I.4 Who is responsible for obtaining these raw materials?

		Male household head	Female household head/wife	Children	Other
1	Enclosures	( )	( )	( )	( )
2	Shade	( )	( )	( )	( )
3	Construction	( )	( )	( )	( )
4	Mats	( )	( )	( )	( )
5	Windbreaks	( )	( )	( )	( )
6	Tools and household utensils	( )	( )	( )	( )

J. INDUSTRIAL WOOD USE

J.1 For which home industries do you use wood?

1	Brick making	( )
2	Pottery	( )
3	Charcoal making	( )
4	Crafts	( )

J.2 How do you obtain the wood?

		Collection	Production	Purchase
1	Brick making	( )	( )	( )
2	Pottery	( )	( )	( )
3	Charcoal making	( )	( )	( )
4	Crafts	( )	( )	( )

J.3 Can you obtain enough wood for your home industries?

		Yes	No
1	Brick making	( )	( )
2	Pottery	( )	( )
3	Charcoal making	( )	( )
4	Crafts	( )	( )

K. TREES

K.1 Have you planted and raised trees on your farm?

Yes ( ) No ( )

K.2 If not, why?

1	No trees available	( )
2	Desired species unavailable	( )
3	No time for tree planting	( )
4	Not enough land	( )
5	Trees have low priority	( )
6	Nurseries are too far away	( )
7	No means of transporting seedlings	( )
9	Other (specify)_____	

K.3 When did you start planting trees on your farm?

1	Less than 1 year ago	( )
2	1-3 years ago	( )
3	3-5 years ago	( )
4	5-10 year ago	( )
5	More than ten years ago	( )
6	Several generations ago	( )

K.4 Where on your farm did you plant trees?

1	On uncultivated land	( )
2	On previously cropped land	( )
3	On boundaries	( )
4	Around homestead	( )
5	Among crops	( )
6	On pastures	( )
7	Other (specify)_____	

K.5 Which tree species have you planted and for what purpose?

1=firewood; 2=fodder; 3=food; 4=construction/carpentry; 5=fibers; 6=tools; 7=medicine; 8=windbreak; 9=enclosures; 10=ornamental; 11=sale; 12=other(specify);

K.5.1	Eucalyptus	___	___	___	___	___
K.5.2	Cypress	___	___	___	___	___
K.5.3	Grevillea	___	___	___	___	___
K.5.4	Pine	___	___	___	___	___
K.5.5	Avocado	___	___	___	___	___
K.5.6	Papaya	___	___	___	___	___
K.5.7	Euphorbia	___	___	___	___	___
K.5.8	Black Wattle	___	___	___	___	___
K.5.9	Ficus	___	___	___	___	___
K.5.10	Markhamia	___	___	___	___	___
K.5.11	Erythrina	___	___	___	___	___
K.5.12	_____	___	___	___	___	___
K.5.13	_____	___	___	___	___	___
K.5.14	_____	___	___	___	___	___
K.5.15	_____	___	___	___	___	___

K.6 How many trees of each species have you planted and how many of them have died?

		Number Planted	Number Died
K.6.1	Eucalyptus	_____	_____
K.6.2	Cypress	_____	_____
K.6.3	Grevillea	_____	_____
K.6.4	Pine	_____	_____
K.6.5	Avocado	_____	_____
K.6.6	Papaya	_____	_____
K.6.7	Euphorbia	_____	_____
K.6.8	Black Wattle	_____	_____
K.6.9	Ficus	_____	_____
K.6.10	Markhamia	_____	_____
K.6.11	Erythrina	_____	_____
K.6.12	_____	_____	_____
K.6.13	_____	_____	_____
K.6.14	_____	_____	_____
K.6.15	_____	_____	_____

K.7 How did you obtain seed or seedlings of each species?

1=seed collection; 2=seedlings received from Commune/Sector nursery; 3=seedlings from other nursery; 4=from other farms; 5=natural regeneration;

K.7.1	Eucalyptus	___	___	___
K.7.2	Cypress	___	___	___
K.7.3	Grevillea	___	___	___
K.7.4	Pine	___	___	___
K.7.5	Avocado	___	___	___
K.7.6	Papaya	___	___	___
K.7.7	Euphorbia	___	___	___
K.7.8	Black Wattle	___	___	___
K.7.9	Ficus	___	___	___
K.7.10	Markhamia	___	___	___
K.7.11	Erythrina	___	___	___
K.7.12	_____	___	___	___
K.7.13	_____	___	___	___
K.7.14	_____	___	___	___
K.7.15	_____	___	___	___

K.8 Have you left any indigenous trees on your farm?

Yes ( ) No ( )

K.9 If yes, which indigenous trees do you have and what do you use them for?

1=firewood; 2=fodder; 3=food; 4=construction/carpentry; 5=fibers; 6=tools; 7=medicine; 8=windbreaks; 9=enclosures; 10=ornamentals; 11=sale; 12=other (specify);

K.9.1	_____	___	___	___	___	___
K.9.2	_____	___	___	___	___	___
K.9.3	_____	___	___	___	___	___
K.9.4	_____	___	___	___	___	___
K.9.5	_____	___	___	___	___	___
K.9.6	_____	___	___	___	___	___
K.9.7	_____	___	___	___	___	___
K.9.8	_____	___	___	___	___	___
K.9.9	_____	___	___	___	___	___
K.9.10	_____	___	___	___	___	___

K.10 Would you like to plant more trees?

Yes ( ) No ( )

K.11 If yes, which species would you like to plant and for what purpose?

1=firewood; 2=fodder; 3=food; 4=construction/carpentry; 5=fibers; 6=tools; 7=medicine; 8=windbreaks; 9=enclosures; 10=ornamentals; 11=sale; 12=other (specify);

K.5.1	Eucalyptus	___	___	___	___	___
K.5.2	Cypress	___	___	___	___	___
K.5.3	Grevillea	___	___	___	___	___
K.5.4	Pine	___	___	___	___	___
K.5.5	Avocado	___	___	___	___	___
K.5.6	Papaya	___	___	___	___	___
K.5.7	Euphorbia	___	___	___	___	___
K.5.8	Black Wattle	___	___	___	___	___
K.5.9	Ficus	___	___	___	___	___
K.5.10	Markhamia	___	___	___	___	___
K.5.11	Erythrina	___	___	___	___	___
K.5.12	_____	___	___	___	___	___
K.5.13	_____	___	___	___	___	___
K.5.14	_____	___	___	___	___	___
K.5.15	_____	___	___	___	___	___

K.12 If not, why?

1 I have enough trees ( )
2 Do not have enough land ( )
3 The seedlings do not grow well ( )
4 No time ( )
5 Seedlings are eaten by animals ( )
6 Trees attract pests and animals ( )
7 Other (specify)_____

K.13 Would you be willing to pay for seedlings of the desired species?

Yes ( ) No ( )

K.14 If not, why?

1 Not common to pay for seedlings ( )
2 Not enough money ( )
3 Trees have low priority ( )
4 Other (specify)_____

K.15 If yes, how much would you be willing to pay per seedling for the different types of trees?

	1-10FRW	11-20FRW	21-30FRW	31-50FRW	>50FRW
K.15.1 Fruit trees	( )	( )	( )	( )	( )
K.15.2 Firewood trees	( )	( )	( )	( )	( )
K.15.3 Construction/ carpentry trees	( )	( )	( )	( )	( )
K.15.4 Other (specify)	( )	( )	( )	( )	( )

L. SKETCH OF FARM

Please draw a sketch of the farm indicating the location of the house and other buildings, the different tree species and their relative density, as well as any soil conservation measures.

APPENDIX II

INTERVIEW RESPONSE FORM

Name of Respondent: _____

Sector: _____

Interview Starting Time: _____

NOTE BELOW QUESTIONS WHICH PROVED TO BE DIFFICULT TO ASK OR WHICH THE RESPONDENT HAD DIFFICULTY IN UNDERSTANDING OR ANSWERING: GIVE YOUR REASONS FOR THESE DIFFICULTIES AND SUGGESTIONS FOR CHANGES

Question	Reason

Did the respondent show signs of being bored or wishing to discontinue the interview?

Yes ( ) No ( )

If yes at what point (question number)? _____

Provide below your assessment of the accuracy of the respondent's answers and give brief reasons.

_____

_____

_____

Other comments and suggestions for improving the questionnaire:

_____

_____

Interview ending time: _____

Interview Duration: _____

AFTER COMPLETING THE INTERVIEW ATTACH THIS FORM TO THE FRONT OF THE QUESTIONNAIRE

APPENDIX III

TABULATED RESULTS OF COMMUNE-WIDE FREQUENCIES

I.RESPONDENTS CHARACTERISTICS

1. Sex (240):

Male	87.5 %	(210)
Female	12.5 %	(30)

2. Age (240):

< 25 years	5.8 %	(14)
25 - 34 years	34.6 %	(83)
35 - 44 years	20.0 %	(48)
45 - 54 years	19.1 %	(46)
55 - 64 years	11.7 %	(28)
> 64 years	8.8 %	(21)

Mean age: 41.3 years

3. Level of education: (240)

Illiterate	55.9 %	(134)
Primary school	42.1 %	(101)
Secondary school	1.2 %	(3)
Professional training	0.8 %	(2)

4. Religious Belief (234):

Catholic	58.5 %	(137)
Animist	24.4 %	(57)
Protestant	10.3 %	(24)
Seventh Day Adventist	2.6 %	(6)
Moslem	2.1 %	(5)
Baptist	2.1 %	(5)

II. LAND USE HISTORY

1. Length of time farmed in the area (240):

<= 5 years	20.0 %	(48)
> 5 years	80.0 %	(192)

2. Incidence of recognized soil degradation (238):

Yes	73.1 %	(174)
No	26.9 %	(64)

3. Symptoms of soil degradation (% of total of 174):

Reduced soil productivity	96.5 %	(168)
Loss of topsoil	63.7 %	(111)
Increased pests/diseases	42.7 %	(74)
Dryness of soil	0.6 %	(1)

4. Action taken (% of total of 174):

Terracing	22.5 %	(39)
Reduced tillage	57.2 %	(99)
Increased fallow	46.2 %	(80)
Change of crops	78.0 %	(136)
Left the area	4.0 %	(7)
Strip cropping	15.6 %	(27)
Application of compost/dung	54.9 %	(96)
Pesticides, fungicides	0.6 %	(1)
Better timing of crops	0.6 %	(1)

III. LANDOWNERSHIP

1. Number of plots owned (240):

No land	0.8 %	(2)
One plot	42.5 %	(102)
Two plots	27.1 %	(65)
Three plots	15.8 %	(38)
Four plots	7.1 %	(17)
Five plots and more	6.7 %	(16)
More than one plot	56.7 %	(136)

2. Total land owned (240):

<= 1 ha	32.1 %	(77)
1.1 - 2 ha	28.3 %	(68)
2.1 - 3 ha	17.5 %	(42)
3.1 - 5 ha	14.6 %	(35)
> 5 ha	7.5 %	(18)

Mean: 2.11 ha

3. Title to land (240):

Yes	82.5 %	(198)
No	17.5 %	(42)

4. Reason for not owning title (% of total of 42):

Commune property	7.1 %	(3)
Tenant farming	7.1 %	(3)
Title in process	23.8 %	(10)
Traditional (no legal) title	62.0 %	(26)

IV. LABOR

1. Number of people in household (240):

1 - 4	38.5 %	(92)
5 - 7	33.9 %	(81)
> 7	27.6 %	(67)

Mean household size: 6 persons

2. Number of people working on the farm (240):

1 - 3	48.8 %	(117)
4 - 6	19.2 %	(46)
> 6	32.0 %	(77)

Mean: 6.3 people

2. Labor force:

Only family members	73.8 %	(177)
Full time hired labor	5.4 %	(13)
Part time (seasonal) hired labor	25.4 %	(61)

3. Membership in local organizations:

None	39.6 %	(95)
Commission Technique	0.4 %	(1)
Conseil Communal	0.0 %	(0)
Conseil de Dévéloppement	0.4 %	(1)
Chef de Cellule	2.1 %	(5)
Services Techniques	0.8 %	(2)
Cooperatives	20.0 %	(48)
Religious groups	0.4 %	(1)
Political associations	0.4 %	(1)
Women's groups	0.0 %	(0)
Sports clubs	1.7 %	(4)
Ikibina (informal credit association)	44.2 %	(106)

V. FOOD PRODUCTION (240)

crop	percent grown	consumption only (%)	sale only (%)	consumption and sale (%)
Beans, peas, soy	99.6 (239)	40.8 (98)	-	58.8 (141)
Corn	96.7 (232)	62.1 (149)	2.1 (5)	32.5 (78)
Sorghum, Eleusine	99,6 (239)	33.3 (80)	-	66.3 (159)
Sweet potatoes, potatoes	95.9 (230)	54.6 (131)	-	41.3 (99)
Bananas	89.6 (215)	7.5 (18)	-	82.1 (197)
Manioc, taro	83.0 (199)	36.7 (88)	-	46.3 (111)
Coffee	43.3 (104)	-	43.3 (104)	-
Vegetables	40.0 (96)	22.5 (54)	0.8 (2)	16.7 (40)
Tobacco	26.3 (63)	12.5 (30)	2.1 (5)	11.7 (28)
Peanuts	23.7 (57)	7.9 (19)	0.4 (1)	15.4 (37)
Fruits	20.0 (48)	10.8 (26)	-	9.2 (22)
Tea	1.7 (4)	-	0.4 (1)	1.3 (3)

VI. LIVESTOCK

1. Ownership:

	% owners	mean number owned
Cattle	15.8 (38)	2.1
Goats	75.0 (180)	4.0
Sheep	12.1 (29)	2.2
Pigs	3.0 (8)	2.1
Poultry	52.5 (126)	5.0
Livestock	80.8 (194)	2.6

2. Source of fodder (% of total of 194):

On-farm natural pasture	88.7 %	(172)
Off-farm natural pasture	44.8 %	(87)
Fodder produced on farm	45.9 %	(49)
Fodder produced elsewhere	6.7 %	(13)
Fodder purchased	0.5 %	(1)

3. Fodder sufficiency (% of total of 199):

Sufficient	72.4 %	(144)
Insufficient	27.6 %	(55)

4. Reasons for insufficiency (% of total of 54):

Seasonal availability	55.6 %	(30)
Insufficient land	71.4 %	(40)
Pasture quality	20.4 %	(11)
Other	1.9 %	(1)

VII. WATER

1. Main source of water (240):

source	dry season	rainy season
Rainwater	1.3 % (3)	14.6 % (35)
Springs	39.4 % (93)	35.8 % (86)
Brooks, rivers	26.3 % (62)	23.8 % (57)
Wells	27.5 % (65)	20.0 % (48)
Cisterns, piped water	5.1 % (12)	5.1 % (12)
Ponds	4.7 % (11)	9.6 % (23)

2. Distance of principal water source (240):

distance	dry season	rainy season
< 500 m	34.2 % (82)	47.7 % (114)
500 m - 1 km	39.6 % (95)	34.3 % (82)
1 - 2 km	21.3 % (51)	14.6 % (35)
2 - 5 km	4.2 % (10)	2.5 % (6)
> 5 km	0.8 % (2)	0.8 % (2)

Mean distance: Dry season: 0.73 km
Rainy season: 0.89 km

VIII. HOUSEHOLD ENERGY

1. Principal energy source for cooking (240):

Firewood	97.5 %	(234)
Charcoal	0.4 %	(1)
Agricultural residues	18.3 %	(44)
Dung	0.4 %	(1)
Kerosene	0.4 %	(1)

2. Other household uses of combustibles (240):

use	firewood	residues	charcoal
Ironing	33.8 % (81)	-	13.3 % (32)
Beer brewing	70.0 % (168)	67.9 % (163)	-
Lighting	15.8 % (38)	5.4 % (13)	-
Heating	61.7 % (148)	37.9 % (91)	-
Washing	2.1 % (5)	-	-

3. Responsibility for firewood collection (238):

Male household head	66.0 %	(157)
Female household head	55.0 %	(131)
Children	57.2 %	(136)
Other	0.8 %	(2)

4. Firewood procurement (235):

Collection of dead wood	60.0 %	(141)
Cutting tree branches	36.2 %	(85)
Cutting down trees	67.2 %	(158)
Buying wood	10.2 %	(24)
Asking neighbors	2.6 %	(6)

5. Source of Firewood (234):

Own farm	69.2 %	(162)
Other farms	35.9 %	(84)
Communal woodlots	1.7 %	(4)
Roadsides	1.3 %	(3)
Uninhabited land	30.3 %	(71)
From neighbors	2.6 %	(6)

6. Firewood scarcity (230):

Yes	27.8 %	(64)
No	72.2 %	(166)

IX. WOODY RAW MATERIALS

1. Uses (240):

use	trees	shrubs
Enclosures	28.3 % (68)	25.0 % (60)
Shade	24.2 % (58)	21.7 % (23)
Construction	95.4 % (229)	20.8 % (50)
Mats	15.8 % (38)	54.2 % (130)
Windbreaks	43.8 % (105)	36.3 % (87)
Tools	90.8 % (218)	12.9 % (31)

2. Procurement:

use	collection	production	purchase
Enclosures (108)	38.9 % (42)	62.0 % (67)	0.9 % (1)
Shade (80)	31.3 % (25)	70.0 % (56)	1.3 % (1)
Construction (231)	26.4 % (61)	58.9 % (136)	46.3 % (107)
Mats (134)	41.8 % (56)	51.5 % (69)	11.9 % (16)
Windbreaks (164)	32.9 % (54)	67.1 % (110)	0.6 % (1)
Tools (222)	18.9 % (42)	43.2 % (96)	56.8 % (126)

3. Sufficiency:

use	sufficient	insufficient
Enclosures	58.3 % (63)	41.7 % (45)
Shade	62.5 % (50)	37.5 % (30)
Construction	46.8 % (108)	53.2 % (123)
Mats	80.6 % (106)	19.4 % (28)
Windbreaks	63.9 % (106)	36.1 % (60)
Tools	49.5 % (110)	50.5 % (112)

X. INDUSTRIAL WOOD USES (240)

Brick making	1.7 % (4)
Pottery	0.8 % (2)
Charcoal making	1.3 % (3)
Crafts	1.7 % (4)

XI. PREVIOUS TREE PLANTING

1. Trees planted on farm (240):

Yes	94.6 % (227)
No	5.4 (13)

2. Reasons for not planting trees (% of total of 11):

Insufficient land	54.5 % (6)
Desired species unavailable	27.3 % (3)
Other	18.2 % (2)

3. First tree planting (215):

Less than 1 year ago	7.0 %	(15)
1 - 3 years ago	13.0 %	(28)
3 - 5 years ago	12.1 %	(26)
5 - 10 years ago	20.5 %	(44)
More than 10 years ago	22.3 %	(48)
Several generations ago	25.1 %	(54)

4. Location on farm (220):

Boundaries	60.5 %	(133)
Among crops	41.8 %	(92)
Around homestead	39.1 %	(86)
On terrace	28.2 %	(62)
On the hill	15.9 %	(35)
Previously cropped land	14.5 %	(32)
Uncultivated land	11.8 %	(26)
Grazing areas	5.9 %	(13)
Other	4.1 %	(9)

5. Tree species planted (240):

species	mean number	percent of all respondents
Eucalyptus	313.9	80.0 % (192)
Euphorbia	(hedge)	75.8 % (182)
Avocado	4.9	59.2 % (142)
Ficus	23.1	56.3 % (135)
Markhamia	16.0	38.8 % (93)
Papaya	3.6	38.3 % (92)
Grevillea	6.1	34.2 % (82)
Cypress	15.4	26.7 % (64)
Erythrina	6.9	23.3 % (56)
Black Wattle	55.5	10.8 % (26)
Guava	4.2	9.6 % (23)
Dracaena		5.6 % (13)
Mango		5.6 % (13)
Vernonia amygdalina		5.6 % (13)

less than 5 %: Citrus, Iboza riparia, Securidaca spp., Senecio stuhlmannii, Jackfruit, Rhizinus, Solanum, Callitris, Mulberry Jacaranda, Pine

6. Purpose of trees planted (% of total of 227):

Species	fire-wood	fodder	food	construct. carpentry	fibers	tools	medicine	enclosures, windbreaks	sale
Eucalyptus	97.4	0.5	0.5	99.0	-	17.2	-	6.2	6.3
Cypress	29.7	-	-	15.6	-	78.1	-	14.1	1.6
Grevillea	31.7	-	-	29.3	-	86.6	-	2.4	1.2
Avocado	-	-	99.3	-	-	-	-	-	6.1
Papaya	-	-	97.8	-	-	-	-	1.1	5.4
Euphorbia	33.5	-	0.5	19.2	-	2.7	-	95.0	-
Black Wattle	80.8	3.8	-	50.0	-	15.4	-	23.0	-
Ficus	37.8	8.1	-	15.6	8.9	76.3	-	26.7	-
Markhamia	58.7	-	-	44.1	2.2	73.1	-	7.6	2.2
Erythrina	44.6	-	-	1.8	-	75.0	12.5	3.6	-
Guava	4.3	-	100.0	-	-	-	-	-	4.3

7. Origin of seed/seedlings (% of total of 217):

Species	collected, natural regeneration	nursery	other farms
Eucalyptus	34.7	63.8	10.1
Cypress	12.1	83.3	4.5
Grevillea	33.4	48.1	21.0
Avocado	15.9	83.3	3.8
Papaya	43.0	31.3	28.0
Euphorbia	22.7	0.6	77.9
Black Wattle	66.7	-	33.3
Ficus	28.5	0.7	71.4
Markhamia	42.6	13.8	45.7
Erythrina	89.5	7.1	8.8
Guava	12.0	56.0	32.0

XII. INDIGENOUS TREES LEFT ON FARM

1. Trees left (232):

Yes	78.0 %	(181)
No	22.0 %	(51)

2. Species (232):

Erythrina abyssinica (Umuko)	36.2 %	(84)
Vernonia amygdalina (Umubilizi)	15.9 %	(37)
Acacia sieberiana (Umunyinya)	15.5 %	(36)
Rhizinus spp. (Ibibonorono)	11.6 %	(27)
Ficus spp.	11.2 %	(26)
Acacia hockii (Umugenge)	9.1 %	(21)
Entada abyssinica (Umusange)	5.6 %	(13)
Solanum aculeastrum (Umutobo)	5.2 %	(12)
Albizia spp. (Umusebeya)	4.8 %	(11)

3. Purpose (% of total of 181):

	fire-wood	fodder	food	constr. carpen-try	fiber	tools	medi-cine	enclo-sure, wind-break, shade	crop sup-port	ferti-lizer	sale	bee-hive
Acacia sieberiana	88.9	-	2.8	22.2	-	16.7	-	11.1	-	8.3	-	2.8
Rhizinus	85.2	-	-	14.8	-	-	-	7.4	25.9	-	-	-
Vernonia amygdalina	81.1	10.8	2.7	27.0	-	10.8	67.6	10.8	2.7	-	-	-
Erythrina abyssinica	65.5	1.2	-	4.8	-	67.9	21.4	-	-	2.4	1.2	-
Entada abyssinica	92.3	-	7.7	15.4	-	23.1	23.1	-	-	15.4	-	7.7
Acacia hockii	100.0	4.8	-	4.8	-	-	-	-	-	-	-	-
Ficus spp.	61.5	-	-	11.5	3.8	84.6	3.8	7.6	-	-	-	-
Albizia spp.	90.9	-	9.1	27.3	-	18.2	-	-	-	18.2	-	-
Solanum aculeastrum	91.7	-	-	-	-	-	8.3	25.0	-	-	-	-
Combretum spp.	95.0	5.0	5.0	50.0	-	15.0	-	5.0	-	5.0	-	-

XIII. FUTURE TREE PLANTING

1. More trees wanted to plant (238):

Yes	87.4 %	(208)
No	12.6 %	(30)

2. Reasons for not wanting more trees (% of total of 30):

Insufficient land	70.0 %	(21)
Insufficient time or too old	33.3 %	(10)
Enough trees	16.7 %	(5)
Poor seedling growth	10.0 %	(3)

3. Species wanted versus species planted (240):

species	wanted	planted
Avocado	69.2 % (166)	59.2 % (142)
Eucalyptus	60.8 % (146)	80.8 % (192)
Papaya	40.8 % (98)	38.3 % (92)
Grevillea	27.5 % (66)	34.2 % (82)
Guava	22.1 % (53)	9.6 % (23)
Cypress	15.0 % (36)	26.7 % (64)
Citrus	10.4 % (25)	0.0 % (0)
Mango	7.9 % (19)	0.0 % (0)
Markhamia	5.8 % (14)	38.8 % (93)
Annona reticulata	5.4 % (13)	0.0 % (0)
Maesopsis	2.4 % (10)	0.0 % (0)
Ficus	< 2.0 %	56.3 % (135)
Erythrina	< 2.0 %	23.3 % (56)
Black Wattle	< 2.0 %	10.8 % (26)
Dracaena	< 2.0 %	5.6 % (15)
Vernonia	< 2.0 %	5.6 % (15)

4. Purpose of trees wanted (% of people who want each species):

species	fire-wood	food	constr. carpen-try	tools	enclos. wind-breaks	ferti-lizer	sale
Avocado	0.5	99.5	0.5	0.5	-	-	5.7
Eucalyptus	100.0	0.4	97.6	18.9	4.8	-	7.1
Papaya	-	100.0	-	-	-	-	3.5
Grevillea	56.6	-	34.2	92.1	7.9	1.3	3.9
Guava	-	100.0	-	-	-	-	9.8
Cypress	47.6	-	40.5	85.7	28.6	-	4.8
Citrus	-	100.0	-	-	-	-	17.2
Mango	-	100.0	-	-	-	-	9.1
Markhamia	56.3	-	56.3	93.8	-	6.3	-
Annona	-	100.0	-	-	-	-	13.3
Maesopsis	18.2	-	27.3	81.8	9.1	-	-

XIV. WILLINGNESS TO PAY FOR SEEDLINGS

1. Willing to pay (220 total):

Yes	76 % (168)
No	24 % (52)

2. Reasons for unwillingness to pay (% of total of 52):

Not enough money	72.5 % (38)
Not common to pay	41.2 % (21)
Low priority	15.7 % (8)

3. Price for seedlings (% of total of 168)

price	fruit trees	firewood trees	construction, carpentry trees
1 - 10 FRW	79.8 % (134)	93.9 % (158)	90.4 % (152)
11 - 20 FRW	11.7 % (20)	4.3 % (7)	6.7 % (11)
21 - 30 FRW	4.3 % (7)	0.6 % (1)	1.1 % (2)
> 30 FRW	4.3 % (7)	0.6 % (1)	1.8 % (3)

APPENDIX IV

RESULTS OF CROSSTABULATIONS OF KEY VARIABLES
(Commune-wide)

Table 4.1 Size of landholdings

n.s. = no statistically significant difference

Variable	<= 1 ha	1-2.5 ha	> 2.5 ha
Age*	45 % are <= 30 years old 23 % are > 50 years old	43 % are <= 30 years old 25 % are > 50 years old	11 % are <= 30 years old 48 % are > 50 years old
Sex	n.s.	n.s.	n.s.
Education	n.s.	n.s.	n.s.
Sector	53 % in Gitebwe	60 % in Nyagisozi 50 % in Mugera 47 % in Nyabiheke	47 % in Nyagayaga 43 % in Gitoki 43 % in Gituza
Length of time farmed in area	51 % of farmers with <= 5 years 25 % of farmers with > 5 years	39 % of farmers with <= 5 years 35 % of farmers with > 5 years	8 % of farmers with <= 5 years 38 % of farmers with > 5 years
Number of plots owned	43 % of farmers with 1 plot 21 % of farmers with > 1 plot	33 % of farmers with 1 plot 39 % of farmers with > 1 plot	25 % of farmers with 1 plot 38 % of farmers with > 1 plot
Household size	10 % with more than 7 persons	25 % with more than 7 persons	47 % with more than 7 persons
Labor	14 % with more than 6 people working	30 % with more than 6 people working	51 % with more than 6 people working
Recognized soil degradation	n.s.	n.s.	n.s.
Cashcrop coffee	20 % grow coffee	41 % grow coffee	36 % grow coffee
Cashcrop bananas	n.s.	n.s.	n.s.
Livestock	36 % have no livestock 11 % have > 4 animals	19 % have no livestock 24 % have > 4 animals	12 % have no livestock 43 % have > 5 animals
Cattle	3 % have cattle	8 % have cattle	16 % have cattle

* 45% of farmers who have <=1 ha of land are <=30 years old, while 23% of farmers who have <=1 ha of land are >50 years old.

Table 4.2 Length of time farmed in the area

n.s. = no statistically significant difference

Variable	<= 5 years	> 5 years
Age	69 % are <= 30 years old 27 % are 31-50 years old 4 % are > 50 years old	16 % are <= 30 years old 51 % are 31-50 years old 33 % are > 50 years old
Household size	69 % have 1-4 persons 8 % have > 7 persons	31 % have 1-4 persons 33 % have > 7 persons
Labor	65 % farms with < 3 people working 22 % farms with > 6 people working	31 % farms with < 3 people working 35 % farms with > 6 people working
Number of plots	n.s.	n.s.
Recognized soil degradation	n.s.	n.s.
Cashcrop coffee	27 % grow coffee	48 % grow coffee
Cashcrop bananas	65 % sell bananas	86 % sell bananas
Livestock	35 % own no livestock 12 % own > 4 animals	18 % own no livestock 30 % own > 4 animals
Cattle	n.s.	n.s.

Table 4.3 Age of farmer

n.s. = no statistically significant difference

Variable	<= 30	31-50	> 50
Household size	75 % have 1-4 persons	16 % have 1-4 persons	41 % have 1-4 persons
Labor	71 % with < 3 people working 22 % with > 6 people working	26 % with < 3 people working 33 % with > 6 people working	25 % with < 3 people working 42 % with > 6 people working
Education	45 % illiterate	46 % illiterate	86 % illiterate
Religion	60 % catholic 23 % animist 12 % other	69 % catholic 18 % animist 13 % other	31 % catholic 36 % animist 28 % other

Table 4.4 Crosstabulation of perceived firewood scarcity with key variables

n.s. = no statistically significant difference

Variable	Firewood Scarcity Perceived
Sector	88 % in Gituza 53 % in Gitebwe 30 % in Mugera 18 % in Nyakayaga 17% in Nyagisozi 10 % in Nyabiheke 7 % in Mukarange 7 % in Gitoke
Sex	n.s.
Age	18 % of farmers <= 30 years old 26 % of farmers 31-50 years old 43 % of farmers > 50 years old
Household size	n.s.
Size of landholdings	n.s.
Length of time farmed in the area	15 % of farmers with <= 5 years 31 % of farmers with > 5 years
Use of agricultural residues as fuel	n.s.
Use of firewood for beer brewing	35 % of farmers who make beer 15 % of farmers who do not make beer
Collection of dead wood for fuel	18 % of farmers who collect dead wood 44 % of farmers who do not collect dead wood
Cutting down trees for firewood	37 % of farmers who cut trees for firewood 11 % of farmers who do not cut trees
Buying firewood	0 % of farmers who buy firewood
Firewwod from own farm	37 % of farmers who get firewood from own farm 10 % of farmers who do not
Firewood from other farms	16 % of farmers who get firewood from other farms 36 % of farmers who do not
Firewood from uninhabited land	16 % of farmers who get firewood from uninhabited land 34 % of farmers who do not

Table 4.5 Crosstabulation of number of trees planted with key variables

n.s. = no statistically significant difference

Variable	<= 50 trees planted	> 300 trees planted
Sector	60 % of Mukarange 73 % of Nyabiheke 10 % of Gituza	7 % of Mukarange 0 % of Nyabiheke 67 % of Gituza
Age	51 % of <= 30 year old farmers 36 % of > 50 year old farmers	19 % of <= 30 year old farmers 36 % of > 50 year old farmers
Household size	54 % of 1-4 person households 21 % of > 7 person households	20 % of 1-4 person households 30 % of > 7 person households
Education	n.s.	n.s.
Size of landholdings	60 % of <= 1 ha farms 23 % of > 2.4 ha farms	13 % of <= 1 ha farms 34 % of > 2.4 ha farms
Title to land	34 % of farmers with title 55 % of farmers without title	29 % of farmers with title 15 % of farmers without title
Number of plots	51 % with 1 plot 9 % with > 1 plot	25 % with 1 plot 40 % with > 1 plot
Length of time farmed in area	61 % of farmers with <= 5 years 31 % of farmers with > 5 years	8 % of farmers with <= 5 years 31 % of farmers with > 5 years
Cashcrop coffee	53 % of farmers who do not grow coffee 10 % of coffee growers	15 % of farmers who do not grow coffee 48 % of coffee growers
Cashcrop bananas	n.s.	n.s.
Recognized firewood scarcity	n.s.	n.s.
Cutting trees for firewood	21 % of farmers who cut trees 68 % of farmers who do not cut trees	37 % of farmers who cut trees 7 % of farmers who do not cut trees
Buying firewwod	n.s.	n.s.
Using wood for beer brewing	n.s.	n.s.

Variable	<= 50 trees planted	> 300 trees planted
Firewood from own farm	26 % of farmers who get wood from own farm 61 % of farmers who do not	35 % of farmers who get wood from own farm 8 % of farmers who do not
Firewood from other farms	47 % of farmers who get it from other farms 34 % of farmers who do not	14 % of farmers who get it from other farms 34 5 of farmers who do not
Firewood from uninhabited land	55 % of farmers who do 29 % of farmers who do not	16 % of farmers who do 31 % of farmers who do not

Table 4.6 Crosstabulation of willingness to plant more trees with key variables

n.s. = no statistically significant difference

Variable	More trees wanted	less more trees wanted
Sector	n.s.	n.s.
Age	94 % of <= 30 year old farmers 68 % of > 50 year old farmers	6 % of <=30 year old farmers 32 % of > 50 year old farmers
Household size	n.s.	n.s.
Education	n.s.	n.s.
Size of land-holdings	n.s.	n.s.
Title to land	n.s.	n.s.
Recognized soil degradation	n.s.	n.s.
Length of time farmed in area	n.s.	n.s.
Indigenous trees left on farm	91 % of farmers who have indigenous trees 76 % of farmers who do not	9 % of farmers who have indigenous trees 24 % of farmers who do not

Variable	More trees wanted	No more trees wanted
Wood for beer brewing	n.s.	n.s.
Agricultural residues for fuel	n.s.	n.s.
Firewood scarcity	n.s.	n.s.
Planted firewood species	89 % of farmers who planted firewood species 71 % of farmers who have not	11 % of farmers who planted firewood species 29 % of farmers who have not
Cutting trees for firewood	91 % of farmers who cut trees 80 % of farmers who do not	9 % of farmers who cut trees 20 % of farmers who do not
Buying firewood	n.s.	n.s.
Source of firewood	n.s.	n.s.

APPENDIX V

AVERAGE PRICE FOR SEEDLINGS FARMERS ARE WILLING TO PAY

(from 76 follow-up surveys, January to March '86)

SPECIES	AVERAGE PRICE (FRW)*	SAMPLE
Eucalyptus	2.5	35
Grevillea	2.6	17
Cypress	4.3	11
Leucaena	1.4	6
Cedrella	4.9	6
Maesopsis	8.9	5
Markhamia	7.0	2
Sesbania	2.0	2
Pine	3.0	2
Avocado	5.8	28
Papaya	4.0	24
Citrus	7.2	11
Mango	6.0	9
Guava	4.6	7
Annona	10.0	3
Passionfruit	4.5	2
Jackfruit	7.5	2

* 1 FRW is approximately 0.01 US $