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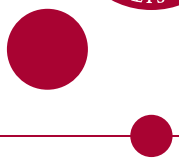

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TRANSFORMING LIVES AND LANDSCAPES

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Title
Tree seedling growers in Malawi - who, why and how?

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Photo on frontpage
A tree nursery at Chia Lagoon, Malawi.
Photo: Anna Sparks, USAID/Malawi

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Preface

The present report contains methods and findings from the survey of nurseries in Malawi and it can be read in conjunction with a case study of a sub-sample of these nurseries. The overall objective of the assessment was to contribute to an improved seed supply to tree planting farmers in Africa and the immediate objective to contribute to a comprehensive understanding of opportunities and constraints for improving seed systems for agroforestry in Malawi.

The assessment was made within the framework of Improved Seed Supply for Agroforestry in African Countries (ISSAAC), a Danida supported programme implemented in cooperation between F*orest & Landscape Denmark* (FLD) and World Agroforestry Centre (ICRAF).

ISSAAC carried out surveys on different aspects of tree seed systems in Burkina Faso (with a focus on villagers' use of seed), Kenya (with a focus on sources of reproductive material), Malawi (with a focus on small-scale nurseries, and Uganda (with a focus on non-governmental organisations and community-based organisations.

The surveys are documented in the following reports:

Ræbild, R., Bassirou, B., Lillesø, J.P.B., Yago, E. L. and Damas, P. 2004.
Farmers' planting practices in Burkina Faso. A survey carried out by the project 'Improved Seed Supply for Agroforestry in African Countries' (ISSAAC). *Forest & Landscape* Working Papers no. 5-2004.

Mbora, A. and Lillesø, J.P.B. 2007.
Status of tree seed and vegetative sources of various organisations in Kenya: Mt. Kenya Area as a Case Study. Development and Environment Series No 9-2007. *Forest & Landscape Denmark*

Mvula, P. and Lillesø, J.P.B. 2007.
Tree Seedling growers in Malawi – who, why and how? Development and Environment Series No 5-2007. *Forest & Landscape Denmark*

Namoto, M. and M.G. Likoswe. 2007.
Case studies of nurseries in Malawi. *Forest & Landscape* Working Papers no. 20. 2007.

Brandi, E., Lillesø, J.P.B., Moestrup, S. and Kisera, H.K. 2007.
Do organisations provide quality seed to smallholders? A study on tree planting in Uganda, by NGOs and CBOs. Development and Environment Series No 8-2007. *Forest & Landscape Denmark*

In addition to the above surveys, two preliminary baseline studies were conducted in Uganda (a district study of nurseries and farmers) and in Malawi (a preliminary investigation of organisations involved in seed supply).

Asare, R. and Pedersen, A.P. (2004).
Distribution of Tree Seed and Seedlings. A survey conducted in Kabale District, Uganda. The ICRAF/Danida Programme on Improved Seed Systems for Agroforestry in African Countries (ISSAAC). Forest & Landscape Working Papers no. 2-2004. *Forest & Landscape Denmark*.

Pedersen, A. P. and Chirwa, P. W. (2005).
Tree seed in Malawi. Organisational survey. *Forest & Landscape* Working Papers no. 8-2005.

Executive Summary

Objective of our study
Our overall objective with the present study is to contribute to an improved seed supply to tree planting farmers in Malawi. We believe that an improved understanding of how and why farmers establish tree nurseries is required in order to identify opportunities and constraints for improving seed systems for agroforestry in Malawi.

Methodology
This major survey sampled 360 nurseries in 6 districts. A second minor survey compiled 42 nursery case studies.

Situations may vary between districts and we decided therefore to cover 6 districts in our study. The districts were carefully selected taking into account population density and silvicultural zones.

Situations may differ also according to size of nursery. We therefore decided to stratify the sampling to ensure that we covered small, intermediate and large nurseries. This study thus included a 2-stage sampling of the survey districts. Research Assistants were first sent out to the six districts to take stock of the nurseries in the respective districts. Every operator in the district was listed and all the nurseries were listed recording size and location of the nurseries. After obtaining a complete list of nurseries in the district, the nurseries were stratified by size from the smallest to the largest and arranged in four groups. Fifteen nurseries were then randomly selected for interviews from each group giving a total of sixty nurseries per district.

Research Assistants were trained to conduct the interviews based on the questionnaire that had been prepared earlier. FRIM technicians had been trained in doing case studies but since the nature of their work is more technical, more experienced research assistants who have done this type of work before were oriented in the case studies as well (the complete case studies are published separately and extracts from the case studies are used in the present document to illustrate particular points in the present report). It was aimed at providing a balance of the information to be collected. After the training, the survey tools were pre-tested in Zomba and necessary adjustments made.

In brief the survey found the following major trends for the nurseries in Malawi
Ownership: Most nurseries are situated on owned land in home yards, riverbanks or dambos. The proportion of individually owned nurseries was found to be relatively high (40-60%), except for Chikwawa where more than 90% was found to be group owned. The private nurseries are run mostly by men who can read and write. Most people or groups started their nurseries using

a mixture of own capital and gifts either from friends or institutions. Among large nurseries, the majority were group owned, while individually owned nurseries were overrepresented among the small nurseries we sampled.

Reason: For a majority of individuals or groups, provision of seedlings for their own planting was the major reason the nursery, but around a third of nurseries indicated that they also established nurseries so as to sell seedlings. Nursery business appears to be embraced by people having several different types of main livelihoods, not only farming.

Support: Individuals or groups started most of the nurseries, but support from governmental department (mainly Forestry Department) played an important role. Again, some variation between districts was observed: for example in Blantyre almost 90% of the nurseries reported to have received support from a government department while this was the case in less than 50% of the sampled nurseries in Chikwawa. The external assistance for establishment seemed to have favoured group nurseries, both during establishment phase and later on. The support from FRIM/Forestry Department and Agriculture Department are quite consistent across districts (respectively high and low). The support from NGOs was also quite consistent as a group, but different NGOs provided support in different districts and NGOs reached fewer nurseries. Despite some nursery owners reporting lack of information and guidance, the majority reported getting support from different individuals and institutions. In general most support came from Forest Extension staff. Support to nurseries (group or individually owned) was mostly technical in the form of advice on how to raise seeds and some of the support was the provision of inputs like polythene bags. Very little support was given to nurseries by organizations in terms of seed distribution

The majority of nurseries report to have received their knowledge and skills informally and by associating with others. A large proportion of nurseries reports to be in contact with other nurseries, but with large variation between districts.

The organization that people in all districts mentioned having contact with was the Forest Department and at a lower scale, the Department of Agriculture. NGOs were influential in four districts with one or two NGOs in each district. In Blantyre and Salima, the influence of NGOs was low.

Species: Accessibility is likely to be one of the main criteria for selection of species. This may indicate that there is a lack of seed sources for many useful agroforestry species. Most of the species were raised from seeds. This was the case even for the majority of fruit and nut species were grown in the nurseries and strongly indicates that germplasm provision is suboptimal. Seed supply: Nurseries acquire seed on their own (own, forest, neighbours) in the districts from 25% to 62% of their species. Except for one NGO, NGOs and Agricultural Department purchase seed in only a single district. Forestry Department was an active buyer (to a varying degree) in five districts. The approach of the NGOs, FRIM/Forestry Department (FD), and Agricultural Department (AD) is to provide free seed to nurseries.

Customers: In the case of those that intended to sell their seedlings, their main customers were most often private individuals. The purchases from organisations are likely to be for free handouts to farmers, and provide income for nurseries. In general, customers came from considerable distances to purchase from nurseries.

Constraints: A need for flow of technical information to the nurseries was observed. Lack of markets for seedlings was not seen as a major problem in most districts, which (coupled with earlier information that seedlings are for sale) seem to indicate that most nurseries produce for known customers or own use. Lack of tree seed was identified as a constraint in several districts. Many of the species that nurseries report to want, but are unable to find, were found already to be used by other nurseries. Still, availability was the main reason why people were presently not raising species that they would like to raise. This indicates that lack of information exchange between nurseries is a constraint for otherwise profitable seed dispersal.

Among the skills desired by most people, tree propagation techniques ranked highest across the six districts. This was followed by pricking techniques and seed collection techniques. Distribution skills are generally ranked low.

Conclusions: The offer of species from organisations seems rather limited and supply based rather than based on demand. Efficient production and distribution chains that can market a variety of suitable species to local areas in Malawi do not seem to exist. Our hypothesis is that unavailability of species to nursery owners are caused by a combination of four factors: (i) the information flow to and between nurseries is inadequate; (ii) supporting institutions have not made seed (and local seed sources) locally available; (iii) supporting institutions (including Department of Horticulture) have not made grafts of improved fruit varieties locally available; (iv) the information flow between nurseries and potential seed source producers is inadequate, (v) skills on propagation are lacking.

Overall the survey indicates that support to nurseries has been limited with respect to sourcing of suitable species, and with respect to development of nurseries as an enterprise. We therefore recommend that public support to nurseries be improved. We suggest that such support should focus on the nurseries ability to function as private enterprises that can meet local demand with the right species, in the right quantities and qualities, and at the right price. Engagement of government agencies, NGOs and donors in this endeavour is highly called for.

The emerging consensus is that creation of sustainable crop seed systems will require changes in the approach of government, donors and NGOs.

Acknowledgements

This study would not have materialized was it not for the goodwill of the nursery owners that responded to the questionnaire and were willing to give their life histories. To all the respondents, the authors of this report owe great gratitude. Special thanks to Dr. Tony Simons, Principal Tree Scientist of ICRAF for provided funding for this study.

The authors also wish to thank the Research Assistants and Technicians for the professional and hard work that they did. They spent sleepless nights writing reports so as to keep up with time. The Research Assistants included Mr. James Mwera, Mr. McDonald Chitekwe, Mr. Patrick Msukwa, Miss Monice Kachinjika and Miss Monica Kububa. The technicians comprised Mr. M. Namoto and Mr. M.G. Likoswe. In the same line we would like to thank the very hard working drivers from FRIM for safely driving the teams around. We also highly appreciate the help with statistical analysis by Professor Erik Dahl Kjær, *Forest & Landscape Denmark* at the Faculty of Life Sciences, Copenhagen University, Denmark. Esben Brandi-Hansen (Junior Professional Officer funded by Danida) digitized the Malawi silvicultural map (Hardcastle, 1980). Aggrey Aguma, ICRAF, Southern Africa prepared the district map.

The Management at FRIM deserve special thanks. Special mention is made to Dr. Kayambazinthu and Dr. Chilima for supporting the survey team and process technically, morally and financially.

We are grateful to the Foundation - G.B. Hartmanns Fond - for making it possible for J.P.B. Lillesø to write up and finalise the present document as part of a more general assignment of documenting tree seed supply in the tropics.

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Abbreviations and acronyms

AD	Agriculture Department
ADMARC	Agricultural Development and Marketing Corporation
ADRA	Adventist Development and Relief Agency
CADECOM	Catholic Development Commission
CGIAR	Consultative Group on International Agricultural Research
CPAR	Canadian Physician for Aid and Relief
ELDP	Evangelical Lutheran Development Programme
FAO	Food and Agriculture Organization
FD	Forestry Department
FRIM	Forest Research Institute of Malawi
ICRAF	International Centre for Research in Agro Forestry
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IFDC	International Centre for Soil Fertility and Agricultural Development
ISSAAC	Improved Tree Seed Supply for Agriculture in African Countries
JICA	Japanese International Cooperation Agency
LRC	Land Resources Centre
MAFE	Malawi Agroforestry Extension Project
MASAF	Malawi Social Action Fund
MEET	Malawi Environment Endowment Trust
NASFAM	National Smallholders Farmers Association of Malawi
NGO	Non-Governmental Organization
NTSC	National Tree Seed Centre
PROSCAP	Promotion of Soil Conservation and Rural Production
SADC	Southern African Development Community
SUNESMA	Support to Neno Smallholder Macadamia Farmers
USAID	United States Agency for International Development
WLS	Wildlife Society Tension Project

1. Introduction

ISSAAC (Improved Tree Seed Supply for Agriculture in African Countries) is a project shared by the World Agroforestry Centre (ICRAF), Centre for *Forest & Landscape Denmark* (formerly Danida Forest Seed Centre) and national tree seed centres in 3 participating countries (Burkina Faso, Malawi and Uganda, a survey in Kenya was later added). The overall objective of the project is to improve seed supply to tree planting farmers by establishing an understanding of opportunities and constraints for improving seed systems for agroforestry in the selected countries.

In each of the countries ISSAAC has looked at different aspects of tree seed systems. In the Burkina Faso survey, the focus was on seed access in villages. In the Uganda survey, the focus was on seed distribution by NGOs; in the Kenya survey, the focus was on seed sources; in the Malawi survey, presented here, the focus was on nurseries.

1.1 Seed systems

A well-functioning seed system has been defined by Maredia *et al.* (1999) as »one that uses the appropriate combination of formal, informal, market and non-market channels to stimulate and efficiently meet farmers' evolving demand for quality seed«. A well functioning tree seed system therefore also requires availability of varieties that can meet the requirements of farmers and that farmers are well informed about the availability of these varieties. In many African countries the National Tree Seed Centres (NTSCs) have traditionally had the responsibility to provide seed to tree planters. In most countries the NTSCs, however, now play a minor role in tree seed procurement, while a large number of NGO projects procure and deliver tree seed to farmers. Most of these projects exist for a limited time and are active in relatively small areas and work with a limited number of species (compared to the number of species generally available in the tropics and subtropics[1]). Tree seed and seedling production and distribution systems share these problems with agricultural seed and agricultural input systems, where most of the formal crop seed activities in sub-Saharan Africa have been through parastatals, and where NGOs support smallholders with crop seed that are not provided by the parastatals or the private companies (Tripp, 2001, Maredia *et al.*, 1999, Wiggins and Cromwell, 1995; Friis-Hansen, 2000).

For the majority of smallholders, success of the formal crop seed systems has been limited to a few crops such as hybrid maize and sorghum (Wiggins and Cromwell, 1995). Many of the crop seed parastatals have now been privatised or dissolved, mainly because they were seen as inefficient and too dependent on state or donor subsidies, however, access to improved seed of a wide variety of suitable crop varieties has not been improved by privatising the parastatals and the seed production and marketing is still a major limitation for poor farmers (Tripp and Rorbach, 2001).

[1] There are probably at least 60,000 tree species on Earth (Grandtner, 2005) and perhaps even up to 100,000 (Oldfield *et al.,* 1998). Some 2,500 to 3,000 of these species have been registered as forestry or agroforestry species (Simons, 1998) and only a small handful of these species have ever been tested for the performance of their populations in different environments. Experience from well know eucalypt and pine species shows that for a large proportion of species, an individual species is composed of different populations that are adapted to different types of environments.

The main challenge is to meet the demand for good species and varieties by large numbers of dispersed and relatively isolated smallholders (Tripp and Rorbach, 2001). This will require that the high transaction costs for production and distribution are reduced by (a) Increasing effective demand for improved varieties among smallholders; (b) Decreasing the cost of seed production and distribution; and (c) Improving infrastructure, rules and regulations; and avoiding market distortions of free seed distribution (Maredia et al., 1999). Such a change is thought to lead to an enabling environment for smaller scale crop seed enterprises.

The change in crop seed systems has been underway for a relatively long time. Tripp and Rorbach (2001) describe the approach and degree of success of NGO/project attempts to improve local crop seed supply. The World Bank is promoting seed system change through "Initiatives for Sustainable Seed Systems in Africa" (Gisselquist et al, 2001) and SADC Regional Seed Security Network (SADC, 2004). The International Center for Soil Fertility and Agricultural Development (IFDC) is actively involved in country-specific assessments to promote the development of agricultural input markets in Africa (IFDC, 2000), supported by USAID, European Union, and a range of European donors. The CGIAR centres are likewise implementing a project on supporting the development of small scale seed enterprises that can meet the potential demand from smallholders (ICRISAT, 2004) and most recently Gates Foundation has joined with Rockefeller foundation to improve crop seed systems in Africa (Gates, 2006; Rockefeller, 2006).

National tree seed centres (NTSCs) are now facing increasing demands to become financially self supporting – e.g. the NTSC in Uganda has been privatised, Kenya Tree Seed Centre is now managed on a cost recovery basis, and the same is planned for the Malawi NTSC (personal information from NTSCs). The lesson from crop seed systems, however, is that privatization in itself will not increase the reach of suitable seed to smallholders. The challenge for the tree seed sector is therefore to identify how the public and private sector can collaborate with the aim of reaching smallholders with productive trees.

1.2 Provision of planting material to farmers

Due to nature-given differences between trees (perennial woody species) and annual crop species, not all aspects of crop seed systems are valid for tree seed systems. In particular the seed source identification/establishment and management is different, due to the larger size and longevity and breeding systems of perennial woody species, as compared to crops. For practically all products from trees, seed is a very small part of the total cost of production – in plantation forestry the cost of seed is usually a couple of percent of the establishment costs, while for crops the seed multiplication ratio (grain: seed sown) is very high and seed is a considerable cost of production. These nature-given differences indicate that seed production, procurement and distribution should be thought of on larger landscape units than for crop seed production (a good genetic quality tree seed source can produce seed for very large numbers of customers), and that tree seed and

seedlings in principle is a relatively inexpensive input for farm production. Furthermore, there is an aspect of tree seed distribution to farmers that sets tree seed apart from crop seed distribution: Tree seed is most often purchased by or given to farmers' in the form of seedlings. Tree seedling nurseries are therefore one of the crucial links in the production, procurement and distribution chain for tree seeds.

Trees have traditionally been seen by project planners as a natural resource to be protected by reforestation and conservation and only relatively recently have trees been more widely promoted as farm crops that can be planted, harvested and sold or used as any other crop (Murray and Bannister, 2004; Simons, 1998; Simons and Leakey, 2004). Correspondingly some of the main issues in support of farmers are the organisation of nursery production (centralised versus decentralised) and how seed and nursery production should be subsidized (Murray and Bannister, 2004; Boehringer *et al.*, 2004a; Boehringer *et al.* 2004b, Aalbæk, 2001; Shanks and Carter, 1994; Andreasen and Boland, 1996).

2. Study Objectives and Methodology

2.1 Study Objectives

The overall objective of the assessment was to contribute to an improved seed supply to tree planting farmers in Malawi and the immediate objective is to establish an understanding of opportunities and constraints for improving seed and nursery systems for agroforestry in Malawi.

Specifically, the study set out to test four hypotheses that have been established from cumulated evidence and casual observations. These are:

1) limited support to set-up independent structures to deliver tree seed and seedlings, and no or minimal consideration for the sustainability of the tree seed and seedling delivery after projects/programmes have ended,
2) no or minimal consideration is given to genetic quality (see box below),
3) a very limited number of species is promoted and/or used, and
4) no thorough analysis is done to establish the species with the highest potential benefit locally.

Box 1. Aspects of genetic quality of trees and shrubs

There are two aspects of genetic quality of trees and shrubs. The first aspect is related to the fact that most trees and shrubs are outbreeders, i.e. they must receive pollen from unrelated trees to avoid inbreeding. The most common seed collection practice in agroforestry is to collect seed from farmland. The trees that are planted in farmland will therefore not only produce agroforestry products for farmers, but will also be the mother trees for the next generations of trees to be planted. To maintain a healthy population of trees in the landscape it is therefore very important that the population continue to consist of many unrelated trees, and this is best done by collecting seed from many trees throughout the landscape. The second aspect is related to the fact that trees adapt to the environment in which they grow. Many tree species with distributions across different environments may develop different ecotypes. For example, if a species is distributed in areas with relatively low rainfall and high temperatures as well as in areas with relatively high rainfall and low temperatures, the species may have developed two different ecotypes (also called provenances), such that one provenance grows optimally only in its own environment. Most often it is only possible to discover ecotypes through long term tests. A common sense approach to avoid this potential problem is to develop a planting zone system, which can provide guidance on where to collect seed for planting of different species at different sites. The silvicultural zones depicted in Figure 2 would be a good starting point for developing such a planting zone system.

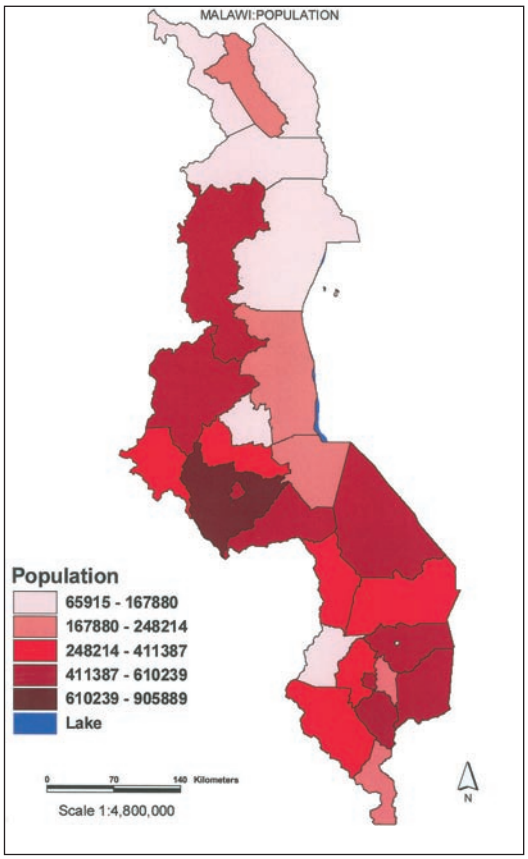

Figure 1. Malawi - Population Density by districts (from Benson, 2002)

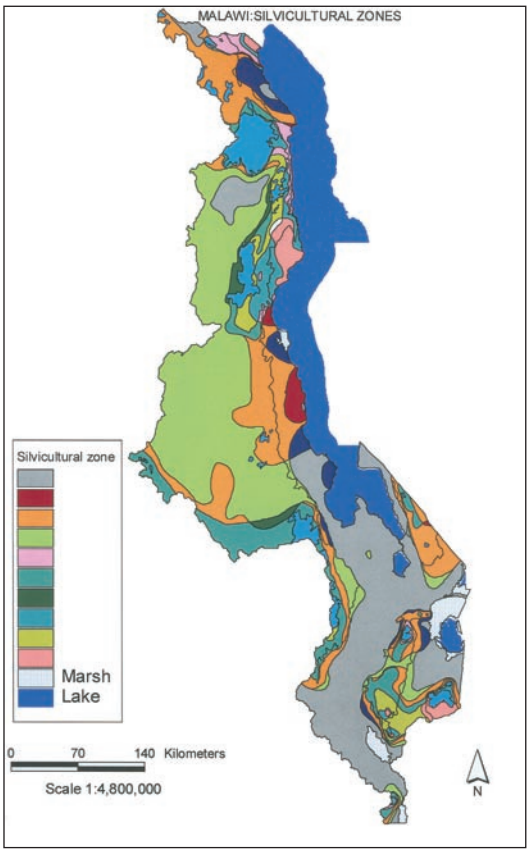

Figure 2. Malawi – Silviculture Zones. (Digitized by E. Brandi, based on Hardcastle (1980)

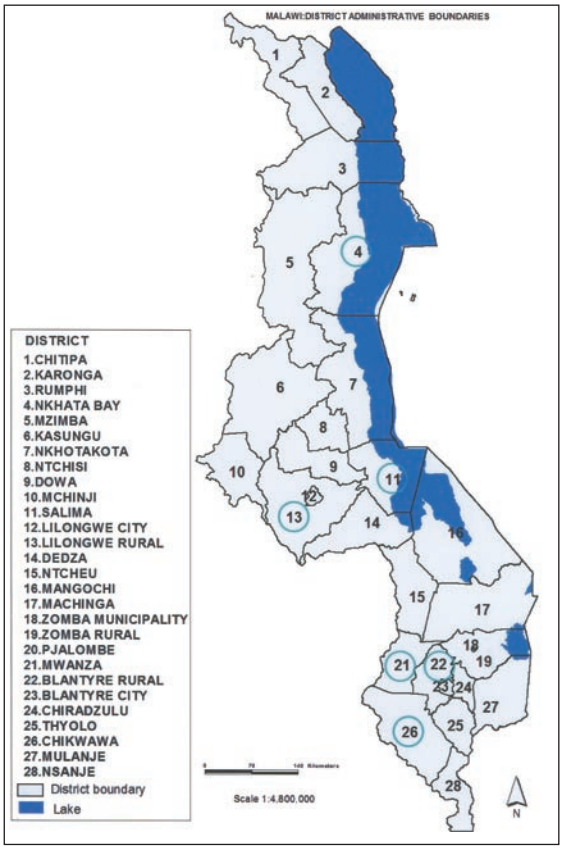

Figure 3. Malawi - districts and survey districts (circled). (prepared by Aggrey Aguma, ICRAF, Southern Africa)

2.2 Sample Design

The aim and the design of the study was defined by the first and second authors. The study was supervised by the first author and implemented by research assistants with previous experience from studies carried out by University of Malawi, Centre for Social Research, Zomba and supported by technicians from Forest Research Institute of Malawi (FRIM).

The study did a 2-stage sampling of the survey districts. The districts were purposely selected taking into account population density (Figure 1) and environment variation - silvicultural zones (Figure 2). Taking the above into account, the following districts were selected: Nkhata Bay in the Northern Region, Lilongwe and Salima in the Central Region and Blantyre, Mwanza and Chikwawa in the Southern Region (Figure 3).

Research Assistants were then sent out to the six districts to take stock of the nurseries in the districts. Every operator in each district was listed and all the nurseries were listed recording the sizes and location of the nurseries. After obtaining a complete list of nurseries in the district, the nurseries were stratified by size from the smallest to the largest and arranged in four groups. Fifteen nurseries were then randomly selected for interviews from each group giving a total of sixty nurseries per district (Table 1 and Figure 1).

Table 1. Sample selection

District	Total Nurseries	Sample
Chikwawa	218	60
Mwanza	71	60
Blantyre	213	60
Lilongwe	1177	60
Salima	111	60
Nkhata Bay	145	60

Research Assistants were then trained to conduct the interviews based on the questionnaire that had been prepared earlier (see questionnaire in appendix 1). The FRIM technicians were trained in doing case studies, with support from the research assistants (the complete case studies are published separately from this document and extracts from the case studies are used in the present document to illustrate particular points). After the training, the survey tools were pre-tested in Zomba and necessary adjustments made to the tools. Thereafter the team left for data collection. The field work took place in 2004. The data were collated, tabulated and analysed using the software packages SAS and MSAccess.

3. Results

3.1 Nursery Background Information

3.1.1 Group and private nurseries (and male/female owners)

This section presents background information on the nurseries that were visited on this survey. Table 2 shows that on average the majority of nursery owners in the six districts were groups, while a large minority were privately owned. The majority of the privately owned were males. In this report therefore, whenever there is discussion on individual characteristics of owners, it refers to the privately owned sub sample of the nurseries.

District variations reveal that in Chikwawa less than 10 percent of nurseries are privately owned, while in the other five districts private ownership varies from 35 to 58 percent. In Chikwawa district (with a low population density) the proportion of individual and group nurseries relationship is 13.9, while in the other districts the relationship varies between 0.7 and 1.9 (average of all districts is 1.6).

Table 2. Private (by male/female) and Group nurseries by districts (%)

District	Male	Female	M+F (Private)	Group
Chikwawa	5.0	1.7	6.7	93.3
Mwanza	28.3	13.3	41.6	58.3
Blantyre	33.3	20.0	53.3	46.7
Lilongwe	33.3	1.7	35.0	65.0
Salima	36.7	3.3	40.0	60.0
Nkhata Bay	56.7	1.7	58.4	41.7
Average	32.2	6.9	39.1	60.8

3.1.2 Education Level of Nursery Owners

Table 3 shows that overall about 50 per cent of the individuals had attended standard six and above, while overall some 17 per cent had no education.

Table 3. Highest education of the owner of the private nursery by district (%)

District	No Education	Std 1- 5	Std 6 – 8	Form 1- 4	Higher
Chikwawa	33.3	0.0	66.7	0.0	0.0
Mwanza	17.4	30.4	39.1	13.0	0.0
Blantyre	3.1	31.3	43.8	21.9	0.0
Lilongwe	20.0	25.0	45.0	10.0	0.0
Salima	14.3	9.5	66.7	9.5	0.0
Nkhata Bay	12.1	15.2	36.4	24.2	4.1
Average	16.7	18.6	49.6	13.1	0.7

The primary school takes 8 years from Standard 1 to 8. Secondary school education takes 4 years from Form 1 to Form 4

3.1.3 Land Ownership

Most of the nurseries were on land that the owners either owned (79.6%) or borrowed (18.7%) as shown by Table 4. The incidence of borrowed land however was highest in Blantyre (43.3%) and lowest in Nkhata-Bay (6.8%). This could show the relative amount of land scarcity and or abundance, respectively. This result is regardless of whether the nursery was individual or group owned.

Table 4. Ownership of the land on which nursery is located by district (%)

District	Owner	Borrowed	Rented	Other
Chikwawa	85.0	15.0	0.0	0.0
Mwanza	76.3	23.7	0.0	0.0
Blantyre	55.0	43.3	1.7	0.0
Lilongwe	86.7	10.0	3.3	0.0
Salima	83.3	13.3	1.7	1.7
Nkhata Bay	91.5	6.8	0.0	1.7
Average	79.6	18.7	1.1	0.6

3.1.4 Location of Nursery

Table 5 shows that overall most nurseries (41.3%) were located in the home yard with Salima (55%) reporting the highest nurseries in the home yard and Nkhata-Bay (31.7%) reporting the lowest. In Blantyre (38.3%) and Mwanza (37.3%) larger proportions of nurseries were located on the riverbanks. In Lilongwe (32.2%) and Nkhata-Bay (25%), a good proportion of nurseries were located in dambos[2]. As in the case of land ownership, location of the nursery too was not dependent on whether the nursery was individual or group owned.

Table 5. Location of the nursery by district (%)

District	Dambo	River Banks	Home Yard	Field	Other Places
Chikwawa	3.3	11.7	51.7	31.7	1.7
Mwanza	8.5	37.3	30.5	15.3	8.5
Blantyre	15.0	38.3	33.3	8.3	5.0
Lilongwe	32.2	5.1	45.8	10.2	6.8
Salima	5.0	5.0	55.0	18.3	16.7
Nkhata Bay	25.0	28.3	31.7	8.3	6.7
Average	14.8	20.9	41.3	15.4	7.5

3.1.5 Establishment of nurseries

Who established the nursery?

Individuals or groups concerned had started most of the nurseries. Only in Chikwawa were a large proportion of nurseries (21.7%), started by a church NGO, CADECOM (Table 6). Thus, most nurseries were established by local entrepreneurs.

[2] Dambo refers to wetlands

Table 6. Who started the nursery by district (%)

Person/Institution	Chikwawa	Mwanza	Blantyre	Lilongwe	Salima	Nkhata Bay
Own initiative						
Self – present owner (s)	65.0	90.0	88.3	95.0	96.6	95.0
Parents to present owner(s)	0.0	0.0	0.0	0.0	0.0	3.3
NGOs						
MASAF	0.0	1.7	0.0	0.0	0.0	0.0
CADECOM	21.7	0.0	0.0	0.0	0.0	0.0
CPAR	0.0	0.0	0.0	0.0	0.0	1.7
ELDP	8.3	0.0	0.0	0.0	0.0	0.0
MEET	0.0	0.0	1.7	0.0	0.0	0.0
Government Department	5.0	3.3	5.0	0.0	0.0	0.0

Support during the establishment phase?

Across the board, the institution that helped people with the establishment of the nursery was the Forest Department (Table 7), while Agricultural Department had a consistent but smaller support role. It was only in Chikwawa that church NGOs, CADECOM (40.7%) and ELDP (23.7%) played a major role. Particular NGOs are focusing assistance on a few districts each.

Table 7. Person/Institution that assisted in the establishment of the nursery by district (%)

Person/Institution	Chikwawa	Mwanza	Blantyre	Lilongwe	Salima	Nkhata Bay
Friends/Neighbours	1.7	8.8	13.6	6.7	1.8	3.3
NGOs						
InterAide	0.0	0.0	0.0	3.3	0.0	0.0
MASAF	0.0	7.0	1.7	3.3	1.8	0.0
CADECOM	40.7	0.0	0.0	0.0	0.0	0.0
World Vision	0.0	0.0	0.0	1.7	0.0	21.7
CPAR	0.0	0.0	0.0	0.0	0.0	5.0
WLS	0.0	15.8	0.0	0.0	0.0	0.0
ELDP	23.7	0.0	0.0	0.0	0.0	3.3
NASFAM	0.0	0.0	0.0	1.7	0.0	0.0
MEET	0.0	0.0	3.4	0.0	0.0	3.3
Land Resource Center	0.0	0.0	0.0	1.7	1.8	0.0
Government Departments						
Forestry Department	33.9	77.2	81.4	76.7	76.8	56.7
Agricultural department	10.2	8.8	6.8	3.3	12.5	8.3
Other	0.0	14.0	23.7	15.0	8.9	13.3

Reasons for establishment of nurseries

The nurseries were established for a number of reasons, but for a majority of the people or groups (94.7%), provision of seedlings for their own planting was the major reason (Table 8). In Lilongwe and Chikwawa individuals or groups that were interviewed indicated the provision of seedlings as the main reason. A smaller proportion indicated that they also established nurseries so as to sell seedlings. The proportions reporting this was highest in Blantyre (51.7%), and here 18% indicated that they did not establish the nursery in order to provide own seedlings. In Lilongwe, a large proportion (43.3%) also indicated that selling was a main reason for establishing a nursery, but in this district provision of own seedling was an important reason for all the interviewed nurseries. On average, a third of the nurseries expressed an intention to use the nursery as an income generating activity. It should be noted that a number of people reported two reasons. Hence the percentages do not add up to 100.

Table 8. Reason for the establishment of the nursery in different districts (%)

District	Provision of own seedlings	Selling	Other
Chikwawa	100.0	15.0	1.7
Mwanza	95.0	28.3	0.0
Blantyre	81.7	51.7	0.0
Lilongwe	100.0	43.3	1.7
Salima	96.7	36.7	5.0
Nkhata Bay	95.0	33.3	5.0
Average	94.7	34.7	2.2

Capital

Most people or groups started their nurseries using a mixture of own capital and gifts either from friends or institutions (Table 9). As was the case in the establishment of the nursery, here too people could give two answers, but most of the people started the nurseries using their own capital. It is probable that many organisations require that nursery owners and groups contribute with own capital, it is therefore not possible through this question to evaluate how dependent start-up of nurseries has been on external support.

Table 9. How nursery was started by district (%)

District	Own Capital	Loan	Gift	Other
Chikwawa	93.3	0.0	91.7	6.7
Mwanza	98.3	0.0	91.7	0.0
Blantyre	83.3	0.0	81.7	1.7
Lilongwe	28.3	0.0	86.7	1.7
Salima	71.2	0.0	88.1	3.4
Nkhata Bay	53.3	1.7	85.0	1.7
Average	71.3	0.3	87.5	2.5

Box 2. From Case Studies - Nursery start-up

(Salima): Teresa Edison lives in Mwamadi village, traditional authority Kambwiri. She is married and has four children. Her main source of income is ganyu and she also has a garden where she grows maize (MH 18) and groundnuts (CG 7). In the past years both she and the husband were members of Tigwirizane Club, which is in the village, but because of a few quarrels in the club they pulled out in the year 2002 and started their own tree nursery in 2003. She does her nursery work with her husband and her two small children.

(Mwanza): Mr. Kasapha owns a nursery, which is in Chikolosa village, TA Kandulu in Mwanza district. The nursery started in 1999 with an aim of planting in his garden. Until 4th November he was working with post office and now survives on selling mandalena and seedlings. The nursery was established close to river and bore-hole about 400 meters from home. After establishing in the pots, the seedlings were later taken home to avoid theft.

3.1.6 Main Source of Livelihoods for Individual Nursery Owners

A large but varying proportion of individual nursery owners in most districts earned their livelihood through farming (Table 10). In Chikwawa, half the nursery owners earned their livelihood through salaried employment. Nursery business appears to be embraced by people having several different types of main livelihoods, not only farming.

Table 10. Main source of livelihood of the owner of the nursery by district (%)

Person/Institution	Chikwawa	Mwanza	Blantyre	Lilongwe	Salima	Nkhata Bay	Average
Farming	25.0	52.2	34.4	57.1	79.2	52.9	50.1
Business	25.0	21.7	34.4	19.0	8.3	8.8	19.5
Ganyu[3] on Farm	0.0	8.7	9.4	14.3	4.2	5.9	7.1
Off Farm ganyu	0.0	4.3	9.4	0.0	8.3	8.8	5.1
Salaried employment	50.0	8.7	9.4	4.8	0.0	14.7	14.6
Other	0.0	4.3	3.1	4.8	0.0	8.8	3.5

3.2 Seed Production and Distribution

3.2.1 Species Grown in nurseries

The study uncovered a range of tree species that are grown in the 6 sampled districts. A total of 75 species were grown in the six districts, while in individual districts the total varies from 24 species in Salima to 52 species in Blantyre[4]. The species abundance curves per district show a few dominant species with a long tail of rarer species. Many species occur only in one or a few districts.

[3] Ganyu is widely used in Malawi to describe a range of short term rural labour relationships (for more information see also http://www.eldis.org/)

[4] Chikawa (39); Mwanza (47); Blantyre (52); Lilongwe (36); Salima (24); and Nkhatabay (32)

The most commonly grown species (minimum of 5% in any of the districts) are shown in Table 11. The six most popular species are: the two *Senna* species are exotics mainly good for firewood. *Faidherbia albida* is an indigenous tree, valuable for its crop-improving effects in dry areas and as fodder, *Khaya nyasica* is a valuable indigenous timber tree, which is also used for medicine. *Afzelia quanzensis* is an indigenous tree with a wide range of uses, including timber, fodder and medicine. *Eucalyptus* species are fast growing exotic timber and pole trees. Another eight species are less consistently popular: *Acacia polyacantha* is an exotic, now mainly used for firewood. *Albizia* species (probably mainly *Albizia lebbeck*) are mainly used for firewood and timber. *Azadirachta indica* is an exotic, mainly used for medicine and as a pesticide, but also firewood. *Delonix regia* is an exotic ornamental also used for firewood. *Gliricidia sepium* is an exotic, used for fodder, soil enrichment and firewood. *Breonadia microcephala* is an indigenous tree species used for building materials, firewood, medicine.

Table 11. Species grown in nurseries (percentages per district – species over 5% in any district)

Overall Rank	Rank in overall number of plants	Most common Species	Chikwawa	Mwanza	Blantyre	Lilongwe	Salima	Nkhata Bay
1	2	*Eucalyptus species*	3.0	12.7	18.4	7.3	11.9	21.1
2	1	*Senna siamea*	13.7	9.0	3.9	15.8	22.0	7.8
3	5	*Faidherbia albida*	7.5	5.3	9.1	7.7	8.7	13.3
4	3	*Senna spectabilis*	9.3	10.2	6.8	14.3	5.5	3.6
5	10	*Afzelia quanzensis*	3.3	10.7	6.5	4.4	5.0	4.2
6	9	*Khaya nyasica*	4.5	4.1	4.5	5.5	11.0	3.0
7	4	*Albizia species*	8.7	4.9	2.3	1.5	0.9	2.4
8	16	*Carica papaya*	2.7	2.9	3.9	4.8	6.0	0.0
9	25	*Mangifera indica*	1.2	2.0	1.9	3.7	2.8	7.2
10	7	*Gliricidia sepium*	8.7	2.9	4.2	0.4	0.0	0.0
11	8	*Acacia polyacantha*	4.5	1.2	1.9	5.9	1.4	1.2
12	12	*Delonix regia*	5.4	1.6	0.6	1.8	0.9	0.6
13	17	*Breonadia microcephala*	0.3	1.2	0.3	0.0	0.0	8.4
14	6	*Azadirachta indica*	7.2	0.4	0.3	0.0	0.0	0.0
		Total number of species	**39**	**47**	**52**	**36**	**24**	**32**

It is likely that the exotic species are local landraces that developed from introductions many years ago (some may have limited genetic diversity), except for *Gliricidia sepium*, which was introduced by ICRAF/FRIM a few years back. The list of the most popular six species has a good correspondence with a listing of species supplied to NGOs from the three major seed suppliers - LRC, FRIM, and ICRAF (Pedersen *et al.*, 2004, page 8) and could indicate that the NGO species spread to nurseries. On the other hand, most of the NGO species are available in the landscape and may be collected both by the NGOs and the nurseries. Only *Gliricidia sepium* is currently produced in seed orchards (Pedersen *et al.*, 2004). Exotic fruit trees do not have high priority for the three major seed suppliers (Pedersen *et al.*, 2004).

It is likely that *Carica papaya* and *Mangifera indica* were collected by nurseries themselves (in particular because most seedlings were produced from seed). *Tephrosia vogelii*, which has a very high priority by the three major seed suppliers (Pedersen *et al.*, 2004) is found rarely in the nurseries.

Box 3. From Case Studies – Deciding on species to collect and mother trees

(Lilongwe) Mr. Maganizo Nchoka - deciding on species to collect and mother trees. In this nursery, the most demanded and important tree species are: Senna siamea, Senna spectabilis and fruit trees. He said some are also asking for mbawa (Khaya nyasica). All the important species were locally collected. To decide on which species to collect, he said, »I have been over hearing on the radio and always says lets replace the trees back in deforested areas«. So he collects some indigenous species for home yard forestation. He also mentioned that seedlings are one of his main sources of income. He collects seeds and raises seedlings for sale. He sold tree seedlings in the year 2000 and realised about 27,000 K. [about USD190] from the sale of 9,000 seedlings (that year was a crucial hunger devastating year). He said he raises fruit trees for his own planting and also for sale. He said fruits are nutritious that's why he concentrates also in planting more. On how to find the mother trees for collecting of seed he looks for particular characteristics. The mother trees for establishing seedlings are mainly around Nathenje ADMARC. He says he looks for trees with mature seeds and not diseased. For species he cannot find, he says he asks for assistance from extension advisors at the land resource offices. But in most cases he travels very far (walking distances) to collect seeds. He said he always ensures he has a wider range of trees for customers. For the important trees, the sources or mother trees are nearby (Nathenje ADMARC). For fruit trees, he said he has no reliable seed source or mother tree. He said he just buys fruits from the market or pick them on the pathways.

(Chikwawa) Mr. Wilfred Mchacha Sintilawo - deciding on species to collect and mother trees. He collected locally Senna siamea, Albizia lebeck and Azadirachta indica. Afzelia quanzensis was given by forestry extension worker producing 109, 100, 22 and 88 seedlings respectively. Mr. Mchacha decided to collect the species, which are commonly found within the area and can produce good timber, poles shelter and firewood. He finds mother trees by moving around in the village looking for a good population of Senna siamea trees which fruit very well. The seed was collecbted at Lalanje Admarc, planted in 1990. When the species he wants cannot be found, he asks forestry extension worker to assist in providing the seed for the particular species or walk long distances to look for it. For example one species was collected from a distance of 75km where he spent a night using a bicycle. If the species he wants is still not found then the programme of raising it is abandoned.

3.2.2 Acquisition of reproductive material

Most of the species were raised from seeds. In all the 6 districts more than 90% of the nurseries raised their seedlings from seeds (Table 12).

Table 12. Acquisition of reproductive material by district (%)

District	From seed	Grafted	Wildings
Chikwawa	100.0	0.0	0.0
Mwanza	92.2	3.3	4.5
Blantyre	99.0	0.0	1.0
Lilongwe	100.0	0.0	0.0
Salima	99.5	0.0	0.5
Nkhata Bay	93.4	0.0	6.6

Seeing that fruit species are frequently raised in nurseries, it is noteworthy that grafting is so little used. In commercial horticulture grafting is the method whereby the growers can ensure homogeneity of quality as well as early and high production capacity. That most fruit trees are grown from seed in nurseries indicates that growers will have delayed and low quality of production of their fruit crops.

Out of the 266 cases where well-known fruit and nut species were grown in the nurseries only 4 were raised from grafts (Table 13). Cultivars of these species would produce high quality fruits and nuts and when grafted the quality will be known and production will start after one or two years. The quality of fruits and nuts that are raised from seed will be uncertain and for most species the plants will only start to produce after many years.

Table 13. Source of reproductive material for fruit trees

Scientific Name	Seed	Grafted	Wildlings	Other
Anacardium occidentale	3			
Anona senegalensis	18		1	
Carica papaya	53		1	
Citrus limon	27			
Citrus nobilis	13	1		
Citrus sinensis	10	1		
Litchi chinensis	1			
Macadamia integrifolia	3			
Mangifera indica	42	1		
Passiflora edulis	5	1		
Persea Americana	8			
Psidium guajava	21			
Sclerocarya birrea	1			
Syzygium guineense	4		1	
Tamarindus indica	3			
Uapaca kirkiana	23			
Ziziphus mauritiana	24			
Total	**259**	**4**	**3**	**0**

3.2.3 Size of the Nursery

The average number of seedlings raised varied from district to district and between individual nurseries and group nurseries (Table 14). In general though, groups produced more seedlings than individuals. This result is true in all the six districts, where the average of the group nurseries was from 100% larger than the corresponding averages from individual nurseries (Table 14). It should be noted that the variation in size between the nurseries is very big and a lot of variation is thus present in the observations on size. Still, individual nurseries were significantly smaller than group nurseries when testing in a simple pairwise (per district) comparison.

The group nurseries in Chikwawa district had on average a much larger production than the other districts. One explanation for the higher productivity in the community nurseries could be that group nurseries in general had more resources at hand (see discussion and conclusions).

Table 14. Mean size (average number of plants produced) of nurseries in the sample

District	Individual nurseries		Group nurseries	
	Mean	Std. Dev.	Mean	Std. Dev.
Chikwawa	2,490	3,090	12,181	13,188
Mwanza	583	558	3,522	7,698
Blantyre	3,352	6,058	5,360	5,006
Lilongwe	1,068	1,040	5,947	6,925
Salima	1,470	1,644	2,721	7,537
Nkhata Bay	438	687	1,852	2,505
Average	1,474	3,241	6,306	9,660

3.2.4 From where do nurseries get reproductive material?

Nurseries (individual and group) acquired their seeds from different places and contribution from the different places varied by district (counted on a per species basis, not as volume of seed) as can be seen in Table 15. Nurseries acquire seed on their own (own, forest, neighbours) in the districts from 25% (Nkhata Bay) to 62% (Chikwawa) of their species. Nurseries acquire seed from NGOs, FRIM/Forest Department and Agriculture department from 60% (Nkhata Bay) to 35% (Chikwawa) of species. The support from FRIM/Forestry Department and Agriculture Department are quite consistent across districts (respectively high and low). The support from NGOs was also quite consistent as a group, but different NGOs provided support in different districts).

Table 15. Places where reproductive material was acquired (by district, %)*

Source	Chikwawa	Mwanza	Blantyre	Lilongwe	Salima	Nkhata Bay
Own initiative						
Forest	42.0	11.9	19.0	15.3	8.3	3.0
Neighbour	2.1	7.0	9.5	9.5	5.5	6.6
Own	17.6	12.7	12.1	4.4	12.0	15.7
From organisations						
NGOs	17.0	15.6	22.5	14.2	4.1	12.0
FRIM/Forest Department	10.7	43.4	23.8	32.5	41.5	41.6
Agricultural Department	7.4	3.3	0.6	2.2	13.4	6.6
Other	3.3	6.1	12.4	21.9	15.2	14.5
Proportion of this bought	0.6	6.1	15.6	7.3	5.6	4.8
Proportion of this given	36.0	66.0	48.6	52.9	63.0	55.4
Proportion of this collected	63.4	27.9	35.9	39.8	31.5	39.8

*Counted by each species in a nursery

Table 16 shows from where nurseries acquire reproductive material (germplasm) and how they acquire the material. It is quite clear that the approach of the NGOs, FRIM/Forestry Department (FD), and Agricultural Department (AD) is to provide free seed to nurseries. Nurseries mainly collect from »forest« and »own«, while acquiring from »neighbours« is a mixture of collection, gifts and purchase. Acquisition from »other« is mainly collection and purchase. 35 different species were also purchased by nurseries. The top six species were fruits. In total, fruits are 62% of purchase cases.

Table 16. Place of acquisition and way of acquisition (all district, %)*

	Place of acquisition						
Way of Acquisition	**Forest**	**Neighbour**	**Own**	**NGO**	**FRIM/ FD**	**AD**	**Other**
Bought	0.0	11.7	2.6	3.4	3.0	1.2	36.5
Given	3.4	33.0	0.5	96.6	95.1	98.8	8.3
Collected	96.6	55.3	96.9	0.0	1.9	0.0	55.2

*Counted by each species in a nursery

Overall there is no simple relationship between the size of a nursery and the degree to which the nursery receives seed from others (Figure 4). A number of nurseries depend highly on external procured seed, but the majority of nurseries collect seed themselves. The average percent of self procured seed for small scale nurseries (< 1,000 seedlings) was 36%, for nurseries 1000-5000 the average percent of self procured seed was 37%, whereas it was 36% for nurseries 5000-10,000. That is almost the same average up to 10,000 seedlings. However, for nurseries > 10,000 the average degree of self procured seed was almost twice as high (64%). Large nurseries thus on average procure a higher fraction of the seed themselves compared to smaller nurseries, but the most important observation is probably the substantial variation between nurseries in all size groups (see Figure 4).

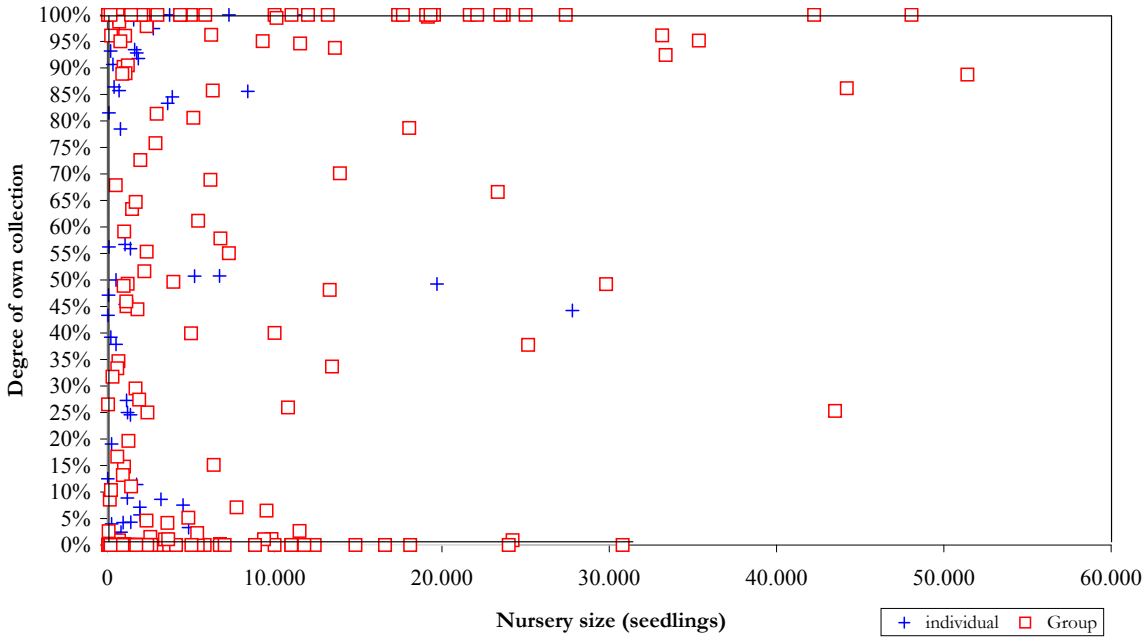

Figure 4. Degree of own collection by nurseries

Box 4. From Case Studies - Collection

(Lilongwe) Mr. Likiasi D. Chindenga – collection. Both species in the nursery were collected; of course some of the seedlings for both species were given to him by the forest department. When he saw that the seedlings given to him were not enough he collected himself from his own trees close to the nursery. He determines the species to collect seed from by the mother trees that he has and from encouragement by NGOs like NASFAM. This season NASFAM encouraged him to sow blue gum because they said they will buy some of the seedlings so that they could distribute to other farmers. He also admitted that seeds for casius (*Senna siamea*) and blue gum (*Eucalyptus sp.*) are very close to his nursery and he has a small forest about half a kilometre, which has a lot of casius and bluegum. Also blue gum is very good for poles used for constructing houses; an example was given where he showed me his house built of bluegum poles. The respondent said that Mr Chigalu, an extension worker for forest, taught him that for him to choose which mother tree to collect seeds from, for bluegum the tree has to be straight and must have enough seeds. On the other hand casius must have mature seeds and the tree must have enough seeds. This, he said is followed and on top of that, the area has a lot of casius and bluegum which was planted long time ago which makes him not to have a choice but to look at those trees that are near as they are many. He added to say that, it is very easy to find the mother trees in the area because they are everywhere in the village and even just close to his nursery; about 20 metres away he has enough mother trees. Usually when he cannot find the species that he wants he asks for some from the forest department and some of his friends that have nurseries. If both options fail there is nothing he can do.

(Blantyre) Mr. Lewis Kaliati – collection. He intends to plant these seedlings in his family's woodlot. In his nursery, he has a total of 752 blue gum seedlings and 144 acacia. For the blue gum, the seed was locally collected. The seed for acacia was given to him by an extension worker from the Department of Forestry. It was learnt later, towards the end of this interview, that the respondent collected few acacia seed to supplement what he got from the Department of Forestry. The blue gum seed was collected from blue gum trees that are in a small woodlot behind his house. The respondent reported that what he had been wanting are tree seedlings to plant in his woodlot. He noted that the area is hot and requires trees that can withstand heat. He identified bluegum to be a tree that is suitable for the area. He further explained that he did not know any type of blue gum, but he wanted the bluegum whose bark is easy to peel/remove. He noted that weevils do not attack such bluegum. However, he could not tell by the looks, which bluegum met these qualities (from his existing woodlot). The wanting of seed coincided with the wanting of firewood to burn bricks. He cut four blue gum trees as firewood for burning bricks. Of the four, one had the required qualities. He immediately took away the small branches that were bearing pods. He also said that the seed that he collected was enough for the intended scale of production. He said that if he cannot find species he wants, he would ask forestry extension staff for seeds.

3.2.5 Who procures from the nurseries?

Most nursery owners intended either to plant the seedlings they had raised or to sell. The latter reason indicates that there is a market for seedlings. In the case of those that intended to sell their seedlings, their main customers were most often private individuals (Table 17). Except for MASAF, NGOs and Agricultural Department purchase seed in only a single district. Forestry Department was an active buyer (to a varying degree) in five districts. The purchases from organisations are likely to be for free handouts to farmers.

Table 17. Seedling procurers by district (%)

Species	Chikwawa	Mwanza	Blantyre	Lilongwe	Salima	Nkhata Bay
Private	75.0	94.4	100.0	100.0	100.0	100.0
MASAF	50.0	0.0	5.0	4.3	0.0	0.0
CADECOM	12.5	0.0	0.0	0.0	0.0	0.0
World Vision	0.0	0.0	0.0	0.0	0.0	7.1
CPAR	0.0	0.0	0.0	0.0	0.0	14.3
WLS	0.0	11.1	0.0	0.0	0.0	0.0
Projects	0.0	0.0	0.0	0.0	9.1	0.0
Forestry Department	12.5	22.2	5.0	26.1	0.0	28.6
Agriculture department	0.0	0.0	0.0	0.0	0.0	7.1
Other	0.0	0.0	5.0	4.3	9.1	7.1

Individuals or institutions that came to buy seedlings from the nurseries came from different places of varying distances. Figure 5 shows that in general, customers buying from individual nurseries came from distant places, ranging from an average of 61.6 kilometres in Mwanza to 1.2 kilometres in Salima. In case of customers for group nurseries, the longest average distance was 20.5 kilometres recorded in Blantyre and the shortest of 2.0 kilometres was in Nkhata Bay. Overall mean distances were 19.8 Km in the case of private nurseries and 8.3 Km in the case of group nurseries. The differences between these groups were not statistically significant.

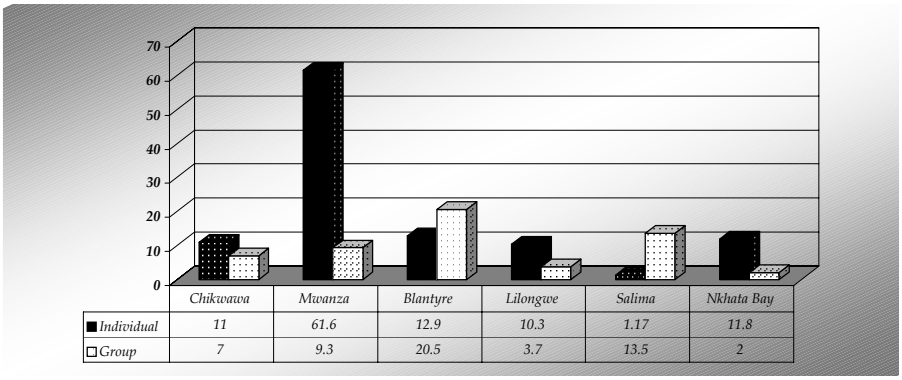

Figure 5. Mean distance from which customers come to individual and group nurseries - by district (Km)

3.3 Problems/Constraints and Support

The study also tried to find out the problems that nursery owners faced in the course of carrying out their work. Table 18 gives the results and the recorded problems have been sorted into three major groups: technical problems, capacity problems, and seed system problems. The major technical problem is pests on seedlings (which could be caused by insufficient knowledge or lack of access to pesticides), while germination failure varies considerably between districts (which could be caused by by insufficient knowledge or the use of different species). The major capacity problem is water scarcity, which is related to the necessity that seedlings must be grown during the dry season to be ready for planting out during the wet season.

The reporting of water scarcity is not significantly related to the location of nurseries (home yards, riverbanks and dambo). The major seed system problem is lack of other inputs and implements (which could be caused by lack of spare cash for purchasing inputs or a general unavailability of inputs). Limited tree seed is also perceived as a major constraint to a varying degree in all districts.

Overall Table 18 indicates that there is a need for a flow of technical information to the nurseries, and that tree seed is a constraint in several districts. Lack of markets for seedlings is not seen as a major problem in most districts, which (coupled with earlier information that seedlings are for sale) seem to indicate that most nurseries produce for known customers or that sale of seed is not of paramount importance for nurseries.

Table 18. Problems and constraints faced in the nurseries (%)

Problems	Chikwawa	Mwanza	Blantyre	Lilongwe	Salima	Nkhata Bay
None	3.3	3.3	3.3	3.3	0.0	3.3
Technical problems						
Pests on seedlings	55.0	46.7	58.3	50.0	78.3	61.7
Germination failure	21.7	10.0	10.0	3.3	3.3	5.0
Lack of pots	0.0	0.0	1.7	0.0	0.0	0.0
Capacity problems						
Water Scarcity	33.3	11.7	13.3	30.0	23.3	21.7
Inadequate nursery space	1.7	1.7	1.7	3.3	1.7	0.0
Livestock damage	13.3	13.3	3.3	8.3	6.7	5.0
High labour demand	6.7	11.7	16.7	21.7	20.0	15.0
Transporting seedlings	3.3	0.0	0.0	1.7	3.3	3.3
Theft	0.0	1.7	3.3	1.7	1.7	3.3
Bush fires	0.0	1.7	0.0	0.0	0.0	1.7
Damage by people	0.0	0.0	0.0	0.0	1.7	1.7
Long distance	0.0	0.0	0.0	0.0	1.7	0.0
Wash away	0.0	0.0	0.0	0.0	0.0	1.7

Table 18 continued overleaf

Problems	Chikwawa	Mwanza	Blantyre	Lilongwe	Salima	Nkhata Bay
Seed system problems						
Lack of information or guidance	5.0	15.0	21.7	8.3	11.7	11.7
Lack of other inputs	58.3	63.3	51.7	80.0	75.0	65.0
Limited tree seed	28.3	10.0	41.7	23.3	13.3	15.0
Lack of market for seedlings	5.0	15.0	35.0	15.0	3.3	8.3
Lack of cooperation	10.0	6.7	5.0	1.7	5.0	5.0
Lack of motivation	31.7	0.0	1.7	1.7	1.7	0.0

Box 5. From Case Studies – Constraints and opportunities

(Blantyre) Mr. John Saidi Nursery. It started in 1994 and the owner formerly worked with Malawi Housing Corporation from 1974 to 1990. As a nurseryman,he survives on nursery business and managed to buy a dairy cow with money realized from the business and is hopeful next year will start producing milk. He has approximately 100 customers. They come from distances of over 90km like Zomba, Chikwawa and Thyolo. Mr. John Saidi is in good contact with other nursery owners/managers. The benefits he sees in these contacts are sharing of ideas, knowledge, skills and techniques, it encourages nursery business as they discuss ways of improving their nurseries and market, they share seedlings/ seed and customers when he has or hasn't seedlings /seed in his nursery with those that have. The main opportunities in his nursery business are good income that assists him acquiring things he misses in his life like dairy cow, fees for his children, soap, food etc. Afforestation is also enhanced in this way. Working hard can fulfil these opportunities and government has to intervene in exploring market and providing capital to smallholder farmers. The main constraints in this business are discouragement from other people in the village who sometimes steal his seedlings or even destroying, lack of inputs such as enough tubes, seed and market of the seedlings is lacking. Technical advices from offices around him on how get seed for new species in the area. The constraints can be overcome by provision of training and exchange visits with other nurseries, provision of capital to buy inputs such as seed as well as opening good market with assistance of government and non governmental organizations.

(Chikwawa) Mrs. Veronica Harry Nursery. This nursery started in 2002 with the purpose of planting in her garden and for sale. She survives on cotton, millet and maize farming. The nursery owner is in contact with other nursery managers who are close. The benefits from this contact are that they share knowledge and experience on how to manage the nursery such as sowing techniques, right time for pricking out seedlings and treatment of seeds to improve germination. They also do share seed and tubes in case one does not have or not enough for his/her target. The main opportunity she can see in this business is availability of seedlings, which can be planted for shade, timber, firewood and poles. When proper market is identified then it can be a good source of income for the betterment of her family in improving her economic status as well as standard of living. This can be fulfilled by working hard and proper coordination with the forestry extension worker in the area as well as exchange visits with other nursery managers. Limited tree seed and tubes, lack of market for seedlings, livestock damage, lack of equipment/tools such as hoes, shovels and wheelbarrow and hunger, which encourages her to do piece work in other people gardens instead of working in the nursery, are the main constraints in her nursery business. These constraints can be overcome by fencing the nursery to prevent livestock damage, availability of the seed of the required species by forestry extension worker especially for the species which are not locally found there but can do well under that climatic conditions and provision of loan to nursery owners in order to purchase the required inputs in time but above all government should intervene in identifying market for the seedlings.

Despite some nursery owners reporting lack of information and guidance, the majority reported getting support from different individuals and institutions (Table 19). Most support came from forest extension staff. Agricultural extension staff also played a major role. In Chikwawa, CADECOM and ELDP also provided support and in Nkhata-Bay, World Vision did the same.

Table 19. Supporters of nurseries business by district (%)

Species	Chikwawa	Mwanza	Blantyre	Lilongwe	Salima	Nkhata Bay
Nobody	0.0	8.3	3.4	0.0	5.5	6.7
Other Farmers	3.4	1.7	10.2	0.0	0.0	0.0
Government Departments						
Agriculture Extension Staff	22.0	6.7	6.8	11.7	23.6	13.3
Forest Extension Staff	39.0	83.3	91.5	86.7	85.5	68.3
NGOs						
InterAide	0.0	0.0	0.0	5.0	1.8	0.0
MASAF	0.0	5.0	0.0	5.0	1.8	0.0
CADECOM	42.4	1.7	0.0	0.0	0.0	0.0
World Vision	0.0	0.0	1.7	1.7	0.0	23.3
CPAR	0.0	0.0	0.0	0.0	0.0	5.0
WLS	0.0	21.7	0.0	0.0	0.0	0.0
ELDP	27.1	0.0	0.0	0.0	0.0	3.3
MEET	0.0	0.0	1.7	0.0	0.0	3.3
Land Resource Centre	0.0	0.0	0.0	1.7	1.8	0.0
Other	1.7	8.3	22.0	15.0	12.7	15.0

External assistance for support favoured group nurseries. All of the group nurseries reported external support, while this was the case for 10% of the individual nurseries (Table 20). Further, NGOs seem to favour community nurseries. Of the 42 nurseries supported by NGOs, 35 (83%) were community nurseries, while community nurseries only constitute 62% of the nurseries supported by the governmental departments (overall community nurseries constitute 61% of the nurseries).

Table 20. Support to nurseries according to type of nursery ownership (%)

	Nursery types		
Support organisation	**Community nurseries (%)**	**Individual nurseries (%)**	**Total number of Nurseries**
Other farmers	33	67	N= 9
Government extension	62	38	N=277
NGOs	83	17	N= 42
Others	55	45	N= 11
No support	0	100	N= 14

Note: Differences between support organisations are highly significant ($\chi 2 = 34.16$, $P<0.001$).

The support by government extension differed from the support by NGOs in the way the support was distributed along size classes of nurseries (Table 21). Support from government extension is directed towards the smaller nurseries. While NGO support to the largest two size classes is 54% of their total support, the proportion of the support from government extension to the two classes is 19%.

Table 21. Support to size classes of nurseries

	</=1,000	1,001-5,000	5,001-10,000	>10,000
Other farmers	4	1	3	1
Government extension	124	101	22	29
NGOs	8	11	7	15
Other	5	3	0	2
Nobody	11	3	0	0

Note: Differences between Government extension and NGOs are highly significant ($\chi 2 = 27.22$, $P<0.001$)

Support to nurseries (group or individually owned) was mostly technical in the form of advice on how to raise seeds and some of the support was the provision of inputs like polythene bags (Table 22). Very little support was given to nurseries by organizations in terms of seedling distribution.

Table 22. Kind of obtained support according to district (%)

District	Technical	Inputs	Distribution	Other
Chikwawa	100.0	96.5	1.8	0.0
Mwanza	98.2	96.4	1.8	0.0
Blantyre	94.7	87.7	0.0	0.0
Lilongwe	100.0	96.7	5.0	1.7
Salima	96.5	100.0	0.0	1.8
Nkhata Bay	94.6	96.4	3.6	0.0
Average	97.4	95.6	2.0	0.6

3.4 Future Plans

Apart from what people raised at the time of the survey, the survey sought to know if there were any species that people were interested to raise but could not do so. Table 23 gives these results and there is a great variation across districts, but it is noTable that most of the species are already used by other nurseries. The lesson from this Table is not the exact numbers for the demand of particular species, as there will be a profusion of reasons for the unavailability of species at the nursery sites and for different nursery owners. We have therefore grouped the species into types of species, which have a similar historical background for their presence in Malawi and in most cases similar criteria for genetic evaluation of their quality. We then provide *hypotheses* for the reasons of their unavailability to nursery owners.

Exotic timber species: Several of the species have become naturalised in Malawi and landraces have developed: *Eucalyptus, Senna siamea, Senna spectabilis, Albizzia lebbeck, and Melia azedarach*. These species are generally available in the landscape, but in places over-cutting of good specimens may have lead to negative selection, such that only inferior trees are available for seed collection in particular *Senna siamea, Senna spectabilis,* and *Albizia lebbeck*. *Pinus* species have been introduced to the country by the Forest Department and seed sources of good material are available, but perhaps not locally. For the local landraces, seed (but not necessarily good seed) will probably be accessible in areas where the species can grow. *When it is reported in Table 23 that nurseries could not get hold of these species, a likely explanation is that the information flow to and between nurseries is very inadequate.*

Other exotic species: *Azadirachta indica* is naturalised in Malawi and used by farmers for medicine, pesticides and a range of other products. In areas where the species can grow seed will be available. *Delonix regia* is naturalised in Malawi and used as an ornamental. In areas where the species can grow seed will be available. *Gliricidia sepium* and *Leucaena leucocephala* are two agroforestry species used for fodder. The species are fairly recent introductions and probably only available locally through supporting institutions. *When it is reported in Table 23 that nurseries could not get hold of the two first species, a likely explanation is that the information flow to and between nurseries is very inadequate. When it is reported in Table 23 that nurseries could not get hold of the two last species, supporting institutions have not made seed (and local seed sources) locally available.*

Exotic fruit trees: mango (*Mangifera indica*), orange (*Citrus sinensis*), papaya (*Carica papaya*) and guava (*Psidium guajava*) are naturalised in Malawi, but many superior varieties are in principle available in the country. These varieties will produce fruits of much higher value than the naturalised mango, papaya, orange, and guava. *When it is reported in Table 23 that nurseries could not get hold of these fruit trees, supporting institutions (including Department of Horticulture) have not made grafts of improved varieties locally available.*

Indigenous trees: *Afzelia quanzensis*, *Faidherbia albida*, *Khaya nyasica*, *Acacia polyacantha*, *Breonadia microcephala* and *Uapaka kirkiana*. The three species *Afzelia quanzensis*, *Faidherbia albida*, *Khaya nyasica* are among the most widely used species (see Table 11). *When it is reported in Table 23 that nurseries could not get hold of the species, a likely explanation is that the information flow to and between nurseries is very inadequate* (however, availability of *Khaya nyasica* may be limited due to limited storage capacity of seed). The three other species *Acacia polyacantha*, *Breonadia microcephala*, *Uapaka kirkiana* are aparently planted less frequently. *When it is reported in Table 23 that nurseries could not get hold of the species, a likely explanation is that the information flow between nurseries and seed source producers is inadequate.*

Table 23. Interested to get, but could not get by district (species over 5% in any district)

Scientific Name	Chikwawa	Mwanza	Blantyre	Lilongwe	Salima	Nkhata Bay
Exotic timber species						
Eucalyptus species	25.8	9.2	1.0	4.7	11.8	9.4
Pinus species	0.0	4.6	2.9	2.9	4.7	18.9
Exotic fruit trees						
Citrus sinensis	4.5	3.1	5.9	9.3	13.6	5.5
Mangifera indica	10.1	4.6	5.9	7.6	7.7	3.1
Prunus persica	1.1	0.0	1.0	2.9	5.9	0.8
Psidium guajava	2.2	0.0	2.9	1.7	8.9	0.0
Indigenous species						
Afzelia quanzensis	4.5	6.2	9.8	2.9	1.8	3.9
Faidherbia albida	5.6	12.3	2.9	5.2	3.6	5.5
Khaya nyasica	10.1	13.8	13.7	8.1	6.5	5.5
Pterocarpus angolensis	2.2	3.1	4.9	0.6	0.0	7.1
None	14.6	33.8	14.7	1.2	0.6	0.8
Total number of species	**89**	**65**	**102**	**172**	**169**	**127**

Availability (lack of seeds or were not available locally) were the main reasons why people were at present not raising species that they would like to raise (Table 24). This finding is in accord with the earlier findings where it was shown that a large proportion of species was collected by nurseries and could indicate that the offer of species from organizations is rather limited. It also indicates that market mechanisms may not be active in the seed market, but is supply driven by organizations. *A reasonable hypothesis is that efficient production and distribution chains that can market a variety of suitable species to local areas in Malawi do not exist.*

Table 24. Reasons for not producing by district

Reason	Chikwawa	Mwanza	Blantyre	Lilongwe	Salima	Nkhata Bay
Technical problems						
Seeds fail to	6.8	3.2	1.9	4.6	1.8	2.4
Sun destroys	2.3	0.0	1.0	0.0	0.6	3.9
No suitable soil	2.3	3.2	1.0	0.0	1.2	0.0
Destruction by	0.0	1.6	0.0	5.2	10.1	2.4
Seed takes long	0.0	0.0	0.0	0.6	0.0	0.0
Availability						
Not locally found	71.6	74.2	58.7	0.0	0.0	0.0
Not available	17.0	37.1	24.0	1.7	0.0	0.0
Local seed collection	4.5	3.2	0.0	0.0	0.0	0.8
Lack of seeds	3.4	3.2	20.2	78.6	77.5	85.0
Forestry do not	2.3	8.1	11.5	0.0	0.0	0.0
Delay in seed supply	1.1	0.0	0.0	0.6	0.6	0.0
Inadequate material	1.1	4.8	2.9	0.0	0.0	0.0
Lack of implementation	0.0	0.0	2.9	1.2	0.0	0.0

Table 25 continued next page

Reason	Chikwawa	Mwanza	Blantyre	Lilongwe	Salima	Nkhata Bay
Cost considerations						
Lack of funds for	1.1	0.0	0.0	1.7	0.0	3.1
Too expensive	0.0	0.0	1.0	0.0	0.0	0.0
Lack of market	0.0	0.0	0.0	0.0	0.0	0.0
No response	4.5	0.0	1.0	5.8	4.7	2.4

3.5 Skills and Knowledge

This section discusses knowledge and skills for raising and running nurseries. Table 25 shows that the majority got their knowledge and skills informally and by associating with others. Some got the knowledge via the local knowledge, *i.e.* what people have been doing traditionally. The second half of the Table shows that the Forestry Department was the most important source in five of six districts. Different NGOs were major sources of the knowledge and skills in different districts.

Table 25. Source of skills for running the nursery (%)

Source of skill	Chikwawa	Mwanza	Blantyre	Lilongwe	Salima	Nkhata Bay
Local knowledge	8.5	3.3	26.7	18.3	11.9	13.6
Formal education	0.0	3.3	0.0	5.0	0.0	3.4
Informal	81.4	66.7	63.3	76.7	86.4	81.4
Radio	1.7	0.0	0.0	3.3	3.4	0.0
Reading	0.0	6.7	1.7	1.7	0.0	3.4
Learn from others	13.6	31.7	10.0	16.7	16.9	25.4
Special program	0.0	0.0	0.0	0.0	11.7	3.4
Provider organisation						
InterAide	0.0	0.0	0.0	4.5	0.0	0.0
MASAF	0.0	0.0	2.9	0.0	2.1	0.0
CADECOM	39.6	0.0	0.0	0.0	0.0	0.0
World Vision	0.0	0.0	0.0	0.0	0.0	14.3
CPAR	0.0	0.0	0.0	0.0	0.0	4.1
WLS	0.0	12.5	0.0	0.0	0.0	0.0
ELDP	29.2	0.0	0.0	0.0	0.0	0.0
Forestry Department	25.0	80.0	77.1	84.1	77.1	73.5
Agriculture Department	6.3	12.5	5.7	4.5	20.8	10.2
FAO	2.1	0.0	0.0	0.0	2.1	0.0
Land Resource	0.0	0.0	0.0	2.3	0.0	0.0
PROSCAP	0.0	0.0	0.0	4.5	0.0	0.0
ADRA	0.0	2.5	0.0	0.0	0.0	0.0
SUNESMA	0.0	5.0	0.0	0.0	0.0	0.0
European Union	0.0	0.0	0.0	6.8	0.0	0.0

Table 25 continued overleaf

Source of skill	Chikwawa	Mwanza	Blantyre	Lilongwe	Salima	Nkhata Bay
School	0.0	0.0	8.6	0.0	4.2	0.0
JICA	0.0	0.0	0.0	0.0	2.1	0.0
JICA	0.0	0.0	14.3	0.0	0.0	0.0
City Assembly	0.0	0.0	2.9	0.0	0.0	0.0

In most cases, be it individuals or groups (Figure 6) people indicated the desire to learn new techniques in raising seedlings and distributing them. A very high proportion of respondents in the six districts expressed this wish.

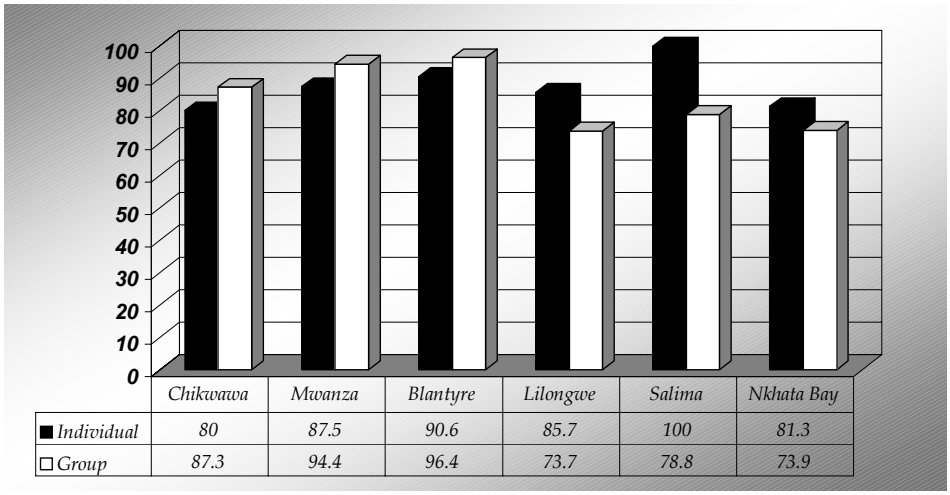

Figure 6. Proportion of individuals/groups wishing to learn new techniques (%)

Among the skills desired by most people (Table 26) tree propagation techniques ranked highest across the six districts. This was followed by pricking techniques and seed collection techniques. Distribution skills are generally ranked low. The »No response« was high in all districts.

Table 26. Skills desired by district

Reason	Chikwawa	Mwanza	Blantyre	Lilongwe	Salima	Nkhata Bay
Seed collection	35.3	23.6	21.4	10.6	11.3	25.0
Distribution	3.9	16.4	8.9	6.4	3.8	4.2
Tree propagation techniques	80.4	70.9	80.4	83.0	92.5	62.5
Pricking out techniques	27.5	21.8	5.4	21.3	15.1	27.1
No response	15.7	21.8	25.0	29.8	13.2	20.8

3.6 Communication between nurseries and/or organisations

A large proportion of nurseries report to be in contact with other nurseries (Figure 7). Among the individual nurseries incidents of contact were highest in Lilongwe (90.5%) and lowest in Salima (41.7%). Amongst group nurseries contact was highest in Chikwawa (83.9%) and lowest in Salima (41.2%). In general therefore, less nursery owners in Salima interacted with other nurseries. One explanation for the large differences between groups and in-

dividuals in Nkhata and Lilongwe could be that group nurseries are closely linked to supporting organisations.

The relatively high level of contact between nurseries and the lack of seed for many species (see Tables 20 and 21) indicate that the information exchange alone is not sufficient to make seed accessible to nurseries.

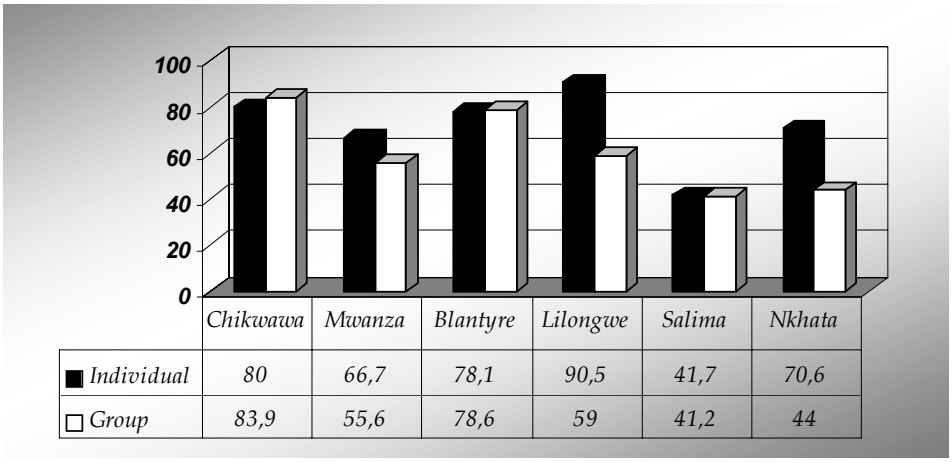

Figure 7. Incidence of contact with other nurseries by district (%)

People that had contacts with other nurseries indicated that there were advantages in doing so. Table 27 indicates that the main advantages of visiting other nurseries are seen as sharing of new information and knowledge, and exchange of seeds and helping each other find markets. The »No response« was high in half the districts.

Table 27. Advantages of being in contact with other nurseries by district

Reason	Chikwawa	Mwanza	Blantyre	Lilongwe	Salima	Nkhata Bay
Help finding markets	2.0	8.3	12.8	2.4	8.3	2.8
New information, guidance, knowledge	100.0	88.9	89.4	97.6	95.8	97.2
Self exposure	2.0	5.6	0.0	11.9	0.0	5.6
Exchanging seed	22.0	5.6	10.6	7.1	12.5	8.3
No response	2.0	5.6	4.3	35.7	37.5	22.2

Those people that reported no contact stated that they did so because of lack of information about other nurseries. Some people said that they were too busy to be visiting other nurseries. Others though said that they did not have a special reason (Table 28). The very high incidence of »No response« indicates that this was not considered a relevant question.

The survey further asked the nurseries if they have contacts with organizations working in the tree seed sector. As expected the majority confirmed this (Figure 8), however the low response from Salima is somewhat puzzling, but may be partly explained by Table 26, where Salima generally reports a low contact with NGOs (but Blantyre has a similarly low contact with NGOs, so other factors contribute to the difference between the two areas).

Table 28. Reasons for not being in contact with other nurseries by district

Reason	Chikwawa	Mwanza	Blantyre	Lilongwe	Salima	Nkhata Bay
Lack of Information	33.3	50.0	46.2	38.9	28.6	29.2
Too Busy	0.0	25.0	15.4	0.0	14.3	25.0
No response	66.7	25.0	38.5	61.1	57.1	45.8

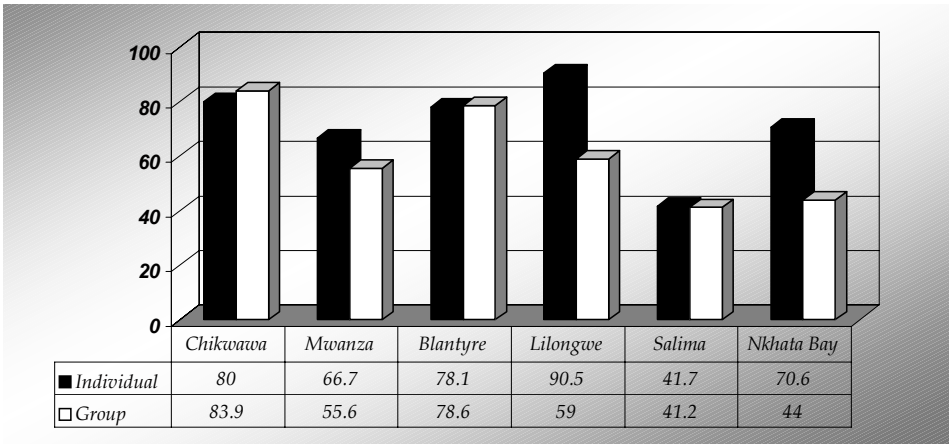

Figure 8. Incidence of contact with organisations working in the seed sector by districts (%)

The organization that people in all districts mentioned having contact with was the Forest Department and on a lower scale, the Department of Agriculture. NGOs were influential in four districts with one or two NGOs in each district. In Blantyre and Salima, the influence of NGOs was low (Table 29).

Table 29. Contacts with organizations working with tree seed and seedlings

Person/Institution	Chikwawa	Mwanza	Blantyre	Lilongwe	Salima	Nkhata Bay
NGOs						
InterAide	0.0	0.0	0.0	6.7	0.0	0.0
MASAF	3.4	5.4	0.0	5.0	1.8	0.0
CADECOM	43.1	1.8	0.0	0.0	1.8	0.0
World Vision	0.0	0.0	1.8	3.3	0.0	27.8
CPAR	1.7	0.0	0.0	0.0	0.0	9.3
WLS	0.0	12.5	0.0	0.0	0.0	0.0
ELDP	27.6	0.0	0.0	0.0	0.0	3.7
ICRAF	3.4	0.0	0.0	0.0	0.0	3.7
MEET	3.4	0.0	1.8	0.0	0.0	3.7
Land Resource Centre	0.0	0.0	3.5	1.7	3.5	0.0
Government Departments						
Forest Department	39.7	89.3	94.7	90.0	91.2	75.9
Agriculture Department	17.2	10.7	1.8	11.7	26.3	13.0
No response	0.0	8.9	12.3	15.0	12.3	9.3

4. Discussion and conclusions

In brief the survey found the following major trends for the nurseries:

The proportion of private ownership of nurseries is relatively high in five out of six districts (Table 2). Most nurseries are situated on owned land (Table 4) in home yards, riverbanks or dambo (Table 5) and for the private nurseries the nurseries are run mostly by men (Table 2) who can read and write (Table 3). Individuals or groups started most of the nurseries (Table 6), but in five out of six districts the Forestry Department (and at a lower level the Agriculture Department) played an important role (Table 6). The external assistance for establishment clearly favoured group nurseries (Table 7). Most people or groups started their nurseries using a mixture of own capital and gifts either from friends or institutions (Table 9). For a majority of the people or groups, provision of seedlings for their own planting was the major reason, but around a third of nurseries indicated that they also established nurseries so as to sell seedlings (Table 8). Nursey business appears to be embraced by people having several different types of main livelihoods, not only farming (Table 10).

Accessibility is likely to be one of the main criteria for selection of species (Table 11). This may indicate that there is a lack of seed sources for a more complete range of useful agroforestry species. Most of the species were raised from seeds (Table 12). Almost all fruit and nut species were grown in the nurseries from seed (Table 13), this strongly indicates that germplasm provision is suboptimal. In general, groups produced more seedlings than individuals (Table 14).

Nurseries acquire seed on their own (own, forest, neighbours) in the districts from 25% to 62% of their species (Table 15). The support from FRIM/Forestry Department and Agriculture Department are quite consistent across districts (respectively high and low). The support from NGOs was also quite consistent as a group, but different NGOs provided support in different districts). The approach of the NGOs, FRIM/Forestry Department (FD), and Agricultural Department (AD) is to provide free seed to nurseries (Table 16).

In the case of those that intended to sell their seedlings, their main customers were most often private individuals (Table 17). Except for one NGO, NGOs and Agricultural Department purchase seedlings in only a single district. Forestry Department was an active buyer (to a varying degree) in five districts. The purchases from organisations are likely to be for free handouts to farmers, and provide income for nurseries. In general, customers came from considerable distances to purchase from nurseries (see Figure 5).

There is a need for a flow of technical information to the nurseries (Table 18), and tree seed is a constraint in several districts. Lack of markets for seedlings is not seen as a major problem in most districts, which (coupled with earlier information that seedlings are for sale) seem to indicate that

most nurseries produce for known customers or that sale of seed is not of paramount importance for nurseries. Despite some nursery owners reporting lack of information and guidance, the majority reported getting support from different individuals and institutions (Table 19). In general most support came from Forest Extension staff. Support to nurseries (group or individually owned) was mostly technical in the form of advice on how to raise seeds and some of the support was the provision of inputs like polythene bags (Table 22). Very little support was given to nurseries by organizations in terms of seed and plant distribution.

External assistance for support favoured group nurseries. In particular, NGOs seem to favour community nurseries (Table 20). The support by government extension differed from the support by NGOs in the way the support was distributed along size classes of nurseries (Table 21). Support from government extension is directed towards the smaller nurseries, while NGOs favoured the larger nurseries.

Many of the species that nurseries report to want, but are unable to find, are already used by other nurseries (Table 23). The lesson from this Table is not the exact numbers for the demand of particular species, as there will be a profusion of reasons for the unavailability of species at the nursery sites and for different nursery owners. The major hypotheses for the reasons of unavailability of species to nursery owners are that:

i) the information flow to and between nurseries is very inadequate;
ii) supporting institutions have not made seed (and local seed sources) locally available;
iii) supporting institutions (including Department of Horticulture) have not made grafts of improved fruit varieties locally available;
iv) the information flow between nurseries and seed source producers is inadequate.

Availability was the main reason why people were presently not raising species that they would like to raise (Table 24). This could indicate that the offer of species from organizations is rather limited. It also indicates that market mechanisms may not be active in the seed market, but is supply driven by organizations. A reasonable hypothesis is that efficient production and distribution chains that can market a variety of suitable species to local areas in Malawi do not exist.

Table 25 shows that the majority of nurseries got their knowledge and skills informally and by associating with others. The Forestry Department was the most important source in five of six districts. Different NGOs were major sources of the knowledge and skills in different districts. Among the skills desired by most people (Table 26) tree propagation techniques ranked highest across the six districts. This was followed by pricking techniques and seed collection techniques. Distribution skills have low priority.

A large proportion of nurseries report to be in contact with other nurseries

(Figure 7), but with large variation between districts. The relatively high level of contact between nurseries and the lack of seed for many species (see Tables 23 and 24) indicate that the information exchange alone is insufficient to make seed accessible to nurseries.

The organization that people in all districts mentioned having contact with was the Forest Department and at a lower scale, the Department of Agriculture. NGOs were influential in four districts with one or two NGOs in each district. In Blantyre and Salima, the influence of NGOs was low (Table 29).

Overall the survey indicates that support to nurseries is insufficient with respect to sourcing of suitable species and with respect to development of nurseries as an enterprise. The survey points to the limitations of the dominating paradigm within the support organisations. The envisioned development pathway for this paradigm is that smallholder tree planting is best supported by providing free seed and seedlings to smallholders and that this is best done through the establishment of group nurseries. Boehringer *et al.* (2003 a) found that germplasm in Malawi, Tanzania and Zambia remains a major constraint for farmer tree planting and suggested that governments should create an enabling environment for the smooth functioning of farmer oriented germplasm systems (Boehringer *et al.* 2003a). Boehringer *et al.* (2003a) suggested that group nurseries is a more efficient pathway in particular in high density population areas and inferred that group nurseries have lower production capacity than individual nurseries due to a trade-off between the building-up of social capital (knowledge and networking within and between groups) and the production of natural capital (seedlings).

The findings in our study indicate that there is not a direct and positive relationship between the proportion of group nurseries and population density. While the distribution of private versus group nurseries between districts were significantly different, in Chikwawa district (with a low population density) the proportions of individual and group nurseries relationship is 13.9, while in the other districts the relationship varies between 0.7 and 1.9 with an average of all districts of 1.6 (see Figure 1 and Benson 2002). The influence of supporting organisations may generally be a more decisive factor for the choice between individual and group nurseries, than scarce resources and high population density. Our study found that NGOs and other projects preferentially support group nurseries and the support from NGOs is particularly strong in the district with highest proportion of group nurseries.

In our study, groups produced more seedlings than individual nurseries. This result is found in all the six districts and is statistically significant. With respect to the argument of a trade off between building natural and social capital, we found – in contrast to Boehringer *et al.* (2003a), that group nurseries had higher productivity of plants and we infer that there is no trade-off and prefer the explanation that the higher productivity is a consequence of the greater project resources available to group nurseries.

Boehringer *et al.* (2003 a) finds that tree seedlings in their study area were produced primarily for own use and not for sale. This is also the case for

our study. However, around a third of our nurseries have intentions of selling seedlings and they actually sell seed, in particular to private buyers and to a lesser extent to organisations.

The relative ranking of problems faced by nurseries corresponds remarkably well with a similar ranking of Boehringer *et al.* (2003b, Table 1, page 206) - most problems are identical and have fairly similar ranking. The only major difference is for 'no problem', which is ranked first in that study, but is ranked 7 in our study (Table 18) . In both studies "lack of markets" is ranked very low, which may not only reflect a genuine lack of interest, but it could also reflect the supply orientation of most supporting organisations (leaving no room for development of markets). Our survey indicates that there is a potential for supporting these small scale entrepreneurs by enabling and supporting the development of a market. The current support to nurseries in Malawi is, however, mainly technical and through supply of inputs. There is very little support to distribution.

Our conclusion of the comparison of this study with that of Boehringer *et al.* (2003a and b) is that the concepts of natural, human and social capital should be seen in a wider context of the seed and seedling sector as a whole and not in the context of a project sphere of how nurseries develop with seed provided by projects. While we agree that natural, human and social capital is required for development of the sector, we would include the seed production and procurement in the natural and human capital and development of business and networking skills as part of the social capital for seed and seedling provision to customers (farmers).

The hypotheses revisited

In light of the overall objective and the four hypotheses advanced in section 2.1, the following are preliminary conclusions on the hypotheses:

- There is no strategy or support to set-up independent structures to deliver tree seed and seedlings, and no or minimal consideration for the sustainability of the tree seed and seedling delivery after the project/ program has ended

The nurseries in the study are potentially the main agents for developing efficient market based seed and seedling production and distribution chains in Malawi. The majority of nurseries have received support for establishment; in particular group nurseries have been favoured by NGOs. Most of the nurseries have private customers, but the main objective of almost all nurseries is to provide seed for own use. The problems and constraints faced by nurseries indicate that the flow of technical information to the nurseries is inadequate, but also there is no support for increasing sales and incomes from nurseries.

A majority of the nurseries are supported with seed by the Department of Forest and in many districts NGOs and Agriculture Department also support with seed, but availability was the main reason why people were presently not raising species that they would like to raise (Table 24). The most

used species are characterised by being easily accessible, indicating that there is a lack of good seed sources for a more complete range of useful agroforestry species. This finding is in accord with the findings where it was shown that a large proportion of species was collected by nurseries (Table 16), and could indicate that the offer of species from organizations is rather limited. It also indicates that market mechanisms may not be active in the seed market, but is supply driven by organizations.

A reasonable conclusion is therefore that efficient production and distribution chains that can market a variety of suitable species to local areas do not exist in Malawi and that helping organisations are not helping to increase the efficiency of production and distribution chains. The hypothesis therefore cannot be rejected that there is no strategy or support to set-up independent structures to deliver tree seed, and no or minimal consideration for the sustainability of the tree seed delivery after the project/program has ended.

Table 30 provides shows a rough estimation of the production of seedlings by nurseries in the districts (based on average Figures). The Table shows that the production is considerable – even at the current low level of support.

Table 30. Estimates of overall seedling production

	% Individual nurseries	% Group nurseries	Mean size Individua; nurs eries	Mean size group nurseries	Tot Ind. Nurseries	Tot group nurseries	# Nurseries per district	Average Total production of surveyed nurs by district	Estimated Total production in districts
Chikwawa	6.7	93.3	2,490	12,181	10,010	681,892	218	691,902	2,513,911
Mwanza	41.6	58.3	583	3,522	14,552	123,200	71	137,751	163,006
Blantyre	53.3	46.7	3,352	5,360	107,197	150,187	213	257,384	913,714
Lilongwe	35.0	65.0	1,068	5,947	22,428	231,933	1,177	254,361	4,989,715
Salima	40.0	60.0	1,470	2,721	35,280	97,956	111	133,236	246,487
Nkhata Bay	58.4	41.7	438	1,852	15,348	46,337	145	61,685	149,071
					204,814	1,331,505	1,935	1,536,319	8,975,903

- *No or minimal consideration is given to genetic quality*

The study does not provide direct evidence of what consideration nurseries and organisations give to genetic quality. The most used species (Table 11) does indicate that availability is the main criterion for collection and that seed is collected from whatever is available.

The case studies (Mvula *et al.*, 2006) provide a strong indication that own collections by nurseries is mostly from one or a few trees (they have economical reasons for collecting from as few trees as possible). Most collection is done locally and to the extent that seedling are planted in the same environment (locally) there is no major risk of mis-match between collection and planting sites.

The study did not attempt to get direct information on genetic concerns of

the organisations that provide seed to nurseries, but the most used species indicate that the seed from these species was originally collected on public land and farmland. Pedersen and Chirwa (2005) indicate that many organisations often collect seed through communities and local seed collectors. Pedersen and Chirwa (2005) also conclude from interviews with 25 major stakeholders[5] in Malawi that genetic quality within species was of virtually no concern among those interviewed. The larger quantities of seed collected by organisations will for most species ensure that seed is collected from a large number of mother trees (one of the requirements of good genetic quality). The species-site matching could, however, be a problem if seed is transported long distances from collection site to planting site[6].

The hypothesis that no or minimal considerations are given to genetic quality cannot be rejected

- *A very limited number of species is promoted and/or used.*

A total of 76 species were grown in the six districts, while in individual districts the total varies from 24 species in Salima to 52 species in Blantyre. The species abundance curves per district show a few dominant species with a long tail of rarer species. Many species occur only in one or a few districts, while the most common species are shared in all districts. The hypothesis cannot be confirmed with respect to total number of species.

- *No thorough analysis is done to establish the species with the highest potential benefit locally.*

It appears that organisations are proposing the same species across districts and there are few indications that the potential for tailoring species to different environments and markets is utilised by the supporting organisations. The hypothesis that no thorough analysis is done to establish the species with the highest potential cannot be rejected.

5 NGOs, GOs, commercial and semi-commercial companies and other stakeholders.

6 The authors do not agree with the interpretation of species-site matching that is discussed in Pedersen and Chirwa (2005)

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Correspondingly some of the main issues in support to farmers are the organisation of nursery production (centralised versus decentralised) and how seed and nursery production should be subsidized (Murray and Bannister, 2004; Boehringer *et al.*, 2004a; Boehringer *et al.*, 2004b, Aalbæk, 2001; Shanks and Carter, 1994; Andreasen and Boland, 1996).

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6. Appendix I Questionnaire

FOREST RESEARCH INSTITUTE OF MALAWI

Assessment of Seed Production and Distribution in Malawi

Introduction: This questionnaire is for understanding how nurseries operate with respect to seed, activities and market potential of plants.

PART A: IDENTIFICATION

Item	Code
District	
Site Name	
Name of Nursery	
Name of Interviewer	
Date of Interview (Day, Month, Year)	2003
Name of Respondent	
Sex of Respondent 1 = Male 2 = Female	
Status of Respondent 1 = Owner 2 = Employee, 3 = Relation 4 = Chair person of the group/Group member, 5 = Government employee, 6 = other	
Sex of Owner (if different from above) 1 = Male 2 = Female 3 = Group	
Highest Education of Owner 1 = No education 2 = Std 1 - 5, 3 = Std 6 – 8, 4 = Form 1 - 4, 5 = Higher	
GPS Coordinates Latitude S Longitude E Altitude m.a.s.l.	

NURSERY DETAILS

1. Type of nursery: 1. Individual, 2. Group, 3. Other (Specify) _____
2. Size of nursery (*Number of seedlings*) _____
3. Owner of land 1 = Owner, 2 = Borrowed, 3 = Rented, 4 = Other (Specify) _____
4. Location of Nursery 1 = Dambo, 2 = River banks, 3 = Home yard, 4 = Field, 5 = Other (Specify) _____
5. Number of employees/People working in the nursery _____
6. Who started this nursery? 1 = Self, 2 = Parents, 3 = InterAide 4=MASAF 5=CADECOM 6=World Vision 7=CPAR 8=WLS 9=ELDP 10= NASFAM 11=ICRAFT 12= MEET 13= Land resource centre 14=Government Department, 15= Other (Specify)_____
   _____
7. When was this nursery started (Year)? _____
8. Why was this nursery started? 1 = Provide own seedlings, 2 = Selling, 3 = Other (Specify) _____ (Multiple answers)
9. How was this nursery started? 1 = Own capital, 2 = Loan, 3 = Gift, 4 = Other (Specify) _____(Multiple answers)
10. Who assisted in establishing this nursery? 1 = Friends/Neighbours, 2 = InterAide 3=MA SAF 4=CADECOM 5=World Vision 6=CPAR 7=WLS 8=ELDP 9=NASFAM 10= ICRAF 11= MEET 12=Land Resource centre 13 = Forest Department, 14= Agricultural Department, 15=other (Specify) _____

PART B:
ADDRESS THE SECTION TO NURSERIES OWNED BY INDIVIDUALS ONLY

11. Where do you get seeds for your agricultural activities?

Seed	Species	Where from? 1 = Own 2 = Buy 3 = Friends/relations InterAide 4=MASAF 5=CADECOM 6=World Vision 7=CPAR 8=WLS 9=ELDP 10= Government 11 = Other (Specify) _____

12. Age of owner of nursery _____

13. Main livelihood of Nursery Owner

1 = Farming, 2 = Business, 3 = Ganyu on farm, 4 = Off farm Ganyu,

5 = Salaried employment, 6 = Other (Specify) _____

14. Materials of the walls of the main dwelling of the owner of the nursery

1= Earth/Mud, 2 = Sun-Dried Bricks, 3 = Burnt Bricks, 4 = Other (Specify)_____

15. Materials of the floor of the main dwelling of the owner of the nursery

1 = Earth/Mud, 2 = Cement, 3 = Other (Specify)_____

16. Materials of the roof of the main dwelling of the owner of the nursery

1 = Thatch, 2 = Plastic Sheets, 3 = Iron Sheets, 4 = Tiles, 5 = Other (Specify) _____

17. Livestock owned by owner of nursery

Livestock	**#at yr Start**	**#at yr End**	**Purchased/born/gift**	**Sold/Consumed**
Cattle				
Goats				
Sheep				
Pigs				
Chickens				
Pigeons				
Other (Specify) _				

PART C:
SPECIES PRODUCED IN THE CURRENT SEASON AND THEIR SOURCE

18. Species	19. How acquired? 1= From seed, 2 = grafted, 3 = Wildings, 4 = Other vegetative	20. From where 1=Forest 2=Neighbour 3=NGO(specify) 4=Own 5=FRIM/Forest department 6=Agriculture 7=Other (specify)	21. How acquired? 1=Bought, 2=Given 3=Collected (If bought, probe for price)	22. How many plants have you produced this season	23. How do you intend to use the seedlings 1 = Use for own planting, 2 = Gift (to who), 3 = Sale (where, price), 4 = Wont use 5 = Other (Sp.)

24. What inputs/Implements did you use in the nursery?	1 = Yes 2 = No (If 2 go to next line)	25. Where did you get them?	26. How did you acquire these? 1 = Bought 2, = Gift, 3= collected locally, 4 = locally made, 5= Household items
Poly Bags			
Chemical Fertilizer			
Pesticides			
Hoes			
Watering canes			
Wheelbarrows			
Shovels			
Panga Knife			
Other (Specify)_____			

27. What species are you planning to produce in the next season?
28. What problems and constraints do you face in your nursery?
    1 = None, 2 = Pests on seedlings, 3 = Scarcity of water, 4 = Lack of adequate nursery space, 5 = Damage by livestock, 6 = Lack of information/Guidance, 7 = Limited tree seed, 8 = High labour demand, 9 = Transporting seedlings, 10 = Lack of market for seedlings, 11 = Theft, 12 = Other (Specify)_____
29. Which one is the most pressing? _____
30. Who gives you support in your nursery business?
    1 = Nobody, 2 = other farmers, 3 = Extension staff agriculture, 4= Extension staff Forest, 5= Interaide, 6=MASAF , 7=CADECOM, 8=World Vision, 9=CPAR, 10=WLS, 11=ELDP, 12=NASFAM, 13= ICRAF, 14= MEET, 15=Land Resource centre,

16 = Other (Specify) _____

31. What kind of support do you get?
    1= Technical 2= Inputs 3= Distribution 4= Other (specify)
32. If sometimes you sell who are your customers?
    1 = Private , 2 = InterAide, 3=MASAF, 4=CADECOM, 5=World Vision, 6=CPAR,
    7=WLS, 8=ELDP, 9=NASFAM, 10= ICRAF, 11= MEET, 12=Land Resource centre,
    13 =Projects, 14 = Forestry Department, 15= Agricultural Department,
    16= Other (Specify)_____
33. Which one of the above is your biggest customer? _____
34. How far do most of your customers come from? (Distance in kilometres/ hours by foot)
    KM _____, HRS _____
35. What species would you like to produce in the nursery i.e. species that you would like to produce but cannot do so now?

Species	**36. Why can't you produce them?**	**37. Why would you like to produce the species?**

38. Do you have contact with other nurseries? 1 = Yes 2 = No (If 2 go to Q 40)
39. If yes, could you please tell me the advantages of being in contact with other nurseries?
    1= Help each other in finding market, 2= Getting new information/guidance/knowledge,
    3=Self exposure, 4= Exchanging seed 5= Other (specify)_____
40. If no, why are you not in contact?
    1= Lack of information about other nurseries, 2= Too busy,
    3=Other specify _____
41. Where did you learn the skills of running a nursery?
    1 = Local knowledge 2 = Formal education (where & Institution training) _____,
    3 = Informal where)_____ 4 = Radio, 5 = Reading (what)_____,
    6= Learn from others, 7 = Special program, 8 = other (Specify) _____
42. Are there any techniques that you would like to learn (for the nursery work)?
    1 = Yes 2 = No
43. If yes, what skills?
    1= Seed collection, 2= Distribution, 3= Tree propagation techniques,
    4 = Pricking Out techniques, 5= other specify_____
44. Do you have contact with organisations working with tree seed and seedlings?
    1 = Yes 2 = N0 (If no go to Q45)
45. If yes, what organization?
    1 = InterAide, 2=MASAF, 3=CADECOM, 4=World Vision, 5=CPAR, 6=WLS, 7=ELDP,
    8= NASFAM, 9= ICRAF, 10= MEET 11= Land Resource Centre, 12 =WLS, 9= Forestry
    Department, 10= Agriculture Department, 11= Other (specify)_____
46. Do you have additional comments regarding the business of seed production and distribu
    tion?_____

Thank you very much for the time and collaboration that you have given me

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