Forest Resources Management and Conservation Programme

EFD Project No. 8 ACP UG 030

Tree Improvement for Timber Plantations in Uganda

By Alan Pottinger
2003

Table of Contents

Acknowledgements

I would like to thank Paul Jacovelli and all of the staff at the Forest Resources Management and Conservation Programme and the National Tree Seed Centre for their time, generosity and support towards this consultancy.

Terms of Reference

TITLE: Tree Improvement for Timber Plantations

DURATION: 20 professional days.

TIMING: March – May 2003.

LOCATION: Based in Kampala, Uganda but with extensive travel throughout the country.

BACKGROUND: Although the Forestry department successfully established plantations in Uganda in the late 60s and early 70s, many of the best stands have been harvested. There are still remaining, however, some good 'mother trees' that could provide genetic material for future plantations. A major constraint is that *Pinus caribaea* appears to be a shy seeder in Uganda and efforts to vegetatively propagate cuttings have not been very successful. With the Forest Resources Management and Conservation Programme (FRMCP) embarking on a new wave of plantation development, including promoting the private sector, there is a desperate need for good quality planting materials of the main species, particularly *Pinus caribaea, P. oocarpa* and *Eucalyptus grandis*.

OBJECTIVES:

1. To identify, preserve and multiply superior genotypes of the main plantation species in Uganda.
2. To identify the most suitable sources of seed to support Uganda's planned plantation development programme.

SPECIFIC TASKS:

(i) To identify suitable sources of genetic material within existing plantations in Uganda.

(ii) To draw up short and long-term plans for the FRMCP with regard to seed supply – including the creation of seed stands, seed orchards and/or the importation of seed.

(iii) To review the potential of the National Tree Seed Centre to provide quality seed to support the planned plantation development in Uganda for the next 5-years.

(iv) To review the FRMCP's attempts at grafting Pines and conduct practical training sessions to demonstrate optimal techniques.

REPORTING: The consultant shall provide a summary of the key findings and recommendations in debriefing meeting at the Forestry Department Headquarters. Thereafter, the consultant shall provide a draft report to LTS that needs to reach the EC / Uganda Programme Coordinator within 14 days of the Consultant's departure from Uganda. The Programme Coordinator shall provide comments on the draft report within 7 days of receiving it. The Consultant shall then submit the final report via LTS to the Programme Coordinator within 7 days of receiving the comments. The Contracting Authority shall take a decision on the final draft and associated documents within 2 weeks of the Programme Coordinator receiving it. If no comment is received within this period, the report shall be deemed approved.

Executive summary

The state of tree improvement in the plantation sector in Uganda is extremely poor. There has been no significant tree improvement since the 1970s, there are no adequately trained staff, and there is no tree improvement strategy. The genetic resource of the country has been damaged by years of civil unrest and inactivity in the forestry sector. This has resulted in a resource that is unclear in nature, untested and insecure. The continuing degradation of the genetic resources in Uganda's plantations is indicative of a lack of planning for the future and has left the forestry sector dependent upon the importation of seed from abroad.

A tree improvement strategy is suggested that will provide a robust, cost effective means of addressing the problems facing the plantation sector in terms of securing seed and seedlings of high genetic quality. It is recommended that a Tree Improvement Steering Group is established, consisting of all relevant stakeholders in Uganda, which will oversee the work of the new post of Tree Improvement Specialist. This post is designed to initiate the early stages of the tree improvement strategy and will focus on the conservation of exitising genetic resources, and the establishment of tests and seed orchards. Due to the lack of technical expertise within Uganda in tree improvement it is suggested that a partnership is created with an organisation within Africa that has relevant experience. A suggestion is made of who this might be and how such an arrangement could work.

Key issues to address include securing the future of the National Tree Seed Centre, promoting the status of research in the NFA and improving the level of staff expertise in tree improvement.

It would be imprudent and inaccurate to suggest that there is an easy or quick solution to rectifying years of inactivity in tree improvement in Uganda. The situation is extremely serious and a clear commitment to supporting a new strategy and the associated staff positions is urgently required.

1. Tree improvement in Uganda

1.1. Background

1.1.1. The importance of tree improvement

Tree improvement is the cornerstone of forestry. Without access to good genetic stock there is no possibility to optimise timber production, regardless of the quality of subsequent silvicultural management. Many forestry programmes recognise this and invest in tree improvement activities, but many don't and suffer the consequences of poor growth and form in their growing stock.

The range of activities associated with tree improvement can seem endless, expensive and necessitate specialist experience, but in reality this is no different from any other area of forestry. All sectors have their own specialists and have their own unique activities. The difference between tree improvement and many other forestry sectors is that the consequences of failure to invest are not always immediately obvious. Poor quality growing stock can be attributed to many causes, and is often the result of interacting forces, but the fact that we can't *see* the genetic make-up of a tree means that attribution of blame frequently falls at the feet of areas of forest management other than tree improvement.

In any country, in any situation, if the plantation growing stock is to be improved significant attention needs to be paid to its genetic constitution. This entails careful management through a clearly defined tree improvement strategy.

1.1.2. What has been done and sources of information

Uganda's recent history has resulted in a decline in its forest management expertise and record keeping which while not unique in its pattern is more severe than almost anywhere else. The journey from forest management techniques employed by a colonial power, through post-colonial stability and then civil disturbance is a common one. However, in Uganda's case the results from a forestry perspective have been catastrophic not only in the degree of damage inflicted on the forests and forest service, but, more surprisingly, in the time it has taken to address these problems. It is striking that there has been virtually no significant tree improvement activity since the end of the Civil War in 1986.

Access to reliable reports on any aspect of tree improvement either pre- or post- civil disturbance is extremely difficult. Not only is there no central office of records, but neither is there any record of what reports were written, or where they might be. The current lack of staff in the Forest Department with any experience of tree improvement in Uganda only serves to compound the problem.

1.2. Where we are today: consequences and implications

1.2.1. Summary of state of tree improvement in Uganda

A summary of the state of tree improvement in Uganda in 2003 is as follows:

- There has been virtually no tree improvement activity since the late 1970s.
- There are no staff within the Forest Department who have experience of tree improvement activity within Uganda prior to the period of civil disturbance that began in 1979.
- There are no current staff within the Forest Department with a significant level of tree improvement expertise gained from anywhere else.
- Many records of tree improvement activities have been destroyed and dispersed with the result that the information base is:
    - Likely to be poor.
    - Unclear in terms of both content and location.

The combination of virtually no tree improvement activities having been carried out over such a long period of time, the poor level of access to useful records and low levels of staff expertise is unusual and has created a void in genetic improvement of the plantation growing stock that should be starkly apparent to any forester.

1.2.2. Lack of silvicultural management and its implications

The area where the lack of silvicultural management over the past 20 years or so has had greatest impact on tree improvement activities is in Seed Production Areas (SPAs), and plantations which could have been designated as such. In most plantations there has been a complete absence of silvicultural thinning with the result that the best phenotypes were not identified at the appropriate time for conservation and potential introduction into tree breeding activities. This has meant that not only is it now virtually impossible to make meaningful plus tree selections (see Section 1.2.3.1.) but also the lack of thinning has resulted in small crowns thereby reducing the potential for seed production.

1.2.3. Lack of tree improvement activity and its implications

1.2.3.1. Problems with plus tree selection

Plus tree selection is based on the comparison of the phenotypic qualities of a tree with its immediate neighbours. Ideally it should take place in an environment that mimics the likely management regime that will be used in the plantation. This generally means that plus tree selection should take the absence of significant competition between trees. Unfortunately, the lack of both silvicultural and tree improvement activity in Uganda's has resulted in overstocked plantations, many of which have been creamed of their best specimens. The result is that environmental pressures have been able to exert an undesirable influence over genotypic expression thereby compromising the potential to carry out meaningful plus tree selection. In other words, it has become increasingly difficult to determine whether the growth habit of a tree is due to its genetic potential or the fact that it has been growing in an overcrowded plantation.

In a normal situation this would mean that such trees and plantations would simply be excluded from plus tree selection programmes. However, the implication in Uganda is quite different. With no tree improvement infrastructure of seed orchards, SPAs and clone banks and no significant areas of well managed plantations from which to make 'normal' plus tree selections the question is whether or not there is any justification to carry out plus tree selection at all.

1.2.3.2. Problems with SPA designation

In a normal tree improvement programme it is common to designate certain areas of either natural forest or plantation as SPAs. This is a broad term that covers any significant area of mature or semi-mature trees (in terms of rotation length) which is considered to be of good or important genetic quality and to which minimal silvicultural treatment is applied. SPAs are frequently areas of an important provenance which have been silviculturally thinned.

Although SPAs have the disadvantage that the trees are not selected intensively they are a useful way of producing large amounts of seed without large investments and as such play a valuable role in many tree improvement programmes. The need in Uganda for production of large amounts of seed of proven performance would tend to suggest the employment of large areas of SPAs. However, the lack of information on seed source in many cases coupled with poor silvicultural management has severely compromised the potential to employ SPAs.

Although previous activities in the 1990s (reported by Namuyangu, 2000) see ref page – is this an FD report? had assessed the complete plantation resource for SPAs, and identified SPAs (see table below), it is clear that most sources are insecure. [It is unclear how they calculated seed production (not shown below).] Furthermore, it is recognized that the lack of silvicultural thinning, and their age (around 30 years) is likely to severely limit their seed production capability.

Table heading?

Species	Location	Size (ha)	Protection status
Pinus caribaea	Wampanga Cpt W-2 Hoima	0.656	Not well protected
Pinus caribaea	Namasiga Forest Reserve Eastern Block Jinja	0.05	Not well protected
Pinus caribaea	Katugo pine plantation Cpt 5 Nakasongola	0.02	Not well protected
Pinus caribaea	Pigire Forest Reserve Soroti	0.6	Not well protected
Pinus caribaea	Katugo pine plantation Nakasongola	6.7	Well protected
Pinus caribaea	Kabindo Forest Reserve Kiboga	0.1	Well protected
Pinus oocarpa	Pigire Forest Reserve Soroti	0.5	Not well protected

Pinus oocarpa	Wampanga M-4B Hoima	0.11	Not well protected
Pinus oocarpa	Lendu Forest Reserve Nebbi	1.00	Well protected
Pinus oocarpa	Namisaga Forest Reserve Western Block Jinja	0.02	Not well protected
Pinus oocarpa	Rwoho pine plantation Cpt 6 Mbarara	0.01	Not well protected

Musiimo-Byenkya (in prep) reports the on-going attempts to identify potential SPAs from within existing stands in Uganda and to identify an adequate management plan. While this is an activity that is worth supporting as a means of utilizing the existing genetic resource it assumes that both seed production and the genetic quality of the SPAs will be acceptable.

While it is likely that the genetic quality may be relatively poor it is suggested that the establishment of SPAs proceeds in order to provide seed to meet immediate needs. At the same time this seed should be tested, along with other sources (namely from Queensland and Central America).

In view of the limitations listed above it is not possible to be certain that expenditure on any further activity in conservation, seed collection and testing of seed from the current plantation resource is cost effective. However, it is felt appropriate to continue with these activities because it is the only tree improvement activity currently underway and it is important to support the initiative in order to maintain moral, keep active and expand the skills experience of the staff.

The potential danger of pursuing these activities should be mitigated against by limiting the use of this seed in the plantation programme until test results reveal its value. Such results should be available within about 4 years.

The uncertainty surrounding potential seed production from such stands, particularly their response to thinning, emphasizes the need to carry out observations of phenology, seed production and seed quality. The value of further activity in designation of these mature SPAs is dependent upon results from these studies.

1.2.4. Lack of trained staff and its implications

1.2.4.1. *Current level of staff expertise in tree improvement*

The lack of availability of suitably trained staff to carry out tree improvement activities is a significant obstacle to making progress in this area. There are no employees within either the Forest Department or the FRMCP who have either significant formal tree improvement training or experience of tree improvement activities on the ground in Uganda.

The information, skills and experience in tree improvement in Uganda that may be of use to a state supported tree improvement programme appear to lie in the hands of the following three people:

- The key source of knowledge and experience on matters of tree improvement in Uganda is an ex-Forest Department employee, **Mr Peter Karani.** Mr Karani was the most senior tree breeder in Uganda in the 1970s and 1980s and has first hand experience of tree improvement activities carried out throughout the country. His knowledge has been sought by the FRMCP on several occasions through his employment at a freelance consultant.

  There is a worrying reliance on Mr Karani's continued involvement with tree improvement matters in Uganda and no account appears to have been taken of the eventual lack of information that will be available from that source.

- The only person at the National Tree Seed Centre who any tree improvement training who is currently involved in associated activities on behalf of the state is **Mr Musimon Byewingi** (Deputy Manager of the National Tree Seed Centre) who undertook a 3-month training course with the Danida Forest Tree Seed Centre (DFSC), in Denmark, several years ago. Mr Byewingi's training is basic and he would be the first to acknowledge its limitations when considering a significant expansion of tree improvement activities in Uganda.

  Several of Mr Byewingi's colleagues who were also trained at DFSC have since left state employment to provide seed and seedlings to the private sector.

- **Mr Francis Esegu** (Director of the Forest Research Institute – FORRI) is the only person working within the state forestry sector who holds a higher degree in Forest Genetics and Tree Breeding. However, Mr Esegu has not been involved to a significant degree with development of tree improvement activities within either the Forest Department or the FRMCP.

1.2.4.2. The implications of the current level of staff expertise

It should not be necessary to state the seriousness of the present lack of skills in tree improvement. While it is not the objective of this report to examine in great detail the historical reasons for the current state of affairs it is nonetheless staggering that the Forest Department could have allowed tree improvement expertise to disappear.

It should also be obvious that the current state of staffing is well below the critical mass required to attempt to run any meaningful tree improvement programme. Without a serious attempt to improve the level of expertise of staff either through training or recruitment there is no possibility of carrying out the required tree improvement activities to support the new National Forest Authority (NFA).

1.2.5. <u>Lack of tree improvement strategy and its implications</u>

A strategy for tree improvement is required in order to carry out a coherent range of activities to support the plantation sector. Tree improvement, like silviculture, relies on a series of interlinked activities to take place in order to fulfil its potential. Without a plan of activities and a programme of when they will take place it is impossible to imagine how tree improvement can make a significant impact on the current poor state of the plantation sector in Uganda.

2. A tree improvement strategy for Uganda

2.1. Objectives of a tree improvement strategy

A tree improvement strategy is designed to provide access to planting material of improved genetic quality. That quality is evaluated as part of the programme of activities. Figure 1 outlines the steps involved in a basic tree improvement strategy suitable for Uganda and indicates the current status of activities. Before discussing the programme in detail the following major points should be recognised:

- Research is a key element of a tree improvement strategy.
- Preliminary steps have already been completed.
- Many further steps need to be undertaken in order to supply seed to the 2nd generation plantation programme.

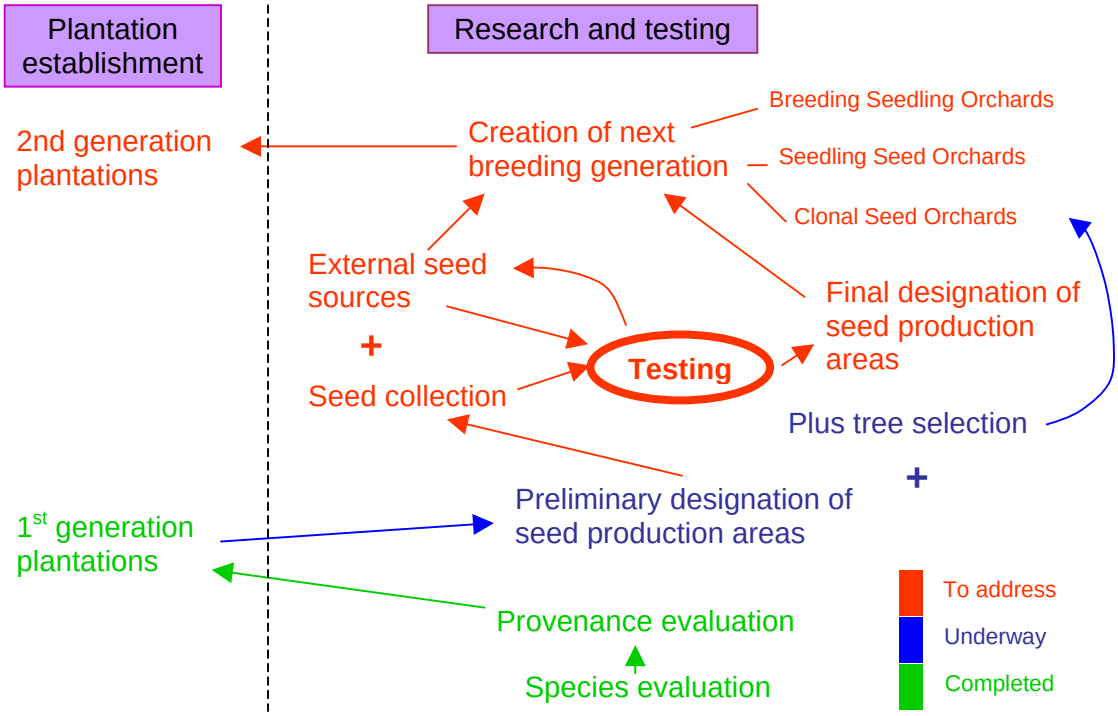

FIGURE 1 *Outline of the elements of a basic tree improvement strategy with reference to activities in Uganda*

2.2 Tree improvement in Uganda to date

Species selection trials carried out in the middle of the last century indicated the value of the current major plantation species *Pinus caribaea* var. *hondurensis*, *Pinus oocarpa* and *Eucalyptus grandis*. Provenance evaluation trials carried out mainly in the 1960s and 70s provided indications of the best performing provenances within those species, and this provided the basis for seed supply from exotic sources for the 1st generation of plantations of those species*. This

approach to species and provenance evaluation remains the classic approach to determining the appropriate source of planting material for plantation establishment and the activities carried out in Uganda provided a strong basis for future activities. Normally, such activities would have followed immediately as part of an on-going programme of improvement and establishment of national capability in seed production. However, internal civil unrest which began in 1979 resulted in an almost complete cessation of all aspects of tree improvement which, despite the establishment of political stability in 1986, has largely remained the case until the past two years.

*Could you include here a summary of your recommendations of the most likely species/provenances from the OFI/Ugandan trials? Pat Hardcastle and I drew up a list of likely pines from:

- P. caribaea (Queensland and C. America – provs?)
- P. oocarpa (prov?)
- P. tec (MPL, Yucul and Malawi S.O.)
- P. Patula (RSA S.O.?)
- P. kesiya (prov?)
- P. taeda (prov?)

I will forward you a copy of Pat's report.

2.3 A strategy for the future

The lost years have not only caused a delay in the development of a tree improvement programme but have led to damage of the genetic resource through uncontrolled extraction of some of the best trees. Furthermore, for reasons described above the lack of silvicultural activity has had a negative rather than simply a neutral effect on the ability to assess the current genetic resource. To make matters worse, the destruction of records and loss of staff from the Forest Department have contributed to the virtual non-existence of any tree improvement activity or expertise. The challenge facing Uganda is therefore not simply one of picking up from where things were left, but trying to salvage what is useful while at the same time attempting to establish a completely new team and a new genetic resource to serve the plantation programme. The basic strategy illustrated above is designed to do this by using simple, cost effective techniques that will utilise the facilities currently available. The approach recommended is deliberately low-tec but should provide a strong strategic base for future seed production for both national, and potentially international, sale.

2.4 Key components of the strategy

2.4.1 Preliminary designation of seed production areas (SPAs)

Due to the problems listed in Section 1.2.3.2 it could be argued that SPAs should not be considered part of the tree improvement strategy, and would therefore not form a major part of future plans. However, while it is true that the genetic quality of the standing trees is questionable the designation of some areas as SPAs and collection of seed from them is justified on the following grounds:

- They will provide a resource of seed of 'tested' quality (i.e. they can be expected to achieve certain minimum standards).

- They will provide a use for the standing resource and thereby provide valuable experience in SPA management.
- Their use could be seen as a moral boost for staff by illustrating that there are national genetic resources that are of some value.

Identification of stands for conversion to SPAs has already begun under the guidance of Mr Byewingi to the satisfaction of the consultant and this programme should continue.

2.4.2 Plus tree selection

Plus tree selection is a major component of most tree improvement strategies and is a means of identifying trees with superior phenotypes for testing and incorporation into breeding programmes. The depletion of genetic resources referred to in Section 1.2.3.1 has limited the scope for incorporation of the best individual trees into the programme but nonetheless there are superior trees that merit selection and this process has already started following training provided by Mr Karani. It is strongly recommended that this programme is continued. However, it is important to remember that plus tree selection is a means to an end, and not simply a means in itself. In other words plans must be made for incorporation of the trees into the improvement programme.

Plus trees can contribute to tree improvement efforts in the following three main ways:

- Collection of scions for establishment in a clone bank or clonal orchard.
- Collection of seed for testing.
- Collection of seed for contribution to a seed orchard.

Scion collection is an important way of securing genotypes and has added relevance in any country, such as Uganda, where uncontrolled logging may occur. As such it is important to develop skills in scion collection and establishment of grafted trees (ortets). A grafting practical class was undertaken by several Forest Department staff in order to develop skills and discuss key issues relevant to grafting success. Initial steps were taken during the consultancy to identify possible causes for the lack of grafting success experienced in recent years by Forest Department. Although discussions suggested that staff lacked experience in post-grafting care no clear cause was evident. It is recommended that staff continue to practice the technique of grafting and post-grafting care of ortets and keep clear records of health of the ortets[1].

[1] Grafting is a fairly straightforward process and success of 80-100% should be expected from the pine scions taken. The key to improving success is practice, recording health of ortets and experimentation with techniques. The best manual to provide information on vegetative propagation is 'Vegetative Tree Propagation in Agroforestry' produced by the World Agroforestry Centre. It is available free of charge from their website at

Once established, ortets should be established in clone banks with the primary objective of conservation of the genotypes of the trees. Although it is tempting to create clonal seed orchards from these ortets this should be avoided in the early stages of the tree improvement programme as the absence of test results of their progeny would limit their value.

In order to gain an indication of the true value of plus trees it is necessary to test their progeny (in this case open pollinated or half-sib) against others. This can be achieved either in a test designed specifically for this purpose or a Breeding Seedling Orchard (BSO) which is a specially designed test that allows evaluation of several families followed by thinning of the weaker families in order to create a seed orchard. The advantage of this approach over conventional testing is that it saves the time normally required to establish a seedling seed orchard.

There is no 'set' number of trees to identify as plus trees. The number included in the tree improvement programme is dependent upon many factors included in the overall strategy, not least the value of the existing genetic resource and will become apparent as the strategy is developed and implemented. However, when discussing the concepts behind designation of 'plus trees' the uncertainty of staff regarding their understanding of the difference between the terms phenotype and genotype, and the importance of environmental influences, highlighted the need for training in some of the basic concepts of tree improvement.

2.4.3 External seed sources

Following the recognition of a shortfall in seed of known and acceptable genetic quality, the FRMCP began importing seed of *Pinus caribaea* var. *hondurensis* from Queensland, Australia. Communication between the consultant and the seed producers in Australia in order to determine the suitability of such seed for Ugandan conditions has not yet revealed adequate test results. It is hoped that such information will be forthcoming shortly. Presumably this can now be updated with recent information. However, early indications of growth from the seed when established in Uganda are promising in terms of both form and vigour, particularly when compared to growth of similar aged trees from seed collected from within Uganda.

Although one of the objectives of the tree improvement strategy will be to enable Uganda to be self-sufficient in seed of plantation species, this situation is a long way off. Until then there is an immediate need to provide seed and seedlings of high genetic quality to meet the needs of the expected rapid expansion of the plantation programme. In order to meet these needs it is therefore likely that seed importation will have to continue in the foreseeable future.[2]

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http://www.worldagroforestrycentre.org/newsitem.asp?NewsItemId=81 can't download from web-site (comes up with error message) but will follow up with WAC

[2] The decision on where such seed should come from will be determined in part by information on performance to be provided by the seed supplier.

2.4.4 Testing

Testing, or evaluation, is the central point around which a tree improvement programme operates. It is only through this research element that information on performance can be obtained, verified and used to create the next generation of seed for the plantation programme. Simply collecting, or purchasing seed, for sale to plantation investors does not constitute a tree improvement programme.

Staff must be trained and land made available for the establishment of field trials that will enable comparisons of performance between different seed sources. The exact composition of experiments, their number and design can only be determined once the tree improvement strategy has been approved in principle and finalised in detail, but they should contain 'families' (i.e. open pollinated seed) from all of the potential sources of seed (i.e. seed collected within Uganda – from SPAs and Plus Trees, and seed purchased from outside the country).

The design of trials should be basic and robust. More specific recommendations (e.g. min. 5x5 tree plots with buffer surround?). Two approaches to design and evaluation are possible; traditional field trials and BSOs, as described above in 2.4.2. The advantages of BSOs in terms of efficiency are clear but they require a higher level of skill in their establishment and management if they are to fulfil their potential. The choice between approaches will depend largely on the approach to training and further external input determined by the tree improvement programme. The recommendation of this report is that staff with experience in BSO establishment and management are engaged as part of the overall training package of Ugandan tree improvement staff. Although BSOs are not widely employed this is due more to the slow rate of change in forestry research than any inherent problems with the approach.

The trials should be located throughout the country to take account of the different environmental conditions encountered by the plantations. The location, and number, will be determined by the location of plantations and variation in site types.

2.4.5 Creation of the next breeding generation

The objective of testing and elimination of the poorest families is to create the breeding population that will supply the next generation of trees for the plantation programme. The location of the breeding populations will be determined either by the location of the BSOs (if this is the approach taken to testing) or established on sites specifically selected by tree improvement staff for their seed production capabilities, access and security.

Current pine seed orchards are listed below:

- 5 ha Kasagara (seed obtained from DFSC (is origin known?), ordered by Rachael Musoke) established in 2000.

- 12 ha at Namasiga planted in 2000, 2001 and more to plant this year.
- 1 ha Nakwaya P2001 PC (seed from Gulu – no other information available on source – this stand was managed as a research plot and had been thinned to 100trees)

Seed orchard design is something that NTSC staff appear to understand only from documents, and they freely admit to needing help. Interestingly, the report by Musiimo-Byenkya (in prep) states the correct approach to SO establishment but the SOs established prior to his arrival (Nov 2002) show the lack of appreciation of basic principles of pollination (e.g. the SO at Namasiga is located on a hill, has blocks as strips rather than squares, and the blocks of provenances of the same species are too close together. The SO at Kasagala also appears to have been planted as strips rather than blocks).

2.5 Proposed tree improvement strategy

Although it is the intention of this report to provide a clear strategy for tree improvement in Uganda it would be inappropriate, given the lack of existing strategy and the short time permitted by the consultancy, to do anything other than establish the foundations of a programme. A detailed strategy will only develop following a significant input of time from experienced professionals as outlined in the partnership suggested in Section 4.3.1.

The purpose of this section is therefore to highlight the overall objectives of the strategy and establish priority tasks that can be initiated while the more detailed strategy is being developed. A logical framework approach has deliberately not been employed as this would lead to a false impression of the establishment of firm plans.

2.5.1 Key points in the strategy

The overall **objective** of the strategy should be ***'To conserve, utilise and develop the genetic resources of Uganda's trees for the benefit of the forest plantation sector'.***

The **main activities** should be

- The conservation of existing genetic resources.
- The testing and utilisation of existing generic resources.
- The development of new genetic resources

2.5.2 Key initial activities within the strategy

Within the broad framework outlined above the following are priority tasks that should be initiated as soon as possible:

- Establishment of field tests of seed sources.
- Continuation of plus tree selection and conservation through grafting in clone banks.

- Continuation of designation of SPAs[3], enforcement of their protection, and collection of seed from them.
- Establishment of seed orchards (see 2.5.3)
- Establishment of partnership agreement outlined in 2.4.4

Seed sources should only be introduced into the plantation programme following thorough testing. This is not the case at present, and seed from both Uganda and Australia is being used without any data relating to growth or comparative performance on any site. There is no excuse for not establishing some form of field evaluation of seed sources and this must be given top priority. Simple designs will suffice that are well within the capability of current staff to implement.

An overarching issue that became apparent during the consultancy was the complete absence of a culture of experimentation. It was apparent that questions are not regularly asked by staff regarding biological issues, data are not collected, and experiments are not established. While this might seem an insignificant point it is important because it is essential for staff involved in a tree improvement programme to strive to investigate issues surrounding testing and evaluation of their trees. An enquiring person will identify key issues that need to be investigated while one that is not encouraged to ask questions and seek answers will not assist in optimising the efficiency of the tree improvement programme. It is essential that staff are involved from an early stage in establishing experiments, collecting data and discussing results.

2.5.3 Establishment of seed orchards

In the absence of a programme of vegetative propagation (which is not recommended in the foreseeable future for the Ugandan pine improvement programme[4]), the principle means of delivering germplasm is by production of seed. There are two main sources of seed for this activity at present and two approaches that can be employed.

The sources are:

- Seed collected from trees within Uganda
- Imported seed (currently from Queensland, Australia)

The approaches to multiplication are through the establishment of:

- Seed orchards
- Breeding Seedling Orchards (BSOs)

[3] While staff had been trained to a certain standard in the identification of SPAs, sites for seed orchards, and establishment of seed orchards, there was clearly a lack of certainty surrounding some basic principles and also a necessity for greater knowledge in certain areas. Some discussion and training took place in the field but this is an issue that needs to be addressed as part of the Training Options discussed in Section 4.3.

[4] Vegetative propagation of Eucalyptus species is being addressed by the Tree Biotechnology Project run by FORRI FORRI have not been communicating well with the FD/FRMCP, however., despite obvious benefits for both parties. Their clonal euc. trials seem to be focussed more on agroforestry/community forestry rather than commercial planting.

As indicated above, information on the performance of the seed imported from Queensland when grown in similar situations to Uganda is pending but early indications of performance in Uganda (after 2 years of growth) appear good. If there are no obvious limitations to using this source of seed it is recommended that this continues to be a major component of the seed provision programme until superior seed from within Uganda is available.

Seed is currently being collected from SPAs within Uganda but it generally comprises a bulk collection of seed of uncertain origin. It would be unwise to consider this to be a significant component of the seed provision programme until its performance has been tested. It is therefore a priority to establish field trials on several sites to compare the performance of Ugandan sources against seed from Queensland.

The pros and cons of establishing seed orchards and BSOs has been discussed in 2.4.4 but at this stage it is not possible to consider establishing the latter. There is no clear published manual on the establishment of BSOs that could be used without the input of an experienced tree breeder. However, it is suggested that this could be the principal means of evaluation and seed production if suitable expertise is available thought the partnership arrangement suggested in Section 4.3.1

At this stage, until the quality of the seed collected from the Ugandan SPAs has been assessed it is not possible to consider establishing seed orchards with seed collected from that source. However, it is possible that seed orchards could be established with seed from the Queensland seed and information on the legality of this is pending. If this is permissible, it would become a priority issue and the consultant would provide a suitable design. It would appear from recent communication from DPI that this is not on!

3. The role of research in a tree improvement strategy

3.1. What is the role of research in a tree improvement strategy?

Figure 1 illustrates that a basic tree improvement programme can be seen as a series of tests leading to means of seed production. Unfortunately, too many seed centres and forestry programmes do not consider seriously the need for the former, and simply focus on production and delivery of seed and seedlings. Although focussing solely on the distribution of vast quantities of planting stock may look good in annual reports, without due effort and consideration of the genetic quality of that stock it is simply storing-up problems for the future. A commitment to undertaking the testing and evaluation of genetic resources is therefore essential if there is to be any tree improvement.

3.2. Who should carry it out?

In the current institutional arrangement and staff levels it would appear clear that FORRI should be engaged directly in undertaking research on behalf of the plantation programme. Their Director is the most experienced tree improvement specialist in the state sector and personal communication revealed he is keen for FORRI to play a more prominent role in tree improvement activities. However, in common with FRMCP staff, he feels frustrated at the limited opportunities that have arisen to forge closer collaboration. Such a situation would suggest that if a tree improvement strategy is to be developed and acted upon there needs to be a mechanism to encourage a better relationship between FORRI and the FRMCP/FD/NFA.

In addition, there are other individuals and organisations whose views should be sought when considering research and whose expertise could be utilised. Most prominent amongst these is the National Tree Seed Centre (NTSC) who are charged with providing seed for both the state and private sectors. Others include Makerere University, private industry and NGOs involved with tree planting. We are not confident at all of contracting out research to NTSC and I can't see this changing until the NFA has really been in place a while (2004/5?). The best bet at this stage would be Rwenzori Highlands Tea Co. who have offered to carry out research and are very interested in commercial tree farming.

In order to capitalise upon the interest and skills available it is proposed that a Tree Improvement Steering Group should be formed including all of the partners listed above. (See Section 6.2 for more details).

4. Staff requirements

4.1. Outline of staff requirements

At present there are no appropriate staff to manage and implement a tree improvement programme managed by the state for the purpose of improving the plantation sector. It is proposed that in order to pursue the objectives of the tree improvement strategy outlined above it is necessary to have a minimum of one tree improvement specialist (hereinafter referred to as the TI Specialist), supported by staff capable of carrying out tasks under his/her supervision. Where those tasks require training (e.g. in establishment of experimental trials and seed orchards) it is expected that the TI Specialist will be able to provide such training. This assumption is based on the consultant's assessment of the current level of staff capability (particularly the fact that trained tree climbers are already available).

This recommendation may appear surprisingly basic and is in stark contrast to the staffing levels suggested by NORAD in their evaluation of the NTSC in 2000 (NORAD 2000). However, it is made for the following reasons:

- The immediate needs of the plantation sector and the NFA in terms of tree improvement are to initiate a series of basic activities that will underpin future development. This does not require individuals with higher degrees or many years of tree improvement experience.
- The number of trained staff required to run the programme in the future may increase and the level of expertise needed to manage the programme may be higher than is currently proposed.
- It is important to present a cost-effective programme with targets that are well defined and achievable within a short period. In this regard it is essential to remember that Uganda's immediate tree improvement needs are relatively basic.
- There are no suitably qualified staff within the ranks of the Forest Department or FRMCP and none who would appear to warrant 'fast-tracking' though intensive high level tree improvement training courses.
- The TI Specialist should be trained to a level that will enable him/her to manage the early stages of the outlined strategy. In other words they will have a practical and targeted remit but they will not be expected to have expert knowledge or to be able to produce plans for the medium- or long-term future without further support.

4.2 Suggestion for the position of Tree Improvement specialist

Ideally there would already be within the ranks of the Forest Department or NTSC a fairly young, graduate forester with some background in tree improvement who could be trained to take over the position of TI Specialist with a view to taking the programme forward over the next 10 years. Such an individual does not exist and the potential candidates for the position appear limited. With this in mind, and recognising the desire to recruit within the country, it is suggested that the post of

Tree Improvement Specialist is considered an interim position with the objective of the post being to get the programme started within the next two or three years.[5] After this time it is likely that someone with greater experience and skills would be required to take the programme forward into the next phase of development.

Terms of Reference for the initial post have been suggested (see Appendix). They have been written bearing in mind both the short-term objectives of the programme and also the pool of likely candidates who might be available. They are, accordingly, relatively modest and could be filled by someone with a basic understanding of tree improvement.

A strong candidate for the position would appear to be Mr Musimon Byewingi of the NTSC. Informal discussions held with him would suggest he would be interested in such a position.

4.3 Training options

4.3.1 Forming a partnership

Rather than the traditional approach of employing expensive international consultants to carry out short-term training on an infrequent basis it is proposed that a 'partnership' should be developed with an organisation within Africa that already has relevant tree improvement experience and specialists. The objective of such an approach would be to provide a more cost-effective approach to training and support.

Ideally, the partner would provide training, advice and possibly even germplasm, and would have experience of plantation forestry in similar environments (both physically and politically) to those faced in Uganda. The possibilities to develop such partnerships in Africa are limited due to the general lack of plantation forestry expertise on the continent but three options would appear to present themselves; Zimbabwe, DR Congo and South Africa. All thee countries have strong experience in plantation forestry with the same major timber species as employed in Uganda but the unstable political situation in Zimbabwe and potential language problems in DR Congo would tend to make those options less attractive.

The high reputation of the private sector's involvement in plantation forestry in South Africa coupled with the existing links between MONDI Forests and FORRI in the Tree Biotechnology Project would tend to suggest that MONDI Forests should be approached to discuss such a partnership. It is envisaged that this relationship would have two major components:

- Intensive field training for the Tree Improvement Specialist both in Uganda and South Africa.
- The availability of advice from MONDI staff (through an annual review of the programme in Uganda, and frequent email contact).

[5] It would be expected that this position would be supported through external inputs described in Section 4.

Such an approach would provide the guidance and support needed to the TI Specialist from knowledgeable foresters currently engaged in tree improvement to support existing plantation programmes. It should also provide such information at a more competitive price than employing international consultants.

A tentative approach has already been made to Mondi RSA who have expressed 'interest' (but no more at this stage). We will be following up shortly.

4.3.2 Consultants

Short-term external inputs from tree improvement specialists will be important to the overall development of the capabilities of the NFA to deliver high quality seed for the plantation sector, but such inputs should come from individuals who have a significant commitment to the programme. In this regard it is recommended that consultant inputs are part of a larger programme of collaboration with an existing programme who will act as 'partners' in the development of tree improvement in Uganda (See 4.3.1)

4.3.3 Counterpart

Counterpart training, whereby an individual receives intensive training over a period of usually 6-12 months from a specialist either on placement or within their own organisation, is a common approach to developing skills in long-term partnerships. It may have a role to play in this situation depending on the type of association developed but it is not considered to be the principal means of training that should be employed at the beginning of the partnership.

4.3.4 Training courses

Courses can also offer useful means of developing skills, particularly in a targeted manner. However, the training needs of the TI Specialist in order to establish the programme would be determined to some extent by the level of experience of the post holder. For example, if Mr Byewingi was selected he would not require basic training as he has already undertaken a 3-month training course in forest genetics and seed handling at DFSC. If his appointment was to occur there would be no obvious need for him to attend an external training course in the first nine months or so of the appointment. This time would be better spent getting the programme up and running.

5. The National Tree Seed Centre

The National Tree Seed Centre (NTSC) is a high quality facility that has the potential to play a leading role within a tree improvement strategy for Uganda. However, it is facing challenges to its position from competition from the private sector and lack of support from the Government. The trouble is that it has had huge support from donors but with very little to show for it (other than a very nice building!) Its true value is not realised as it has been judged by inappropriate criteria. If it continues to be undervalued it will not fulfil its potential and, more seriously, the genetic value of trees growing in the plantation sector will be undermined.

Graudal and Kjaer (2000) in their review of national tree seed centres in Africa characterise three types of sustainability; financial, technical and institutional. The NTSC has attained none. It is not financially stable, there is a poor level of technical expertise available and it does not have links with other significant organizations. However, they emphasize that a long term view must be taken when considering the value of tree seed centres and that governments should not make the mistake of looking only at short-term gains.

5.1. Seed supply challenges

5.1.1. Assessment of seed demand

- The key baseline study carried out into seed demand and supply by Kaumi and Esegu (2000) stated that that annual seed demand 'up to 2004' will be (in kg) as stated below:

Species	Private softwood plantations	Compensatory timber plantations
Pinus caribaea	20	80
Pinus oocarpa	10	50
Pinus tecunumanii	5	40

The report concluded that seed collection was undertaken largely by private individuals for use in private nurseries (i.e. it was unregulated) and that 'The NTS Project at present is playing a very minor part in fulfilling seed requirements of the many seed users within the country'. The authors also observed that it is difficult to predict seed yield due to uncertainties of how the Compensatory Timber Plantations project will progress.

They recognized the difficulty in guaranteeing genetic quality from any of the existing SPAs for the reasons listed in Section 1.2.3.2. But it is very interesting that they recommend 'the Commissioner for Forestry should ban use of seed collected locally for use in the establishment of new conifer plantations and replanting harvested areas. All seed required should be bought from the NTSC'. But the seed coming from the NTSC is terrible – and definitely not selected from Plus Trees. We have no confidence in their claims of supplying 'quality seed' I'm afraid. This concurs with this authors views (discussed in Section 5.1.3)

5.1.2. Competition from the private sector

At present the NTSC is competing with private seed suppliers – largely unsuccessfully. The problem facing the NTSC is a disparity in the appreciation of the importance of genetic quality of seed between themselves and their customers. Establishing seed orchards, carrying out tests, and collecting seed from selected sources is an expensive business and this cost is inevitably passed on to customers. The private sector is less concerned with the genetic quality of its seed and therefore does not incur these costs with the result that it can sell seed and seedlings of ostensibly the same quality as the NTSC at a lower price (eg Calliandra is sold from NTSC at 30 000 UgSh/Kg, but VI sell it at 15 000 Ug Sh/Kg. *Pinus caribaea* seed sold from NTSC costs 250 000 kg UgSh/Kg, but from the private sector it is 50 000 kg UgSh/Kg). Under such conditions it will not be possible for the NTSC to compete with the private sector without one or a combination of the following occurring:

- Recognition amongst customers of the benefits of genetic quality and a willingness to pay a premium for it.
- Long-term subsidization of the seed supply activities of the NTSC.
- Legislation to enforce genetic quality standards. We are tying this recommendation in with our Sawlog Grant Scheme by insisting on seed from 'approved sources' only: for *P. caribaea* this will be Queensland at this stage.

The NTSC have carried out advertising on radio and in newspapers to highlight the value of their seed but it has to be recognised that explaining the concepts of improved genetic value in trees is not an easy task. While this may seem odd given people's acceptance of improved varieties of agricultural crops there appears to be a worldwide reluctance to accept the same can be true of trees. Whether this is due to trees' longevity, their perceived 'wildness' or the lack of appreciation of why anyone should want to 'improve' a tree is difficult to ascertain. But the outcome is the same; prospective customers cannot be expected to understand that trees grown from seed sold by the NTSC will grow into better trees than those from seed sold by a private company. Again, their claims are not borne out by the results in the young plantations we have raised from their seed; forcing us to to bypass them and import for our own needs. We are even selling onto private investors at cost price (*ca*. US$375/kg). Although the 5-year plan for the future of the NTSC emphasises the need for marketing it is likely that the opportunities for significantly improving the income through this avenue are limited Ministry of Water, Lands and the Environment 2002b).

The NTSC was established and has been maintained through financial support provided by the Government of Uganda and international donor agencies. These funds have provided facilities which are certainly of a high enough standard to manage seed supply issues in Uganda for the foreseeable future. However, the financial viability of the NTSC is highly questionable in the aftermath of the planned withdrawal of funds by NORAD (Ministry of Water, Lands and Environment 2002a). A business plan covering the withdrawal period prepared by the Ministry of Water, Lands and Environment is dependent upon an over-optimistic view of seed sales on the road towards financial self-sufficiency and cannot be viewed as a useful plan for the future (Ministry of Water, Lands and

Environment 2002b). A more realistic picture would be to see seed sales failing to support the NTSC and this situation leading to its ultimate closure. This must not be allowed to happen as the NTSC has a vital part to play in the tree improvement strategy and therefore the future of the Ugandan plantation sector.

The combination of the need to highlight the importance of genetic quality in seed supply and the requirement for income to support a nationally important strategic asset suggests that government intervention may be required through some degree of legislation.

5.1.3. Legislation relating to seed procurement for the plantation programme

Both government and private investors agree that in order to maximise returns from the forthcoming massive expansion in the plantation forestry sector it is essential that seed of the best genetic quality is used. However, as highlighted above, the best is rarely the cheapest, and with a lack of appreciation of the benefits of investing in good quality seed it is highly probable that the majority of the planting that will take place will be with seed of poor quality. If this situation is allowed to persist it will not support the objectives of the plantation programme.

In order to address this serious problem it is suggested that legislation is enacted that will permit only approved seed to be planted on government owned land. The definition of 'approved' should include both physiological and genetic criteria, such as viability and origin. This need not be complicated or difficult for any seed supplier to provide but it have the benefits of guaranteeing the genetic quality of planting stock, encouraging investors to pay a premium for good quality seed and increase the income for the NTSC. However, the National Forest Policy indicates support for the private sector in seed supply and marketing (p22) so it is essential that any possible conflict is considered.

5.1.4. Determination of the area of seed orchards required

It is very difficult to determine the area of orchards required because there are no clear data on seed production capabilities in each of the seed zones. In addition, the demand from tree growers is unclear (i.e. the NTSC work plan suggests that 49 000ha of plantations will be established in the next 3 years, but it is not clear whether this will take place, and with which species). If 5,000 ha are planted by 2006, we will have done well!

In order to assist in preparation of plans for seed production it is essential to:

- get data on PC (what is this?) SO production in good areas
- estimate seed needs in Uganda.

5.2. Assessing the value of the NTSC

There has been an overemphasis on using only a financial criterion upon which to evaluate the success of the NTSC when in fact its value to Uganda is much broader than that. The NTSC has both commercial and public good activities but there is a view within the NTSC that they need to be separated. If the NTSC was to concentrate on only its commercial operations then only about 30% of

costs can be covered. The Public Good activities include seed source management, seed research, school seed supply, tree improvement, training services, conservation and protection of seed sources.

The importance of forests and forestry to the country at large are dependent on good quality seed and the provision of this to farmers and private investors marks a significant social and economic service provided by the Centre. In addition, the environmental benefits from improved tree cover in terms are maximised by using seed from the best sources.

5.3 Restructuring the NTSC

It may be possible to restructure the NTSC and reduce its operating costs by the following:

- move to smaller building (this is unlikely to happen but should still be considered)
- reduce staff costs by removing all standing labour and replace it with contract staff. This is particularly necessary in seed collection operations and appears to be underway

However, regardless of the ability to cut costs, it is still unlikely that the NTSC can be completely financially self sufficient.

6. Tree improvement in the National Forest Authority

6.1 Managing a tree improvement strategy for Uganda

The organisations that are likely to play the major role in the tree improvement programme for Uganda (FRMCP, FORRI and NTSC) have all indicated their support for the generation of a tree improvement strategy for Uganda. With the commitment of FRMCP to develop training of appropriate staff, and the support of key partners to work together to manage a tree improvement strategy there is a strong likelihood of establishing a successful tree improvement programme.

6.2 Creation of the Tree Improvement Steering Group

In order to manage the tree improvement strategy it is proposed that a Steering Group is established consisting of the following key partners:

- FORRI
- NTSC
- NFA/FRMCP
- Makerere University
- Private sector (e.g. Uganda Sawmillers Association,,Uganda National Tree Farmers Association) this last group are small scale planters
- NGOs & CBOs

Each partner would have one staff member designated on the Group but would be permitted to bring non-participating staff members with them to the meetings.

It is suggested that the Director of FORRI would be invited to chair the group, and that NFA/FRMCP would act as secretary.

The Group should meet quarterly.

Priority tasks would include the following:

- Determination of outline tree improvement strategy. Key issues to include the following:
  - Approval of the concept of a strategy.
  - Timetable for its preparation and designation of responsibility for its compilation (suggestion – collaboration between FRMCP and Alan Pottinger)
  - Identification of key roles (particularly Tree Improvement Specialist)
  - Identification of key tasks and preparation of a timetable of activities.
- Preparation of a complete catalogue of all relevant reports and papers relating to tree improvement in Uganda and provision of a central library for their storage.
- Creation of demonstration plots of tree improvement activities for publicity purposes (e.g. species evaluation trials, grafted pines, seed orchards) at several sites.

Appendices

Documents read

Anonymous (2002) The National Tree Seed Centre Public Good Delivery Programme

Graudal, L. and Kjaer, E.D. (2000) Can national tree seed programmes generate economic, social and/or environmental benefits that cover their costs? Considerations on economics, sustainability and challenges ahead for tree seed centres in tropical countries. Presentation given at the SAFORGEN Regional Training Workshop on the Conservation and Sustainable Use of Forest Genetic Resources in Eastern and Southern Africa, Nairobi, Kenya, 6-11 December 1999. 17pp

Namuyangu, J. (2000) Seed Production Areas (unpub.) FD?

Kaumi, Y.S. and Esegu, F.O. (2000) Baseline survey seed demand/supply for Uganda National Tree Seed Project 86pp

Ministry of Water, Lands and Environment (1998) NTS Project Phase II 1998-2003 Project Document 1998 99pp

Ministry of Water, Lands and Environment (2001) The Uganda Forest Policy 29pp

Ministry of Water, Lands and Environment (2002a) Proposal for NORAD support to the Forestry Sector Programme: 2003-2005

Ministry of Water, Lands and Environment (2002b) National Tree Seed Centre Business Plan (Revised Draft)

Musiimo-Byenkya, S.K. (in prep) Management plan for seed stands located in existing softwood plantations in Uganda 2003-2013 16pp FD?

NORAD (2000) Project Document National Tree Seed Project Phase III 2000-2003

Sjoholm, H.; Kasolo, W.K. and Namirembe, S. (2000) Review of the National Tree Seed Project Phase IIA 1999-2000

Diary of activities

- Tues 25/3
    - Travel from UK (evening)

- Wed 26/3
    - Arrive Kampala (am).
    - AM - Discussion with Kikangi Israel (Forest Officer, seconded from FD to FRCMP) and, Mugote Ezrah (Israel's deputy) regarding background to the situation with TI in Uganda.
    - PM – discussion with Paul Jacovelli (Chief Technical Advisor) and Steve Nsita (his Deputy) regarding the background to project.

- Thurs 27/3
    - AM – Attendance at final presentation by Harvesting and Sawmilling Consultants.
    - PM – visit to Kifu with Paul, Israel and Musimon Byewingi (Deputy Manager National Tree Seed Centre).
- Fri 28/3
    - AM – Attendance at presentation of Ecotourism Consultant
        - PM- visit to National Tree Seed Centre (NTSC) for discussions with Mr Kyaroki Ambrose (Manager) and other staff.
- Sat 29/3
    - Visit to Katugo, nursery and plantations.
- Sun 30/3
    - Writing notes and reading reports.
- Monday 31/3
    - AM waiting to head out on field trip.
    - PM visit to Namasiga to see SPA.
    - PM visit to SOs at Igeyero.
- Tues 1/4
    - Visited South Busoga and Bukaleba
- Wed 2/4
    - Met with Francis Esegu, Director, FORRI (Forestry Resources Research Institute.
    - Met with Peter Karani (Consultant).
- Thurs 3/4
    - AM Office work.
        - PM Grafting practical in Katugo.
- Friday 4/4
    - Meeting with Israel to answer the following Qs
    - Office work.
- Saturday 5/4
    - Report writing.
- Sunday 6/4
    - Preparation of presentation for Thursday
- Monday 7/4
    - Visited Kifu nursery and plantations.
        - Visited Tree Biotechnology Project at Kifu.
- Tuesday 8/4

    - Visited NTSC to discussed various issues with Simon.
    - PM report writing and document reading.
- Wednesday 9/4
    - Presentation preparation and run-through with Paul.
    - Report preparation
- Thursday
    - AM Presentation of draft report at FCMP
    - PM Meeting with Francis Esegu (FORRI)

Draft Terms of Reference for the position of Tree Improvement Specialist with the National Forest Authority of Uganda

Job specification

- To pursue the objectives of the tree improvement strategy of Uganda ***'To conserve, utilise and develop the genetic resources of Uganda's trees for the benefit of the forest plantation sector'.***
- This will be a short-term post designed to start activities related to the new Uganda Tree Improvement Strategy.
- It will be the most senior active position in tree improvement and will therefore entail running the national tree improvement programme on a day-to-day basis.

Key tasks and responsibilities

- The candidate will report directly to the Tree Improvement Steering Committee who will determine his/her work plan. I would suggest that they report directly to the FRMCP or Forest Resources Manager in the NFA rather than a Technical Committee?
- Tasks will involve planning and implementing conservation, seed collection, seed supply, and experimentation associated with the goals of the Tree Improvement Strategy.

Candidate specification

- A degree in forestry or its equivalent.
- A minimum of some degree of formal training in forest genetics, tree breeding or seed handling but there is no necessity of a higher degree in any of those subjects.
- The candidate will be expected to travel frequently within Uganda.
- The post is challenging and requires a candidate who will show a high level of drive and interest in order to carry out an intensive work programme.
- The candidate will be expected to work closely with both the Tree Improvement Steering Group and any consultants, partners or advisors

Terms and conditions

- The post will be for a period of one year (with a 6-month probationary period) with the possibility of extending for another year.