WORKING TOWARDS THE WIDER DISTRIBUTION OF TREE SEED IN AFRICA: THE ACTIVITIES OF THE HENRY DOUBLEDAY RESEARCH ASSOCIATION

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SUMMARY

This paper reviews the need for quality tree seed in forestry planting programmes. This is being addressed by a number of research organizations operating at an international level to supply seed for research trials and pilot plantations in various parts of the world. The paper draws attention to the problem faced by many small-scale, non-research forestry programmes in obtaining such seed, and documents the work of the Henry Doubleday Research Association in attempting to meet this need in Africa.

BACKGROUND

The Henry Doubleday Research Association (HDRA) has, since 1986, been coordinating research into the physiology and propagation of drought and salt tolerant tree species. As this work has become more widely known, the project has received many requests for tree seeds, particularly for species selected for arid, semi-arid and saline areas, from a variety of groups involved in tree planting in Africa. A tree seed distribution project was set up to provide multipurpose trees for planting around homesteads, along boundaries, in village woodlots, in upland watersheds and increasingly, for integration into agroforestry systems. This case study explores the issues faced by the HDRA as the tree seed distribution network was set up, and during the first four years of its operation.

DIFFICULTIES IN COLLECTING SEEDS AT FARM LEVEL

Information Dissemination

The task of tree propagation and improvement has traditionally fallen to individual farmers. There is local knowledge on propagation of trees through collection of seeds or cuttings from local indigenous trees. However, this information may not be widely disseminated among the population and techniques tend to be localized. Often trees for fuelwood and fodder arise naturally and are left uncut at field boundaries. Trees tend to be planted for fruit and cash. Even economically useful palms are allowed to regenerate naturally and are protected where they arise.

When new ideas of actually raising multipurpose trees are taken up, local farmers often equate this with the need for exotic, introduced, `super species' which are perceived to be better than anything locally available. There is detailed knowledge of local trees including their value for fuel, medicines and other uses, but these trees are often not considered for forestry and agroforestry plantation. The use of lesser known indigenous trees should not be overlooked in the face of exotic species about which information is more widely available.

Seed Quality

A number of common practices result in the collection of poor quality seed. Seeds are sometimes collected from poor quality fruit as the best fruit is sold fresh. Farmers do not maintain genetic purity through the isolation of varieties and the elimination of unwanted or inferior plants. The seeds which are collected are often those which are most accessible including those lying on the ground. These are vulnerable to attack by seed eating insects and fungal pathogens. Seeds harvested from small trees which are easy to reach may result in a greater frequency of small trees

in subsequent populations.

Often all the non indigenous trees in an area, or even a whole country, have arisen from an extremely limited genetic base introduced as one small seed lot, commonly during colonial times in the 18th and 19th century. The original introduction may not have been selected for any useful characters, or indeed may have been selected for ornamental and amenity properties, which may well not be the qualities now sought for multipurpose use.

Agroforestry Trees

The introduction of new agroforestry technologies has necessitated the use of trees which have a root and canopy structure suitable for integration into agroforestry systems. The trees are grown adjacent to, or among, annual field crops. They must also help improve or stabilize soil properties, for example through the ability of the tree to fix nitrogen through symbiosis with nitrogen fixing bacteria, or through the incorporation of increased levels of organic matter when the leaves are applied as a green manure. Agroforestry species must not, however, display negative allelopathic effects on the adjacent crops or compete aggressively for water and nutrients.

Trees which fulfil these criteria include a number which have now become widespread as agroforestry species, such as *Leucaena leucocephala, Gliricidia sepium, Calliandra calothyrsus* and *Faidherbia albida.* These are often not indigenous to the areas in which they are utilized and may not, therefore, be locally available. If the required seed cannot be obtained from national sources, it must be obtained elsewhere, including the international seed market.

Need for Provenance Tested Seed

Multipurpose trees come, at present, almost exclusively from wild, `unimproved' populations. Considerable individual variation exists within a single species. Many of the most important species are self incompatible so seed characters are inherited from different parent trees, increasing the variation between individual seeds. Trees grown from seeds collected from a number of trees within one area, when compared with trees from seeds of the same species from a different area, will often exhibit marked differences in growth rates, growth form, pod production, tolerance of environmental stresses, thorniness and the presence of antinutritional factors. Even seeds collected from an individual tree will produce progeny with highly variable characteristics.

This variation can be exploited to allow plant breeders to develop varieties with particular desirable characteristics. Such conventional breeding programmes with multipurpose trees are rare, although the techniques have been well established for high value temperate and tropical commercial forestry species such as eucalyptus and spruce. A well known example of the breeding of an agroforestry species is that carried out at the University of Hawaii by Dr Brewbaker and colleagues, who have selected vigorous `giant type' varieties of *Leucaena leucocephala* from the natural population.

An alternative method for rapidly isolating and exploiting useful variation between individual trees is to propagate these vegetatively by cuttings. This type of work has been carried out to establish high yielding clones of commercial species such as eucalyptus and poplars. This, again, is not a well developed technique for multipurpose tropical trees and has, associated with it, more problems of storage, quality control, phytosanitary certification, transport and distribution, than does the use of seeds.

When a species has been selected to test in a particular locality it is important to include trees from different populations (provenances) of that species in order to gain the widest genetic range possible and to determine which provenance is most suitable for that area and for the purpose for which is being selected.

PROBLEMS WITH SEED QUALITY ON THE INTERNATIONAL MARKET

Seeds available on the international market are often subject to the same quality constraints as those collected at farm level. They are collected contractually on request with the emphasis on quantity, often at the expense of quality. Seeds are collected from trees in the population which may not necessarily display ideal properties. In the interests of labour saving, each individual tree is often stripped of seed, including those which are under or over-ripe. This general problem of quality control was addressed at a meeting at the International Council for Research in Agroforestry (ICRAF) in Nairobi in late 1992 (Vercoe, pers. comm).[1]

FINANCE

To purchase seeds on the international market it is necessary to pay for the seeds, certification and transport in advance, by bankers order, in foreign currency. Many of those requiring seeds are farming at subsistence levels and those who have formed into self help groups and NGOs are equally short on funding. It is difficult for NGOs or individuals to obtain sufficient funds to meet the high cost of overseas seed purchase and for these groups, and even government forestry departments, to obtain foreign exchange clearance from central banks and finance ministries in less developed countries.

OTHER SEED DISTRIBUTION NETWORKS

Tree seeds can be obtained free of charge from a few sources, but each of these has limitations. Three examples are the DANIDA Forest Tree Seed Centre in Denmark, ICRAF in Nairobi, Kenya, and the Australian Tree Seed Centre at the CSIRO Division of Forestry, Canberra, Australia. The Centre Technique Forestier Tropical (CTFT) in France also supplies seed to certain (generally francophone) countries, whilst the Oxford Forestry Institute (OFI) in the UK provides research seedlots to selected projects and countries.

DANIDA grade their available seeds in terms of the quality of information and viability of seed lots. Good quality seeds which have full collection details available are reserved for scientific research programmes or seed orchards. Small groups which wish to conduct `look-see' trials appear, from the DANIDA policy statements, to be excluded from receiving high quality seed. ICRAF will supply seed to research projects on the basis of a trials network in return for a full scientific report on the results. Other groups which are not necessarily research based are thus excluded from receiving quality tested seed of known provenance. The Australian Tree Seed Centre (ATSC) provides free research seedlots of Australian woody species under the `Seeds of Australian Trees' project, funded by the Australian Centre for International Agricultural Research (ACIAR). If necessary, assistance may include site-specific recommendations, the supply of

[1] *First International Symposium on Seed Procurement and Legal Regulations for Forest Reproductive Material in Tropical and Subtropical Countries* 4 - 10 October, 1992.

literature and advisory visits to recipient countries by suitably qualified specialists. The focus is again on research, the services of the ATSC being made available to research projects and pilot plantations in selected countries of Asia, Africa, Latin America and the South Pacific. In recent years, a database on species performance known as TREDAT has been developed collaboratively by the Queensland Department of Forestry and CSIRO. This is being used to encourage the collection and dissemination of information on the performance and site suitability of species and provenances supplied by the ATSC.

Apart from these organizations, seed may occasionally be supplied through development groups and networking publications. Usually a single species is involved, and there is no link with scientific trials. Such offers are nevertheless worthwhile because they are based on practical evaluation, in situ, at the farm level.

THE INITIATION OF THE HDRA TREE SEED DISTRIBUTION PROJECT

Realising the difficulty in obtaining seed faced by small groups and a large number of non-research based tree planting projects, including those run by international agencies and governments, the HDRA decided to set up a tree seed distribution network. Funding was initially obtained from the Joint Funding Scheme of the British Government's Overseas Development Administration, and from the UK-based `Charity Projects' to fund tree seed distribution to groups working in Africa. This was later expanded by additional funds from other small donors to allow the scheme to extend to other developing countries.

PROJECT OBJECTIVES

These are to:–

- collect and store semi-bulk quantities of quality, tested seeds of multipurpose trees;
- advertise the availability of seeds of selected species through appropriate development literature and through HDRA contacts;
- select suitable species to fulfil the specific requirements of recipients in the context of their prevailing climatic, topographical and soil conditions, information for which is gathered on a Tree Seed Request Form;
- supply free of charge quality, tested and properly stored seeds;
- provide necessary information to allow the recipient to understand the uses to which the trees may be put and to cultivate and manage the trees successfully;
- collate information on the performance of each planting programme, and to make this information available to guide the future selection of species in the same or a similar area.

INITIAL EXPERIENCES OBTAINING SEED SUPPLIES

Initially the project was forced to rely heavily on commercial supplies of seed, with the problems of seed quality associated with these sources. Seed purchases were rarely accompanied by provenance information or collection details including date of collection, site description, altitude, latitude and longitude. This prevents the accurate matching of seed source with the planting site.

In some rare cases the species name on the packet did not correspond with the seeds. This has extremely serious implications for the possibility of inadvertently releasing potentially weedy species, or simply causing confusion.

PROBLEMS OBTAINING IMPROVED, QUALITY SEED SUPPLIES

The HDRA has made considerable efforts to secure seeds from provenance trials conducted by international research groups. Much research has concentrated on the selection of appropriate species and provenances to provide a wide variety of products and services in a range of climatic conditions. Some notable provenance work has been carried out by the Oxford Forestry Institute (OFI) on a number of species including *Calliandra calothyrsus, Gliricidia sepium, Faidherbia albida* and *Acacia tortilis.* CSIRO in Australia has also undertaken a great deal of work on the identification and characterization of numerous Australian *Acacias* and their selection for quality germplasm.

At the end of the research programmes, the information and plant material identified as particularly useful is rarely disseminated to field level. The results and information are published in scientific literature, often not accessible to people who are involved in practical planting programmes. Little effort has been made to extend the results of the trials to farmers and landowners. The HDRA has been actively involved in encouraging research groups to make germplasm available for distribution and, recently, the emphasis in research funding has shifted towards adaptive measures, designed to deliver germplasm and technologies to grassroots organizations and farmers.

INCOME GENERATING ACTIVITIES

In an effort to encourage the development of income generating activities, the HDRA has a positive policy to buy back, at international market rates, as much seed as possible from collaborating projects.

The HDRA arranged for the collection of a drought tolerant *Sesbania* from Kenya, *Sesbania sesban* variety *nubica*. This is more drought tolerant than other *Sesbania sesban* varieties. It performs particularly well in dry areas when compared with *Sesbania sesban* purchased on the international market and is normally collected in the Indian sub-continent. Seeds were sent to the Cape Verde Islands and raised by the HDRA in a seed orchard on land owned by the National Agricultural Institute. When the trees matured and produced seed we purchased the seed from the Cape Verdean National Agricultural Institute at international market rates.

In Ghana, a seed recipient has set up a small commercial enterprise selling tree seeds from the trees raised from HDRA seed and again we buy back seeds from him wherever possible.

SPECIES SELECTION

Field officers frequently lack access to information which would allow them to make informed species selections. Much of the available information is scattered among publications and it is particularly difficult for groups in developing countries to obtain the most up to date information. The HDRA, therefore, responds to general requests for seeds and information by issuing tree seed request forms to all applicants. It is vital that a clear picture of the prevailing environmental conditions is obtained, thus avoiding the introduction of unsuitable or weedy species. Full climatic and edaphic details are requested together with details of exactly which tree properties and products are required by the recipient. This is very important as a tree which is not perceived to be of value will not be tended. A league table was drawn up to illustrate the most requested tree products and properties (Table 1).

HDRA staff were pleased to note that soil improvement was listed as the most commonly requested tree property. This illustrates a prevailing understanding of the environmental benefits to be obtained from reafforestation and agroforestry practices. Fodder, fruit and firewood were, as expected, also listed as important products.

Species are selected with the aid of the HDRA's own experience and a large body of literature and databases. A library of texts describing species and their environmental requirements has been set up over eight years. We have also obtained databases and tree selection software, including the ICRAF Multipurpose Tree Seed (MPTS) Database and the CSIRO `World' climatic mapping programme. The MPTS database allows the operator to enter details of climate and product requirements, the database will then produce a shortlist of species. The `World' database theoretically allows the operator to input environmental details of an individual species and will then map areas in Africa and Australia which correspond with these environmental parameters. It also allows the climatic conditions in an area on the world map to be pinpointed and displayed. Each of these programmes has limitations and their use must be tempered with the operator's own knowledge and experience.

TABLE 1: DESIRABLE TREE PROPERTIES IN ORDER OF PREFERENCE

Property of Tree	% of Projects Quoting this Property as Important
Soil improvement	61.9
Fodder	61.2
Fruit	59.0
Firewood	58.2
Planting with crops	54.5
Nitrogen fixation	53.0
Timber	42.5
Hedges	32.1
Shade	31.3
Shelterbelt	29.9
Planting in Pasture	26.1
Honey	26.1
Charcoal	24.6
Pest control products	23.9
Medicine	21.6
Other edible products	18.7
Amenity	14.2
Dead fencing	12.7
Sand dune fixation	10.4
Other secondary products	09.7

SEED STORAGE AND SUPPLY

When seeds arrive at the HDRA they are assigned an accession number, tested for viability and visually checked for weed seeds and infestation. The seeds are then split into smaller quantities, sealed in labelled foil bags, and stored at 4°C.

Seeds are airmailed to the recipient in sufficient quantities for practical introduction trials. This usually amounts to between 1,000 and 3,000 seeds per species depending on seed size and availability. The number of species is determined by the area available for tree planting and on the number of species suitable for the local climate and the required purpose. Occasionally a group has, after initial species evaluation, approached the HDRA for larger quantities of seeds for wider planting. An alternative range of species may also be sent for evaluation as a follow-up to lessons learned from the first trials. After this secondary seed supply the trees should thereafter provide sufficient seed for future planting in that region.

The seeds are accompanied by a phytosanitary certificate from the point of source. Where

customs regulations demand, an import permit is obtained in the receiving country and is sent to the UK to accompany the seeds. The seeds are also accompanied by information on the cultivation and management of each species.

INFORMATION FEEDBACK

Recipients are requested to complete a feedback questionnaire when the trees have been planted in their permanent growing position. Data is requested on germination, survival in nursery and survival and growth in the field. This information is incorporated into our databases and is used to aid further species selection in that region.

The feedback has indicated that almost every project has had success with at least one species. It has also illustrated the wider value of the trees on a community scale. As part of a nutrition promotion programme in Kenya, the seedlings were distributed among local women, each woman receiving trees for fruit, timber and firewood. Species include *Psidium guajava, Punica granatum, Grevillea robusta* and *Tamarindus indica*. Forestry extension information and monitoring was provided by the local forestry department and the women meet weekly to discuss a number of issues including their tree planting work.

In a farm tree growing project run by an NGO in Togo, four out of the seven species supplied — *Gmelina arborea, Leucaena leucocephala, Cajanus cajan* and *Sesbania sesban* — have proven very successful and are being used for forestry/agroforestry demonstrations at the project site and at a local school. At least 300 people participate in training courses at these sites annually.

RECIPIENT PROJECTS — RESULTS AND EXPERIENCES

Seventy percent of the projects which have approached the HDRA for seeds may be described as non-governmental organizations. This category includes small self-help groups, training establishments, groups concentrating on particular issues and international aid agencies involved in tree planting projects.

A questionnaire in English and French was designed to determine the applicability and usefulness of the HDRA Tree Seed Distribution Project. The questionnaires were sent to 68% of the projects and received a higher than expected response rate of 48%, 56 replies in total. Thirty three of these projects are involved in demonstration activities, attracting over 10,000 visitors in total, per annum. Table 2 shows the number of visitors visiting each type of project.

TABLE 2 THE NUMBER OF VISITORS ATTENDING THE DIFFERENT TYPES OF PROJECT RECIPIENTS

Type of organization	Number of projects	Number of visitors	Average per project
Schools	5	1000	200
Self Help	4	2333	583
Cooperative	5	100	20
Individual	5	1600	320
Church	9	2800	320
NGO	24	2330	97

The dissemination of agroforestry technologies and plant material was identified by the HDRA to be one of the most crucial aspects of the project and the success of dissemination activities within the project was given particular emphasis in the report. Most successful at dissemination of information are the highly motivated self help groups which are a powerful enabling mechanism, particularly for women.

A secondary economic benefit of tree planting programmes run by NGOs is employment creation. Twenty-two of the projects employ people to tend the trees and many of these, particularly NGOs, are in a position to positively discriminate in favour of female workers. Women were generally paid wages on par with male employees.

In conclusion the report pointed out that respondents clearly indicated that the HDRA is providing the resources they need and that there is a high degree of dissemination of results.

FUTURE PLANS

A number of the international forestry research centres have now recognized the need to provide bulk supplies of selected trees for wider distribution, and funding is becoming available for such work. The CSIRO and the OFI have been working towards tackling this problem and it is hoped some concrete results will be seen internationally in the near future.

It is one of the aims of the HDRA to encourage individuals or government forestry departments within each country to take control eventually of its own seed supply, either through free seed distribution funded through government sources or as a commercial enterprise.

Setting up reliable, regional seed supply networks would entail the cultivation of seed orchards, careful management of seed collection and storage and the setting up of distribution networks in-country. Great care must be taken when planting seed orchards to plant trees of known, tested, provenance which are suitable for cultivation in that country. To be successful, seed orchards must be designed and planted to maximize the ability of the trees to breed true. In some cases provenance trials can be successfully converted into elite seed orchards reducing the time lag between research and seed supply. There is, therefore, a need for researchers to transfer

knowledge and technology in seed orchard techniques, and to provide suitable germplasm at this critical stage in forestry development. This will require a concerted, collaborative effort from international forestry research teams.

In the meantime, the HDRA will continue to provide help with the supply of quality seeds for reafforestation and demonstration activities wherever they are required.

ACRONYMS

ACIAR	Australian Centre for International Agricultural Research
ATSC	Australian Tree Seed Centre
CSIRO	Commonwealth Scientific and Industrial Research Organization (of the Government of Australia)
ICRAF	International Council for Research in Agroforestry
HDRA	Henry Doubleday Research Association
OFI	Oxford Forestry Institute

ACKNOWLEDGEMENT

We are grateful to Tim Vercoe, Officer-in-Charge at the Australian Tree Seed Centre, CSIRO Division of Forestry, PO Box 4008, Canberra, ACT, Australia, for adding comments about the work of the ATSC.

Credits

Editors of this paper:	Gill Shepherd Jane Carter Michael Richards
Translator:	Ivana Wilson
DTP:	Ivana Wilson
Printed by:	Russell Press Ltd, Nottingham on recycled paper

RDFN logo by Terry Hirst
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The Rural Development Forestry Network is funded by the EUROPEAN COMMISSION and ODA