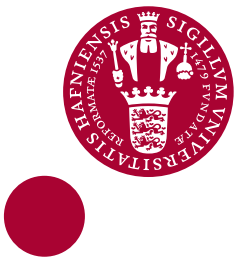

The Strategies and Procedures for an Integrated National Tree Seed Programme for Seed Procurement, Tree Improvement and Genetic Resources

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compiled by
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Contents

1 INTRODUCTION

The many parties involved in a national tree seed programme must coordinate their efforts and put the tasks into an appropriate order of priority to make the programme a success.

In the following we have tried to outline the objectives, present the problems, and give an idea of how activities should be coordinated and implemented to ensure a well-balanced programme comprising the three elements: seed procurement, tree improvement, and conservation of forest genetic resources.

The proper solution will vary with time and from one country to the other, but the outlined overall reflections should be maintained.

2 OBJECTIVES

The long-term objective of a national tree seed programme is to ensure the provision of a sustained supply of seed of high genetic and physiological quality for afforestation and tree planting schemes aimed at the creation of well-adapted populations of woody species.

The fulfilment of the long-term objective will improve wood production and provide other benefits from growing plants, contribute to the restoration of degraded environments, and help meet people's requirements for fuel, timber, poles, fodder, food and shelter.

The immediate objective is to prepare strategies for seed procurement and tree improvement which will make it possible to cover the immediate seed demand appropriately and at the same time incorporate long-term measures such as selection, conservation, and establishment of seed sources and breeding populations.

Most tree seed centres in tropical regions are faced with great problems of satisfying immediate demands for seed. Naturally the activities will initially focus on meeting these demands, which may imply a broader (less selected) acceptance of species, provenances, and seed sources than desired in a larger perspective.

When a tree seed programme for sustained and improved seed production is being developed, it is important to combine the short-term and the long-term view right from the start of the programme. This necessitates an identification of available seed sources and a registration of seed collected or possibly imported with a certain minimum of information on origin, location, and factual data on quantity, treatment and distribution. Without this basic information about origin and genetic background it is not possible to obtain a satisfactory long-term tree seed programme.

3. PRESENTATION OF PROBLEMS

The rapidly growing planting programmes in both tropic and sub-tropic regions result in a rapidly increasing demand for seed of local species as well as exotics.

Therefore, there is a need to establish or strengthen national seed centres to ensure a continuous and sufficient supply of well-adapted seed of high quality.

There is a need, internationally, to promote the exchange of well-documented seed and the establishment of coordinated testing of seed sources etc. through cooperation between national seed centres, possibly via regional centres.

The different tasks of seed procurement may be divided into four groups: organisation, techniques, genetics, and economic and temporal relations. These will be treated in the following.

3.1 Organisational aspects

The seed centres must have direct cooperation with the national forest department and other important agencies and institutes and must develop an extension service to ensure close cooperation with practical forestry. It is important that all means are not allocated a central centre only but, where appropriate, sub-centres should be established well-placed for essential seed-collection areas and for principal customers.

A national centre should have complete knowledge of what is happening within the seed sector. However, the work of the national centre should not be so centralised that local initiative for an acceptable seed procurement is restrained, particularly if the national centre is unable to accomplish the task.

The part of research and development demanding experts and expensive equipment should however be centrally positioned.

The benefits of an improved seed supply go to the afforestation and tree planting projects of the country. In many developing countries these are predominantly under government control. Therefore tree seed centres should, in principle, be a governmental concern.

However, seed crops vary from year to year; so in order to make use of a good seed year it is important that the system of financial appropriation be as flexible as possible. Governmental control of budgets and expenditure has a universal tendency towards over-rigidity, and financial administrators must be informed of the special character of forest seed programmes, of their seasonal nature and variation from year to year, and of the need to secure specially trained personnel and flexible budgets.

Sufficient planning and organisation is essential. A simple reason for the lack of seed may often be that seed orders are not sent to the seed-collecting unit early

enough to be included in the year's seed collection. Other examples show that seed may be available but not supplied in time because of complicated procedures.

3.2 Technical aspects

Large amounts of seed are lost because of bad timing for collection. The seed may either have fallen before the time of collection or may have been collected before it was mature, whereby the viability of the seed is often lost. Moreover, much seed is damaged during storage before sowing. Greater care and simple improvement of facilities for storage could reduce the losses considerably for many species. Finally, much seed is wasted because of insufficient knowledge and care in the nurseries. Consequently, there is a demand for the spreading of already existing knowledge. Lately, many new species have come into use e.g. for agroforestry. For many of these species, questions on flowering and seed- physiology have not been investigated. Research and development of appropriate seed-handling techniques is necessary.

The large percentage of waste within the seed sector has two serious consequences apart from the economic losses that are directly connected with the cost of seed collection and seed processing. Firstly, the great waste of seed results in an increased demand for seed collection so that procurement of seed of desired species will often not be achieved, also even if one is not particularly critical as to the seed sources applied. Secondly, the effect of the results of a tree improvement programme cannot be optimal before there is an essential amendment in the utilisation of improved seed.

3.3 Genetic aspects

It is a well-known fact that choice of seed source within the natural distribution of a species may be decisive for the success, mediocrity or complete failure of future stands. Tree improvement is an important aid, comprising all practices designed to produce genetically more desirable trees. The challenge in tree improvement strategy is to formulate long-term plans through many generations, which, nevertheless, are flexible and/or robust enough to embrace changes in silvicultural methods as well as innovations in genetical and propagation methods (Wellendorf and Kaosa-ard, 1988). For many species considerable gain can be achieved through tree improvement (see Appendix 1) and in practice many examples have shown what may be lost by careless choice of seed source. Therefore, it is essential that a national tree seed programme is not only concentrated on procuring a required amount of viable seed but that due consideration should be paid to the genetic constitution and that tree improvement and conservation of forest genetic resources are taken into account as necessary elements to form a whole (Palmberg, 1987). On the other hand, it is important that research and development is only initiated when it is justified from an overall point of view of objectives, priorities and resources.

A tree improvement programme need not be expensive or demand sophisticated equipment. **In the first phase, one makes use of what is available in nature**.

The prerequisites for a tree improvement programme are shown in Appendix 2 (Willan, 1985) and preliminary considerations are shown in Appendix 3 (Palmberg et al., 1985a).

The term "tree improvement" - or, even more so, "genetics" - often gives the idea of sophisticated and highly specialized activities. However, in practice, tree improvement generally only signifies varying degrees of adjustment of forest management and plantation practices, taking into account some basic genetic principles. Based on an understanding of such principles, we can utilize and consciously manipulate the materials nature has provided and developed over thousands of years, and at the same time ensure that we keep our options open for the future by including, as an inseparable part of the improvement strategy, the conservation of the variation found within and between species (Palmberg, 1987).

Provenance research deals mainly with testing of seed sources. The results should be used for seed procurement and form the basis for selection and breeding in a tree improvement programme, as the trial results give the tree breeder information of genetic diversity and directions for the location of valuable breeding populations.

In connection with genetic aspects we have emphasized how important it is to make good use of the most suitable materials available in nature. It should be emphasized that it is extremely important that this material is preserved.

"Conservation, used in its proper sense, embraces both preservation and utilization. Conservation is, in fact, an aspect of resource management which ensures that utilization of the resource is sustainable, at the same time safeguarding genetic diversity essential for its maintenance" (Palmberg, 1985b).

Great efforts should be made to ensure that important species or seed sources in danger of extinction will be preserved in so far as it is reasonable.

3.4 Economic aspects and temporal relations

Beside the organisational, technical and genetic aspects, aspects of economy and time perspectives play an essential role in the preparation of programmes.
As mentioned in section 3.3, tree improvement and seed procurement need not be costly. Simple and cheap operations like controlled seed collection from selected trees in good local stands may give considerable improvement of the plant material compared to casual seed harvest. Such simple procedures may be carried out at short notice without much preparation.

If greater genetic improvement is required, more intensive tree improvement and seed-procurement programmes must be started. Such programmes will often demand great economic as well as professional resources. Furthermore, it must be anticipated that a considerable number of years will pass before the results can be harvested in the form of genetically improved seed.

The relations between intensity (thus also cost), time factor and genetic gains of the programmes are illustrated in Appendices 2 and 3.

During the implementation of an integrated national seed programme it is important that detailed socio-economic analyses are carried out in order to put the individual elements of the programme in order of priority.

The result of such an analysis may be for instance that no tree improvement programme is established for a less important species, but seed is collected from local stands. For a species of high priority it may be economically advantageous to start a more intensive tree-improvement and seed-procurement programme.

During the period that passes before genetically improved seed is available as a result of an intensive programme, the seed demand must be covered by the best suited material available at any one time.

As mentioned in chapter 2, the procurement of seed must be improved both technically and genetically. In the past, and still in some areas in the present, seed has been used too often on the sole criterion of its availability. For example a local species may have been used because seed was available but it was inherently incapable of providing the type of product or service desired (e.g. too slow growing, unsuitable wood properties). Or available seed of a species suited to a cool dry climate may have been used in a hot wet climate.

With increasing experience, it should be possible to identify species and seed sources which are certain or likely to be adaptable to local sites and certain or likely to provide the desired end-product or service. A mature local stand must clearly be well adapted and, if the species has properties well suited to the desired end-product, can constitute an acceptable seed source. Later it may be possible to improve seed sources still further by using:

(a) Selected sources (selected for phenotypic superiority).
(b) Tested sources (of proven genotypic superiority on the basis of replicated tests).

The real problem arises when a suitable seed source can be identified but is incapable of providing a sufficient quantity of seed at a reasonable cost. Thus the question is whether it is acceptable simply **to use the species and seed sources available (and fulfil planting targets) or insist on procuring the most desirable species and sources (and plant less than the planned planting area)**.

It must also be taken into consideration that in many cases it is imperative to plant as soon as possible to avoid further degradation of the environment. In these cases it may be right to plant the best available provided this will survive and no other possibility exists. In later phases better seed sources may then be used. If years are spent waiting for the best suited seed or plant material, there is a risk that the environment has become so deteriorated that planting with the selected material has become impossible or is bound to fail.

3.5 Conclusions

It appears that full support from the authorities, sustainability, permanent and well-trained staff plus an effective extension service are all necessary conditions for the success of a national tree seed programme. At the pro-fessional level there must be a close cooperation between the following three components for a well balanced programme.

Seed Procurement	**Tree Improvement**	**Gene-Resource Conservation**
All practices designed to produce seed of high physiological quality for a sustained supply of plants.	All practices designed to produce genetically more desirable trees, including tree breeding.	All practices designed to protect and maintain genetic variation for sustained utilization.

It is of vital importance that the individual elements of a seed procure-ment programme are harmonized so that the final result is fulfilling the stipulated objectives in a socio-economically acceptable way.

It is moreover important that flexibility is incorporated into the programmes.

4 ACTIVITIES

On the left-hand side of table 1, are found the most important activities necessary for a national tree seed programme, which is assumed to have sufficient staff, facilities and equipment.

On the right-hand side of the table are stated the professional sections that are needed to ensure integrated activities.

The institutional set-up will vary from one country to the other and with time. The crucial point is that a unit is established to ensure the coordination between the three sections: seed procurement, tree improvement, and conservation of forest genetic resources, irrespective of the institutional affiliation of these sections.

The purpose of the table is to clarify how activities are related and how responsibilities shall or may be divided.

In the columns under the different sections it is stated who is responsible for action (x) and who are cooperating partners (x) in the activity in question. It is shown clearly that more than one section is involved in many of the important activities, either in order to make good use of all professional knowledge or because one section carries out work for another section. It is emphasised that **only if such cooperation is maintained, proper solutions may be reached in a rational way**.

Table 1 **AN INTEGRATED TREE SEED PROGRAMME**

ACTIVITIES — Responsibility for action ⊗ / Cooperating Agency ×	Forest Dept etc.	Seed section	Improvement section	Gene res. section
1. Estimation of species priorities in future planting programmes				
For industrial and timber production	⊗			
For fuelwood and local demand for small timber	⊗			
For agroforestry, social forestry and shelter	⊗			
2. Estimation of seed demand by major species				
Current and future plant demands	⊗	×		
Current and future plant demands converted to seed demand	×	⊗		
3. Estimation of areas needed for seed production by major species				
Seed yield per ha per year by species		⊗		
Area needed: i.e. seed demand divided by seed yield/ha/year		⊗		
4. National seed supply potential				
Survey of major species distribution	×	⊗	×	×
Establishment of seed zones	×	⊗	×	×
Survey of seed sources and breeding material registered		×	⊗	×
Exploration of potential: seed sources and breeding material	×	×	⊗	×
5. Short and long term strategies for seed procurement and tree improvement				
Needs, possibilities and justification by species	×	⊗	×	×
Outline of a seed procurement programme by species	×	⊗	×	
Outline of a tree improvement programme by species	×	×	⊗	×
Decisions on 1st priority species for seed production	⊗	×		
Work plan for " " " " " "		⊗		
Decisions on " " " " improvement	⊗		×	×
Work plan for " " " " "			⊗	
6. Selection, establishment, management, conservation of seed sources				
Registration of seed sources and breeding material established		×	⊗	
Identification of potential sources and breeding "		×	⊗	×
Selection and establishment of — new seed sources from superior mat.		×	⊗	
Selection and establishment of — base populations for future breeding			⊗	
Conservation of important, endangered species/seed sources	×		×	⊗
Testing of selected species, populations + breeding material		×	⊗	×
Establishment of sources + breeding mat., superior in tests		×	⊗	
Management and documentation: standard seed sources		⊗		
Management and documentation: advanced seed sources and breeding material			⊗	
Management and documentation: forest genetic conservation			⊗	⊗
7. Seed procurement and supply				
Assessment of seed crops		⊗		
Collection and temporary storage		⊗	×	×
Curing and processing		⊗	×	×
Import	×	⊗	×	×
Testing and storage		⊗	×	×
Seed requests and supply, including export	×	⊗	×	×
Seed documentation		⊗	×	×

A few remarks to each of the 7 activities:

1. Estimation of species priorities. This is clearly a matter of forest policy to be solved by the responsible ministries. Priorities will vary with time and a national tree seed programme must therefore be flexible.

2. Estimation of seed demand. Reliable information is most often not available. Even if there is reasonably reliable information on plant demand, conversion to seed demand is extremely difficult, as for instance plant yield per kilo seed varies immensely and is unknown for many species.

3. Estimation of areas needed for seed production. Similar uncertainty as mentioned for item 2 applies here. The aim is a rough estimate.

4. National seed supply potential. A close cooperation is demanded with institutions not mentioned in the table e.g. botanical and plant geographical institutions having wide knowledge of species distribution, ecological zones etc. In order to ensure seed procurement for the immediate future, known seed sources should be controlled and new seed sources for local use should be identified, developed for seed production and protected (cf. item 6).

5. Short- and long-term strategies and programmes. Flexible programmes should be prepared for the most important tree species. In this connection it is important to clarify that a tree species of high priority in a planting programme may not necessarily have high priority in a tree improvement programme. The order of priority in the latter should be fixed in accordance with the demand for improvement in a species and how well the desired improvement is anticipated to be achieved by reasonable effort compared to other tree species of high priority.

On the other hand there may be species of limited application where improvement in quality is necessary and possible. In this case, return and input should be balanced against future use of area. All in all it should be remembered that the same input will result in greater economic returns where small improvements are achieved for a tree species over large planting areas than where great improvements are achieved for a species not so widely planted (cf. Appendices 2 and 3).

When the necessary survey has been made, decisions must be taken and work plans prepared denoting what may be achieved for each tree species by means of the given resources. These work plans are decisive for the extent of the activities in item 6.

6. Selection, establishment, management and conservation of seed sources. This is a current process that should start with evaluation of the seed sources so far utilised and proceed by searching for possible new seed sources, which should be identified and protected. In many cases it will be appropriate to combine these activities with the survey of the distribution of major species (see item 4). Close cooperation with district forest officers acquainted with the locality is important. Species elimination trials and provenance trials are necessary for a reliable evaluation of the species in question. A schematic overall outline of a tree improvement programme is given in Appendix 4. It should however be stressed that, in practice, improvement programmes, in many cases, do not include all the components of the schematic outline.

7. Seed procurement and supply. All activities mentioned under items 1-6 serve the purpose of ensuring a sustained supply of seed from sources that are well suited for the purpose of the planting programme in question and for the chosen planting sites.

A national tree seed centre with sub-stations is often the best method of performing the administrative and technical tasks involved in the activities mentioned in item 7, page 7.

Particularly, timing of seed collections, storage of seed from collection to distribution and a reliable dispatch system are important. Research and development of techniques are necessary if seed waste is to be reduced.

If the national tree seed centre, where appropriate, undertakes the responsibility of collection, processing, storage and testing of seed for tree improvement activities, these activities will become more effective and cheaper.

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Appendix 1

From author's summary

(Technical Note No. 36: R.L. Willan, Economic Returns from Tree Improvement in Tropicai and Sub-tropical Conditions)

Such evidence as is available suggests that benefits to be derived from tree improvement in the tropics and sub-tropics will be at least as great as in temperate regions. A reasonable estimate of gains from provenance selection and the first cycle of individual selection within provenances (un-rogued seed orchards applicable to large-scale commercial plantations, is as follows:

VALUE GAINS IN COMMERCIAL PLANTATIONS FROM EARLY STAGES OF TREE IMPROVEMENT

Degree of variability between provenances	**Value gain expected from provenance selection (%)**	**Degree of variability within provenances**	**Value gain expected from individual selection (first cycle managed but unrogued seed orchards) (%)**	**Total value gain expected (%)**
High	10-20	High	15-30	25-50
	..	Moderate	5-15	15-35
	"	Low	1-5	11-25
Moderate	5-10	High	15-30	20-40
		Hoderate	5-15	10-25
		Low	1-5	6-15
Low	1-5	High	15-30	16-35
		Moderate	5-15	6-20
		Low	1-5	2-10

Economic returns, in terms of the Internal Rate of Return (IRR) , should exceed 10% for provenance selection and attain 12-15% for first cycle selection within provenances, for species with moderate or high variability. When tree improvement value gains are applied over large areas, the economic benefits may amount to millions of dollars.

Appendix 2

From
Forest Tree Improvement, FAO Forestry Paper No. 20,1985.
(R.L. Wi1lan: Tree Improvement in Relation to National Policy and Forest management)

PREREQUISITES FOR A TREE IMPROVEMENT PROGRAMME

Prima facie: Even though there may be a case for plantation forestry and tree breeding in a country, expenditure of funds and effort demands certain prerequisites:

A: The planting programme

(l) **Availability and control of land.** The large investment involved in plantation forestry can be justified only if there is an assurance that forestry will remain the object of land management for at least one rotation. Even with »fast-growing species« this is like1y to extend for one or more decades. And the manageria1 authority must have ful1 control of the land throughout the period. Excellent security of tenure may exist if the plantations are on government-owned forest land inc1uded in a national land usage plan by which continuity of management is promised for some years ahead. Land which is fragmented among numerous small private owners is usually unsuitab1e for plantation forestry. On the other hand, tree breeding may have a part to p1ay in the provision of trees for diffuse planting in agrisi1vicu1ture, **provided** that the farmer is convinced of the va1ue of the product and of the need to protect and manage the trees.

(2) **Sca1e of operations.** No matter how great the gains to be derived from treebreeding, the basic minimum costs of a small research unit need to be spread over an adequate area if they are to pay for themselves. For example a unit costing $100,000 a year and producing improved seed capab1e of yie1ding an increase in discounted product va1ue of $100 per ha per year, would more than pay for itself on a 10,000 ha a year programme but cou1d not be justified for a 100 ha a year programme.

(3) **Avai1ability af markets.** There needs to be reasonable assurance af markets for plantation produce, either within the country or through export. Not only must the markets exist, but they must be within economic distance. Plantations, even on-high yielding sites, may be uneconomic if transport costs are cripp1ing.

B. The tree improvement programme

(4) There must be reasonable assurance, e.g. in a written policy statement by the financing authority, that **staff and funds** will be provided to the tree improvement programme on a **continuing basis.** As Zobel (1969) has stated: »Will I have the backing in funds, facilities and manpower to do a decent job? If not, then don't start: A halfhearted programme, poorly done, wi1l only sour people on forestry and its potentials.« If a trained tree breeder is not already available from within the country, provision to train one must be made from the start.

(5) **Assessment af technica1 information avai1ab1e from elsewhere**. Results of research in other countries with similar environments may reduce, if not eliminate, the need to start a national tree improvement programme **de novo**. For sma11 countries with modest planting programmes, a regional research unit may provide the same results as severa1 national programmes and at a lower cost. Examp1es of regional tree improvement programmes are those which operated in East Africa during the 1960ies and 70ies and CATIE now operating for Central America. Even where a country's planting programme is large and is carricd out on a unique range of sites, international exchange of information and of genetic materia1 can do much to avoid dup1ication and concentrate research on solving the most important problems or exploiting the most promising opportunities.

Appendix 3

From
Forest Tree Improvement, FAD Forestry Paper No. 20, 1985.
(C. Palmberg, O.K. Paul & R.L. Willan: Planning and Strategies af a Tree Development Programme)

PRELIMINARY CONSIDERATIONS

The first step in planning a tree improvement programme is to ascertain the types of products likely to be required and the aims of forest management now and in the future.

Such an investigation and consideration of the following points will be needed in order to develop a strategic plan for the tree improvement programme: at step two the following are examined.

A. Administrative considerations

(i) **Formulation and statement of the aims of the tree improvement programme** in order that they will contribute most effectively to the overall objectives. Aims must be expressed as simply and precisely as possible.

(ii) **Assurance of possibilities to provide funds, equipment, facilities, and qualified personnel.** Provision for extra training may be required.

(iii) **Assurance of programme continuity.** It is desirable that suitable personnel be encouraged to make a career of tree breeding. If there are doubts about continuity of competent staff, it is essential to choose simple, robust strategies for the programme.

(iv) **Possible reorganization of administrative resources** to locate tree breeder and staff in suitable headquarters together with colleagues working on silviculture, soils and nutrition, wood quality and products, forest management, etc.

(v) **Consideration of cooperation** in improvement work at local, regional, national and international levels. This can lead to cost sharing of technical assistance and research, exchange of ideas and generation of enthusiasm.

B. Technical considerations

(i) **Determination of the factors limiting forest production** in the region and ways and means of manipulating these to meet stated overall objectives. It is essential to build a tree improvement programme on a base of sound silviculture, management and utilization. The relatively long time scale of tree improvement work and the possibility of rapid technological change in other techniques of forest management and utilization should also be borne in mind.

(ii) **Choice of species and provenances** to provide the desired type of products. Identification of the best species and provenances for each major site type in potential planting areas is essential.

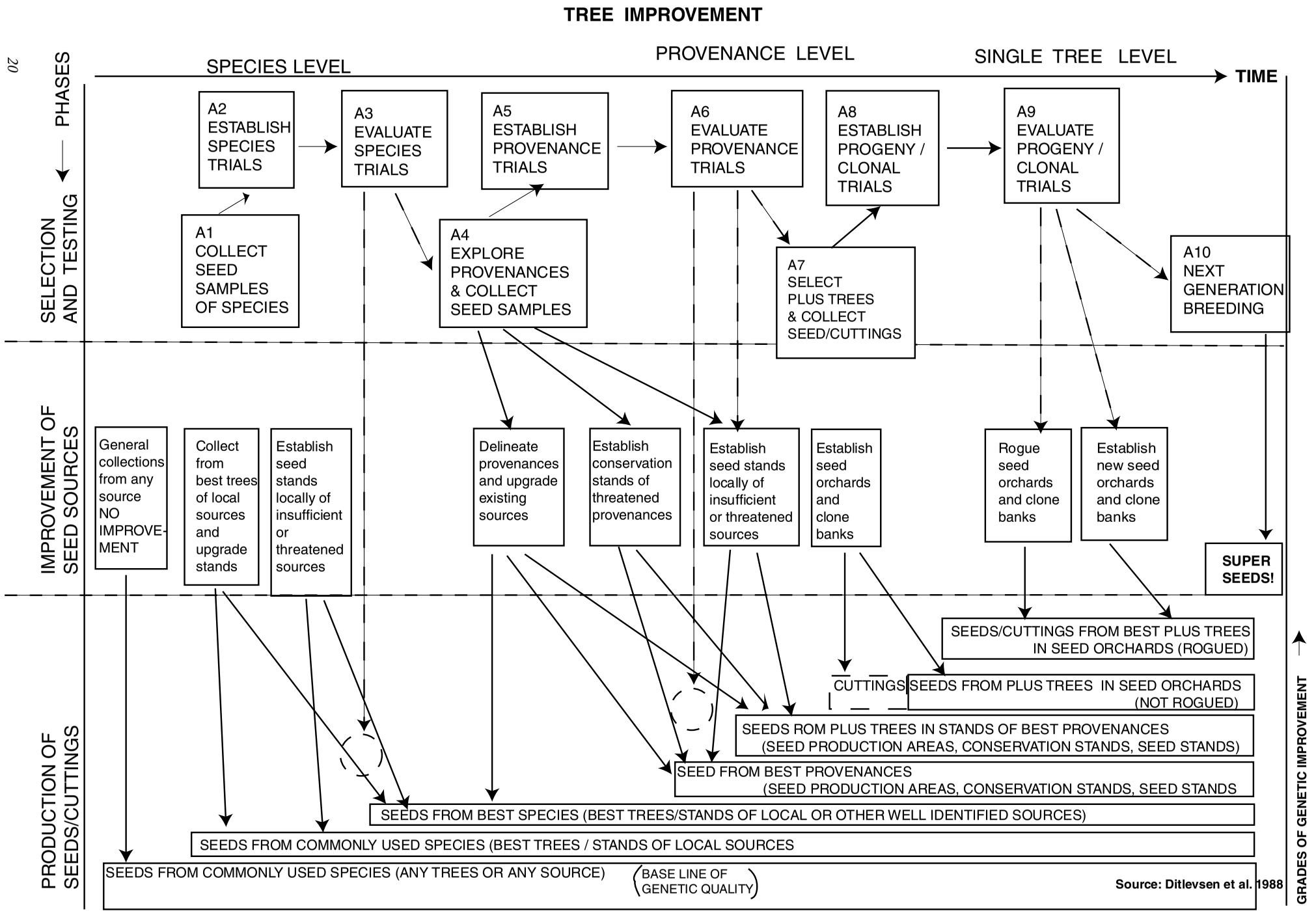
The availability of basic biological information on the species (i.e. their ecological and morphological variability, individual variation and case of regeneration by seed and vegetative means), as well as of possible techniques for improvement based on cxperienccs in other countries should be invcstigatcd. Spccial characteristics of individual species can often be uscd to advantage.

(iii) Determination of the chararcteristics which are best manipulated by genetic means. Basic studies to securc reliablc estimates of genetic parameters will provide **information** of great value in improving efficiency of selection and of breeding strategy.

The development of simple assessment methods, efficient record keeping and data handling procedures will often be required in connection with these studies.

(iv) **Specification of the number of generations and number of years needed** to achieve a certain degree of improvement in important characteristics. This information should be critically examined in the light of urgency for the improveq material.

(vi) Throughout the programme, the **gathering of data for the evaluation of costs** and benefits.


TREE IMPROVEMENT
PHASES
SELECTION AND TESTING
IMPROVEMENT OF SEED SOURCES
PRODUCTION OF SEEDS/CUTTINGS
SPECIES LEVEL
PROVENANCE LEVEL
SINGLE TREE LEVEL
TIME
A1 COLLECT SEED SAMPLES OF SPECIES
A2 ESTABLISH SPECIES TRIALS
A3 EVALUATE SPECIES TRIALS
A4 EXPLORE PROVENANCES & COLLECT SEED SAMPLES
A5 ESTABLISH PROVENANCE TRIALS
A6 EVALUATE PROVENANCE TRIALS
A7 SELECT PLUS TREES & COLLECT SEED/CUTTINGS
A8 ESTABLISH PROGENY / CLONAL TRIALS
A9 EVALUATE PROGENY / CLONAL TRIALS
A10 NEXT GENERATION BREEDING
General collections from any source NO IMPROVE-MENT
Collect from best trees of local sources and upgrade stands
Establish seed stands locally of insufficient or threatened sources
Delineate provenances and upgrade existing sources
Establish conservation stands of threatened provenances
Establish seed stands locally of insufficient or threatened sources
Establish seed orchards and clone banks
Rogue seed orchards and clone banks
Establish new seed orchards and clone banks
SUPER SEEDS!
SEEDS/CUTTINGS FROM BEST PLUS TREES IN SEED ORCHARDS (ROGUED)
CUTTINGS
SEEDS FROM PLUS TREES IN SEED ORCHARDS (NOT ROGUED)
SEEDS ROM PLUS TREES IN STANDS OF BEST PROVENANCES (SEED PRODUCTION AREAS, CONSERVATION STANDS, SEED STANDS)
SEED FROM BEST PROVENANCES (SEED PRODUCTION AREAS, CONSERVATION STANDS, SEED STANDS
SEEDS FROM BEST SPECIES (BEST TREES/STANDS OF LOCAL OR OTHER WELL IDENTIFIED SOURCES)
SEEDS FROM COMMONLY USED SPECIES (BEST TREES / STANDS OF LOCAL SOURCES
SEEDS FROM COMMONLY USED SPECIES (ANY TREES OR ANY SOURCE)
BASE LINE OF GENETIC QUALITY
GRADES OF GENETIC IMPROVEMENT
Source: Ditlevsen et al. 1988