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PROPOSALS FOR A GLOBAL PROGRAMME FOR IMPROVED USE OF FOREST GENETIC RESOURCES

SUMMARY

The paper outlines the role of forest genetic resources in developing the world's forests, stresses the importance of international coordination and financing, and reviews past progress. It shows the inter-relationship between the field operations of Exploration, Collection, Evaluation, Conservation and Utilization and the importance of each to a balanced programme. It proposes a global programme for improved use of forest genetic resources and indicates the finance needed to cover the quinquennium 1975-79. The proposals cover the field operations noted above, as well as the supporting services of information dissemination, training, research, coordination and seed certification, and suggest potential sources of finance.

ABBREVIATIONS

AGPE	Crop Ecology and Genetic Resources Unit (Plant Production and Protection Division, FAO)
CCMFR	Committee for Coordination of Mediterranean Forestry Research
CFI	Commonwealth Forestry Institute (Oxford)
CGIAR	Consultative Group on International Agricultural Research
CTFT	Centre Technique Forestier Tropical (France)
DANIDA	Danish International Development Agency
EEC	European Economic Community
FAO	Food and Agriculture Organization of the United Nations
FDFR	Federal Department of Forest Research (Nigeria)
FGRI	Forest Genetic Resources Information
FRI	Forest Research Institute (Canberra)
IBDF	Instituto Brasileiro de Desenvolvimento Florestal
IBPGR	International Board for Plant Genetic Resources
IBRD	International Bank for Reconstruction and Development
INIF	Instituto Nacional de Investigaciones Forestales (Mexico)
ISS	Istituto Sperimentale per la Selvicoltura (Florence)
IUCN	International Union for the Conservation of Nature and Natural Resources
IUFRO	International Union of Forestry Research Organizations
MAB	Man and Biosphere (UNESCO Programme)
OECD	Organization for Economic Cooperation and Development
TAC	Technical Advisory Committee (of CGIAR)
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational Scientific and Cultural Organization

PROPOSALS FOR A GLOBAL PROGRAMME FOR IMPROVED USE OF FOREST GENETIC RESOURCES

I. INTRODUCTION

1. The basis for the present proposals was contained in the FAO Secretariat Note "Proposals for an International Programme for Improved Use of Forest Genetic Resources" (FO: FGR/3/4) presented to the Third Session of the FAO Panel of Experts on Forest Gene Resources (Rome, May 1974). The Panel endorsed the substance of the proposals, but suggested some condensation and revision. It accepted the cost figures as a realistic estimate of the financial resources required to implement the Programme, but noted that some of the detailed figures for country contributions should be considered as indicative only. It also noted that no allowance had been made for inflation. It recommended the revision of the paper, after revised estimates had been received from countries.

2. The present paper has been revised in the light of the Panel's comments and the latest information available, but certain country contributions remain indicative only. A factor for inflation of 15 percent per annum has been incorporated. The proposals cover the quinquennium 1975-79, but should be considered as only the first stage of a long-term programme which will need to be continued and expanded over several decades. They are limited to international aspects and do not include exclusively national efforts such as collection and transfer of propagating material within a single country.

3. The programme presented is considered practicable to implement and maintains a reasonable balance between the various operations. It has considerable flexibility. For example, in exploration/collection a reduction in available funds in a given period would reduce the number of species without affecting the value of the work in the species collected, while an increase in funds would make possible accelerated progress in the priority 2 and 3 species. In conservation, the establishment of a single 10 ha block on one site (estimated 1975 cost $400) for conservation and selection ex situ is a valuable and viable operation in itself, whether or not other provenances and species are established at the same time.

4. In the immediate future, the highest importance is attached to the establishment of a number of prototype conservation/selection stands ex situ, to a continuation and strengthening of current efforts in exploration and collection and to the implementation of workable projects for effective ecosystem conservation in situ.

II. BACKGROUND INFORMATION

5. A noteworthy feature of the present world forestry scene is the constant increase in the emphasis placed on man-made forest plantations, particularly of exotics. In 1965 the global area of man-made forests was estimated at about 80 million hectares and was expected to double in 20 years (FAO 1967). This increase in forest plantations is a result of the rising demand for wood at a time when forest land is being converted to agriculture and other uses. There is, therefore, a need to grow more wood on the reduced area of forest land still available. Some can be grown in natural forests, but their utilisable productivity, particularly in the tropics, is usually low. By combining the use of fast-growing, locally adapted species and provenances with careful evaluation of the planting site and intensive management, the forester may obtain up to ten times the production from fast-growing plantations as from natural forest.

6. Planting can be used for other purposes than wood production. Modern techniques of forest landscaping and the judicious use of different species afford the means to combine production with amenity in forestry, while in some regions the value of plantations for protective purposes, as shelterbelts or for watershed protection, outweighs the productive value. In suitable conditions the method of enrichment planting enables the forester to improve the value of natural forest without excessive exposure of the forest soil to insolation and mechanical compaction. Wherever it is used, artificial regeneration gives the opportunity to control the source of the seed and hence to affect the genetic quality of the future crop. Yet, this opportunity is too seldom realised.

7. The various phases or operations commonly recognized as essential steps to the fuller use of existing genetic resources are the following:

1. Exploration
2. Collection
3. Evaluation
4. Conservation
5. Utilization

These operations are common to both forest and agricultural crops, but the degree of emphasis accorded to each varies greatly from species to species. Afforestation, in contrast with animal and crop husbandry, is still concerned primarily with "wild" species. Thus exploration, followed by identification and use of the most productive seed source of a given species is an essential first step in the whole process of domestication and tree improvement. At the same time, the earlier phases all look forward to utilisation as their ultimate objective.

Exotics

8. Exotics play a dominant role in plantation forestry in many countries. *Pinus radiata* in New Zealand, Australia and Chile, *Pinus patula* in Africa, *Pinus elliottii* in South America, Australia and Africa, *Picea sitchensis* in Europe and *Eucalyptus* species in numerous countries in the tropics and sub-tropics are just a few examples out of many. These are exotics not only ecologically, in the sense that they did not grow naturally on the sites to which they have been introduced, but also nationally, in the sense that the seed for initial introduction had to be obtained from foreign countries.

9. Most introductions of exotics in the past have introduced only a small fraction of the total genetic variation within the natural range of the species. Choice of the original seed source has depended rather on seed availability than on adaptability to the new home. In many countries, not only has it been impossible to identify the most suitable provenances for large-scale planting, but in the past the supply of seed has been inadequate, even in the most important species, to allow local comparative testing of the necessary range of provenances. In some cases the very existence of potentially valuable provenances may be unknown.

International Aspects

10. The transfer of tree seed (or other propagating material) from one country to another, whether for small-scale testing in provenance trials, or as bulk supplies for large-scale planting, introduces an international element into seed procurement. This is compounded whenever a species occurs naturally in a number of different source countries and is in demand for introduction by a number of introducing countries. An idea of the extent of this international element may be obtained from the summary of recent progress contained in Appendix 1.

11. As pointed out by Kemp et al. (1972), some species are now of greater importance in the countries to which they have been introduced than in the countries where they are indigenous. Too often both the source and recipient countries lack the staff and funds

for exploration and seed collection. This applies particularly to some developing countries in the tropics and the sub-tropics which need to initiate large afforestation projects as quickly as possible. Only if coordinated international action can assist in the rapid identification of the most suitable seed sources, can such projects achieve their objectives efficiently.

12. Another cause for urgency is the danger of losing whole populations as a result of pressure to divert the land carrying natural stands to some other purpose (Kemp et al. 1972). Though the risk of an entire species of major forestry importance becoming extinct is small, there is a real danger that certain populations could vanish within a decade. Populations that occur at the limits of the species range or in isolated blocks are particularly vulnerable and may have high frequencies of genes, e.g. for drought resistance, which would be of value for marginal sites in countries of introduction.

13. Introductions of the type outlined above are for the purpose of selecting seed sources considered "superior" for a specific purpose or for growing on a specific site. In the long term the situation needs more flexibility. The forester cannot say with confidence which kind of trees should be planted in 50 years' time. So he must preserve his options, seeking out and preserving, not only a limited range of genetic resources considered superior for short-term objectives, but also the widest possible variation which can be used to fulfil needs, at present unpredictable. Tree breeders are fortunate in that many of the species with which they work are predominantly "wild", heterozygous and out-breeding. Long-term strategy must conserve as much of this genetic diversity as possible, in addition to improving the narrower gene pools suited to specific purposes.

14. The operations of exploration and collection, on which most emphasis has been placed recently, are particularly well suited to, and in need of, international support. At the same time, it has become clear that the other operations essential to integrated development - evaluation, conservation and utilization - will require increasing attention in the future.

15. Progress in development of improved forest gene resources will remain largely dependent on the active efforts of individual countries or research institutes, but these can only be fully effective in an international framework. Action so far taken has fallen far short of the needs. The proposals now made attempt to outline a realistic programme for future action and the resources required to implement it. It should be emphasized that this covers only the international aspects. These are small in comparison with the sum total of national efforts in tree improvement, but they are vital. Without the international catalyst national efforts can have only limited success.

III. PAST PROGRESS

III A. INTERNATIONAL COORDINATION

Consultative Group on International Agricultural Research (CGIAR)
International Board for Plant Genetic Resources (IBPGR)

16. The CGIAR has as its main purpose the mobilization of long-term financial support from international agencies, governments and private sources in order to cover gaps in agricultural research in developing countries. It was established in January 1971, under the joint sponsorship of the IBRD, FAO and UNDP. The IBPGR, one of the subsidiary bodies of the CGIAR, was established in February 1974 to provide coordination of international action in plant genetic resources and to recommend projects to the CGIAR for financing. During 1974, the first (partial) year of its operation, expenditure by the IBPGR was about US $40 000. Anticipated expenditure during 1975 was about $0.6 million, and budget proposals for 1976 amounted to $1.3 million. One member of the IBPGR is a forester (Monsieur P. Bouvarel of France).

Food and Agriculture Organization (FAO)

17. Although the then Forestry and Forest Industries Division had started financial support of exploration and collection activities a year or two before, it is convenient to take the FAO/IBP Technical Conference on the Exploration, Utilization and Conservation of Plant Genetic Resources (Rome, September 1967) as the starting point for FAO's recent activities in forest gene resources. Foresters made a significant contribution both to the Conference itself and to the book "Genetic Resources in Plants, their Exploration and Conservation" (Frankel & Bennett, 1970), which resulted. The Conference was valuable in drawing attention to the urgent need for action on gene resources and in identifying the various operations or phases which needed attention. It resulted in the formation of two panels of experts, one on forest gene resources and the other on plant exploration and introduction, and a modest increase of funds in FAO's Regular Programme for the purpose of supporting these activities.

18. The FAO Panel of Experts on Forest Gene Resources met in 1968, 1971 and 1974. During its first session (FAO 1969) it

i) decided to concentrate the expenditure of what modest funds were then available to FAO on the operations of exploration and collection;

ii) decided to use this money by supporting institutes already working actively and competently in this field, rather than by attempting to set up any new unit de novo;

iii) drew up a list of species by regions and classified into three priority classes;

iv) drew up an action programme allocating a tentative time scale for the exploration and collection expeditions required over the current decade.

v) proposed a sum of US $140,000 per biennium w.e.f. 1970/71 as the minimum required to implement this action programme.

The second session of the Panel confirmed and up-dated this action programme (FAO 1972).

19. The sums actually allocated for exploration and collection under FAO's Regular Programme from 1966 to 1975 are shown in Appendix 2. It can be seen that recent allocations fell considerably short of what the Panel recommended.

20 At its Third Session, the Panel endorsed proposals for a greatly expanded Global Programme for Forest Genetic Resources, which is described in Section IV (FAO 1974 b).

21. A recent additional contribution from FAO's Regular Programme has been the publication of "Forest Genetic Resources Information", by which information about activities in forest genetic resources is disseminated in three languages to a wide readership (FAO 1973 a, 1973 b, 1974 a). . The contribution of FAO staff working in field projects financed by the United Nations Development Programme is described in paragraph 28.

International Biological Programme (IBP)

22. IBP cooperated in the joint FAO/IBP Technical Conference in 1967. It was also responsible for the production of handbook No.11 entitled "Genetic Resources in Plants, their Exploration and Conservation", edited by O.H. Frankel and E. Bennett (1970). In addition to its specific contribution to plant genetic resources, IBP has also been active, through its section CT (Conservation of terrestrial communities) in the field of conservation in general. The purpose of the operations of that section were defined as "The establishment of the necessary scientific basis for a comprehensive world programme for safeguarding of areas of biological or physiographical importance for future scientists". An important part of this work has

been the IBP/CT survey of areas already being conserved or considered worthy of conservation. This work, however, has been concerned directly with the conservation of vegetation types or ecosystems, and not specifically with the gene pools of individual species.

International Union for the Conservation of Nature and Natural Resources (IUCN)

23. IUCN has published Vol. 5 on Angiospermae in its series of loose-leaf data books which cover endangered or rare species (IUCN 1970/71). As of September 1971 it contained 12 species classified as large trees (15 m or more in height) and 29 species classified as small trees (less than 15 m high). Apart from its work on endangered species IUCN plays an important role in ecological conservation in general through its compilation of lists of national parks, nature reserves, etc. and its formulation of criteria by which to judge and classify them. It has recently formed a new Threatened Plants Committee to intensify action in conservation.

International Union of Forestry Research Organization (IUFRO)

24. IUFRO's interest has been concentrated mainly on the research activity of evaluation (provenance trials). It was responsible for organizing the first international provenance trials in 1907 and further trials, which included replicated and randomised layouts, in 1938 and 1944. A list compiled by IUFRO in 1969 indicated the existence of international provenance trials covering 22 species, in which the number of participant countries ranged from 2 to 17 per species. It may be noted, however, that until the mid-1960s IUFRO provenance trials were confined almost entirely to temperate species. Only within the last 10 years has attention been turned towards the tropical and sub-tropical species which are likely to give considerably quicker results.

25. Since the 1960s IUFRO has paid considerable attention to the problems of exploration and seed procurement, operations which are essential to the efficient conduct of provenance trials. Since the working group on procurement of seeds started operations in 1966, it has achieved notable results in the collection of important conifers from North America, such as Douglas fir, Sitka spruce and Contorta pine. Seed of these species has been widely distributed in the temperate zones. From the nature of their geographical distribution, countries benefiting from this operation have included more developed than developing.

26. After the recent reorganization of IUFRO a special subject group was formed in Division 2, which is concerned with Species, Provenances and Gene Resources. It includes one working party which deals specifically with Conservation of Forest Gene Resources.

Organization for Economic Cooperation and Development (OECD)

27. Proposals for "The OECD System for the Control of Forest Reproductive Materials Moving in International Trade" have been under discussion for some years. The latest version of these proposals constitutes a useful set of guidelines on seed certification and related matters, but few countries even among OECD Members have implemented it yet.

United Nations Development Programme (UNDP)

28. The Administrator of the UNDP expressed support to the FAO/IBP 1967 Technical Conference on Plant Genetic Resources. With their wide distribution through developing countries, UNDP projects are excellently placed to assist in international seed procurement. An example of a recent contribution from a UNDP project executed by FAO has been the collection of *Araucaria angustifolia* provenances in Brazil. This was carried out by FAO and Brazilian counterpart project staff, with financial support from FAO's regular programme. UNDP has also financed several training courses in forest tree improvement.

29. Proposals for a UNDP Global Research Project on Forest Genetic Resources, as recommended by the 15th IUFRO Congress and the 7th World Forestry Congress, were submitted by FAO in

1972, but the UNDP decided that a programme for forest genetic resources, together with plant genetic resources, would be more appropriately considered by the IBPGR for possible financing by the Consultative Group and other organizations (see paragraph 16).

United Nations Environment Programme (UNEP)

30. UNEP has already indicated its interest in forest genetic resources by agreeing to finance in 1974 a short-term project entitled "Methodology of Conservation of Forest Genetic Resources". A follow-up of this project, in the shape of a two year project request entitled Conservation of Forest Genetic Resources, has been submitted to UNEP for financing. UNEP's primary concern is in the field of genetic conservation.

United Nations Educational Cultural and Scientific Organization (UNESCO)

31. UNESCO has recently formulated project 8 within its programme for Man and the Biosphere (MAB). Project MAB 8 is entitled "The conservation of natural areas and of the genetic material they contain". It should be noted that this project could play a leading role in the conservation of forest gene resources *in situ*, but would not be concerned with conservation *ex situ*. One section of the report of a recent meeting under this project was devoted to "Conservation of Genetic Diversity" (UNESCO 1973).

Bilateral Contributions to International Action

32. Bilateral aid contributions to exploration and collection of forest gene resources have been considerable over the past five years. The Danish, French and U.K. governments have well integrated programmes in this field, and other governments contribute indirectly through the activities of staff whose salaries come entirely from their own governments (e.g. Australia, Mexico). It is difficult to assess the exact contribution in monetary terms, but it is certainly over 80,000 dollars a year, three to four times the average direct annual rate of contribution of FAO to exploration and collection over the same period. At the same time it is worth remarking that at present only a few of the major donor countries are engaged directly in this valuable work.

III B. RECENT PROGRESS IN FIELD OPERATIONS

33. Brief notes on the needs and implications of the various field operations are in Section IV A. The following section refers only to recent progress.

Exploration/Collection

34. As noted above (paragraph 18), the Panel of Experts on Forest Gene Resources, at its first meeting in 1968, decided that the limited funds which it expected would be available to FAO should be concentrated entirely on exploration and collection. It did so on the grounds that only after exploration had sharpened knowledge of natural variation and endangered populations while evaluation provided experience on comparative performance in new environments, would there be the requisite firm basis on which to plan action for conservation and utilization.

35. A summary of the most important recent collections is in Appendix 1, and fuller details appear in the Report of the Third Session of the Panel (FAO 1974 b). Although it has not been possible to achieve all that was planned, the policy of concentrating funds on exploration and collection of a restricted number of important species has led to some solid progress. It is significant that in provenance trials of *Tectona* a number of seed sources have been used which originated from introductions of the species. The importance of exotic plantations as readily accessible and locally adapted sources of seed ("land-races") is likely to increase rapidly. Recent work in *Eucalyptus camaldulensis* has included re-collection of provenances such as Petford and Lake Albacutya which showed superiority for certain sites in earlier trials.

36. For a few species the initial phase of exploration and collection for the purpose of evaluation is complete and the way is open for more attention to be paid to conservation and to studies on individual selection and breeding.

Evaluation

37. A large part of the collections listed in Appendix 1 has already been distributed to interested countries for testing. In a number of cases the institutes responsible for the distribution of seed for provenance trials have recommended testing procedures for cooperating countries (e.g. Lacaze 1970, Burley and Turnbull 1970, Keiding 1972). Responsibility for the conduct of the trials, including finance, is that of the countries in which they are placed.

38. The majority of provenance trials resulting from recent seed collections are too young to have yielded useful information. A notable exception is the series of trials coordinated by FAO's Committee of Forestry Research in the Mediterranean using the fast-growing species Eucalyptus camaldulensis, of which the seed was collected in 1965. They show that Eucalyptus camaldulensis not only exhibits big differences in performance between different provenances but also a clear interaction between provenance and site, and thus confirm that provenance research is as important for tropical as for temperate species.

Conservation

39. No funds for conservation were provided in FAO's action programme and there is little progress to report. In IUFRO the recently formed working party on conservation of forest gene resources has already produced a number of data sheets on rare or endangered species of forest importance, which provide the basic information essential to effective conservation, while IUCN has continued to add sheets to its Red Data Book No. 5.

Utilization

40. No funds for utilization were provided in FAO's action programme and there is little progress to report at the international level; but a number of countries have improved their arrangements for bulk seed supply and have made good progress in their national tree breeding programmes.

41. A detailed proposal for international exchange of improved material from seed orchards of an important species, Pinus caribaea, has recently been published (Nikles 1973); in the past, exchange between countries has been made on an ad hoc basis.

III C. PROGRESS IN ANCILLARY ACTIVITIES

Information

42. At its second session in 1971 the FAO Panel of Experts on Forest Gene Resources noted that the impact of successful activities in exploration and collection had been reduced because information on what had been done and what was planned did not reach the right people at the right time. It therefore requested FAO's Forestry Department to produce a newsletter type of publication at recurrent intervals. With this number, four issues of "Forest Genetic Resources Information" have been prepared to date. The intention is to publish information as and when it is available, without attempting to fulfil a set number of issues per year.

Data Storage/Retrieval

43. At its second session the FAO Panel of Experts on Forest Gene Resources considered that it was then premature to attempt a standardised system of data recording for forest gene resources until the methods used, both in agricultural crop data recording and in general

forest data recording, had been defined more clearly.

44. The amount of data now becoming available from provenance and other genetic trials, which are being established every year, has increased the need to devise systems for computerised storage of information on an international basis. Recent developments which should stimulate more rapid progress in the future are (a) Strengthening of FAO's Crop Ecology and Genetic Resources Unit, with particular reference to the plant information and retrieval system TAXIR; (b) Development at the Commonwealth Forestry Institute (CFI) Oxford of proposals for INTFORPROV - computer-based data banks for international, tropical provenance experiments (Burley, Andrew and Templeman 1973).

Training

45. Training courses on forest tree improvement were held in Raleigh, North Carolina, USA (financed by UNDP) in 1969, in Sopron, Hungary (financed by UNDP) in 1971 and in Limuru, Kenya (financed by DANIDA) in 1973. A training course on forest seed collection and handling (financed by DANIDA) was held in Chiang Mai, Thailand, in 1975. In a related field it should be noted that the Department of Botany, University of Birmingham, England, now offers a one year M.Sc. course in conservation and utilisation of plant genetic resources.

IV. A GLOBAL PROGRAMME FOR FOREST GENETIC RESOURCES

A. NOTES ON PROGRAMME

Sequence

46. In producing the 5 year Action Programme which appears as Section IV B (pages 16 - 50), the following sequence was followed:

(1) Identify species and field operations on which action is required over the next two decades.

(2) Assign relative priority to the various combinations of species/field operation where possible. See Table 6.

(3) Incorporate the high priority species/field operations into the 5 year Action Programme (1975-79).

(4) Incorporate general activities (training, information, etc.) into the programme.

(5) Estimate costs of the various projects separately.

(6) Identify institutes capable of assuming operational responsibility for the various projects.

(7) Identify projects likely to be financed by existing and on-going programmes.

(8) Suggest possible sources of finance for projects not covered by existing and on-going programmes.

Species

47. An up-to-date list of species on which action is necessary appears in Table 6. It is based on earlier lists drawn up by the Panel of Experts on Forest Gene Resources at its first and second sessions and was brought up-to-date at the Panel's third session in May, 1974 (FAO, 1974 b).

Field Operations

48. At its first two sessions the Panel considered species priorities in the operations of exploration and collection only. As a result of progress in these operations, it was able at its Third Session to consider the relative priority of a number of possible field operations for each species, in addition to its long-term economic importance. The priorities are given in Table 6, the form of which was derived from the model shown in Fowler and Yeatman (1973). In many cases there is insufficient knowledge to fill in the priority of a particular field operation, since this may depend on the result of a previous operation not yet completed, e.g. action to conserve endangered populations depends on knowledge of conservation status gained from earlier exploration.

49. The following field operations are shown separately:

1. Botanical Exploration

50. This is taken to include the correct taxonomic identification of species and knowledge of the limits of its distribution, with particular reference to isolated occurrences. For some species adequate information on this has been available well before the start of genecological exploration, for others it may be necessary to combine the two operations together. In the past botanical exploration has often led to species trials, as genecological exploration now leads to provenance trials.

2. Genecological Exploration

51. This is taken to include the study of patterns of ecological and phenotypic variation within the natural range. It leads directly to provenance seed collecting.

3. Collection for the Purpose of Evaluation

52. This follows from and can to some extent be combined with genecological exploration. The purpose is to collect relatively small samples of seed from each of a relatively large number of seed sources, covering the whole natural distribution, for evaluation. In the initial stage collections comprise range-wide sampling on a fairly coarse grid. In some cases a second stage, sampling a limited part of the range on a finer network, may be called for, perhaps ten or fifteen years later, after the results of the first stage provenance trials are available.

4. Evaluation (Provenance Trials)

53. As a rule collection of range-wide samples for provenance testing should be followed by immediate establishement of the trials themselves. In some cases, where a country has not the necessary trained staff to carry out the trials at once, the collection may need to be held in seed store for a few years until the necessary meticulous supervision for the trials can be assured.

54. Finance to cover the costs of provenance trials has been omitted from the proposed programme in Section IV B on the grounds that it should be an integral part of each country's afforestation programme and hence a national rather than an international responsibility. As such it may qualify, in a developing country, for bilateral or multilateral technical assistance.

55. International assistance is desirable through the provision of standardised procedures for the design, layout, assessments and analysis of results. This can best be done by the institute or organization which collects and distributes the seed. As the volume of information from provenance trials becomes ever greater, the need for internationally accepted programmes for computerised storage and retrieval of the information will become imperative.

5. Conservation in situ

56. Conservation in situ, as part of a viable natural ecosystem, is the most desirable method of conserving forest genetic resources, provided that the area can be given full protection and provided that the genetic resources are available for collection and use both within and outside the country of origin. Where the exploration phase has indicated that conservation in situ is both practicable and desirable, the necessary action to make this conservation a reality must be taken as soon as possible. This involves the passing of legislation, the marking of boundaries, and measures for effective protection, as well as some action in the field of public relations and education. Much of this must be done by the government of the country itself, but international assistance may be required, particularly in training. The period required to get effective conservation in situ into operation is likely to be considerably longer than that required to collect bulk quantities of seed for conservation ex situ.

57. The most logical approach to conservation in situ is to combine the conservation of the ecosystem with the conservation of the genetic resources it contains. Some conflict may arise in the case of the strict "inviolable" nature reserve in which even seed collection may be forbidden, but a compromise can usually be effected through the use of several zones of varying intensity of management.

58. Little is known about the minimum area needed to form a viable unit for conservation, either of the ecosystem or of the genetic resources, and a great deal more research is needed. For genetic conservation it is important to conserve a range of different provenances. A single large reserve in the centre of the range of a species is usually less effective than several smaller reserves covering a greater part of the variation among provenances.

6. Collection for Conservation/Selection ex situ

59. Where the exploration phase has shown that certain populations are endangered but that conservation in situ is not likely to be possible, action to effect conservation ex situ must be taken at once. Collection for conservation ex situ involves the early collection of substantial quantities of seed of an endangered provenance either for temporary storage as seed or for immediate establishment of artificial stands on new sites. Similar procedures and quantities are required if selection and breeding, rather than conservation, are the primary purpose of the ex situ stands. (See Section 10 for information on individual selection and breeding.)

7. Storage as Seed, Research on Seed and on Floral Biology

60. Storage of forest reproductive materials, most commonly of seed, is not only an important means of conserving genetic resources but is often needed temporarily before evaluation and utilisation. It is here included under field operations, since it forms an essential link between collection and the later field operations. The provision of seed, both source identified and of known adaptability to new sites, is expensive; but much of the benefit can be lost if the seed does not receive meticulous handling and storage. For many species, particularly in the tropics, there is inadequate knowledge of this subject, therefore research must be augmented immediately and will need additional finance. In the related fields of floral biology, pollination and fertilisation, still less is known about most tropical species, and research needs to be initiated at once.

8. Conservation ex situ

61. The establishment of artificial stands outside the natural range, but with a good prospect of long-term conservation, is a highly promising method of conserving gene pools. It requires careful siting and meticulous standards of site preparation, planting and tending. The cost per unit area must therefore be appreciably higher than that of normal plantation establishment. Since the stands should be at least 10 ha. each in area, this

is an expensive operation. Some developing countries may be unable to cover the cost from their own resources, therefore bilateral or international aid funds should be freely available. The establishment period will average about five years, after which it is expected that normal maintenance can be carried out by the local forest service from its own resources. A possible arrangement could be that, in return for financial assistance in the establishment period, the countries in which stands are planted should agree to make 50% of the eventual seed harvest available to other interested countries. The stands would often serve for selection and further breeding as well as for conservation.

62. A combination of in situ and ex situ conservation may be the solution in some species, certain provenances being suitable for permanent conservation in their natural ecosystems while others must be transferred to a new home if they are to survive.

9. Utilisation of Bulk Supplies

63. As information becomes increasingly available from provenance trials as to the most suitable seed source for a given planting site, emphasis will switch to the utilisation of bulk supplies of these locally adapted provenances for large-scale plantation establishment. Bulk seed supply should be the responsibility primarily of Government Forest Services or commercial seed merchants, but international involvement in ensuring common standards of quality and control through regional seed certification schemes will be essential. Artificial plantations of locally adapted "land races" will play an increasing part in future bulk seed supplies and offer better opportunities for quality control than natural stands.

10. Individual Selection and Breeding

64. Individual selection and breeding within locally adapted provenances provide a method of achieving additional improvement in productivity. In the case of exotics, an important interim stage between successful provenance trials and large-scale afforestation with the best-adapted provenances may be the establishment of one or more substantial blocks (minimum area 10 ha. each) of these provenances to act as seed stands and as a basis for local selection and breeding. The same stands may combine the purposes of ex situ conservation and selection. For some provenances, difficulties in seed procurement may be due to inaccessibility of the natural stands and the excess of seed demand over supply rather than to genetic erosion. Although effective conservation of the provenance in situ may be assured in such cases, establishment of selection stands in the introducing country is still essential and merits the same degree of financial assistance to developing countries as described above for ex situ conservation stands. For the purpose of estimating costs (Table 4 in Section IV B), selection and conservation ex situ stands are considered together.

65. Though programmes of tree improvement are well advanced in a few species, e.g. poplars and the southern pines of the U.S.A., in many others of high potential they have scarcely started. As with provenance trials, research and multiplication should be the primary responsibility of individual countries, but continuing international action will be needed to stimulate and coordinate exchange between countries of reproductive material from superior genotypes assessed to a common standard. While most countries will probably make most use of their own superior material, it is expected that 25 to 30 percent of superior material might come from overseas in order to maintain a suitably wide genetic base in the long-term programme.

66. For the establishment of seed orchards in developing countries planned to serve regional needs, a similar approach is proposed as for conservation stands ex situ (see paragraph 61) - substantial financial support from international or bilateral sources to cover the costs of the establishment period, in return for which 50 percent of seed harvest from the orchard should be made available to other countries.

Priorities

67. Three priority classes are used in Table 6. Though the distinctions between them are somewhat arbitrary, their approximate time-scale equivalents are:

Priority 1 (highest)	Action should start (or be continued) in quinquennium 1975-79 at latest
Priority 2	Action should start in quinquennium 1980-84 at latest
Priority 3	Action should start in quinquennium 1985-89 at latest.

Continuing Regional Programmes

68. Recent experience has stressed the advantages of a continuing regional programme in exploration and collection, in preference to single expeditions. It is essential in order to provide adequate coverage of a wide-ranging species. It also allows maximum flexibility in switching operations from collection for evaluation to collection for conservation or from one species to another, when completion of one stage or the vagaries of seed years makes it desirable. A strong continuing regional programme may justify exploration and collection of priority 2 species in that region before priority 1 species in another region where there is no continuing programme.

Time-scale for Field Operations

69. The period needed to complete each field operation must vary considerably according to species. Appendix 3 shows an estimated time-scale for a typical tropical pine such as Pinus caribaea. Of particular note is the period needed for the initial operations of genecological exploration and collection for evaluation - 3 years. This period was found necessary not only for tropical pines in Central America but also for Douglas Fir in western North America. Where collection for conservation ex situ is shown to be necessary, a further two years should be allowed for this.

Ancillary Activities

70. The above field operations will be concerned directly with individual species. More general activities which are essential to a balanced programme for forest genetic resources and which are included in the proposals in Section IV B comprise:

(1) Information services
(2) Data storage/retrieval
(3) Training
(4) Regional seed certification schemes
(5) Overall coordination

Operational Responsibility

71. Competence in field operations is essential. In some cases forest institutes already operating an active programme can be assigned responsibility with confidence. These are indicated in the tables. In some regions it may be difficult to find an existing institute suitable to carry out operations; in such cases it will be necessary to appraise the need to establish new regional forest gene centres, which might be attached to existing forestry or agricultural research centres. Funds to cover the appraisal are included in Tables 1a and 1b of the global programme.

Sources of Finance

72. Sources of finance which are already supporting the current programme in forest gene resources and which can be expected, with some confidence, to continue financial support

in the period 1975-79 are indicated in the tables by the symbol *. Possible new sources of finance have been suggested in accordance with known spheres of interest, e.g. UNEP is likely to be particularly concerned with conservation aspects while CGIAR is likely to lay emphasis on research needs.

Incomplete Estimates

73. Certain cost estimates are incomplete or tentative. These are shown in parentheses.

Summary of tables in Section IV B

74. Table 1a shows the global costs broken down by operation, with an indication of the proportion of cost to be borne by (1) hopefully continuing programmes (2) new finance. Table 1b indicates the estimated cost of the programme and suggests sources of funds, with a breakdown by operation under each proposed contributor. Tables 2 and 3 give a regional breakdown for the two operations of Exploration and collection for the purpose of evaluation (Table 2) and Collection for the purpose of conservation ex situ (Table 3). Table 4 gives additional information on the operation for Establishment of conservation/selection stands ex situ, while Table 5 summarises action to be taken for establishment and maintenance of Strict Natural Reserves for conservation in situ. Table 6 is a comprehensive list of the priorities of the programme by region, species and operation.

Inflation

75. In estimating costs, an annual rate of inflation of 15% has been assumed.

IV B. PROPOSED PROGRAMME 1975-79

Table 1a

SUMMARY OF GLOBAL PROGRAMME BY OPERATIONS

Note: 1 = Funds expected to be available from continuation of existing programme
2 = Additional funding required from new sources.

Operation		1975	1976	1977-79	Total 1975-79
Explore/Collect for evaluation	1	205	232	929	1366
	2	36	49	223	308
	Total	241	281	1152	1674
Collect to conserve	1	25.5	29.5	120	175
	2	(33)	(62)	(358)	(453)
	Total	(58.5)	(91.5)	(478)	(628)
Conserve *ex situ*	1	–	–	–	–
	2	90	156	290	536
	Total	90	156	290	536
Conserve *in situ*	1	–	–	–	–
	2	40	120	460	620
	Total	40	120	460	620
Training	1	68	9	117	194
	2	8	9	37	54
	Total	76	18	154	248
Data storage/retrieval	1	–	–	–	–
	2	30	70	150	250
	Total	30	70	150	250
Flowering/seed research	1	5	6	24	35
	2	25	60	165	250
	Total	30	66	189	285
International seed orchards	1	–	–	–	–
	2	40	70	140	250
	Total	40	70	140	250
Seed certification	1	–	–	–	–
	2	–	5	18	23
	Total	–	5	18	23
Appraise need for regional centres	1	–	–	–	–
	2	–	50	–	50
	Total	–	50	–	50
Information services	1	8	9	37	54
	2	–	25	35	60
	Total	8	34	72	114
Coordination (including panel meetings)	1	25	30	139	194
	2	–	36	145	181
	Total	25	66	284	375
Total	1	336.5	315.5	1366	2018
	2	302	712	2021	3035
	Total	638.5	1027.5	3387	5053

Table 1b

ESTIMATED COST OF GLOBAL PROGRAMME FOR IMPROVED USE OF FOREST GENETIC RESOURCES AND PROPOSED SOURCES OF FUNDS

Operations and proposed sources of funds	Estimated cost (thousand dollars) 1975	1976	1977-79	Total 1975-79	Remarks
UNEP					
Collection for conservation/selection *ex situ*	6	17	102	125	See Table 3
Conservation/selection *ex situ*	56	107	193	356	See Table 4
Conservation *in situ*	20	60	230	310	See Table 5
Dissemination of information	-	25	35	60	Publication of data sheets on endangered species and of manual on overall strategy for improving international use of forest genetic resources. Operational responsibility: IUFRO
Total	82	209	560	851	
CGIAR					
Exploration/collection for evaluation	15	18	70	103	See Table 2
Data storage/retrieval research	30	70	150	250	Operational responsibility: a suitable institute/university combining expertise on data storage/retrieval and on forest genetic resources. Must be closely integrated with similar research and development for crop plants
Establishment of prototype conservation selection stands *ex situ*	15	20	28	63	See Table 4
Establishment of prototype international seed orchards	40	70	140	250	Species - *Pinus caribaea* var. *hondurensis*. Operational responsibility-forest services or research institutes in selected countries
Coordination, training	-	30	120	150	
Appraisal of the need for international forest gene centres	-	50	-	50	By consultants
Total	100	258	508	866	

Table 1b(cont'd)

Operations and proposed sources of funds	Estimated cost (thousand dollars). 1975	1976	1977-79	Total 1975-79	Remarks
FAO					
Exploration/collection for evaluation *	21	30	124	175	See Table 2
Dissemination of information *	8	9	37	54	Production of "Forest Genetic Resources Information"
Panel meetings*	-	1	24	25	
Coordination, training	25	35	140	200	
Total	54	75	325	454	Sub-programme 2.2.3.2 in current programme of work
UNDP (excluding contributions through CGIAR)					
Training fellowships*	8	9	37	54	
Field work on individual country projects	?	?	?	?	Included below with developing countries/UNDP
Total	(8)	(9)	(37)	(54)	
UN Regional Economic Commissions					
Advice on creation/ improvement of regional seed certification schemes	-	5	18	23	By consultants
Total	-	5	18	23	
Australia*					
Exploration/collection for evaluation	39	45	179	263	See Table 2
Collection for conservation/selection ex situ	4	4	17	25	See Table 3
Total	43	49	196	288	
Denmark*					
Exploration/collection for evaluation	20	23	92	135	See Table 2
Collection for conservation/selection ex situ	10	12	48	70	See Table 3
Seed handling research	5	6	24	35	Conducted at Danish/FAO Seed Centre Humlebaek
Training	60	-	80	140	
Total	95	41	244	380	

Table 1b(cont'd)

Operations and proposed sources of funds	Estimated cost (thousand dollars) 1975	1976	1977-79	Total 1975-79	Remarks
East Africa					
Exploration/collection for evaluation*	4	5	17	26	See Table 2
Collection for conservation/selection ex situ*	0.5	0.5	2	3	See Table 3
Conservation/selection ex situ*	1	2	6	9	See Table 4
Conservation in situ	10	12	46	68	See Table 5
Total	15.5	19.5	71	106	
France*					
Exploration/collection for evaluation	15	6	23	44	See Table 2
Collection for conservation/selection ex situ	-	2	18	20	See Table 3
Total	15	8	41	64	
India					
Exploration/collection for evaluation*	10	12	48	70	See Table 2
Collection for conservation/selection ex situ*	10	12	48	70	See Table 3
Conservation/selection ex situ	5	4	10	19	See Table 4
Conservation in situ	10	12	46	68	See Table 5
Total	35	40	152	227	
Mexico					
Exploration/collection for evaluation	8	9	37	54	See Table 2
Collection for conservation/selection ex situ	-	3	27	30	See Table 3
Conservation/selection ex situ	-	2	3	5	See Table 4
Total	8	14	67	89	
Nigeria					
Exploration/collection for evaluation*	5	6	23	34	See Table 2
Collection for conservation/selection ex situ	-	2	18	20	See Table 3
Conservation/selection ex situ	3	4	11	18	See Table 4
Total	8	12	52	72	

Table 1b(cont'd)

Operations and proposed sources of funds	Estimated cost (thousand dollars) 1975	1976	1977-79	Total 1975-79	Remarks
U.K. *					
Exploration/collection for evaluation	20	23	92	135	See Table 2
Collection for conservation/selection ex situ	15	17	70	102	See Table 3
Total	35	40	162	237	
Other Bilateral Aid					
Exploration/collection for evaluation	-	5	16	21	See Table 2
Collection for conservation/selection ex situ	-	2	13	15	See Table 3
Flowering and Seed research	25	60	165	250	Both financial and operational responsibility-donor country with suitable expertise. Substancial part of research should be located in tropics
Conservation/selection ex situ *	1	2	6	9	
Training fellowships	8	9	37	54	
Total	34	78	237	349	
Developed countries (self-financing)					
Exploration/collection for evaluation*	62	73	285	420	See Table 2
Collection for conservation/selection ex situ*	(7)	(9)	(45)	(61)	See Table 3
Total	(69)	(82)	(330)	(481)	
Other developing countries (with/without UNDP assistance)					
Exploration/collection for evaluation	22	26	146	194	See Table 2
Collection for conservation/selection ex situ	6	11	70	87	See Table 3
Conservation/selection ex situ	9	15	33	57	See Table 4
Conservation in situ	-	36	138	174	See Table 5
Total	37	88	387	512	
Grand Total	(638.5)	(1027.5)	(3387)	(5053)	

Table 2 - EXPLORATION AND COLLECTION FOR THE PURPOSE OF EVALUATION

+ Note: Based on priorities given in Table 6.

Country/Region	Number of species+ Priority 1	Number of species+ Priority 2	Proposed sources of funds	Estimated cost (thousand dollars) 1975	1976	Total 1977-79	Total 1975-79	Operational responsibility
1. Canada/USA	8	9	FAO *	3	3	14	20	IUFRO, individual countries/ UNDP
			Developed countries *	25	29	116	170	
			Developing countries/UNDP	-	-	40	40	
			Total requirement	28	32	170	230	
2. Mexico	2	8	FAO *	5	6	24	35	INIF Mexico, bilateral aid or UNDP
			Mexico (INIF)*	8	9	37	54	
			Bilateral aid or UNDP	-	5	16	21	
			Total requirement	13	20	77	110	
3. Central America	1	11	FAO *	-	6	24	30	CFI, Oxford
			UK *	20	23	92	135	
			Total requirement	20	29	116	165	
4. South America	1	6	CGIAR	5	6	24	35	Countries/UNDP
			Developing countries/UNDP *	8	9	38	55	
			Total requirement	13	15	62	90	
5. Northern and Central Europe	1	-	Developed countries *	20	23	92	135	IUFRO, developed countries
			Total requirement	20	23	92	135	
6. Mediterranean	5	5	FAO *	3	3	14	20	Committee on the Coordination of Mediterranean Forestry Research
			Developed countries *	5	6	23	34	
			Developing countries*/UNDP	5	6	25	36	
			Total requirement	13	15	62	90	

Table 2 (cont'd)

Country/Region	Number of species+ Priority 1	Number of species+ Priority 2	Proposed sources of funds	Estimated cost (thousand dollars) 1975	1976	Total 1977-79	Total 1975-79	Operational responsibility
7. Africa	13	5	CGIAR	6	7	28	41	FDFR Nigeria, CTFT France
			East Africa*	4	5	17	26	
			France (CTFT)*	5	6	23	34	
			Nigeria (FDFR)*	5	6	23	34	
			Total requirement	20	24	91	135	
8. North and Central Asia	7	12	CGIAR	4	5	18	27	Countries/UNDP
			Developed countries	12	15	54	81	
			Developing countries/UNDP	4	5	18	27	
			Total requirement	20	25	90	135	
9. South and S.E. Asia	7	3	FAO *	5	6	24	35	Danish/FAO Seed Centre, FRI Canberra, CTFT France, FRI Dehra Dun, Countries/UNDP
			Denmark*	20	23	92	135	
			Australia*	15	17	69	101	
			France*	10	-	-	10	
			India*	10	12	48	70	
			Developing countries/UNDP	5	6	25	36	
			Total requirement	65	64	258	387	
10. Australia	34	51	FAO *	5	6	24	35	FRI Canberra
			Australia *	24	28	110	162	
			Total requirement	29	34	134	197	

Table 2 (cont'd)

Country/Region	Number of species+ Priority 1	Number of species+ Priority 2	Proposed sources of funds	Estimated cost (thousand dollars) 1975	1976	Total 1977-79	Total 1975-79	Operational responsibility
11. Global totals by proposed sources of funds			FAO *	21	30	124	175	
			CGIAR	15	18	70	103	
			Australia*	39	45	179	263	
			Denmark*	20	23	92	135	
			East Africa*	4	5	17	26	
			France	15	6	23	44	
			India*	10	12	48	70	
			Mexico*	8	9	37	54	
			Nigeria*	5	6	23	34	
			U.K. *	20	23	92	135	
			Other bilateral aid	-	5	16	21	
			Developed countries (self-financed)	62	73	285	420	
			Other Developing countries (with/without UNDP assistance)	22	26	146	194	
GRAND TOTAL				241	281	1152	1674	

Table 3 - COLLECTION FOR THE PURPOSE OF CONSERVATION/SELECTION EX SITU

+ Note: Based on priorities given in Table 6.

Country/Region	Number of species+ Priority 1	Number of species+ Priority 2	Proposed sources of funds	Estimated cost (thousand dollars) 1975	1976	Total 1977-79	Total 1975-79	Operational responsibility
1. Canada/USA	1	-	Developed countries	?				Developed countries. In a number of cases conservation in situ may be more appropriate
2. Mexico	11	10	UNEP	-	2	18	20	INIF, Mexico, bilateral aid
			Mexico (INIF)	-	3	27	30	
			? Bilateral aid or UNDP ?	-	2	13	15	
			Total requirement	-	7	58	65	
3. Central America	7	3	UNEP	-	4	14	18	CFI Oxford
			U.K. *	15	17	70	102	
			Total requirement	15	21	84	120	
4. South America	1	3	UNEP	-	2	18	20	Countries/UNDP
			Developing countries/UNDP	-	3	27	30	
			Total requirement	-	5	45	50	
5. North and Central Europe	-	-	Developed countries	?				Developed countries. In a number of cases conservation in situ may be more appropriate
6. Mediterranean	6	-	UNEP	1	2	12	15	Committee on the Coordination of Mediterranean Forestry Research
			Developed countries	1	3	21	25	
			Developing countries/UNDP	1	3	21	25	
			Total requirement	3	8	54	65	

Table 3 (cont'd)

Country/Region	Number of species+ Priority 1	Priority 2	Proposed sources of funds	Estimated cost (thousand dollars) 1975	1976	Total 1977-79	Total 1975-79	Operational responsibility
7. Africa	12	3	UNEP	-	2	18	20	FDFR Nigeria, CTFT France
			East Africa *	0.5	0.5	2	3	
			France (CTFT)	-	2	18	20	
			Nigeria (FDFR)	-	2	18	20	
			Total requirement	0.5	6.5	56	63	
8. North and Central Asia	2		UNEP	2	2	8	12	Countries/UNDP
			Developed countries	6	6	24	36	
			Developing countries/UNDP	2	2	8	12	
			Total requirement	10	10	40	60	
9. South and S.E. Asia	4	1	UNEP	3	3	14	20	Danish/FAO Seed Centre, FRI, Canberra, Countries/UNDP
			Denmark *	10	12	48	70	
			Australia	3	3	14	20	
			India	10	12	48	70	
			Other developing countries/ UNDP	3	3	14	20	
			Total requirement	29	33	138	200	
10. Australia	2	2	Australia	1	1	3	5	Australia. In a number of cases conservation in situ may be more appropriate
11. Global totals by proposed sources of funds			UNEP	6	17	102	125	
			Australia	4	4	17	25	
			Denmark *	10	12	48	70	
			East Africa *	0.5	0.5	2	3	
			France	-	2	18	20	
			India	10	12	48	70	
			Mexico	-	3	27	30	
			Nigeria	-	2	18	20	
			U.K. *	15	17	70	102	
			Other bilateral aid	-	2	13	15	
			Developed countries self financing	(7)	(9)	(45)	(61)	
			Other Developing countries with/without UNDP assistance	6	11	70	78	
GRAND TOTAL				(58.5)	(91.5)	(478)	(628)	

Table 4 - ESTABLISHMENT OF PROVENANCE CONSERVATION/SELECTION STANDS EX SITU

+ Additional finance needed in 1980 to cover 5 year establishment period
o Additional finance needed in 1980 and 1981 to cover 5 year establishment period

Species and area etc.	Proposed "Host" Countries	Proposed sources of funds	Estimated cost (thousand dollars) 1975	1976	Total 1977-79	Total 1975-79	Operational responsibility	Remarks
1. Eucalyptus camaldulensis	1. Nigeria	CGIAR (direct costs)	5	5	6	16	Introducing Countries	Prototype Stands for refining techniques and costings
		Nigeria (supervision)	1	1	2	4		
2 sites per country	2. India	CGIAR (direct costs)	5	5	6	16		
2 provenances per site		India (supervision)	1	1	2	4		
10 ha per provenance plot	3. Ivory Coast	CGIAR (direct costs)	5	5	6	16		
		Ivory Coast (supervision)	1	1	2	4		
	4. Sudan	CGIAR (direct costs)	-	5	10	15+		
		Sudan (supervision)	-	1	2	3+		
	Total - Euc. camaldulensis		18	24	36	78		
2. Eucalyptus tereticornis	1. Nigeria	UNEP (direct costs)	-	-	13	13o	Introducing Countries	
		Nigeria (supervision)	-	-	3	3o		
2 sites per country	2. India	UNEP (direct costs)	-	5	10	15+		
2 provenances per site		India (supervision)	-	1	2	3+		
10 ha per provenance plot	3. Congo	UNEP (direct costs)	-	-	13	13o		
		Congo (supervision)	-	-	3	3o		
	4. Sudan	UNEP (direct costs)	-	5	10	15+		
		Sudan (supervision)	-	1	2	3+		
	Total - Euc. tereticornis		-	12	56	68		

Table 4 (cont'd)

Species and area etc.	Proposed "Host" Countries	Proposed sources of funds	Estimated cost (thousand dollars) 1975	1976	Total 1977-79	Total 1975-79	Operational responsibility	Remarks
3. Pinus caribaea var. hondurensis	1. Nigeria	UNEP (direct costs)	-	8	14	22+		
		Nigeria (supervision)	-	2	3	5+		
	2. East Africa	East Africa	1	1	3	5		
		Bilateral assistance	1	1	3	5		
	3. Fiji	UNEP (direct costs)	8	7	9	24		
2 sites per country		Fiji (supervision)	2	1	3	6	Introducing	
3 provenances per site	4. Thailand	UNEP (direct costs)	-	8	14	22+		
10 ha per provenance plot		Thailand (supervision)	-	2	3	5+	Countries	
	5. India	UNEP (direct costs)	8	7	9	24		
		India (supervision)	2	1	3	6		
	6. Venezuela	UNEP (direct costs)	-	8	14	22+		
		Venezuela (supervision)	-	2	3	5+		
	7. Congo	UNEP (direct costs)	8	7	9	24		
		Congo (supervision)	2	1	3	6		
	Total - Pinus caribaea var. hondurensis		32	56	93	181		
4. Pinus oocarpa	1. Nigeria	UNEP (direct costs)	8	7	9	24		
		Nigeria (supervision)	2	1	3	6		
	2. East Africa	East Africa	-	1	3	4+		
		Bilateral assistance	-	1	3	4+		
	3. Zambia	UNEP (direct costs)	8	7	9	24		
2 sites per country		Zambia (supervision)	2	1	3	6	Introducing	
3 provenances per site	4. Congo	UNEP (direct costs)	-	8	14	22+		
10 ha per provenance plot		Congo (supervision)	-	2	3	5+		
	5. India	UNEP (direct costs)	8	7	9	24	Countries	
		India (supervision)	2	1	3	6		
	6. Thailand	UNEP (direct costs)	-	8	14	22+		
		Thailand (supervision)	-	2	3	5+		
	7. Mexico	UNEP (direct costs)	-	8	14	22+		
		Mexico (supervision)	-	2	3	5+		
	8. Brazil	UNEP (direct costs	8	7	9	24		
		Brazil (supervision)	2	1	3	6		
	Total - Pinus oocarpa		40	64	105	209		

Table 4 (cont'd)

Species and area etc.	Proposed "Host" Countries	Proposed sources of funds	Estimated cost (thousand dollars) 1975	1976	Total 1977-79	Total 1975-79	Operational responsibility	Remarks
5. Totals by proposed sources of funds		UNEP	56	107	193	356		
		CGIAR	15	20	28	63		
		Brazil	2	1	3	6		
		Congo	2	3	9	14		
		East Africa	1	2	6	9		
		Fiji	2	1	3	6		
		India	5	4	10	19		
		Ivory Coast	1	1	2	4		
		Mexico	-	2	3	5		
		Nigeria	3	4	11	18		
		Sudan	-	2	4	6		
		Thailand	-	4	6	10		
		Venezuela	-	2	3	5		
		Zambia	2	1	3	6		
		Bilateral assistance	1	2	6	9		
Grand Total			90	156	290	536		

Table 5 - ESTABLISHMENT AND MANAGEMENT OF STRICT NATURAL RESERVES FOR CONSERVATION IN SITU

Country/Region	Proposed sources of funds	Estimated cost (thousand dollars) 1975	1976	Total 1977-79	Total 1975-79	Remarks
1. Brazil	UNEP (other costs)	-	12	46	58	Operation responsibility of countries concerned, with assistance from FAO, IUCN, UNESCO. Salary of specialist forest gene resources conservation officers to be paid by countries concerned. Field costs, travel training and fellowships to be paid by UNEP.
	Brazil (salary)	-	12	46	58	
2. Central America	UNEP (other costs)	-	12	46	58	
	C. American countries (salary)	-	12	46	58	
3. India	UNEP (other costs)	10	12	46	68	
	India	10	12	46	68	
4. West Africa	UNEP (other costs)	-	12	46	58	
	W. African countries (salary)	-	12	46	58	
5. East Africa	UNEP (other costs)	10	12	46	68	
	E. African countries (salary)	10	12	46	68	
6. Totals by proposed sources of funds	UNEP	20	60	230	310	
	Brazil	-	12	46	58	
	C. American countries	-	12	46	58	
	India	10	12	46	68	
	W. African countries	-	12	46	58	
	E. African countries	10	12	46	68	
Grand Total		40	120	460	620	

Table 6

FOREST GENETIC RESOURCES PRIORITIES (BY REGION, SPECIES AND OPERATION)

Note:

(1) General This Table was derived by the FAO Panel of Experts on Forest Gene Resources and also appears as Appendix 4 of the Panel's Third Session (FAO, 1974 b). The Panel recognised that many of the priority ratings must be considered tentative. In many cases information is inadequate to allow even a tentative rating to be made; these are indicated as - . Nevertheless the present attempt should be useful in relating the priorities of various operations to each other and in indicating the many gaps in knowledge which exist. Periodic revision of the priorities will be needed in the light of the better information which it is hoped will be forthcoming from foresters and tree breeders all over the world.

(2) Species importance The importance rating for a species is expected to remain constant over one to several decades, as compared with priority ratings for individual operations which may change within a few years. Allocation of importance rating is somewhat arbitrary, but approximates to:

1 = already planted annually on a large scale in a number of different countries.

2 = already planted annually over substantial areas in one or more countries, or considered to have exceptional promise for large-scale planting.

3 = not yet planted on a large-scale, but considered to have high potential for investigation with a view to future large-scale planting.

(3) Operational priorities Three priority ratings are used. Though the distinctions between them are somewhat arbitrary, their approximate time-scale equivalents are:

Priority 1 (highest)	Action should start (or be continued) in quinquennium 1975-79 at latest.
Priority 2	Action should start in quinquennium 1980-84 at latest
Priority 3	Action should start in quinquennium 1985-89 at latest

(4) Relationship of operational priorities to species importance Individual species may have higher priority for a particular operation than for their importance rating only in the case of endangered species and only for the conservation operation.

Individual species may have lower priority for some operations than their importance rating. e.g. a species of importance rating 1 may be priority 3 for exploration and collection because these operations have been recently successfully accomplished e.g. *Pinus caribaea* var. *hondurensis* in Central America.

Species of importance rating 1 normally merit priority 1 in at least one operation.

(5) (E) signifies endangered with extinction or severe depletion of the gene-pool.

Table 6 (cont'd)

Species \ Operation	Importance rating		Operational priority rating										Remarks
			Exploration		Evaluation		Conservation				Utilisation		
	Wood Production	Other Purposes	Botanical	Geneological	Collection for Testing	Testing (Provenance Trials)	In Situ	Collection for Conservation	Storage as Seed etc.	Ex Situ in Artificial Stands	Use of Bulk Supplies	Individual Selection and Breeding	
1. Western USA and Canada													
Abies amabilis	3		3	3	-	-	-	-	-	-	-	-	
Abies concolor	3		3	3	-	3	-	-	-	-	-	-	
Abies grandis	1		-	1	3	3	-	-	-	-	-	-	
Abies lasiocarpa	2		-	2	2	2	-	-	-	-	-	-	
Abies procera	1		-	1	1	1	-	-	-	-	-	-	
Alnus rubra	3		3	3	3	3	-	-	-	-	-	3	
Cupressus arizonica	3	3	3	3	3	3	-	-	-	-	3	3	For shelterbelts and windbreaks
Cupressus macrocarpa	3		3	3	3	3	-	-	-	-	-	-	
Larix orientalis	3		3	3	3	3	-	-	-	-	-	-	
Picea glauca	1		1	1	1	1	-	-	-	-	-	1	
Picea sitchensis	1		3	3	3	3	-	-	-	-	1	1	
Picea engelmannii	2		2	2	2	2	-	-	-	-	-	2	
Pinus attenuata	2		3	3	-	-	-	-	-	-	-	3	
Pinus contorta	1		3	3	3	3	3	-	-	-	1	1	
Pinus jeffreyi	2		3	-	-	-	-	-	-	-	-	-	
Pinus lambertiana	3		3	3	3	3	-	-	-	-	-	-	
Pinus monticola	2		2	2	2	2	-	-	-	-	-	2	
Pinus ponderosa	1		1	1	1	1	3	-	-	-	1	1	
Pinus radiata	1		1	1	3	1	-	1	1	1	1	1	

Table 6 (cont'd)

Species \ Operation	Importance rating		Operational priority rating										Remarks
			Exploration		Evaluation		Conservation				Utilisation		
	Wood Production	Other Purposes	Botanical	Genecological	Collection for Testing	Testing (Provenance Trials)	In Situ	Collection for Conservation	Storage as Seed etc.	Ex Situ in Artificial Stands	Use of Bulk Supplies	Individual Selection and Breeding	
Populus tremuloides	1		3	3	-	-	-	-	-	-	3	1	
Populus trichocarpa	1		3	3	-	-	-	-	-	-	3	1	
Pseudotsuga menziesii	1		3	3	3	3	3	-	-	-	1	1	
Pseudotsuga macrocarpa	2		2	-	2	2	-	-	-	-	-	2	
Tsuga heterophylla	3		3	3	3	3	-	-	-	-	-	3	
2. Eastern USA and Canada													
Abies balsamea	3		-	-	3	3	-	-	-	-	3	3	
Abies fraseri	3	2	-	-	3	3	3	-	-	-	3	3	
Betula alleghaniensis	3		-	-	3	3	-	-	-	-	3	3	
Carya cordiformis	3		3	3	3	-	-	-	-	-	-	-	
Carya ovata	3		3	3	3	-	-	-	-	-	-	-	
Juglans cinerea	3		3	3	3	3	3	-	-	-	-	-	
Juglans nigra	2		2	2	2	2	3	-	-	-	2	2	
Larix laricina	2		2	-	-	-	-	-	-	-	-	-	
Liquidambar styraciflua	2		-	-	-	2	-	-	-	-	2	2	
Liriodendron tulipifera	1		-	-	-	1	-	-	-	-	1	1	

Table 6 (cont'd)

Species \ Operation	Importance rating		Operational priority rating										Remarks
			Exploration		Evaluation		Conservation				Utilisation		
	Wood Production	Other Purposes	Botanical	Genecological	Collection for Testing	Testing (Provenance Trials)	In Situ	Collection for Conservation	Storage as Seed etc.	Ex Situ in Artificial Stands	Use of Bulk Supplies	Individual Selection and Breeding	
Picea glauca	1		1	1	1	1	-	-	-	-	-	1	
Picea mariana	1		1	1	3	1	-	-	-	-	-	-	
Picea rubens	.		2	2	-	-	-	-	-	-	-	-	
Platanus occidentalis	2		2	2	2	2	-	-	-	-	2	2	
Pinus banksiana	1		3	1	1	1	-	-	-	-	1	1	
Pinus clausa	3		3	3	3	3	3	-	-	-	3	3	
Pinus echinata	2		-	-	2	2	-	-	-	-	2	2	
Pinus elliottii (both var.)	1		-	-	1	1	2	-	-	-	1	1	
Pinus palustris	1		-	-	1	1	2	-	-	-	1	1	
Pinus serotina			2	2	2	2	3	-	-	-	3	3	
Pinus taeda	1		-	-	1	1	2	-	-	-	1	1	
Pinus virginiana	2		3	3	2	2	-	-	-	-	2	2	
Populus deltoides	1		1	1	-	1	1	-	-	-	1	1	
Populus tremuloides	1		3	3	-	3	-	-	-	-	3	1	
Populus trichocarpa	1		3	3	-	-	-	-	-	-	3	1	
Prunus serotina	3		3	3	3	3	3	-	-	-	3	3	
Quercus alba	3		3	3	-	3	3	-	-	-	3	3	
Quercus borealis	1		-	-	-	1	3	-	-	-	2	1	
Quercus macrocarpa	3		-	-	-	-	3	-	-	-	-	-	
Robinia pseudoacacia	3		-	-	3	3	-	-	-	-	-	-	
Ulmus americana	3		-	-	-	-	3	-	-	3	3	3	

Table 6 (cont'd)

Species \ Operation	Importance rating		Operational priority rating										Remarks
			Exploration		Evaluation		Conservation				Utilisation		
	Wood Production	Other Purposes	Botanical	Genecological	Collection for Testing	Testing (Provenance Trials)	In Situ	Collection for Conservation	Storage as Seed etc.	Ex Situ in Artificial Stands	Use of Bulk Supplies	Individual Selection and Breeding	
3. Mexico,													
Abies religiosa	3	2	2	3	3	2	-	3	2	-	2	2	
Abies guatemalensis	3		3	3	3	-	-	3	3	-	3	3	
Acacia spp.	3		3	3	3	3	-	3	3	-	3	3	
Alnus jorullensis	3		3	3	-	-	-	-	-	-	-	-	
Cedrela mexicana (syn. odorata)	1		1	1	2	1	1	2	1	1	3	1	and related species
Cordia alliodora	2		2	2	2	2	-	2	2	-	3	3	
Cupressus lusitanica (syn. lindleyi)	2		2	2	3	3	2	2	2	-	2	2	
Fraxinus uhdei	3		3	3	3	3	3	3	3	-	3	3	
Liquidambar styraciflua	2		2	3	2	3	2	2	2	-	2	3	
Picea chihuahuana	-		-	-	-	-	1	1	1	1	-	-	(E)
Picea mexicana	-		-	-	-	-	1	1	1	1	-	-	(E)
Pinus douglasiana	2	2	3	3	3	3	2	2	2	-	-	2	
Pinus greggii	3		3	3	3	3	-	3	3	-	-	3	
Pinus jeffreyi	2		3	3	3	-	-	2	2	-	3	3	
Pinus lambertiana	3		3	3	3	2	-	3	3	-	3	3	
Pinus leiophylla	2	1	3	3	3	3	-	2	2	-	-	2	turpentine production
Pinus maximartinezii	2	2	2	2	2	2	1	1	1	1	-	-	(E)
Pinus michoacana	1	1	1	1	3	3	2	2	2	-	2	2	turpentine production
Pinus montezumae	1	1	2	1	2	1	2	2	2	-	2	2	" "

Table 6 (cont'd)

Species \ Operation	Importance rating		Operational priority rating										Remarks
			Exploration		Evaluation		Conservation				Utilisation		
	Wood Production	Other Purposes	Botanical	Geneological	Collection for Testing	Testing (Provenance Trials)	In Situ	Collection for Conservation	Storage as Seed etc.	Ex Situ in Artificial Stands	Use of Bulk Supplies	Individual Selection and Breeding	
Pinus oocarpa	1	1	1	1	1	1	1	1	1	1	2	1	turpentine production
Pinus patula	1		1	1	1	1	1	1	1	1	2	1	
Pinus ponderosa	1		1	1	3	3	-	3	3	-	3	3	
Pinus radiata	1		2	3	2	2	-	1	1	1	3	-	(E)
Pinus pseudostrobus	2	1	2	1	2	2	2	2	2	-	2	1	turpentine production
Pinus strobus var. chiapensis	3		3	3	3	3	1	1	1	1	-	1	(E)
Pinus tenuifolia	1		3	3	3	-	-	1	1	-	3	3	(E)
Populus spp.	3		3	3	3	3	-	1	1	1	3	3	(E)
Prosopis spp.	3		3	3	3	3	-	-	3	-	3	3	
Pseudotsuga spp.	3		3	3	3	3	1	1	1	1	-	2	(E)
Swietenia macrophylla	1		2	2	2	1	2	1	1	2	-	1	(E)
Swietenia humilis	3		3	3	3	3	-	3	3	-	-	1	
Terminalia amazonica	3		3	3	3	3	-	3	3	-	3	3	
4. Caribbean, Central and South America													
Abies guatemalensis	3		3	3	3	3	-	-	-	-	-	-	
Alnus jorullensis		3	3	3	3	3	3	-	-	-	-	-	
Araucaria angustifolia	1		1	1	1	1	1	-	-	-	-	-	(E) certain provenances
Bombacopsis quinatum	2		2	2	2	2	1	-	-	-	-	-	(E)
Cedrela odorata	1		2	2	2	2	1	1	1	1	3	1	and related species, for selection and breeding for resistance to Hypsipyla

Table 6 (cont'd)

Species \ Operation	Importance rating		Operational priority rating										Remarks
			Exploration		Evaluation		Conservation				Utilisation		
	Wood Production	Other Purposes	Botanical	Genecological	Collection for Testing	Testing (Provenance Trials)	In Situ	Collection for Conservation	Storage as Seed etc.	Ex Situ in Artificial Stands	Use of Bulk Supplies	Individual Selection and Breeding	
Cordia alliodora	2		2	2	2	2	2	-	-	-	-	-	
Cupressus lusitanica	3		3	3	-	-	-	-	-	-	-	-	
Juglans spp.	2		2	2	2	2	-	-	-	-	-	-	
Liquidambar styraçiflua	2		2	2	2	2	-	-	-	-	-	-	
Nothofagus spp.	2		2	2	2	2	-	-	-	-	-	-	
Pinus caribaea var. bahamensis	1		3	3	3	3	1	1	1	1	1	1	(E)
Pinus caribaea var. caribaea	1		3	3	3	3	1	1	1	1	1	1	
Pinus caribaea var. hondurensis	1		3	3	3	3	1	1	1	1	1	1	
Pinus montezumae	2		2	2	2	2	-	-	-	-	-	-	
Pinus occidentalis		2	2	2	2	2	2	-	-	-	-	-	
Pinus oocarpa	1		1	1	3	3	1	1	1	1	1	1	
Pinus pseudostrobus/ tenuifolia	1		1	1	1	1	1	1	1	-	-	-	
Pinus strobus var. chiapensis	2		2	2	2	2	1	1	1	-	-	-	(E)
Pinus tropicalis	3		3	3	3	3	-	-	-	-	-	-	
Swietenia humilis		1	2	2	2	2	1	2	2	2	2	1	selection and breeding for resistance to Hypsipyla
Swietenia macrophylla	1		2	2	2	2	1	2	2	2	2	1	" " " "
Swietenia mahagoni		1	2	2	2	2	1	2	2	2	2	1	" " " "
Terminalia amazonica	3		3	3	3	3	-	-	-	-	-	-	

Table 6 (cont'd)

Species \ Operation	Importance rating		Operational priority rating										Remarks
			Exploration		Evaluation		Conservation				Utilisation		
	Wood Production	Other Purposes	Botanical	Genecological	Collection for Testing	Testing (Provenance Trials)	In Situ	Collection for Conservation	Storage as Seed etc.	Ex Situ in Artificial Stands	Use of Bulk Supplies	Individual Selection and Breeding	
5. Northern and Central Europe													
Abies alba	2		-	-	-	-	2	-	-	-	-	-	Sources in Rumania, Ukraine & Yugoslavia
Betula verrucosa	2		-	-	-	-	-	-	-	-	-	3	
Fagus sylvatica	2		-	-	-	-	-	-	-	-	2		Sources in Slovakia and Rumania
Juglans regia	2	1	-	-	-	-	2	-	-	-	-	3	Sources in S.E. Europe
Larix decidua	1		-	-	-	-	-	-	-	-	-	3	
Larix sukaczewii	1		-	-	-	2	-	-	-	-	2	-	
Picea abies	1		-	-	-	-	-	-	-	-	-	3	
Pinus nigra	1		1	1	1	1	-	-	-	-	-	-	
Pinus sylvestris	1		-	-	-	-	-	-	-	-	-	3	
Populus nigra	2		-	-	-	-	-	-	-	-	-	3	
Populus tremula	2		-	-	-	-	-	-	-	-	-	3	
Quercus pedunculata	3		-	-	-	-	-	-	-	-	-	3	
Quercus sessiliflora	3		-	-	-	-	-	-	-	-	-	3	
Ulmus glabra	1		-	-	-	-	-	-	-	-	-	3	
6. Mediterranean Region, Southern Europe and Near East													
Abies cephalonica	1		1	1	1	1	2	-	-	-	1	2	
Abies nebrodensis		1	-	-	-	-	1	1	1	1	-	-	(E)

Table 6 (cont'd)

Species \ Operation	Importance rating		Operational priority rating										Remarks
			Exploration		Evaluation		Conservation				Utilisation		
	Wood Production	Other Purposes	Botanical	Genecological	Collection for Testing	Testing (Provenance Trials)	In Situ	Collection for Conservation	Storage as Seed etc.	Ex Situ in Artificial Stands	Use of Bulk Supplies	Individual Selection and Breeding	
Abies nordmanniana/ bornmülleriana	2		3	3	2	2	-	-	-	-	2	2	
Abies pinsapo	2		-	-	2	-	2	-	-	-	-	-	
Cedrus atlantica	2		2	2	2	2	-	-	-	-	1	2	
Cedrus libani	3		3	3	2	2	1	-	-	-	-	-	(E) in Lebanon
Cupressus sempervirens	1		-	2	1	1	-	-	-	-	1	-	testing for resistance to Coryneum cardinale
Cupressus dupreziana		1	1	1	-	-	1	1	1	1	1	1	(E)
Eucalyptus camaldulensis	1		-	-	1	1	-	1	1	1	1	1	
Picea omorica	3		-	3	-	-	3	-	-	-	-	-	
Pinus brutia	1		-	3	-	1	-	1	-	-	1	1	provenance trials starting in 74-75
Pinus brutia var. eldarica	1		1	1	1	1	1	1	1	1	2	-	(E)
Pinus halepensis	1		-	-	-	1	-	-	-	-	1	1	provenance trials starting in 74-75
Pinus nigra	1		1	1	1	1	-	-	-	1	1	1	
Pinus peuce	3		3	3	-	-	-	-	-	-	-	-	
Pinus pinaster	1		-	2	2	2	1	1	1	1	1	1	selection and breeding in progress
Pinus pinea	1		-	-	-	-	-	-	-	-	1	-	

Table 6 (cont'd)

Species \ Operation	Importance rating		Operational priority rating										Remarks
			Exploration		Evaluation		Conservation				Utilisation		
	Wood Production	Other Purposes	Botanical	Genecological	Collection for Testing	Testing (Provenance Trials)	In Situ	Collection for Conservation	Storage as Seed etc.	Ex Situ in Artificial Stands	Use of Bulk Supplies	Individual Selection and Breeding	
7. (a) North, North-East and Central Asia													
Abies pinceana	3		-	3	3	-	-	-	-	-	-	-	
Abies pindrow	3		-	3	3	-	-	-	-	-	-	-	
Abies sachalinensis	2		-	2	2	2	-	-	-	-	-	-	of value for species hybridization
Abies spp. (Central and S. China)		3	-	2	2	-	-	-	-	-	-	-	ornamental, and breeding through species hybridization
Alnus sp.	2	2	-	2	2	-	-	-	-	-	-	-	soil conservation, hybridization
Cedrus deodara	2		-	2	2	-	-	-	-	-	-	-	
Chosenia arbutifolia	2		-	2	2	-	-	-	-	-	-	-	possible use for South America on "mini-rotation"
Cryptomeria japonica	2		-	-	-	-	-	-	-	-	-	2	of interest also to N.E. India
Cunninghamia lanceolata	3		-	3	3	-	-	-	-	-	-	-	
Cupressus torulosa var.kashmiriana	2		-	2	-	-	-	-	-	-	-	2	
Juglans regia		1	-	-	-	-	1	-	-	-	-	-	nut crop in India
Larix leptolepis	1		-	-	-	-	-	-	-	-	-	2	
Larix sibirica	1		-	-	2	2	-	-	-	-	-	-	
Larix sukaczewii	1		-	-	2	2	-	-	-	-	2	-	
Picea asperata	3		-	2	2	-	-	-	-	-	-	-	largely unknown

Table 6 (cont'd)

Species \ Operation	Importance rating		Operational priority rating										Remarks
			Exploration		Evaluation		Conservation				Utilisation		
	Wood Production	Other Purposes	Botanical	Genecological	Collection for Testing	Testing (Provenance Trials)	In Situ	Collection for Conservation	Storage as Seed etc.	Ex Situ in Artificial Stands	Use of Bulk Supplies	Individual Selection and Breeding	
Picea spp. (Central and S. China)		2	-	2	2	-	-	-	-	-	-	-	possibilities for use outside China
Pinus armandii	2		-	2	2	-	-	-	-	-	-	-	
Pinus cembra	3		-	-	1	-	-	-	-	-	-	-	important for rust resistance breeding
Pinus griffithii	1	1	-	-	1	1	-	-	-	-	-	1	" " "
Pinus koraiensis	3		-	3	3	-	-	-	-	-	-	-	
Pinus massoniana	3		-	-	3	-	-	-	-	-	-	-	
Pinus morrisonicola	1		-	-	-	-	1	1	1	-	-	-	(E)
Pinus pentaphylla	1		-	-	-	-	1	1	1	-	-	-	(E)
Pinus roxburghii	1	1	-	-	1	1	-	-	-	-	-	1	important for rust resistance breeding and for resin
Pinus sylvestris	1		-	-	1	1	-	-	-	-	-	-	Siberian provenances little used outside USSR
Populus nigra	1		-	1	1	-	-	-	-	-	-	-	
Populus ciliata	2		-	2	2	-	-	-	-	-	-	-	
Populus maximowiczii	1		-	1	1	1	-	-	-	-	-	-	
Populus suaveolens	2		-	2	2	-	-	-	-	-	-	-	
Populus spp. (Central and N.E. Asia)	2		-	1	1	-	-	-	-	-	-	-	important for further breeding
Populus yunnanensis	3		-	3	3	-	-	-	-	-	-	-	

Table 6 (cont'd)

Species \ Operation	Importance rating		Operational priority rating										Remarks
			Exploration		Evaluation		Conservation				Utilisation		
	Wood Production	Other Purposes	Botanical	Genecological	Collection for Testing	Testing (Provenance Trials)	In Situ	Collection for Conservation	Storage as Seed etc.	Ex Situ in Artificial Stands	Use of Bulk Supplies	Individual Selection and Breeding	
7. (b) South-East Asia													
Acacia nilotica		1	-	-	-	-	1	-	-	2	-	-	for soil protection and range management in arid zone
Acacia senegal		1	-	-	-	-	2	-	-	1	-	-	" " " "
Albizia falcata	2		-	2	2	2	-	-	-	-	-	-	important for pulp
Anthocephalus cadamba (syn. A. chinensis)	3		-	3	3	3	-	-	-	-	-	-	proved difficult to grow in monoculture (India)
Araucaria cunninghamii	1		-	1	1	1	3	-	-	-	2	2	
Araucaria hunsteinii	1		-	1	1	1	3	-	-	-	2	2	
Azadirachta indica	1		-	1	1	1	2	-	-	1	1	2	
Bamboo spp.	1	1	1	-	-	-	1	-	-	-	-	-	sporadic flowering habit may endanger regeneration
Bischofia javanica	3		-	3	3	3	3	-	-	-	-	-	
Bombax ceiba	1		-	-	2	2	-	-	-	-	-	1	
Dalbergia latifolia	1		-	-	-	-	1	1	-	1	-	-	
Dalbergia sissoo	1		-	1	1	1	-	-	-	2	-	2	v. promising N. India and Pakistan
Dipterocarpus spp.	1		-	-	-	-	1	1	1	-	-	-	needs research on seed storage
Eucalyptus deglupta	1		-	1	1	1	2	1	-	1	-	2	
Eucalyptus urophylla	1		-	1	2	1	-	-	-	1	2	3	
Gmelina arborea	1		-	1	1	1	2	2	2	2	1	1	needs research on seed storage
Pinus kesiya (syn. khasya, insularis)	1		-	2	1	1	2	-	-	1	1	1	

Table 6 (cont'd)

Species \ Operation	Importance rating		Operational priority rating										Remarks
			Exploration		Evaluation		Conservation				Utilisation		
	Wood Production	Other Purposes	Botanical	Genecological	Collection for Testing	Testing (Provenance Trials)	In Situ	Collection for Conservation	Storage as Seed etc.	Ex Situ in Artificial Stands	Use of Bulk Supplies	Individual Selection and Breeding	
Pinus merkusii/ merkusiana	1		-	2	1	1	-	1	-	1	-	1	
Santalum album		2	-	-	-	-	-	-	-	-	-	2	high priority parts of S. India
Tectona grandis	1		-	2	1	1	1	-	-	1	2	1	
Toona ciliata	3		-	3	-	-	-	-	-	-	-	-	
Toona serrata	3		-	3	-	-	-	-	-	-	-	-	
8. Africa													
Acacia albida		1	-	1	1	1	1	1	1	1	1	1	important for soil protection and range management in arid zones, also for gum, tannin or fodder production
Acacia nilotica		1	-	1	1	1	1	1	1	1	1	1	
Acacia senegal		1	-	1	1	1	1	1	1	1	1	1	
Acacia tortilis		1	-	1	1	1	1	1	1	1	1	1	
Alluaudia procera	2		-	-	-	-	1	-	-	-	-	-	(E) in Madagascar
Aucoumea klaineana	1		-	1	1	-	1	-	-	1	-	2	(E) of great local importance to some W. African countries
Brachylaena hutchinsii	2		-	-	-	-	1	-	-	-	-	-	(E) in part of range
Burtt-davya nyasica	3		3	-	-	-	-	-	-	-	-	-	
Chlorophora excelsa	1		2	1	-	-	3	1	3	1	1	1	selection for resistance to gall of utmost importance
Chlorophora regia	1		2	1	-	-	3	1	3	1	1	1	
Diospyros spp.	1		-	-	-	-	1	-	-	1	-	-	for ebony wood

Table 6 (cont'd)

Species \ Operation	Importance rating		Operational priority rating										Remarks
			Exploration		Evaluation		Conservation				Utilisation		
	Wood Production	Other Purposes	Botanical	Genecological	Collection for Testing	Testing (Provenance Trials)	In Situ	Collection for Conservation	Storage as Seed etc.	Ex Situ in Artificial Stands	Use of Bulk Supplies	Individual Selection and Breeding	
Entandrophragma angolense	1		-	1	1	1	2	1	2	1	1	1	selection for resistance to shoot borer of utmost importance
Entandrophragma cylindricum	1		-	1	1	1	2	1	2	1	1	1	" " " " "
Entandrophragma utile	1		-	1	1	1	2	1	2	1	1	1	" " " " "
Gymnostemon zaizou	1		-	-	-	-	1	-	-	-	-	-	(E) in Ivory Coast
Juniperus procera	2		-	-	-	-	3	-	-	-	-	-	conserve as part of ecosystem
Khaya anthotheca	1		-	1	1	1	-	-	-	-	-	-	selection for resistance to shoot borer of utmost importance
Khaya grandifoliola	1		-	1	1	1	1	-	-	-	-	-	" " " " "
Khaya ivorensis	1		-	1	1	1	-	-	-	-	-	-	" " " " "
Khaya nyasica	2		-	-	-	-	2	-	-	-	-	-	" " " " "
Khaya senegalensis	1		-	2	2	2	1	-	-	-	3	-	(E)in northern part of range
Maesopsis eminii	2		-	-	-	2	-	-	-	-	-	2	important in Uganda
Mitragyna ciliata	2		2	2	2	2	1	2	2	2	2	2	locally important in W. Africa
Nauclea diderrichii	2		2	2	2	2	1	2	2	2	2	2	" " " "
Pericopsis elata (syn. Afrormosia elata)	2		2	2	2	2	1	1	1	1	-	-	(E)
Pterocarpus angolensis	2		-	-	-	-	2	-	-	-	-	-	
Pterygota macrocarpa	3		-	-	-	-	2	-	-	2	-	-	

Table 6 (cont'd)

Species \ Operation	Importance rating		Operational priority rating										Remarks
			Exploration		Evaluation		Conservation				Utilisation		
	Wood Production	Other Purposes	Botanical	Genecological	Collection for Testing	Testing (Provenance Trials)	In Situ	Collection for Conservation	Storage as Seed etc.	Ex Situ in Artificial Stands	Use of Bulk Supplies	Individual Selection and Breeding	
Terminalia ivorensis	1		–	1	–	–	–	–	–	1	1	1	
Terminalia superba	1		–	1	1	1	1	1	1	1	1	1	
Triplochiton scleroxylon	1		1	1	1	1	1	1	1	1	1	1	
Turraeanthus africana	1		2	2	2	2	1	2	2	2	2	2	locally important in W. Africa
Widdringtonia whytei	2		–	–	–	–	3	–	–	–	–	–	conserve as part of ecosystem
9. Australia													
Acacia binervata	2			2	2								
Acacia cyanophylla	3	1		2	2	2					2		coastal shelter and salt tolerance
Acacia elata	2			2	2								
Acacia peuce	2	2		2	2	2	1	2					Limited distribution, use in v. arid areas
Acacia pruinocarpa	3	2	3		3								
Acacia salicina	2	2		2	2	2					2		shelter in arid zones with high pH
Araucaria cunninghamii	1			1	1	1	3				2	2	selection and breeding in Australia
Callitris glauca	1			3		3					3		
Callitris intratropica	1			2		2	3				2		
Casuarina decaisneana	2	2		2		3	3						use for shelter in arid zones

Table 6 (cont'd)

Species \ Operation	Importance rating		Operational priority rating										Remarks
			Exploration		Evaluation		Conservation				Utilisation		
	Wood Production	Other Purposes	Botanical	Genecological	Collection for Testing	Testing (Provenance Trials)	In Situ	Collection for Conservation	Storage as Seed etc.	Ex Situ in Artificial Stands	Use of Bulk Supplies	Individual Selection and Breeding	
Casuarina glauca	3	3		3									use for coastal windbreaks
Eucalyptus acmenioides	1			2	2	2							
E. alba	2		2	2			3		3		2		
E. argophloia	2				2		1		1				
E. astringens	1	2		2	2	1					2		tannin production
E. bicostata	1			1	1	1	1	2			1	3	
E. botryoides	1	3		1	1	2			3		2		use for coastal windbreaks, sand fixation
E. brassiana	2		2	2	2	2			3				
E. brevifolia	3	1	1		2								use for shelter in arid zones
E. brockwayi	1		3		2		3				2		
E. camaldulensis	1			1	1	2	1	1	3		1	1	
E. cambageana	2			2		2							
E. citriodora	1	1		2	1	1			3		1	2	use for oil production
E. cladocalyx	2	2		2	3	2	2		3		3		use for windbreaks
E. cloeziana	1			1	1	2	3		3		2	2	
E. crebra	1			2	2	2			3				
E. cypellocarpa	1			2	2	2			3				
E. dalrympleana	1		3	2	2	2			3		1	1	
E. deanei	1		2	2	1	2			3		1	1	
E. delegatensis	1		2	2	2	2						2	
E. dives var. "C"		1		1	2	2	1		3			1	oil production

Table 6 (cont'd)

Species \ Operation	Importance rating		Operational priority rating										Remarks
			Exploration		Evaluation		Conservation				Utilisation		
	Wood Production	Other Purposes	Botanical	Genecological	Collection for Testing	Testing (Provenance Trials)	In Situ	Collection for Conservation	Storage as Seed etc.	Ex Situ in Artificial Stands	Use of Bulk Supplies	Individual Selection and Breeding	
Eucalyptus drepanophylla	2			3	2	3							
E. dunnii	1			2	1	2	1				1	1	
E. exserta	2			2		2							
E. fibrosa spp. fibrosa	2			2									
E. fastigata	1		1	2	1	2			3		2	3	
E. gamophylla	3	2		2	2				3				oil production
E. gillii	2	3	3		2								shelter in arid zones
E. glaucescens	2	2		2	2	2							ornamental in cool temperate areas
E. globulus	1			1	1	1	1				1		
E. gomphocephala	1			2	2	1			3		1		
E. gongylocarpa	2	1		1	1								shelter in v. arid zones
E. grandis	1			1	1	1					1	1	selection and breeding in Australia/Africa & South America
E. gunnii	1	2		2	2	3					1		Ornamental in cool temperate areas
E. houseana	2			2	2	2							
E. interterta	2			2	2	2			3				
E. kingsmillii	3			3	3								
E. kondininensis	1			3	1	2	2		3		2		salt tolerant species
E. laevopinea	2	2		2	2	2							oil production

Table 6 (cont'd)

Species \ Operation	Importance rating		Operational priority rating										Remarks
			Exploration		Evaluation		Conservation				Utilisation		
	Wood Production	Other Purposes	Botanical	Genecological	Collection for Testing	Testing (Provenance Trials)	In Situ	Collection for Conservation	Storage as Seed etc.	Ex Situ in Artificial Stands	Use of Bulk Supplies	Individual Selection and Breeding	
Eucalyptus largiflorens (bicolor)	2			3	3	3							tolerates sites with high pH
E. leptophleba	3		3		3	3							
E. leucoxylon	1	3		2	2	2							ornamental in cool temperate areas
E. longifolia	2			3	3	3							
E. loxophleba	2			3	2	2							Shelter in arid zones
E. macarthuri	2	2			2						2		oil production in high altitude tropics
E. maculata	1			1	1	1					2		
E. maidenii	1			1	1	1					1		
E. melanoxylon	2	2		2	2								shelter in arid zones
E. microcorys	1		1	1	3	2							
E. microtheca	1		1	1	1	2					2		
E. miniata	2	3		2	2	2							ornamental in tropical areas
E. moluccana	2		2	2	3	3							
E. muellerana	1		3	2	1	2					2		
E. nesophila	2			2	2	3							
E. niphophila	3	2	3	3	3	3					3		ornamental in cool temperate areas
E. nitens	1			1	1	1					2		
E. occidentalis	1	2		1	1	1					2		shelter in arid zones, salt tolerant

Table 6 (cont'd)

Species \ Operation	Importance rating		Operational priority rating										Remarks
			Exploration		Evaluation		Conservation				Utilisation		
	Wood Production	Other Purposes	Botanical	Genecological	Collection for Testing	Testing (Provenance Trials)	In Situ	Collection for Conservation	Storage as Seed etc.	Ex Situ in Artificial Stands	Use of Bulk Supplies	Individual Selection and Breeding	
Eucalyptus ochrophloia	2			3	2	2							
E. Oleosa	3	2	3	2	3	3							shelter in arid zones
E. oleosa var. glauca	3	2											shelter in arid zones
E. oleosa var. longicornis	2	2		2	2	2							tree form E. oleosa
E. oreades	1		2	1	1								potential pulp species
E. paniculata	1			3	3	2							
E. papuana	2			3	2	3			2				
E. parvifolia	2				2	2							cold resistant, hybrids with E. viminalis
E. paucifiora	3	2		3	3								ornamental and protection in cool temperate areas
E. pilularis	1			3	1	2							
E. polycarpa	2		2	2	2	3							
E. populnea	2		2	3	3	3							
E. propinqua	1		1	1									
E. pruinosa	3	2	2	3	2								ornamental and protection in arid zones
E. pseudoglobulus	1			1	1		1	2					
E. punctata	1		1	1	2	2					2		
E. pyrocarpa	1			1	1	1							formerly E. pilularis var. pyriformis

Table 6 (cont'd)

Species \ Operation	Importance rating		Operational priority rating										Remarks
			Exploration		Evaluation		Conservation				Utilisation		
	Wood Production	Other Purposes	Botanical	Genecological	Collection for Testing	Testing (Provenance Trials)	In Situ	Collection for Conservation	Storage as Seed etc.	Ex Situ in Artificial Stands	Use of Bulk Supplies	Individual Selection and Breeding	
Eucalyptus quadrangulata	1			1	1								
E. radiata var. australiana		1	3		2	2						1	oil production (cineole)
E. raveretiana	2			2	2								
E. regnans	1			1	1	1					1	1	selection and breeding in Australia
E. resinifera	1			2	2	2					1		
E. robusta	1		3	1	1	1					1		
E. rudis	1		3	2	2	2							
E. saligna	1		1	1	1	1					1	1	
E. salmonophloia	1		3	1	1	1					2		
E. sargentii	1		3	1	1	1	1			2	1		very salt tolerant
E. seesana	2		3	3	3	3							
E. siderophloia	2		2	3	3	3							
E. sideroxylon	1		1	1	1	1					2		tolerates high pH in semi arid areas
E. sieberi	1			1	1								potential pulp species, temperate areas
E. spathulata	2			2	2								very salt tolerant
E. sphaerocarpa	2			2	2								new species, subtropical
E. staigerana		2		3	2	2						2	oil production in tropical areas
E. striaticalyx	3	2	3	2	2	2							shelter in arid zones

Table 6 (cont'd)

Species \ Operation	Importance rating		Operational priority rating										Remarks
			Exploration		Evaluation		Conservation				Utilisation		
	Wood Production	Other Purposes	Botanical	Geneological	Collection for Testing	Testing (Provenance Trials)	In Situ	Collection for Conservation	Storage as Seed etc.	Ex Situ in Artificial Stands	Use of Bulk Supplies	Individual Selection and Breeding	
Eucalyptus tectifica	3		3	3	3	3							
E. tereticornis	1			1	1	1							
E. terminalis	2	1		1	2	2							shelter in arid zones
E. tessellaris	2		2	2	2	2							
E. tetrodonta	2			3	2	2							
E. thozetiana	2			2	2	2							
E. torelliana	2		2	2	2	2							
E. torquata	3	2		3	3								ornamental in warm temperate areas
E. umbrawarrensis	3			3	3								tropical dry country species
E. viminalis	1		1	1	1	1							
E. zygophylla	3		3	3	3	3							

APPENDIX 1

Recent or current Provenance Seed Collections of Wide Interest

Species	Organizations responsible 2)	COLLECTION			DISTRIBUTION 1)	
		Year	Number of		Number of	
			Countries	Provenances	Countries	Sites
Abies lasiocarpa	IUFRO, Iceland, Denmark	1971-73	2	25		
Araucaria angustifolia	IBDF, UNDP, FAO	1973	2	18	8	
Eucalyptus alba	CTFT France	1972-73	3	20	7	
E. "brassiana"	CTFT France	1972-73	1	5	7	
E. camaldulensis	FRI Canberra, CCMFR	1965	2	34	18	30
E. camaldulensis	FRI Canberra	1970-73	1	46		
E. camaldulensis	CTFT France	1972-73	1	54	7	
E. microtheca	FRI Canberra	1972	1	7		
E. nesophila	CTFT France	1972-73	1	8	5	
E. tereticornis/ E. "brassiana"	FRI Canberra	1970-73	1	15		
E. tereticornis	CTFT France	1972-73	1	10	7	
E. urophylla	CTFT France	1972-73	2	70	4	
Melaleuca leucadendron	CTFT France	1972-73	1	5	3	
M. viridiflora	CTFT France	1972-73	1	5	3	
Picea engelmannii	IUFRO, Iceland, Denmark	1971-73	2	29		
P. mariana	Canada	1971	2	53		
P. sitchensis	IUFRO	1970-72	2	67	16	
Pinus caribaea var. hondurensis	CFI Oxford	1970-71	4	51	39	162
P. oocarpa	CFI Oxford	1970-71	4			
P. contorta	IUFRO	1967-72	2	169	22	
P. kesiya	FRI Canberra	1969	2	21	29	
P. merkusiana/ P. merkusii	CFI Oxford	1967	5	9	19	
P. merkusiana	Thailand, Denmark	1971-72	1	18		
P. oocarpa	INIF Mexico	1972-73	1	11		
P. patula	INIF Mexico	1972-73	1	3	18	67
P. pseudostrobus/ P. tenuifolia	CFI Oxford	1970-74	3	8		
P. pseudostrobus/ P. tenuifolia	INIF Mexico	1972-73	1	5		
Populus deltoides	Poplar Council of America	1967	1	192 3)	16	
P. trichocarpa	IUFRO	1972-73	2	75		
Pseudotsuga menziesii	IUFRO	1966-72	3	187	30	
Tectona grandis	CTFT France Denmark	1968-69 1971-72	2 10	16 68	4 13	44

Notes: 1) Includes proposed distribution in certain species
2) For abbreviations see page 2
3) Single tree collections

APPENDIX 2

FOREST GENETIC RESOURCES

FAO FINANCIAL CONTRIBUTIONS (REGULAR PROGRAMME)

(US$)

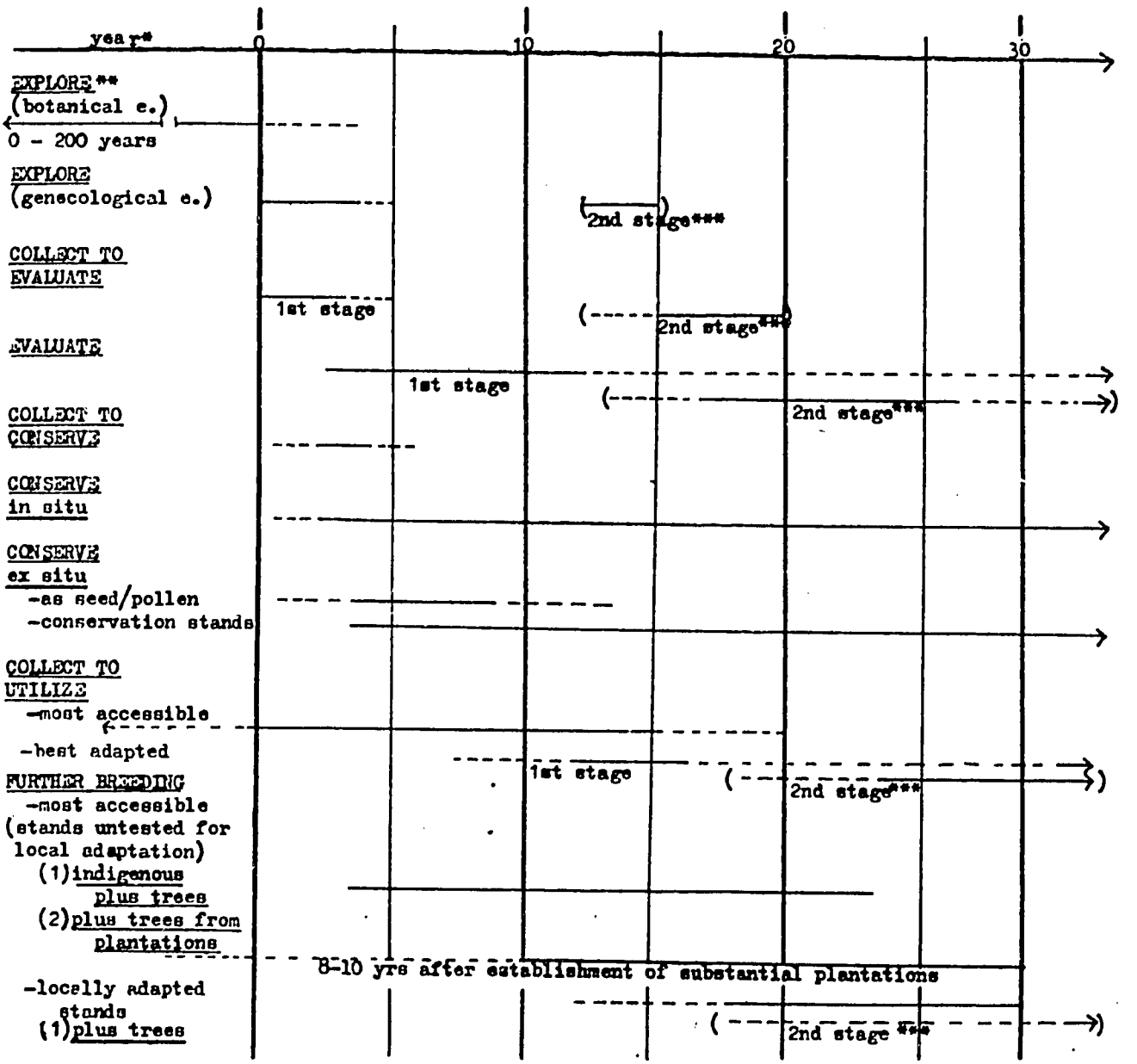
ALLOCATED TO	1966/67	1968/69	1970/71	1972/73	1974/75
A. SEED PROCUREMENT					
1. F.R.I., Canberra (Eucalypts, Araucaria etc)	10,000	13,000	10,000	10,000	15,000
2. C.F.I., Oxford (Central American pines)	-	-	15,000	15,000	-
3. I.N.I.F., Mexico (Mexican pines)	-	-	5,000	5,000	10,000
4. I.U.F.R.O. (N.American conifers)	-	-	1,200	5,000	1,000
5. UNDP/FAO/Brazil (Araucaria, tropical hardwoods)	-	-	-	8,000	3,000
6. F.D.F.R. Nigeria/CTFT France (tropical hardwoods)	-	-	-	5,000	5,000
7. I.S.S. Florence (Mediterranean conifers, eucalypts)	-	-	5,000	3,000	1,500
8. Seed Centre Macon, USA (cost of seed to developing countries)	-	-	-	500	-
9. Others	-	1,500	-	-	4,500
Sub-total (seed procurement)	10,000	14,500	36,200	51,500	40,000
B. INFORMATION					
1. "Forest Genetic Resources Information"	-	-	-	16,000	17,500
C. OTHER					
1. Panel Meetings	-	(10,000)	(9,000)	-	(14,000)
2. H.Q. staff direct costs					
(a) FAO Regular Programme	(5,000)	(10,000)	(12,000)	(18,500)	(18,500)
(b) Finnish Government Programme	-	-	(4,000)	(16,500)	(4,000)
Sub-total (other)	(5,000)	(20,000)	(25,000)	(35,000)	(36,500)
Total	15,000	34,500	61,200	102,500	94,000

Note : Figures in parenthesis are approximate

APPENDIX 3

FOREST GENETIC RESOURCES OPERATIONS:

POSSIBLE TIME SCALE FOR A TROPICAL PINE



* year 0 = start of genecological exploration. It is assumed that any preliminary planning necessary will start before year 0.

** although the taxonomic exploration has only gone on for a limited period exploration for practical purposes may have gone on since primitive man recognized useful species.

*** 2nd stage studies (more detailed examination of variation over a limited part of the range) may not always be necessary.

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