

PD-ABL-315

**A
PLAN OF WORK
FOR
TECHNICAL TRAINING
IN
TREE IMPROVEMENT
TREE SEED TECHNOLOGY
AND
NURSERY TECHNOLOGY

FOR
WINROCK INTERNATIONAL**

**by
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EXECUTIVE SUMMARY

This document presents a detailed plan for major training and related activities oriented to tree improvement, seed technology, and nursery technology in Pakistan. The plan schedules three separate and independent workshops in Pakistan and one international conference. Each workshop considers one significant theme and involves collaboration between Pakistan and US scientists and institutions. Further, each workshop serves as a core activity around which other activities are clustered. Following is the list of activities which are proposed.

1. Three workshops in Pakistan that involve Pakistani and US collaboration on the following themes: Tree Improvement, Tree Seed Technology, and Nursery Technology.
2. Two to five months of specialized training for six scientists from Pakistan with specialization in tree improvement, tree seed technology, and nursery technology.
3. The initiation of collaborative research activities between Pakistan and US scientists based on areas of mutual interest and need.
4. Identification and procurement of specialized equipment to support workshops in tree improvement, tree seed technology and nursery technology.
5. Three secondary workshops to facilitate the completion of plans designed to promote national programs in tree improvement, tree seed technology, and nursery technology.
6. One international conference on technologies for managing forest tree seed in the arid and semi arid regions of Asia to be hosted by the Government of Pakistan.

II. PROJECT BACKGROUND

The Forestry Planning and Development Project was initiated jointly in 1985 by the Office of the Inspector General of Forests, Government of Pakistan and the US Agency for International Development. Phase I of the Project terminated in February 1989. Phase II of the Project will terminate in August, 1993. The Winrock International Institute for Agricultural Development is responsible to the US Agency for International Development for facilitating the implementation of the Project. The Project has two major goals:

1. to help Pakistan increase its indigenous energy supply and achieve energy self-sufficiency;
2. to reverse the process of deforestation in Pakistan and to expand the extremely limited forest base.

In support of these goals, the Project has three objectives:

1. to strengthen the capability of Federal, Provincial and local institutions to design, implement, and evaluate policies and programs for increasing the production of fuelwood and timber in the country to increase the supply of energy and achieve self-sufficiency in energy;

2. to demonstrate the economic, technical and social feasibility of producing tree crops on privately owned farms and range lands to reverse the process of deforestation and to develop plantation management patterns in the private sector of the country;

3. to strengthen the institutional arrangements for developing research and training programs to achieve the objective of increased energy and wood production.

Since 1985, many activities in support of the Project's goals and objectives have been initiated. Some of these activities have been completed while others are still underway. Other important activities are being considered at this time for future implementation. Three such activities, essential to the successful artificial reforestation of the forest lands of Pakistan are the subject of this report. These are training activities relevant to tree improvement, tree seed technology and nursery technology.

III. PURPOSE OF THE PLAN OF WORK

Within the context of the Project's goals and objectives, this consultant was asked to formulate a written draft plan of work that identifies and schedules, in conceptual detail,

one or more workshops which will result in an integrated package of trainings, technical manuals, and possible research collaborations in arid land reforestation. The training activities to be considered are to focus on the scientific principles and management practices relevant to:

1. tree improvement,
2. tree seed technology,
3. nursery technology.

The scope of work for this consultancy is presented in Appendix A.

The draft plan of work addresses each of these three essential components of an artificial reforestation system and presents an integrated package of training program activities for each component. A schematic diagram of the three components of an artificial reforestation system is presented in Figure 1.

IV. THE RECOMMENDED PLAN OF WORK

The draft plan of work presented in this document was developed following discussions and on-site visits with officials of the Government of Pakistan, the US Agency for International Development and Winrock International. Discussions with these officials were held at Islamabad, Faisalabad and Peshawar, Pakistan between June 25 and July 15, 1991. The itinerary of visits is presented in Appendix B. The names of officials who provided advice and other information on these matters is presented in Appendix C. To the extent possible, the draft plan of work presents a synthesis of the perspectives and expectations of the officials involved.

The draft plan of work is consistent with the needs of Pakistan as illustrated by an assessment of the national reforestation system conducted by myself and several senior officials with considerable knowledge of the system. Within the context of a 10 year planning horizon, we considered the status of 14 components of the system for each of the nine species (groups) that were identified as accounting for 90 percent of the area planted annually. The 126 combinations of species and program components were assessed according to status as presented in Figure 2. Over 90 percent of the combinations were considered to be deficient in some respect. Based on this assessment, a national problem exists in tree improvement, seed technology and nursery technology. Internationally, these activities are addressed through the development of comprehensive national plans. Such plans and their implementation is very important for the future of forestry in Pakistan.

The proposed plan of work explicitly addresses the following considerations:

1. the scope of work for the consultancy which specifies the three components of interest in the artificial reforestation system; that is, tree improvement, tree seed technology and nursery technology, and the several program activities relevant to each component of the system; training, preparation of manuals, identification of collaborative research opportunities, identification of equipment needs, and recommendations on possible training locations with appropriate facilities;

2. the interests, concerns, and expectations of the officials of Pakistan from both national and provincial agencies and from Winrock International and the US Agency for International Development;

3. the perspective of the consultant based upon background materials reviewed and from experience.

To this end, the framework for the plan of work is structured to provide a separate set of activities relevant to training for each of the three distinct components of the artificial reforestation system. Each proposed set of inter-related training activities is clustered in a logical and consistent manner in relation to a core training activity, a national training workshop in Pakistan. More specifically, the plan of work recommends the following set of training activities to be undertaken in conjunction with the national workshop:

1. special training in the United States;
2. preparation of a training manual;
3. preliminary identification of problems and opportunities for further Pakistan/US collaboration;
4. identification of equipment and other needs for the national workshop and for longer - term program development.
5. associated workshops and conferences.

The national workshops in Pakistan will emphasize both the science based principles and state-of-the-technology practices relevant to the subject of the workshop. These will be presented and debated within the context of a specifically defined national need presented below. This activity is to be construed as neither a seminar nor a symposium nor a short-course. It is to be a workshop. Attendees are to be selected carefully giving attention to their levels of education, their professional and scientific experiences and accomplishments, and their anticipated future roles in the national needs

activity proposed by the workshop. Further, each attendee will be expected to contribute significantly to the workshop in part through the completion of a pre-assigned responsibility. The workshop is expected:

1. to provide an understanding of a framework for initiating and conducting a national needs program in each of the three components of the artificial reforestation system;
2. to identify further the opportunities for Pakistan /US collaboration in this area;
3. to identify the equipment and facilities needed for successful conduct of a longer - term program;
4. to initiate an appropriate networking system to facilitate communications among scientists and professionals specializing in the national need.

The plan of work also proposes a set of follow-up workshops to be convened after the lead workshop. The main purpose of the follow-up workshops is to assess the progress in completing the national needs program as prescribed in the lead workshop and to identify the problems which may have occurred. A secondary purpose of the follow-up workshops is to ensure the continuing development of the specialized communications network. The number of follow-up workshops, their locations and their agendas will be considered and proposed at the national lead workshop.

The intent of the overall training strategy recommended here is to enhance the expertise of a nucleus of Pakistani professionals and scientists in each of the three components of the artificial reforestation system. Following the two year period between now and the termination of the Project in Aug. 1993, there should be in place a cadre of well informed Pakistani scientists and professionals who are able to complete the program. More specifically, the rationale behind the strategy for clustered training activities in tree seed technology is to provide a mechanism through which a national woody plant seed manual for Pakistan can be developed. The completion of the design, framework and logistical strategy for such a manual could be completed within the life of the project. Completion of the woody plant seed manual itself will depend upon the resources committed to the task over time. Similarly for example, the rationale for the strategy to cluster training activities in tree improvement around a lead workshop is to create the scientific, technical and professional expertise necessary to develop and implement a national tree improvement plan for Pakistan. Likewise, a comparable set of training activities will provide a plan for the design and implementation of a national nurseries research program.

The collective benefits from the synergistic effects of clustered activities will be enhanced if the scheduling of those activities coincides appropriately with the schedule of the core activity, the national lead workshop. Interpersonal associations and relationships developed in the special training and lead workshop activities will provide a positive basis for initiating longer-term scientific collaboration between Pakistani and US scientists and institutions. Further, the use of clustered training activities is expected to promote the development of both formal and informal networking arrangements in Pakistan among scientists and professionals working on topics of common interest.

The model selected for structuring and delivering the training activities proposed in this plan of work has been used successfully elsewhere in the past. It has several important characteristics which make it especially relevant to the forestry situation in Pakistan. It enables technology to be transferred relatively quickly to large numbers of specialized personnel. It also prescribes methods for the trainees to apply the technologies to real world situations. As a result, it can promote change in a relatively short period of time. Additionally, it promotes team participation in the teaching and learning processes which in turn promotes a sense of proprietorship among participants in the program activities. This provides a substantial basis for sustaining these programs successfully in Pakistan following the end of the initial training period.

A. Tree Improvement

As the forestry programs of Pakistan continue to develop, those responsible for reforestation and subsequently forest productivity will become increasingly concerned about the genetic quality of the planting stock and the opportunities to achieve better planting stock through selection. Consequently, the long term interests of Pakistan can be well served by considering as a national need, a national forest tree improvement plan. To this end, an integrated and comprehensive training program to address a national forest tree improvement plan in Pakistan is proposed. A description of the individual training activities is presented below. A list of universities with recognized programs of strength in forest genetics and tree improvement in the United States is also presented.

1. A National Needs Assessment for Tree Improvement

An intensive three day meeting of senior forest officers and other officials with national forestry decision-making responsibilities will be convened to establish the overall priorities, policies, and procedures including constraints to

be followed in the development of a national tree improvement plan. The scientific, technical, and organizational options to be considered will be presented by two specialists from the United States working collaboratively with two specialists from Pakistan. Using this information as a basis for decision-making the officials from Pakistan will recommend:

a. the magnitude, diversity and time frame of the tree improvement plan recognizing the ultimate needs for improved planting stock;

b. the organization structure with responsibility centers necessary to implement the national tree improvement plan;

c. the resource requirements and commitments necessary to support the agreed upon plan.

2. A Workshop on a National Tree Improvement Plan

An intensive two week workshop will be conducted for 25 participating forest officers¹ in Pakistan to outline and discuss the elements and logistics of a national plan for woody perennial germplasm management in Pakistan. The national plan will provide a coordinated strategy for the collection, evaluation, improvement, maintenance, and exchange of germplasm of woody perennials relevant to forestry and farm forestry in Pakistan. The workshop will address tree improvement strategies, components of tree improvement plans, and methods for dealing with critical factors affecting the establishment, implementation and management of tree improvement plans. All species relevant to forestry and farm forestry will be included in the plan. Each species will be assigned a priority to indicate the sequence in which improvement activities will occur.

Further, the workshop will emphasize the science based principles of forest genetics, the contemporary technologies relevant to tree improvement practices, the logistics relevant to implementing a national plan, the appropriate organizational structure with centers of responsibility, and the general resource requirements. Additionally, the workshop will recognize explicitly and integrate appropriately into the national plan the tree improvement accomplishments achieved to-date by the Government of Pakistan and its agencies. The workshop also will recommend in a preliminary manner the role of follow-up workshops for assessing progress in completing the plan and resolving unforeseen problems. Finally, the workshop will consider the possibility of contributing to

¹ Officers who have earned the M.Sc. and higher degrees.

an international conference on seed technology proposed for Pakistan in January, 1993. This conference is discussed later in this report.

Two scientists from Pakistan together with two scientists from the United States will be responsible for developing the detailed syllabus and subject matter content of the workshop. These four scientists will be responsible for serving as instructors at the workshop. The Government of Pakistan will be responsible for selecting the two scientists from Pakistan. These scientists should have experience in tree improvement work and should be scheduled for continuing career assignments in this specialized activity. The Government of Pakistan will be responsible for deciding on the location of the workshop. Several responsible officials have recommended the Pakistan Forest Institute at Peshawar as the appropriate site for the workshop. Winrock International will be responsible for coordinating the participation of the US scientists at the workshop.

3. Specialized Training in Tree Improvement

Two scientists from Pakistan will be selected by the Government of Pakistan to participate for a five month period in a specialized training program in tree improvement at a recognized university in the United States. The specialized training will occur prior to the workshop discussed above and will be held at the university in the United States which is selected to assist in the instruction of the technical content at the workshop. The objectives of the specialized training are:

a) to create a four scientist team, two from Pakistan and two from the United States to collaborate on the design of the workshop;

b) to prepare a detailed and comprehensive training manual on a national tree improvement plan for Pakistan. The training manual will become the base document for instruction at the national workshop in Pakistan and will become the reference document for guiding the subsequent development and implementation of a national tree improvement program;

c) to prepare the scientists from Pakistan to become proficient instructors at the workshop.

4. Collaborative Research

During the five month specialized training program within the United States and during the two week workshop in Pakistan, every effort will be made to encourage the participants to identify opportunities for collaborative

research on tree improvement between scientists from Pakistan and the United States. As candidate activities for collaborative research are identified, the scientists from Pakistan will be encouraged to submit proposals for collaborative research to the Government of Pakistan.

5. Equipment and Facilities Identification

The university in the United States with the responsibility for developing the technical content of the workshop described above will prepare, in collaboration with the scientists from Pakistan engaged in five month special training, a detailed list of equipment needed to support the national workshop. Within 45 days of the date when the university in the United States initiates plans for the workshop, the list will be completed and submitted to Winrock International for the Government of Pakistan approval. Unique or special equipment required to support collaborative research between scientists in Pakistan and the United States should be identified separately and included on the list. The equipment list will include procurement specifications.

Additionally, the university will prepare a separate list of equipment and facilities necessary to support a national tree improvement program.

6. Follow-up Workshops

The purpose of the national tree improvement plan for Pakistan is to guide the development and implementation of a national tree improvement program. This is a large and complex undertaking from the perspectives of both the science and management involved. It is unrealistic to assume that the completion of a comprehensive and detailed manual and a successful national workshop may be sufficient activity to complete the national tree improvement plan. As a consequence several follow-up workshops may be necessary. The purpose of these workshops is to assess the progress achieved in completing the plan and to identify any unforeseen problems which may have arisen. The follow-up workshops may be most effective if they have a specific geographic orientation, a specific species orientation, or a specific subject matter orientation such as population genetics or grafting techniques. It will be the responsibility of the participants in the five month training program and the national workshop to plan for the follow-up workshops. The follow-up workshops will be very important in assisting in the development of effective communications networks for scientists and professionals employed in specific aspects of the national tree improvement program.

7. Collaborating Universities in the United States

Universities within the United States which have recognized tree improvement programs and which may have an interest in participating in the five month special training, the manual preparation, the workshop, and related activities include Michigan State University, Mississippi State University, North Carolina State University, Texas A&M University; University of Idaho, University of Florida, and the University of Washington.

8. Scheduling of Activities

Figure 3 presents a recommended schedule of activities with appropriate dates.

B. Tree Seed Technology

As the forestry programs of Pakistan continue to develop, those responsible for tree breeding strategies and seed orchards will be concerned about the harvest and distribution of that relatively expensive seed. Likewise, those responsible for nursery produced seedlings will be concerned about the source, quality and genetic background of their seed supplies. Consequently, the long-term interests of forestry in Pakistan can be well served by an integrated and comprehensive tree seed technology and management program which is prescribed by a national woody plant seed manual. The proposed woody plant seed manual will include a section on seed biology and the principles and general methods of producing and handling woody plant seeds. This will be followed by a section with specific seed data for selected species of trees and other important woody perennials found in Pakistan. The data will address topics such as flowering and fruiting dates, seed processing methods including those for harvesting, collection, post harvest care, conditioning and storage, seed yields and weights, methods of breaking dormancy, seed testing and determination of seed quality. The manual will be illustrated with photographs and drawings of seed of the species.

The manual will consolidate all the technical information that is known about the seeds of woody perennials of Pakistan. The manual will identify knowledge gaps which suggest research initiatives. Further, as Pakistan develops its national seed technology laboratory, the manual together with the laboratory may serve the interests of Pakistan beyond its borders. In as much as many of the species included in the manual have natural ranges which extend beyond the borders of Pakistan, forestry officials from other countries may look to Pakistan for leadership in forest tree seed technology in the region.

To this end, an integrated and comprehensive training program to address the development of a national woody plant seed manual for Pakistan is proposed. A description of the individual activities is presented below. A list of universities with recognized programs of strength in tree seed technology in the United States is also presented.

1. A Workshop on a National Woody Plant Seed Manual

An intensive two week workshop will be conducted for 25 participating forest officers in Pakistan to discuss the elements, structure, and logistics of developing a woody plant seed manual for Pakistan. The manual will provide an organized and coordinated strategy for consolidating and presenting the data and other information necessary to manage a complex, multi-species seed technology program in Pakistan. The workshop will stress the biological principles, processing technologies, organizational control and editorial methods necessary to complete a woody plant seed manual for Pakistan. Further, the workshop will recognize explicitly and integrate appropriately into the national woody plant seed manual the seed technology accomplishments achieved by the Government of Pakistan to-date. The workshop will recommend in a preliminary manner the role of follow-up workshops for assessing progress in developing the woody plant seed manual and for resolving unforeseen problems. Finally, the workshop will initiate the planning process for a major international conference on seed technology proposed for Pakistan in January, 1993.

Because of project time constraints, and the need to immediately initiate this program activity, two scientists from the United States will be responsible for developing the detailed syllabus and subject matter content of the workshop. These two scientists will be responsible for serving as instructors at the workshop. The Government of Pakistan will be responsible for selecting the two scientists from Pakistan to work closely with the two workshop instructors. These scientists should have experience in forest tree seed technology and should be scheduled for continuing career assignments in this specialized activity. The Government of Pakistan will be responsible for deciding on the location of the workshop. Several responsible officials have proposed that the workshop should be held at the Pakistan Forest Institute, Peshawar. Winrock International will be responsible for coordinating the participation of the US scientists at the workshop.

2. Specialized Training in Tree Seed Technology

Two scientists from Pakistan will be selected by the Government of Pakistan to participate in a two to three month

specialized training program in tree seed technology at a recognized university in the United States. The specialized training will occur immediately following the workshop discussed above and will be held at the university which is selected to provide the instruction at the workshop. The objectives of the specialized training are:

a) to address in detail one or more technical issues that directly effect the implementation and production of a national woody plant seed manual for Pakistan;

b) to prepare the scientists from Pakistan to become proficient instructors at follow-up workshops;

c) to commence planning for an international conference on seed technologies for the arid regions of Asia. The proposed conference is described later.

3. Collaborative Research

During the two to three month special training program in the United States and during the two week workshop in Pakistan, every effort will be made to encourage the participants to identify opportunities for collaborative research on the technologies relevant to tree seed which must be addressed in order to complete the woody plant seed manual. As candidate activities for collaborative research with scientists from the United States are identified, the scientists from Pakistan will be encouraged to submit proposals for collaborative research to the Government of Pakistan. One activity which is appropriate for further collaboration is the design and conduct of the proposed international conference on seed technology.

4. Equipment and Facilities Identification

The university in the United States with the responsibility for developing the technical content of the workshop described above will prepare a detailed list of equipment needed to support the workshop. Within 45 days of the date when the university in the United States initiates plans for the workshop, the list will be completed and submitted to Winrock International for Government of Pakistan approval. Unique or special equipment required to support collaborative research between scientists in Pakistan and the United States should be identified separately and included on the list. The equipment list will include procurement specifications.

Additionally, the university will prepare a separate list of equipment and facilities necessary to support the development of a national woody plant seed manual for Pakistan.

5. Follow-up Workshops

The purpose of the plan for a national woody plant seed manual for Pakistan is to guide the development of such a manual. This is a large and complex undertaking from the perspectives of both science and management. It is unrealistic to assume that completion of a comprehensive and detailed training manual and a successful national workshop may be sufficient activity to complete the plan for a national woody plant seed manual. As a consequence, several follow-up workshops may be necessary. The purpose of these workshops is to assess the progress achieved in completing the plan and to resolve any unforeseen problems which may have arisen. The follow-up workshops may be most effective if they have a specific geographic orientation, a specific species orientation, or a specific subject matter orientation such as seed physiology and dormancy, or conditions for seed storage. It will be the responsibility of the participants in the five month training program and the national workshop to plan for the follow-up workshops. The follow-up workshops will be very important in assisting in the development of effective communications networks for scientists and professionals employed in specific aspects of the development of the woody plant seed manual. It is recommended that one follow-up workshop will be scheduled for June, 1992 to continue preparations for the proposed international conference.

6. Collaborating Universities in the United States

Universities within the United States which have recognized forest tree seed technology programs and which may have an interest in participating in the two to three month special training, the manual preparation, the workshop, and related activities include Mississippi State University, Oregon State University, and the University of Georgia.

7. International Conference

It is proposed that a major international conference on technologies for managing tree seeds of the arid and semi-arid regions of Asia be sponsored by the Government of Pakistan at the Pakistan Forest Institute, Peshawar in January, 1993. The proposed conference is intended to represent the formal culmination of accomplishments in forest tree seed technology achieved during this phase of program activities. While the conference will stress tree seed technology, it may recognize the linkages and relationships between tree seed technology activities and activities in tree improvement and nursery management programs.

It is also proposed that much of the planning for the conference can be completed in conjunction with the lead workshop, special training, secondary workshops and other collaborative activities discussed above. The plan must include recommendations on the theme of the conference, the program of the conference including specific topics and specific speakers. It will include recommendations on the length of the conference, the format of the conference and the characteristics of the participants to whom the conference is oriented. The role of the national seed technology laboratory at Pakistan Forest Institute in the conference should be considered.

8. Scheduling of Activities

Figure 4 presents a recommended schedule of activities with appropriate dates.

C. Nursery Technology

As the forestry programs of Pakistan continue to develop, those responsible for the production of high quality and more costly genetically superior seed will be concerned about the proper utilization of this seed in the nurseries. Likewise, those who are responsible for reforestation programs will be concerned about the cost, quality, condition, survival and growth of the seedlings they receive from the nurseries. Equally important, research programs which evaluate treatment differences of planted material can not be properly interpreted unless the planted material can be produced and assessed according to a uniform set of quality standards. Consequently, the long-term interests of forestry in Pakistan can be well served by a tree nursery technology and management program; the third national need. To this end, a clustered program of training and related activities to prepare a plan for a nurseries research program in Pakistan is proposed. The individual activities, their descriptions, and universities in the United States noted for their strengths in nursery management are outlined below.

1. Workshop on Tree Nursery Technology

An intensive two-week workshop will be conducted for 25 participating forest officers in Pakistan to discuss the principles and practices of modern nursery management. Topics to be included in the workshop are seed and seedbed preparation, management of factors affecting seedling growth and development, the physical and physiological measurement of seedling quality, and seedling lifting, storage and transportation. Special emphasis will be given to a national nurseries research program. This program will identify up to seven appropriately diverse geographic locations in Pakistan

in which a research nursery may be located. The characteristics, criteria, and operating strategies for each nursery will be specified. In each case, the nursery will be designed to produce seedlings of a predetermined quality, of predetermined species and predetermined scale of operations. Further the efficiency or cost of production will be a factor in the design. The nursery research program will be developed within the context of supporting tree seed technology and tree improvement programs. The workshop will recognize explicitly and integrate appropriately into the nurseries research plan the accomplishments and achievements of the Government of Pakistan in nursery management to-date. Finally, the workshop will recommend in a preliminary manner the role of follow-up workshops for assessing progress in developing the national nurseries research plan and for resolving unforeseen problems.

Two scientists from Pakistan together with two scientists from the United States will be responsible for developing the detailed syllabus and subject matter content of the workshop. These four scientists will be responsible for serving as instructors at the workshop. The Government of Pakistan will be responsible for selecting the two scientists from Pakistan. These scientists should have experience in forest tree nursery technology and management and should be scheduled for continuing career assignments in this specialized activity. The Government of Pakistan will be responsible for deciding on the location of the workshops. The Pakistan Forest Institute has been suggested as the site for the lead workshop. Winrock International will be responsible for coordinating the participation of the US scientists at the workshop.

2. Specialized Training in Nursery Management

Two scientists from Pakistan will be selected by the Government of Pakistan to participate for a five month period in a specialized training program in nursery management at a recognized university in the United States. The specialized training will occur prior to the workshop discussed above and will be held at the university which is selected to assist in the instruction of the technical content of the workshop. The objectives of the specialized training are;

a) to create a four scientist team, two scientists from Pakistan and two scientists from the United States, to collaborate on the design of the workshop;

b) to prepare a detailed and comprehensive training manual on forest nursery management principles and practices with specific reference to a national nurseries research plan for Pakistan. The training manual will become the base document for instruction at the national workshop in Pakistan and will become the reference document for guiding the development of a national nurseries research program;

c) to prepare the scientists from Pakistan to become proficient instructors at the workshop.

3. Collaborative Research

During the five month specialized training program within the United States and during the two week workshop in Pakistan, every effort will be made to encourage the participants to identify opportunities for collaborative research on forest nursery technologies and practices. As candidate activities for collaborative research with scientists from the United States are identified, the scientists from Pakistan will be encouraged to submit proposals for collaborative research to the Government of Pakistan.

4. Equipment and Facilities Identification

The university in the United States with the responsibility for developing the technical content of the workshop described above will prepare, in collaboration with the scientists from Pakistan engaged in five month special training, a detailed list of equipment needed to support the workshop. Within 45 days of the date when the university in the United States initiates plans for the workshop, the list will be completed and submitted to Winrock International for Government of Pakistan approval. Unique or special equipment required to support collaborative research between scientists in Pakistan and the United States should be identified separately and included on the list. The equipment list is to include procurement specifications.

Additionally, the university will prepare a separate list of equipment and facilities necessary to support the development of the first four nurseries in the national nurseries research program.

5. Follow-up Workshops

The purpose of the plan for a nurseries research strategy for Pakistan is to guide the development of such a program. This is a large and complex undertaking from the perspectives of both science and management. It is unrealistic to assume that completion of a comprehensive and detailed training manual and a successful national workshop will be sufficient activity to complete the national nurseries research plan. As a consequence, several follow-up workshops will be necessary. The purpose of these workshops is to assess the progress achieved in completing the plan and to resolve any unforeseen problems which may have arisen. The follow-up workshops may be most effective if they have a specific geographic orientation, a specific species orientation, or a specific subject matter orientation such as seed germination or root pruning practices. It will be the responsibility of

the participants in the five month training program and the national workshop to plan in a preliminary way for the follow-up workshops. The follow-up workshops will be very important in assisting in the development of effective communications networks for scientists and professionals employed in specific aspects of the development of a national nurseries research program.

6. Collaborating Universities in the United States

Universities within the United States which have recognized forest tree nursery programs and which may have an interest in participating in the five month special training program, the manual preparation, the workshop, and related activities include Michigan State University, North Carolina State University, University of Florida, University of Idaho, and Oregon State University.

7. Scheduling of Activities

Figure 5 presents a recommended schedule of activities with appropriate dates.

V. BUDGET

The budget for the activities proposed in this plan of work is presented on Table 1. This budget estimates the US dollar costs by program activity and component.

Table 1: Estimated US dollar cost of proposed plan of work

Activity	Tree Improv.	Seed Tech.	Nursery Tech.	Total
1. Special Training				
Manual Preparation	26,000	15,000	26,000	67,000
Int'l Travel	<u>18,500</u>	<u>-----</u>	<u>18,500</u>	<u>37,000</u>
sub-total	44,500	15,000	44,500	104,000
2. Workshop				
Instruction	16,300	16,300	16,300	48,900
Int'l Travel	<u>13,400</u>	<u>13,400</u>	<u>13,400</u>	<u>40,200</u>
sub-total	29,700	29,700	29,700	89,100
3. Collaborative Work				
Training	<u>-----</u>	17,800	<u>-----</u>	17,800
Int'l Travel	<u>-----</u>	<u>14,400</u>	<u>-----</u>	<u>14,400</u>
sub-total	<u>-----</u>	32,200	<u>-----</u>	32,200
4. Secondary Workshops				
Training	7,300	4,100	7,300	18,700
Int'l Travel	<u>12,400</u>	<u>5,700</u>	<u>12,400</u>	<u>30,500</u>
sub-total	19,700	9,800	19,700	49,200
5. International Conference				
Consultancy	<u>-----</u>	5,700	<u>-----</u>	5,700
Int'l Travel	<u>-----</u>	<u>10,500</u>	<u>-----</u>	<u>10,500</u>
sub-total	<u>-----</u>	16,200	<u>-----</u>	16,200
6. Total				
	<u>93,900</u>	<u>102,900</u>	<u>93,900</u>	<u>290,700</u>

Figure 1. Components of a comprehensive artificial reforestation system

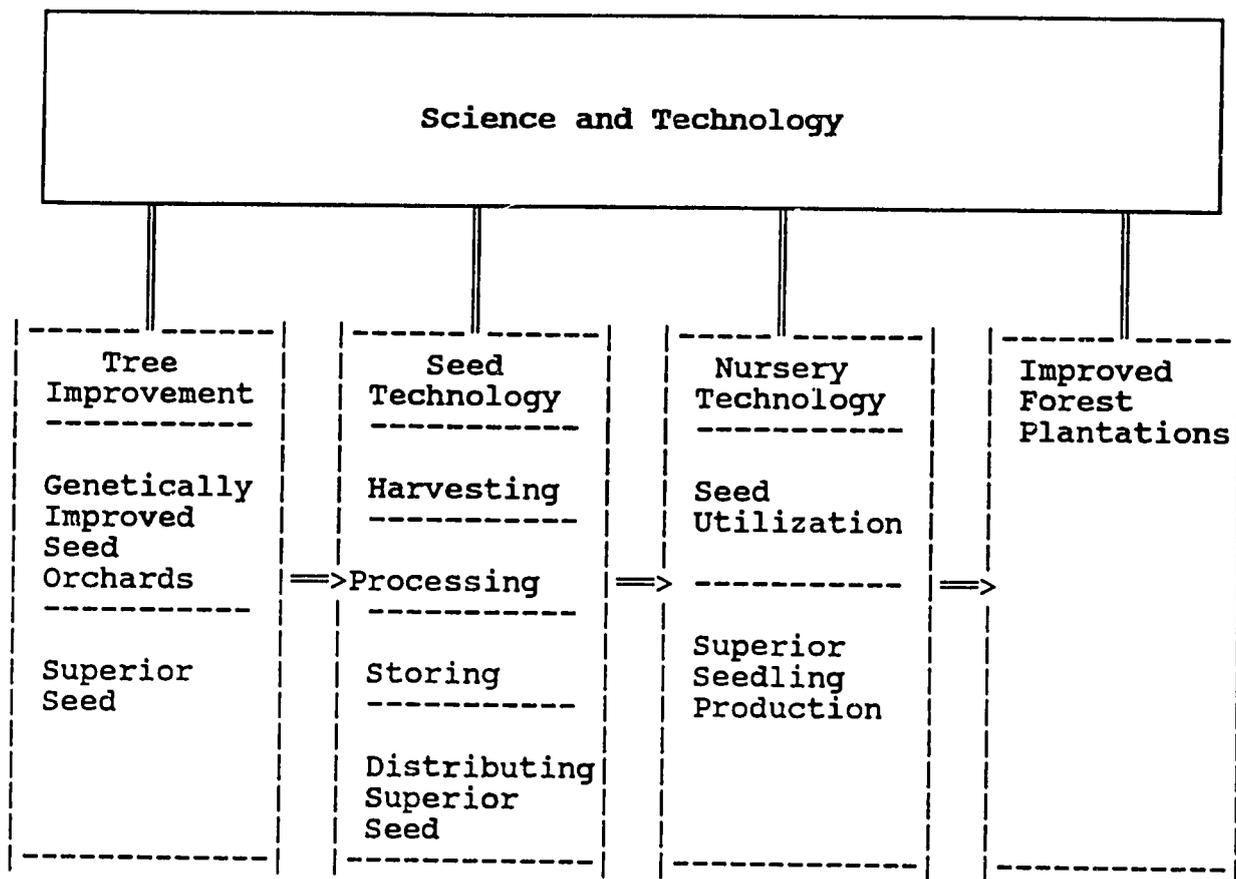


Figure 2. ASSESSMENT OF NATIONAL PROGRAM STATUS WITH THE CONTEXT OF A TEN YEAR PLANNING HORIZON

SPECIES	FIRST GEN SEED ORCHARDS		SECOND GEN SEED ORCHARDS		THIRD GEN SEED ORCHARDS		SEED QUANTITY	SEED QUALITY	NURSERIES		SEEDLING QUANTITIES	SEEDLING QUALITY	AREA TO BE PLANTED ANNUALLY (Known to field officers)	PLANTATION SURVIVAL RATES	OVERALL ASSESSMENT
	Size	#	Size	#	Size	#			Size	No.					
1. Pinus roxburghii	L	L	L	L	L	L	S	U	L	L	S	U	?	U	U
2. Dalbergia sissoo	L	L	L	L	L	L	S	U	L	L	S	S	?	S	U
3. Acacia nilotica	L	L	L	L	L	L	S	S	L	L	S	S	?	S	U
4. Eucalyptus camaldulensis	L	L	L	L	L	L	S	S	L	L	S	S	?	U	U
5. Pinus wallichiana	L	L	L	L	L	L	S	U	L	L	S	U	?	U	U
6. Ledrus deodora	L	L	L	L	L	L	S	U	L	L	S	U	?	U	U
7. Abies webbiana	L	L	L	L	L	L	S	U	L	L	S	U	?	U	U
8. Morus alba	L	L	L	L	L	L	S	U	L	L	S	S	?	S	U
9. Group Salix Populus Salmalia Rubinia	L	L	L	L	L	L	S	U	L	L	S	S	?	S	U
10. Overall Assessment	L	L	L	L	L	L	S	U	L	L	S	U	?	U	U

L = Low S = Shortage U = Unsatisfactory S = Satisfactory ? = Unknown at national level

Figure 3. Proposed schedule of Tree Improvement activities

Activity	1991					1992					1993													
	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	
Training and Workshop preparation in the US.						T	T	T	T	T														
Equipment Specs						E																		
Equipment Procurement in Pakistan						P	P	P	P															
Manual Completion										M														
Preparation in Pakistan for Workshop										P														
Workshop											W													
Logistics for Collaborative Research											L	L	L	L	L	L	L	L	L	L				
Logistics for Secondary Workshops											S	S	S	S	S	S	S	S	S	S				

Figure 4. Proposed schedule of Seed Technology activities

Activity	1991					1992					1993													
	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	
Training in the U.S.						T	T	T																
Equipment Specs	E																							
Equipment Procurement in Pakistan	P	P																						
Manual Completion						C																		
Preparation in Pakistan for Workshop	P	P																						
Workshop						W																		
Logistics for Collaborative Research	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
Logistics for Secondary Workshops	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Secondary Workshop																								W
Preparation for International Conference	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
International Conference																								C

Figure 5. Proposed schedule of Nursery Technology activities

Activity	1991					1992					1993														
	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J		
Training and Workshop preparation in the US.						P	P	P	P	P															
Equipment Specs											E														
Equipment Procurement in Pakistan											P	P	P	P											
Manual Completion																							M		
Preparation in Pakistan for Workshop																							P	P	P
Workshop																									W
Logistics for Collaborative Research						L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	
Logistics for Secondary Workshops						L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	

APPENDIX A

Scope of work for Developing Tree Improvement, Seed Technology and Nursery Technology Workshops.

Scope of Work

A. Within two working days after arriving in Pakistan, the consultant will have finalized an outline of the proposed activities including a travel schedule, and a list of individuals and organizations to be visited.

B. Formulate a written draft of work that identifies and schedules, in conceptual detail, one or more workshops which will result in an integrated package of trainings, technical manuals, and possibly, research collaborations in arid land reforestation. Training activities to be considered are given below. The plan should also identify needs for training facilities and equipment as well as possible training locations.

C. Prior to leaving Pakistan, present orally to GOP, TAT and USAID personnel the written draft work plan proposal for review and comment.

Proposed Training Activities

A. Tree Improvement Activities

1. Training Needs:

The workshop will cover tree improvement strategies; components of tree improvement plans; and methods for dealing with critical factors affecting the establishment, implementation, and management of tree improvement plans.

2. Manuals and Research Collaboration

Assist in the collaborative development and implementation of tree improvement plans for selected farm forestry tree species, i.e. Eucalyptus camaldulensis, Dalbergia sissoo, and Acacia nilotica.

B. Tree Seed Technology

1. Training Needs:

The workshop will cover principles and practices of tree seed production, collection and harvesting, post harvest care, seed conditioning and storage, seed testing, and determination of seed quality by standard methods.

2. Manuals and Research Collaboration:

One or more manuals to guide farm forest officers on the collection, post harvest care, storage, germination and testing of tree seed used in farm forestry reforestation programs will be developed. The manuals will be used in Forest Department training schools and by officers to train their subordinate staff.

C. Nursery Technology

1. Training Needs:

The workshop will cover principles and practices of seed and seedbed preparation, management of factors affecting seedling growth and development, physical and physiological measurement of seedling quality, and seedling lifting, storage, and transportation.

2. Manuals and Research Collaboration:

Initiate development of a manual which describes procedures for physiological measuring and physical grading of farm forestry tree seedlings to assess their quality and to test their field performance. Collaborate in the planning and development of four regional model nurseries.

APPENDIX B

Schedule of Visits

- June 25, 1991 Meet with officials of Winrock International and US Agency for International Development, Islamabad, PK.
- June 26, 1991 Meet with officials of Winrock International Forestry Planning and Development Project, Islamabad, PK.
- June 27, 1991 Meet with officials of the Pakistan Forest Institute, Peshawar, PK.
- June 30, 1991 Meet with officials of the Punjab Forestry Research Institute, Faisalabad, PK.
- July 1, 1991 Continue discussions at the Punjab Forestry Research Institute, Faisalabad, PK.
- July 2, 1991 Meet with officials of Winrock International, Islamabad, PK.
- July 3, 1991 Meet with officials of Winrock International and the Inspector General of Forests, Government of Pakistan, Islamabad, PK.
- July 7, 1991 Meet with officials of the Pakistan Forest Institute, Peshawar, PK.
- July 8, 1991 Continue discussions at the Pakistan Forest Institute.
- July 9, 1991 Continue discussions at the Pakistan Forest Institute.
- July 10, 1991 Meet with officials of the North West Frontier Province Forest Department, Peshawar, PK.
- July 11, 1991 Meet with officials of Winrock International.
- July 14, 1991 Meet with officials of the Office of Inspector General, Government of Pakistan, the US Agency for International Development and Winrock International.

APPENDIX C

Officials Contacted

Abeedullah Jan
Inspector General of Forests
Government of Pakistan
Islamabad, PK

Bashir A. Wani
Dy. Inspector General of Forests
Government of Pakistan
Islamabad, PK.

Nasrullah K. Aziz
Dy. Inspector General of Forests
Government of Pakistan
Islamabad, PK.

Khawaja Hameedullah
Project Officer
US Agency for International Development
Islamabad, PK

Khalid M. Siddiqui
Director General
Pakistan Forest Institute
Peshawar, PK

Mohammad Khan
Research Officer
Pakistan Forest Institute
Peshawar, PK

Raja W. Hussain
Director, Forestry Research
Pakistan Forest Institute
Peshawar, PK.

M. Ismail Chaudhry
Director, Forest Entomology
Pakistan Forest Institute
Peshawar, PK.

Fazli Subhan
Senior Research Officer
Pakistan Forest Institute
Peshawar, Pk.

A. A. Khan
Medicinal Plant Botanist
Pakistan Forest Institute
Peshawar, PK.

Zakaullah Chaudhry
Forest Pathologist
Pakistan Forest Institute
Peshawar, PK.

Altaf Hussain
Assistant Silviculturist
Pakistan Forest Institute
Peshawar, PK.

Tahir Laeeq
Assistant Silviculturist
Pakistan Forest Institute
Peshawar, PK.

Raja M. Ishaq
Research Officer
Pakistan Forest Institute
Peshawar, PK.

Shamsur Rehman
Forest Geneticist
Pakistan Forest Institute
Peshawar, PK.

Yar M. Khan
Chief Conservator of Forests
North West Frontier Forest Department
Peshawar, PK.

Sahibzada M. Hafeez
Director
Punjab Forestry Research Institute
Faisalabad, PK.

Wahid Rashid
Research Officer
Punjab Forestry Research Institute
Faisalabad, PK

Abdul Khaliq
Research Officer
Punjab Forestry Research Institute
Faisalabad, PK

Mumtaz A. Babar
Research Officer
Punjab Forestry Research Institute
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Muhammad Rafique
Research Officer
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Faisalabad, PK

Mohammad Saleem
Research Officer
Punjab Forestry Research Institute
Faisalabad, PK

Muhammad A. Basit
Research Officer
Punjab Forestry Research Institute
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Muhammad Hafeezullah
Research Officer
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Zafar Iqbal
Research Officer
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Muhammed S. Dogar
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Sana A. Khan
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Muhammad Afzal
Research Officer
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Charles R. Hatch
Chief of Party
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Winrock International
Islamabad, PK

George M. Blake
Training & Research Advisor
Forestry Planning & Development Project
Winrock International
Islamabad, PK

Gary G. Naughton
Field Demonstration Forester
Forestry Planning & Development Project
Islamabad, PK.

Mahmood I. Sheikh
Policy & Management Specialist
Forestry Planning & Development Project
Islamabad, PK

Rashid M. Randhawa
Project Director - Punjab
Farm Energy Forestry Project
Islamabad, PK.

DPR/maa