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VISIT OF U.S. TEAM ON MULTIPURPOSE POPLAR TO NEPAL

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SUMMARY

This report summarizes findings of the U.S. Team on Multipurpose Poplar from its two-week visit to Nepal in April 1986. The objectives of the visit were as follows:

- To review concept and scope of a proposed poplar reforestation project in Nepal;
- To identify concerns of the Government of Nepal (GON) pertinent to such a project; and
- To develop a mutually agreeable approach to and initiate the design of a project.

The team met with GON officials to discuss their concerns, needs, and interests. The team also met with other knowledgeable parties in Nepal to learn more about related work and experience from other projects on technology transfer. More than one week was spent on field trips to examine farming and forestry conditions and natural resource conservation needs.

A good working relationship with the Government of Nepal and the Kathmandu Mission of the U.S. Agency for International Development was developed during this trip. Upon return to the U.S., the team reviewed its findings with officials of the U.S. AID and a member of the Senate Appropriations Committee staff.

Based on technical evaluation and a diversity of inputs, the team makes the following recommendations:

1. An approach that integrates choice of species and cultural production systems with existing and anticipated needs of the local people at village level is recommended.
2. The introduction of poplars in Nepal should be restricted to selected areas under special production systems; as most poplar materials are limited in utility by their high water and nutrient requirements.
3. Both native and introduced tree species should be included in the project. Emphasis should be given to fodder-grade evergreen and nitrogen-fixing species. Poplars and willows deserve some attention.
4. Species elimination trials in representative areas should precede extensive production planting. Locally untested material should not be introduced in a large scale.
5. New cultural production systems should be investigated, including ultrashort coppice, contour hedgerow, and alley cropping. New systems should be tested in comparative trials alongside the traditional ones.
6. Effort should begin immediately on the identification of priority regions in order to focus on suitable species and feasible production systems.
7. The project offers opportunities for commercial development in selected areas. These opportunities should be explored.

In conclusion and based on the the good working relationships established with key officials of the GON, the team is optimistic about the development of a successful project that will be satisfactory to both governments.

VISIT OF U.S. TEAM ON MULTIPURPOSE POPLAR TO NEPAL

1 INTRODUCTION

1.1 BACKGROUND

The U.S. Congress has authorized $2.28 million in the FY86 Continuing Resolution for a reforestation project in Nepal. The Congress's objectives for the project are (1) to assist the Government of Nepal (GON) in natural resources conservation and development, (2) to alleviate soil erosion and fodder and fuelwood shortage problems, and (3) to provide impetus to the Nepali efforts to stimulate economic development. Congress has selected Argonne National Laboratory (ANL) for the management of this project.

In an earlier unsolicited proposal, a lrge-scale introduction of poplar cuttings to Nepal had been proposed. The reforestation project, which differs from the unsolicited proposal, included a reduced number of imported cuttings. Even after these changes, concerns about the project by the GON continued to be expressed. To assist in resolving these concerns, AID/Washington assembled a team consisting of Sin-yan Shen (team leader) and Anant Vyas, both of ANL; Paul Heilman of Washington State University; and Reinhard Stettler of the University of Washington. The GON agreed to meet with the team to resolve the issues raised and to cooperate in development of a mutually acceptable approach to the project.

1.2 OBJECTIVES OF THE TEAM VISIT TO NEPAL

The specific objectives, as understood by the team members, were: 1) to review concept and scope of the reforestation project in light of the needs and interests of the GON; 2) to explore with the GON, AID/Kathmandu, and others the possible types of projects which could be successful in Nepal given the current economic and social situation; and 3) to begin the process of development of a project that is acceptable to the GON and that meets the intent of the congressionally defined objectives.

2 TEAM ACTIVITIES

2.1 MEETINGS WITH AID PERSONNEL

Prior to leaving for Nepal the team met with several members of AID in the Washington Office. A briefing to the team was given by Jim Norris, Ken Sherper, Jack Sullivan, Bob Ichord, Cynthia Mackie, and Elizabeth Kvitashvili. At this time, the team was provided with information relating to the background of the project and the organization of the AID Mission in Kathmandu. The background information included copies of the original unsolicited proposal and a letter from Senator Hatfield to the U.S. AID Administrator, Mr. McPherson. The team was also given a project concept paper, a paper outlining the scope of the visit, and copies of published information regarding poplars in the Indian subcontinent. The team was informed of other donor projects in Nepal and of Nepal's own reforestation efforts.

The team arrived in Kathmandu on March 30, 1986, and met the same day with AID Mission Director David Wilson and foresters George Taylor and Burt Levenson. During the trip, the team also met with other members of the AID/Kathmandu Mission -- notably, Deputy Mission Director Janet Ballantyne and Chief of Agricultural and Resource Conservation Charles Hash. The mission arranged all meetings with the GON officials and also made arrangements for the field trips. A large amount of documentation on forestry and rural development in Nepal was also provided to the team by the mission. The mission staff was very helpful to the team. The team thanks all the AID members who provided help. Thanks are also due Dharma Raj Suwal, Agricultural Program Specialist; Shreebindu Bajracharya, Forester; Chitra Rana of the Travel Office, and the secretaries to both the Director and the Deputy Director of the AID Mission.

After the visit, the team returned to Washington, D.C. on May 1 to report on the trip to AID officials and to Jeff Booth of the Senate Appropriations Committee Staff.

2.2 MEETINGS WITH GON OFFICIALS

The team met with a member of the National Planning Commission of Nepal, who is responsible for forestry, soil conservation and energy; the Secretary of the Ministry of Forest and Soil Conservation (the line ministry for the project); and the Secretary of the Ministry of Finance, who approves spending of funds within the government. The team also met with technical administrators and researchers in the forestry sector to identify issues relating to the project and Nepalese research needs.

2.3 OTHER ACTIVITIES IN NEPAL

On March 31, the team met with Ambassador L.J. Weil and Counselor L.R. Macfarlane at the U.S. Embassy. Ambassador Weil discussed his recent meeting with Senator Mark O. Hatfield who expressed his desire to make this project a total benefit to the Nepalese people. Ambassador Weil was pleased with the ANL approach aiming at complete technology transfer to the Nepalese people.

The team also met with British, Australian, and Chinese technical persons currently involved in forestry and industrial projects in Nepal. The intent of these meetings with the foreign technical advisors was to learn about their projects and their efforts to achieve technology transfer. The team also met with forestry faculty at the Hetauda Campus of Tribhuvan University, where a project on fodder and fuelwood trees is sponsored by the International Development and Research Center (IDRC), Canada.

While in Nepal, the team obtained and reviewed planning documents and in-country agriculture and forestry research literature in order to learn more about Napalese programs and priorities and to assess results of past research work. The team was able to identify possible industrial uses of wood, with some of the uses bringing new industrial development to Nepal. The review of forestry literature provided information on past and ongoing work on local and introduced species.

In order to observe biomass production and natural resources conservation needs, to gather information about field trials, and to obtain as much understanding of

logistical, administrative, and social issues as possible, the team undertook several fiel trips. These field trips were arranged by AID/Kathmandu and the Forestry Departmen of Nepal. The team visited a nursery and some trial plantations in the Kathmandı Valley, undertook a seven-day trip to Solu-Khumbu region in the Sagarmatha (Mt Everest) zone, and visited the Tarai and Inner-Tarai physiographic regions. A detailec account of these meetings and field trips is provided in the Appendix.

3 OBSERVATIONS ON AGRICULTURE AND FORESTRY IN NEPAL

Agriculture dominates the Nepali life and economy. The present system of rural economy is based on centuries-old experience of the local natural conditions. Terraces are labor investments through generations in tackling the problem of slope, while native irrigation channels epitomize the farmers' ingenuity to improve their lot. The value of land improvement is fully recognized by the Nepalese, but the scope for extension of agricultural land is limited.

The agricultural process is highly diversified as a result of differences in resource conditions. It is erroneous to equate the agricultural system prevalent in Kathmandu Valley with those of the Hills and the Tarai. The system in Kathmandu is more akin to the horticultural economy of the Far East. Any project design which overlooks the basic differences between the subsistence economy of the Hills and the exchange economy of the Tarai must suffer from overgeneralization. In the Hills that support large population, agriculture depends on cattle manure, and cattle depend on forest fodder.

Wood provides the energy for cooking, drying food, space heating, distilling alcohol, and making charcoal. Ninety-five percent of the energy consumed in the Hills comes from firewood. A large portion of this wood comes from public forests. All of this causes deforestation, which in turn promotes soil erosion.

For a long time, Nepalese farmers have been using indigenous tree leaves for feeding their animals. Over a hundred species of such valuable fodder trees are known. Fodder trees are thus an important economic input to the livelihood of the Nepalese farmer and play an important role in the ecosystem of Nepal. In the Hills where subsistence farming is prevalent, tree-lopping is often carried out to excess and is the cause of chronic fodder shortages, deterioration of soil fertility, and (in part) erosion. Finding ways and means of providing an improved, sustained yield is crucial to improving the living conditions of the Nepalese farmer.

Species selection trials were conducted by Tribhuvan University for Tarai, Inner Tarai, and the Mid Hills regions of Nepal to identify the best species to be introduced into farms. Looking at the growth data, the performance of the trees, and the choice of the farmers, the following species show promise: *D. sissoo*, *Leucaena leucocephala*, *Cassia siamea*, *Sesbania grandiflora*, *Melia azedarach*, and *Eucalyptus camaldulensis* for the Tarai; *D. sissoo*, *Leucaena leucocephala*, *Albizia julibrissin*, and *Eucalyptus camaldulensis* for the Inner Tarai; and *Prunus cerasoides*, *Ficus glaberrina*, *D. sissoo*,and *Artocarpus lakoocha* for the lower Mid Hills.

Of central importance to many problems of the mountain regions is the multipurpose tree. In high elevations these trees provide both fuel and fodder, with the major shortage in the higher area being mostly fodder. In middle elevations, the shortages of fuel and fodder appear to be compounded by the need for small timber. A broad array of native species is available to serve these multiple needs. Increased planting of these species is desired. However, the existing array of species may be complemented by the introduction of suitable new species and cultivars.

Fast-growing trees are present in the mountain region. Two outstanding examples are *Pinus wallichiana* and *Alnus nepalensis*. Both are used for timber production, particularly the latter species, are used for fuel. The pine is the major species being planted in the area. The best specimens of *Alnus nepalensis* occur on wetter soils, but it was observed to occur on drier, middle elevation ridges (8,000 feet). Limited effort to plant this species is made, because it is considered to establish itself naturally, particularly on recently disturbed sites.

Poplars are likely to be of limited value in addressing the problems and needs of the mountain regions. Most sites are too droughty and/or infertile for satisfactory poplar growth. Local farmers consider poplars generally unsatisfactory for fodder and fuel, as well as for timber. Poplars were introduced to the Jiri area more than a decade ago. From there they have spread in small numbers to the Phaphlu/Salleri Region. Only one farmer used them for fodder. Others used them for border plantings at property

boundaries and, in two cases, they had been planted in an attempt to stabilize gully erosion. Little evidence was seen that farmers expressed interest in additional planting of poplars beyond their first trials. Poor planting practices were observed which undoubtedly caused reduced success in establishment and may be partly responsible for lack of enthusiasm about poplar planting.

4 FINDINGS RELEVANT TO THE DEVELOPMENT OF A PROJECT

A large potential exists for trees to meet growing Nepalese needs for fuel, fodder, food, and income as well as to sustain land productivity. To realize this potential will require improved management of land and forest resources and enhanced research on development of improved stock and culture and management of multipurpose trees.

4.1 CONCERNS OF THE GOVERNMENT OF NEPAL

The main concerns of the Government of Nepal about the originally proposed project are as follows:

- o Poplars may only be suitable for certain locations.
- o Utility of Poplars is not well known to local residents.
  - Quality as fodder is considered poorer than that of local species.
  - Quality as firewood is also considered poor.
- o The poplar clones proposed for introduction in Nepal have not been tested in that country and may not perform satisfactorily.
- o Mass planting of eucalyptus in the past was cited as a bad experience. The large-scale introduction of a foreign plant material constitutes a possible phytosanitary hazard.
- o A significant portion of the funds should be spent in hiring local technical and other workers.
- o The large number of donor projects has resulted in a shortage of skilled manpower.

As to the priority regions and their respective needs, an array of concerns was expressed to the team by the various officials of GON. The following is a summary of major concerns in the respective regions.

National Planning Commission

- o Mountain -- natural resources conservation
  -- firewood production
- o Hills -- livestock development (i.e., fodder)
- o Tarai -- commercialization

Ministry of Forest and Soil Conservation

- o All regions -- increased employment
- o Hills -- fodder production

Ministry of Finance

- o Hills -- resource conservation (fuelwood, fodder, etc.)
- o Tarai -- ecological balance

4.2 ROLE OF POPLAR RELATIVE TO OTHER SPECIES

Poplar, though not yet preferred by the Nepalese, can be acceptable in some areas. Poplar clones of various origins have been tried and the following unfavorable characteristics noted:

- o insect damage,
- o poor survival rate (partly due to poor sites),
- o undesirable surface roots,
- o bole cracking, and
- o poor tolerance to drought shown by exotic clones.

The poplar species *P. ciliata* has been in existence in Nepal for at least 200 years and is found in high hills and the Kathmandu Valley. Popularity of this species in low-rainfall regions was reported.

Poplar as a possible fodder source would have to be pitted against the many *Ficus spp.* of proven quality and popular acceptance. Similarly, as a fuel source poplar would have to compare favorably with other local species, notably *Alnus nepalensis*.

A majority of local residents still assume the availability of free firewood from nearby forests. This affects species selection for planting on farms, since high-value timber species are preferred even though they have slower growth. *D. sissoo* is widely preferred as a lumber species. The quality of poplar wood is considered poor for timber and fuelwood; however, its use for match stock is of interest to the GON. Presently, the local species *Bombax ciba* is used for matchsticks. *Ceiba pentandra* (kapok) is being tested.

Using inputs from the forestry sector of Nepal, the team summarizes possible use of poplars as follows:

- o Tarai -- Production of match stock
- o Kathmandu and Pokhara Valleys -- Production of fuel and timber
- o Mid Hills -- Production of fodder

4.3 PROJECT CRITERIA AND DESIGN FRAMEWORK

The team recognizes the following as major criteria which must be satisfied before the project is of any real value:

(1) The planning of the project must coincide with present and mid-term needs recognized by the GON. The areas of need include:

- o regions of high priority for economic development,
- o areas of high priority for natural resource conservation and development,
- o sectors requiring improved economic conditions, and
- o sectors requiring biomass as feedstock or fuel.

(2) The project must be designed to be sustained after ANL leaves, either by generating positive cash flows or by meeting natural resources conservation goals. This is especially important in view of the fact that many past projects are suffering from a lack of maintenance funds.

(3) In order to achieve complete technology transfer, ANL should train and employ as many Nepalese as possible during the project. This will ensure the existence of a local talent pool to expand the activities in post-project years and to implement regional plans.

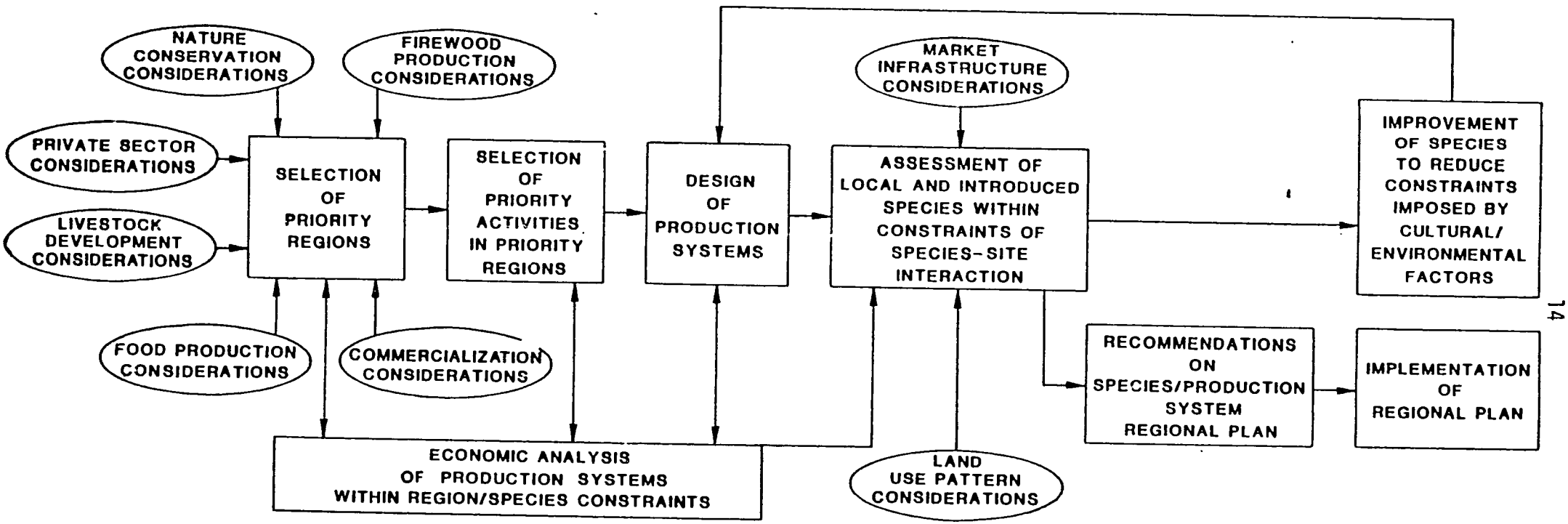
The team proposed a framework for the project design as depicted in Fig. 1. This framework was developed using inputs from GON officials and in consultation with Mission staff, including Janet Ballantyne, Jossette Maxwell, Charles Hash, and others. It was submitted to Chief Conservator Mansur Haque, who reviewed the framework and agreed with the approach.

The selection of the priority regions for development within Nepal is the key activity. This selection will be accomplished in collaboration with the Government of Nepal based on the following considerations:

- commercialization
- livestock development
- private sector
- firewood production
- natural resources conservation
- food production

The selection of priority activities within the candidate regions will determine the range of production systems, which may include:

- alley cropping
- short rotation
- ultrashort-rotation coppice culture
- contour hedgerow


NATURE CONSERVATION CONSIDERATIONS
FIREWOOD PRODUCTION CONSIDERATIONS
PRIVATE SECTOR CONSIDERATIONS
LIVESTOCK DEVELOPMENT CONSIDERATIONS
SELECTION OF PRIORITY REGIONS
SELECTION OF PRIORITY ACTIVITIES IN PRIORITY REGIONS
DESIGN OF PRODUCTION SYSTEMS
MARKET INFRASTRUCTURE CONSIDERATIONS
ASSESSMENT OF LOCAL AND INTRODUCED SPECIES WITHIN CONSTRAINTS OF SPECIES-SITE INTERACTION
IMPROVEMENT OF SPECIES TO REDUCE CONSTRAINTS IMPOSED BY CULTURAL/ ENVIRONMENTAL FACTORS
FOOD PRODUCTION CONSIDERATIONS
COMMERCIALIZATION CONSIDERATIONS
RECOMMENDATIONS ON SPECIES/PRODUCTION SYSTEM REGIONAL PLAN
IMPLEMENTATION OF REGIONAL PLAN
ECONOMIC ANALYSIS OF PRODUCTION SYSTEMS WITHIN REGION/SPECIES CONSTRAINTS
LAND USE PATTERN CONSIDERATIONS

Within each production system design, local and/or introduced tree species will be assessed under field conditions and complete economics of the proposed production system established. The viability of the production systems will also be critically assessed, taking into account land-use patterns and market-infrastructure considerations. At the end of the project, a regional plan of action will be recommended to the Government of Nepal, at which time additional activities may be initiated to improve species with the objective of reducing constraints imposed by cultural/environmental factors.

4.4 PROJECT SCHEDULE

The initiation of new foreign-aid projects in Nepal follows the following procedure:

1. The line ministries involved (e.g., Agriculture, Forestry) propose activities to the National Planning Commission.
2. The National Planning Commission reviews the proposal and discusses possible modifications with the line ministries.
3. Upon approval of the National Planning Commission, the proposed activities become part of the national plan, and the planning document is forwarded to the Ministry of Finance.
4. The Ministry of Finance approves the document and makes the final decision on the Government of Nepal contribution to the budget.

The whole process may take from one month to over a year. For a straightforward proposal, approval might reasonably be expected in three to six months.

Based on discussions with the U.S. AID/Kathmandu staff, it is anticipated that the preimplementation phase (after project approval) will take about a year and a half. It is unlikely that properly screened and tested stock will be available for transplantation to the production plots before three years have elapsed. The time required for the production segment of the effort could be two to ten years, depending upon the time

necessary to establish a viable cropping system to produce fodder, fuelwood, or a commercial product. An illustrative timetable follows:

Phase I (3-5 years)

1. Obtain approvals and a prepare plan, including agreement on regions.
2. Select nursery locations.
3. Screen and select species (preliminary only).
4. Establish nursery (testing sites).
5. Monitor performance of candidate species.
6. Select most successful candidates.

Phase II (5-10 years)

1. Transplant successful stock to production plots.
2. Monitor growth and health. Harvest and utilize wood products.
3. Evaluate species and development/production system.

5 RECOMMENDATIONS

5.1 PROJECT APPROACH

An approach that integrates choice of species and cultural production systems with existing and anticipated needs of the local people at village level is recommended. The project should take advantage of ongoing efforts by GON and other programs. Training of technical staff should be an integral project component, with complete technology transfer being the ultimate goal by the end of the project.

5.2 LIMITATIONS OF POPLARS

Because of their high water and nutrient requirements, most poplars are of limited use in many locations in Nepal, notably in the hills. Further limitations may be in their suitability as fuel and fodder under the conventional cultural systems as compared to other tree species. Careful selection of sites, clones, and cultural systems is, therefore, of critical importance if poplar culture is to succeed and be supported by local people.

5.3 SPECIES TO BE CONSIDERED

Both native and introduced species should be included in the project. Native fodder trees need to be tested in short-rotation coppice culture. Evergreen species may be suitable to meet the need for fodder during the periods of fodder shortage. Special consideration should be given to nitrogen-fixing species because of their soil-improving ability. Among the *Salicaceae*, poplars are not the only genus to be considered, but willows which are genetically more diversified deserve serious attention for their fodder value.

5.4 SPECIES INTRODUCTION

Species elimination trials in representative areas on a modest scale should precede extensive production planting. Locally untested material should not be introduced on a large scale. In the introduction of new material, special attention should be given to the need for genetic diversity and to the prevention of new pathogens and pests during procurement.

5.5 CULTURAL PRODUCTION SYSTEMS

Production systems new to Nepal need to be investigated. Ultrashort-rotation (one or more harvests per year) coppice culture may prove attractive, either in blocks or contour hedgerows. The latter, if sufficiently spaced, will permit farming while at the same time stabilizing slopes and reducing soil erosion. Alley cropping, combining agricultural production with tree growth, would have potential in the Tarai. New systems should be tested against established ones in comparative demonstration trials.

5.6 PRIORITY REGIONS

Efforts should start immediately on selection of priority regions. Early identification of priority regions is necessary to focus on appropriate species and production systems. Much assistance will be needed in this process from the GON. Key elements in the prioritizing will be the regional needs for fodder and fuel and the urgency for conservation measures. Additional. consideration should be given to the ease of administration and the demonstration value of new planting trials.

5.7 COMMERCIALIZATION CONSIDERATIONS

This project may also be used to address the commercial uses of wood. Industrial and economic development are assigned a high priority by the GON. Feasibile products are pulp, paper, match stock, plywood, and furniture. Successful demonstration trials may spur incentive programs for the involvement of the private sector. Prime target

areas are the Tarai, the Inner Tarai, as well as the Kathmandu and Pokhara Valleys.

5.8 PROJECT SCHEDULE

A two-phase project schedule is recommended. During the first phase (3-5 years) the project sill concentrate on the establishment of nurseries and the selection of promising species. The second phase (5-10 years) will deal with species/production systems demonstrations in larger scale production areas.

6 ACCOMPLISHMENTS

We summarize here the major accomplishments of the U.S. team:

(1) During this trip, excellent working relationship was established with GON officials and the forestry research community.

(2) A basic project design framework was established.

(3) The Government of Nepal will assist in the identification of priority regions and end-use considerations.

(4) Strong support from the U.S. AID/Kathmandu Mission was received.

(5) The team briefed the AID/Washington Mission and the Senate Appropriations Committee and generated positive feelings about the project.

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APPENDIX

MEETINGS AND FIELD-TRIP SUMMARIES

National Planning Commission (NPC)

Dr. V.B. Pradhan, NPC member responsible for forestry, soil conservation and energy, discussed priorities as seen by the National Planning Commission. He acknowledges the lack of an overall economic analysis component in the planning process. He attached high importance to a paper mill project in the Tarai using Sawai grass as feedstock. Dr. Pradhan ascertained that in the North, natural resources conservation and firewood production are the high priority areas. In the Tarai, the Government is promoting commercialization activities to induce private sector investment. In many cases, the Government provides land for the private sector projects. A tax benefit structure has also been proposed. Dr. Pradhan further stressed the importance of the development of the livestock sector in the Hill regions. Fruit horticulture and biogas production are some of the mid-term items that he discussed.

Dr. Pradhan discussed in detail the project approval initiation and process with the team.

Ministry of Forest and Soil Conservation

Mr. J.L. Maskey, Secretary of Forest and Soil Conservation, gave a lot of background information relating to Nepal. Nearly 87% of the residential energy demand is supplied by wood. Some deforestation is conditional for development projects such as roads and power transmission line construction and installation of irrigation systems. Two corporations under the Ministry of Forestry and Soil Conservation handle the distribution of wood products from conditional deforestation. These corporations are the Timber Corporation of Nepal and the Fuelwood Corporation of Nepal. In 1982, 29% of the land area was covered by forests. A desirable goal is to have 40-42% of the land covered by forests.

Mr. Maskey cited a study (he did not name it) which estimated a need of planting 50,000 hectares every year to meet the continuous demand for fuel and fodder. He stated that a master plan for the forestry sector was being developed.

On reforestation, Mr. Maskey cited the seventh five-year plan which requires planting of 15,000 hectares of land during the first year (i.e., 1986) and 160,000 hectares during the next four years. They strive for an ecological "balance" between cleared agricultural lands and forest lands. He mentioned the community forestry approach in which local panchayats are allowed to manage some part of government forests. Seventy-five percent of profit from such panchayat managed forests is retained by the panchayats. Private ownership of forest lands is also encouraged. Such private ownership is limited to 10 hectares (25 bigha). Currently, 29 Hill districts and 11 Tarai districts are included in the community forestry projects. *Pinus* represents 75% of the planted trees.

Mr. Maskey showed interest in a new Japanese carbonization process that offers the potential to increase the utilization of low value timber for energy. He commented on the limited potential for poplar materials:

- Match and veneer industries in the Tarai.
- Potential value for addressing the fuelwood and fodder shortages in the Hill regions.

Mr. Maskey stated that commercial forestry was an eventual goal if high productivity is achieved. He also placed emphasis on need to increase employment in all regions.

Later at the dinner, Mr. Maskey discussed the original proposal of transporting 5 million cuttings from U.S.A. to Nepal. In his opinion, it was not practical. A majority of project budget will be spent on transportation leaving very little to carry out planting and management. Also, he thought that the Solu-Khumbu area may not be the most

suitable site for such a project.

Ministry of Finance

At the Ministry of Finance, Mr. Heet Singh Shreshtha, additional Secretary, discussed the development of new paper and pulp mills. A ten-tonne capacity plant will start up in 1986 near Bharatpur (the Bhrikuti Paper Mill). The plant is being built with assistance from China. A thirty-tonne capacity plant is to be built in Nepalgunj (Western Nepal) with loans from the Asian Development Bank. Both these plants are in the public sector and use Sawai grass as feedstock. One more plant is coming up in the private sector for which he did not have any information. He also stated that out of an annual budget of 11 million rupees, 7 billion rupees were developmental funds. Mr. Lok Bahadur Shrestha, finance secretary, stated that their earlier poplar experience was not positive. "Poplar trees deplete soil nutrients, propagate surface roots, and fall down during wind storms. Poplar's low-heating value and high-moisture content make it less desirable as fuelwood. Poplar provided less of fodder opportunity than some local species," he said.

Forestry Survey and Research Office

The team visited Mr. Ek Raj Sharma, Chief of Forestry Survey and Research Office. Two members of Mr. Sharma's staff, Mr. R. Joshi and Mr. S.G. Jha, and J. Kenneth Jackson of U.K./Nepal Silvicultural Research project, were also present. Mr. Sharma mentioned present use of *Bombax ciba* for match sticks. The stock of this hardwood species is depleting. Hybrid poplars may provide wood for match sticks in the future. His choice of poplar clone would be *Populus euramericana (I-214). In his opinion, a commercial tree plantation would be possible in the Tarai area. Mr. Sharma sees three areas in Nepal for which experimentation with poplars seem appropriate:*

- *The Tarai Region with emphasis on production of match stock.*

- *The Kathmandu and Pokhara Valleys with emphasis on fuel and timber production.*
- *The middle Hill Region with emphasis on fodder.*

His office could provide land for test plots and nursery.

Mr. Joshi mentioned his test trials with Populus ciliata. He promised to provide a copy of his report. Poplar is grown in the Mustang area where annual rain fall is 250-300 cm. The normal rural practice is to plant 4½-5½ ft long stems up to 3 inches in diameter. Two to three stems are planted in a 1¼-1½ ft deep hole. The present species used in the Mustang area is *Populus ciliata.* Some trials with *Populus euramericana* are to be carried out.

The native alder, *Alnus nepalensis,* was discussed next. This species grows well on moist soil even in hilly areas. The tree was described as an extremely important and valuable tree species for soil conservation. It typically colonizes steep eroded slopes, grows quite rapidly to tree size and is commonly harvested when it reaches 12 inch DBH (5 to 20 years of age). It has excellent wood suitable for furniture components and for insulation strips commonly used with electrical wiring in buildings. Mr. Pachrabusa has initiated a providence study of this species. Hybridization with *A. rubra* and vegetative propagation of this species are considered of potential interest.

A summary of poplar research work in Nepal was distributed by Ken Jackson. Populus euramericana has done well in roadside planting but successful block planting is not seen. *Populus nigra* (Lombardi poplar) is also seen in roadside planting in the Kathmandu Valley. During 1966-70, a number of clones were introduced into Jiri Multipurpose Development Project. Jiri is 80 km east of Kathmandu at an altitude of 2000 m. The clones included *Populus euramericana, Populus ciliata, Populus monilifera.* The best growth was observed from *Populus monilifera.* A poplar clone from Jiri is planted in the Salleri area of Solu-Khumbu by the local people. Around 1968, a number of poplar clones were planted at Sikarichaur (near Kaulithani, alt. 1740 m), and at Thimi

nursery between Kathmandu and Bhaktapur (alt. 1300 m). Unfortunately, no records of performance of these clones are available. Two clones of *Populus deltoides* have been introduced in the Sagarnath Scheme in the Tarai by Mr. Kevin White. Growth is promising. A number of poplar clones were very recently introduced in a nursery near Butwal (the Tarai area) by Mr. P.A. Lindgren of the United Missions to Nepal (UMN). He plans to use the poplars as core-stock for veneers in the UMN owned plywood factory. Several other clones mainly *Populus euramericana*, several clones of *Populus deltoides*, and *Populus nigra* are planted at the Chalnakhel nursery. Since the project leader was recently transferred, not a lot of information is available.

Application areas of multipurpose trees (this project) was discussed next. Planting trees for commercial purpose was considered possible in the Tarai and the Kathmandu-Pokhara Valley areas. Conservation and soil stabilization should be the goal in the Hill areas with the possibility of fodder production.

Nurseries need to be setup next to places where expertise was available. The use of agricultural experience should be most welcome, and the nursery sites must be near a continuous water supply.

Activities involving vegetative propagation of native species and development of clonal nursery (nurseries) were discussed and considered very welcome. A.P. Parajuli is involved in a study program at Oxford to develop the technical expertise in the vegetative propagation of fodder tree species.

As regards to planting practices, field planting is usually done during the period from middle of June to early July (beginning of monsoon season). Poplar stands may be planted in nursery prior to field planting to develop rooted stock. Such nursery planting is done between November and March depending upon the region. Cuttings from the U.S. could be shipped between November and March. Quarantine regulations require a phytosanitary certificate from the donor country.

One concern regarding the possible lack of dormant season in the Tarai region was dispelled. The region has two months of dormant season for poplars during

December and January.

Community Forestry and Afforestation Division

Mr. Baban Kayastha, Chief of Community Forestry and Afforestation Division, provided some information on the region and agricultural practices in the hills. Generally, when a hillside is cleared for farming, soil erosion sets in. Once depleted, these sites are abandoned and they continue to erode. The present population to livestock ratio is about one. There may be more livestock than people.

The availability of plants and grazing is limited to 7-8 months in the hill regions. Trees are expected to provide fodder for 4-5 months. Also, manure making is done by spreading tree leaves in animal stalls. With fodder and manure demand increasing, trees are converted to small bushes due to repeated lopping.

On land ownership, Mr. Kayastha explained that initially few rich people claimed land ownership. Though a recent government decree has proclaimed that all forests belong to the government, an average person's perception does not appear to have changed.

After reviewing social forestry experiences in India and Korea, Nepal introduced community forestry. The project has several components:

1. The government agreed to pass control of up to 500 hectares of an existing forest to a local panchayat (village governing body) for management. All income from panchayat protected forests (PPF) is shared by panchayat and the government. A PPF is thereon open to the community members to obtain fuelwood and fodder at regular intervals. A community forest administrator (CFA) keeps records of forest products removed. Seventy-five percent of the income from a PPF goes to the panchayat. A PPF may remain open to obtain tree leaves for manure if a panchayat so decides.
2. A panchayat is allowed to plant trees on up to 125 hectares of barren land.

The panchayat operates a nursery and occasionally provides his own security person(s) to avoid grazing of young trees. A nursery foreman (naike) is provided by the government. A panchayat is involved in all phases of such panchayat forest (PF) including site and species selection and management. A variety of grass that grows between trees is cut by the village members for cattle feeding. Cattle is not allowed to graze in a PF since such practice increased chances of accidental damage when the trees are young and also reduces vegetative cover of the soil. Once trees have developed substantial crowns, growth of grass is retarded but, tree leaves substitute this loss.

3. Private planting of trees is also encouraged. The survival rate of privately planted seedlings is observed to be 50%, while PPF survival rate is 60%.

The community forestry project covers 29 districts in the middle Himalayas and 13 districts in the Tarai. Funding for the project is provided through loans from World Bank.

Mr. Kayastha also pointed out other community efforts such as introduction of efficient stoves and study tours of successful panchayat forests by other panchayat members. The new clay stove allows better use of heat contents of hot air and reduces the amount of smoke. Such stoves cost Rs 75-80 and are given free to villagers. The idea behind study tours is to motivate people through examples. These tours have been very successful.

Nursery and Poplar Plantation Visit

On April 2, 1986, the team visited Chalnakhel (alt. 1395 m) nursery in the Lalitpur district. The nursery is established to develop seedlings, conduct initial growth experiments, and to analyze alternative nursery techniques.

A poplar clonal nursery is established to multiply and obtain a large number of

cuttings using a limited number of clones introduced from outside. All clones appeared to be doing well in irrigated condition. These include two small groups of clones. The first group, obtained from Pakistan, contained six clones - I-214 and 5 *P. deltoides* selections. Initial survival of two clones of the first group was poor, but subsequent nursery planting success was good (88-100% survival). According to the records, height growth was comparable among all six clones with I-214 being second best (statistical significance not known). The second group of six clones was obtained one year later and also came from Pakistan. This group contained two of the original six *deltoides* selections as well as S_7/C_3, a *P. deltoides* selection from Texas, USA, which has also been tested in Washington State and which was mislabeled in the trial as a *P. euramericana* hybrid. Growth rate of three of the deltoides clones is very impressive indeed with annual growth of over 3 meters in the nursery. These three clones were reported to be 18/62, 69/55, and 19/60 (90/60?). S_7/C_3 was harvested but appeared to grow slightly less vigorously than the top three. Some poplar plants showed borer insect and termite damage.

Mr. Ian Napier, of the U.K. Nepal Silvicultural Research Project, showed his trial of growing native species. These deciduous *Ficus* species have large succulent leaves and are preferred by local people. He has started this trial during the last year from seeds. He plans to try some cuttings later.

Mr. Napier also showed his trials with pines. Pines are grown from seeds and effect of fertilizing with compost is also analyzed. Pines do not provide fodder but, they grow on steep slopes and poor soils. These characteristics of pines have made them very popular in hills. On preference of species by the local people, Mr. Napier pointed out the difference among men and women. Women prefer native trees which provide fuelwood and fodder while men prefer pines since they require less management and provide good construction timber.

The team also visited some ten-year old poplars planted on the edge of the nursery and some older *Alnus nepalensis*. The poplars showed presence of surface roots.

Alnus nepalensis showed leaf damage by insects. The nursery forewoman said that the insects appear every year.

Two small poplar field plantations were visited next. The first plantation at Gagalfedi in the Kathmandu district required approximately half-a-mile walk from the roadside. The site is at 1364 m altitude on the side of a hill with southwestern aspect, and sandy soil. The purpose of this plantation (0.1 ha in size) is to conduct survival trials and evaluate growth. The populus clone planted is euramericana, at 2x2 m spacing. A total of 250 plants were dug out from Chalnakhel nursery (Lalitpur district) with ball of soil, were carried to the site, and planted the same day. After 13½ months 88% of the plants have survived. The rate of growth during this period is not appreciable (from 176 cm to 192 cm in height). Some stems showed borer insect damage with no insect in sight.

The second plantation near Changu Narayan in the Bhaktapur district, is on the side of a steep hill at an altitude of 1425 m. The site (0.16 ha) has southern aspect and rocky soil. Three-hundred plants of *P. euramericana* with roots but without any soil were transported and planted the same day in July 1984. After a year, only seven plants survived. The site was recently replanted with 21 cm long cuttings of *Populus nigra*, *Populus euramericana*, and *Populus deltoides*. The cuttings have started to sprout but survival is not promising due to rocky soil and lack of frequent irrigation.

Chief Conservator of Forests

The first meeting with Mr. Mansur Ali Haque, Chief Conservator of Forests, started with introductory briefing by Sinyan Shen on the purpose of the proposed project. Mr. Haque discussed his species elimination trials. High yield eucalyptus and ipil-ipil species are being tried in the Tarai. Ipil-ipil is better wood for burning than poplar and the recent K156 clone has fodder quality leaves. Though protein content analysis of these leaves is not yet conducted, such capability does exist. In some trials of Dalbergia sissoo yields up to 60 cu.m. per hectare are achieved as compared to natural forest yield of less than 8 cu.m. Mr. Haque also mentioned that the timberline in Nepal

normally extended to 12,000 ft while ipil-ipil could be planted up to 6,000 ft. Regarding planting of trees for fodder and introduction of stall feeding of animals, Mr. Haque stated that stall feeding of animals was prevalent in the Tarai region. A mixture of grass, bushes, and trees need to be planted in a Silvipasture setup in the hills region to provide vegetative cover for soil conservation and to meet the need for fodder.

Mr. Haque mentioned suitability of poplar for match sticks, plywood, and pulp. Match sticks in Nepal are made using *Bombax ciba*, plywood production is very limited, and pulp is made out of Sawai grass (a variety of tall grass that grows in the Tarai). Mr. Haque also mentioned that poplar boles crack after two years of growth in India. This makes poplar unsuitable for lumber.

On planting trees for multiple use, Mr. Haque said it has to match people's needs. Most of the farmers in the Hill region give priority to producing grain while the Tarai farmers have shown a variety of interest. Some demonstration of advantage of multipurpose tree species would help acceptance.

From his chief conservator point of view, Mr. Haque mentioned destruction of forest due to dry season fires. He would prefer drought and fire resistant tree species which have multiple uses. He has studied the experiences of the neighboring countries and tries to keep continuous contacts. He would prefer not to duplicate experiments already conducted or are being conducted in the neighboring countries since such experiments are resource intensive. He is faced with shortage of funds and skilled manpower.

On the proposed joint U.S. - Government of Nepal project, Mr. Haque agreed with Sin-yan Shen that it should be able to sustain itself at the end of its trial period.

Mr. Haque mentioned a forest sector master plan that is being developed with the help of Asian Development Bank (ADB). The plan will review national needs and provide future direction of action. Mr Haque also mentioned targets of planting set forth in the current five-year plan.

During the second meeting with Mr. Haque, Sinyan Shen first discussed a

proposed project design framework. Also, three major objectives of the project were pointed out: 1) the work carried out under this project should match priorities of the Government of Nepal, 2) any production system introduced should be economically viable, and 3) as much local talent should be employed as possible to ensure effective transfer of technology.

Mr. Haque agreed with the design framework and stated that all external considerations needed to be examined closely as ANL has proposed. GON has started in this direction with the help of the Asian Development Bank. A long-range (25 yrs.) plan is being developed for the forestry sector. Also, a coordinating committee is developing forestry sector priorities.

Sin-yan Shen talked about agro-forestry approach to increase production and to take advantage of advanced silvicultural practices. He also explained initial research work necessary to match species, sites, end-use purposes, and production systems. Mr. Haque discussed his department's species trials and intercropping experiments at the Sagarnath Project. The department has tested Dalbergia Sissoo, Leucaena (ipil-ipil), eucalyptus, and teak. Intercropping experiments have been very successful in saving trees from fires damage (result of dry grass catching fire) and in providing some farm income to landless peasants. An income as high as Rs. 4000 per hectare has been provided to people who otherwise would have had intermittent employment.

Commenting on the multipurpose tree species paper Dr. Shen had given him earlier, Mr. Haque stated his department's jurisdiction was limited to lumber and fuelwood. Animal fodder and application of agricultural practices are outside the realm of his sector. Also, the technique of very dense planting for ultrashort-rotation biomass production may not be suitable for the forestry land under his department's control.

Discussion then centered around preparation of a proposal for the U.S. AID/ANL-GON project. Mr. Haque provided Sinyan Shen with a proposal he prepared for the European Economic Council (EEC). He also stated that his department is faced with shortage of skilled manpower. He hopes that new graduates and certificate-holders will

provide him sufficient manpower to initiate a project.

Mr. Haque promised to prepare a short technical proposal sometime the following week. He showed optimism at the possibility of an agreement on the content of the project.

Visit to the Tarai and Inner Tarai

On April 9-11, Sinyan Shen, Anant Vyas, and Dharma Raj Suwal, Program Specialist (Agr.), USAID/Kathmandu, traveled to the Tarai and the Inner Tarai. They met with operators and designers of the Bhrikuti paper mill in Chitwan district, discussed results of lumber and fodder production experiments at the Institute of Forestry, Tribhuvan University, and visited the Sagarnath Forest Development Project, a large-scale demonstration project for commercial forestry.

The Bhrikuti paper mill was completely constructed with a grant from China with equipment shipped from China and installed under supervision of Chinese personnel. The plant is near completion and with most equipment in test operation. The Chinese engineers are in the process of transferring operational techniques to Nepalese engineers and a number of them will continue to stay at the plant after start-up later this year to maintain a smooth operation. Chief Engineer Li Yidi quoted a requirement of 7-9 tons of Sawai grass for every ton of writing-grade paper produced. The Sawai grass is gathered by contractors who also sell the same grass across the border to India. Wheat straws are also used. Rice straws are not available because they are usually fed to animals, but are preferred over wheat straws, according to Mr. Li. Both soft wood and hard wood can be used, and in fact will increase the production efficiency of paper. However, at the present, grass is available to the plant but not wood. The plant engineers were enthused by the team's objective which is to provide multipurpose trees to Nepal.

At the Hetauda Campus of the Tribhuvan University, the party was briefed on the IDRC (International Development and Research Center) project in collaboration with Canada. Discussions were held with Mr. J.N. Rayamjhi, Assistant Dean, Mr. Madhav

Karki of the university faculty, and Shesh Kant Kafle, who works directly on the IDRC project. Mr. Dixit, the project coordinator, was present during a nursery tour on the next day.

Mr. Kafle briefed the team on four species being tried under the project:

1) Leucaena (ipil-ipil) for fuel and fodder,

2) Dalbergia Sissoo for fuel and fodder,

3) Kapuk (Ciaba pentandra) for softwood-match sticks, and

4) native species Badahar (Artocarpus lakoocha) for fodder and fuel.

The native species, Badahar, also provides lamp oil from its seeds. Among the observations made by us are: a) Lucaena grows faster than Dalbergia sissoo but after two years, they provide nearly the same amount of fodder; b) Both Lucaena and Sissoo are nitrogen-fixing species but no specific measurement of amount of nitrogen are available; and c) Trees are lopped at approximately 7 ft height. Thus fodder is provided by regrowth. Coppice growth is not tried.

Mr. Rayamjhi gave some information about the management of the IRDC project. The project staff provides seedlings to villagers and a technical assistance regarding methods of planting and management at no charge. Villagers normally plant trees on the edge of their fields.

Mr. Karki said that the most popluar species was Lucaena because of its faster growth as compared to that of Sissoo. Sissoo is still planted due to its potential of higher quality timber. Eucalyptus grows the fastest in the region but it is not popular due to the conception that it lowers the water table. Also while selecting a species, a farmer places higher value on timber since he assumes fuelwood to be available free from the nearby forests.

At the Sagarnath Project, meetings were held with Project Manager Tara N. Bhatarai, Australian Advisor Kevin J. White and staff members. The Sagarnath Project

lies wholly in the Bhabar Tarai zone at an altitude of 100 m immediately south of the Siwalik/Churiya range, the Southern most of the three Himalayan mountain chains. This zone is of variable width up to 10 km and is characterized by deep Siwalik outwash layers of freely draining sands gravels and boulders. The water table is usually at great depth and the vegetation, dependent on rain-fed irrigation, is adapted to a short period of a subtropical summer excess rainfall with 93% of the annual precipitation received May to October and a cool dry winter. The area is forested but has - and still is - subject to heavy selective logging; the forests conform to Champions' North Indian Tropical Moist Deciduous Forests Type of Moist Plains Sal forest and Moist Mixed Deciduous forest.

The Project area potential for plantations is of some 13,000 ha, a block of approximately 20 km east west and 8 km north south, bisected by the East West Highway with the Sagarnath office some 90/km southeast of Kathmandu and 38 km northwest of Janakpur. It is accessible through bituminous roads to Kathmandu (240 km) and to Simra (80 km west) and Janakpur (57 km) airports.

The Project aims to convert this forest area to fast-growing high wood-yielding tree plantations of relatively few species, e.g., Dalbergia sissoo and Eucalyptus camaldulensis at the rate of approximately 1000 ha per year. The project area will have a plantation area of approximately 10,000 ha to be established at the rate of 1000 ha a year with fast-growing high-yielding industrial wood. The objectives, according to Project Manager Tara N. Bhatarai, are:

- to replace depleted and degraded sal forest with fast-growing short-rotation species,
- to provide employment for landless and unskilled workers,
  - full time 850
  - part time 800,
- to provide systematic skills training in forestry operations, and
- to serve a prototype role and to provide a model for the replacement of

other depleted forest areas of the Tarai.

A nursery within the project raises 2,000,000 seedlings a year; now mainly Eucalyptus with a nursery time period per seedling of 5 weeks before they are ready for planting. The team discussed nursery production of Eucalyptus cuttings at length with Kevin J. White, Austrailian Advisor. The Plantation area established to date is:

Sissoo	1424 ha
Eucalyptus	1458 ha
Other species	406 ha
Total	**3288 ha**

With regard toEucalyptus camaldulensis, Petford provenance is growing 30-40 m^3/ha per year -- a market value of Rs 100/per month. The following species are also in extensive field tests:

Acacia auriculaeformis	Eucalyptus spp.
Acrocarpus fraxinifolius	Gmelina arborea
Albizzia lebbeck	Leucaena leucocephala
Albizzia procera	Melia azedrachta
Cassia siamea	Populus deltoides
Dalbergia latifolia	Pinus spp.
Dendrocalamus strictus	Prosopsis juliflora

The following table shows comparative performance of different trials:

TABLE Species in Field Trials

Species	Remarks
Acacia auriculaeformis	Moderate chlorosis, fair
Acacia auriculaeformis	Unimpressive
Acacia auriculaeformis	Fair
Acrocarpul fraxinifolius	Planted 1985
Albizzia lebbeck	Failed
Albizzia lebbeck	Failed
Albizzia lebbeck	Healthy, not impressive
Albizzia procera	Unimpressive
Albizzia procera	Unimpressive
Albizzia procera	Unimpressive
Cassia siamea	Healthy, good
Cassia siamea	Healthy, good
Cassia siamea	Healthy, fair
Dalbergia latifolia	Failed
Dendrocalamus strictus	Healthy, vigorous
Eucalyptus spp.	
Gmelinea arborea	Poor
Leucaena leucocephala	Fair - good
Melia azedrachta	
Pinus spp.	
Populus deltoides G3	Good

TABLE Species in Field Trials (Cont'd)

Species	Remarks
Populus deltoides G48	Good
Prosopsis juliflora	Poor
Prosopsis juliflora	Poor
Prosopsis juliflora	Poor
Tectona grandis	Good

Field Trip to Solu-Khumbu

During the team's first week in meetings with government officials of Nepal and with technical personnel from foreign aid agencies and members of the Mission, it became clear that virtually everyone placed much importance on a visit by the review team to the Solu-Khumbu District. This district was originally proposed as the site of the poplar project and, in addition, it was considered representative of middle and upper elevation hill conditions. This visit took place during the period April 6-12. Participants included Sinyan Shen and Anant Vyas (April 6-7), Paul Heilman, Reinhard Stettler, George Taylor, Kenneth Jackson, Rajendra Joshi, Shreebindu Bajracharya, Shanta Tamrakar (District Forest Controller (DFC) for Salleri District), four porters, one guide and several forest guards.

Day 1 - Flight to Lukla (9,300 feet). Descent to Surkye (7,700 feet). Climb to Phuiyan (9,800 feet) and Bupsa Ridge (10,200 feet), then descent to Kharikhola. Objects of Interest: Natural vegetation in the middle and higher elevations, land use practices, farming systems, wood use, effects of man-caused fire on vegetation.

Day 2 - Kharikhola Panchayat Nursery, descent to Dudhkosi River (5,200 feet) and climb to Tragsindo-La Monastery (approximately 10,000 feet). Objects of Interest: Panchayat Nursery; site selection criteria, cultural practices; use of fodder trees on private agricultural land; natural vegetation; lopping practices on native conifers and hardwoods.

Day 3 -Climb from Tragsindo-La Monastery to Trakshindu Pass (11,500 feet) then descent to Ringomo, Phaphlu and Salleri District Headquarters and DFC Office. Objects of Interest: Natural vegetation in the Abies Zone; the role of horticulture in the local economy (apple); utilization of pine (*Pinus wallichiana*); problems of overgrazing and unstable soils; a few poplars probably *P. ciliata*

(Jiri source), planted in Salleri; vegetative propagation of these poplars in the Panchayat Nursery at Salleri; small-scale poplars planting by a private landowner (improperly planted) for soil stabilization.

Day 4 - Ascent from Salleri to Phaphlu, then descent to Salu River, then ascent along Junbesi Riber to Junbesi; from there climb to upper Tragdobuk. Objects of Interest: Small-scale poplar (Jiri source) and willow planting along river bank; small number of the same poplars planted on upland site to stabilize soils; excellent natural stands of *Pinus wallichiana*; willow pollarding for fodder; natural vegetation in the oak-rhododendron zone.

Day 5 - Climb to snow-covered Lonjura Pass (11,580 feet), from there long descent via Seti to Kenja. Objects of Interest: Natural vegetation in rhododendron-birch zone. Fencing of natural oak forest used for fodder production combined with stall feeding of yak bull; land use practices on steep hillsides; small number of poplars (Jiri source) planted in Kenja along river bank.

Day 6 - After following the Likhu Kola River, ascent to Bhandar and Denrali Pass (8,900 feet), descent to shivalaya. Objects of Interest: Complete defoliation of *Alnus nepalensis* stands by outbreak of native catarpillar; alder and pine plantations in fertile valley of Bhandar; use of alder as small structural timbers and for firewood; small number of poplars (Jiri source) planted by farmer around farm on hillside.

Day 7 - Ascent from Shivalaya to Mali over top of ridge to Jiri. Two U.S. AID cars await us there and take us via Charikot/Lamasangu back to Kathmandu. Objects of Interest: Heavily overgrazed land between Mali and Jiri; quite dense stands of pine and alder along crest of ridge; extensive and successful plantation

of *Pinus wallichiana* near Jiri (about 10 years old); the original Jiri source of poplar probably *Populus ciliata* with no evidence of renewed plantings; well established but spotty alder stands along Jiri-Charikot Road; need for additional soil cover and tree planting.