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TECHNICAL ASSESSMENT

AGROFORESTRY RESEARCH SUBPROJECT

AGRICULTURAL RESEARCH PROJECT
Project No. 386-0470

BY

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AGRICULTURAL RESEARCH PROJECT TECHNICAL ASSESSMENT

AGROFORESTRY RESEARCH SUBPROJECT

I. Subproject Description

A. Purpose

Although India's agroforestry research program may be the largest and best organized in the world, demands on it for technology still vastly exceeds the output. Data are rapidly becoming available from empirical field trials, but the complex interactions of trees, annual crops, weeds, microbes and animals are difficult to understand. Only through a more thorough knowledge of the mechanisms underlying these interactions can researchers and practioners make better management prescriptions for components of agroforestry systems. This knowledge will only come from a research system with well trained, capable scientists.

1. Statement of Purpose

The purpose of this subproject is to strengthen agroforestry science in ICAR's All-India Coordinated Research Project on Agroforestry. In this context, strengthening agroforestry science means to develop a critical mass of scientists at SAUs and ICAR institutes which can undertake ecosystem studies that combine accurate field measurements and repeatable techniques with the increased use of mechanistic hypotheses testing. This community of scientists will make results of existing trials more interpretable and reduce the need for their repetition, thus producing a greater amount of useful information to its clients during a given period of time.

2. Linkage to Higher Goal

During the first half of the 1980's USAID, in collaboration with India, began implementing social forestry programs in India's central and northern states. The total cost of these programs was about $110 million. A major component of this activity involved the planting of trees on marginal and degraded lands. The development of technologies necessary to insure successful tree planting in these stressful environments was identified as a needed feature of the social forestry programs. Since Forest Departments did not have the manpower, facilities or training to effectively undertake this assignment, USAID chose to collaborate with ICAR through the Agroforestry Research Subproject to develop this capacity within the agricultural research system.

In 1985 then Prime Minister Rajiv Gandhi announced that India would plant 5-million hectares of trees annually on India's marginal and degraded lands. This directive further expanded

India's social forestry programs and placed added pressure on the nation's institutions to produce trained manpower in the forestry sector. The Forestry Faculty Development initiative in SAU's was a response by ICAR, with USAID assistance, to address this manpower development mandate. Since these faculty also had research responsibilities, the Agroforestry Research Subproject provides a mechanism to support faculty research, to provide for the continued development and improvement of faculty research skills, and to help bring relevance to social forestry educational curricula.

In 1988 the acceptance of the resolution on National Forest Policy provided added impetus to strengthening agroforestry research. The section of the 1988 Resolution titled Forest-based Industries states that the forest-based industry should raise its raw material needs by establishing a direct relationship between the factory and private individuals who raise trees, that forest-based industries must involve local people in raising trees, and that farmers be encouraged to grow wood species required for forest-based industry. Furthermore, it states that raw materials from natural forests will not be available to forest-based industries. This policy can only be implemented if farmers have access to technologies that allows them to grow trees as part of their cropping systems. The Agroforestry Research Subproject will help develop and transfer these technologies to farmers.

Finally, agricultural research frequently has an individual crop focus. Increasing concern for the social and environmental short- and long-term impacts of cropping systems and changes in cropping systems has forced agriculture researchers to view the impacts of their studies in a broader context than simply the crop response. Integrated pest management programs and, currently, sustainable agriculture initiatives are noteworthy in giving agricultural research more of a systems orientation. This is an orientation that better allows researchers to understand and quantify both the short- and long-term social, biological and economic impacts before the release of new germplasm and technology. The Agroforestry Research Subproject that is the subject of this assessment will continue and strengthen the ability of agricultural scientists to quantify and predict the behavior of agricultural systems.

B. Specific Objectives

1. Statement of Problems

Research on agroforestry systems involves a unique set of new challenges associated with the quantification of agricultural and forestry systems. A major thrust of agroforestry research is to focus attention on the evaluation of systems with tree-crop interactions, whereas traditional agricultural research primarily focuses on monoculture systems. In agroforestry,

research priorities, formalized research efforts, and efficient designs to meet these objectives are all relatively new. Agroforestry research multiplies the agronomic and forestry differences in terms of biological and statistical complexity. The diverse characteristics of these two systems are highlighted in the following comparison:

Agronomy	Forestry
- Few Species	- Many species
- Relatively uniform plant material site conditions	- Large variation in plant material site conditions
- Similar small sized plants	- Large variation in plant sizes
- Generally monoculture	- Generally mixtures
- Short time spans	- Long time spans

In light of these factors, three problems readily surface. The first is the low availability of scientists with degrees or educational backgrounds in forestry and agriculture. The second is a lack of ecosystem-level research aimed at understanding why agroforestry systems respond as they do. The third is the limited number of organized and effective germplasm collection, selection and propagation programs. To resolve these shortcomings two clear needs emerged:

a. an understanding at the ecosystem level of the functioning of existing agroforestry systems, particularly with regard to competitive interactions, sustainability, and interactions with animal and human populations; and

b. how to collect, screen, propagate, plant and manage the immense number of woody species that could be components of agroforestry systems.

Most of the scientific manpower resource currently available for agroforestry is from agriculture and most of the quantitative approaches are modified from agronomic field research experience. This has resulted in the following problems:

a. Researchers frequently express a lack of confidence and experience using methodologies derived from the agronomic experience where there is relative uniformity and well understood designs and applying these concepts to the new and highly variable agroforestry situation.

b. Quantitative expertise is relatively isolated from agroforestry programs which leads to a high potential for scientist not getting the designs that they need and the quantitative expertise not experience enough with agroforestry systems to anticipate and deal with the many analytical challenges.

c. Lack of direct access by researchers to computer facilities reduces the effective use and analysis of data and the development of agroforestry models.

2. Descriptive Statement of Objectives

The objectives of the Agroforestry Research Subproject are to:

a. Facilitate the strengthening of agroforestry science in ICAR's All-India Coordinated Research Project in Agroforestry.

b. Increase the number of scientists with specialized training in agroforestry research through short-term training, specialized in-country workshops and postgraduate Ph.D programs. The training will strengthen and increase the participating scientist's capacity to utilize field, analytical and laboratory methodologies used in the study of agroforestry systems. The specialized training also develops selected workshops to be offered in India for SAU and ICAR scientists.

c. Quantify agroforestry systems using models for data accounting, generation of hypotheses, prediction of system behavior and establishing research priorities.

d. Initiate ecosystem-level studies of agroforestry systems to understand and quantify plant-site interactions.

e. Initiate agroforestry focused germplasm collection, screening, propagation and improvement programs including the development of operational procedures and technical reference manuals for selected components of the system.

f. Develop methodologies and assessments for incorporating economic, social and environmental factors into the study of agroforestry systems.

g. Create analytical laboratories with the capability to do sophisticated soil and plant tissue analyses needed in the study of ecosystems.

C. Input/Output Matrices by Objective

1. Specification of Inputs

a. U.S.

U.S. inputs consist of both overseas and in-country training, technical assistance for research collaboration and in-country training programs, and the purchase of commodities. The total estimated value of these inputs was $1,894,000. Table 1 gives U.S. inputs by subproject objective.

b. GOI

GOI inputs consist of posting and nomination of research scientists for training and collaboration activities, in-country training programs, research facilities, and provision of research and in-country training operating funds. The reflectable component of these inputs is estimated to be Rs. 115.7 lakh. The Seventh Five-Year Plan earmarked Rs. 176.53 lakh for the operation of the All-India Coordinated Research Project on Agroforestry and the development of the National Research Center for Agroforestry. Table 1 gives GOI inputs by subproject objective. Table 2 identifies specialized and Ph.D Agroforestry Research Subproject training by agroforestry research centers.

2. Specification of Linked Outputs

Table 1 also indicates the proposed outputs associated with U.S. and GOI inputs for each subproject objective and identifies those outputs which have been completed. The objective associated with increasing the number of trained scientists specializing in agroforestry is being achieved through long- and short-term training under the Subproject on Agroforestry Research as well as the Forestry Faculty Development Initiative. Table 3 indicates the number of scientists by institutional location that have completed or are completing training in agroforestry science.

TABLE 1. Inputs and Outputs by Subproject Objectives.

Objective	Input	Output	Status
Facilitate Agro-Forestry Research Coordination	U.S.		
	Science Advisors	Subproject Mgmt. Committee	Continuing
		Detailed 2-Yr. Work Plan	Completed
	GOI		
	Scientists	Management Team Coord. Tour	Completed
		Mid-Term Evaluation	Completed
		Research Coord. Planning Tour	Completed
		Technical Assessment	In-Progress
Increase No. of Trained Scientists	U.S.		
	Specialized Training		
	Modeling	1 Scientist	Completed
	Ecosystem Science	2 Scientists Nutrient Cycl	Completed
		2 Scientists Root Interact	Being Selected
		2 Scientists Plant Interact	Being Selected
	Seed/Tree Improvement	1 Scientist Seed Tech	Completed
		1 Scientist Nursery Tech	Completed
		2 Scientists Tree Impr	In-Progress
	Social Sci	2 Scientists Eval. Methods	Being Selected
	Ph.D Training		
	Modeling	1 Scientist	In-Progress
	Ecosystem Science	1 Scientist Nutrient Cycl	In-Progress
		1 Scientist Root Interact	In-Progress
		1 Scientist Plant Interact	In-Progress
	Seed/Tree Improvement	1 Scientist Seed Tech	In-Progress
		1 Scientist Nursery Tech	In-Progress
		2 Scientists Tree Impr	Nominated
	Social Sci	1 Scientist Eval. Methods	Nominated
	GOI		
	Scientists		

TABLE 1. Input and Outputs by Objectives (Continued).

Objective	Input	Output	Status
Quantify Agro-Forestry Systems	U.S. Scientists Equipment GOI Scientists Facilities	Modeling Workshop 21 Scientists Trained	Held at Jhansi
		7 Computer Systems	Installed 1 NRC 6 Reg
		32 Sets of Field Measuring Equipment (Attachment I)	Ordered 1 NRC 6 Reg 25 Local
		Research Programs	AICRPAF On-Going Studies
		Collaborative Research	Being Developed
Initiate Ecosystem Studies	U.S. Scientists Equipment GOI Scientists Facilities	Nutrient Cycling Workshop 23 Scientists Trained	Held at Jodhpur
		Root Interaction Workshop	Yet To Begin
		Plant Interaction Workshop	Yet To Begin
		7 Sets of Measure Equipment for Ecosystem Field Studies (Attachment I)	Ordered 1 NRC 6 Reg
		Research Programs	AICRPAF On-Going Studies
		Collaborative Research	Being Developed
Establish Germ-Plasm Collection Nur. Mgmt. & Tree Improv. Prog.	U.S. Scientists GOI Scientists Facilities	Seed Technology Workshop 20 Scientists Trained	Held at TNAU
		Nursery Tech Workshop	Being Developed
		Tree Improvement Workshop	Being Developed
		Research Programs	AICRPAF On-Going Studies
		Collaborative	Being

TABLE 1. Input and Outputs by Objectives (Continued).

Objective	Input	Output	Status
Social Science Assessments and Analysis	U.S. Scientists GOI Scientists Facilities	Evaluation Methodologies Workshop Research Programs Collaborative Research	Being Developed AICRPAF On-Going Studies Being Developed
Development of Analytical Labs	U.S. Equipment GOI Equipment Facilities	Analytical Lab Equipment (Attachment 1)	Ordered 1 NRC 6 Reg

TABLE 2. Agroforestry Specialized and Ph.D Training by Agroforestry Research Centers.

	No. of Scientists Trained		
	Specialized Training	Ph.D Training	Total
NATIONAL CENTER			
NRC - Jhansi	1	1	2
REGIONAL CENTERS			
SKUAT-Srinagar			
GAU-Dhantiwada	1		1
UAS-Dharwar			
NDUAT-Faizabad			
BAU-Ranchi			
ICAR RC-Shillong			
LOCAL CENTERS			
PAU-Ludhiana			
HAU-Hissar	1		1
YSPUHF-Solan	1		1
GBPUAT-Pantnagar			
UU-Udaipur			
MPKV-Rahuri			
KKV-Dapoli			
KAU-Mannuthy			
TNAU-Coimbatore			
APAU-Hyderabad			
MAU-Parbhani			
PKV-Akola			
JNKVV-Jabalpur			
OUAT-Bhubaneshwar			
BCKVV-Kalyani			
CSAUAT-Kanpur	1		1
RAU-Pusa			
AAU-Jorhat			
CSWCRTI-Dehra Dun	1	2	3
CAZRI-Jodhpur	1	2	3
CRIDA-Hyderabad		1	1
ICAR RC-Sikkim		1	1
-Imphal		1	1
-Agartala		1	1
CARC-Port Blair			
SUBTOTAL	7	9	16
Unidentified	6		6
TOTAL	13	9	22

TABLE 3. Scientists Trained Under the Agroforestry Research Subproject and the Forestry Faculty Development Initiative by Agroforestry Research Centers.

	No. of Scientists Trained		
	AF Subproject	FF Development	Total
NATIONAL CENTER			
NRC - Jhansi	2		2
REGIONAL CENTERS			
SKUAT-Srinagar		5	5
GAU-Dhantiwada	1		1
UAS-Dharwar		5	5
NDUAT-Faizabad			
BAU-Ranchi		5	5
ICAR RC-Shillong			
LOCAL CENTERS			
PAU-Ludhiana		5	5
HAU-Hissar	1	6	7
YSPUHF-Solan	1	5	6
GBPUAT-Pantnagar		6	6
UU-Udaipur			
MPKV-Rahuri			
KKV-Dapoli		6	6
KAU-Mannuthy		6	6
TNAU-Coimbatore		6	6
APAU-Hyderabad			
MAU-Parbhani			
PKV-Akola		5	5
JNKVV-Jabalpur		6	6
OUAT-Bhubaneshwar		2	2
BCKVV-Kalyani			
CSAUAT-Kanpur	1	1	2
RAU-Pusa			
AAU-Jorhat		3	3
CSWCRTI-Dehra Dun	3		3
CAZRI-Jodhpur	3		3
CRIDA-Hyderabad	1		1
ICAR RC-Sikkim	1		1
-Imphal	1		1
-Agartala	1		1
CARC-Port Blair			
Unidentified	6		6
TOTAL	22	72	94

II. Technical Assessment

A. Input/Output Progress by Objective

1. Assessment of Inputs Provided

a. U.S. (Appropriateness, Timeliness, Quality)

U.S. inputs have been appropriate, generally timely and of high quality. An initial input was the joint preparation of a 2-year work plan by U.S. and GOI scientists in May 1988. The numerous number of linked but separate project inputs could have increased the implementation problems associated with the subproject. However, the work plan was extremely effective in implementing the project and, for the most part, the subproject has maintained the schedule proposed in that work plan. Recent meetings between the GOI Project Coordinator and collaborating U.S. universities should result in a similar collaborative research work plan for the last two years of the project.

The U.S. universities participating in subproject activities are recognized for competence in their respective areas. Involving several U.S. and GOI institutions has had the positive effect of providing a more diverse array of experiences and environments.

It is highly unlikely that the individuals sent to the U.S. will complete their Ph.D degree training by the end of the subproject. The 18-month period allocated to Ph.D training only provides the individuals an opportunity to complete the course work portion of their programs. Since they have just departed or are only now departing, adequate time does not remain for them to complete their degrees under proposed subproject time frames. It is important that this training be jointly discussed between the individuals, the universities, USAID and ICAR so all parties help identify solutions which will allow the participants to complete their programs and be granted Ph.D degrees.

Negative factors have tended to be the exception. The two most noteworthy areas needing improvement tend to be in the timely purchase and supply of computer and scientific equipment. The scheduling of U.S. scientists to participate in workshops and research collaborations requires constant monitoring and can resulted in delays in subproject activities.

b. GOI (Appropriateness, Timeliness, Quality)

GOI inputs generally have been appropriate, timely and of high quality. Nomination and approval of GOI participating scientists has been prompt and has identified capable and committed individuals. National and regional centers were promptly identified and research facilities and operating funds have been maintained and expanded.

The development of scientists with Ph.D degrees under this subproject will allow Indian institutions to grant Ph.D degrees in the future. Possibly greater emphasis could be given to the selection of Ph.D nominees from subproject institutions with academic programs.

2. Assessment of Outputs Achieved (Qualitative)

For the most part, the subproject has achieved the outputs scheduled in its 2-year work plan and is progressing well towards the achievement of subproject objectives. During the remainder of the subproject emphasis is scheduled and needs to be placed on social science and collaborative research activities. This will allow the subproject to achieve its objectives and will also enhance networking between U.S. and GOI institutions and scientists.

B. Progress Toward Objectives

1. Appropriateness of Objective Priorities

a. ICAR/SAU System

One measure of the appropriateness of the subproject's priorities is to assess the way they are viewed by independent observers. Dr. P.K.R. Nair's evaluation of the All-India Coordinated Research Project on Agroforestry provides such an independent review. That review also emphasized the need to:

- increase the involvement of social and economic scientists in the planning and implementation of agroforestry activities.

- concentrate on why and how agroforestry systems work as opposed to simply recording what happens under a specific treatment activity.

- use conceptual models and systems analysis methodologies to focus attention on why and how agroforestry systems work.

That same review identified system modeling and analysis, informatics-expert systems, agroforestry education and training, and biotechnology research and application as areas that it recommended for increased support under the Agroforestry Research Subproject. The first three of these are directly related to the subproject's present objectives and the fourth in closely related to the existing germplasm thrust.

There is no indication that conditions have changed which decrease the appropriateness of the subproject's initial

objectives. In fact, ICAR's increasing need to develop technologies which help India's rural agricultural communities diversify the products they produce is increasing the appropriateness of this subproject.

b. Indian System

India's National Forest Policy resolution of 1988 has the meeting of the fuelwood, fodder, minor forest produce and small timber requirements of its rural and tribal populations as a basic objective. One of its strategies is the development of tree crops and fodder resources through technical assistance provided by government organizations. This subproject is directly increasing India's capacity to provide that needed technology. That policy also charges India's forest based industries to obtain their raw material needs from private individuals and not from government owned forests. This further increases the importance of developing agroforestry systems which can be used by farmers to achieve this new private sector mandate.

2. Importance of U.S. Interests

a. Current

Ecosystem level studies and the maintenance of germplasm resources has and continues to be of critical interest to U.S. scientists, organizations and industries. This information is desired so a better understanding and management of natural resource systems is possible. This subproject is helping to promote that information.

b. Future

Increasing emphasis is expected to be placed on the maintenance of germplasm resources and the sustainable social and ecological management of biological systems. India's agroforestry systems provide an excellent laboratory for the development of methodologies needed to study and understand complex social and biological systems. A well established science community staffed with capable individuals in essential if U.S. scientist's are to effectively collaborate in India. This subproject is creating that science community.

3. U.S. Role and Advantage in Cooperation

Although it is not generally considered an agroforestry system, U.S. scientists study and develop methodologies useful in the multiple use management systems involving the ecologically diverse, mixed species, mixed age class forests of north America. Social and environmental constraints imposed on the multiple resource management of these systems add the social dimension that

is so prevalent in more traditional agroforestry systems. The Agroforestry Research Subproject provides U.S. scientists an opportunity to collaborate in the application of new concepts and technologies in a world class agroforestry environment where responses in the biological system can be measured in months rather than years. Furthermore, it provides opportunities for U.S. students and scientists to develop skills, experiences and technologies which they can then apply to both foreign and domestic ecosystems. This opportunity has traditionally been almost exclusively the domain of the European forest science community. Changes in world trade and environmental issues makes it increasingly important that the U.S. forest science community have greater knowledge of world ecosystems.

C. Progress Toward Purpose

1. Relevance

a. ICAR/SAU System

India is in the process of incorporating the forest sciences into its university systems. This requires the development of individuals and institutions with the capacity to provide degree education and develop new knowledge in this field of science. This subproject, coupled with ICAR's and the SAUs Forestry Faculty Development Initiative, provides the needed support and assistance to help institutions develop this capacity in its scientists.

b. Indian System

India's large and expanding rural populations place increasing emphasis on the development of technologies and management practices that will lead to rural development and increasing rural incomes. Its national policies support this emphasis through reforestation programs on marginal and degraded lands and through the development and implementation of agroforestry systems which support rural agribusiness and forest-based industries, improve soil and water conservation practices, enhance the environment, and provide risk avoidance measures. Agroforestry systems being developed under the subproject will lead to the development of technologies that make the management of marginal and waste lands economically and socially viable activities.

2. Mutuality of Interests

a. Current

Of increasing priority to land management agencies and organizations is the measurement of resource productivity and

the understanding of resource sustainability. This is reflected in the current focus on the development and implementation of sustainable agricultural systems. The development of technologies and management practices for these systems is and will continue to be of special interest to agroforestry scientists throughout the world.

b. Future

Increasing world wide interest and importance in agroforestry research is reflected by the CGIAR's recent decision to include the International Council for Research in Agroforestry in its membership. Since this Council's focus will be on Africa, CGIAR expressed the need for a similar focus in Asia. Indin's strong internal agroforestry research system of agricultural universities and federal research institutes, its large number of trained agroforestry scientists, its tremendously diverse ecosystems, and its potential to capitalize on ICRISAT's programs all suggest India, either as the central institution or as a network member, will play a prominent agroforestry leadership role in Asia. The U.S. science communities continued collaboration with Indian colleagues will facilitate the U.S.'s direct involvement in the expansion of CGIAR's agroforestry programs and the development of new technologies.

3. Follow-On Cooperation

The current subproject terminates in June 1992. At that time the current subproject's initial objectives are expected to be accomplished. However, the continued development of ICAR's scientists should be view as a long-term activity. ICAR, ideally in collaboration with USAID, might consider designing a follow-on project which would continue the development of its agroforestry trained scientists. Such an activity could include individuals who participated in both the Agroforestry Research Subproject and the Forestry Faculty Development initiative. Components of this activity might include the following suggestions.

a. Scientist to Scientist

The purpose of this subproject is explicitly to develop a community of individuals trained in areas of science which allows them to understand and develop methodologies appropriate for agroforestry systems. This subproject only begins this development process. If the subproject's purpose is to be achieved this development must continue into the future. This is most likely to occur if an environment is created that allows and encourages continued learning. The availability of research operating fund for SAU scientists that are provided in a manner similar to those available to scientists associated with coordinated projects would facilitate the continued growth of

scientists. The continuation of the following activities would also help ensure that the subproject's purpose is achieved:

- Provision of and access to library materials at all subproject locations.

- Provision of and access to computers and scientific equipment at all subproject locations.

- Development of and support for participation in professional associations and forestry networks within India, throughout the region and internationally.

- Access to and participation in competitive grant programs which encourage collaboration between scientists.

b. Inter-Institutional

As stated above, the purpose of this subproject is explicitly to develop a community of individuals trained in areas of science which allows them to understand and develop methodologies appropriate for agroforestry systems. This development process and will only be achieve if a critical mass of scientists is developed. Without a critical mass, development of a forestry science capacity within institutions is difficult. With a critical mass long-term collaboration between institutions is possible. Because of mutually perceived benefits, collaborations often continues between institutions regardless of the political policies between the countries in which they reside. Thus, the development and fostering of these ties is desirable from both a political as well as a scientific perspective. This is most likely to occur if an environment is created that allows and encourages science. The continuation of the following activities would help ensure that the subproject's purpose is achieved:

- Continued development of a critical mass of scientists with the capacity to undertake research in agroforestry. Ideally additional scientists could be identified and provided specialized training during the remainder of this subproject.

- Support which ensures that individuals participating in Ph.D degree programs are able to obtain their degrees.

- Develop and hold at least one national symposium on agroforestry research with emphasis on quantifying and predicting the behavior of agroforestry systems.

- Support for and participation in professional forestry networks between Indian and U.S. institutions.

III. Future Opportunity

It is an exciting time for forestry research in India; a time that places the forestry sector at a new crossroads. Historically, state owned or operated industries relied almost exclusively on federal and state agencies to provide the raw materials from which they produced their products. Frequently these arrangement were heavily distorted by subsidies and other government interventions.

The 1988 resolution on National Forest Policy mandates that future industrial raw material supplies exclusively be provided by private producers rather than public agencies; a mandate which creates tremendous opportunity for private individuals and rural, forestry-based agribusinesses. Unfortunately India's forestry institutions have not previously focused on the needs of this private sector client. If india's new policy directive is to succeed, these private tree growers will need technologies which make their production systems economically and biologically efficient and socially and environmentally sustainable.

ICAR's agroforestry focused research institutions have begun to provide that technology. The Agroforestry Research Subproject is their positive response. Their beginning is impressive. They deserve, and more importantly India's forest-based private sector deserves, an opportunity to succeed. Continuation of the Agroforestry Research Subproject is key to that opportunity.

ATTACHMENT 1

ANALYTICAL LABORATORY EQUIPMENT

NATIONAL RESEARCH CENTER
- Analytical Lab Equipment
  - Plant Stress Monitor
  - Photosynthesis System
  - Steady State Porometer
  - Auto Kjeldahl Analyzer
  - Spectrophotometer
  - AA Spectrophotometer
  - Centrifuge
  - Electric Analytical Balance
  - Top Loading Balance
- Equipment for Ecosystem Field Studies
  - Infrared Thermometer
  - Leaf Area Meter
  - Soil Moisture Measuring Equipment
- Field Measuring Equipment
  - Dendrometer-Reloscope
  - Power Saw
  - Tree Measurement Set
  - Assorted Measurement Items

REGIONAL CENTERS
- Analytical Lab Equipment
  - Electric Analytical Balance
  - Top Loading Balance
- Equipment for Ecosystem Field Studies
  - Infrared Thermometer
  - Leaf Area Meter
  - Soil Moisture Measuring Equipment
- Field Measuring Equipment
  - Power Saw
  - Tree Measurement Set
  - Assorted Measurement Items

LOCAL CENTERS
- Field Measuring Equipment
  - Power Saw
  - Tree Measurement Set
  - Assorted Measurement Items