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R E P O R T

INTEGRATED NUTRIENT SUPPLY AND MANAGEMENT

New Delhi, India

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Consultant Report by

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Integrated Nutrient Supply and Management Subproject

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I. EXECUTIVE SUMMARY

The initial Integrated Nutrient Supply and Management (INSAM) Design was completed during the months of March-April, 1987. The scope of work for this consultancy required participants in the INSAM workshop to assist in research priority planning and develop amoverall operational plan for execution of the projects under INSAM. This was build upon the design teams report of 1987.

During this consultancy, civil unrest prevented planned visits to Hisar and Ludhiana and desired visits to the Indian Institute of Soil Sciences (IISS) in Bhopal and other ICAR Institutes. The INSAM workshop was transferred from Karnal to IARI, New Delhi with only 10 of the 20 invited participants present. While accomplishments from this workshop might be less than originally hoped for the three priority project areas appeared to have strong agreement among the participants.

The status issues factored into our recommendations for projects on a priority basis were: 1) unification on a more organized system the numerous all-India Coordinated projects and specialized research programs; 2) institutionalization of INSAM into the emerging Indian Institute of Soil Science (IISS). We view IISS to take the leadership role in INSAM providing strong leadership in basic research. IISS must also serve as a grant directing agency for the INSAM research most appropriate for State Agricultural Universities and/or region centers. This later function would serve for regional needs, refinement and adaptations of research to the many soils across India's 21 agro-ecological regions.

We also recommend a two stage undertaking of INSAM; 1) short-term and 2) long-term. This phase-on undertaking will permit IISS to develop a stronger leadership position and time for adjustments in all-India programs to focus on research needs identified during the INSAM workshop. The three research priority areas are:

A. Short-term

1. Nutrient Response Interpretations Model (NRIM) and Decision Support System (DSS)for Development of the Prototype Integrated Nutrient Supply and Management (PINSAM) model. This will also develop data base management capability within IISS.

B. Long-term.

1. Complementary/Alternative Nutrient Systems (CANS). This will focus on how to agriculturally utilize 1) organic residues provided in villages, cities and biogas plants; 2) biofertilizers; 3) legumes in rotations; 4)agroforestry organic management; 5) green manues, all within a natural resource availability context for sustainable agricultural production.

2. Soil Productivity Indexes (SPI) for major agro-ecological zones. This will utilize soil chemical and physical properties to calculate verifiable productivity indexes for the major soil associations. This is especially important as India must address best land use policies and use of amendments and nutrients for the soils in dryland and acid zones. About 1/3 of India's area is in the acid soil region and there has been little research to develop their sustainable productivity.

We believe this step-wise or phase-on series of INSAM research and training activities will achieve the desired end products necessary for Integrated Nutrient Supply and Management necessary for long-term sustainability of India's agriculture.

I. INTRODUCTION

A. PREVIOUS CONSULTANCY

India is endowed with a wide range of climatic regimes, diverse soil types and abundant sunshine favoring high levels of biomass production in 21 agro-ecological regions. The technological developments in the agricultural sector brought about during the last two to three decades has enabled the country to reach self-sufficiency in the production of food necessary for the growing population. At the present growth rate, the population is expected to reach one billion by the year 2000, with food grain requirements of 245 million metric tons. This food grain requirement, along with cooking oil, fibre, fuel and construction material needs must be provided within the present soil resource base. To supply these internal needs and for agriculture to continue to maintain its position as a leader in exports for foreign exchange earning, it will be necessary to integrate the efficient use of inorganic fertilizer nutrients with organic and biological resources into a sustainable production systems approach.

The justification of the Integrated Nutrient Supply Management (INSAM) program, background review, subproject strategy and plan of work is outlined in the Study Team Report of Roger G. Hanson, John L. Malcolm and Jack V. Baird (1987) which will be built upon in this report.

B. INSAM GOAL

The goal of the INSAM program will be: "to provide the most agronomically, ecologically and environmentally sound nutrient supply and management technology for farmers to provide sustainable agriculture production for long-term human needs".

II. INDIAN INSTITUTE OF SOIL SCIENCE

A. MANDATE AND OBJECTIVES

The Indian Institute of Soil Science (IISS) was established in Bhopal, Madhya Pradesh) in 1988 and has been designated by the Indian Council for Agricultural Research (ICAR) to take leadership in the INSAM Program. The institutional mandate is: "Provide a scientific basis for enhancing and sustaining productivity of soil resources with minimal environmental degradation". The following institutional objectives have been formulated:

1) "carry out basic and strategic research on soils, especially the physical, chemical and biological processes related to management of nutrients, water and energy;

2) develop advanced technology for sustainable systems of input management in soils that are most efficient and least environmentally polluting;

3) develop expertise and backstop other organizations engaged in research on agriculture, forestry, fishery and various environmental concerns;

4) exchange information with scientists engaged in similar pursuits through group discussions, symposia, conference and publications and

5) collaborate with State Agriculture Universities (SAU), national, international and other research organizations in the fulfillment of the above objectives."

In line with the mandate and objectives, IISS, with respect to the INSAM program should provide national leadership in:

1) conducting selected basic and applied research, and

2) collaboration with and support of research at other institutes, centers and state agricultural universities.

Following are some suggested criterias prioritising research activities of IISS and research to be supported through grants.

B. CRITERIA FOR IISS RESEARCH AGENDA FOR INSAM

The following criteria are suggested for identifying the IISS research agenda for the INSAM program:

1) focuses on the basic science and methologies necessary for the success of INSAM;

2) is fundamental to the introduction, development and utilization of advanced technologies for INSAM; and

3) provides those granting activities and collaborative functions that give IISS a leadership role in INSAM.

In addition, IISS would be expected to help formulate national needs of INSAM and supportive programmes and provide leadership in their accomplishments.

C. CRITERIA FOR IISS GRANTS AGENDA FOR INSAM

For planning purposes, India has organized along 15 agro-climatic zones with subsequent identifications of 21 agro-ecological regions. National research needs must therefore be modified in accordance with regional necessities. To accomplish this, it is

expected that IISS would serve as a grant coordinating body to fulfill INSAM's national impact. The following general research grant criteria could be followed by IISS to insure full impact of this research:

1) fits with the total national INSAM program;

2) is required for adaptation and refinement to a specific agro-ecological region; and

3) is most cost-effective because of institutional comparative advantage.

The granting activities can be used to support regional research necessities of INSAM and should be open to institutions with regional mandates.

III. INSAM PROPOSAL

The integrated Nutrient Supply and Management (INSAM) Program is proposed to concentrate concurrently on establishment of short and long term activities via coordination by the newly established Indian Institute of Soil Science (IISS) of the Indian Council for Agricultural Research (ICAR).

A. SHORT-TERM ACTIVITIES

Short-term activities are proposed to begin in November 1, 1990 and carry through June 30, 1992. The first part, to be completed by December 31, 1991, includes the establishment of the Decision Support System (DSS) which will develop models for Prototype Integrated Nutrient Supply And Management Systems (PINSAMS) for India's priority cropping systems and agro-ecological regions. A computerized data bank of IISS will be established to gather, store, utilize and release nutrient management data generated at the ICAR's various institutes, all-India coordinated research projects and programs, the State Agricultural Universities (SAU), and others. The computerized DSS will be used to create the PINSAMS models from the data. Linkages among Indian and International scientists in selected workshops will allow initial refinement of the PINSAMS models which will be used to improve agricultural productivity in the priority cropping systems and agro-ecological regions.

The second part, to be completed by June 30, 1992 will concentrate on gaps/constraints identified in the initial PINSAMS models. To fill these gaps, field and laboratory research for the appropriate institutions will be planned in concert with on going research in such areas as complementary/alternative nutrient sources, e.g. recycling nutrients from village and city wastes and agro-forestry, improved fertilizer (especially N and P) efficiencies, biological nitrogen fixation (BNF), and others. To facilitate the planning

process, a team of four to five senior soil scientists selected by ICAR will confer, over a three week period with counterpart scientists at their U.S. institutional focusing on field and laboratory research to be conducted. The data generated from these research activities to be conducted under the next category can then be used to refine further the PINSAMS models.

B. LONG-TERM ACTIVITIES

Long-term activities are the research activities planned under the above category and are proposed to begin July 1, 1992. These will be conducted primarily by the appropriate Indian institutions and funded from their core budgets complemented by IISS research grants. Research results will allow for further refinement of the PINSAMS models and further improvement of sustainable agricultural productivity in the priority cropping systems and agro-ecological zones.

That portions of the short and long term activities above elaborated are continuing activities is obvious. Currently, there is no central coordinating "clearing house" for the widespread soil fertility/plant nutrition research being conducted in India. The ICAR through the IISS and its PINSAMS can be of great service to India as she moves to improve her sustainable agricultural productivity consistent with her needs for continued food self-sufficiency, to meet cooking oil, fiber, fuel and construction materials requirements, and to maintain needed foreign exchange earnings.

The INSAMS also is expected to contribute private sector employment opportunities and help alleviate sanitary problems facing villages, cities and farms as more efficient ways are found to utilize important natural resources for sustainable agricultural production.

IV INSAM PRIORITY PROJECTS

A. NUTRIENT RESPONSE INTERPRETATION MODEL (NRIM) AND DECISION SUPPORT SYSTEM (DSS) DEVELOPMENT

1. PROBLEMS TO BE SOLVED:

Plant nutrients, because of their basic importance to the production of food, cooking oils, fibre, fuel and construction materials places fertilizers on the essential commodity list. National production, imports, use of organic residues, wastes products, biofertilizers and Biological Nitrogen Fixation (BNF) will all be required to meet total nutrient needs. To maximize nutrient use efficiency across the numerous soils and cropping systems has been the subject of many of the all-India coordinated and other research projects. These research programs have generated large quantities of data that needs to collected, formatted, stored and developed into

interpretation response models. The development of a Prototype Integrated Nutrient Supply and Management model (PINSAM) will provide the vehicle to bring these data into a more applicable and interpretative form.

Nutrient response interpretation models (NRIM) developed to account for nutrient requirements, inputs, losses etc. are helpful in summarizing research data and quantifications, but input needs still requires decisions from experts. Decision Support System (DSS) or knowledge-based systems are designed to record the knowledge and problem-solving skills of experts. The bringing together of NRIM and DSS will be the construction of the prototype model, PINSAM.

Often conducted are field studies that do not always provide new information because sources of variation such as weather, crop diseases, inflate the experimental error and reduced the amount of useful information that can be extracted from the study. A nutrient management decision support system including soil taxonomic category, soil analytical data, crop response, input costs, management costs, production value, etc. can be used to manage nutrient input costs. A well organized method of formatting, storing and retrieving such information becomes important as the volume of information grows. Before resorting to establishing new studies, the knowledge base can be consulted to determine what the research gaps are and what research needs to be initiated.

2. OBJECTIVES:

The objectives of this project are to:

a) Develop standard format data base to be used to collect soil fertility research data generated by the all-India and other research programs.

a) Design and construct nutrient response interpretation models (NRIM) that can be used to interpret soil test research data presently available.

c) Design the prototype computer software for the nutrient management Decision Support Systems (DSS) employing learning and deductive capability and prepare the necessary DSS training manuals to be used for the workshop in India.

d) Organize and conduct training workshop on the development and use of the nutrient decision support system as an educational and a management tool.

e) Evaluate the nutrient management decision support system as a tool for the identification of information gaps and refinement needed to prioritize research needs for integrated nutrient supply and management.

3. PLAN OF WORK:

This plan of work will include consultation, short-term training, software development and the planning and conducting of a workshop. To accomplish this will require the identification of Indian and U.S. scientists that will be in the project throughout its execution. The following sequence of events should be used to complete the consultation, training, software development and collaborative workshop.

One or two of the U.S. scientists will provide a 10-14 day consultation in India to:

1) assess available computer hardware for capacity and compatibility of this equipment;

2) outline information parameters in data sets needed to develop the interpretation models and the prototype decision support system. The Indian scientists (see b. page 9) will be responsible for collecting and bringing these data sets to the U.S.

After this initial consultant visit, the Indian scientists will come to the University of Hawaii for specialized training and the consultancy of NRIM, DSS and the PINSAM model.

1) Organize and conduct a two stage training program at the lead institution (probably the University of Hawaii). These two training activities would be:

   a) nutrient response interpretation model development;

   b) design and construction of the prototype decisions support system.

2) Prepare the manual that will be used in training workshop.

The first training would be of the short-course type while the second would be oriented to hands on one-on-one development activities.

After the training in the U.S., the Indian and U.S. scientists will work collaborating to:

1) Organize and conduct the training workshop in India. This workshop would be a collaborative undertaking by the India and two lead U.S. scientist.

2) Install a data base storage and retrieval system at IISS.

The overall program will not only involve training, but would also establish the formats for computer data acquisition, storage, retrieval and utilization of the national, regional and state institutions. This capability would be institutionalized within the Indian Institute of Soil Science (IISS).

Concurrent to the development of PINSAM and DSS programs there will be a three week research study program for your senior level Indian Soil Scientists (Program Leader) to visit key U.S. Institutions of excellents for INSAM collaboration. This study visit will provide the Indian Scientists the opportunity to establish institutional contacts and take a greater role in leadership in research program planning. Special effort will be made to visit some mother soil Testing Laboratories such as at North Carolina State University and University of Georgia.

4. PROPOSED INDIA-U.S. PROJECT LEADERS:

1) Potential U.S. Scientists

Dr. Russell Yost - University of Hawaii
Dr. Stephen Itoga - University of Hawaii
Dr. Goro Uehera - University of Hawaii
Dr. Gordon Minor - North Carolina State University
Dr. Lloyd Hossner - Texas A&M University
Mr. Neil Caudle - North Carolina State University
Dr. Stanley Buol - North Carolina State University

2) Suggested Indian Scientists

a. For PINSAM & DSS Development:

The Indian scientists to collaborate in this project will not be specifically identified. To accomplish both the nutrient interpretation response model development and nutrient management decision support system design and construction it is proposed that at least three (3) and preferably four (4) scientists be selected. One of these scientists needs to have some understanding in computer software development. The other three should have computer experience, be soil scientists with research background in soil fertility-nutrient management-soil test calibration-soil taxonomy. They should be sufficiently senior to provide leadership and training in design, construction and use in electronic data acquisition and use.

b. For study visit.

Four senior Indian soil scientists (Program Leader) that will be involved in long-term planning and execution of INSAM programs.

5. POTENTIAL EQUIPMENT AND BUDGET NEEDS

A. Equipment for Training:

Item/Activity	Unit Costs US $	Total Costs U.S.$
5 sets computer software	2,000	10,000
5 computer sets	15,000	75,000
- Supplies for manuals	-	1,000
- Misc supplies	-	3,000
	Sub Total	88,000

B. Training Costs:

1. Participant Costs (3-4 participants for 4-6 months)		
Fees	10,000	40,000
24 months per diem	2,250	54,000
4 Round trip air travel	3,800	15,200
2. Participation U.S. Institutional Costs (For other than Hawaii Faculty)		
25 days institutional input	250	6,250
5 round trip transportation	1,800	9,000
25 days maintenance costs	110	2,750
3. Costs for workshop in India (Support Indian Participants) 2-weeks training for 15 scientists	Rs.6,500	- Rs.97,500
	Sub Total	127,200

C. Consultancy (Two consultants for 1.5 months each)

78 days consults costs	285	22,230
92 days per diem	105	9,660
4 round trip air fare	3,800	15,200
Misc.pre-travel costs	-	2,000
Sub Total	-	49,090

D. Indirect costs (Total minus equipment x 50%) 90,145

TOTAL $346,435 Rs.97,500

B. COMPLEMENTARY/ALTERNATIVE NUTRIENT SYSTEMS (CANS)

1. PROBLEMS TO BE SOLVED:

It is essential that India look to supplement inorganic fertilizers with complementary/alternative nutrient sources to supply part of the 20 million tonnes of primary nutrients (N,P,K) required annually by 2000 A.D./ to meet the food production demands of 245 million metric tons. Also supplied by some sources of CANS will be [portions of the secondary nutrients (S,Ca,Mg) and micronutrients (Zn,Mn,Fe,B,Mo,Cl) to be required. Inherent in this approach is recycling and biofertilizers, with the associated needs of improved fertilizer recommendations and efficiencies. India for example, could use more fully its 650 million tonnes (415 million tonnes unused) of rural organic compost and 15.9 million tonnes (9.2 millions tonnes unused) of urban compost to complement its use of inorganic fertilizers to improve and sustain its agricultural productivity. Similar statements about the importance of more fully utilizing biofertilizer and green manures could be made.

2. OBJECTIVE:

To determine how to agriculturally utilize 1) organic residues produced by villages, cities, industry and agroforestry, 2) biofertilizers, and 3) green manures in a more integrated manner with inorganic fertilizers. Implicit in this is the need for improved fertilizer recommendations and improved fertilizer efficiencies based on the use of complementary nutrient sources.

3. PLAN OF WORK:

a. Determine nutrient content, composting methods, biogas production and utilization, enrichment techniques, application and utilization of city and village wastes, including sewage, and or residues produced by agroforestry.

b. Determine most efficient microorganisms for rapid decomposition of organic residues and their role in supplementing and/or enhancing nutrient use efficiency in priority cropping systems and agroecological regions.

c. Determine deep rooted tree species best adapted for "deep pumping of nutrients" for use in agroforestry systems in priority cropping systems and agroecological zones.

d. Determine most efficient green manure crops for priority cropping systems and agroecological zones.

4. POTENTIAL PROJECT LEADERS:
(Depends on ICAR and IISS)

5. PROPOSED INDO-U.S COLLABORATION:
(Depends on ICAR and IISS)

6. BUDGET:

(To be determined in collaboration with ICAR and IISS at the research planning to be done January 1 - June 30, 1992. Overall, initial estimate for a five year project is $U.S. 7.8 million). This budget should include model "agro-lab" of equipment for IISS.

C. DEVELOPMENT OF SOIL PRODUCTIVITY INDEXES FOR AGROECOLOGICAL ZONES.

1. PROBLEMS TO BE UNDERTAKEN:

Increasing population and need for food, cooking oil, fiber, fuel and shelter materials will place more production pressure on irrigated lands and require increased productivity on acid, rainfed and dryland soils. Efficient integrated nutrient management on the acid soils which comprise one-third of India's soils, will require understanding the productive capacity of these soils in the context of rainfed conditions. Addition of fertilizers, organic materials and other amendments can modify the surface layer. Quantification of the soil properties that control soil productivity will be necessary to prescribe the efficient use of nutrient amendments for sustainable production.

The characterization of the soil productivity indexes for all the agroecological zones can also be used to select crops, cropping systems and other aspects of best land use. The productivity index will need to be based on soil taxonomic classification, soil physical and chemical parameters. This undertaking will be long-term because of the need to link to the soil taxonomic base, select representatives benchmark soils, complete physical and chemical characterization. A production research agenda will need to be established and completed to derive and verify the productivity indexes for these benchmark soils.

2. OBJECTIVES:

The objectives of the project will be to:

1) develop working groups of soil scientists to quantify soil parameters that influences production capacity of soils and establish productivity indexes for major soil units in acid, rainfed and other major regions;

2) link soil taxonomic data to the soil production parameters into a data base for best land use selection;

3) develop soil-plant-nutrient management knowledge base to make best agronomic, ecological and economic use of acid, rainfed soils.

3. PLAN OF WORK:

This research activity is classified as long-term because it will require more complete physical and staff development of the Indian Institute of Soil Science. A research team in soil physics, soil chemistry, soil fertility, soil conservation and geostatistics will be important to insure full development of the productivity index project.

Representative benchmark soils need to be selected in the acid, rainfed regions. These will be classified taxonomically and undisturbed cores will be collected on which to measure the physical and chemical parameters. By horizon, soil pH, electric conductivity, bulk density, water holding capacity and available nutrient levels are some of capacity parameters to be measured. Cropping studies will need to be conducted to verify rooting depths of principle crops as a function of soil properties. The productivity index of the benchmark soils will be calculated and tested under field conditions. These data can be incorporated into data bases to be used for integrated nutrient management. The soil productivity index should be used as a basis for land use, yield potential to formulate fertilizer recommendations.

4. PROPOSED INDO-U.S. SCIENTIST COLLABORATION:

There are probably only three to four universities that have worked extensively with developing diagnostic models suitable for use in deriving soil productivity indexes. Texas A&M and cooperative USDA/ARS colleagues have worked on systems for dryland areas, while the University of Missouri has concentrated research on acid soils with subsoil hard pans. Research on productivity index at North Carolina State University offers conditions not too unlike some soil systems in India. Until the IISS manpower is better defined, it is difficult to identify collaboration from the Indian side. It might be necessary to select candidates for long-term or degree training to successfully develop this team.

POTENTIAL PROJECT LEADERS

U.S. Collaboration

Dr. L.D. Hossner	- Texas A&M University
Dr. C.J. Gantzer	- University of Missouri
Dr. D.K. Cassel	- North Carolina State University
Dr. R.R. Allmaras	- USDA/ARS University of Minnesota
Dr. G.F. Hall	- Ohio State University
Dr. P.W. Fryrear	- USDA/ARS, Brig Springs, Texas
Dr. L.D. Wilding	- Texas A & M University
Dr. Fred Cox	- North Carolina State University

Indian Collaboration

The team to be selected should include a senior scientist from the Bureau of Soil Survey and Land Use Planning. Other disciplines needed will be soil physics, soil chemistry, soil fertility, soil and water conservation and geostatistics. It would be expected

that the All-India soil test correlation and other program leaders will need to be included in the long-term research agenda to verify productivity indexes.

5. POTENTIAL EQUIPMENT AND BUDGET NEEDS

This section can not be completed until IISS equipment and manpower becomes more definite. To fully develop the program into the functional stage probably would require a 5-year commitment in funding. An estimate of about 350,000 to 400,000/year (average) might be reasonable number for which to budget.

	Unit Price U.S.$	Total Cost U.S.$
A. Equipment and Supplies		
1- Atomic absorption spectrophotometer	20,000	20,000
1- PH meter	2,000	2,000
1- Spectrophotometer	10,000	10,000
1- Conductivity bridge	6,000	6,000
2- Soil grinders (plastic, stainless steel)	1,500	3,000
1- Gidings core probe	10,000	10,000
1- Bulk density gouge	12,500	12,500
1- Mettler analytical balance	2,000	2,000
2- Computers	15,000	30,000
Other equipment and supplies		75,000
		170,500
B. Training		
Fees	-	75,000
Maintenance costs	-	340,000
Airfare transportations	-	70,000
		485,000
C. Consultancy		
Fees (1170 days)	285	333,450
Per diem (1365 days)	105	143,325
Airfare transportation (30 round trips)	3,800	114,000
Misc (30 trips)	500	15,000
	Sub Total	605,775
D. Indirect costs (total minus equipment x 50%)		618,100
	Total	1,879,373

V. INSAM MANAGEMENT STRUCTURE

A seven-member committee under the chairmanship of the Deputy Director General (Soils, Agronomy, Agroforestry and Water Management) of ICAR will be responsible for the management of the INSAM program. The IISS Director, who will serve as the implementation leader of INSAM, will be a member of the management committee as well. Other committee members will be the Assistant Director General (Soils) of ICAR Project Coordinators of two All-India Coordinated Research Projects and two senior soil nutrient management scientists from two SAU.

VI. APPENDIX MATERIALS

A. ONE TIME PURCHASE OF SPECIALIZED EQUIPMENT NEEDED FOR THE INDIAN INSTITUTE OF SOIL SCIENCE

ITEM	$
Computer (486 processor or Higher Speed) 3- Terminals and Software packages.	30,000
Atomic Absorption spectrophotometer Graphic Furnace, Lamps, accessories	45,000
ICP Analytical Unit	150,000
UV-VIS spectrophotometer	25,000
Infrared Spectrophotometer	25,000
Gas Chromatograph	25,000
Auto-analyzer	40,000
Soil grinder (2 regular stainless steel, 2 plastic)	5,000
Plant grinding wiley mill	2,000
Cryostat	12,500
Auto Titrator	14,000
Mettler analytical balances (3)	6,000
Growth Chamber	15,000
Liquid Scintillation counter (packard)	60,000
X-Ray Diffraction unit	90,000

Mass spectrometer	110,000
Ultrasonic vibrator	5,000
Bi-parlite root augers (5)	50,000
Fraction collectors with perisible pump (4)	80,000
Automatic weather stations (4)	40,000
Root Length Gauge	6,250
Photometer	6,250
Soil Moisture probe	8,750
Soil Water vacuum sampler (30)	7,500
Plant Water status consol.	5,000
NMR	45,000
Research Microscope	12,500
HPLC	42,500
Refrigerated Centrifuge	20,000
Total	958,250

B. SPECIALIZED WORKSHOP TRAINING EQUIPMENT

VCR and Camera	- 1,400
Monitor - Large size	- 3,500
Slide screen projector	- 1,500
Field Camera 35 mm - and lenses	- 550
Xerox - copier	- 5,000
Total	11,950

C. INSAM WORKSHOP LIST (2-3 OCTOBER 1990)

I Attended

Dr. R.K. Pandey
Project Director
Directorate of Cropping Systems Research
Modipuram, Dist. Meerut,
U.P.

Dr. D.M. Hegde
Project Coordinator
Directorate of Cropping Systems Research
Modipuram, Dist. Meerut,
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Project Coordinator, Micornutrients
Indian Institute of Soil Science
Bhopal - 462 011, M.P.

Dr. K.C.K. Reddy
Project Coordinator, Soil Test Crop Response
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Dr. K.K.M. Nambiar
Project Coordinator
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and Agricultural Chemistry
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Dr. P.N. Takkar
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Dr. K.D. Singh
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Dr. M. Valayutham
Assist. Director General (Soils)
ICAR, New Delhi-110 012

Dr. J.S.P. Yadav
Program Specialist
USAID/AGRE
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India Coordinator
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Dr. John J. Nicholaides, III
Director of International Agriculture
Associate Dean of Agriculture
Vice Chancellor for Research & Professor of Agronomy
University of Illinois
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Dr.Roger G. Hanson
Director, Management Entity
Soil Management Collaborative Research Support Program
Box 7113 Williams Hall
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II UNABLE TO ATTEND

Dr. K.K.R. Bhardwaj
Project Coordinator
Decomposition and Recycling of Organic Wastes
(ICAR) HPKVV, Palampur - 176 062, H.P.

Dr. O.P. Meelu
Professor
Div. of Soil Science
Punjab Agrl, University
Ludhiana - 141 004 (Punjab)

Dr. M.L. Chaudhary
Department of Soil Science
Haryana Agril.University
Hisar - 125 004

Dr. Rajendra Prasad
Professor, Division of Agronomy
IARI, New Delhi - 110 012

Dr. K.G. Pillai
Principal Scientist
Directorate of Rice Research
Rajendranagar
Hyderabad - 500 300, A.P.

Dr. N. Panda
Dean,
College of Agriculture
Orissa Univ. of Agrl. & Tech.
Bhubaneswar - 751 003 (Orissa)

Dr. N. Sankaran
Director
Centre for Crop and Management
Tamil Nadu Agril. University
Coimbatore - 641 003
Tamil Nadu

Dr. G.S. Sekhon
Director
Potash Research Institute
Sector 19, Dharuhera
Delhi Gurgaon Road
Gurgaon - 122 001 (Haryana)

Dr. D.R. Bhumbla
Bhumbla Farm
LSSRI Post Office
Karnal (Haryana)

Dr. G.B. Singh
Asstt. Director General (Agronomy)
ICAR, New Delhi-110 001

D. SPECIALIZED DISCIPLINE CONSULTANTS NEEDED

1. Organic matter composition, breakdown and competition with soil organism for soil nitrogen.
2. Model Plant growth and, nutrient uptake and cycling
3. Diagnostic techniques and methods of soil and plant analysis
4. Modelling of nutrient management Input-output for long term management.
5. Water-soil-plant-nutrient interactions and modelling.
6. Rhizosphere Biology and Chemistry
7. Microbial biomass and nutrient transformations
8. Biological Nitrogen Fixation
9. Kinetics of nutrient reactions and availability to plants
10. Soil testing and plant analysis laboratory management.

E. RESOURCE MATERIALS

Abrol, I.P.,V.V. Dhruva Narayana, 1990. Technologies for waste land development. Publication and Information Division. Indian Council of Agricultural Research, Krishi Anusandhan Bhavan, New Delhi 110 012, India.

Hanson, Roger G., John L. Malcolem and Jack V. Baird, 1987. Subproject Draft: Integrated Nutrient Supply and Management. Winrock International, New Delhi, India.

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Pasricha, N.S., M.S. Aulakh, G.S. Bahl and H.S. Baddesha, 1987. Nutrient response of oilseed and pulse crops in Punjab. Department of Soils. Punjab Agricultural University, Ludhiana, Punjab, India.

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Singh, R.P. and S.K. Das, 1984 Nitrogen management in cropping systems with particular reference to rainfed lands in India. ICAR-all India Coordinated Research Project for Dryland Agriculture, Saidabad P.O., Hyderabad - 500 659, Andhra Pradesh, India.

Singh, Bhajat and S.P.S. Bran, 1986. Long-term effect of NPK and in Fertilizations in Maize-wheat rotation on any yeild and soil characteristics (1970-1984). Department of Soils, Punjab Agricultural University, Ludhiana, Punjab, India.

Takkar, P.N. 1990. Integrated Nutrient Supply and Management. Indian Institute of Soil Science, Bhopal-462 011, Madhya Pradesh, India.

Takkar, P.N., T.M. Chhibba and S.K. Mehta. 1990. Twenty years of coordinated Research on Micronutrients in Soils and Plants. Indian Institute of Soil Science, Bhopal - 462 011, India.

Yadav, J.S.P. 1989. Integrated Nutrient Supply and Management (INSAM) - Need and USAID initiative. USAID/New Delhi, India .

Department of Agricultural Research and Education 1988-89 Annual Report, Ministry of Agriculture, Government of India, New Delhi, India.

CSSRI. An Introduction, Central Soil Salinity Research Institute, Karnal - 132 001, Haryana, India.

REPORTS:

Soil Fertility and Fertilizer Use. 1990. Vol. IV Nutrient Management and Supply System for Sustaining Agriculture in the 1990's. IFFCO. New Delhi, India.

Organic Manures and Biofertilizers. 1988. Division of Microbiology. IARI. New Delhi, India.

Economic Survey 1988-1989. Economic Division. Ministry of Finance, Government of India, New Delhi, India.

Report of the Working Group on Agricultural Research and Education for the formulation of the Eighth Five-Year Plan (1990-1995). 1989 (August). Planning Commission, Government of India, New Delhi, India.

Integrated Nutrient Supply and Management in Multiple Cropping Systems. 1984. ICAR, New Delhi, India.

Strategy and Approach to VIIIth plan. 1989. Division of Soil, Agronomy, and Agroforestry. ICAR, New Delhi, India.

TERMS OF REFERENCE

1. Dr. John J. Nicholaides, III	Director of International Agril; Assoc. Dean of Agril; Asst. Vice Chancellor for Research; & Professor of Agronomy, Univ. of Illinois.
2. Dr. Roger G. Hanson	Director, Management Entity, Soil Management Collaborative Research Support Program, North Carolina State Univ., Raleigh, N.C.

Brief Scope of Work during the period: SEPT.20 - OCT.6, 1990

1. To participate at the INSAM Workshop and to assist in research priority planning methodology.

2. To assist in the development of a detailed work plan in the area of integrated nutrient management of cropping sequence taking into account the ongoing activities in the various coordinated research projects related to this area and the suggestions given in Appendix E & F of the design team report. (Report available in ICAR)

3. To formulate an operational framework for the execution of the project across the centres in the country.,

4. To finalize the areas for consultancy visits of experts from USA, study tour, and training programs for Indian Scientists to USA, and the detailed estimate of the outlay required for the execution of the project.

5. To submit written report summarizing consultancy activities and recommendations to the project.

6. To give an oral debriefing to ICAR/USAID and Winrock before departure from New Delhi.

TENTATIVE PROGRAM FOR ***

1) DR. JOHN J. NICHOLAIDES, III
2) DR. ROGER G. HANSON

Arrival Schedule in Delhi:

1. Dr. Nicholaides : Thursday, Sept. 20, via PK 270 at 15:30 from Lahore
2. Dr. Hanson : Friday, Sept. 21, via LH 760 at 12:40 hrs from USA
   Stay at: Hyatt Regency Hotel, New Delhi

PROGRAM

Sept.21 (Fri)	9-10:30 AM:	Winrock - Delhi office
	11:00 AM:	USAID Meeting with Mr. John A. Becker & Dr. J.S.P. Yadav
	PM:	Free
" 22 (Sat)	2:30 PM:	ICAR Meeting with Dr. I.P. Abrol, Deputy Director General (Soils); Dr. [illegible].N. Takkar, Director, Indian Institute of Soils, Bhopal, and others.
" 24 (Mon)	AM & PM :	Business meeting in ICAR (to be finalised on Sat. 22)
" 25 (Tue)	AM :	Travel to Haryana Agrl Univ., Hisar - by road Visit to HAU-Hisar (Stay: HAU Guest House)
" 26 (Wed)	Noon :	Travel to Punjab Agril Univ., Ludhiana - by road Stay: PAU Guest House
" 27 (Thur)	AM & PM :	Visit to PAU-Ludhiana
" 28 (Fri)	AM :	Travel to Delhi - by road
" 29 & 30 (Sat & Sun)	:	Free at Delhi
Oct. 1 (Mon)	2:00 PM :	Travel to Karnal by road
" 2-4 (Tue-Thur)	:	INSAM WORKSHOP AT KARNAL
" 4 (Thur)	PM :	Travel to Delhi by road
" 5 (Fri)	:	Report preparation
" 6 (Sat)	:	Depart Delhi

*** Due to disturbances site visits could not be undertaken: However, utilized the time for discussions and review of reports.