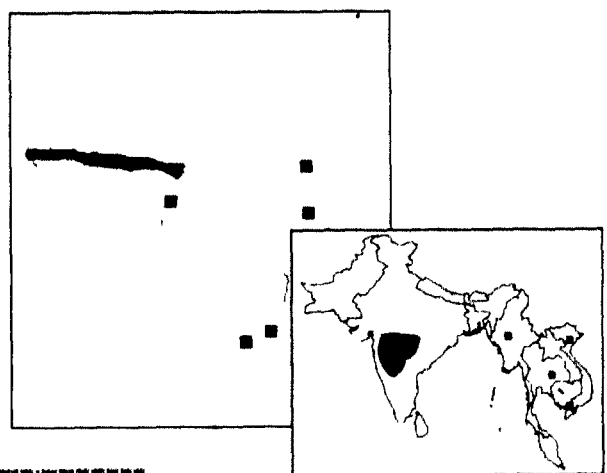
ICRISAT RESEARCH PROJECT PROFORMA

MULTI COMMODITY SYSTEMS PROJECT 3



Strategies for enhanced productivity and sustainability in tropical, intermediate rainfall zone

October 1994

Multiple Commodity Systems Project 3

Project Proforma

Contents

ICRISAT Asia Center
Inter-Office Memorandum

TO : Dr. D.E. Byth DATE: 17 October 1994

FROM : S.K. Debrah/S.M. Virmani

SUB : Submission of Project Proforma of MCSP 3: Strategies for enhanced productivity and sustainability in tropical, intermediate rainfall (125-150 days) predominately rainfed cereal/legume based land use systems.

We are pleased to forward 2 copies of the completed Global Proforma for the Multiple Commodity Systems Project 3 (MCSP 3). It relates to strategies for sustained productivity of high—and medium- water holding capacity soils in Asia and Africa. MCSP 3 consists of three subprojects, a fourth subproject is enclosed as an Appendix, as recommended by the RPRC. The subprojects are:

- Subproject A: Design and evaluation of strategies to overcome soil, water and nutrient management constraints to crop intensification in high water holding capacity soils in PS 7 (Asia) and PS 15 (WCA).

- Subproject B: Identification of resource management strategies for improved and sustainable crop production in medium- low-water holding capacity soils (sandy Alfisols in WCA, Vertic Inceptisols and Alfisols in Asia) in PS 7 and PS 15.

- Subproject C: Enhancing sustainability of postrainy season cropping in PS 8 through crop and soil management interventions.

- Subproject D: Evaluation of the effects of different crop and soil management strategies on pest, disease, and weed management dynamics, and adverse effects of pesticide residues.

2. We had detailed discussions on outlines, objectives and activities of the subprojects with PTLs of MCSP1 & 2. Dr. M.V.K. Sivakumar has been consulted throughout the finalization of the project. The project has been prepared within the SSY resources allocated by CJ's Committee. A total of 3.19 SSY have been utilized for IAC and 1.2 SSY for WCA. The allocation for different divisions is: 2.11 SSY for Soils and Agroclimatology, 1.555 SSY for Agronomy, and 0.725 SSY for Socioeconomics and Policy Division

3. We received detailed comments from Dr. D.D. Rohrbach during global project formulation stage about the SSY distribution for SEPD themes, in particular for SEA. However, as we had to abide by CJ's Committee's recommendations, some of DRR's suggestions could not be incorporated. We request you and RPRC to kindly reexamine the resource allocation. SEPD appears in many themes and its research is much more pervasive across various programs of the Institute.

4. We have appended minutes of the consultation meetings we had with Indian NARS: The Central Research Institute for Dryland Agriculture (CRIDA) and the National Bureau of Soil Survey and Land Use Planning (NBSS&LUP). You will kindly note that the research agenda proposed for the IAC segment of MCSP 3 has generally been endorsed and we expect an excellent collaboration built on years of mutual trust.

5. Finally, we wish to place on record that we have received excellent cooperation from our project development teams. MVKS, CJ, DDR, CR and KH have been very helpful at various stages of project development. We thank you for your continued support and guidance.

S.K. Debrah
S.M. Virmani

Research Project Planning Proforma

MCSP 3: RESEARCH PROJECT PLANNING PROFORMA

1. **Title: Strategies for enhanced productivity and sustainability in tropical, intermediate rainfall zone.**

2. **Production System(s)**
   - **Primary** : PS 7, PS 8, PS 15, PS 21
   - **Secondary** : PS 4, PS 9, PS 14, PS 20

3. **Outputs:**

Outputs	Location	Target PS(s)	MTP themes	SSY/ Disciplines	Link project
A. Design and evaluation of strategies to overcome soil, water and nutrient management constraints to crop intensification in high water holding capacity soils in PS 7 (Asia) and PS 15 (WCA)	IAC/WCA		12, 14, 23, 25, 29, 37, 38, 40, 50, 51, 52, 54, 55, 58	SACD = 0.995 AD = 0.615 SEPD = 0.320	For management: MCSP3 For research outputs: SG2&3, Joint Vertisol project in Ethiopia, PP1, CP1, MCSP2, Econ1, MCSP1, GN1&2
B. Identification of resource management strategies for improved and sustainable crop production in medium-low water holding capacity soils (sandy Alfisols in WCA, Vertic Inceptisols and Alfisols in Asia) in PS 7 and PS 15	IAC/WCA		12, 14, 23, 25, 29, 37, 38, 40, 50, 51, 52, 54, 55, 58	SACD = 0.855 AD = 0.670 SEPD = 0.305	For management: MCSP3 For research outputs: SG2, PP1, CP2, GN2, MCSP1&2, Econ1
C. Enhancing sustainability of postrainy season cropping in PS 8 via crop and soil management interventions	IAC		14, 25, 29, 52, 54, 55	SACD = 0.26 AD = 0.22 SEPD = 0.07	For management: MCSP3 For research outputs: PP1, PM2, SG5, CP2, MCSP2, Econ1&2
D. Evaluation of the effects of different crop and soil management strategies on pest, disease, and weed management dynamics, and adverse effects of pesticide residues	IAC/WCA		50, 52	SACD = 0.05 SEPD = 0.03	For management: MCSP3 For research outputs: MCSP1&2, PP1

4. **Impact:** MCSP 3 represents medium rainfall ecozone of the semi-arid tropics with dependable 125-150 days growing season length. Crop intensification through inter- double-cropping is feasible if appropriate soil, water and nutrient management strategies are applied. The proposed research would help sustain agricultural productivity and enhance the quality of the environment by eliminating land degradation. An integrated multidisciplinary research portfolio is proposed which will result in a series of improved technological options that are user-friendly, socially relevant and economically feasible.

5. **Annual budget:** 4.39 SSY = US$ 908,730

Overview

- Budget IAC, WCA and Global (Tables 1 and 2)
- List of Subprojects, Objectives and Activities
- Proposed Project Team Members

A Proposed Research Plan for MCSP 3

Introduction

Multiple Commodity Systems Project-3 (MCSP-3) focuses on Production Systems (PSs) 7, 8, 15, 18 and 21 as primary target areas. The location of PS 7 and PS 8 in India is shown in Fig. 1. PS 7 is characterized as a "tropical, intermediate rainfall, predominately rainfed and rainy season sorghum/pigeonpea, groundnut/cotton/millet based land-use systems region". It occurs principally in the Eastern Deccan plateau in India and in portions of Central Myanmar, Northeast Thailand (Fig. 2.), and dry climatic areas of Indonesia, sloping land areas of the Philippines.

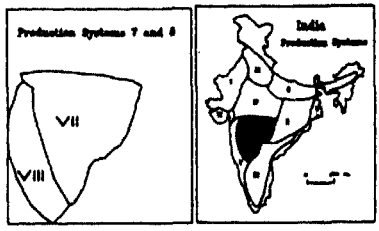


Fig. 1: Location of PS 7 and PS 8 in India.

The location of PS 15 and PS 18 in West and Central Africa is shown in Fig. 3.

PS 8 is agroclimatically characterized as the "tropical, undependable low rainfall, primarily rainfed postrainy season sorghum, millet, oilseed-based cropping systems". This region covers much of the Western Deccan plateau in India. In the Indian subcontinent annual rainfall in PS 7 and PS 8 ranges between 700 and 1000 mm. Bulk of this rainfall is received during Jun-Oct rainy season. The soils in PSs 7, 8, 15, 18 and 21 are predominately Vertisols, Inceptisols and

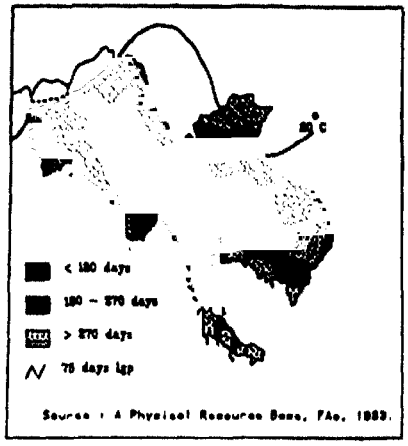


Fig. 2: PS 7 areas in Southeast Asia.

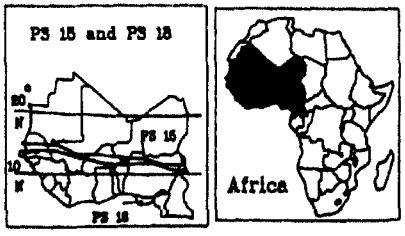


Fig. 3: Location of PS 15 and PS 18 in WCA.

associated Alfisols. The average length of the growing season (LGS) in PS 7 and PS 8 ranges between 90 and 210 days (Fig. 4). PS 15, situated in the South Sudanian zone is similar to PS 7 in Asia. It is characterized by 800-1000 mm

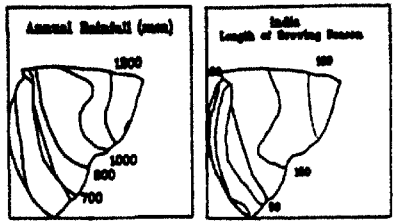


Fig. 4: Rainfall and LGS in PS 7 and PS 8.

rainfall and a 125-150 day LGS. The cropping system there is sorghum-based with legume crops such as groundnut and cowpea as prominent components. Some maize, cotton and millet are also grown. PS 18 occurs in the Sahelio-Sudanian region of Western-Central Africa which is prone to seasonal inundation. The cropping system there is postrainy season sorghum/millet/groundnut-based and the soils are mostly Vertisols. This ecoregion is somewhat similar to PS 8 in Asia. PS 21 is comprised of mid-latitudinal, sub-humid intermediate rainfall zone having LGS of 100-125 days in Eastern and Southern Africa. The major crops cultivated there are sorghum, maize, groundnut, and finger millet.

Context of Research

The ecoregions represented in MCSP-3 constitute the heartland of rainfed agriculture in Asia and Africa. The rainfall in PS 7, PS 15 and PS 18 is dependable and the soils are medium deep to deep (> 1 m depth). The length of the growing season varies between 120-210 days (Figs. 4&5). This region is most suited for double cropping through intercropping or sequential cropping systems. It could become the 'green revolution' area of rainfed drylands. Yield gap analysis for sorghum has shown that it is of the order of 3 t ha^{-1} between researcher and farmer managed plots. Similar yield gap for groundnut is 2.5 t ha^{-1}, for pigeonpea 2 t ha^{-1}, for chickpea 2 t ha^{-1} and for pearl millet 1.5 t ha^{-1}. Thus there is a great potential for impact in these PSs because of a less risky environment (Figs. 6a, 6b, 7, and 8a, 8b).

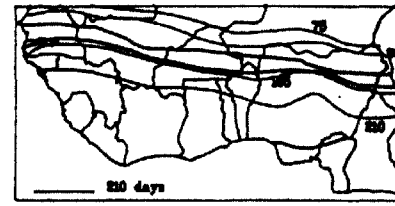


Fig. 5: Length of growing season in PS 15 and PS 18.

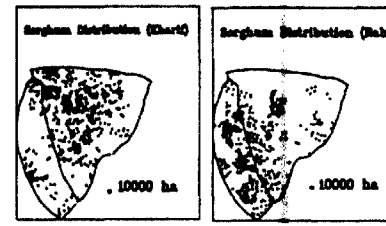


Fig. 6a: Sorghum distribution in PS 7 and PS 8 (India).

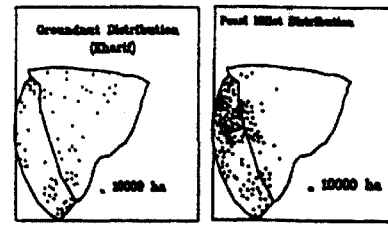


Fig. 6b: Groundnut and millet distribution in PS 7 and PS 8 (India).

ICRISAT, CIRAD and NARS have conducted extensive component research (mostly on-

station) and have developed: (1) a series of HYV's for the crops grown in [illegible] represented by MCSP-3; (2) have some soil, water, and nutrient management technologies; (3) have identified improved cropping systems; and (4) have tested some plant protection technologies. However, not much integrative production system research work has been done. Our linkages with the NARS and on-farm validation work have been weak. This new project will review and incorporate the experience of Vertisol Management Technology which was formulated and tested earlier in PS 7. Also, in the future systems rather than component-based investigations will be emphasized in our research portfolio.

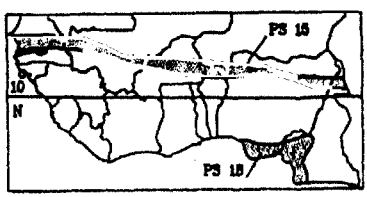


Fig. 7: PS 15 and 18 in WCA.

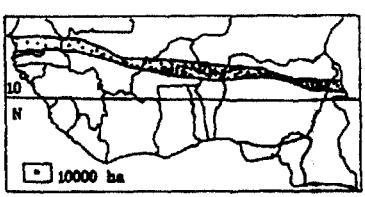


Fig. 8a: Distribution of sorghum in PS 15 (WCA).

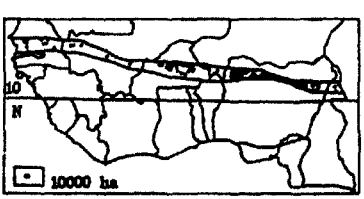


Fig. 8b: Distribution of millet in PS 15 (WCA).

Opportunities

The research and development context of agriculture in rainfed agriculture has undergone a total change following the publication of Agenda 21. Today we are concerned in research with increased production which centers around sustainability, equity, and conservation of natural resources. Therefore integrated research targeted to different agroecoregions (represented herein by PS 7, PS 8, and PS 15) is necessary, so that the adoption levels of the improved technologies can be improved. There is also increased awareness to make technologies user-friendly. Thus the proposed agenda of MCSP-3 takes into account the farm-level assets and constraints: both in the pre-introduction, testing, validation, and post-adoption of new technologies. There would thus be a continuum of linkages between farmers—NARS, CIRAD and IARCs. Much of the base line strategic and applied research proposed in MCSP-3 will be conducted at benchmark sites which are located in the NARS experimental stations and on-farms.

Production Constraints and Benchmark Sites

The major constraints to sustainable crop production in PSs comprising MCSP-3 are: Low adoption of HYV's, inappropriate management practices, loss of soil organic matter, serious nutrient depletion, deterioration of soil structure, erosion of top soil, water-logging and salinization, and continual depletion of diversity of soil biota. The degradation of natural resources is alarming in rainfed areas both in Asia and Africa. This trend will have to be reversed. It is therefore proposed to conduct interdisciplinary multi-institutional research at the IAC and across benchmark locations in India at Solapur, Indore or Akola and at selected sites in Myanmar, Thailand, Indonesia, Vietnam, Philippines in Asia; and in Ethiopia, Kenya in Eastern Africa. Similarly benchmark sites would be selected in Mali, Nigeria, Burkina Faso and Cameroon; and Southern Africa for collaborative research and development.

Fig. 9: Chickpea and pigeonpea in PS 7 and PS 8 (India).

Proposed Subprojects

For the identification of strategies for improved and sustainable crop production across PS 7, PS 8, PS 15 and PS 18 which comprise MCSP-3, four subprojects (A-D) are proposed. A brief description of these subprojects is given below:

A. Design and evaluation of strategies to overcome soil, water, nutrient management and socioeconomic constraints to crop intensification in high water holding capacity soil in PS 7 and PS 15.

Research in this subproject would be targeted to the assessment of the natural resource endowments, biotic and abiotic stresses. Land-use management systems which alleviate soil and water constraints (e.g., water-logging in Vertisols) would be reassessed together with integrated nutrient, pest and disease, and water management studies at benchmark sites. Socioeconomic constraints to double cropping will be assessed. Technology exchange activities would comprise collaborative research with NARS, NGOs, SAUs and adoption/impact studies. HRD aspects of collaborative work would be strengthened. Primary outputs of the subproject would be a better assessment of land and water technology on hydrologic units and integrated crop management technologies efficiently which utilize the available land and water resources. Sustainable use of natural resources, would be a key element in realizing reduction in soil degradation in PS 7. Research would be done in concert with PP1, SG2, GN2&3, CP1 (Fig. 9), MCSP-1&2 and 4, and ECON1&2. MTP themes relevant to this subproject are: 12, 14, 25, 29, 50, 52, 54, 55 Asia and SEA; and 23, 37, 38 in WCA.

B. Evaluation of strategies for improved and sustainable crop production on low water holding capacity soils in PS7 and PS 15.

This subproject aims to develop sustainable crop production technologies for shallow soils. Vertisols that undergo degradation due to soil erosion and do not meet the soil depth criteria established by soil taxonomy are called Vertic Inceptisols. These soils occur in the Vertisol regions but are more extensive. In India, out of the 72 m ha under black soil, the area under Vertic Inceptisols is 60 m ha (Fig. 10). These soils have low to medium water holding capacity, are droughty, are poor in soil nutrients, and currently have a low and unsustainable crop productivity. Very little work has been done on the integrative farming systems for this production system in PS 7 and PS 8.

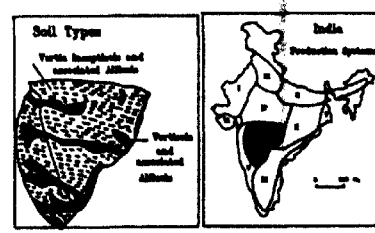


Fig. 10: Distribution of Vertisols, Vertic Inceptisols and associated soils in PS 7 and PS 8.

In West and Central Africa the predominant soils are sandy Alfisols (Ustalfs). In these areas the major land use is sorghum/groundnut. These soils have low water holding capacity, because their low clay content. Research needs to be

intensified in PS 15, to sustain production in this Sudanian bioclimatic ecoregion (Fig. 11).

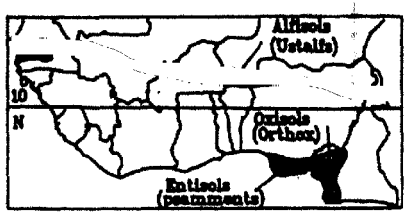


Fig. 11: Soil types in West Africa in PS 15 and PS 18.

In MCSP-3 subproject B, it is proposed to (a) assemble technologies for improving the productivity and (b) to identify farmer-acceptable technical options for sustaining productivity while minimizing land degradation on Vertic Inceptisols. Research under this subproject would be conducted at IAC and CRIDA research stations at Akola and Indore. Sorghum/millet-cotton-pigeonpea (SDPs & MDPs)—based cropping systems will be evaluated with respect to land degradation/toxification due to pesticide residues in soil and water. A major output of the research would be sustainable land-use technologies for Vertic Inceptisols. This research will find wide-scale applicability in MCSP-2 and PSs 8, 15, 18 and 21; we would link our research with SG2, SG1, GN2&3, PP1, ECON1&2 and PM2. MTP theme relevant to this subproject are: 14, 25, 29, 50, 52 and 55 in Asia and SEA, and 37, 38 and 40 in WCA.

C. Enhancing sustainability of postrainy season cropping in PS 8, (and PS 18) via crop and soil management interventions.

There is a large area (ca. 15 m ha) under arable cropping in Western Deccan plateau which predominates in *rabi* cropping. The rainfall distribution in this PS is skewed in a way that over half of the seasonal rainfall is received in the months of Sep and Oct. The main constraints to sustainable cropping in PS 8 are receding soil moisture, exposure of crops to terminal drought, shoot fly in sorghum, and wilt and *Helicoverpa* in pigeonpea.

Previous work done by ICRISAT was conducted at IAC, these results did not find much applicability in PS 8. It is now proposed to link this work with the SCSP (SG 5) and to conduct collaborative research at a CRIDA research station at Solapur. This would be the major benchmark for PS 8 research. Soil water and nutrient use efficiency through effective catchment management, the use of IPM/IDM techniques (SG2 and 5) and shoot fly tolerant sorghum material (SG5) would be the cornerstone of the new strategies. The results of this research may find application in PS 18 (in West Africa), although there are differences in agronomic management. The postrainy sorghum in PS 8 is direct seeded, while it is transplanted in PS 18. MTP themes relevant to this subproject are: 14, 25, 29, 33, 35, 55, 64, 70, 71, and 76. Although no research activity is currently planned for WCA in PS 18, attention should be paid to this ecoregion whenever the funding situation improves. The dry season sorghum contribution significantly to the sorghum production in the region. As soon as the network on transplanted sorghum is formed (Cameroon, Nigeria, Chad, CAR are currently discussing the proposal), ICRISAT should interact with the countries involved.

D. Evaluation of the effects of different crop and soil management strategies on pest, disease and weed dynamics; and inadverse effects of pesticide residues.

Intensification of agriculture is one of the primary goals of research undertaken in MCSP-3. The use of chemicals—fertilizers and biocides would also increase. It would be necessary to evaluate the consequences of pesticide use on crop production on one hand, and on environmental quality, and human health on the other.

Under this subproject, it is proposed (a) to quantify the role of IPM/IDM strategies on the

pesticide use in cotton and pigeonpea-based farming systems in PS 7; and (b) to study buildup of biocide residues at selected benchmark locations and at farmers' fields. Initial research would emphasize compilation of farmers' management practices of pesticide use. The IPM/IDM technologies already evolved would be tested, so that the adverse and indiscriminate use of pesticides is quantified. Health hazard and environmental degradation aspects would be surveyed. The work would be done in link with SG2, SG5, PP1, MCSP-2, and ECON1. MTP theme relevant to this subproject is 52.

Subproject D is proposed initially for the first year of MTP. Based on data collected and progress made, it would be submitted for external funding in 1996.

LINKAGES AND PARTNERSHIP

Strong linkages would be forged between this project and the single commodity projects (particularly sorghum and groundnut in WCA; sorghum, pigeonpea and millet in Asia and SEA) as well as the multicommodity project in PSs 4, 9, 13, 14 and 21. Partnership with the NARS through their commodity and farming systems networks is envisaged.

Role of the CIRAD

In WCA, our major partner in MCSP-3 is the CIRAD sorghum team who are having expertise in sorghum breeding, agronomy, entomology and weed science (particularly of Striga). Their participation is anticipated in the proposed subprojects. In subprojects A and B, the sorghum breeder will work with the ICRISAT team in screening and evaluating materials that fit into the farming systems of southern Sudanian bioclimatic zone, the agronomist will provide expertise in soil water and nutrient management research, both on-station and on-farm, and the entomologist and striga specialist will be involved in developing and testing IPM/IDM strategies on-farm.

Staff Needs and Resourcing

Data on staff needs and salary costs at IAC are given in Table 1. The resourcing of MCSP-3 from different MTP themes is detailed in Table 2. A summary of proposed subproject activities and resources is given in Attachment 1. A tentative list of Program Team Members is given in Attachment 2.

A total of 3.19 SSY are required for MCSP-3 at the IAC, and 1.20 SSY for the Western and Central Africa in semi-arid tropics.

Concluding Statement

Production systems 7, 8 in Asia and 15, 18 and 21 in Africa present major ecoregions for intensification of food production in the semi-arid tropics. Sustaining and improving productivity in these ecoregions would be a priority research portfolio for ICRISAT, because there exists a large untapped potential for increasing agricultural productivity in these production systems. The natural resources of the ecoregions are getting seriously threatened due to large-scale land degradation, particularly because of water erosion and unscientific use of land resources. The research proposed under MCSP-3 is aimed to reverse the current trends and usher in an era of sustainable agriculture through an active IARC-NARS-farmers participative research and development process. Technology exchange and impact related studies would be given a prominent place in the MCSP-3 research portfolio.

Table 1. Staff needs and salary costs for MCSP 3 project.

ICRISAT Asia Center:

Category	SACD	AD	SEPD	Grand total[2]	Total salary Amount ($)	IPM/IDM activity[3]			Technology exchange[4]
						Staff		Amount ($)	
SSY	1.61	1.08[1]	0.80	3.19	660,330	0.80		167,670	--
IRS	1.80	0.10	0.80	2.80	209,000	0.00 (Path.)	0.35 (Ent.)	33,250	0.25
NRS	5.00	1.25	0.75	7.00	48,900	0.45	1.20	11,055	0.25
RF	0.33	--	--	0.33	1,700	0.50	--	17,000	
RS	4.00	1.00	1.00	6.00	30,000	1.00	--	500	
VS	--	--	--	--	--	--	--	--	
TS	9.00	2.00	2.00	13.00	42,900	1.50	1.50	9,900	
FS	10.00	2.00	3.00	15.00	39,000	0.70	3.00	9,000	
RWF	8.00	3.00	--	11.00	17,600	--	--	--	
TFL	90.00	10.00	1.00	61.00	12,200	3.50	5.00	1,700	
Total					463,380			82,905	
% of SSY amount					61.53			49.44	

Annual Budget for IAC: 3.19 x 207,000 = $ 660,330

Notes 1. 0.62 SSY of Agroclimatology + 0.46 Agronomy as per Ex-Agronomy group
2 Does not include SSY and resources for IPM/IDM from Entomology and Pathology (please refer Note 3)
3. Indicative SCSP resources needed in MCSP-3 for IPM/IDM related activities in systems frame Probable themes 11,20,33,41,64,70,71
4 For networking activities with Asian NARS, resources from CLAN

West and Central Africa:

Category	SACD	AD	SEPD	Grand total	Total salary Amount ($)
SSY	0.50	0 475	0.225	1.20	248,400
IRS	0.261	0 263	0 105	0.829	59,755
NRS	--	--	--	--	--
RF	--	--	0.37	--	12,950
RS/VS	--	--	--	--	--
Sr Tech	0.85	1 95	1.325	3.925	25,500
Tech	0.625	1.45	1.075	3 15	8,510
FS	1 750	1.76	4.18	7 71	7,920
RWF[1]	1.00	3.00	2.00	6.00	9,220
TFL[2]	2.05	6.00	6 05	14 10	7,050
TFL[3]	--	8.00	--	8.00	4,266
Total					135,170

Annual Budget for WCA: 1.20 x 207,000 = $ 248,000

Notes: 1. Village Investigator
2. Skilled;
3. Unskilled

Table 1 (contd.)

Category	SACD	AD	SEPD	Grand total	Total salary Amount ($)	IPM/IDM activity[1]			Technology exchange
						Staff		Amount ($)	
SSY	2.11	1.886	0.726	4.39	906,730	0.80		167,870	--
IRS	1.861	0.383	0.605	2.829	268,755	0.00 (Path.)	0.25 (Ent.)	33,250	0.25
NRS	5.00	1.25	0.75	7.00	48,900	0.45	1.20	11,055	0.25
RF	0.25	--	0.37	0.62	21,700	0.80	--	17,600	
RS	4.00	1.00	1.00	6.00	30,000	1.00	--	500	
VS	--	--	--	--	--	--	--	--	
TS	10.25	5.40	4.40	20.07	78,910	1.50	1.50	9,900	
FS	11.75	3.78	7.18	22.71	46,920	0.70	3.00	9,000	
RWF	9.00	6.00	2.00	17.00	26,820	--	--	--	
TFL	83.06	24.00	7.06	83.10	23,515	3.50	5.00	1,700	
Total					541,520			82,905	
% of SSY amount					59.59			49.44	

Annual Budget for MCSP 3: 4.39 x 207,000 = $ 906,730

Notes: 1. Indicative SCSP resources needed in MCSP-3 for IPM/IDM related activities in systems frame Probable themes: 11,20,33,41,64,70,71

Table 2. Details of the tentative SSYs utilization by MCSP 3 from different MTP themes along with their indicative SSYs.

ICRISAT Asia Center:

Theme #	Indicative SSYs				SSYs used by MCSP 3			
	SACD	AD	SEPD	Total	SACD	AD[1]	SEPD	Total
12	--	--	--	1.90	0.06	--	--	0.06
14	0.75	0.40	0.15	1.30	0.32	0.14	--	0.46
25	1.00	0.50	0.30	1.80	0.35	0.17	0.20	0.72
29	1.00	1.00	0.30	2.30	0.30	0.62	--	0.92
50	0.10	0.10	0.40	0.60	0.15	0.03	--	0.18
52	0.25	0.10	1.00+ 0.10 (Medical)	1.45	0.03	0.03	0.30	0.36
54	--	0.15	0.15	0.35	--	0.09	--	0.09
55	0.75	0.15	0.10	1.00	0.40	--	--	0.40
Total	3.85	2.40	2.50	8.75	1.61	1.08	0.50	3.19

Notes: 1. 0.62 SSY of Agroclimatology + 0.46 SSY of Agronomy as per Ex-Agronomy Group of RMP.

West and Central Africa:

Theme #	Indicative SSYs				SSYs used by MCSP 3			
	SACD	AD	SEPD	Total	SACD	AD[1]	SEPD	Total[1]
23	0.60	0.80	--	1.40	0.025	0.075	--	0.10
37	0.90	1.00	0.10	2.00	0.10	0.20	0.10	0.40
38	--	0.10	0.50+ 0.10 (Breeding)	0.70	0.025	--	0.075	0.10
39	0.20	1.30	0.10	1.60	--	--	--	--
40	0.95	0.20	0.60	1.75	0.375	0.175	0.05	0.60
Total	2.65	3.40	1.40	7.45	0.525	0.45	0.225	1.20

Notes: 1. In line with allocations to MCSP 3 — WCA by CJ.

Global:

Region	Indicative SSYs				SSYs used by MCSP 3			
	SACD	AD	SEPD	Total	SEPD	AD	SEPD	Total
IAC	3.85	2.40	2.50	8.75	1.61	1.08	0.50	3.19
WCA	2.65	3.40	1.40	7.45	0.525	0.45	0.225	1.20
Global	6.50	5.80	3.90	16.20	2.135	1.53	0.725	4.39

MCSP 3: LIST OF SUBPROJECTS, OBJECTIVES, AND ACTIVITIES

Strategies for enhanced productivity and sustainability in tropical, intermediate rainfall (125-150 days) predominately rainfed cereal/legume based land-use systems.

Subproject A: Design and evaluate crop intensification in high water holding capacity soils in PS 7 and PS 15.

Objective 1: Characterization of natural and socioeconomic resource base and identification of constraints to double cropping (including intercropping). IAC/WCA/SEA

Activity A1: Characterize resource base, delineate potentially suitable areas, and diagnose constraints and opportunities. IAC/WCA

Objective 2: Identify/develop component technologies for alleviating major biotic and abiotic constraints. IAC/WCA

Activity A2: Study genotypes, cropping systems, and integrated water and nutrient management practices including assessment of farmer practices. IAC/WCA

Activity A3: Identify strategies to alleviate waterlogging and improve soil aeration to facilitate rainy season cropping in high water holding capacity soils. IAC

Activity A4: Identify strategies to alleviate constraints to crop establishment of postrainy season crop in double cropping. IAC/WCA

Activity A5: Pest and disease surveys and evaluation of IPM/IDM practices in different cropping systems for better targeting biotic stress management approaches with special reference to striga in WCA. IAC/WCA

Activity A6: Assess effectiveness of traditional farmers' practices on pest and disease management, and improved systems including their relative economic feasibility. WCA

Objective 3: Integrate and evaluate promising strategies for intensification of crop production. IAC/WCA

Activity A7: Integrate and evaluate promising strategies for double cropping including intercropping in collaboration with NARS. IAC/WCA

Activity A8: On-farm evaluation of improved cultivars under different cropping patterns and management levels. WCA

Activity A9: Analysis of constraints to adoption of improved technologies including characterization of farmers preferences for cultivar traits and technology options. WCA

Subproject B: Identification of resource management strategies for improved and sustainable crop production in medium-low water holding capacity soils (sandy Alfisols in WCA, Vertic Inceptisols and Alfisols in Asia) in PS 7 and PS 15.

Objective 1: To identify farmer acceptable soil and water management technologies for minimizing soil degradation; and to assemble technologies for improving crop productivity based on improved management of socioeconomic and natural resources. IAC/WCA/SEA

Activity B1: Characterization of socioeconomic and natural resources across the continuum from sandy Alfisols to Alfisols in WCA and from shallow Vertic soils to Vertisols (including associated Alfisols) in Asia, and identification and characterization of benchmark sites for collaborative research. IAC/WCA

Activity B2: Assessment of soil degradation or impacts on crop productivity and quantification of different soil degradation process. IAC

Activity B3: Develop integrated nutrient (and water management) strategies for sustainable crop production in Vertic soils/Alfisols in Asia, and sandy Alfisols in WCA. IAC/WCA

Activity B4: On-station evaluation of alternate land-use systems by integrating farmers perceptions and knowledge on Agroforestry and silvipastoral systems for rehabilitating degraded lands. IAC

Activity B5: Evaluation of long-term effects of crop rotation under different fertility, soil and water conservation practices on crop production, yield and stability. IAC/WCA

Activity B6: Integrate and evaluate farmer-acceptable strategies for minimizing soil degradation and restoration of degraded soils including their economic feasibility. IAC/WCA

Subproject C: Enhancing sustainability of postrainy season cropping in PS 6 via crop and soil management interventions.

Objective 1: Characterize and enhance socioeconomic and natural resource base for sustained crop production.

Activity C1: Characterization of socioeconomic and natural resource base and identification of constraints for early sowing of *rabi* sorghum and other crops, and map sub-regions with biotic and abiotic constraints. IAC

Activity C2: Test and adapt *in-situ* moisture conservation techniques. IAC

Activity C3: Improve soil fertility through efficient fallow management for sustainable postrainy season sorghum production. IAC

Activity C4: Introduction and evaluation of improved germplasm for postrainy season sorghum and rainy season pearl millet. IAC

Subproject D[1]: Evaluation of the effects of different crop and soil management strategies on pest, disease and weed management dynamics and inadverse effects of pesticide residues.

Activity D1: To characterize damage due to pests, diseases and weeds in a few selected sorghum- or cotton-based systems. IAC/WCA

Activity D2: To evaluate consequences of excessive pesticide use on environment from secondary data. IAC

1. Subsidiary short-term subproject

MCSP 3: TENTATIVE LIST OF PROJECT TEAM MEMBERS

IAC	WCA	SEA
Virmani, S.M.	Debrah, S.K.	Rohrbach, D.D.
Laryea, K.B.	Tabo, R.	Kelley, T.G.
Wani, S.P.	Yapi, A.	
Joshi, P.K.	Sivakumar, M.V.K.	
Pathak, P.	Bationo, A.	
Singh, P.	Murty, D.S.	
Rego, T.J.	Shetty, S.V.R.	
Singh, S.D.	Williams, J.H.	
Lee, K.K.	Ntare, B.R.	
Potdar, M.V.	Gupta, S.C.	
Anders, M.M.	Hess, D.E.	
Awadhwal, N.K.	Waliyar, F.	
Shanower, T.	Gigou, J.	
Ito, O.	Grard, P.	
Alagarswamy, G.	Chantereau, J.	
Sue Hall	Ratnadass, A.	
Gowda, C.L.L.	Gottfried, R.H.	
Ramakrishna, A.	Tenkuano, A.	

Subproject A

Design and evaluation of strategies to overcome soil, water and nutrient management constraints to crop intensification in high water holding capacity soils in PS 7 (Asia) and PS 15 (WCA)

MCSP 3 SUBPROJECT A: CROP INTENSIFICATION

1. **Title: Design and evaluation of strategies to overcome soil, water and nutrient management constraints to crop intensification in high water holding capacity soils in PS 7 (Asia) and PS 15 (WCA).**

Keywords: Vertisols, double cropping, intercropping, sustainable management.

Background, Need and Opportunities: In PS 7 and PS 15 intensification of cropping from single to double cropping represents one of the most promising avenues for increasing productivity. The opportunity for double cropping is provided by the relatively high and dependable rainfall of PS 7 and PS 15 and the high water holding capacity of the soils (eg. Vertisols, deeper Alfisols). However, a number of constraints limit the possibilities for double cropping.

Drainage and waterlogging problems limit rainy season cropping on Vertisols. Strategic work at ICRISAT and NARS has developed land surface configurations for improving drainage.

In PS 7 difficulty in double cropping is establishing a post-rainy season crop. The surface layer of the soil profile is often dry when the post-rainy season crop is sown, even though there may be adequate water in the deeper layers of the profile to sustain the crop.

Suitable cropping systems which are economically attractive to farmers are required. Earlier maturing rainy season crops leave more moisture in the soil for establishing the postrainy season crop. However, when the crop, particularly sorghum, matures early, there is a high risk of incidence of pests and diseases. Late rains also interfere with crop maturity leading to quality deterioration. Thus adequate IPM/IDM strategies or pest/disease tolerant cultivars are necessary.

Intensifying the cropping system is unlikely to be sustainable on Vertisols and deeper Alfisols unless integrated soil fertility management is also practiced.

A major problem addressed by this subproject in WCA is the lack of adoption of improved cultivars and management practices in the production system. ICRISAT and its partners have in the past developed high yielding sorghum and groundnut varieties as well as agronomic practices. In most cases cultivars were developed without the participation of the final end-users, particularly the farmers. They were often developed under mono-culture conditions with high inputs while farmers usually grow them in mixed cropping conditions with low inputs. As a result, wide gaps exist between on-station and on-farm yields and farmers have consequently not adopted the improved cultivars to any appreciable extent.

The subproject thus seeks to prevent the flow of inappropriate genetic material and practices into the farming system by developing cultivars and agronomic practices that are well adapted to, and fit into the production system. Feedback would be sought from farmers in the entire technology development process and technologies refined accordingly, to enhance the chances of adoption. A major component of the subproject will be the diagnosis of constraints to the adoption of cultivars already available, as well as the prospects of the adoption of newly introduced cultivars and management practices.

This subproject proposes activities that would identify strategies to enable intensification of agriculture. It builds on ICRISAT's strength in developing general principles for double cropping. Diagnostic work to understand farmers' perceptions of the constraints and opportunities for double cropping will be done in close collaboration with CIRAD and NARS. Promising technologies will be integrated and evaluated on-station and on-farm with NARS and farmers.

Close links will be maintained with SCSPs (SG2, PP1), MCSP1 and Econ 1 for provision of suitable cultivars (early maturing, waterlogging/pest/disease tolerant) and for IPM/IDM strategies. The performance of new genetic material will be evaluated comparatively so that the MCSP3 research serves as a feedback to the Germplasm Enhancement Division.

2. **Objectives :**

   I. Characterization of natural and sc rese irce base and identification of constraints to double cropping (including intercropping).

   II. Identify/develop component technologies for alleviating major biotic and abiotic constraints.

   III. Integrate and evaluate promising technologies/strategies for intensification of crop production.

3. **Supertheme(s)/research areas :**

   Superthemes (RDDs)

   3.1 Characterization of production environments
   3.2 Soil and water conservation/management
   3.3 Integrated nutrient management
   3.4 Natural resource management and sustainability
   3.5 Systems analysis
   3.6 Impact assessment and technology adoption
   3.7 Integrated pest management

Theme #	Title	Total SSY	Proportion involved (%)
IAC			
12	Adoption/Impact	1.50	2.00
14	Soil nutrient	1.30	13.80
25	Soil structure	1.80	16.11
29	Water deficit	2.30	16.09
50	Characterization	0.60	11.66
52	Natural resource	1.45	7.59
54	Farmers' preferences	0.35	8.57
55	Beneficial organisms	1.00	15.00
WCA/SEA			
23	Soil fertility	0.10	25.00
37	Water deficit	0.40	18.75
38	Technology adoption	0.10	100.00
40	Characterization of environment	0.60	83.30
51[1]	Microeconomic studies	0.20	0.00
52[2]	Natural resources	0.20	0.00
58[3]	Consumer/demand studies	0.50	0.00

1. 0.2 SSY made available for economic work in SEA
2. 0.2 SSY made available for economics work in SEA
3. 0.5 SSY allocated by CJ but is fully resourced in Econ2

4. **Link project**

- for management	MCSP 3
- for research outputs	SG 2/3; Dutch funded Vertisol Project in Ethiopia. PP 1, GP 1, MCSP 2, Econ 1, MCSP 1 (WCA) GN1/GN2

5. **Crop and/or systems** — Sorghum/chickpea, rainy season millet, pigeonpea, soybean, wheat, sunflower in double cropping systems (IAC, SEA). [sorghum based cropping systems with groundnut, maize, cowpea, (WCA)]

6. **Region(s) of inference:**

- Primary production system(s)	PS 7 (Asia), PS 15 (WCA), PS 21 (SEA)
- Secondary production system(s)	PS 4, PS 8, PS 9 (Asia), PS 14 (WCA), PS 20 (SEA)

7. **Central database file numbers:**

- Production systems	PS 5, 7, 8, 9, 15 and 21
- MTP themes	IAC: 12, 14, 23, 25, 29, 40, 52, 54, 55 WCA: 23, 37, 38, 40, 51, 52, 58
- Other	CIRAD

8. **Research strategy and requirements** — Please refer to attached table and details that follow.

8. Research strategy and requirements:

ICRISAT Asia Center (IAC):

Research Activity/ type	Description of activity[1]	Status	Disciplines involved	Level and duration of appointment									Location of research	Model system	Year of		Research Methodology	Partners	Budget US$ 254,810
				IRS	NRS	RF	RS	VS	TS	FS	RWF	TFL			Initiation	Completion			
Diagnostic	A1	2	AC	0.15	0.15		0.50		0 65	0 65	0.00	1.00	Akola, Indore, Parbhani, IAC, Ethiopia	Vertisol (PS 7)	1995	1999	Surveys, data collection and analysis	CRIDA IMD NBSS &LUP JNKVV MAU	39,330
			SB	0.02	0.05														
			SC	0.01	0.10														
			SP	0.05	0.10														
			AD		0.15														
			SEPD	0.05	0.15		0.50		0 60	0 70	0.00	0.00							
Strategic	A2	2	SB	0.01	0.30		0.50		0 75	0 70	0.30	3.50	IAC, Parbhani, Indore, Ethiopia	PS 7	1995	1999	On-station experiment and modelling	CRIDA Univ. of Gottingen	
			SC	0.02	0.20		0 00		0 60	0 60	0.25	3.00							
			SEPD		0.05		0.50		0 10	0 10									
Applied/ Adaptive	A3	2	AC		0.15				0.25	0.20	0.30	1 00							
			SB	0.01	0.00				0 05	0 05	0.20	1.00							
			SC	0.01	0.05				0 10	0.10	0.25	1.00							
			SP	0.07	0.25		0.50		0.70	0 70	0.25	3.00							
			AD		0.20				0.20	0.10		2.00							
			SEPD	0.03															
Strategic/ Applied	A4	2	AC										IAC, Parbhani, Indore, Ethiopia	PS 7	1995	1999	On-station experiment and on-farm testing	CRIDA	
			SP		0.05				0 10	0.15	0 15	1.00							

8. Research strategy and requirements: (Contd.)

Research Activity/ type	Description of activity[1]	Status	Disciplines involved	Level and duration of appointment									Location of research	Model system	Year of		Research Methodology	Partners	Budget US$ 264,610
				IRS	NRS	RF	RS	VS	TS	FS	RWF	TFL			Initiation	Completion			
Diagnostic	A5	2	CPD										PS 7	PS 7	1985	1986	On-farm surveys		
Applied	A6	2	AC	0.05									IAC, Parbhani, Indore, Ethiopia	PS 7	1985	1989	On-station and on-farm studies		
			SB	0.04					0.05	0.05	0.10	0.00							
			SC	0.02					0.10	0.05									
			CPD																
Applied/ Adaptive	A7	2	AC	0.05	0.15				0.10	0.15	0.45	1.00	Parbhani, Indore, IAC, Ethiopia	PS 7	1985	1989	On-station experiment, on-farm studies, modeling	CRIDA APSRU MAU JNKVV	
			SB	0.02	0.10				0.15	0.20	0.15	1.00							
			SC	0.04	0.05	0.15			0.20	0.25	0.25	1.5							
			SP	0.03	0.20				0.20	0.40	0.60	2.00							
			AD		0.20		1.00		0.60	0.70	1.00	2.00							
			SEPD	0.07	0.10				0.10	0.20		0.5							

1. Please refer details of subproject for description of activities.

8. Research strategy and requirements: (Contd.)

West and Central Africa/Southern and Eastern Africa (WCA/ESA)

Research Activity Type	Activity1 description	Disciplines involved	Level and duration of appointment									Location of research	Model system	Year to Conc	Research method	Partners	Budget
			RS	RS	RF	VS	S.TECH	TECH	FA	RWF(VR)	LABOR						
A1. Characterization of resource base, disease potentially notable areas, and diagnose constraints/ opportunities	A1	Agrstn (AD)						0.5				WCA	Field and Lab	1995 to 1997	GIS Field survey, interviews	HARS FAO WHO WMO AGRHYMET	19995
		Phy (AD)															
		Agrost (SACD)	0.30	1.00	0.30	0.70	0.73	0.33	1.40								
		Soils+Wt(SACD)															
		Econ (SEPD)			0.05												
A5. Pest and disease surveys and evaluation of IPM/IDM practices with emphasis on Striga	A5	Agrstn (AD)	0.02				0.10					WCA	Field	1995 to 1997	Farm surveys and assessments	CIRAD IER	27995
		Phy (AD)															
		Agrost (SACD)															
		Soils+Wt(SACD)						0.50									
		Econ (SEPD)	0.05		0.10		0.10		0.30								
A6. Access traditional farmer practices on pests and diseases	A6	Agrstn (AD)						0.05	0.40			WCA	Farmers fields	1995 to 1998	Surveys, GIS interviews	CIRAD IER	14999
		Phy (AD)															
		Agrost(SACD)															
		Soils+Wt(SACD)															
		Econ (SEPD)	0.02				0.20	0.05	0.20	2.0							
A8. On-farm evaluation of improved cultivars under different cropping systems	A8	Agrstn (AD)	0.025					0.05	1.0			WCA	Farmers fields	1995 to 1997	On-farm visits and evaluation	SCSPs HARS WCA/ESN	37995
		Phy (AD)															
		Agrost (SACD)															
		Soils+Wt(SACD)															
		Econ (SEPD)			0.05		0.20		1.0	2.0							
A9. Analysis of constraints to adoption of technologies and cultivars	A9	Agrstn (AD)										WCA	Region	1995 to 1998	Surveys of farmers	HARS WCA/ESN	5175
		Phy (AD)															
		Agrost (SACD)															
		Soils+Wt(SACD)															
		Econ (SEPD)			0.05		0.07		1.0								

1. Please refer details of outputput for description of activities.

DETAILS OF SUBPROJECT A: CROP INTENSIFICATION

Title: Identify strategies to overcome biotic, physical and socioeconomic constraints to double cropping on potentially suitable Vertisols.

Key words: Vertisols, double cropping, sustainable management.

Introduction: Vertisols in PS-7 represent a vast underutilized soil resource. Double cropping on these soils can provide an important pathway for improving resource utilization efficiency and substantially increase agricultural production. In the past, ICRISAT was closely associated with management research on Vertisols. Although there is a broad understanding of ingredients of improved technologies for double cropping on these soils, there is a need to review the specific experience of NARS, NGOs and farmers in the last decade and conduct on-farm and on-station studies to : (a) identify strategies to alleviate specific constraints viz., water logging, low fertility, establishment of post-rainy season crops and pests and diseases and (b) integrate technologies in a systems context and promote on-farm verification studies.

Resource requirement: (SSY)

	SACD	AD	SEPD	Total
IAC:	0.62	0.44	0.17	1.23
WCA:	0.375	0.175	0.15	0.70

Objective 1: Characterization of natural resource base and identification of constraints to double cropping.

Activity A1: Characterize resource base, delineate potentially suitable areas, and diagnose constraints and opportunities.

Resources (SSY):

	SACD	AD	SEPD	Total
IAC:	0.06	0.10	0.03	0.19
WCA:	0.325	0.025	0.025	0.375

Justification: Critical analyses of systems and characterization of natural resources is central to identify strategies to overcome constraints to the adoption of double cropping by farmers. Much of the information available currently is incomplete. There is a need to assemble and synthesize the necessary information using new tools now available: GIS, 1:1 million scale soil maps, and soil information for over 400 bench mark sites.

During the delineation of the production systems for West Africa, the production system working group recognized that many production system descriptors are not yet known and that further information on the farming systems characteristics needs to be collected. PS 15 of West Africa covers southern Senegal, Guinea Bissau, Guinea, southern Mali, south central Burkina Faso, northern Benin, northern Nigeria, northern Ghana, northern Togo, northern Cameroun, southern Chad and north Central African Republic. Previous studies at ISC described some of the PS characteristics in Mali and Burkina Faso. Hence there is a need to collect data from the other countries and provide a more complete description of the PS 15 in a GIS framework. This activity is multidisciplinary and will combine expertise in agroclimatology, geography, agronomy and economics and the information will be used to assess the agroecological

potential of the production system for targeting future research in the region. The activities include a quantitative description of important cropping systems as well as the major socio-economic, biotic and abiotic constraints to increased production.

Sub-activities:

1.1 Assemble and synthesize information on soil, climatic, crops and input use.

1.2 Collection and verification of available secondary climate, soil, economic and production databases for assessment of agroecological potential for targeting future research

1.3 Analyze spatial distribution of constraints, yield gaps and opportunity for crop intensification, and prepare maps using GIS.

1.4 Quantitative description of the important cropping systems and assessment of major socioeconomic, biotic and abiotic constraints to production at selected benchmark sites

1.5 Elicit farmer's perception and analyze farm level constraints to crop intensification at benchmark locations (Parbhani, Indore, Medak)

Milestones:

1.1 Report on status of congruent data bases on climate, soil and crops and climatic analysis in agronomically relevant terms. (1997, 80%)[1]. Cooperators: IMD[2], NBSS & LUP and SMSS.

1.2 Report on the agroecological potential of PS 15. (1997, 80%).

1.3 Preparation of GIS aided maps showing spatial distribution of biotic and abiotic constraints. (1997, 80%). Cooperator: NBSS & LUP.

1.4 Report on the major constraints to production in selected benchmark sites. (1997, 80%).

1.5 Report on farm level constraints and determinants of double cropping and changes in resource use pattern, including labor allocation. (1997, 70%). Cooperator: CRIDA.

Objective 2: Identify/develop component technologies for alleviating major biotic and abiotic constraints.

Activity A2: Study genotypes, cropping systems, water and nutrient management practices including assessment of farmers' practices.

Resources (SSV):

	$ACD	AD	SEPD	Total
IAC:	0.15	0.08	0.02	0.25

1. Figures in parenthesis denote probability of Success.

2. IMD = India Meteorological Department; NBSS & LUP = National Bureau of Soil Survey & Land Use Planning; SMSS = Soil Management Support Services (USDA).

Justification : Intensification of crop production in PS-7 on Vertisols (which are nutritionally poor soils) is not likely to be sustainable unless nutrient constraints (N, P & Zn) and economic constraints are alleviated. To achieve sustainable production through double cropping on Vertisols the primary need of the systems is to develop a plan of integrated nutrient management. Research on mechanisms of legumes benefits; contribution of nutrients from different sources, their efficient utilization by crops, and interactive effects of different nutrient sources on crop production is essential.

Sub-activities:

2.1 Study the contribution of different sources in an nutrient to INM mode, their efficient utilization and effect on crop productivity.

2.2 Study interactive effects of different sources of nutrients, quantify N, P, and organic matter dynamics and their relationship to soil micro-organisms (beneficial and detrimental) in a series of soil-plant systems.

2.3 Examine the potential adoption of INM strategies and identify constraints in their adoption.

Milestones:

2.1 Report on nutritional demands of the selected double cropping systems based on nutrient budgeting. (1996, 80%).

2.2 Estimates of technical and allocative efficiencies of nutrient management. (1996, 80%).

2.3 Efficient crop species to use legume residual N will be identified. (1997, 90%).

2.4 Report on contribution and interaction of different sources of N and P, role of microorganisms in INM systems. (1997, 80%).

2.5 Promising INM strategies will be available for technical and economic evaluation in on-farm trials. (1996, 80%).

2.6 Simulation model for quantification of N availability. (1996, 60%). Cooperator: University of Gottingen.

Activity A3: Identify strategies to alleviate waterlogging and improve soil aeration to facilitate rainy season cropping in high water holding capacity soils.

Resources (SSY):

	SACD	AD	SEPD	Total
IAC:	0.15	0.09	0.02	0.26

Justification: In the past, ICRISAT and the NARS have conducted strategic studies and on-farm testing using mainly ridge and furrow (RF) and broadbed and furrow (BBF) systems. The adoption of BBF by farmers is low. In recent years, some NARS/NGOs and farmers have attempted to modify BBF to suit their needs and resources. Given the diversity of topography, and soil depth in farmers fields, recommendations on surface configurations should be based on initial diagnosis of technical and socioeconomic factors. There should also be predictive tools for selecting options. In view of the crucial importance of this work for double cropping and ICRISAT's past involvement, it is proposed that ICRISAT should revisit this topic in cooperation with NARS/NGOs.

Sub-activities:

3.1 Assess technical and socioeconomic constraints to adoption of recommended land configurations in Vertisol areas with rainfall > 800 mm.

3.2 Modify recommended land configurations based on constraints identified in 2.1.

3.3 Measure parameters that can be included in systems modeling for extrapolating site- and season-specific results to other locations.

Milestones:

3.1 Information on technical and socioeconomic constraints. (1996, 80%). Cooperator: CRIDA.

3.2 Land configurations that enhance surface drainage and are acceptable to farmers. (1996, 80%). Cooperators: CRIDA, SAUs Akola and Indore.

3.3 Parameters for modeling to extrapolate research results. (1996, 80%). Cooperator: APSRU[3].

Activity A4: Identify strategies to alleviate constraints to crop establishment of postrainy crop in double cropping.

Resources (SSY):

	SACD	AD	SEPD	Total
IAC:	0.04	0.02	0.00	0.06

Justification: The surface layer (0-15 cm depth) of soil is often dry when postrainy season crops are planted even though there may be adequate water in deeper layers of profile to sustain crop growth. The possibilities of improving seed germination and seedling emergence through crop sequencing and soil management need to be explored.

Sub-activities:

4.1 Study crop sequencing strategies with good potential to exploit late rainfall after the main season.

4.2 Study soil surface management and seed placement options.

Milestone:

4.1 Crop sequencing strategies with good potential to exploit late rainfall after the main season. (1998, 70%).

4.2 Soil surface management and seed placement options. (1998, 60%).

Activity A5: Pests and disease surveys and evaluation of IPM/IDM practices in different cropping systems for better targeting biotic stress management approaches with the special reference to striga in WCA.

3. APSRU = Agricultural Production Systems Research Unit, Australia.

Resources (SSY):

	SACD	AD	SEPD	Total
IAC:	0.00	0.00	0.00	0.10*
WCA:	0.05	0.05	0.025	0.125

(*Source themes to be identified)

Justification: Comprehensive data base on disease/pest scenario and crop losses in relation to different cropping systems over years, and the changes in the crop losses that occur due to (i) fluctuations in environmental factors over years and (ii) change of a crop in a given cropping system are not available. GIS-aided systematic surveys for four consecutive years at selected locations, in collaboration with NARS and farmers, will provide us baseline data for better targeting IPM/IDM strategies.

Weed control packages have been developed by ICRISAT and its partners to alleviate labour constraints, yet smallholder farmers in West Africa have been unsuccessful in controlling weeds in their fields. This is particularly true of Striga species, which cause considerable damage to food crops grown by subsistence farmers in the region. One reason for lack of adoption is the absence of economically feasible and effective techniques that are adapted to local conditions. This project aims at identifying Striga control methods that are easily adaptable to the socio-economic environment of small farmers in the region. It takes a multidisciplinary approach and is closely linked with the single commodity systems projects, particularly sorghum. It also complements the work of the work of CIRAD scientists on Striga control, and extends it to include the participation of IER's farming systems team (ESPGRN, Sikasso) as well as farmers. An integrated approach consisting of cultural, chemical, physical, biological and cultivar resistance will be tested on the farmers' fields and the appropriate control methods for reducing loses due to Striga will be recommended.

Sub-activities:

5.1 Survey and collect information on the distribution of pests and diseases, and crop losses.

5.2 Analyze data collected for four consecutive years at selected locations for understanding pest and disease dynamics.

5.3 On-farm evaluation of the effects of genotype, cultural practice (cropping pattern, tillage, etc) on weeds, particularly Striga infestation.

Milestones:

5.1 A data set on the distribution of pests and diseases, and their severities. (1996, 80%). Cooperators: NARS, SCSP.

5.2 Information on seasonal occurrence, and changes in the distribution and severities of pests and diseases. (1998, 60%). Cooperators: NARS, SCSPs, MCSP2.

5.3 Selection of benchmark village sites for evaluation of the effects of genotype/cultural practice interactions on Striga control. (1995, 85%).

5.4 On-farm evaluation of the effects of genotype/cultural practice interactions on Striga control (1998, 70%).

Activity A6: Assess effectiveness of traditional farmers' practices on pest and disease management and improved systems including their relative economic feasibility.

Resources (SSY):

	SACD	AD	SEPD	Total
IAC:	0.02	0.05	0.02	0.09+0.25*
WCA:	--	0.025	0.025	0.05

(*Same as activity 5)

Justification : To keep crop losses due to pests and diseases below threshold levels, integration of various control options is essential for sustainable production. This activity is aimed at evaluation of different IPM/IDM options at benchmark locations and at farmers' fields.

Farmers use several traditional methods for pest and disease control. Weeding which is the most common method for controlling weed constitutes a major labour constraint as roughly 38 to 48% of total household labour spent in pre-harvest activities goes into weeding. Weeding may also not be appropriate for heavily infested fields where in most cases farmers simply abandon them to fallow for long periods of time. Other pest and disease control methods include rotation and burning. This project aims at assessing the effectiveness of the various techniques employed by farmers for pest and disease control. The work will be carried out in collaboration with farming systems group of IER (Mali) in the Koutiala area. It will involve surveys and interviews of farmers. An important component of the activity is the diagnosis of why farmers have not adopted IPM/IDM/ISM packages that are already available in the region. IPM/IDM/ISM packages that will be developed in the single commodity systems context will be evaluated on farmers' fields and their economic feasibility evaluated.

Sub-activities:

6.1 Use on-farm survey data and results of on-station studies for design of IPM/IDM packages.

6.2 Assess traditional practices of weed control, particularly Striga control.

6.3 Diagnose the constraints to existing IPM, IDM packages in the region.

6.4 On-farm evaluation of packages at selected locations.

Milestones:

6.1 Effective IPM/IDM packages including resistant/tolerant cultivars for on-farm evaluation. (1996, 80%). Cooperators: NARS, SCSPs, MCSP 2.

6.2 Report on the traditional practices of pest and weed control in Southern Mali. (1995, 90%).

6.3 Report on the constraints to the adoption of IPM/IDM/ISM packages. (1996, 80%).

6.4 Information on the performance of above packages under farmers' field conditions. (1998, 60%). Cooperators: NARS/SAUs.

Objective 3: Integrate and evaluate promising technologies/strategies for double cropping.

Activity A7: Integrate and evaluate promising strategies for double cropping including intercropping in collaboration with NARS.

Resources (SSY):

	SACD	AD	SEPD	Total
IAC:	0.20	0.10	0.08	0.38

Justification: Double cropping research needs a systems approach. Various component technologies based upon above mentioned activities need to be integrated and evaluated under on-station and on-farm conditions. System models need to be used for extrapolating results to other locations.

Sub-activities:

7.1 On-station long-term evaluation of integrated soil, water, crop, nutrient and IPM/IDM strategies for identification of sustainable double cropping systems.

7.2 Assessing technical and economic viability of promising technologies of drainage, nutrient management, cropping systems and IPM/IDM strategies for double cropping on farmers' fields with NARS/NGOs and farmers.

7.3 Adapt and validate submodels of soil, nutrient and cropping systems and examine opportunities for double cropping in PS 7 by relating rainfall, soil depth, and crops with the length of growing season. Identify suitable environments for adoption of double cropping technology.

Milestones:

7.1 Identification of integrated technologies for sustainable double cropping for on-farm evaluation. (1988).

7.2 Report on research and extension implications based on research station and on-farm studies, and recommendation domains for promising technologies. (1998, 60%).

7.3 Validated systems model (APSIM) for applications in PS-7. (1999, 60%). Cooperator: APSRU.

7.4 Report on integration of experimental and modeling results for assessing sustainability of different management strategies for double cropping in different environments. (1999, 60%).

Activity A8: On-farm evaluation of improved cultivars under different cropping patterns and management levels.

Resources (SSY):

	SACD	AD	SEPD	Total
WCA:	--	0.075	0.05	0.125

Justification: High performing and promising cultivars emanating from the single commodity systems projects will be tested under farmers' conditions and under different cropping patterns for their adaptability and performance in the system. The activity builds upon past work where crop improvement scientists screened and selected materials under monoculture and high management conditions. The emphasis here

will be to identify cultivars that show stability over time and respond to moderate management levels and mixed-cropping conditions of the farmer. This will involve farmer participation and the feedback obtained will be useful in targeting the cultivars to the farming system.

Sub-activities:

8.1 Selection of benchmark village sites and participating farmers.
8.2 On-farm evaluation of sorghum and groundnut cultivars under different levels of management.

8.1 Selection of test sites and participating farmers. (1995, 75%).

8.2 Reports on promising cultivar/management systems packages. (1996, 70%).

8.3 Reports on feedback from farmers on the performance of different cultivars under different levels of management. (1997, 75%)

Activity A9: Analysis of constraints to adoption of improved technology including characterization of farmers' preferences for cultivar traits and technology options.

Resources (SSY):

	SACD	AD	SEPD	Total
WCA:	–	–	0.025	0.025

Justification: This activity's objective is to diagnose the physical, technical and socio-economic constraints to the adoption of crop cultivars and resource management practices. An analysis of farmer preferences for grain traits will include preferences for organoleptic properties of the cultivars. This activity extends earlier work by including grain quality traits desired by the end-users, particularly subsistence farmers in the breeding objectives. This addresses the problem of the lack of adoption of some high yielding and disease resistant materials that are already available but have poor food qualities.

Sub-activities

9.1 Diagnosis of why farmers have not adopted sorghum varieties released in selected countries of West Africa.

9.2 Diagnosis of why farmers have not adopted resources management techniques in selected countries.

Milestones:

9.1 Information on constraints to adoption of already released sorghum cultivars in case study countries, jointly with sorghum network. (1995, 60%).

9.2 Information on constraints to adoption of already released resource management techniques (for example fertilizer recommendations) in selected case countries, jointly with NARS. (1996, 60%).

Priority:

Activity	Rating[a]	Activity	Rating[a]
1. Database Assembly	1	6. IPM/IDM	1
2. Nutrient Management	1	7. Integration/Evaluation Modeling	2
3. Alleviate waterlogging	1	8. On-farm evaluation	1
4. Crop establishment	2	9. Analysis of constraints	1
5. Pest & Disease Surveys	2		

[a]1 = High; 2 = Medium; 3 = Low.

Staffing and salary costs for Subproject A of MCSP 3.

IAC:

Category	Staffing needs			Total salary	
	SACD	AD	SEPD	Staff	Amount $
SSY	0.62	0.44	0.17	1.23	254,610
IRS	0.60	--	0.15	0.75	71,250
NRS	1.95	0.55	0.30	2.80	18,760
RF	0.15	--	--	0.15	5,250
RS	1.50	1.00	1.00	3.50	17,500
VS	--	--	--	--	--
TS	4.00	0.80	0.80	5.60	18,480
FS	4.25	0.80	1.00	6.05	15,730
RWF	3.25	1.00	--	4.25	6,800
TFL	20.00	4.00	0.50	24.50	4,900
Total					158,670
% of SSY amount					62.31

9. Research team:

IAC[1]:

Discipline	IRS	NRS	RF	RS	VS	TS	FS	RWF	TFL
Agroclimatology	0.25	0.45	--	0.50	--	1.00	1.00	0.75	3.00
Agronomy	--	0.55	--	1.00	--	0.80	0.80	1.00	4.00
Soil Biology	0.10	0.50	--	0.50	--	1.00	1.00	0.75	5.50
Soil Chemistry	0.10	0.40	0.15	0.00	-	1.00	1.00	0.75	5.50
Soil Physics	0.15	0.60	--	0.50	--	1.00	1.25	1.00	6.00
SEPD	0.15	0.30	--	1.00	--	0.80	1.00	--	0.50
Total	0.75	2.80	0.15	3.50	--	5.60	6.05	4.25	24.50

WCA:

Discipline	IRS	NRS	RF	RS	VS	Sr. Tech	Tech	FA	RWF	Labor
AD	0.175	--	--	--	--	0.10	1.05	1.40	--	--
SACD	0.375	--	0.33	--	1.00	0.73	0.38	1.40	--	--
SEPD	0.15	--	0.25	--	--	0.57	0.05	2.50	4.00	--
Total	0.70	--	0.58	--	1.00	1.40	1.53	5.30	4.00	--

1. Annual staff needs are same during the five year period.

10. Milestones:

1.1 Report on status of congruent data bases on climate, soil and crops and climatic analysis in agronomically relevant terms. (1997)

1.2 Preparation of GIS aided maps showing spatial distribution of biotic and abiotic constraints. (1997)

1.3 Report on farm level constraints and determinants of double cropping and changes in resource use pattern, including labor allocation. (1997)

1.4 Report on agroecological potential of PS 15. (1997)

1.5 Report on the major constraints to production at benchmark sites. (1997)

2.1 Report on nutritional demands of the selected double cropping systems based on nutrient budgeting. (1996)

2.2 Promising crops, cultivars, and suitable crop management options for on-station evaluation. (1996)

2.3 Estimates of technical and allocative efficiencies of nutrient management. (1996)

2.4 Efficient crop species to use legume residual N will be identified. (1997)

2.5 Report on contribution and interaction of different sources of N and P, role of microorganisms in INM systems. (1997)

2.6 Promising INM strategies will be available for technical and economic evaluation in on-farm trials. (1998)

2.7 Simulation model for quantification of N availability. (1998)

2.8 Promising crops, cultivars and double cropping systems for on-farm evaluation. (1998)

3.1 Information on technical and socioeconomic constraints. (1996)

3.2 Land configurations that enhance surface drainage and are acceptable to farmers. (1998)

3.3 Parameters for modeling to extrapolate research results. (1998)

4.1 Benchmark village selections. (1995)

4.2 On-farm evaluation of effects of genotypes and cultural practices on Striga control. (1998)

4.3 Crop sequencing strategies with good potential to exploit late rainfall after the main season. (1998)

4.4 Soil surface management and seed placement options. (1998)

5.1 Report on traditional methods of pest and weed control in southern Mali. (1995)

5.2 Report on constraints to adoption at IPM/IDM/ISM packages. (1996)

5.3 A data set on the distribution of pests and diseases, and their severities. (1996)

5.4 Information on seasonal occurrence, and changes in the distribution and severities of pests and diseases. (1998)

6.1 Effective IPM/IDM packages including resistant/tolerant cultivars for on-farm evaluation. (1996)

6.2 Information on the performance of above packages under farmers' field conditions. (1998)

7.1 Identification of integrated technologies for sustainable double cropping for on-farm evaluation. (1998)

7.2 Report on research and extension implications based on research station and on-farm studies, and recommendation domains for promising technologies. (1998)

7.3 Validated systems model (APSIM) for applications in PS-7. (1999)

7.4 Report on integration of experimental and modeling results for assessing sustainability of different management strategies for double cropping in different environments. (1999)

8.1 Selection of test sites and participating farmers for on-farm work. (1995)

8.2 Report on promising cultivars/management systems. (1998)

8.3 Report on feedback from the farmers on the performance of different cultivars and techniques. (1997)

9.1 Information on the constraints to adoption of released cultivars. (1995)

9.2 Information on the constraints to resource management techniques. (1996)

11. Probability of success:

Objective	Milestones[1]	Probability of success (%)	Time frame
1. Characterization of natural and socioeconomic resource base and identification of constraints to double cropping.	1.1 Status report on climatic and soil data bases	80	1995-1997
	1.2 Spatial distribution maps	80	1995-1997
	1.3 Farm level constraints and resource use pattern	70	1995-1997
	1.4 Report on agroecological potential of PS 15	80	1995-1997
	1.5 Report on the major constraints to production at benchmark sites	80	1995-1997
2. Identify/develop component technologies for alleviating major biotic and abiotic constraints.	2.1 Nutritional demands	80	1995-1996
	2.2 Crop management options	70	1995-1996
	2.3 Efficiency estimates of nutrient management	90	1995-1997
	2.4 Crop species to use legume residual N	80	1995-1998
	2.5 Interaction of sources of N, P and role of micro-organisms in INM	60	1995-1998
	2.6 Promising INM strategies	80	1995-1998
	2.7 Simulation model for N availability	60	1995-1998
	2.8 Cropping systems for on-farm evaluation	70	1995-1998
	3.1 Information on technical and socio-economic constraints	80	1995-1996
	3.2 Land configuration to enhance drainage	80	1995-1998
	3.3 Parameters for modeling to extrapolate results	70	1995-1998
	4.1 Selection of benchmark village sites for evaluation of genotype/cultural practice interactions on Striga control	85	1995
	4.2 On-farm evaluation of the effects of genotype/cultural practice interactions on Striga control	70	1995-1998
	4.3 Crop sequencing strategies	60	1995-1998
	4.4 Soil management and seed placement options	80	1995-1998

11. Probability of success: (Contd.)

Objective	Milestones[1]	Probability of success (%)	Time frame
2. Identify/develop component technologies for alleviating major biotic and abiotic constraints.	5.1 Report on traditional methods of pest and weed control in southern Mali	90	1995
	5.2 Report on constraints to adoption of IPM/IDM/ISM packages	80	1995-1996
	5.3 Distribution of pests and diseases	80	1995-1996
	5.4 Seasonal distribution and severities of pests and diseases	60	1995-1998
	6.1 IPM/IDM packages	80	1995-1996
	6.2 Performance of IPM/IDM packages	85	1995-1998
3. Integrate and evaluate promising technologies/ strategies for intensification of crop production.	7.1 Integrated technologies for on-farm evaluation	60	1995-1999
	7.2 Research and extension implications and recommendation domains	60	1995-1996
	7.3 Validated systems model	60	1995-1998
	7.4 Experimental and modeling results for assessing sustainability	60	1995-1999
	8.1 Selection of test sites and participating farmers for on-farm work	75	1995
	8.2 Reports on promising cultivar/management systems	70	1995-1998
	8.3 Reports on feedback from farmers on the performance of different cultivars and techniques	75	1995-1997
	9.1 Information on the constraints to adoption of released cultivars	60	1995
	9.2 Information on the constraints to resource management techniques	60	1995-1998

1. Numbers are related to the milestones in details of subproject.

12. Economic value (Million US $) of success:

13. Technology exchange activities:

IAC:

Item	Y1	Y2	Y3	Y4	Y5
Publication type	2 CP	1 RB 2 CP 1 JA	2 CP 1 JA	2 CP 2 JA	1 RB 2 CP 2 JA
Workshop/ Conference		Regional workshop on integrated nutrient management practices Yield-gap analysis for Vertisol and deep Alfisols in Peninsular India (Regional Workshop)		International workshop on soil degradation and sustainability of agriculture in the SAT	Technologies for high water holding capacity soils in Peninsular India and Sudanian zone of WA.
Training (in-service staff - NARS)			Management of Vertisols[4]		
Network activities	Ethiopia, Kenya, Zimbabwe, India NARS	Ethiopia, Kenya, Zimbabwe NARS	Ethiopia, Kenya, Zimbabwe NARS	Ethiopia, Kenya, Zimbabwe NARS	Ethiopia, Kenya, Zimbabwe NARS

WCA:

Item	Y1	Y2	Y3	Y4	Y5
Publication type		1 JA	2 CP	2 JA	2 JA
Workshop/ Conference		1	1	2	2
Training (in-service staff - NARS)		Yes	Yes	Yes	Yes
Network activities		Yes	Yes	Yes	Yes

14. Budget:

IMCr

Head of expenditure	Year 1 (1995)	Year 2	Year 3	Year 4	Year 5
Salaries	168,670	168,670	168,670	168,670	168,670
Operating	67,940	67,940	68,940	62,940	60,640
Travel	18,000[1]	18,000[1]	18,000[1]	20,000	20,000
Capital[11]	30,000[4]	30,000[5]	30,000[6]	15,000[8]	30,000[10]
TECHNOLOGY EXCHANGE					
Publication	3,000	3,000	3,000	3,000	5,000
Workshop	10,000[2]	10,000[2]	10,000[7]	10,000[2]	10,000[2]
Training	(22,750)[3]	(22,750)[3]	(22,750)[3]+ 8,000[6]	(22,750)[3]	(22,750)[3]
Network activities					
Total	254,610	254,610	254,610	254,610	254,610

Notes:

1. Includes one meeting of project team members with collaborators.
2. Pooled money of two years will be used for organizing regional workshop on INM in collaboration with other projects.
3. Salaries for RS & RF already accounted in salaries.
4. Laptop computer 486 or equivalent, automatic weather station.
5. Four-wheel drive land cruiser.
6. Regional training course in collaboration with other subproject/projects.
7. Three years pooled money will be utilized for organizing Intl. workshop on soil degradation, complimentary funding will be sought from other projects; Intl. agencies etc.
8. Neutron probes, stage level recorder.
9. Data logger and modem for transferring data.
10. IBM 586 or equivalent for GIS modelling research.
11. Capital items' costs are not included in project budget.

WCA:

Head of expenditure	Year 1 (1995)	Year 2	Year 3	Year 4	Year 5
Salaries	103,668	103,668	103,668	160,700	160,500
Operating	16,850	16,850	16,850	17,000	17,000
Travel	27,567	27,567	27,567	30,000	30,000
Technology Exchange	16,050	16,050	16,050	18,000	18,000
Miscellaneous	1,286	1,286	1,286	1,200	1,200
Total	165,400[1]	165,400	165,400	226,900	226,900

1. Includes 20,400 non-salary costs (0.70 SSY x 207,000 = 144,900 + 20,400 = 165,400) from IFDC research in WCA (Dr. Andre Bationo).

15. Environmental stability/sustainability:

This subproject will emphasize sustainable utilization of Vertisols. The technologies proposed to be developed in this subproject are likely to have a positive effect on the environment.

In WCA the subproject will have a positive effect on the environment and sustainability. By characterizing the production environment, the ecological zones where agricultural potentials exist will be delineated and targeted for crop intensification. Marginal lands will be less exploited. By undertaking research that alleviates the major biotic and abiotic constraints, and integrating cultivars that are well adapted and accepted by farmers, poverty and hunger, which result in environmental degradation will be averted.

16. Relationship to other projects:

This subproject will be linked to MCSP 2, SG 2, PP 1 and Dutch funded Vertisol Project in Ethiopia.

The WCA subproject will be linked with, and has relevance for the single commodity systems projects with PS 7 and 15 focus. In West Africa, the activities of the subproject will be linked with activities of other collaborating institutions, particularly CIRAD and the Sorghum Network.

17. Gender implication:

Gender target is an important component of this subproject. Few components specifically focus the issues related to the role of gender in adoption of double cropping and its implications on their employment and equity. It is hypothesized that introduction of double cropping in the PS 7 will increase the employment opportunities and generate additional income to the farm family.

Output from this subproject should be of benefit to women farmers. The production system characterization will provide useful information on the types of systems where women input is significant, for further emphasis. Results from the activities aimed at alleviating biotic constraints such as weeds would benefit women as women labour is used in weeding in most production systems in West Africa. Similarly, crop intensification is expected to result in the generation of additional income for the household as a whole.

18. Prospects for special funding: Nil

19. Index of priority:

	IAC	WCA	Global
I	34.58	37.00	35.60
II	31.67	39.35	35.74
III	32.48	38.78	34.77

20. Indicative funding:

IAC	WCA	Global
254,610	165,400	420,010

Subproject B

Identification of resource management strategies for improved and sustainable crop production in medium-low water holding capacity soils (sandy Alfisols in WCA, Vertic Inceptisols and Alfisols in Asia) in PS 7 and PS 15

MCSP 3 SUBPROJECT 8: SUSTAINING CROP PRODUCTION IN MARGINAL ENVIRONMENTS

1. Title: Identification of resource management strategies for improved and sustainable crop production in medium-low water holding capacity soils (sandy Alfisols in WCA, Vertic Inceptisols and Alfisols in Asia) in PS 7 and PS 15.

Keywords: Efficient resource utilization/management, Integrated nutrient management, Soil degradation, Sustainability, Vertic Inceptisols

Background, Needs and Opportunities: Vertic Inceptisols cover a large area (about 60%) in PS 7 and PS 8 in India. As these soils are often located on lands exceeding 2% slope and are shallow in depth, they suffer from erosion due to inappropriate soil and crop management practices. The productivity of present cropping systems on these soils is threatened because of severe depletion/loss of nutrients and soil biota. These soils are prone to degradation and declined productivity. For reducing soil erosion, maintenance of enough canopy cover is essential for which nutrient constraints must be alleviated. For minimizing soil degradation and restoring productivity of such soils farmers friendly technologies are urgently needed.

The external panel review (EPR) in 1990 recommended that ICRISAT should conduct research on soil degradation processes in the drylands. The research and development context of agriculture in dryland has undergone a total change following the publication of Agenda 21. A new paradigm for research which relies on efficient resource utilization, increased reliance on renewable resources, biological processes like biological nitrogen fixation, and reduced chemical use. Today we are concerned in research with increased productivity which centers around sustainability, equity, and conservation of natural resources.

The main constraints for sustaining/increasing crop productivity on Vertic Inceptisols are: low water retention capacity, soil erosion, depletion of soil nutrients, and soil biota, inappropriate soil and crop management practices and low adoption of high yielding cultivars. Not enough information is available on the extent of degradation of Vertic Inceptisols and also the relative contribution of various processes to soil degradation. Most studies relating to soil degradation have concentrated on measuring soil erosion and recommending engineering options. There is an urgent need to understand contribution of various processes to soil degradation and take a holistic approach to develop farmer friendly soil and crop management technologies for minimizing soil degradation and restoring productivity of degraded soils for sustaining agriculture on these soils.

This subproject's focus in WCA is to develop crop and soil management strategies that enhance water and nutrient use efficiency. It addresses the problem of soil fertility and intermittent drought in the production system. Farmers are generally aware of the soil fertility problem. They use manure, crop residues, shifting cultivation, and fallowing to restore soil fertility. Some of these practices have become infeasible due to high population pressure and scarcity of cultivable land. This work builds on ICRISAT's work on soil fertility restoration and water harvesting techniques (e.g tied ridges, diguettes etc.) in the region. The focus of the subproject is the use of crop management strategies (intercropping cereals with leguminous crops, manuring, terracing, crop rotation, etc) to enhance water and nutrient use efficiency.

To fulfil the above needs for minimizing degradation of Vertic Inceptisols and sustain crop productivity the following research agenda is proposed to fulfil the following objectives.

2. **Objective:**

To identify farmer acceptable soil and water management technologies for minimizing soil degradation; and to assemble technologies for improving crop productivity based on improved management of socioeconomic and natural resources.

3. **Superthemes(s)/research areas:**

Superthemes (RDDs)

3.1 Characterization of production environments
3.2 Soil and water conservation/management
3.3 Integrated nutrient management
3.4 Natural resource management and sustainability
3.5 Systems analysis
3.6 Integrated pest management
3.7 Impact assessment and technology adoption.

Theme #	Title	Total SSY	Proportion involved (%)
IAC:			
12	Adoption/Impact	1.50	2.00
14	Soil nutrients	1.30	14.61
25	Soil structure	1.80	16.11
29	Water deficit	2.30	15.21
50	Characterization	0.60	10.00
52	Natural resource	1.45	13.79
54	Farmers' preferences	0.35	11.43
55	Beneficial organisms	1.00	17.00
WCA:			
37	Water deficit	0.40	81.25
38	Technology adoption	0.10	00.00
23	Soil fertility	0.10	75.00
40	Characterization of production systems	0.60	16.66
51	Microeconomic studies	0.00	00.00
52	Natural resources	0.00	00.00
58	Consumption/demand	0.00	00.00

4. **Link Project**

- for management : MCSP 3
- for research outputs : SG2, PP1, CP2, GN2, MCSP 1, MCSP 2, Econ. 1

5. **Crops and/or systems involved** : Sorghum, Pigeonpea, Groundnut, Chickpea, Cotton, Maize, Pearl millet, Cowpea Systems: sorghum/pigeonpea, pigeonpea/groundnut, sorghum-chickpea.

6. **Region(s) of Inference:**

- Primary production system(s) : PS 7, in Asia, PS 14, PS 15 in WCA, PS 21 in SEA

- Secondary production system(s) : PS 4, PS 8, PS 9, Asia, PS 14, PS 16 in WCA and PS 20 in SEA

7. **Central file numbers:**

- Production systems
- MTP themes
- Others

8. **Research strategy and requirements** Please refer to the attached table and details that follow.

8. Research strategy and requirements:

ICRISAT Asia Center (IAC):

Research Activity/ type	Description of activity[1]	Status	Disciplines involved	Level and duration of appointment									Location of research	Model system	Year		Research methodology	Partners	Budget SBY 1.35= $275,310
				IRS	NRS	RF	RS	VS	TS	FS	RWF	TFL			Initiation	Completion			
Diagnostic/ Strategic	B1	2	AC	0.15	0.15				0.55	0.55	0.00	0.50	IAC Akola CRIDA	Vertic Inceptisols (PS 7& PS 8)	1985	1989	Field surveys for consistent identification. Assembly and analysis of soil and climatic data. Spatial distribution of constraints.	NBSS & LUP CRIDA SMSS	43,470
			SB	0.02	0.10														
			SC	0.02	0.05														
			SP	0.03	0.10														
			AD	-	0.10														
			SEPD	0.05	0.15				0.50	0.70									
Strategic/ Applied	B2	2	AC	0.03	0.10				0.20	0.20	0.00	0.75	IAC Akola CRIDA	Vertic Inceptisols	1985	1989	Assessment of soil degradation thru on-farm surveys. On-station trials for quantifying contribution of different processes of soil degradation effects.	CRIDA SAU APSRU	87,995
			SB	0.03			0.40		0.10	0.10	0.10	1.00							
			SC	0.02	--				0.05	0.05	0.10	1.00							
			SP	0.03	0.30		0.50		0.50	0.70	0.50	3.00							
			SEPD	0.05					0.10	0.10									

8. Research strategy and requirements: (Contd.)

Research Activity/ type	Description of activity[1]	Status	Disciplines involved	Level and duration of appointment									Location of research	Modal systems	Year		Research methodology	Partners	Budget BBY 1.30= $876,349
				IRS	NRS	RF	RS	VS	TS	FS	RWF	TFL			Initiation	Completion			
Strategic/ Applied	83	2	SB		0.30		0.60		0.60	0.70	0.55	3.00	IAC Alaba CRIDA	Vertic Inceptisols	1985	1989	On-station trials for studying interactive effects of different nutrient elements. Onfarm trials and lab experiments to study legume residue dynamics.	CRIDA	$1,789
			SC		0.25		–		0.60	0.65	0.75	3.00							
Applied	84	1	AC	0.60					0.10	0.05		0.25	IAC	Vertic Inceptisols	1985	1989	On-station trials to develop potential land use systems.		$8,789
			SB	0.00					0.10	0.05	0.20	0.50							
			SP	0.02	0.15				0.10	0.20	0.10	1.00							
			AD		0.15		0.50		0.20	0.20	0.00	1.50							
Strategic/ Applied	85	2	SB		0.10								IAC Alaba CRIDA	Vertic Inceptisols	1985	1989	On-station trials to evaluate long-term effects of soil and crop management practices on sustainability	CRIDA	$8,910
			SC	0.00					0.05	0.10	0.1	0.5							
			SP	0.02	0.05				0.10	0.10	0.1	0.5							
			AD		0.10				0.20	0.10	0.25	1.0							

8. Research strategy and requirements: (Contd.)

Research Activity/ type	Description of activity[1]	Status	Disciplines involved	Level and duration of appointment									Location of research	Model system	Year		Research methodology	Partners	Budget SSY 1.00= $273,310
				IRS	NRS	RF	RS	VS	TS	FS	RWF	TFL			Initiation	Completion			
Applied/ Adaptive	8ii	1	AC	0.05	0.20		0.50		0.15	0.20	0.25	1.50	IAC Akola CRIDA	Vertic Inceptisol	1985	1988	On-station trials to study integrated soil and crop management practices on productivity, and sustainability. Onfarm evaluation of integrated technologies. Estimation thro modelling and GIS.	CRIDA APSRU	74,480
			SB	0.02	0.10				0.20	0.15	0.20	1.00							
			SC	0.03	0.10	0.10			0.30	0.20	0.10	1.00							
			SP	0.05	0.10		0.50		0.30	0.50	0.20	1.50							
			AD		0.20		0.50		0.80	0.50	0.75	1.50							
			SEPD	0.05	0.15				0.20	0.20	0.00	0.50							

1. Please refer details of subproject for description of activities.

8. Research strategy and requirements: (Contd.)

West and Central Africa (WCA):

Research Activity Type	Description of subAg[1]	Discipline involved	Level and duration of appointment									Location of research	Model system	Year in Con	Research method	Partners	Budget
			YRS	NRS	RF	VS	S.TECH	TECH	FA	RWF(VS)	LABOR						
8B. Develop integrated nutrient and water management strategies for Alfisols & Vertisols	03	Agron(AD) Phy(AD) Agron(SAICD) Soils+WE(SACD) Econ(SEPD)	0.04 0.04 0.02		0.025		0.05 0.075 0.075	1.00	1.00 1.00			WCA	Station and on-farm	1995 to 1999	On-station on-farm trials	CRAD IRAD	41,400
8A. Evaluation of long-term effects of crop rotations etc on crop production, yield and stability	05	Agron(AD) Phy(AD) Agron(SAICD) Soils+WE(SACD) Econ(SEPD)	0.05 0.10		0.025		0.075 0.15	1.00	1.00 1.05			WCA	Station and farm	1995 to 1999	On-station and on-farm trials	CRAD IRAD	45,675
8A. Integrate and evaluate farmer-acceptable strategies for minimizing soil degradation in receding fertility	05	Agron(AD) Phy(AD) Agron(SAICD) Soils+WE(SACD) Econ(SEPD)	0.02 0.01 0.02		0.05			0.025	2.00	2.00		WCA	Farm	1995 to 1997	Survey of farmers	CRAD IRAD	15,000

1. Please refer details of subproject for description of activities.

DETAILS OF SUBPROJECT B: SUSTAINING CROP PRODUCTION IN MARGINAL ENVIRONMENTS

Title: Identification of resource management strategies for improved and sustainable crop production in medium-low water holding capacity soils in PS 7 and PS 15 (sandy Alfisols in WCA, Vertic Inceptisols and Alfisols in Asia).

Keywords: Vertic Inceptisols, Soil degradation, Sustainable resource and crop management.

Introduction: Vertic Inceptisols cover a large area (about 60%) in PS-7 and 8. As these soils are often located on lands exceeding 2% slope and are shallow in depth, they suffer from erosion effects leading to severe depletion of soil, nutrients and beneficial organisms. The impacts of this degradation are further accentuated due to continuous cropping with inadequate nutrient and organic matter inputs. The objective of the subproject is to identify practices which arrest or reverse soil degradation and improve productivity of Vertic Inceptisols.

Objective: To identify farmer acceptable soil and crop management technologies for minimizing soil degradation and to assemble technologies for improving crop productivity based on improved management of natural resources.

Resource requirement (SSY):

	SACD	AD	SEPD	Total
IAC:	0.68	0.42	0.23	1.33
WCA:	0.175	0.25	0.075	0.50

Activity B1: Characterization of socioeconomic and natural resources across the continuum from sandy Alfisols to Alfisols in WCA and from shallow Vertic soils to Vertisols (including associated Alfisols in Asia) and identification and characterization of benchmark sites for collaborative research.

Justification: Much of the information available on soil, climate and cropping systems for Vertic Inceptisols is rather sketchy and incomplete. It needs to be compiled in agronomically relevant terms with the use of new tools e.g., GIS and 1:1 million scale maps.. Therefore characterization and delineation of areas with differing resource endowments and status of land degradation are urgently needed.

Resources (SSY):

	SACD	AD	SEPD	Total
IAC:	0.08	0.08	0.05	0.21

Research strategy:

In collaboration with CRIDA, NBSS & LUP, SMSS and SAU's:

- Characterization of natural resources and the selected benchmark locations through assembly, synthesis and management of climatic and soils data bases.
- Through onfarm surveys identify biotic and abiotic constraints involved in soil degradation.
- Using GIS aided maps spatial distribution of biotic and abiotic constraints.

Milestones:

1.1 Identification and characterization of benchmark sites for studying effects of land degradation. (1996, 80%). Cooperators: SAU's, SMSS.

1.2 Congruent data bases on climate and soil, and climatic analysis in agronomically relevant terms. (1998, 80%). Cooperators: NBSS & LUP, NARS, SMSS.

1.3 GIS aided maps showing spatial distribution of biotic and abiotic constraints. (1997, 80%). Cooperator: CRIDA.

Activity B2: Assessment of soil degradation or impacts on crop productivity and quantification of different degradation processes.

Background: The EPR in 1990 recommended that ICRISAT should conduct research on soil degradation processes in the drylands. This recommendation is particularly important for Vertic Inceptisols because if conservation effective farming systems are not adopted, these soils will become unproductive over a short period of time. Degradation in Vertic Inceptisol may be due to several processes. Information on the relative contribution of these processes to soil degradation and the inter-relationships of processes is scanty. Additionally, there is need to study effect of different organic, inorganic amendments and biological conservation practices (e.g. vegetative barriers, crop cover etc.) on soil processes. This research should take into account farmers' circumstances and should include evaluation of promising technologies on farmers' fields in watershed projects already in progress in cooperation with NARS/NGOs.

Resources (SSY):

	SACD	AD	SEPD	Total
IAC:	0.20	0.05	0.03	0.28

Research strategy:

- At Benchmark locations/sites effects of soil degradation on crop productivity will be assessed through crop yield surveys in fields with different levels of degradation, farmers interviews and extrapolation of results through modeling.

- On-station trials at benchmark sites to study contribution of different processes of soil degradation, modeling of various process and extrapolation of results to predict the extent of soil degradation at other locations.

- On-farm evaluation of selected integrated technologies based on farmers' perception and on-station results in collaboration with NARS/NGOs in watershed model.

Milestones:

2.1 Technical assessment of soil degradation. (1996, 80%).

2.2 Perception of farmers on soil degradation. (1996, 80%). Linked Project: ECON 2.

2.3 Assessing cost of soil degradation and its effect on crop productivity. (1997, 75%). Linked Project: ECON 2.

2.4 Identify indicators of soil degradation. (1997, 65%).

2.5 Information on and quantification of soil degradation processes. (1998, 70%).

2.6 Apply process models to extrapolate research results to other locations. (1999, 60%). Cooperators: APSRU, CRIDA, SAUs.

Activity B3: Development of integrated nutrient management and water strategies for sustainable crop production in Vertic soils/Alfisols in Asia and sandy Alfisols in WCA.

Background: Mechanisms of legumes benefits in improving soil fertility are not understood well. Earlier work on the contribution of legumes through biological nitrogen fixation (BNF) to crop productivity will help in building a research program for identifying appropriate legumes which contribute substantially through BNF. However, exact contribution of different (biological, mineral and organic) sources of nutrients need to be quantified to develop INM systems for sustaining crop production.

This activity integrates technology components of water and nutrient use efficiencies in a systems context. These will be evaluated in on-station and on-farm conditions to determine their combined medium to long-term effects on system productivity. It complements the past work of ICRISAT scientist in West Africa where components were evaluated on their effects on single crops. This activity extends that work by evaluating the effects of integrated SWNM strategies in a systems context.

Resources (SSY):

	SACD	AD	SEPD	Total
IAC:	0.20	0.05	0.00	0.25
WCA:	0.075	0.075	0.05	0.20

Research strategy:

IAC:

- A multidisciplinary team will estimate nutrient needs of selected cropping systems through nutrient budgeting.
- On-station trials to quantify contribution of various nutrient sources (biological, mineral, and organic) in selected cropping systems.
- On-station and greenhouse experiments to understand mechanisms of contribution of legumes to increased crop productivity.
- Organic matter and nutrient dynamics under INM practices.
- On-station trials to study interactive effects of different nutrient sources on nutrient availability and crop productivity.

WCA:

- On farm verification of component technologies for water use efficiency.
- On farm verification of component technologies for nutrient use efficiency.
- On farm verification of integrated (water and nutrient) technologies.

Milestones:

3.1 Report on on-farm verification of component technologies (water). 1996, 70% probability.

3.2 Report on on-farm verification of component technologies (nutrients). (1997, 70%).

3.3 Report on nutritional demands and existing nutrient management practices of the selected cropping systems of Vertic Inceptisols. (1996, 80%). Linked Project: MCSP 2.

3.4 Appropriate legumes and crop species which can use legume residual N efficiently. (1997, 60%). Linked Project: MCSP 4, CP2

3.5 Report on integrated SWN technologies on system productivity. (1998, 60%).

3.6 Report on contribution and interaction of different sources of N and P, role of microorganisms in INM systems. (1997, 70%).

3.7 Promising INM strategies for evaluation in on-farm trials. (1998, 70%). Linked Projects: ECON 1,2. Cooperator: CRIDA.

3.8 Model for quantification of N availability. (1999, 60%).

Activity B4: On-station evaluation of alternate land use systems by integrating farmers' perceptions and knowledge on agroforestry and silvipastoral systems for rehabilitating degraded lands.

Background: In order to prevent further land degradation, alternate land use systems such as agroforestry and silvipastoral systems are desirable. There is a need to integrate and test the performance of different cropping systems, agroforestry and silvipastoral systems for rehabilitating these lands.

Resources (SSY):

	SACD	AD	SEPD	Total
IAC:	0.05	0.05	0.00	0.10

Research strategy:

- On-station trials to identify appropriate land use systems for restoring degraded lands.

Milestones:

4.1 Potential land use systems for evaluation. (1998, 60%). Linked Projects: ECON 1, MCSP2.

Activity B5: Evaluate long-term effects of various crop rotations under different fertility, soil and water conservation practices on crop production, yield and stability (Linked to Activities 2 and 3).

Background: The main cropping systems in PS-7 are cereal/legume or cotton-based intercropping. The availability of new cultivars with better resistance to pest and disease and drought tolerance provide a new opportunity for increased and sustainable yields of these cropping systems. Due to complex interactions of intercropping systems, a multidisciplinary approach would be essential. Data from this study will be useful for validations of systems models.

Water retention during critical periods of the cropping season is a major constraint in the southern Sudanian zone. Past ICRISAT work on water conservation and use efficiency resulted in the development of harvesting techniques such as tillage, ridging, mulching and contour bunds. This activity extends this work by emphasizing the crop, cropping pattern and management practices that improve water use efficiency. The work would be conducted on farmers' fields with their participation. Similarly, nitrogen and phosphorous are the most limiting nutrients in the production system . Past research has shown that although sorghum's response to N and P is not as high as that of maize, it shows reasonable economic returns under low levels of dosage. Small-holder subsistent farmers may not always have access to inorganic fertilizer. The majority in fact use manure and fallows to restore fertility. This activity investigates the use of genotypes and different management practices to increase nutrient use of efficiency under farmers'conditions.

Resources (SSY):

	SACD	AD	SEPD	Total	IPM/IDM
IAC:	0.05	0.05	0.03	0.13	+ 0.10*
WCA:	0.075	0.15	--	0.225	

Research strategy:

IAC:

- On-station long-term experiments will be conducted to study effects of integrated soil and crop management practices on
  - crop productivity
  - soil fertility and biological activity
  - behavior of pests and diseases in systems

WCA:

- on-station evaluation of long-term effects of different S&W management techniques.
- on-farm evaluation and monitoring of the effects of various S&W management techniques on system productivity.

Milestones:

5.1 Identification of on-station test sites in collaboration with NARS and other partners. (1995, 75%).

5.2 On-station evaluation of selected S & W management techniques. (1996-1998, 80%).

5.3 Selection of benchmark village sites and participating farmers for on-farm S & W management technique evaluation. (1995, 75%).

5.4 On-farm evaluation of the effects S & W management techniques in selected benchmark village sites. (1996-1998, 60%).

5.5 Promising crops, cultivars and cropping systems and their management practices for their evaluation. (1997, 70%). Linked Project: MCSP 2.

Activity B6: Integrate and evaluate farmer-acceptable strategies for minimizing soil degradation and restoring degraded soils including their economic feasibility.

Background: This research is aimed to integrate the results of strategic studies and farmers' perception. On-farm evaluation of promising technologies in watershed projects will be done. Models and GIS will be used to extrapolate results.

Farmers employ several techniques for managing nutrient and water on their fields. The fertility restoration practices include rotation, fallow, shifting cultivation and the use of farm yard manure. The water retention techniques include mulching, tied ridges, and rock bunds. In some regions of Burkina Faso, farmers practice the "Zaï" as a water retention and soil restoration technique. The "Zaï" is a technique in which shallow holes are dug to trap rain water and to slow down runoff. These holes also serve as reservoirs for organic matter (manure or compost) which offer nutrients to plants as well as retain water. Traditional methods are effective for small family farms but as family sizes grow they become constrained by the availability of organic matter, labour and land. This activity analyses the effects of traditional methods on water and nutrient use efficiency. It also investigates the reasons for the choices of techniques and the constraints to adoption of improved soil nutrient and water management techniques already available in the region.

Resources (SSY):

	SACD	AD	SEPD	Total	IPM/IDM
IAC:	0.10	0.14	0.12	0.36	+ 0.25
WCA:	0.025	0.025	0.025	0.075	

Research strategy:

IAC:

- On-station trials in collaboration with NARS to evaluate integrated soil and crop management strategies for their effect on crop productivity
- On-farm evaluation of integrated management strategies in watershed model in collaboration with NARS/NGOs
- Calibration and validation of system's model using data sets from on-farm and on-station trials.
- Extrapolation of results using models to identify domains for transfer of technology and its spill over areas.

WCA:

- Documentation of traditional nutrient and water management practices and their effects on systems productivity.
- Information on the constraints to the adoption of nutrient and water management techniques.

Milestones:

6.1 Report on traditional practices for nutrient and water management. (by March 1996, 75%).

6.2 Report on the constraints to the adoption of nutrient and water management techniques. (1997, 80%).

6.3 Identification of promising cropping systems (crops/cultivars) and their management practices - soil fertility and water management for on-station evaluation. (1997, 80%).

6.4 Potential cropping systems and their soil, water, nutrient and IPM/IDM management for on-farm evaluation. (1998, 80%).

6.5 In consultation with NARS/NGOS promising technologies will be identified for on-farm evaluation. (1996, 80%).

6.6 Report on economic viability of alternative control measures of land degradation. (1998, 70%).

6.7 Report on performance of selected technologies for increasing productivity and rehabilitation of degraded lands under different scenarios. (1999, 70%).

6.8 Assembly of data in standardized formats from strategic research for evaluation of systems model. (1996, 70%).

6.9 Test, calibrate and validate model. (1997, 70%).

6.10 Identifications of domains for application of different technologies and spillover areas. (1999, 60%).

Priority:

Activity	Rating*	Activity	Rating
1. Characterization of natural resources	1	4. Alternate land use systems.	3
		5. Crop rotations	2
2. Soil degradation effects on crop productivity.	1	6. Strategies for restoring degraded soils.	1
3. Integrated nutrient management	1		

*1 = High; 2 = Medium; 3 = Low.

Staffing and salary costs for subproject B of MCSP 3.

IAC:

Category	Staffing needs			Total salary	
	SACD	AD	SEPD	Staff	Amount $
SSY	0.68	0.42	0.23	1.33	275,310
IRS	0.61	--	0.15	0.76	72,200
NRS	2.15	0.55	0.30	3.00	20,100
RF	0.10	--	--	0.10	3,500
RS	2.50	1.00	--	3.50	17,500
VS	--	--	--	--	--
TS	4.00	1.00	0.80	5.80	19,140
FS	4.50	0.80	1.00	6.30	16,380
RWF	3.25	1.00	0.00	4.25	6,800
TFL	20.00	4.00	0.50	24.50	4,900
Total					160,520
% of SSY amount					58 30

9. Research team:

IAC[1]:

Discipline	IRS	NRS	RF	RS	VS	TS	FS	RWF	TFL
Agroclimatology	0.26	0.45		0.50		1.00	1.00	0.25	3.00
Soil Biology	0.10	0.60		1.00		1.00	1.00	1.05	5.50
Soil Chemistry	0.10	0.40	0.10	--		1.00	1.00	1.05	5.50
Soil Physics	0.15	0.70		1.00		1.00	1.50	0.90	6.00
Agronomy	--	0.55		1.00		1.00	0.80	1.00	4.00
SEPD	0.15	0.30				0.80	1.00	--	0.50
Total	0.76	3.00	0.10	3.50		5.80	6.30	4.25	24.50

WCA:

Discipline	IRS	NRS	RF	RS	VS	Snr. Tech	Tech	FA	RWF	Total
AD	0.25					0.175		4.00		4.425
SACD	0.175		0.025			0.225	1.00			1.425
SEPD	0.075		0.075			0.075	0.125	1.00	2.00	3.35
Total	0.50		1.00			0.475	1.125	5.00	2.00	9.20

1. Annual staff needs are same during five years at IAC and WCA.

10. Milestones:

1.1 Identification and characterization of benchmark sites for studying effects of land degradation. (1998)

1.2 Congruent data bases on climate and soil, and climatic analysis in agronomically relevant terms. (1996)

1.3 GIS aided maps showing spatial distribution of biotic and abiotic constraints. (1998)

2.1 Technical assessment of soil degradation. (1996)

2.2 Perception of farmers on soil degradation. (1996)

2.3 Assessing cost of soil degradation. (1997)

2.4 Identify indicators of soil degradation. (1997)

2.5 Information on and quantification of soil degradation processes. (1996)

2.6 Apply process models to extrapolate research results to other locations. (1999)

3.1 Report on water technologies. (1996)

3.2 Report on nutrient technologies. (1997)

3.3 Report on nutritional demands and existing nutrient management practices of the selected cropping systems of Vertic Inceptisols. (1996)

3.4 Appropriate legumes and crop species which can use legume residual N efficiently. (1997)

3.5 Report on SWN technologies. (1996)

3.6 Report on contribution and interaction of different sources of N and P, role of microorganisms in INM systems. (1997)

3.7 Promising INM strategies for evaluation in on-farm trials. (1998)

3.8 Model for quantification of N availability. (1999)

4.1 Potential land use systems for evaluation. (1998)

5.1 Identification of on-station test sites. (1995)

5.2 Benchmark village selection. (1995)

5.3 On-station evaluation of SWN techniques. (1998)

5.4 On-farm evaluation of the effects of SWN techniques. (1998)

5.5 Promising crops, cultivars and cropping systems and their management practices for their evaluation. (1997)

6.1 Report on traditional nutrient and water management. (1996)

6.2 Report on adoption constraints. (1997)

6.3 Identification of promising cropping systems (crops/cultivars) and their management practices - soil fertility and water management for on-station evaluation. (1998)

6.4 Potential cropping systems and their soil, water, nutrient and IPM/IDM management for on-farm evaluation. (1996)

6.5 In consultation with NARS/NGOS promising technologies will be identified for on-farm evaluation. (1996)

6.6 Report on economic viability of alternative control measures of soil degradation. (1998)

6.7 Report on performance of selected technologies for increasing productivity and rehabilitation of degraded soils under different scenarios. (1999)

6.8 Assembly of data in standardized formats from strategic research for evaluation of systems model. (1996)

6.9 Test, calibrate and validate model. (1997)

6.10 Identifications of domains for application of different technologies and spillover areas. (1999)

11. Probability of success:

Objective	Milestones[1]	Probability of success (%)	Time frame
1. To identify farmer acceptable technologies for minimizing soil degradation and to assemble technologies for improving crop productivity	1.1 Benchmark site characterization	80	1995-1996
	1.2 Soil & climatic data analysis	80	1995-1996
	1.3 Spatial distribution maps	80	1995-1996
	2.1 Soil degradation assessment	80	1995-1996
	2.2 Farmers' perception	80	1995-1996
	2.3 Cost of soil degradation	75	1996-1997
	2.4 Indicators of soil degradation	65	1996-1997
	2.5 Soil degradation processes	70	1996-1998
	2.6 Extrapolation using models	60	1998-1999
	3.1 Report on water technologies	70	1996
	3.2 Report on nutrient technologies	70	1997
	3.3 Nutrient budgeting	80	1995-1996
	3.4 Legumes contribution, efficient crops	80	1995-1997
	3.5 Report on SWN technologies	60	1998
	3.6 Interaction effects of nutrient sources	70	1995-1997
	3.7 INM strategies	70	1997-1998
	3.8 N availability model	60	1997-1999
	4.1 Land use systems	80	1997-1998
	5.1 Identification of on-station test sites	75	1995
	5.2 Benchmark village selection	75	1995
	5.3 On-station evaluation of SWN techniques	75	1996-1998
	5.4 On-farm evaluation of the effects of SWN techniques	60	1996-1998
	5.5 Cropping systems & management practices	70	1995-1997
	6.1 Report on traditional nutrient and water management	80	1995-1998
	6.2 Report on adoption constraints	75	1998
	6.3 Cropping systems/management practices -- on-station evaluation	80	1997
	6.4 On-farm evaluation	80	1996-1998
	6.5 Promising technologies	80	1995-1997
	6.6 Economic viability of methods for controlling soil degradation	70	1997-1998
	6.7 Performance of selected technologies	70	1997-1999
	6.8 Data assembly for system's model evaluation	70	1995-1996
	6.9 Validation of systems model	70	1996-1997
	6.10 Domain identification	60	1995-1999

1. Numbers are related to the milestones in details of subproject.

12. Economic value (Million US $) of success:

13. Technology exchange activities:

IAC:

Item	Y1	Y2	Y3	Y4	Y5
Publication type	JA 1 CP 2	JA 1 CP 2	JA 2 CP 3 RB 1	JA 2 CP 3	JA 2 CP 3
Workshop/ Conference		Regional workshop on integrated nutrient management		International Workshop on soil degradation and sustainability of agriculture in the SAT	
Training (in-service staff - NARS)		3 Research Scholars		3 Research Scholars Regional training course for dept staff in techniques for controlling soil degradation	2 Research Scholars
Network activities	On-station and on-farm trials in collaboration with NARS and NGOs.				

WCA:

Item	Y1	Y2	Y3	Y4	Y5
Publication type			JA 2	JA 2	JA 2
Workshops/ Conferences			Yes		Yes
Training (in-service staff - NARS)		Yes	Yes	Yes	Yes
Network activities		Yes	Yes	Yes	Yes

14. Budget:

IAC:

Head of expenditure	Year 1 (1995)	Year 2	Year 3	Year 4	Year 5
Salaries	160,520	160,520	160,520	160,520	160,520
Operating	81,790	81,790	75,790	72,790	74,790
Travel	20,000[1]	20,000[1]	25,000[1]	23,000[1]	25,000[1]
Capital	50,000[4]	30,000[5]	95,000[6]	10,000[9]	10,000[10]
TECHNOLOGY EXCHANGE					
Publication	3,000	3,000	4,000	4,000	5,000
Workshop/ Conference	10,000[2]	10,000[2]	10,000[7]	10,000[7]	10,000[7]
Training	(21,000)[3]	(21,000)[3]	(21,000)[3]	(21,000)[3] 5,000[8]	(21,000)[3]
Network activities					
Total	275,310	275,310	275,310	275,310	275,310

SSY 1.33 = US$ 275,310

Notes:

1. Includes one meeting of project team members with collaborators.
2. Pooled money of two years will be used for organizing regional workshop on INM in collaboration with other projects.
3. Salaries for RS & RF already accounted in salaries.
4. Two autotitrators for chemical analysis, neutron probe and automatic weather station; the cost is not included in project budget.
5. One water distillation set and one phase contrast microscope, note book cost is not included in project budget.
6. Regional training course in collaboration with other subproject/projects.
7. Three years pooled money will be utilized for organizing intl. workshop on soil degradation, complimentary funding will be sought from other projects; intl. agencies etc.
8. Autoanalyser for N and P analysis.
9. Data logger and modem for transferring data.
10. IBM 586 or equivalent for modelling research.

14. Budget: (Contd.)

WCA:

Head of expenditure	Year 1 (1995)	Year 2	Year 3	Year 4	Year 5
Salaries	53,820	53,820	53,820	73,600	77,700
Operating	11,025	11,025	11,025	13,200	14,000
Travel	27,500	27,500	27,500	29,200	31,500
Technology Exchange	9,400	9,400	4,400	1,200	1,400
Miscellaneous	1,755	1,755	1,755	1,820	1,900
Total	103,500	103,500	103,500	119,020	126,500
Capital Requirements					

15. Environmental stability/sustainability: Sustainability - Ranking = 5

In the semi-arid tropics of India, Vertic Inceptisols occupy 60 m ha. These soils are fragile because they are located on slopes, have low CEC, are shallow and are low in organic matter content. Their current productivity in rainfed agriculture, for ICRISAT mandate crops is very low (300-800 kg ha^{-1}). To sustain agriculture in this region, it is essential to conduct research and develop, teste and extend productive & environmentally friendly technologies.

The outputs from the subproject will have a positive effect on the long-term sustainability of Alfisols and vertic inceptisols. By developing and diffusing technologies that use water and soil nutrients efficiently, the pressure on land degradation in the target system will be reduced.

16. Relationship to other projects:

This project will be linked to MCSP-2 and SCSP SG2 and PP1. The technologies developed will have implication for Vertisol area of Myanmar in Asia and PS14 and 16 (West Africa), and PS 20 22-23 (S&EA).

Linked with, and has relevance for the single commodity systems projects with a PS 7 and 15 focus. Also closely linked with CIRAD projects on long-term soil fertility and degradation studies.

17. Gender implications:

Improved technologies to control and rehabilitate soil degradation of the Vertic Inceptisols will sustain farm income and employment opportunities. Some of the activities of the subproject will document gender related constraints in acceptance of the past efforts in disseminating improved technologies to control soil degradation. The outputs will essentially be helpful in developing improved technologies in the light of the gender constraints.

The outputs from the subproject is expected to be gender neutral (i.e of benefit to the household as a whole, irrespective of its composition).

18. Prospects for special funding:

Efforts will be made to develop links with Australian institutions for simulation modeling research.

19. Index of priority:		IAC	WCA	Global
	I' =	36.42	31.21	34.68
	II =	35 02	34 81	34.94
	III =	34.08	35 50	34 47

20. Indicative funding:	IAC	WCA	Global
	275,310	103,500	378,810

1. As per criteria given in DEB's memo dated 17 Aug 1994.

Subproject C

Enhancing sustainability of postrainy season cropping in PS 8 via crop and soil management interventions

MCSP 3 SUBPROJECT C: POSTRAINY SEASON CROPPING

1. **Title: Enhancing sustainability of postrainy season cropping in PS 8 via crop and soil management interventions.**

Keywords: *In-situ* soil and water conservation, fallow management, integrated pest and disease management, shootfly tolerant cultivars/landrace hybrids.

Background, Need and Opportunities: Geographically, production system 8 covers much of the western Deccan Plateau of India, comprising mostly of western Maharashtra and some parts of Karnataka. Because of the western Ghats, this area falls under the "rain-shadow" effect of the south-west monsoons. Rainfall in this region is low to medium (600-700 mm) and highly variable and uncertain for successful cropping during the rainy season. Length of growing season varies from 90 to 120 days. The soils are mainly Vertisols and Vertic Inceptisols with some Alfisols which are exposed to degradation due to poor soil cover during most of the rainy season. Cropping systems in PS 8 are predominantly *rabi* sorghum-based on deep Vertisols and *kharif* pearl millet-based on Vertic Inceptisols. The current average yield of *rabi* sorghum is 0.62 t/ha and 0.52 t/ha for pearl millet. Other crops, which are grown to a relatively lesser extent, are groundnut, pigeonpea, sunflower, safflower, and chickpea.

PS 8 is primarily a drought prone area. Primary reasons for low crop yields in this region are poor soil and water management leading to land degradation during the rainy season, use of low yielding traditional cultivars, and low levels of crop and nutrient management because of water limitations during the postrainy season, and inadequate crop protection from diseases and pests. Among the pests, shoot fly is the major yield reducer of early sown *rabi* sorghum. Crop production in this region can be increased and sustained through improved soil and water (rainfall) management during the rainy and postrainy season coupled with improved (disease and drought resistant) cultivars and nutrient management. There have been recommendations for soil, water, and nutrient management practices (eg. graded bunds, deep placement of fertilizers etc.) by the Dryland Research Centers of ICAR, but their adoption have been low. There is a scope for improving the design of indigenous and recommended soil and water management practices to improve their adaptation to site-specific factors. Additionally, some of the in situ moisture conservation practices (such as pitting, micro-catchments, tillage etc.) need to be evaluated. There is also a scope for improving the efficiency of mineral fertilizer use and improving *kharif* fallow management by introducing short duration legumes to improve nutrient availability to *rabi* sorghum. Improved disease and drought resistant cultivars of *rabi* sorghum and pearl millet developed at ICRISAT and NARS have the potential for adoption in this region.

ICRISAT has the comparative advantage in the above mentioned areas of both applied and strategic research. Research results obtained from this subproject will also have implications for Muskwari sorghum production in production system 18 of West Africa. This subproject aims at developing technologies for improving the productivity and sustainability of land use in PS 8 through enhanced natural resource utilization. These studies will be conducted in a collaborative mode with CRIDA and the Maharashtra State Agricultural University. The objective of this subproject identified is:

2. **Objective:** Characterize and enhance socioeconomic and natural resource base for sustained crop production.

3. **Superthemes(s)/research areas:**

Superthemes (RDDs)

3.1 Characterization of production environments
3.2 Integrated nutrient management
3.3 Soil and water conservation/management
3.4 Systems analysis
3.5 Integrated systems - insects and diseases

Theme #	Title	Total SSY	Proportion involved (%)
14	Soil nutrients	1.30	6.92
25	Soil structure	1.80	7.77
29	Water deficit	2.30	8.69
52	Natural resources	1.45	1.38
54	Farmers' preference	0.35	5.71
55	Beneficial organisms	1.00	8.00

4. **Link project:**

- for management : MCSP 3
- for research outputs : PP 1, PM 2, SG 5, CP 2, MCSP 2, ECON 1, and ECON 2

5. **Crop and/or systems involved** : *Rabi* sorghum, *Kharif* pearl millet, pigeonpea, sunflower, safflower, chickpea

6. **Region(s) of inference:**

- Primary production system(s) : PS 8
- Secondary production system(s) : PS 7, PS 9, PS 18

7. **Central database file numbers:**

- Production systems :
- MTP themes :
- Other :

8. **Research strategy and requirements** : Please refer to the attached table and details that follow.

8. Research strategy and resource requirements:

Research Activity/type	Description of activity[1]	Status	Disciplines involved	Level and duration of appointment									Location of research	Model system	Year		Research methodology	Partners	Budget SSY 8.74 = 8193,160
				IRS	NRS	RF	RS	VS	TS	FS	RWF	TFL			Initiation	Completion			
Diagnostic	C1	2	AC	0.09	0.05					0.15			IAC Solapur CRIDA	Vertisols and Vertic Inceptisols (PS 9)	1988	1989	Field surveys, data collection and analysis	CRIDA IMD RRRS AAUP MPAU, Rahuri	35,160
			SB	0.02															
			SC	0.02															
			SP	0.10					0.10	0.20	0.20	1.00							
			SEPD	0.10	0.15				0.30	0.50									
Strategic/ Applied	C2	2	AC		0.15				0.20	0.30	0.50	2.00	IAC Solapur CRIDA	Vertisols and Vertic Inceptisols (PS 9)	1985	1989	On-station field trials	CRIDA MPAU, Rahuri	35,160
			SB	0.03															
			SC	0.08	0.05				0.05										
			SP		0.30				0.30	0.30	0.50	4.00							
Strategic/ Applied	C3	2	SB		0.20				0.25	0.25	0.25	2.00	IAC Solapur CRIDA	Vertisols and Vertic Inceptisols (PS 9)	1985	1989	On-station and on-farm trials	CRIDA MPAU, Rahuri	35,160
			SC	0.05	0.15				0.20	0.25	0.25	2.00							
Applied	C4	1	AB	0.10	0.15				0.20	0.40	1.00	2.00	IAC Solapur CRIDA	Vertisols and Vertic Inceptisols (PS 9)	1985	1989	On-farm trials	CRIDA Solapur	16,320

1. Please refer details of subproject for description of activities.

DETAILS OF SUBPROJECT C: POSTRAINY SEASON CROPPING

Title: Enhancing sustainability of postrainy season cropping in PS 8 via improved crop and soil management interventions.

Keywords: *In-situ* soil and water conservation, fallow management, integrated pest and disease management, shootfly tolerant cultivars/landrace hybrids.

Resource requirement: (SSY)

	SACD	AD	SEPD	Total
IAC:	0.26	0.22	0.07	0.55

Objective I: Characterize and enhance socio-economic and natural resource base for sustained crop production.

Activity C1: Characterization of socio-economic and natural resource base and identification of constraints for early sowing of *rabi* sorghum and other crops, and map subregions with biotic and abiotic constraints.

Justification: PS 8 is a tropical low to medium rainfall environment. Rainfall in this region is erratic and uncertain for successful crop production during the rainy season. Postrainy season sorghum has traditionally been an important crop in PS 8 because of its high quality grain and fodder production. Its productivity depends upon adequate soil water storage at sowing and its recharge by rain, if any, during the crop growth period. Over the years the sorghum yields in PS 8 have been static and the crop is facing competition from other crops. Therefore a quantitative assessment of agroecological potential and the identification of constraints for increasing sorghum production seems to warrant the concerted attention.

Milestones:

1.1 Report on base line information on climate, soils, length of growing season, and cropping patterns. (1997, 80%).

1.2 Spatial distribution of abiotic and biotic constraints and their intensity. (1998, 60%).

1.3 Report on farmers' perception of constraints and opportunities for early sowing of *rabi* sorghum. (1995, 85%)

1.4 Yield probability distribution of early sown landrace hybrids/shootfly tolerant cultivars at benchmark sites. (1999, 70%).

Research strategy: Field surveys will be conducted to diagnose farmers' perception of constraints and records of available data on soil and climate will be analyzed and mapped.

Resources (SSY):

	SACD	AD	SEPD	Total
IAC:	0.06	0.05	0.04	0.15

Activity C2: Test and adapt *in-situ* moisture conservation techniques.

Justification: As most of the land area in PS 8 is left fallow during the rainy season, significant losses of soil and water occur as a consequence of high intensity storms. There are opportunities for increasing crop production through improved soil and water management practices by increasing resource use efficiencies. The dryland research centers in PS 8 have developed recommendations for soil and water conservation (e.g. graded bunds) but their adoption is low. In recent years, studies by Winrock/ICRISAT/ICAR have highlighted the role of indigenous soil and water conservation practices which need to be evaluated scientifically. There is scope for improving the design of indigenous and recommended practices and their transferability through adaptation to site-specific factors. In addition, there is need to evaluate other *in-situ* moisture conservation techniques (e.g. pitting, microcatchments and tillage options) in this production system.

Milestones:

2.1 Recommendations on promising practices for moisture conservation (1996, 80%).

2.2 Information on modified practices and model parameters for moisture conservation techniques. (1998, 70%).

Research strategy: On-farm surveys and review and analysis of secondary data; on-station study at Solapur dryland station to measure soil and crop parameters and evaluate management systems.

Resources (SSY):

	SACD	AD	SEPD	Total
IAC:	0.10	0.03	0.02	0.15

Activity C3: Improve soil fertility through efficient fallow management for sustainable postrainy season sorghum production.

Justification: Earlier work has shown that good responses to mineral fertilizer application are obtained when enough soil moisture is available in the top soil layer. But this is not the case always during the postrainy season when the crops are grown on receding soil moisture. Deep placement of fertilizers though useful has not been found to be a practicable solution. Instead of keeping these lands fallow in rainy season if short duration legumes could be grown which can be used for green manuring, or used as fodder or as grain. This practice will check soil erosion and result in a better utilization of resources for improved soil fertility. The *rabi* sorghum yields could thus be sustained. Detailed analysis of nutrient budgeting of improved systems will be required to evaluate long-term effects on soil fertility and sustainability.

Milestones:

3.1 Crops/cultivars suitable for growing during rainy season in improved fallow management will be identified (1996, 70%).

3.2 Report on contribution of legumes grown in rainy season on soil fertility and *rabi* sorghum productivity (1997, 70%).

3.3 Report on contribution and interaction of different sources of N and P; role of microorganisms in INM systems (1997, 70%).

3.4 Promising fallow management and INM strategies for evaluation in on-farm trials (1998, 60%).

Research strategy: Multidisciplinary on-station trials will be conducted to evaluate nutrient budgeting in systems; different sources of nutrients, nutrient cycling, and soil processes will be studied to develop integrated nutrient management strategies.

Resources (SSY):

	SACD	AD	SEPD	Total
IAC:	0.10	0.05	0.01	0.16

Activity C4: Introduction and evaluation of improved genetic materials for postrainy season sorghum and rainy season pearl millet.

Justification: *Rabi* sorghum and *kharif* pearl millet are the major crops grown in PS 8. Traditional cultivars are still grown in these areas because of associated risks with unpredictable rainfall. Improved cultivars of sorghum (eg. landrace hybrids) and pearl millet need to be evaluated under better soil and water management technologies on-farm for their yield performance and farmers acceptance. This activity will help to introduce new genetic material on farmers' fields in PS 8.

Milestones:

4.1 Report on the farmers' perceptions of improved *rabi* sorghum and *kharif* pearl millet cultivars (1995, 90%). Linked to SEPD 1.

4.2 Feedback on the suitability of available cultivars and opportunities for further development (1997, 90%).

4.3 Identification of high yielding cultivars of sorghum and pearl millet. (1998, 85%).

Research strategy: Improved cultivars of sorghum and pearl millet will be imported from SG 5 and PM 2 and evaluated on-station and on-farm for their suitability in PS 8.

Resources (SSY):

	AD	Total
IAC:	0.09	0.09

Priority :

Activity	Rating[a]	Activity	Rating[a]
1. Characterization	1	3. Improved soil fertility	1
2. *In-situ* moisture conservation	1	4. Introduction of genetic materials	2

[a]1 = High; 2 = Medium; 3 = Low.

Staffing and salary costs for Subproject C of MCSP 3.

IAC:

Category	Staffing needs			Total salary	
	SACD	AD	SEPD	Staff	Amount $
SSY	0.26	0.22	0.01	0.55	113,850
IRS	0.34	0.10	0.10	0.54	51,300
NRS	0.90	0.15	0.15	1.20	8,040
RF	--	--	--	--	--
RS	--	--	--	--	--
VS	--	--	--	--	--
TS	1.00	0.20	0.30	1.50	4,950
FS	1.25	0.40	0.50	2.15	5,590
RWF	1.50	1.00	--	2.50	4,000
TFL	10.00	2.00	--	12.00	2,400
Total					76,280
% of SSY amount					67.00

9. Research team:

IAC[1]:

Discipline	IRS	NRS	RF	RS	VS	TS	FS	RWF	TFL
Agroclimatology	0.09	0.20	--	--	--	0.20	0.45	0.50	2.00
Soil Biology	0.05	0.20	--	--	--	0.25	0.25	0.25	2.00
Soil Chemistry	0.10	0.20	--	--	--	0.25	0.25	0.25	2.00
Soil Physics	0.10	0.30	--	--	--	0.30	0.30	0.50	4.00
Agronomy	0.10	0.15	--	--	--	0.20	0.40	1.00	2.00
SEPD	0.10	0.15	--	--	--	0.30	0.50	--	--
Total	0.54	1.20	--	--	--	1.50	2.15	2.50	12.00

1. Annual staff needs are same during the five year period.

10. Milestones:

1.1 Report on base line information on climate, soils, length of growing season, and cropping patterns. (1997)

1.2 Spatial distribution of abiotic and biotic constraints and their intensity. (1998)

1.3 Report on farmers' perception of constraints and opportunities for early sowing of *rabi* sorghum. (1995)

1.4 Yield probability distribution of early sown landrace hybrids/shootfly tolerant cultivars at benchmark sites. (1999)

2.1 Recommendations on promising practices for moisture conservation. (1996)

2.2 Information on modified practices and model parameters for moisture conservation techniques. (1998)

3.1 Crops/cultivars suitable for growing during rainy season in improved fallow management will be identified. (1996)

3.2 Report on contribution of legumes grown in rainy season on soil fertility and *rabi* sorghum productivity. (1997)

3.3 Report on contribution and interaction of different sources of N and P; role of microorganisms in INM systems. (1997)

3.4 Promising fallow management and INM strategies for evaluation in on-farm trials. (1998)

4.1 Report on the farmers' perceptions of improved *rabi* sorghum and *kharif* pearl millet cultivars. (1995)

4.2 Feedback on the suitability of available cultivars and opportunities for further development. (1997)

4.3 Identification of high yielding cultivars of sorghum and pearl millet. (1998)

11. Probability of

Objective	Milestones[1]	Probability of success (%)	Time frame
1 Characterization of natural resource base and identification of constraints to crop production in PS 8.	1 1 Base line information on resources and cropping patterns	80	1995-1997
	1 2 Spatial distribution of abiotic and biotic stresses	60	1995-1998
	1 3 Farmers perception, constraints and opportunities	85	1995-1995
	1 4 Yield probability of sorghum at benchmark sites	70	1995-1999
	2 1 Promising practices for moisture conservation	80	1995-1996
	2 2 Model parameters for moisture conservation techniques	70	1995-1998
	3 1 Crops/cultivars for fallow management	70	1995-1996
	3.2 Contribution of legumes to soil fertility	70	1995-1997
	3 3 Integrated nutrient management strategies	70	1995-1997
	3 4 Fallow management and INM strategies for on-farm	60	1995-1998
	4 1 Farmers' perception of improved cultivars	90	1995-1995
	4 2 Feedback on suitability of new cultivars	90	1995-1997
	4 3 Identification of high yielding cultivars for PS 8	85	1995-1998

1 Numbers are related to the milestones in details of subproject

12. Economic value (Million US $) of success

13. Technology exchange activities:

Item	Y1	Y2	Y3	Y4	Y5
Publication type	1 CP	1 RB 1 CP	1 CP 1 JA	1 CP 1 JA	2 CP 2 JA
Workshop/ Conference		Soil/water/ nutrient management in low rainfall areas			Crop production technologies for low rainfall areas
Training (in-service staff- NARS	Training of one local staff in project activities	Training of one local staff in project activities	Training of one local staff in project activities		
Network activities	On-station and on-farm trials with NARS and NGOs and project planning meetings.				

14. Budget:

IAC:

Head of expenditure	Year 1 (1995)	Year 2	Year 3	Year 4	Year 5
Salaries	76,280	76,280	76,280	76,280	76,280
Operating	21,070	19,070	20,570	20,570	19,070
Travel	10,000[1]	10,000[1]	11,000[1]	11,000[1]	11,000[1]
Capital	(15000)[6]	(15000)[6]	(7000)[7]	(5000)[8]	(5000)[9]
TECHNOLOGY EXCHANGE					
Publication	1,000	1,000	1,000	1,500	1,500
Workshop/ Conference	4,000[2]	6,000[3]	4,000[2]	4,000[2]	6,000[3]
Training	1,000[4]	1,000[4]	500[4]	-	-
Network activities	500	500	500	500	-
Total	113,850	113,850	113,850	113,850	113,850

1. Includes the costs of meetings of project team members with the collaborators.
2. Includes the costs of project planning/workplan meetings.

3. Money saved from previous years will also be added to this amount for regional workshop purposes.
4. Short-term training of ICRISAT and national staff in specific areas of the project work.
5. For purchase of a neutron probe and a weather station to be placed in the region at benchmark sites.
6. Required for the purchase of data recording systems and runoff recorders.
7. For a laptop or an equivalent computer.

8&9. To meet the component replacement costs of the items purchased in the previous years.

Note: Costs in parentheses not included in the total budget

15. Environmental stability/sustainability: Sustainability - Ranking = 5

Soil and water management practices which specifically are aimed at reducing soil erosion and water loss will be identified. Appropriate IPM/IDM practices for the production systems will also contribute to environmental sustainability.

16. Relationship to other projects:

This project will have strong linkages with MCSP 2, ECON 1, ECON 2, SG 5, PM 2 and IPM/IDM research in other SCSPs projects. Information collected on resources, constraints (abiotic/biotic/socioeconomic), and opportunities for increased crop production will be exported to projects SG 5 and IPM/IDM research in SCSPs. Improved cultivars of sorghum and pear millet produced in SG 5 and PM 2 will be imported into this projects activities for integration with soil, water, and nutrient management technologies. Information generated on socioeconomic constraints to *rabi* sorghum production will be exported to ECON 1. Subproject milestones identified for import/export are 1.1, 1.2, 1.3, 1.4, 3.2, 4.1, 4.2, 4.3 and 5.1.

17. Gender implication:

Role of gender is vital in adopting improved soil and water conservation practices and the integrated pest/disease management strategies. One of the output of the subproject will provide the information about the effective participation of gender in community based development programs

18. Prospects for special funding

19. Index of priority: I = 36.67
II = 30.64
III = 31.06

20. Indicative funding: $ 113,850 yr^{-1} (1995-1995)

Appendix I
Subproject D

Evaluation of the effects of different crop and soil management strategies on pest, disease, and weed management dynamics, and adverse effects of pesticide residues

MCSP 3 SUBPROJECT D: PESTICIDE RESIDUES

1. **Title: Evaluation of the effects of different crop and soil management strategies on pest, disease, and weed management dynamics, and adverse effects of pesticide residues.**[1]

Keywords: Pesticide residue, human health, environment, farmers' perception

Background, Needs and Opportunities:

Pesticides are used to minimize crop loss due to infestation by insect-pests, fungi and other organisms. In some cases, these resulted in soil quality degradation, contamination of water, food and the environment, decimation of natural predators and human health hazards. The pesticide residues in the soil create variety of hazards. These adversely affect the soil beneficial organisms and inhibit the microbial population thereby reduce nitrogen fixation and nutrient availability The toxic effects of pesticides in the form of food and water contamination and environment also affect human (and animal) health and their productivity. Proper understanding of adverse effects of pesticide use in agriculture on the environment and human health is a necessary pre-requisite in the development of appropriate technological and management practices.

Cotton and pigeonpea are important crops in PS 7 and PS 8 Cotton is affected by as many as 135 species of pests In India, the crop occupies about 5 percent of the cultivated area, but consumes more than 50 percent of the total pesticides used in agriculture. Similar intensity of pesticide use is reported for pigeonpea and groundnut. In many situations the escalation in pesticide use has been greater than might seem rational because farmers often incorrectly perceive both the nature of the pest problem and the means available to control it

The proposed research will aim at selected benchmark sites to investigate insect/pest management practices adopted by the farmers, and examine the externalities caused due to indiscriminate use of pesticides in cotton and pigeonpea An attempt will be made to study perception about pesticide effects on health and environment because these vary widely among farmers This research will lead to identification of suitable methods of pesticide use that minimize the adverse effects of the pesticide use in PS 7 and PS 8

2. **Objectives:**

   I. To characterize pesticide use in cotton and pigeonpea base cropping system.

   II. To evaluate the consequences of pesticide use on environment and human health.

3. **Supertheme(s)/research areas:**

Theme #	Title	Total SSY	Proportion involved (%)
50	Characterization of environment	0.60	13.30
52	Natural Resource	1.45	2.00

1. This sub-project is designed to generate sufficient information to develop an externally funded project on "Identify strategies to alleviate/minimize adverse effects of chemical pesticides".

4. **Link project:**

- for management	:	MCSP 3
- for research outputs	:	MCSP 2 & 1, SCSP (PP1) and all projects dealing with IPM/IDM

5. **Crop and/or systems involved** : Cotton and pigeonpea based systems.

6. **Region(s) of inference:**

- primary production system(s)	:	PS 7 and PS 8
- secondary production system(s)	:	PS 9 and 15

7. **Central database file numbers:**

- Production systems	:
- MTP themes	:
- Other	:

8. Research strategy and requirement:

Research Activity/ type	Description of activity	Status	Disciplines involved	Level and duration of appointment			Location of research	Model system	Year		Research Methodology	Partners	Budget (US $)	
				IRS	TS	FS			Initiation	Completion			1996	1996
Diagnostic	D1	2	SEPD	0.05	0.07	0.20	Akola Parbhani Indore	PS 7	1995	1996	Review of literature, On-farm and re-connaissance survey; Data from pesticide companies	NARS in India	5,175	5,175
Diagnostic	D2	1	SEPD	0.05	0.08	0.30	Akola Parbhani Indore	PS 7	1995	1996	Farmers' interview and data analysis	NARS in India	11,200	11,200
			SACD	0.05										

D1 = To characterize damage due to pests, diseases and weeds in a few selected sorghum- r cotton-based systems (IAC/WCA).
D2 = To evaluate consequences of excessive pesticide use on environment from secondary d ita

9. Research team:

IAC:

Discipline	Person Years			
	1995		1996	
	SEPD	SACD	SEPD	SACD
IRS	0.10	0 05	0.10	0.05
TS	0.10	--	0.10	--
FS	0.50	--	0.5	--

10. Milestones:

1.1 Identify and quantify different forms of pesticides used in cotton, pigeonpea, sorghum and millet over the past few years.

1.2 Quantify the residue build-up of pesticides in the soil and quantify their negative effect on productivity and sustainability.

1.3 Quantify the adverse effects of pesticides on the human health (both who regularly apply pesticides and live in high pesticide using region).

2.1 Identification of existing pest control practices employed by the farmers, and estimation of their cost- effectiveness.

2.2 Comparison of measured and farmers' estimates of different pests damage and the efficacy of pesticides on cotton and pigeonpea in benchmark sites

11. Probability of success:

Objective	Milestones	Proba-bility of success (%)	Time frame
1. To characterize pesticide use in cotton and pigeonpea base cropping system.	1.1 Pesticide use 1.2 Negative effects of pesticides 1.3 Pesticides and human health	80 60 60	1995-1995 1995-1996 1995-1996
2. Evaluate the consequences of pesticide use on environment and human health.	2.1 Cost-effectiveness of pesticide control measure. 2.2 Farmers' perception on pesticide externalities	80 60	1995-1995 1995-1996

12. Economic value (Million US$) of success:

13. Technology exchange activities:

Item	Y1	Y2
Publication type	1 CP	1 JA 1 CP 1 RB
Workshop/ Conference	--	--
Training (in-service staff-NARS)	--	--
Network activities	--	--

14. Budget:

Head of expenditure	Year 1 (1995)	Year 2
Salaries	15,880	15,880
Operating	-	
Travel	680	680
Total	16,560	16,560

15. Environmental stability/sustainability: Sustainability ranking - 5

Sufficient information will be generated how excessive use of insecticides and pesticides affects food, soil and water, beneficial organism and human health. The information will be used to direct research strategies to minimize pesticide hazards for sustainable development.

16. Relationship to other projects:

Output of this subproject will be of importance to all projects dealing with IPM/IDM.

The subproject will initiate collaboration with important institutions in India, viz. IPM Institute (ICAR), Cotton Research Institute (ICAR); APAU Research Center, Guntur, and some NGO.

17. Gender implications:

Implication of pesticide use on gender will be an important output of this study. The information will increase awareness about use of pesticides vis-a-vis gender issues.

18. Prospects for special funding:

The outputs of the subproject will be used to develop a project for external funding. EPA(USA), USAID, Ford Foundation, GTZ and ODA may be potential donors for detailed project. Support may also come from health oriented organizations, save the children, WHO, etc.

19. Index of priority:

I = 50.15
II = 50.10
III = 50.75

Appendix II
Interaction with NARS (Asia—India)

Discussions with Central Research Institute for Dryland Agriculture (CRIDA) and National Bureau of Soil Survey and Land Use Planning (NBSS& LUP)

MCSP 3: INTERACTION WITH NARS (ASIA—INDIA)

Discussions with Central Research Institute for Dryland Agriculture (CRIDA)
21 September 1994

Ten senior CRIDA staff led by Director Dr. J.C Katyal met with 12 ICRISAT staff headed by Executive Director, IAC, Dr. C. Renard to discuss cooperative research linkages with ICAR for the sustainable management of resources in production systems 7 & 8 in India. Dr. Katyal welcomed the participants and requested Dr. Renard to chair the session Dr Renard thanked Dr. Katyal and his staff for organizing the discussion He said that the MCSP-3 documentation was well-written; it provided a clear understanding of the project, its objectives and goals, and the necessary background information for identifying research areas of complimentarity.

The overview: Dr. S M. Virmani presented a broad overview of the research organization and management changes that have taken place at ICRISAT during the past few years. He traced the history of Medium Term Planning (MTP) process and highlighted the methodology used for identifying and prioritizing research themes. The databases used in the delineation of the Production System were discussed. The formulation of 23 global research projects was explained with a special reference to the Multi-commodity System Projects (MCSPs). It was noted that a close working partnership with the National Agricultural Research Systems is envisioned in our MTP. The consultations on the frame work for identifying and prioritizing research projects has been done at several levels It is a stepped process Today's CRIDA meeting may be seen as one in a continuum of consultations with NARS for our global projects Our objective is to find out the research activities which are of significant interest to CRIDA within the broad ecozones defined by PSs 7 and 8.

The priority areas of collaboration: Drs K B Laryea, S P Wani, Piara Singh, and P.K Joshi presented highlights of the 4 subprojects of MCSP-3 These subprojects are sustainable management of (A) high water- holding soils (e g., Vertisols) in PS 7; (b) limited water-holding soils (e g., Vertic Inceptisols) in PS 7; (C) postrainy season (rabi) cropped areas in PS 8; and (D) pesticide residues and their impacts in PS 7. The suggested areas for collaboration for each of the subprojects were identified It was stated that the MCSP 3 document is a draft; and that changes will be incorporated after the process of consultations is completed within and outside of ICRISAT.

The salient points of discussion: Dr. Katyal stated that the project was well presented and good details for each of the subprojects have been obtained. Concern was raised on the nature and mode of collaboration. It was agreed that joint research would be undertaken within an activity by teams of ICRISAT and CRIDA staff. Some notable points:

- The method of priority accorded to different activities within subprojects was raised. It was stated that CRIDA staff's view points should also be recognized. It was clarified that ICRISAT's projects are global in nature. The need for integration of view-points of ICRISAT and CRIDA was appreciated. It was agreed that joint planning teams would formulate research program and only priority areas would be investigated.

- It was suggested by CRIDA, and was agreed by all concerned that joint review of the work already done should be completed before work plans are detailed.

- It was pointed out by CRIDA that in PSs 7 and 8, a large proportion of Alfisols exist. It was agreed that

collaborative work will not be limited to Vertisols. Alfisols research will be jointly undertaken with MCSP 2 and MCSP 3 and appropriate linkages would be established.

- A question on the methodology used for identifying constraints was raised. Dr. Katyal was given a copy of MTP Vol. I for consultation.

- Because of the shift of ICRISAT's emphasis to impact, point on the future working relationship between CRIDA and ICRISAT was raised. It was clarified that at the 'work plan' preparation stage the respective responsibilities of each of the institutions would be clearly defined. Direct scientist – scientist contact would be encouraged.

- The issue of watershed approach for sustaining dryland production was raised. CRIDA has undertaken extensive studies on a series of watersheds across India. It was stated that watersheds would continue to be loci for the integration of improved dryland technologies.

- A question on the validity and need of diagnostic work was raised. It was clarified that it would be need-based. Whereever our literature survey shows that adequate diagnostic work has already been done, this activity would be deemphasized.

- Dr. Potdar circulated data showing that the yield gap analysis between farm-level yields of some of the major crops grown in MCSP-3 and the researcher reported yields. This gap is fairly large. It was agreed that we need to determine (a) why such a large yield-gaps continues to exist; and (b) why farmers do not adopt improved dryland technologies on a wider-scale.

Closing remarks: Dr. Renard stated that ICRISAT's global research projects (e.g., MCSP-3) provide an excellent opportunity to serve as contact point between IARCs and national institutions and thanked CRIDA for the opportunity provided for discussion.

Dr. Katyal thanked ICRISAT staff for exposing CRIDA scientists to the new project formulation mode. He appreciated the renewed efforts of ICRISAT for joint work with CRIDA. He was confident that the documents circulated would form an excellent basis for finalizing the collaborative research program. Dr. Katyal especially thanked Dr. Charles Renard for taking time to Chair the session, particularly at a time when he is extremely busy with the staff management affairs of the institute.

ICRISAT-CRIDA Meeting on MCSP-3

21 September 1994

Venue: CRIDA

Chair: **C. Renard**

1530-1535	Opening remarks	J.C. Katyal
1535-1550	Structural changes in ICRISAT's research planning process and MCSP-3	S.M. Virmani
1550-1605	MCSP-3 subproject A: Sustainable management of Vertisols in PS 7	K.B. Laryea
1605-1615	MCSP-3 subproject B: Vertic Inceptisols in PS 7	S P. Wani
1615-1625	MCSP-3 subproject C: *Rabi* areas	Piara Singh
1625-1630	MCSP-3 subproject D: Pesticide residues: Impacts	P.K. Joshi
1630-1720	Discussion	
1720-1730	Closing remarks	J.C Katyal

List of Participants

ICRISAT

C. Renard
S.M. Virmani
K.B. Laryea
K.K. Lee
S.P. Wani
Piara Singh
T.J. Rego
M.V. Potdar
G. Alagarswamy
K.L. Srivastava
P.K. Joshi
N.K. Awadhwal

CRIDA

J.C. Katyal
Srinivas Sharma
D. Gangadhar Rao
B.V. Ramana Rao
G.R. Korwar
B. Venkateswarlu
Y.S. Ramakrishna
K.P.R. Vittal
K.L. Sharma
M. Narayana Reddy

Discussions with National Bureau of Soil Survey and Land Use Planning (NBSS&LUP)
6-7 October 1994

A joint meeting of scientists from the National Bureau of Soil Survey and Land Use Planning (NBSS&LUP) and the ICRISAT was organized on 6-7 October 1994. Prof. J. Sehgal, Director, NBSS&LUP, chaired the meeting. The principal purpose of the meeting was to develop collaborative research of mutual interest in Production Systems 7 & 8 to alleviate production constraints and efficient management of natural resources. Prof. Sehgal welcomed the ICRISAT team, and the participating scientists from NBSS&LUP. He briefly narrated the activities of the Bureau. He also explained the background and the purpose of the joint meeting.

Dr. K.B. Laryea thanked Prof. Sehgal and the participating scientists from the Bureau for providing the opportunity to the ICRISAT team to present the MCSP 3. He conveyed message of Dr. Virmani, who was at Niamey to attend the PTLs meeting of MCSPs. Dr. Laryea expressed Dr. Virmani's apologies for his inability to attend this important meeting. Dr. Laryea stated that the document on MCSP 3 is yet to be finalized and sought suggestions from the participating scientists for its improvement. He also welcomed the scientists from Bureau to identify the research activities of mutual interest for future collaboration.

After providing brief background, Dr. Laryea presented the organizational and management changes at ICRISAT during the past two years in order to serve its clients better. He briefly narrated the ICRISAT's Medium Term Plan (MTP), research prioritization procedure, research theme and development of 23 global projects. He then provided an overview of the MCSP 3 with its broad objectives, production systems coverage and the subprojects. He also presented the subproject on 'Double Cropping'. Subsequently Dr. S.P. Wani presented extract of subproject on 'Vertic' Inceptisols'; Dr. Piara Singh on 'Post-rainy Season Cropping Pattern'; and Dr. P.K. Joshi on 'Pesticide Residues'. The presentations were focused on the objectives, activities and the milestones.

The presentations were followed by a brief discussion. Salient points of the discussion are as follows:

General comments on the project: The project was appreciated with the comment that it was impact oriented. It was observed that it focussed to meet the needs of the region through crop intensification and sustainable use of natural resources.

- It was felt that both the Institutes would benefit through collection and exchange of information and database.
- The concern was that the proposed Production Systems followed by ICRISAT differ from the agroeco-regions finalized by the Bureau.
- It was pointed out that depth criteria should be properly specified for subprojects A and B.
- It was suggested that modalities of collaboration and resource allocation may be discussed and worked-out in a separate meeting.
- Scientists participating in individual experiments should also be included for integrating technologies and modelling activities.

The comments on different subprojects were as follows:

Subproject A

- Besides Alfisols and Vertic Inceptisols, other important associated soils present in PS 7 & 8 may also be considered.
- Relationship between crack size and moisture loss need to be studied. It may help in developing appropriate moisture conservation strategies in Vertisols.
- While studying Integrated Nutrient Management, K and Zn may also be included in addition to N and P.
- There is a need to improve the instrumentation and measurement techniques to quantify various parameters in Vertisols. There are limitations in the existing techniques while applying for Vertisols.
- Following areas/activities were identified for possible collaboration
  - Characterization of resource base, including soil resource mapping (SRM), classification and digitization for generating thematic maps using GIS techniques.
  - Integration and evaluation of technologies
  - Crop modelling

Subproject B:

- Title of the subproject may be amended in view of the appropriate soil classification
- Joint action is required to select benchmark locations
- Many land degradation processes are location specific and need extrapolation of results for other areas. That is to be done very cautiously. The Bureau would like to associate in extrapolation studies through modelling.
- Following areas/activities were identified for possible collaboration.
  - Characterization of natural resources
  - Technical assessment of soil degradation.
  - On-station evaluation of land use systems.

Subproject C:

- Following areas/activities were identified for possible collaboration:
  - Baseline data collection.
  - Soil moisture conservation practices.
  - Integration of technologies.

Subproject D:

- Soil series need to be considered while studying pesticide residues.
- Following areas/activities were identified for possible collaboration:
  - During soil resource mapping, sampling for pesticide residues may be done jointly.

Group discussion: Seven groups were formed for detail discussions of relevant research activities. These were related to characterization, soil resource mapping, GIS, morphology, agronomy, soil fertility, and constraint analysis. Scientists from NBSS&LUP briefly discussed their on-going activities and past achievements. Above listed activities for possible collaboration were discussed in detail.

It was suggested that detailed workplans will be developed once the collaborative activities and the modalities are finalized.

Concluding remarks: The efforts of the ICRISAT were appreciated by Prof. Sehgal in consulting the Bureau while developing the project. It was expressed that the collaboration will be fruitful and productive in alleviating the production constraints of the semi-arid tropics.

Prof. Sehgal thanked the ICRISAT team for involving the Bureau in project development and incorporating the suggestions made during the discussions. He assured full support and cooperation of the Bureau to the project activities. Dr. Laryea extended thanks to Prof. Sehgal and his colleagues for their constructive suggestions and participation in the discussions.

ICRISAT-NBSS&LUP Meeting on MCSP-3

6-7 October 1994

Venue: NBSS&LUP, Nagpur

Chair: **J. Sehgal**

6 October 1994

1000-1020	Opening remarks	J. Sehgal
1020-1040	Changes in ICRISAT research	K B Laryea
1040-1100	Management of Vertisols	K.B. Laryea
1100-1120	Vertic Inceptisols	S P. Wani
1120-1140	Postrainy crop	Piara Singh
1140-1200	Pesticide residues	P.K Joshi
1200-1320	Discussion	
1320-1330	Closing remarks	J Sehgal
1430-1730	Discussion with individual scientists	

6 October 1994

1000-1450	Discussion with individual scientists	
1450-1500	Closing remarks	J Sehgal

List of Participants

NBSS&LUP

Prof. J. Sehgal
Dr. S.T. Gaikawad
Dr K.S. Gajbhiye
Dr S.C Yadav
Dr. R K. Saxena
Dr. R.K. Batta
Dr. D.K. Pal
Mr. Sohan Lal
Dr. O. Challa
Dr. D.B. Tamgadege
Dr. J.P. Sharma
Dr. A.K. Maji
Dr. D.K. Mondal

ICRISAT

Dr K.B. Laryea
Dr. S P. Wani
Dr Piara Singh
Dr. P.K. Joshi