SRI LANKA

IMPACT EVALUATION

Rice Research Project
Loan Number 383-T-016 (383-0040)

Prepared for: United States Agency for International Development, Washington, D.C., U.S.A. and Colombo, Sri Lanka

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ACKNOWLEDGEMENTS

We would like to thank the officers involved in rice research, and the farmers who are trying to apply their results, for giving us their time; Gerry Jayawardena for providing us with valuable background and insights; and Chintha and Devika, Robbie McCloskey and Joyce Kling for patiently typing our manuscript.

EXECUTIVE SUMMARY

1. Name of ANE Bureau Office initiating evaluation: ANE/DP/E

   Title of Evaluation: Impact Evaluation of Rice Research Project (383-0040)

   Date: October 15, 1985 to November 8, 1985

2. Purpose of Project Evaluated

   The purposes of the Rice Research Project (Sri Lanka) were to increase domestic food production (essentially by achieving increased rice output), expand employment opportunities, and improve the living standards of small farmers. The project was to contribute to the achievement of these goals by developing the technological base to permit increased productivity of paddy land.

3. Purpose and Methodology of the Evaluation

   The purpose of this evaluation was to measure the impact of the Rice Research Project on Sri Lankan rice production and on the intended beneficiaries: the Department of Agriculture (DOA), the Regional Research Centers (RRC), and paddy farmers. This evaluation was conducted three years after the conclusion of the major portion of the project. The evaluation methodology included visits to 11 research stations, interviews with administrators, researchers, extension personnel and farmers, and a review of documents relating to the project or relevant to project activities. Secondary data was obtained from the Agricultural Economics Division of the DOA, the data bank at the Agrarian Research and Training Institute (ARTI) and other sources cited in Appendix 8.4.

4. Findings

4.1 Institutional Development

   The RRP gave added impetus and resources which contributed to a change in rice research in Sri Lanka. The positive effects of the RRP contribution to training and commodity availability are still being felt in the DOA. However, the efficiency and effectiveness of RRP assistance were reduced by poor management of the project and by continuing weaknesses in research planning and bureaucratic obstacles within GSL.

4.2 Research Achievements

   The rice varietal improvement program was strengthened during the course of the project and remains currently active. Twelve new varieties were released during the course of the project, two new

varieties have been released since project completion, and many others are in the breeding pipeline. New varieties developed continue to be bred for resistance to pests and diseases and adaptation to various agro-ecological zones. The varieties have been readily adopted by farmers. Development of agronomic practices appropriate for small paddy farmers has progressed slowly due to continual difficulties in establishing field trials or an adaptive research program. Strong linkages exist between research and extension.

4.3 Impact on Rice Production and Farms

The project contributed to increased rice production through support of the development of new varieties. Rice production has increased to the point that Sri Lanka has become virtually self-sufficient in rice. Farmers net returns per acre and per bushel from rice have decreased due to increased costs of production per acre and per bushel. Intensified cropping systems have been adopted by high resource farmers but are not a practical option for farmers with economic or environmental constraints.

5. Recommendations

Detailed recommendations are included in Chapter 1 of this report. The recommendations cover the following general measures:

5.1 Programming of training, selection of trainees and selection of courses should be coordinated with other planned activities external to the project, such as staff recruitment and staff upgrading on a research center as well as a division basis.

5.2 Training for technical support staff of other than Research Officer grade should be supported.

5.3 A careful examination of the conditions under which vehicles/equipment/materials will be used should be undertaken before detailed procurement specifications are prepared.

5.4 U.S. manufacturers and suppliers should be encouraged to become familiar with the foreign conditions under which their goods will be used and adapt their products to the needs of users in recipient countries.

5.5 USAID should support the review of the appropriate functions and deployment of resources to the regional research centers.

5.6 USAID should work with PGIA and DOA to develop an in-service training program on research planning and management.

5.7 Regional rice breeders should continue to select varieties adapted to limiting conditions and resistant to pests and diseases.

5.8 Researchers should work closely with extension to assess the potential of various agronamic practices for farmers with limited resources.

5.9 The DOA should seriously consider how it can effectively build on the foundations for adaptive research which have been established under the World Bank Agricultural Extension and Adaptive Research Project.

5.10 Research and extension efforts to improve cropping systems should consider alternatives other than cropping intensity.

5.11 The DOA should direct research efforts to minimize costs of production of rice and improve production of other food crops.

5.12 The GSL should develop economic policies that maintain farm incomes in the event of surplus rice production.

BASIC PROJECT IDENTIFICATION DATA

1. Country: Sri Lanka

2. Project Title: Rice Research Project

3. Project Number: 383-0040 Loan No. 383-T-015

4. Project Dates:

a. First Project Agreement:	January 25, 1977
b. Final Obligation:	January 25, 1977
c. Project Activity Completion Dates:	
Technical Assistance	June 30, 1982
Commodities	August 15, 1982
Training	June 30, 1984

5. Project Funding:

a. AID Bilaterial Funding:	3,800,000
b. Other Major Donors:	200,000
c. Host Country Counterpart Funds:	3,222,000

6. Mode of Implementation:

a. Contract between Department of External Resources (GSL) and the International Rice Research Institute (IRRI)
b. Contract between Department of External Resources (GSL) and the Institute of International Education (IIE)
c. Direct Reimbursement Account

7. Project Design:

The Government of Sri Lanka and USAID/Colombo

8. Responsible Mission Officials:

a. Mission Directors: Mr. T. Arndt (AID Rep.)
Ms. S. J. Littlefield
b. Project Officers: Mr. [illegible]. Antholt
Mr. [illegible]. Wilson
Mr. J. Bonner

9. Previous Evaluations and Reviews:

a. Project Review:	- August 3, 1978
b. Project Review (2nd Year)	- May 21, 1979
c. End-of-Project Evaluation	- August 20, 1982

10. Cost of Present Evaluation:

	Person Days	Dollar Costs
a. Direct Hire:		--
b. Contract:	58	13,907
c. Other:	--	--

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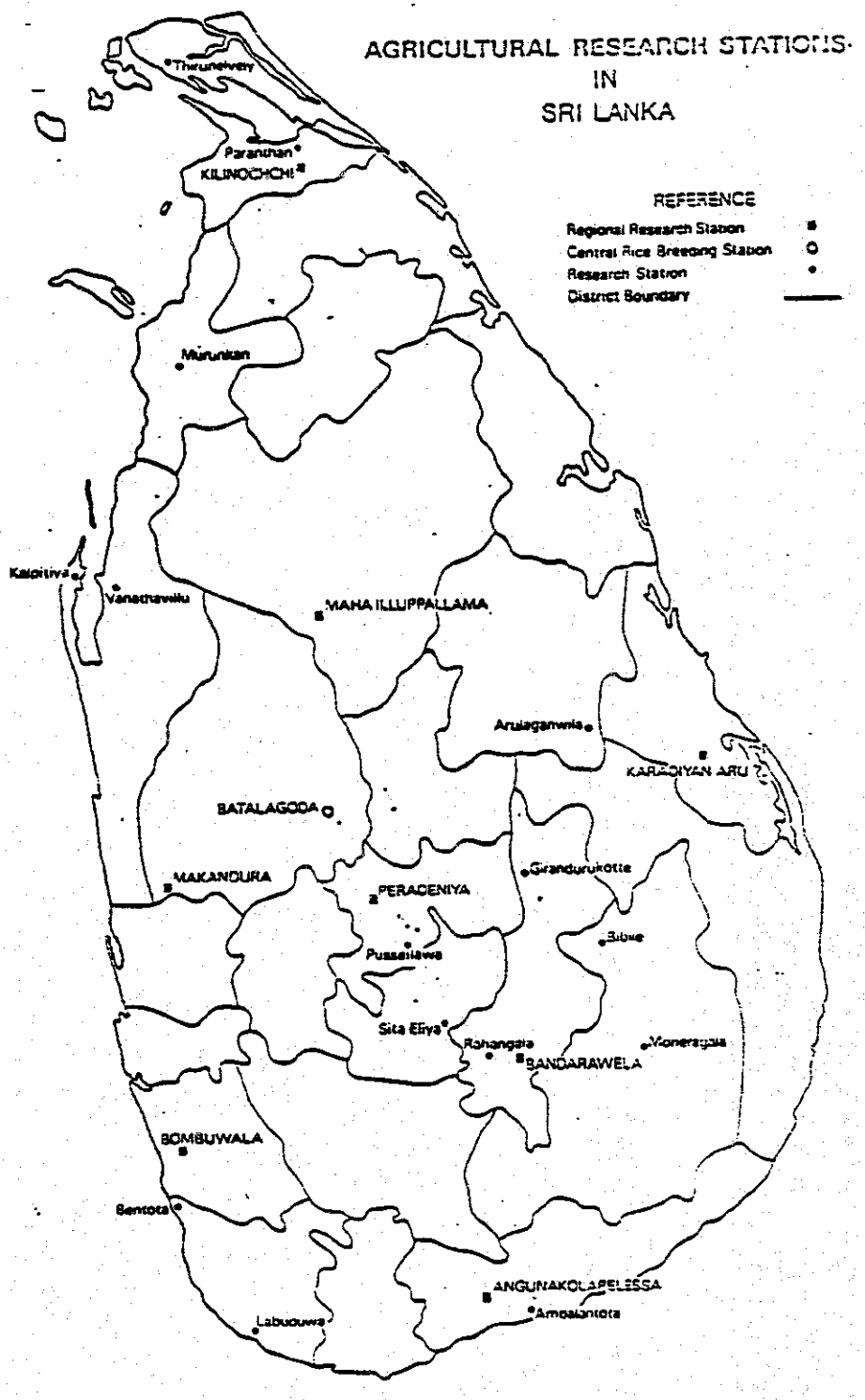
ACRONYMS AND ABBREVIATIONS

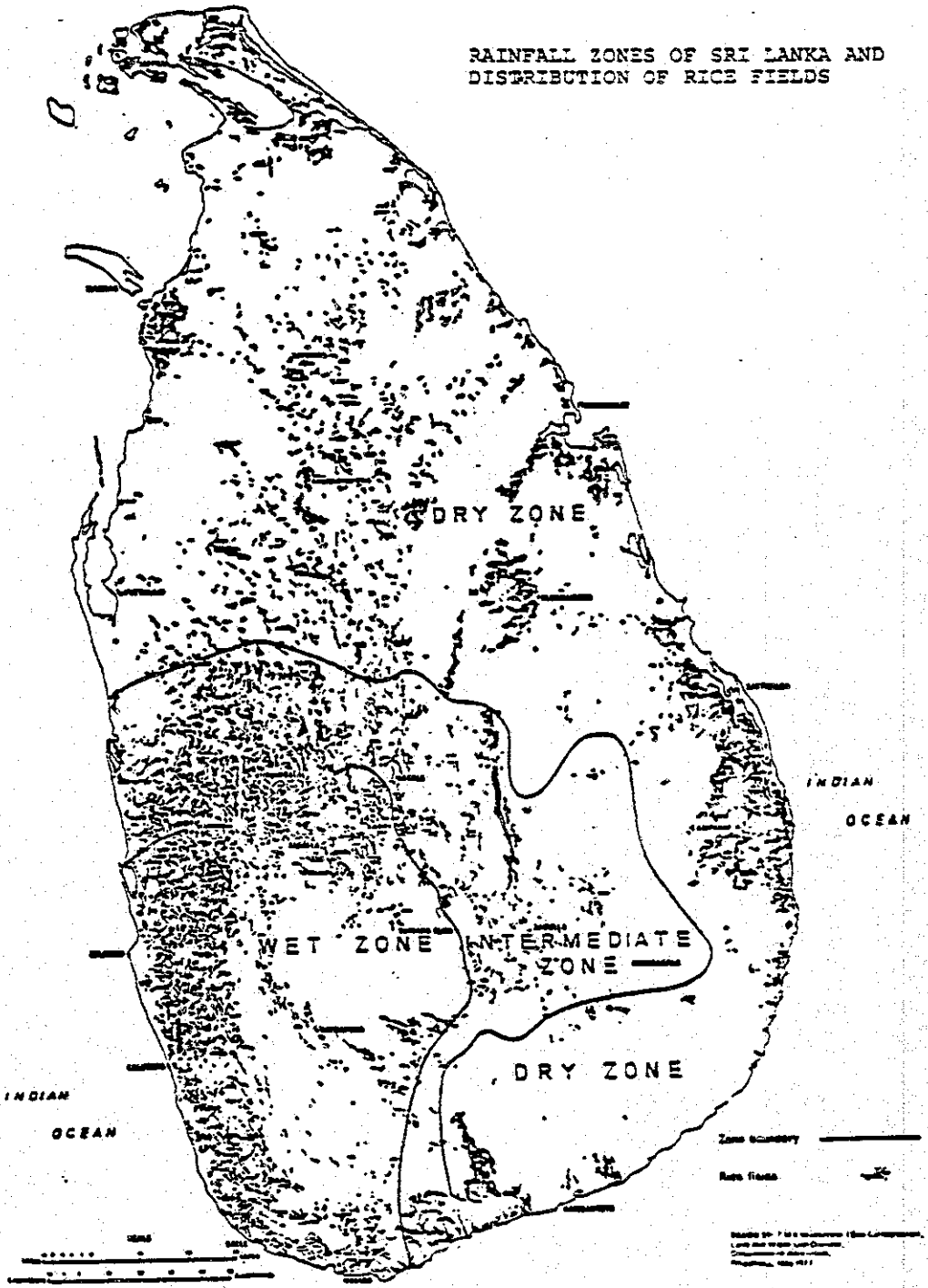
AE&P	Agricultural Economics and Planning Division, Department of Agriculture
AERP	Agricultural Extension and Research Project (World Bank)
AI	Agricultural Instructor
ARG	Agricultural Research Group
ARTI	Agriculture Research and Training Institute
CARI	Central Agriculture Research Institute
CRVT	Coordinated Rice Varietal Trials
DARP	Diversified Agriculture Research Project (USAID)
DOA	Department of Agriculture, Ministry of Agricultural Development and Research
EO	Experimental Officer
FAO	Food and Agriculture Organization
GEU	Genetic Evaluation and Utilization (Program of IRRI)
GSL	Government of Sri Lanka
IDRC	International Development Research Centre (Canada)
IRRI	International Rice Research Institute
ISNAR	International Service for National Agricultural Research
NIV	New Improved Rice Variety
OIV	Old Improved Rice Variety
PGIA	Postgraduate Institute of Agriculture
PMB	Paddy Marketing Board
RA	Research Assistant
RBC	Rice Breeding Center, Batalagoda
RO	Research Officer
RRC	Regional Research Center
RRP	Rice Research Project
RTWG	Regional Technical Working Group
UPLB	University of the Philippines (Los Banos)
USAID	United States Agency for International Development
VAT	Varietal Adaptability Trial

MAP 1


AGRICULTURAL RESEARCH STATIONS
IN
SRI LANKA
REFERENCE
Regional Research Station
Central Rice Breeding Station
Research Station
District Boundary
Thirunelvely
Paranthan
KILINOCHCHI
Mullaitivu
Kalpitiya
Vavuniya
MAHA ILLUPPALLAMA
Anuradhapura
KARAIYAN ARU
BATALAGODA
MAHANDURA
PERADENIYA
Girandurukotte
Bibile
Pussellawa
Sita Eliya
Rahangala
Monaragala
BANDARAWELA
BOMBUWALA
Bentota
ANGUNAKOLAPELESSA
Ambalantota
Labuduwa

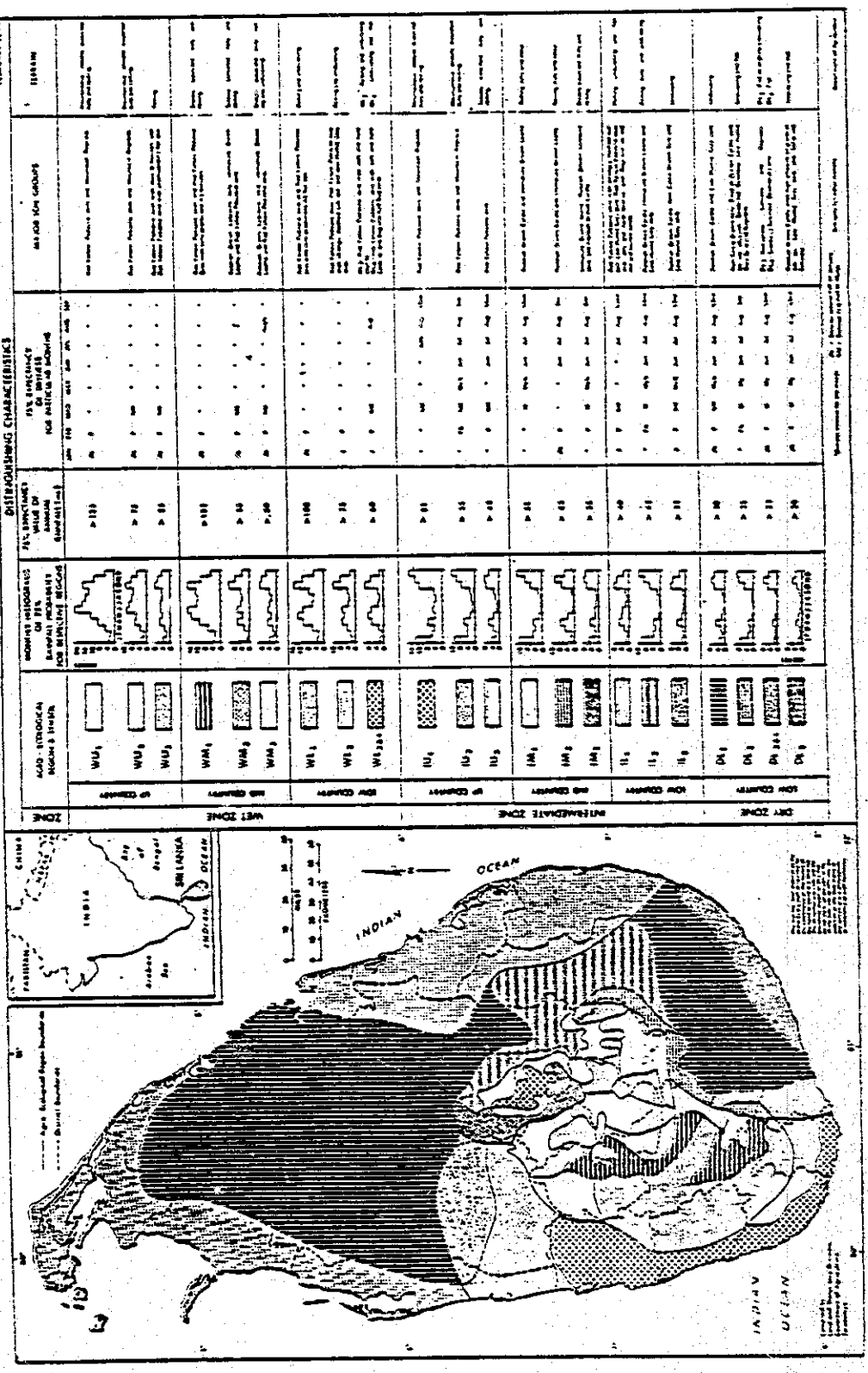
MAP 2

RAINFALL ZONES OF SRI LANKA AND DISTRIBUTION OF RICE FIELDS



AGRO-ECOLOGICAL REGIONS

MAP 3



1. CONCLUSIONS AND RECOMMENDATIONS

1.1 INSTITUTIONAL DEVELOPMENT

1.1.1 The Expansion of Rice Research Capacity

Conclusions

The training component of the RRP has continued to make an important contribution to the quality and relevance of rice research in Sri Lanka.

During the life of the project, the RRP was a major source of foreign resources for rice research and gave a significant impetus to the expansion of rice research capacity in Sri Lanka.

Staff In-Post and Trainee Achievement of Potential

The majority of the staff trained under the RRP have returned to government service, mostly in the Research Division of the Department of Agriculture, and the number of long term trainees under the project is a significant proportion of the staff with training up to the Masters level. Short-term training for grades other than Research Officers has been useful in improving the quality of technical support for researchers. However, inadequate facilities and weaknesses in research planning and management have constrained many trainees from realising their full potential as researchers.

Attrition Rates and the Location and Programming of Training

Among students who received long-term training the record for continuation in government service among those trained in the Philippines appears to be better than that for students trained in the U.S. or Sri Lanka. A short period of studies overseas was considered a useful antecedent to longer-term studies abroad. Limitations on the training capacity of PGIA indicate a continuing need for overseas training and contact visits. Problems associated with bunching of training have at times left research stations incapacitated.

The Relevance of Training

Most of the trainees have been able to apply their training to their research work, although there were instances of *ad hoc* selection of trainees for inappropriate courses.

The Impact of Civil Strife

Civil strife in the country has brought research work in to a virtual standstill in the east. As a result of lack of communication, the extent of research work occurring in the North is unknown to other researchers and administrators. Maha Illuppallama and Bandarawela Regional Research Centers reported some loss of Tamil staff as a result of the ethnic tensions and three of the six Masters students who did not return to government service in Sri Lanka were Tamils.* Other than these losses, officers at the research stations visited by the evaluation team, did not feel the civil strife was adversely affecting their research work.

Effect of the Shortfall in Ph.Ds Trained under the RRP

The shortfall in Ph.D trainees has meant that about one-third of the people with doctorates are occupied in direction and administration of research. The direct involvement of Ph.Ds in agricultural research has consequently been constrained. This has probably reduced the depth of analysis and the amount of innovation in research work.

GSL In-Service Training

GSL has not developed its own in-country in-service training program for research workers, but has continued to rely entirely on donor funding for short-term research training, primarily overseas. As long as donor funding is available for such training, as appears likely through the USAID-assisted Diversified Agriculture Research Project (DARP) and the pending World Bank Agricultural Research Project, GSL's reliance on outside funding is understandable. However, donors should work with GSL to strengthen in-country training capacity for researchers. An important area for improvement is research planning and management.

Recommendations

1. USAID projects for the support of research should include a substantial provision for short-term non-degree training for research and technical support staff. Some of this training, at graduate level, might be provided through PGIA.

2. When appropriate, USAID research-support projects should provide for participation in short-term overseas courses before trainees with limited overseas experience are sent abroad for long-term training.

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*Two of the three were a married couple.

3. Those administering agricultural research training projects should arrange that postgraduate programs combine work in Sri Lanka with work overseas.

4. USAID should work with PGIA and DOA to establish remedial programs in English, mathematics, and statistics for students who are otherwise qualified for postgraduate study overseas but who have failed to satisfy entrance requirements in those subjects.

5. In future training projects the training plan should be coordinated with other planned activities external to the project, such as staff recruitment and staff up-grading not only on a division, but also on a research center basis.

6. Administrators of training projects should carefully coordinate the research disciplines of trainees with the subject matter of the courses in which they will participate. This should be oriented to insuring that trainees will be able to make a fairly immediate contribution to improved research as a result of their training.

7. USAID should consider a means of setting aside agricultural research project funds for the rehabilitation of the research stations in the north and east, to be used when peace is restored in those areas. GSL should be encouraged to do likewise.

8. Given the shortages of Ph.D.'s in the Research Division, DOA should reconsider its deployment of experienced staff between CARI and the regions. It may be necessary to pool scientists with advanced training so that they are able to design programs and supervise work on a number of regional stations. At the same time experienced staff with Masters degrees should be given a series of short in-service management courses so that they can better administer adaptive research work at the stations to which they are posted.

Equipment and Facilities

Conclusions

It was generally felt by Research Station Directors that the availability of RRP commodities gave a needed boost to research activities at a crucial time in the process of regionalisation. Nevertheless, the RRP experience with commodity supplies emphasizes the importance of careful planning in procurement to avoid the waste which was clearly evident. The evaluators' inspections suggested that the simplest supplies were the most used and useful. It also appeared that the smaller stations, with more limited access to donor contributed commodities, were the most resourceful in their use and maintenance of the supplies provided by RRP.

Recommendations

1. The purchase of commodities should be linked to specific research plans and activities.

2. A careful examination of the conditions under which vehicles/ equipment/materials will be used should be undertaken before detailed procurement specifications are prepared. Attention should be given to the local availability of an agent, spare parts, and special skills necessary for repair and maintenance. Commodities should be robust enough to withstand handling by inexperienced users. Electrical equipment should be easily adaptable to local power supplies and be able to withstand sharp fluctuations in power.

3. People trained in the use of equipment should be on the staff of the station for which the equipment is procured. Ideally the researcher who will use the equipment should prepare detailed technical specifications for the tender/order documentation.

4. A thorough examination of existing RRP equipment should be undertaken before further research equipment is procured with USAID funds.

5. If U.S. commodity assistance is to be linked to the purchase of U.S. goods it is essential that there be a complementary effort to insure that U.S. manufacturers and suppliers become familiar with the foreign conditions under which their commodities will be used and adapt their products to the needs of users in recipient countries.

Budget

Conclusion

The rice research budget has undoubtedly been affected by the real decline in the overall DOA research budget since 1982. Limited funds have adversely affected staff mobility and the maintenance of facilities. Low staff salaries have also affected staff morale and reduced the incentive to work. Difficulties in obtaining foreign exchange have made it difficult to purchase equipment, spare parts and research materials which are unavailable in Sri Lanka. In addition, bureaucratic red tape has slowed the ability of research station directors to spend the money which they have been allocated.

Recommendation

1. Further USAID agriculture research projects should work with the DOA to implement the measures for research management improvement outlined in the National Planning Division report to the World Bank for a Sri Lanka Agricultural Research Project.

1.1.2 New Approaches to Research

Regionalisation

Conclusion

The RRP made an important contribution to developing the capacity for regional rice research through the well-timed provision of training and, less effectively commodities to the Department of Agriculture's (DOA) newly designated (in 1977) Regional Research Centers. However, although the benefits of this assistance are still being felt, current thinking indicates that until more researchers have been trained to Ph.D. level there are too few well-trained researchers for each RRC to be fully effective (ARG/ISNAR 1984:18). Furthermore, there are persistent problems in attracting and retaining experienced staff for the regional stations--particularly Angunakolapelessa. There are also the current difficulties with maintaining regional activities in the areas served by Kilinochchi and Karadian Aru RRCs. Consequently the goal of regionalisation can be said to be only partially achieved. The role which should be given to the Central Agricultural Research Institute as a pool of experience and a repository of more sophisticated types of equipment is being reviewed.

Recommendation

1. USAID should support the review of the appropriate functions of and the deployment of resources to the regional research centers. The objective of this review should be to improve the efficiency of utilization of human and material resources without undermining the fundamental rationale behind regionalisation.

Expanded Breeding Program

Conclusion

The work of RRP trainees, the availability of certain RRP commodities, and the foundations laid with the assistance of the IRRI resident scientist in charge of the Rice Breeding Program have made a noticeable contribution to an expanded rice breeding program. However, the rate of progress has probably suffered in recent years as the morale of researchers has declined in the face of budgetary and bureaucratic constraints.

Recommendation

1. DOA should make funds available to improve the living facilities provided for researchers at the smaller regional research centers. The single men's quarters at Angunakolapelessa in particular could benefit from some furniture and decoration.

Genetic Evaluation and Utilization (GEU) Program

Conclusion

Although the formally constituted "GEU teams" envisaged in the Project Paper are not in evidence, rice breeding work is clearly interdisciplinary and has been supported by the training received through RRP.

Recommendations

1. The Annual Rice Conference held until 1984 has been supplanted by a more broadly focused Annual Research Conference. The DOA should therefore institute a smaller scale forum for interdisciplinary exchange on rice research to complement the work of the existing single-discipline committee meetings.

2. DOA should make funds and time available for researchers in the more isolated research stations to make a regular (monthly or bi-monthly) visit to CARI to consult other researchers and the library facilities. A special effort should be made to incorporate junior researchers, who tend to be by-passed, in this program.

Coordination of Rice Research and Cropping Systems

Conclusion

The impetus to cropping systems research provided by the RRP is still evident in cropping systems work currently being undertaken on the RRC's. Cropping systems research has made an improvement over previous, commodity-oriented research by considering the complex interactions that exist between farmers' diverse cropping activities and by considering the socio-economic constraints facing farmers. Many of the researchers interviewed expressed an awareness of the institutional and financial constraints small farmers face in increasing their income. However, the agricultural economists at most research stations are primarily involved in routine collection and reporting of statistical information and are marginal to the research activities of other scientists at the research stations. Diagnostic socio-economic research at the producer level has only been done in a few cases.

Recommendation

1. The job specifications for agricultural economists at research stations should provide for the allocation of half their time to diagnostic field research and they should be expected to work with and report to their fellow researchers at each station. If necessary, additional Economic Assistants should be recruited to enable the agricultural economists to spend less time on the collection of routine statistics and more time on research.

Regional Field Trials and Adaptive Research

Conclusion

The planning for the establishment of regional field trials was ill conceived and the subsequent attempts to establish the trials were badly administered by both the RRP technical adviser and by DOA. The adaptive research program established subsequently under the World Bank Agricultural Extension and Research Project still suffers from a lack of commitment from the DOA.

Recommendation

The DOA should carefully assess the level of effort and commitment of resources necessary to conduct regional trials on farmers' fields. Given a commitment to adaptive research/field trials, the DOA should strengthen the management capability of staff assigned to adaptive research and provide basic supplies and vehicles to enable the work to be undertaken effectively.

1.1.3 Research Management and Administration

Conclusion

The primary source of research management training was expected to come from the IRRI technical advisors, but although some contribution may have been made to research progress in rice breeding and cropping systems, the technical assistance was generally considered to be a disappointment. As a result the RRP can be said to have contributed to improved research management only through the lessons learned from the project flaws. Improved management, not only at the policy level, but also at the practical and personnel level is still sorely needed.

Recommendation

USAID should work with PGIA and DOA to develop an in-service training program on research planning and management. This program should be geared to meet the needs of staff at all levels from Directors (research administration, personnel management) to storekeepers (inventory management) and field workers (use, maintenance and simple repair of equipment).

1.1.4 Monitoring and Evaluation

Conclusions

The surveys for the diagnosis of farming systems and monitoring and evaluation of the RRP have been minimal and have provided very little guidance to scientists in their rice research work. However, it has been possible to make some inferences regarding the impact of RRP on the basis

of statistical data routinely collected by the Agricultural Economics Division of DOA.

Recommendations

1. In future projects it is essential that a program and system for project monitoring and evaluation (M&E) be developed from the projects' inception. A specific officer assigned to the project should be given the responsibility of designing the system and supervising and coordinating its implementation.

2. Before undertaking any new surveys, maximum use should be made of statistical material already available in Sri Lanka. An essential step in survey design is an inventory of the large number of unanalyzed and partially analyzed surveys previously undertaken in Sri Lanka. A further description of how this inventory should be used is in Section 5.4.2.

1.2 RESEARCH ACHIEVEMENTS

1.2.1 Generation of New Varieties Adapted to Regional Diversity and Resistant to Pests and Diseases

Conclusions

The rice varietal improvement program was successful during the course of the project and remains currently active. Sri Lanka's varietal improvement efforts were strengthened through training of scientists and provision of basic scientific equipment. New varieties with high yield potential and resistance to pests and diseases were developed. Twelve new varieties were released during the contract period, one of which resulted directly from the project. Since 1982, two new varieties have been released and many others are in the breeding pipeline. Breeding efforts will continue to have payoffs in the future. Germplasm storage, an important aspect of any breeding program, is inadequate.

Varieties were and continued to be developed and tested that are adaptable to the various agro-ecological zones. Research achievements at regional stations include the release of new varieties from two of the regional stations and varieties in the breeding pipeline from two others. Varieties released in the regional stations are particularly suited for regional soil, climatic, and water management conditions. Breeding efforts at the regional stations are sometimes delayed due to lack of facilities for pest and disease screening. Use of new improved varieties has increased steadily in all regions.

Recommendations

1. Regional rice breeding efforts should continue to select varieties adaptable to limiting conditions such as submergence, drought, salinity cold, and problem soils.

2. Rice breeders should continue to work with entomologists and plant pathologists to breed a wider range of varieties resistant to pests and diseases. The multi-disciplinary rice research working groups should improve coordination for the timely screening of varieties for disease and pest resistance. In the future, improved facilities for screening pests and diseases should be developed at regional stations.

3. The DOA should improve facilities for germplasm storage at Batalogoda and the regional stations.

1.2.2 Research on Improved Agronomic Practices

Conclusions

Research efforts on improved agronomic practices have been overshadowed by efforts oriented toward varietal improvement. Research on agronomic practices has focused on (1) fertilizer use, (2) pest control, (3) disease control, and (4) intensified cropping systems. In general, fertilizer recommendations are across the board with little attention to low resource farmers. Pest and disease control efforts have appropriately emphasized minimal use of chemicals. Various weed control practices have been tested, but have not been readily adopted by farmers. The work on intensified cropping systems has been closely linked to the development of new varieties. Recommendations of practices such as dry sowing, row planting, transplanting, timing of planting of alternative crops and use of shorter duration varieties were all outcomes of the cropping systems effort.

Except for the cropping systems effort, limited work has been directed on improving agronomic practices in the different agro-ecological regions or for farmers with varying levels of resources. Lack of an effective field trials program has slowed the progress of research on agronomic practices in different regions. Research has focused on practices directed to maximizing yields rather than optimizing returns.

Recommendations

1. Researchers at regional stations should increase efforts to improve recommendations for agronomic practices which are suited to various agro-ecological zones.

2. Researchers should work closely with extension in the RTWG meetings to assess the potential of various agronomic practices for farmers with various resource levels.

3. Research efforts to minimize costly production inputs through breeding efforts and county-wide disease and pest screening should be continued.

1.2.3 Impact of Resource Capability Studies

Conclusions

Impact of Resource Capability Studies on DOA

The resource capability studies developed a practical basis for regionalization of research, guided breeding efforts--particularly in the wet zone, were used in training for extension workers, and improved communication between research and extension. Under the project, researchers and extesnion staff were trained to identify problems and production potentials of various classes of ricelands.

Unfortunately training in the use of this methodology is no longer taking place, although many of the basic principles developed through the resource capability studies are widely known by researchers and extension. As the DOA looks to increasing emphasis on crop diversification, the riceland classification scheme can be used as a basis for identifying fields suitable for cultivation of other field crops. With the conclusion of the project, the Land and Water Use Divsion has limited funding to continue research or training activities on resource capability.

Relevance of Resource Capability Studies for Different Regions

The resource capability studies were quite successful in identifying agro-ecological zones, endowments, needs and possible uses, and different rice production requirements of land. As planned in the RRP, detailed studies were focused on the wet and intermediate zones. Based on these studies, breeders are tailoring varieties to the conditions of different agro-ecological regions.

Recommendations

1. The DOA should increase support for the efforts of the Land and Water Use Division to continue research on land resource capabilities.

2. Training programs based on the outcome of the resource capability studies should be included in the training program for extension staff and farmers which are conducted by the Education and Training Division at the regional In-Service Training Centers.

3. Cooperation and communication between the efforts of the Land and Water Use Division of DOA and the Ministry of Lands & Land Development should be encouraged.

1.2.4 Linkages Between Research, Extension and Farmers

Conclusions

Regional Linkages Between Research, Extension and Farmers

Linkages between researchers, extension personnel and farmers are well-established. The initiation of regularized regional meetings between extension and research officers in 1978 was a result of the World Bank AERP project. These meetings improved communication between extension and research and were well coordinated with the regionalization efforts of the RRP. Regionalization of research stations and the establishment of working groups (RTGW) now provide a systematic, two-way flow of information between researchers and farmers, through extension. The regularization of the research-extension linkage has accelerated the transfer of technology to farmers. Farmers are knowledgable of the latest research achievements and researchers are generally aware of farmers' problems in their region.

Field Trials and Adaptive Research

The project failed to develop the Field Trials Division. The 1982 RRP evaluation observed that the field trials program had been incorporated into the World Bank's Agricultural Extension and Adaptive Research Project. The goals of the adaptive research program are similar to the field trials concept, the purpose being to conduct trials on farmers fields and to provide a link between research and extension. Unfortunately, the adaptive research centers are not performing the activities anticipated. Buildings have been constructed in various locations, but often no personnel or trained staff are attached to the centers. Problems include lack of trained personnel, assignment of the most junior staff to centers, isolation of the centers, and lack of equipment and vehicles.

Mahaweli-Research Station Link and Farmer Adoption

Recommendations for farmers in the Mahaweli Scheme are developed at rice research stations. Research stations at Batalagoda, Maha Illuppallama and Girandurakotte are extensively involved in research appropriate for the Mahaweli irrigation scheme. Mahaweli provides a significant amount of funding to the DOA research stations. Cropping systems efforts and research on irrigated conditions in the dry zone are directed toward the Mahaweli scheme. Although the extension officers in Mahaweli work under the Maheweli Authority, village-level officers in the Mahaweli scheme have regular contact with research officers through the RTWG. Field level staff in Mahaweli have multiple responsibilities and often have limited training in agriculture.

Farmers in the Mahaweli project often do not follow recommendations due to lack of water or lack of money. The irregularity of the water supply, especially during Yala, has discouraged farmers from increasing cropping intensity and investing in costly inputs.

Recommendations

1. The DOA should continue to have regular RTWG meetings and research-extension dialogues.

2. Agricultural research officers conducting research related to the Mahaweli scheme should develop recommendations for farmers with varying levels of resources and access to water.

3. Agricultural research officers at regional stations should be required to visit farmers' fields at least once monthly.

4. The DOA should seriously consider how it can effectively build on the foundations for adaptive research which have been established under the World Bank Agricultural Extension and Adaptive Research Project.

1.3 IMPACT ON RICE PRODUCTION AND FARMS

1.3.1 Impact on Rice Production

Conclusions

Sri Lanka has become virtually self-sufficient in rice production. During the project, rice production increased from 70 percent to 85 percent self-sufficiency and in 1984 Sri Lanka was nearly 100 percent self-sufficient in rice. Production increased from 80.9 million bushels in 1977 to 119 million bushels in 1983. Increased production occurred as a result of higher yields and increased acreage under paddy cultivation. Average yield per acre increased from 49 bushels per acre in 1977 to 70 bushels per acre in 1983. From 1977 to 1983, production increased in all agro-ecological regions. The project contributed to increased rice production through support of the development of new varieties and practices.

Recommendations

1. Efforts of the DOA to improve production of other food crops should continue.

2. In the event of rice production surpluses, the GSL must develop price policies that do not result in drastically reduced farm incomes.

1.3.2 Cropping Systems Efforts

Conclusions

Efforts at improving cropping systems were aimed at intensifying rice-based cropping systems in various agro-ecological zones. The development of recommendations promoted under the cropping systems program were not based on a realistic assessment of their suitability for farmers. As a result, various levels of success have been achieved in the different regions.

Intensified cropping systems are more widely adopted by farmers with sufficient water, markets for high value cash crops, cooperation among farmers, and sufficient incomes. The most successful site is located in the intermediate zone, where farmers incomes have increased. For farmers in less favorable circumstances, increasing cropping intensity is not an option. Further understanding of the entire farming system is necessary.

Recommendations

1. The principle of designing and basing programs in different agro-ecological zones should be continued by further cropping systems and farming systems programs.

2. Further cropping systems efforts should include recommendations for water management, marketing possibilities, lower levels of inputs, and chena cultivation.

3. Monitoring of the economic impact of cropping systems efforts should be on-going. Economists and technical staff in different regions should discuss the results and develop new action plans.

4. Prior to establishing new cropping or farming systems sites, research officers must attempt to fully comprehend the farmers' system and make careful plans geared towards improving farmers' imcomes. Cropping intensification is not the only alternative.

1.3.3 Impact on Farm Income and Employment

Conclusions

Despite increased yields, net returns per acre and returns to family labor in relation to the wage rate decreased from 1979 to 1983. The costs of production have increased with yields. Expensive inputs such as chemical fertilizer, pesticides and weedicides have increased the cost of production. As a result of high production costs, many farmers must borrow money and are often forced to mortgage their land. For the small farmers with fixed acreage, farm income from paddy has declined.

Recommendations

1. Rice researchers should produce recommendations that optimize farmer's income as compared to only maximizing their yields.

2. More effort by researchers should be directed toward developing alternatives to chemical inputs.

3. Extension officers should be provided with recommendations for both low and high resource farmers.

1.3.4 Socio-economic, Cultural and Agronomic Constraints to Adoption

Conclusions

New improved varieties have been readily adopted by farmers regardless of socio-economic constraints, but some farmers have faced agronomic constraints to adoption of new improved varieties. These include: salinity, lack of water, and submergence. Labor constraints limit the adoption of practices such as dry sowing, early planting, and transplanting. Increasing cropping intensity is limited by lack of resources, limited markets, and lack of water. Adoption of inputs is constrained by lack of money, high risk, land tenure arrangements, and lack of economically appropriate recommendations.

Recommendations

1. Researchers should develop practices that are less dependent on high cost inputs.

2. The DOA should continue to improve activities such as cropping systems, adaptive research, and research-extension communication that bring researchers closer to farmers.

1.3.5 Rice Processing and Marketing

Conclusions

GSL policy for rice processing and marketing is not adequately geared to managing further substantial increases in rice production. The private sector has become the major influence in rice processing and marketing. Based on current production and the limited possibility of export, problems with price stability are imminent.

Sri Lanka's rice milling industry is below the standards of other Asian countries and is characterized by low technology, low quality rice and a high wastage rate. Product development in rice products has been negligible. Actions have been recommended to improve both marketing and processing, but to this date little action has been taken by the GSL.

Recommendations

1. The GSL should develop economic policies to insure an orderly transition for farmers in the event of surplus rice production to insure the maintainance of farmers' incomes.

2. The Paddy Marketing Board should increase investments in equipment or improve incentives for the private sector to improve rice milling.

3. The DOA should train food scientists to develop rice products.

1.3.6 Water Management Activities

Conclusions

The importance of water management for farmers has been recognized and progress has been made on experiments for improving water management. Past and on-going projects in Sri Lanka have shown that farmer involvement in water management is essential. Recent efforts to organize farmers to improve water management in specific sites are reportedly successful, but more concerted and widespread efforts are necessary. The DOA has remained peripheral in efforts to improve water management.

Recommendations

1. Coordinated efforts between the DOA and Ministry of Lands and Land Development would facilitate improvement in both irrigation management and agricultural production.

2. Future cropping systems work should incorporate the lessons learned in efforts to organize farmers for water management into their activities.

2. PROBLEM AND OVERVIEW

Rice is Sri Lanka's staple food crop, with approximately 2 million acres of land in paddy. Sri Lanka's population was 15.6 million in 1984 with a growth rate of 1.7 percent from 1971 to 1981. Per capita consumption of rice is 104kg/annum.

Although Sri Lanka has a small land area (25,300 square miles or 16.2 million acres), there are wide variations in rainfall, topography and soils. Rice is produced in all the various climatic and soil conditions, resulting in a variety of production situations and constraints. Throughout the country, yield per acre has increased from 36 bushes in 1960 to 70 bushels in 1983. Not only yield per acre but total rice production has increased in Sri Lanka in the past 20 years. Presently, Sri Lanka is virtually self-sufficient in rice.

The Rice Research Project supported the development of new improved varieties and encouraged intensified cropping systems in Yala. Between 1977 and 1983 production has increased from 81 million bushels to 119 million bushels total. The increase in rice production is a consequence of new improved varieties, availability of inputs, increased acreage under production, and increased cropping intensity. A strong agricultural research and extension system has contributed to the introduction and dissemination of improved rice varieties and management practices. Use of new improved varieties has increased over time in all regions, but remains low in areas with salinity, cold and drainage problems. The project was initiated at a time when regionalization of agricultural research was being

established. The rice research project was directly related to the major food needs of the country and was a well-timed effort to improve the production of rice.

Rice production increased throughout the project period and is continuing to increase. However, as the project evaluation conducted in 1982 mentions, while it is tempting to attribute increased rice production to the project, the impact of a single project on rice production is difficult to determine. Certainly the project has contributed to increased rice production through its efforts, but other factors have also contributed to increased rice production. These include: increased paddy land through the Mahaweli irrigation scheme, increased paddy prices, availability of inputs, previous breeding achievements, and favorable weather and the complementary and masking affects of other projects. Although the price per bushel of paddy increased from 41.84 rupees in 1975 to 73.25 rupees in 1984 (Table 2.1), farmers' incomes have not necessarily increased. Costs of production have increased at a faster rate than prices resulting in a decline in paddy farmers' real net income per acre.

3. PROJECT GOAL, PURPOSES, OBJECTIVES AND STRATEGY

The logical framework presented in the Project Paper for the Rice Research Project (RRP) stated that the goals of the project were to increase domestic food production (essentially by achieving increased rice output), expand employment opportunities and improve the living standards of small farmers. The project was to contribute to the achievement of these goals by developing the technological base to permit the increased productivity of paddy land. This increased productivity would be brought about by the adoption of newly developed rice varieties which would increase the yield potential of paddy per unit area in a range of agro-climatic and edaphic zones. The adoption of new varieties was to be complemented by increased cropping intensity on paddy land using alternative cropping systems. These systems were to make it possible to economically grow a second or third crop of paddy, or some other crops, in a year on a given farm area.

Limited rice research capacity in Sri Lanka was indentified as an important constraint to increasing the technological base for rice production. The project therefore had the objective of expanding the national rice research capacity in terms of increased numbers of trained staff and improved availability of vehicles, equipment and supplies. This assistance, as well as long and short-term technical advice from consultants supplied by the International Rice Research Institute (IRRI), were to promote more effective approaches to rice research in Sri Lanka. The approaches identified were (1) the expansion and strengthening of regionally based research; (2) the establishment of a Genetic Evaluation and Utilization Program (GEU); (3) the coordination of Rice Research and Cropping Systems Research; (4) the establishment of a regional framework for on-farm field trials; (5) the support for the completion of a resource capability survey convering the wet and intermediate zones. It was also anticipated that activities undertaken within these approaches would be based on improved linkages with extension and on an increased involvement of farmers in the identification of problems and the specification of research priorities.

USAID's direct contribution to the achievement of these objectives took the form of a loan of US$3,354,000 allocated as follows:

TABLE 3.1: Allocation of Funds Under RRP

	Expenditures ($000)	Percent
Technical Assistance	505	15
Third Country Training	955	29
Commodities	1,113	33
Contracts[a]	781	23
	3,354	100

[a] The term "contracts" includes all technical assistance training and procurement contracts, not included in the IRRI contract.

The likelihood that the loan-supported activities would be translated into the project objectives, purposes and goals depended not only on the quality and appropriateness of the type of technical assistance, training and materials, etc. provided, but also on the commitment of GSL and its research officers to the practice as well as the principles of the project. The level of this commitment would be manifested in the form of cooperation and commitment to regionalisation and inter-and intra-institutional linkages, and a true sympathy for a bottom-up, farming systems approach to developing research priorities. This commitment would also need to be expressed in agricultural policies affecting prices, input availability, marketing and processing.

4. PURPOSE OF THE EVALUATION AND STUDY METHOD

The scope of work for this evaluation describes its purpose as follows:

> The purpose of the evaluation is to measure the impact of the Rice Research Project on Sri Lankan rice production and on the intended beneficiaries: The Department of Agriculture, the production research farms, and the area paddy farms. (See Appendix 8.1)

The specific questions which this evaluation is expected to answer were drawn from the end-of-project evaluation conducted in August, 1982. That evaluation concluded that the full impact of the project on Sri Lanka rice production would only be evident after several years had elapsed. It therefore recommended that an impact evaluation should be undertaken at that time. The present evaluation has been asked to verify that the developments anticipated in the previous evaluation have actually taken place.

In presenting the results of our evaluation we have regrouped the questions in the scope of work to follow the logic of the project and to avoid some overlap in answers. The questions relating to Institutional Development are considered first with regard to the project's impact on the expansion of research capacity in terms of levels of trained staff, materials and equipment and the interaction of these resources with the Department of Agriculture research budget. Reliable and easily used data which could demonstrate the extent of adoption of project-promoted practices and the connection between such practices and farmer welfare were not available to the evaluators. The final section discusses the data collection associated with the project and suggests an approach to future monitoring and evaluation.

Institutional development is then considered in terms of the development of new approaches to research and the related increase in research activities. The examination of institutional development is followed by an assessment of the institutions' research achievements. Here attention is focused on the new rice varieties and practices which have been developed and adopted in the regions and the linkages which have been established between farmers' needs and constraints, extension activities, and research.

Readily available indicators and observations made during the evaluation are then used to determine the impact of the research achievements on farmer welfare and rice production.

The evaluation was undertaken between 15 October and 9 November 1985. The observations and conclusions are based on a review of the documents listed in Appendix 8.4 as well as interviews with individuals who have been associated with the Rice Research Project. The names of the people who were interviewed are listed in Appendix 8.3. Depending on the time available at the research stations visited, a number of farmers living within the area covered by the station were interviewed. Although the number of such interviews was limited, it provided useful insights into the likely impact of the work being done by research stations. The evaluation methodology is presented in Appendix 8.2.

5. INSTITUTIONAL DEVELOPMENT

5.1 THE EXPANSION OF RICE RESEARCH CAPACITY

5.1.1 RRP Training and The Build-up of Research Staff

Staff In-Post and Trainee Achievement of Potential*

Under the Rice Research Project long-term training was provided for 2 Ph.D.s, 31 Masters Degrees, and 2 Diplomas. Both the people who received Ph.D.s through the project are still in service in the Research Division of the Department of Agriculture. Six out of the 31 people who received a Masters Degree under the project have left government service. It was not possible to obtain information on the current posting of the two diplomates.

Among the trainees who could be traced there has been a 23 percent loss of Masters level trainees (Table 5.1). The project has nevertheless contributed approximately one-third of the staff with Masters Degrees in the Research Division.

In addition to providing long-term training, the project financed the participation of 30 Research Officers, 22 Experimental Officers and 75 other technical support and extension officers in short-term courses and study tours of one to eleven months duration. Thirty senior researchers and research officers were also sponsored to participate in conferences, workshops and symposia.

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*A complete list of trainees under the RRP ... The tables presented in this section have been ... this list.

TABLE 5.1: Contribution of RRP Long-Term Training to Staff Strength in the Regional Research Centers, Research Division - Department of Agriculture

	Ph.D.	M.Sci.	Diploma	B.Sc.	Total
Number of Research Officers[a]	25	82	-	98	206
USAID Sponsored Long-Term Trainees	2	31	2	0	35
Number of Trainees Traced in Evaluation	2	26	0	-	28
Number who have Left Government Service	0	6	-	-	6

[a] Officers on Staff of the following stations: 8 Regional Research Centers, Central Agricultural Research - Institute - Gannoruwa, Rice Breeding Centre - Batalagoda, Soil Conservation and Land Use Division.

Figures for August 1984 – Source: Office of Deputy Director (Research) Peradeniya.

The provision of training for grades below Research Officer level was particularly appreciated as a way of improving the technical support available to researchers. However, it has not been possible to determine the proportion of technical support staff other than EOs who received short-term training under the RRP. In addition,* training of officers from the Extension Division and the Economic Division was felt by researchers to have contributed to the ability of these divisions to support the researchers' work. Table 5.2 gives the numbers of officers from each grade who were sent to IRRI on short-term training under the RRP.

* Including officers designated Agricultural Officers, Agricultural Instructors, Agricultural Directors, Subject Matter Specialist and Economic Assistants.

TABLE 5.2: Number of Officers from Each Grade to Receive Short-Term Training Under RRP

Officer Grade	Number of Officers
Research Officer	30
Experimental Officer	22
Research Assistant	16
Soils Officer	4
Agricultural Officer	7
Subject Matter Specialist	1
Agricultural Instructor	39
Economic Assistant	6
Agricultural Engineer	1
Total	127

Table 5.3 indicates that of the officers who could be traced, 7 percent of the Research Officers, 14 percent of the Experimental Officers* and 12 percent of the other officers, have left government service. The remaining trainees who could be traced represent 14 percent of the current number of Research Officers.

*The limited number of Experimental Officers and other officers who could be traced in this evaluation is due to the fact that many of these officers were selected from Extension Division and/or Northern Districts for which no information was available.

Attrition Rates and the Location and Programming of Training

The decision whether to send people abroad for advanced degrees or to make use of existing local academic resources, particularly P.G.I.A., caused problems under the RRP and continues to be a point of contention. The attrition rate among foreign-trained postgraduates has been observed to be higher than that of locally-trained postgraduates (National Planning Division: 5.3). Among the RRP postgraduate trainees the attrition rates were 31 percent for United States trainees, 33 percent for Sri Lanka, P.G.I.A. trainees, and 14 percent for Philippines, UPLB trainees (see Table 5.4). Thus the record among students trained in the Philippines appears to be better than that for students trained in the U.S. or in Sri Lanka. This probably reflects a reluctance to return to Sri Lanka on the part of the U.S. trained students on the one hand and a dissatisfaction with training and career prospects on the part of P.G.I.A. trainees on the other hand.

TABLE 5.3: Contribution of RRP Short-Term Training To Staff Strength in the Regional Research Centers, Research Division - Department of Agriculture

	R.O.s	E.O.s	Others
Number of Officers in Research Division	205	84	Not available
USAID-sponsored Short-Term Trainees[a]	30	22	75
Number of Trainees Traced in Evaluation[a]	28	14	34
Number who have left Government Service[a]	2	2	4
Officers who have left as percent of Officers Traced	7%	14%	12%

[a] Includes all trainees from both Research and other Divisions.

** These percentages only relate to the trainees who could be traced. The P. G. I. A. trainee who is known to have left the government service is married to a U. S.-Trained Masters student who has left government service.

TABLE 5.4: Attrition Rate Among Postgraduates Trained Under the RRP

Degree and Location of Training	Number Trained	Number Traced	Number Leaving Government Service	Percent Leaving
Ph.D. USA	1	1	0	0
PGIA	1	1	0	0
M.Sc. USA	16	16	5[a]	31
UPLB	8	7	1	14
PGIA	7	3	1	33

[a] Including one retired.

Masters' students trained at IRRI were generally satisfied with their experience at UPLB, although it was felt that there should have been financial assistance for the trainees to be accompanied by their families. One RRP trainee who first went to IRRI on short-term training and was subsequently sponsored to obtain a Masters in the United States commented on the value of a short period of studies at UPLB for students with no previous experience of overseas training. He felt that in addition to the usefulness of the training material itself, there was a benefit to be derived from a short initial exposure to life and studies abroad. However, he also felt that having been to IRRI once, there was less value in returning to UPLB for long-term training than in gaining a wider experience by studying elsewhere.

Although there is an argument for increasing local postgraduate training, the current limitations on the training capacity of PGIA, the need to improve the quality of postgraduate degree training at PGIA, and the benefits to Sri Lankan researchers of exposure to researchers and research methods in other countries, all indicate a continuing need for overseas training and contact visits. Under the circumstances, an arrangement, as suggested in the ARG/ISNAR report for the Sri Lanka Agricultural Research project, whereby students' research and course work includes both a period abroad and a period in Sri Lanka, seems sensible (National Planning Division: 5-14).

Another problem regarding training which arose in the RRP was related to the selection of people for long-term training. Clearly only individuals with the qualifications and ability to make full use of the training offered should be selected for further studies. Insofar as the Department suffers from an absolute shortage of people with adequate skill levels in mathematics and statistics, arrangements could be made for PGIA to offer instruction to make up for these deficiencies.

Programming of training should have given more thought to the strain imposed on research stations by a surge of training activities. Most stations have only a limited number (sometimes only one) of specialists in important research subject areas. The departure for training of a number of these specialists at the same time could leave a station incapacitated. Furthermore, if a group of scientists working on a similar field simultaneously depart for training the national research capacity could be jeopardised. Another risk associated with "bunching" of training is the creation of a trained cohort which progresses simultaneously through the governmental career structure, leaving a vacuum unfilled by a trained and experienced cadre which can take over when seniors are promoted, transferred or leave the service. These observations suggest that in future projects the training plan should be coordinated with other planned activities external to the project, such as staff recruitment and staff upgrading--not only on a division, but also a research center, basis.

The Relevance of Training

Most of the staff interviewed felt that the training they received under the project was relevant to their research duties. However, there were instances of officers being sent on a short-term training course simply because their "turn" had come and there was an opening available. Clearly resources could have been better utilized if an effort had been made to find a more relevant course for the officer, rather than just filling a pre-determined training slot.

A number of officers felt that limited research facilities and funds prevented them from fully utilizing their knowledge. The evaluators' observations suggest that bureaucratic and administrative obstacles to effective use of existing resources are also constraints to effective research.

The Impact of Civil Strife

The inter-ethnic tensions in Sri Lanka have contributed to some turnover in staff particularly at Maha Illuppallama and Bandarawela. Some Tamil officers have chosen to return to their homes in the North, while others have left their stations in the North for the safety of the South.

The fact that the evaluation team was unable to visit the Regional Research Centers in Kilinochchi and Karadian Aru reflects the level of insecurity associated with those areas, and it would appear that this is seriously disrupting the research work which can be undertaken there. Communications with those stations by the research network has declined, culminating in the disconnection of the RRP--supported dual channel radio system following the theft of the Kilinochchi radio equipment by Tamil insurgents. The Karadian Aru Station has been closed down and the Station Director evacuated following an attack by Tamil insurgents. However, the staff at other stations visited by the evaluation team did not believe that the civil disruptions were directly impeding their own research work.

Effect of the Shortfall in Ph.Ds Trained under the RRP

The shortfall in Ph.Ds trained under the RRP has reduced the depth of interpretation that has been brought to bear on rice research in Sri Lanka. A suitable target for the number of Ph.Ds as a proportion of research staff in a research institution was estimated to be 35 percent by the Agricultural Research Group/ISNAR (National Planning Division: 5-10). Had the RRP fulfilled its objective of training 10 Ph.Ds, the proportion of Ph.Ds in the RRC staff would have been approximately 17 percent (without providing for the attrition of any trainees). However, the present proportion within the stations, with only 2 RRP-trained Ph.Ds in the regional research system, is 12 percent. Furthermore, the Central Rice Breeding Station at Batalagoda is currently without a Ph.D on the staff.

In 1983 approximately one-third of the Research Officers with Ph.Ds in the Department of Agriculture were employed as Directors (ibid.:5-6). The absorption of a significant proportion of Ph.Ds into administrative functions, combined with a decline in the average length of experience among research and experimental officers has undoubtedly affected the quality of research being undertaken at research stations. In particular, the amount of innovation and the quality of observation and interpretation has been reduced with research undertaken by less experienced staff receiving limited supervision by senior researchers.

GSL In-Service Training

Despite the limitations imposed by a less-than satisfactory level of researchers with Ph.Ds, GSL has no compensating program of its own for in-country in-service training to strengthen less qualified research staff. The government has relied entirely on donor funding for short-term training activities and figures available in 1983 indicated that less than 20 percent of these activities were organized in-country. Although donor funds for short-term training have been forthcoming the ARG/ISNAR report observes that "general reliance on donor funding has meant that STTA (short-term training activities) have been difficult to program and sequence properly in the careers of scientists and this has also tended to exacerbate the 'junket' image of much of STTA (especially overseas)" (ibid.:37).

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*The Agricultural Research Group/ISNAR report found that while in 1975 50 percent of the research and experimental officers had less than 8 years experience, in 1983, 70 percent had less than 8 years experience and 54 percent had less than 3 years experience (ibid.:5-2).

5.1.2 Equipment and Facilities

The RRP provided US$1,113,000 for the procurement of commodities for Research Stations. Table 5.5 contains a representative list of the types of equipment purchased through the project.

TABLE 5.5: Examples of Types of Equipment Purchased with RRP Funds

Category of Equipment	Examples of Equipment
Vehicles/Transport	Jeeps, trucks, sedan cars, motor-cycles, bicycles
Farm Implements	Threshers, seed cleaners, winnowers, chemical sprayers, 2- and 4-wheel tractors with attachments
Laboratory Equipment	Moisture meters, desiccating cabinets, PH meters, ovens, autoclaves, water distillers, scales, mortars and pestles, polysealers, air pumps, hot plates, calculators, voltage adapters and stablizers
Research Supplies	Drying trays, glassware, chemicals, sample bags, tape measures, meter rulers, tarpaulins
Office Supplies and Communications	Staplers, scissors, pencil sharpeners, draughting equip-ment, stationery, radio (dual channe), slide projectors and screens, photocopier
Miscellaneous Furniture	Air conditioners, mattresses, beds, chairs, tables, lamps, refrigerators
Miscellaneous Books and Catalogues	

*The representative list of equipment prepared by the Chief Accountant for the Deputy Director (Research) is found in Appendix 8.6. However, no comprehensive list of equipment purchases under RRP was available to the evaluators.

Usefulness of RRP - Supplied Commodities

Further projects should take care to avoid the pitfalls associated with RRP commodity procurement. Important lessons can be learned from the RRP experience with procurement.

Discussions with research staff, review of available equipment lists and an inspection of RRP - supplied commodities revealed that there were significant short-comings in the original selection of types and makes of supplies. In fact, it would appear that much procurement was done in a haphazard way. Although the project's flexibility in responding to immediate research station needs for chemicals and other supplies was appreciated by many of the people interviewed, the haphazard approach to procurement has also meant that many items have either never been used or broke down prematurely. Vehicles imported from the United States, farm implements other than Kubota 2-wheel and Massey Ferguson 4-wheel tractors, and electrical laboratory equipment were particulary unusable or susceptible to breakage. On the other hand research and office supplies were considered to be very useful. The project's ability to by-pass lengthy GSL procurement procedures for the importation of simple research items that were either locally unavailable or locally available but of poor quality was particularly appreciated. In general, simple and/or reliable commodities such as tarpaulins, scales, tape measures, drying trays, mortars and pestles, and certain consumable items (paper sample bags, glassware, chemicals) have made the most cost-effective contribution to research.

The principal factors contributing to the evident waste associated with RRP vehicle and equipment procurement were: (1) a failure to carefully link the selection of commodities to specific research programs and activities; and (2) a failure to consider the appropriateness of selected equipment for Sri Lankan conditions. Among the local conditions which were insufficiently considered were (examples cited in interviews are noted in parentheses):

- the availability of research scientists and/or technicians skilled in the use of cartian types of equipment (cereal laboratory equipment);
- the availability or procurement of complementary equipment or supplies essential for the utilization of the RRP commodities (spectro photometer, air pump);
- the presence of a local agent to supply spare parts and to service equipment (U.S. - manufactured jeep bodies, sprayers, ovens, slide projectors, calculators, PH meters, photocopiers);
- the local availability of people skilled in improvising repairs (U.S. - manufactured jeep bodies, motorcycles);
- the robustness of equipment in the hands of inexperienced or careless users (sprayers, vehicles and motorcycles);
- the appropriate size of equipment, and its cost of operation (petrol - operated threshers, refrigerators, hot plates, ovens);

- the suitability of equipment for handling paddy--especially when wet (threshers, winnowers, seed cleaners and graders);

- the adaptability of electrical equipment to local power supplies and the ability of the equipment to withstand large fluctuations in power supplies (ovens, calculators, refrigerators, slide projectors, air conditioners).

Furthermore, certain equipment (the autoclave was cited as an example) was technically obsolete at the time of purchase. Such equipment has proved to be not only inefficient but acquisition of spare-parts is an even greater problem than for equipment which is at least still being manufactured (Hewlitt Packard are no longer manufacturing the calculators purchased under the RRP).

Provisions for Maintenance and Repair of RRP Equipment

Very little provision has been made for the maintenance and repair of troublesome RRP vehicles and equipment. The main constraint to the repair of items such as vehicle bodies, refrigerators, ovens, PH meters, calculators, and slide projectors is the lack of an efficient local mechanism for replacing spare-parts and doing repair work. The limited market penetration by American manufacturers and the relatively small number of items of each make and model in the national stock, combined with an absence of local agents and of people familiar with repairing this equipment, has meant that when equipment breaks down the only alternative is to special order imported parts through a lengthy government procedure. In most cases, officers have preferred to do without the equipment.

In general, smaller stations showed the most ingenuity in keeping RRP vehicles operating and in using equipment which may not have been ideally suited to their needs. Larger stations, such as Maha Illuppallama and Angunakolaelessa, which have continued to receive equipment from a number of donors, seem to have less incentive to maximize the use of RRP equipment. Although the retention of some back-up equipment may be justified, equipment now lying unused at Maha Illuppallama, such as 5 moisture testers, 6 anenometers, 1 PH meter, 9 dessicating cabinets, 2 thermometers, and 2 compasses might be usefully reallocated to other stations.

Before further research equipment is procurred with USAID funds, a thorough examination of existing RRP equipment should be undertaken. This review should identify which equipment is worth salvaging, which equipment should be officially scrapped, which equipment could be modified for local use, and which unused equipment could be reallocated to a place where it could be put to good use.

5.1.3 Budget

The ARG/ISNAR report to the Government of Sri Lanka on the Agricultural Research System in Sri Lanka Stated that the total investment in agricultural research in 1983 represented approximately 0.77 percent of

Agricultural Gross Domestic Product (AGDP) in 1982. This was considered to be better than the average level of investment in agricultural research in developing countries, although it fell short of the 2 percent of AGDP suggested by the World Bank as a suitable target to be reached by 1995. The report was alarmed to find that, despite the low level of salaries, 69 percent of funding in the Research Division of the Department of Agriculture went to salaries. This compared with an observation that 30 percent of funding for salaries (and 70 percent for operating cost) would still be somewhat high for effective research. The report concluded that "there seems to be a clear prima facie case that research scientists are seriously constrained in their work by inadequate funds for operation . . ." (ARG/ISNAR, 1984:31-32).

Effect of the Tight Economic Situation on the Rice Research Budget

The proportionate allocation of total GSL research expenditure to paddy research in 1983 was 20.6 percent, compared with a 23.3 percent contribution of paddy to the total production value of agricultural commodities, indicating only a slight incongruence in the allocation of research resources (ibid.:30). Although comparable figures on the funds available for paddy research are not available for 1984 and 1985, the rice research budget has undoubtedly been affected by the real decline in the overall budget since 1982 (see Table 5.6). Furthermore, although there was a large increase in research staff between 1980 and 1982, since 1982 there has been a decline in the combined total number of researchers in the RO, EO and RA grades. After the achievement of an initial improvement in 1980, the ratio of junior researchers (EO and RA) to Research Officers, has remained fairly constant (see Table 5.7). The decline in the Research Division budget has been partially counter-balanced by major contributions from the Mahaweli Authority to the 1985 budgets of Batalogoda Rice Research Station (92 percent of budget), and the regional research stations at Mana Illuppallama (90 percent of budget), Girandurakotte (100 percent of budget), and Angunakolapelessa (44 percent of budget).

Nevertheless, in spite of these increases limited funds have adversely affected staff mobility and the maintenance of facilities. Low staff salaries have also affected staff morale and reduced the incentive to work. Difficulties in obtaining foreign exchange have made it difficult to purchase equipment, parts and research materials which are unavailable in Sri Lanka.

TABLE 5.6: Total Expenditure of Research Division[a] (1980-1985)
(Million SL.Rupees)

Year	Current Value	Deflated Value[b]
1980	18.5	18.5
1981	23.1	18.4
1982	33.0	23.6
1983	35.4	21.3
1984	34.8	16.3
1985	40.0 (estimated)	17.9

[a] GSL Consolidated funds only. Includes both capital and recurrent expenditure.

[b] The Year 1980 was taken as the base for computation.

Source: DOA Research Division, Peradeniya

TABLE 5.7: Number of Research Staff in Research Division (1980-1985)

Category of Staff	Year						
	1980	1981	1982	1983	1984	1985	1980-1985 % Increase
Research Officer	181	199	223	224	225	226	25
Experimental Officer	35	50	97	88	82	82	234
Research Assistants	64	108	106	115	111	111	73
Total	280	367	426	427	419	419	50
Ratio of Research Officers/EO's and RA's	1.82	1.18	1.10	1.10	1.17	1.17	

Source: DOA Research Division, Peradeniya

Rice research has also been affected by two procedural problems which the ARG/ISNAR report identified as reducing the effective use of research funds:

> "Firstly, funds allocated to a given ministry against a research heading are maximum amounts which may be spent. There is no obligation on the recipient ministry to use these funds for the specified research purposes. This is clearly unsatisfactory for long-term research planning. Secondly, when funds have been allocated, the director or deputy director of the research program does not have sufficient financial authority to use the funds and the resources provided efficiently. Substantial delays are common. In 1983, this resulted in major underspending on capital projects by two institutes, even though the funds were available." (ibid.:19)

Some research station directors felt that the greatest immediate budget constraint they faced was the bureaucratic red tape that slowed their ability to spend the money which they have been allocated.

5.2 NEW APPROACHES TO RESEARCH

5.2.1 Regionalization

At the time the RRP was formulated it was felt that the time had come to move the weight of research decision-making from the Central Agricultural Research Institute, (CARI), Gannoruwa, to the Regional Research Centers (RRC). Through this shift it was hoped that the applicability of research would be improved as more research was conducted under circumstances closer to those faced by farmers in each of the different agro-ecological zones in Sri Lanka. Greater regional autonomy in formulating research programs was advocated as a way of ensuring that research activities would respond to local conditions and cropping patterns. But in order for regionalization to be effective the regional centers needed more trained staff and equipment.

When the RRP was formulated, five Regional Research Centers were identified for assistance through the project. In 1985, there were nine RRCs and three research centers devoted to special crops or situations. Some RRCs with responsibility for large areas have smaller satellite experimental stations (see Table 5.8).

TABLE 5.8: Regional Research Centers and Satellite Stations in the Research Division, DOA

1. Regional Research Centers	Satellite Stations
Killinochchi (northern dry zone)	Thirinelvely Paranthan, Murunkan
Maha Illuppallama* (central dry zone)	
Karadian Aru (eastern dry zone)	
Angunakolapelessa* (northern dry zone)	Ambalantota
Makandura (low-country intermediate zone)	Wanathavillu, Kalpitiya
Bandarawela* (up-country intermediate zone)	Rahangala Monaragala, Bibile
Gannoruwa* (mid-country wet zone)	Pussellawa
Bombuwela* (low-country wet zone)	Labuduwa Bentota
Girandurakotte (for Manaweli System C)	

2. Special Research Centers

Batalogoda,* for rice breeding and agronomy
Sita Eliya, for potatoes and vegetables
Aralaganwila, for Mahaweli System B

3. Other Divisions, Research Division Staff

Land and Water Use Division*
Soil Conservation Division
Headquarters Administrative and Technical Staff, Peradeniya

* Research Centers identified to receive assistance in training and commodities under RRP Project Paper, Page 13.

Source: AGP/ISNAR, 1984:72-73.

TABLE 5.9: Regional Distribution of Research Staff and RRP Training

Staff Posting	Staffing strength a/ (number of staff)					Total	Training Under RRP b/ (number of staff)							
	Research Officers				Exp.officers		Long-term Trainees			Short-term Trainees			Conf.& W/Shop	
	Ph.Ds	M.Sc.		B.Sc.	(E.O)		Ph.D	M.Sc	Dip	R.O	E.O.	Other	(Mostly R.Os)	Total
RRCs														
MI.	7	13	(11)	15 (10)	9(7)	44	-	2	-	2	1	4	2	11
AK.	2	5	(4)	11 (7)	5(2)	23	-	3	-	4	1	5	3	16
DD	2	8	(6)	10 (6)	12(6)	32	-	-	-	2	1	2	1	6
CARI	4	21	(23)	17 (9)	18	62	-	4	-	2	4	5	2	17
DW		5		12 (13)	8	25	-	2	-	3	1	6	3	15
KL	2	13		6	13	34	1	2	-	5	2	-	1	11
KA	1	5		4	9	19	-	2						2
MK	1	3		7	6	17	1							1
GK	1	-		8	3	12		1	-	1			1	3
DG	1	4		6		11		1		3	1	1	2	8
LUWS	2	5		2	1	10		1	-	4	1		4	10
Sub Total	25	82		98	84	289	2	18		26	12	23	19	100
HQ												1	4	5
AG.EC.&EXT.								1				13	2	16
Left								7		2	2	4	5	20
Not traced								5	2	2	8	34	8	59
TOTAL TRAINED							2	31	2	30	22	75	30	200

Notes: MI - Maha Illuppallama, AK - Angunakolapelessa, DD - Dandarawela, CARI - Gannoruwa, DW - Dambuwela
KA - Karadian Aru, KL - Kilinnochchi MK - Makandura, GK - Girandurakotte, DG - Dalalagoda, LUWS - Land Use and Soil Conservation, HQ - Headquarters Director Research Division, AG.EC&EXT.- Agriculture Economics & Extension

a/. Data for August 1984 provided by Research Division Headquarters. More recent information collected at some stations during the evaluation is noted in brackets.

b/. Current posting of trainees. RRP trainees posted at satellite stations are counted against the appropriate RRC.

Source: Research Division Headquarters, Peradeniya and interviews at Regional Research Centers. Appendix 8.5 lists RRP trainee

Table 5.9 shows the regional distribution of Research Division staff and of trainees under the RRP. The evaluators were able to trace approximately half of the RRP trainees to the Research Division. Ten percent of the trainees had left government service, and eight percent were traced to the Agricultural Economics and Extension Divisions. Of the 30 percent of the trainees who could not be traced through the evaluators' contacts in the Research Division, many were Agricultural Instructors and are probably working as extension officers around the country. This training has contributed to the ability of the extension service to work with the researchers at the Regional Research Centers. Table 5.10 indicates that the proportional distribution of RRP trainees was fairly well distributed among the regional centers with the exception of Bandarawela, Karadian Aru, Makandura, and Girandurakotte. The latter three stations were not included in the original project conception because they are relatively new, and at Bandarawela crops other than rice are more important in the research program.

The most recent figures available for the distribution of RRP commodities according to value indicate that the RRCs received assistance roughly proportionately to the size of their staff (see Table 5.11).

TABLE 5.10: Proportional Distribution of Research Staff and RRP Trainees by Region

Research Station	Total Research Staff[a]	Percent of Trainees[b]
RRCs		
Mana Illuppallama	15	11
Angunakolapelessa	8	16
Bandarawela	11	6
Gannoruwa (CARI)	21	17
Bombuwela	9	15
Kilinochchi	12	11
Karadian Aru	7	2
Makandura	6	1
Girandurakote	4	3
Batalagoda	4	8
Land and Water Use & Soil Conservation Divisions	3	10
Total	100	100

[a] Includes ROs and EOs only.
[b] Includes only trainees traced in the course of evaluation.

Source: Table 5.9.

TABLE 5.11: Distribution of RRP Commodities as at End-of-Project Evaluation, August 1982

Research Station	Value of[a] RRP Commodities US$	Percent	Percent of Total Research Staff
RRCs			
Maha Illuppallama	117,117.93	14	15
Angunakolapellessa	68,732.34	8	8
Bandarawela	68,919.40	8	11
Gannoruwa (CARI)	133,071.26	16	21
Bombuwela	75,570.59	10	9
Kilinochchi	70,108.68	9	12
Karadian Aru	58,140.14	7	7
Makandura	64,109.33	8	6
Girandurakotte	8,419.00	1	4
Batalagoda	122,826.43	15	4
Land and Water Use & Soil Conservation Divisions	34,965.82	4	3
Sub Total	821,980.92	100	100
Other Locations			
DOR Peradeniya	39,494.90		
Agr. Economist	49,937.42		
Cent. Workshop Spares	30,362.65		
Min. of Agr.	2,331.51		
Sub Total	122,126.48		
Total	944,107.40		

[a] Value of commodities distributed to satellite stations included in the sum for the relevant RRC.

Source: Rutger et al., End of Project Evaluation, 1982: 28.

The greater proportionate assistance received by Batalogoda can be justified by its important role in rice research. However, it should be remembered that, given the limited usefulness of some of the major items procured under the RRP, the value of commodities received may not coincide with the relative benefits derived by the stations who received them.

5.2.2 Expanded Breeding Program

RRP assistance has contributed to an expanded rice breeding program by supporting a shift from selection concentrated on the achievement of high yields under stable environments to breeding for improved performance under adverse conditions such as disease, insect infestation, poor and ill-drained soils, drought and flooding. The benefit of this support is still being felt through the work of RRP trainees in subjects such as varietal testing, entomology, virology, irrigation, water management and drought screening and zinc deficiency (See Appendix 8.5). Commodities such as 2-wheel tractors with attachments, drying trays, sample bags, and cages for insect screening, as well as improved transport, are still being used in the implementation of the breeding program. However, the large quantity of fiberglass sheeting purchased for greenhouse roofing has proven to be entirely inappropriate for the purpose and is lying in unused stacks at Batalagoda and Bombuwela.

The technical advice of the IRRI resident scientist in charge of the Rice Breeding Program was beneficial in assisting in the procurement of research supplies. The scientist also helped to develop currently continuing breeding programs at Batalogoda and Bombuwela. At Batalogoda, he helped to achieve the incorporation of a high level of pest and disease resistance into high-yielding varieties being recommended for suitable rice growing areas. At Bowbuwela, he helped to promote breeding work which concentrated on developing new high yielding and more adaptable varieties for the less stable environments of the wet zone.

Increased exposure to the latest developments in rice breeding which was afforded by participation in the international conferences and workshops and by short visits to RRCs by eminent scientists contracted by IRRI was also useful in generating enthusiasm among Sri Lankan rice researchers. However, it would appear that the morale of rice researchers has subsequently declined in the face of budgetary and bureaucratic constraints.

5.2.3 Genetic Evaluation and Utilization (GEU) Program

The GEU component was included in the formulation of RRP to promote "an interdisciplinary and problem-oriented rice breeding program" (Project Paper: p.16). Although the formally constituted "GEU teams" envisaged in the Project Paper were not in evidence, rice breeding work is clearly interdisciplinary and has been supported by the training received through the RRP. An awareness of the GEU approach has been created among Research Officers, Experimental Officers, Research Assistants and Agricultural Instructors through participation in 4 month GEU courses at IRRI. With the assistance of the RRP rice breeding advisor, committees of entomologists, pathologists, chemists, soil scientists and breeders from all the RRCs were formed to regularly exhange information and ideas. These committees, which were also attended by rice breeders, still continue to meet.

In addition to routine interdisciplinary participation in rice breeding activities, more formal exchanges have taken place at Annual Rice Conferences started in 1980 (under the impetus of the IRRI resident

scientist in charge of rice breeding, with USAID sponsorship) and continued until 1984. In 1985, it was felt that the focus of the conference should be extended to other crops and oil seeds were the subject for the year.

5.2.4 Coordination of Rice Research and Cropping Systems

The impetus to cropping systems research provided by the RRP is still evident in the existing cropping systems work being undertaken in the RRCs. The realization that the varietal improvement program was not sufficient to ensure improved rice production among Sri Lankan farmers promoted the inclusion of a cropping systems component in the RRP project. As a complement to the rice breeding program, the cropping systems research effort was designed to assess farmers' rice--based cropping systems and test the validity of the recommended improvements in cropping intensity and farming practices in various agro-ecological zones. The cropping systems effort has brought an improvement over commodity-oriented research through the recognition of the complex interactions of farmers' cropping activities as well as the greater awareness of the socio-economic constraints facing farmers.

RRP's cropping systems effort, especially for their Mahaweli-oriented work based at Maha Illuppallama/RRC, benefited from the previous and continuing work by IDRC. The RRP was able to build on the staff training and program which the IDRC had established for minor tank irrigation schemes in 1976. The RRP program complemented that of the IDRC by supporting cropping systems research through training, technical assistance and equipment for work at five sites. The sites were located in five regions including: Mahaweli, Bandarawela, Angunakolapelessa, Paranthan and Karadian Aru. The sites were selected to represent the major agro-ecological zones under both rainfed and irrigated conditions. In all cases, the cropping systems were rice-based.

5.2.5 Regional Field Trials and Adaptive Research

The field trials component of the project made no progress during the five years of the project. The purpose of the field trials component was to regionalize the testing of varieties in farmers' fields and develop appropriate management practices for varied soils, water, climatic and economic conditions. The Field Trials Division of the Research Division which had been in operation at Peradeniya for many years, was to be coordinated from the central headquarters at Peradeniya. Field Trials Divisions were to be established at each regional station with one research officer and supporting staff.

The plan was never carried out by the project or by the Department of Agriculture. The failure to develop the Field Trials Division was due to: (1) the lack of a clear conception of the administrative organization of the program and (2) personnel problems with the project and the Department of Agriculture. Decentralization of the Division occurred during the initial phase of the project, but a national coordinator was not assigned for field trials work. In addition, work at regional stations was constrained by lack of vehicles and equipment. Furthermore, during the

course of the project the two team leaders who were also responsible for assisting with field trials were primarily occupied with administering the project. Consequently the team leaders did not establish the field trials program. Both team leaders/field trial specialists were criticized by the Sri Lankan government for their lack of contribution to the Field Trials Division.

5.3 RESEARCH MANAGEMENT AND ADMINISTRATION

5.3.1 Contribution of RRP to Better Research Management

The failure to incorporate training in research management in the project and the lack of management skills among the IRRI long-term technical advisors on the RRP means that the link between improved management and the RRP is difficult to find. However, the RRP has made some contribution to research management through the lessons learned from the project's flaws. A number of researchers felt that the experience with RRP procurement of useless goods has made them more aware of the possible pitfalls in purchasing research commodities. The frequently cited dissatisfaction with the IRRI advisors has contributed to a greater awareness of how to select and obtain the greatest benefit from foreign technical assistants. The dissatisfaction with the organization of the training program may be resulting in Research Division staff stating their preferences more clearly.

While these lessons may be useful, they cannot make a major contribution to improved research management unless they are complemented with other improvements in the system of administration and financial control. Management decisions for the improved deployment of existing physical and financial resources, the coherent selection of research programs and activities, and the most effective utilization of research personnel to maximize both personal satisfaction as well as national welfare, are still wanting at many stations.

The improvements which are still needed are well described in the ARG/ISNAR report which has highlighted a number of shortcomings in the determination and implementation of research programs (ARG/ISNAR, 1984:57ff). The solutions it advocates include improved linkages between research groups and ministry policy makers and planners, the establishment of a national forum to develop national research priorities and perspectives, and the creation of teams of economists and agronomists to survey and analyze farming enterprises operated by small farmers. With respect to research program implementation it observes that while "the research service has built up a good research staff . . . they are not given good opportunities to carry out worthy research programs" (ARG/ISNAR, 1984:51). It recommends increased funding per scientist, more support staff per scientist, and a fuller use of university research capacity. It also "strongly recommend(s) that reward and promotion procedures in all schemes of service for research staff reflect performance in research not merely seniority and administrative responsibility" (ibid.:53). These recommendations should be supported in future AID-assisted programs for agricultural research.

5.4 MONITORING AND EVALUATION

5.4.1 Surveys Under the RRP

Not only was the RRP poorly administered but no clear plan for data collection, monitoring and evaluation of RRP's impact was formulated at the beginning of the project. The surveys for the diagnosis of farming systems and monitoring and evaluation of the RRP have been minimal and have provided very little feedback to guide scientists in their rice research work. Benchmark surveys were undertaken at the inception of project activities on the cropping systems sites but, with the exception of a follow-up survey in 1982 at Uva Paranagama, Bandarwela RRC, no subsequent surveys were undertaken to determine the impact of the RRP-assisted program. Consequently, except at Bandarawela, where the 1982 results were cited to demonstrate the success of the cropping systems work, no survey data were readily available to directly link RRP activities and outputs with changes in farm practices and farmer welfare.

On the other hand, a great deal of statistical data are routinely generated by the Agricultural Economics Division of DOA on farmer practices, use of new and old varieties, costs of production and prices received for agricultural products. This data has been used in this evaluation to make inferences on the possible impact of the RRP. However, there are still problems with the consistency and reliability of the data which have made it difficult to make comparisions through time and between regions.

The RRP did provide some training for agricultural economists and economic assistants, and at least one agricultural economist from the Agricultural Economics and Projects Division (AE&P) of DOA is posted to each RRC. Unfortunately, the economists seem to be almost entirely occupied with their routine statistical duties, and the information they gather has very little direct influence on the RRC research program. The fact that their reports are directed to the AE&P headquarters in Peradeniya has made the economists even more peripheral to the work of the RRCs, as other scientists have felt that this information is of little direct concern to them.

5.4.2 Possible Improvements in Project Data Collection, Monitoring and Evaluation

In future projects, it is essential that a program and system for project monitoring and evaluation (M&E) be developed at project inception. A specific officer assigned to the project should be given the responsibility of designing the system and supervising and coordinating its implementation. The system should maximize the use of the routine data collection which is already undertaken by AE&P, and should supplement this with small scale, sharply focused diagnostic surveys. The surveys should include a panel of farmers who can be regularly visited in the course of the project to establish farmers' needs and responses to recommendations and practices generated by the project.

Before undertaking any new surveys, the person responsible for the M&E of the project should prepare an inventory of the large quantity of survey material, much of which is still unanalyzed or only partially analyzed, scattered around Sri Lanka. As a minimum, the principle sources which should be consulted are ARTI, the Agricultural Economics and Planning Division, DOA, the Marga Institute and the project offices of the principle agricultural projects in the country. For each survey, the size and method of sampling, the date, period and geographical area covered, and the principal subjects included should be noted in the inventory.

A very brief, approximately two weeks, field trip including a limited number of informal farmer interviews in representative areas where surveys have been undertaken should then be completed to obtain a "feel" for the situation in these areas.

This should be followed by an analysis of a sample of the most promising surveys. This analysis should be used to prepare preliminary "base-line" results on the key variables of direct relevance to the project. The results of this preliminary "base-line" analysis should make it possible to identify suitable criteria for stratification and clustering of the target population and to determine a representative yet manageable sample size. It may be appropriate to select the survey sample from respondents who have been interviewed in the surveys under review.

The survey should not attempt to generate data which can be statistically extrapolated to a national level. Rather the survey questionnaires and the sample selected should be designed to supplement the cost of production survey routinely undertaken by AE&P and the regular monitoring being done by the Extension Division as part of its T&V system.

6. RESEARCH ACHIEVEMENTS

6.1 RICE VARIETAL IMPROVEMENT

Sri Lanka's rice varietal improvement program was successful during the course of the project and remains currently active. RRP was one of a number of factors that contributed to the success of the rice breeding effort. At the outset of the project in the late 1970's, Sri Lanka had a strong rice breeding program and a thoughtful and practical plan for a new direction. The varietal improvement program was strengthened through the training of scientists and provision of basic scientific equipment. Favorable paddy prices, availability of inputs, and expansion of irrigated acreage all contributed to the acceptibility of new rice varieties.

Prior to the RRP, the rice varietal improvement program was continuously geared to increased production with an emphasis on selecting varieties with high yield potential. Development of the short plant type in the early 1970's was the major breakthrough, although the achievement of high yields was limited due to insect and disease problems. Since 1977 Sri Lankan scientists were successful in developing varieties with resistance to the

major insect and disease pests. Regionalization of rice research has provided a broader base for varietal improvement, pest and disease screening, and testing under unstable conditions.

Varieties were and continue to be developed and tested that are adaptable to the various agro-ecological conditions of different regions. The research capacity of the regional stations has been strengthened to the extent that new varieties have been released from two of the regional stations and are in the breeding pipeline at two others. Varieties released in the regional stations are particularly suited for the soil, climatic, and water management conditions in the region. Overall, twelve new varieties were released during the contract period, one of which, Bg276-5, resulted directly from the project. Since 1982, two new varieties have been released and many others are in the pipeline. Due to the length of time necessary to develop and release a variety (4 to 10 years), the impact of the project on varietal improvement is occurring presently but much of the impact will be witnessed in the future.

6.1.1 Old Improved Varieties

The project goal of improving Sri Lanka's rice research capabilities builds on a long tradition of rice varietal improvement. In 1958, the first improved variety was released from the Central Rice Research Station at Batalagoda resulting in a series of varieties now referred to as "old improved varieties" (OIV) or the "H" series. Old improved varieties continue to be cultivated by farmers in areas unsuitable to the new improved varieties (NIV). Over time there has been a continuous decline in the extent of hectares in old improved varieties from a total of 229,122 hectares in 1976/77 to 69,741 hectares in 1982/83. Figure 6.1 shows the decline in old improved varieties in Maha and Yala from 1976/77 to 1982/83. The total extent of hectares under old improved varieties by district is presented in Table 6.1.

The old improved varieties in conjunction with the expanded use of inputs resulted in increased paddy production from 36.4 million bushels in 1958/59 to 66.8 million bushels in 1970/71. During the same period the average yield per acre increased from 34.9 to 45.9 bushels. Although the old improved varieties contributed to increased production, the tall plant type characteristic of these varieties resulted in problems of lodging with increased application of nitrogen fertilizer. As a result of lodging, grain losses were high.

6.1.2 New Improved Varieties

The success and problems of the H varieties in conjunction with developments at the International Rice Research Institute set the stage for the development of NIV's. Due to the socio-economic situation of farmers as well as the consumer taste preference for Sri Lankan varieties, the IRRI varieties were not suitable for Sri Lankan conditions. As a result, rice breeders in Sri Lanka established a breeding program to develop intermediate and dwarf varieties with high yield potential suitable for Sri Lanka. The varieties released in the early 1970's were developed with

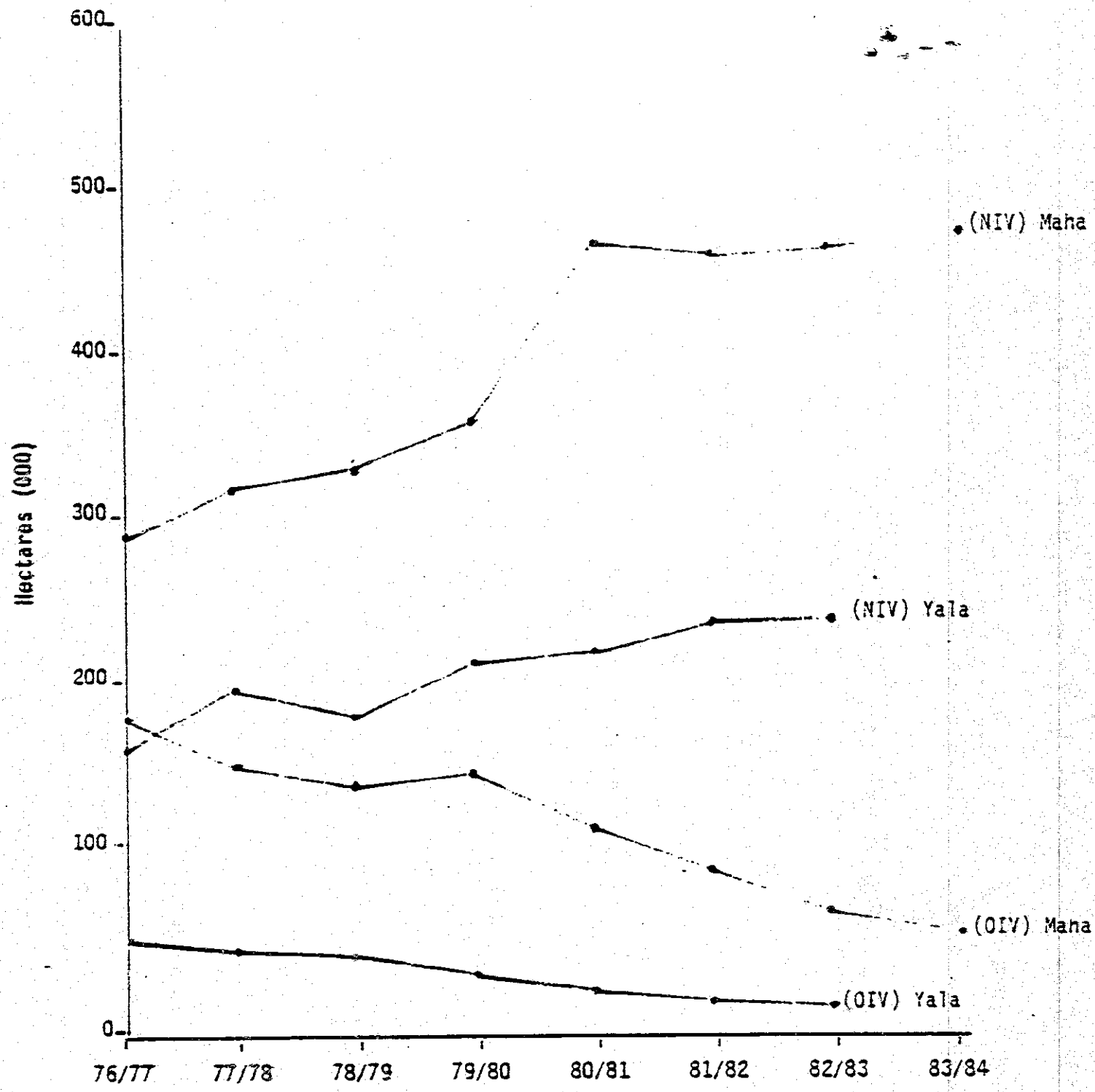

Figure 6.1. Number of Hectares of Rice Under Old and New Improved Varieties in Maha and Yala, 1976/77 to 1983/84.

Source: Sri Lanka Department of Agriculture.

Table 6.1. New Improved Varieties, Year Released, Duration and Characteristics.

Year Released	Variety	Duration	Characteristics*
1971	Bg 34-8	3 month	
	Bg 34-6(R)	3½ month	
1975	Bg 94-1	3½ month	
	Bg 90-2	4½ month	
	Bg 3-5	6 month	Photosensitive
1978	Bg 94-2	3½ month	
	Bg 11-11 (S)	4½ month	
1979	Bg 380	4 month	
	Bg 276-5	3 month	Galle midge resistance
	Bg 400-1	4½ month	"
	Bw 100 (S)	4 month	"
1980	Bg 379-2	4½ month	Brownplant hopper resistance
	Bg 407	6 month	Photosensitive
	Bg 475	6 month	Galle midge resistance
1981	Bg 745-2	6 month	"
	Bg 750	2½ month	"
1982	Bw 272-6 (R)	3 month	"
	Bw 267-3	3½ month	"

Table 6.1. Continued

Year Released	Variety	Duration	Characteristics*
1982	Bw 266-7	3½ month	Galle midge resistance
	Bw 380-2	4½ month	"
	Bg 407-2	6 month	"
1985	Bg 573 (S)	4½ month	"
	Bg 94-1 (R)	3½ month	"

*All varieties resistant to lodging, blast, and bacterial leaf blight.

S = Samba brand type grain
R = Red type rice grain

differing maturing lengths, for adaptation to varying environmental conditions and varying cropping systems. Table 6.2 indicates the new improved varieties released, the date of release, duration and characteristics.

The NIV's developed in the early seventies were bred for resistance to blast and bacterial leaf blight. The NIV's performed best under stable environmental conditions where water, solar intensity, cold, and poor drainage were not limiting factors. Although the improved varieties offered many advantages, they were particularly susceptible to various pests and diseases. Due to increased genetic uniformity and intensified cultural practices such as fertilizer use, the new varieties had greater genetic vulnerability. Serious pest damage was incurred from previously unimportant pests, particularly brown plant hopper and gall midge. New varieties such as Bg400-1, Bg276-5 and Bg379-2, released in the late seventies and early eighties were resistant to gall midge and brown plant hopper. Bg400-1 and Bg379-2 have extremely high yield potential due to plant type, pest resistance and 4-4 1/2 month maturity dates. The yield potential of Bg276-5 is lower, but it offers the advantage of a shorter maturation time of 3 months.

The emphasis on pest resistance was followed by work on rice varieties for unstable environments where the NIV's do not perform well. Varieties were released from Bombuwela and Batalagoda in 1982 that were specifically developed for wet zone conditions. In 1981, Bombuwela released two varieties suitable to replace popular traditional varieties. These two varieties, BW272-6B and Bw267-3 were determined to be suitable for release after intensive testing in farmer's fields. The very early maturing variety Bg750 (2 1/2 months) was designed specifically for zones with short rainfall periods. Work is in progress at Maha Illuppallama on varieties with drought tolerance, a condition faced by many farmers in the dry zone. The research station at Ambalantota and Bombuwela are breeding varieties resistant to salinity.

Use of the NIV's has increased steadily as seen in Figures 6.1 and 6.2. Currently, Bg varieties constitute approximately 70 percent of the total rice area. The short-aged varieties (3 - 3 1/2 months) are most widely used and comprise 62 percent of the total extent cultivated. The three most popular varieties are Bg34-8, Bg276-5 and Bg94-1. New improved varieties released during and after the project period were targeted for cultivation on 44 percent of all acreage under NIV's in 1984/5 and 39 percent of acreage under all improved varieties (See Appendix 8.8)

The extent of area under NIV's varies by district largely due to problems of drought, salinity, cold, flooding and poor soils. Table 6.2 reports the relation between total area sown to paddy and targets for the use of NIV's for 1982/83. In some cases, the targets exceed the area sown, largely as a result of drought conditions that diminished actual sowing in particular districts. Despite the limitations of using targets as an indicator of varietal use, the data indicate variations by regions with the lowest targeted use in relation to area sown in Jaffna, Badulla, Kalutara, Galle, and Nuwara Eliya.

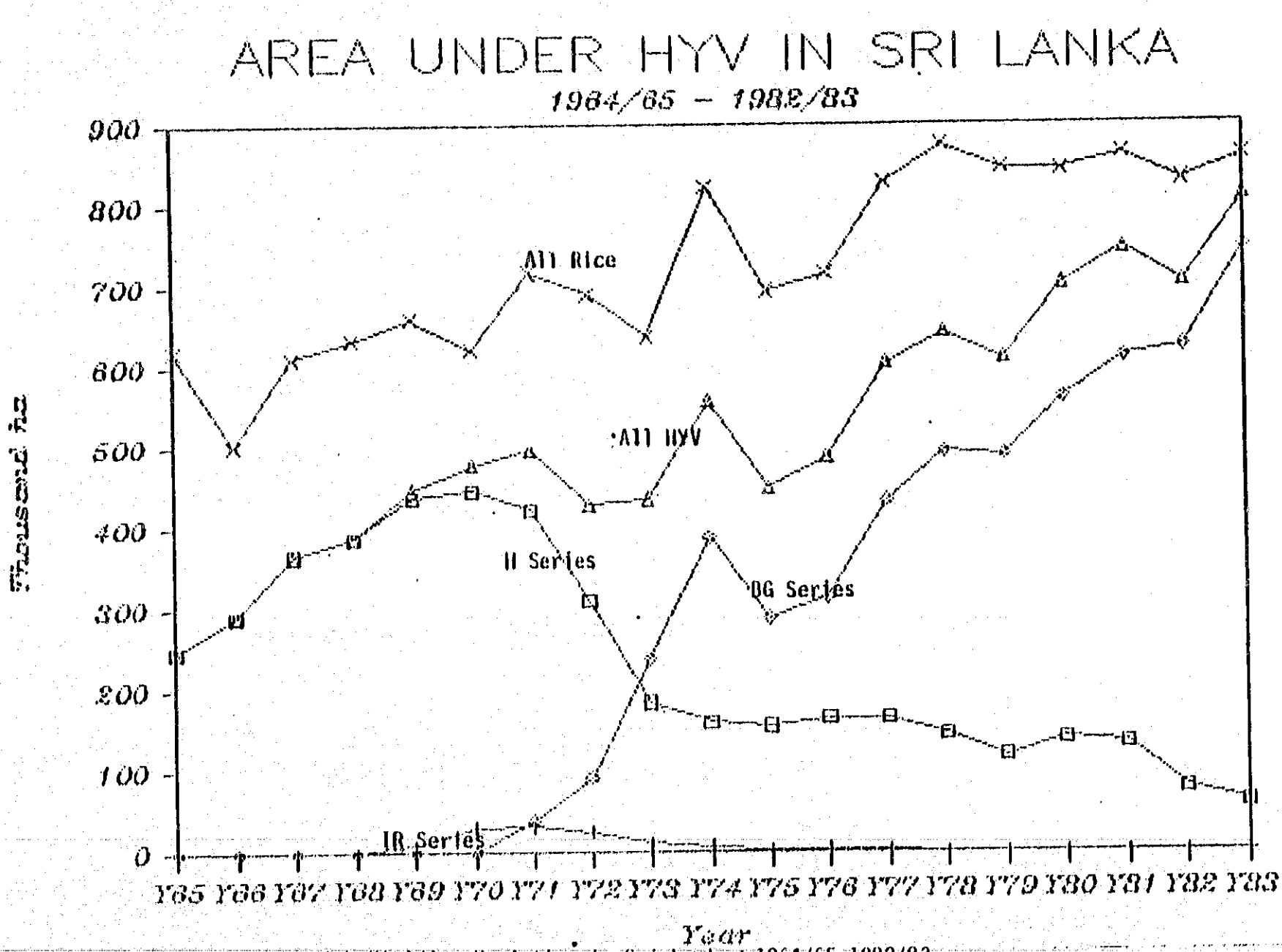

Figure 6.2. Area Under High Yielding Varieties in Sri Lanka, 1964/65-1982/83.

Table 6.2 Hectares Cultivated, Targeted Hectares Under NIV's and Ratio of Hectares Sown to Hectares Targeted for NIV's by District 1982/83.

District	Total Hectares Sown	Targeted Hectares Under NIV	Ratio Hectares Cultivated to Targeted Hectares Under NIV*
Colombo	9690	8996	.92
Gampaha	21046	19615	.78
Kalutara	31438	20971	.66
Galle	30374	17489	.57
Matara	33648	25827	.76
Ratnapura	27585	19395	.70
Kegalle	17592	18760	1.06
Kurenegala	96219	94893	.98
Puttalam	12312	9987	.81
Kandy	28397	28319	.99
Matale	18197	18540	1.01
Nuwara Eliya	11023	7404	.67
Badulla	24959	15868	.63
Monaragala	13093	12933	.98
Jaffna	38759	24426	.63
VaVuniya	14742	11180	.75
Mullativu	15271	12504	.81
Mannar	17227	18642	1.08
An'pura	43129	35753	.82
Pol'naruwa	59639	60284	1.01
Trincomalee	44386	47906	1.07
Batticaloa	56227	66386	1.18
Ampara	81082	87854	1.08
Hambantota	31543	22071	.69
Kalawewa	25653	32770	1.27
Udawalawe	21526	15604	.72

*Figures higher than 1.00 are a result of fewer hectares cultivated than targeted for cultivation.

The effort to select varieties for varying environmental conditions is facilitated through the Coordinated Research Varietal Trials (CRVT) program. Centrally administered from CARI, the CRVT program tests varieties in each region. Varieties are identified that are particularly adaptable for specific regions as well as those that are widely adaptable throughout the country. The success of regionalization of rice breeding is indicated by the inclusion of varieties from four different research stations in the Maha 1984/85 varietal trials. The varieties tested from the 3 1/2 and 4 - 4 1/2 months class are reported in Table 6.3.

TABLE 6.3: 3 1/2 and 4 - 4 1/2 Month Varieties Tested Under Coordinated Varietal Trials, Maha 1984/85 by Station

	Number of Varieties	
	3 1/2 Month	4 - 4 1/2 Month
Station		
Batalagoda	4	2
Bobuwela	3	4
Ambalantota	3	3
Maha Illuppallama	1	1

The inclusion of varieties from four regional stations in the CRVT program indicates the successful regionalization of rice breeding activities.

6.1.3 Current and Future Directions for Varietal Improvement

The current and future strategies for rice breeding include a continuation of past efforts as well as movement in new directions. Strategies include breeding for: (1) pest and disease resistance, (2) unstable environments, and (3) improved grain quality for domestic and export markets.

The program for pest and disease resistance is continuing in an effort to develop a wider range of varieties resistant to blast, stem rot, sheath blight, gall midge, brown plant hopper, thrips and stemborer. Problems such as stem rot are particularly problematic in the wet zone where existing Bg varieties are susceptible. Further work is also needed on grain sterility.

Breeding for unstable environments was a major component of the breeding program at the time of the Rice Research Project and continues to be emphasized. Work is currently underway in areas where old improved

varieties and indigenous varieties are cultivated due to limiting factors such as poor drainage, salinity, alkalinity, iron toxicity, flash floods, and drought. For example, Bombuwela has concentrated on varieties suitable to poorly drained and iron toxic soils that are characteristic of the Colombo, Kalutara, Galle, Matara, Hambantota and Ratnapura Districts. Varieties are continuing to be developed at Bombuwela. The Ambalantota Research Station has red rice varieties under trial for the wet zone and has developed a saline resistant variety, AT69-2, that has recently been recommended to the National Seeds Committee. Trials are continuing at Maha Illuppallama for drought-resistant varieties.

As Sri Lanka nears self-sufficiency in rice production, policy makers are contemplating the possibility of producing rice for export. Currently Sri Lankan varieties do not meet the standards of the international market and it is questionable whether Sri Lanka could gain a competitive advantage over countries currently producing for the export market even if suitable varieties could be developed. Rice varieties preferred by Sri Lankan consumers are not acceptable on the international market. Despite the many limitations involved in producing for the export market, rice researchers at Batalogoda are currently developing varieties suitable for the export market. Three varieties are in the breeding pipeline, but their production potentials are significantly lower than other Bg varieties.

6.1.4 Limitations of the Rice Breeding Program

Overall, the rice breeding program has been quite successful, but several limitations of the regional program are apparent. Despite the decentralized research system with active breeding stations at Maha Illuppallama, Bombuwela, and Ambalantota as well as Batalagoda, new rice varieties have been developed primarily at Batalagoda. Batalagoda continues to have the advantage of better resources in terms of staff, laboratories and equipment devoted to rice research. The continued prominence of Batalagoda in varietal development may be partially attributed to the length of time necessary for the development and release of a new variety. Development of a single variety may take 4 to 10 years. Therefore, the recently developed regional stations may be doing well to have varieties in the breeding pipeline.

Screening for pest and disease resistance is problematic at the regional stations due to lack of facilities. Batalagoda and CARI have adequate facilities and maintain the responsibility for screening of particular pests and diseases. Coordination and cooperation between regional stations and the central stations is not always adequate to ensure timely screening of varieties.

Germplasm storage at Batalagoda and several of the research stations visited is inadequate. One small freezer at Batalagoda is the extent of long-term germplasm storage. At the regional stations, germplasm storage occurs in jars on shelves and each cross and variety must be planted every year.

6.2 RESEARCH ON MANAGEMENT PRACTICES

Research on new varieties is accompanied by research on improved management practices. Formulation of recommended management practices for the new improved varieties has been a major component of the work at the regional stations. New improved varieties require the use of new management practices in order to achieve high yields. Recommended changes in management practices include: (1) fertilizer use; (2) pest control; (3) disease control; and (4) improved cropping systems.

6.2.1 Fertilizer Use

Fertilizer recommendations have been developed by rice researchers in Sri Lanka since the 1940's. Use of fertilizer was not necessary with traditional varieties due to the low response rate of the varieties to fertilizer application. With the introduction of the fertilizer responsive Bg varieties in the early 1970's, fertilizer recommendations were developed for farmers based on different management levels and yield expectations. Special recommendations were also developed for dry zone conditions.

In 1979, a new simplified set of recommendations was developed that remains operative at the present time. The across the board recommendations presently given are not suitable for farmers with low managerial levels and yield expectations. A single basal fertilizer is recommended for use in all rice fields except the bog soils of the low country wet zone. A single top dressing mixture is also recommended for all rice fields. In addition to the across the board recommendations, several recommendations have been developed for specific conditions. Recommendations are available for areas where rainfall or water are limited and for fields that are rotated with high value cash crops that are heavily fertilized. In Bombuwela, improvements in the use of rice straw to increase fertility are being investigated. Nevertheless recommendations for fertilizer use are not widely available for farmers with low resources.

6.2.2 Pest Control

The development and use of new varieties resulted in management difficulties associated with pests, diseases and weeds that were not previously a problem. The increased growth rates of the new varieties due to fertilizer response and the new plant type resulted in increased pest and disease problems and prolific weed growth. In response to these difficulties, entomological research on pests in conjunction with efforts by rice breeders has resulted in a pest control program that utilizes pesticides only as a last resort. Regional monitoring and control of pest outbreaks in addition to scientific research has resulted in the following integrated pest control programs.

1. Development and cultivation of pest resistant varieties;

2. Identification of safe periods for cultivation in relation to the life cycle of different pests;

3. Clean and timely cultivation to limit the increase of pest populations;

4. Regular inspection of rice crops to determine critical build-up levels of pests requiring pesticide control;

5. Protective pesticide use at critical stages of pest infestation;

6. Pesticide use on a need basis for pests such as leaf roller and thrips.

Thus, the breeding program has remained oriented towards minimizing pesticide use through the development of pest resistant varieties. Recommended practices emphasize minimal pesticide use.

6.2.3 Disease Control

As with insects, the priority for control of disease is breeding for resistance. Varieties were developed in the 1970's with resistance to blast and bacterial leaf blight. Since that time, an active program for screening varieties and for varietal trials has developed. Through the Coordinated Rice Varietal Trials, the incidence of diseases in varieties is monitored by assessments of trials in various agro-ecological regions. In addition, screening of hybrids and varieties against blast occurs at Batalagoda and Maha Illuppallama. A program for comparing the incidence of blast under varying conditions was initiated at Karadian Aru in 1981-1982, although at present all work at Karadian Aru has ceased due to the ethnic disturbances. Experiments to test the impact of different fungicides on sheath blight occurred in 1982 at Makandura, however the experiments were abandoned due to drought. A coordinated effort between the regional stations and CARI occurs in testing for seed-born rice pathogens. Seeds from Batalagoda, Bombuwela, Ambalantota, Paranthan, Malwatta, Maha Illuppallama were all tested at CARI in 1982.

6.2.4 Weed Control

Competition with weeds is a major limiting factor for maximizing production of improved varieties. Unlike the taller traditional varieties dwarf varieties are not able to shade out weed growth. Various practices for weed control have been tested including: transplanting, mechanical weed control and herbicides. Despite the high cost of herbicides, approximately 45 percent of the area cultivated in rice is treated with chemical herbicides. Currently, the breeding program at Maha Illuppallama is developing varieties with weed resistance.

6.2.5 Intensified Cropping Systems

Research on appropriate practices for different agro-ecological regions has been enhanced through the cropping systems research endeavor. The impact of the cropping systems component of the project will be discussed later in the report, but it should be noted at this point that research on varieties

and practices was closely linked to intensification of cropping systems in various regions. The development of cropping systems research at the same time as regionalization of research improved scientists' understanding of regional cropping systems and problems to be resolved. Recommendation of practices such as dry sowing, row planting, transplanting, timing of planting alternative crops, and use of shorter duration varieties were all outcomes of the cropping systems effort.

6.2.6 Limitations of Research on Management Practices

Scientific effort in rice research has been oriented primarily towards varietal improvement rather than improved management practices. Although researchers including agronomists, soil scientists, entomologists and plant pathologists have worked to develop recommended practices for the country, more effort in developing recommendations for agro-ecological conditions and farmers with different resource levels is necessary. The lack of an effective field trials program has hampered progress on research management practices.

6.3 RESOURCE CAPABILITY STUDIES

The resource capability studies laid the groundwork for agricultural research and practices specific to different regions. Based on information compiled on rainfall, elevation, soil conditions and topography, the Land and Water Use Division of the DOA published a map in 1976 delineating agro-ecological regions in Sri Lanka (See Map 1). Basic information on the agro-ecological regions has been collected, but as of 1977 this was not readily available to researchers and extension workers. Detailed studies provided a riceland classification scheme particularly for the wet and intermediate zones. The RRP enabled the Land and Water Use Division to familiarize researchers and extension personnel with the results of their efforts and to establish the importance of understanding agroecological conditions for improving rice production.

The outcomes of the resource capability studies are as follows:

1. Development of a practical operating basis for regionalization;
2. Guidance for breeding priorities for varied environments, particularly in the wet zone;
3. Training for extension workers and improvement of extension-research communications;
4. Setting a stage for plans for crop diversification and furtner work on resource capabilities.

6.3.1 Basis for Regionalization

Regionalization of the agricultural research system was based on the recognition of the varying resource capabilities and problems of different regions. The resource capability studies delineated the agroecological conditions of the various regions. For the purpose of providing a broad based understanding of the agro-ecological zones, the Land and Resource Division held various levels of seminars with administrators, high level officers, and district level staff. A common basis for the understanding of the climatic, topographical and soil conditions in the different regions provided regional research centers with a clear demarcation of the geographical areas of their responsibility and a guide for potential problems to be resolved. One indicator of the awareness of the significance of agro-ecological diversity for research work is the prominent display in most regional research stations of the map of Sri Lanka's agro-ecological regions prepared by the Land and Water Use Division of the DOA. At present, the results of the resource capability studies are well-known among the more senior agriculturalists throughout the country and have become a basis for conceptualization of problems.

6.3.2 Breeding Priorities for Varied Environments

Prior to the resource capability studies, rice varieties had been bred and selected for stable conditions. Varieties bred for the stable conditions of the dry zone were not suitable for cultivation in the wet zone. The resource capability studies provided breeders with information for developing varieties for the wet zone.

The RRP contribution to the resource capability studies was specifically focused on the wet and intermediate zones. A scheme of riceland classification for the wet and intermediate zones was developed through studies which identified and classified valley and terrace slope systems, delineated slope categories and completed soil surveys and mapping. These in-depth studies allowed researchers to tailor varieties for the micro-environments found within the agro-ecological zones. The information continues to be used by researchers in their efforts to develop varieties and practices for the types of ricelands delineated in the studies. For example, in the narrow valleys and steep slopes characteristic of the mid-country ricelands, improved rice varieties perform well on the lower slopes, but on the upper slopes traditional or old improved varieties perform better.

6.3.3 Extension Training

In addition to providing a basis for research endeavors, the riceland classification scheme was easily understood. It was used to train extension personnel and farmers to identify various land forms and associated problems and potentials. Recommendations for varieties and practices were provided in relation to these land forms. Field days, attended by both researchers and extension officers, were held in many districts to provide an understanding of the utility of the rice classification scheme. Extension officers were able to assist farmers in

identifying problems in their fields on the basis of this information, and they were consequently more adept at recommending specific varieties and practices to farmers. However, although training for eextension on land use capabilities was extensive during the project, evidence does not exist that follow-up training is occurring. The continuation of the training program has been hampered by lack of funds and changing priorities of the Research Division.

6.3.4 Crop Diversification

As rice production increases towards self-sufficiency, the Sri Lankan Government is beginning to promote diversification into other food crops. The newly initiated USAID Diversified Agriculture Research Project (DARP) and the FAO Rainfed Rice Project scheduled to begin in 1985 will both explore prospects for crop diversification. The riceland classification scheme developed by the resource capability studies could form the basis for introducing crop diversification to farmers. Farmers could be assisted in identifying lands with high yield potential for rice and identifying fields that may be better utilized for raising other field crops. In the dry zone, the resource capability studies can be used to identify soil types and hydrological conditions suitable for the cultivation of crops other than rice. Finally, the resource capability studies have provided a framework for understanding the importance of agro-ecological conditions that is being built upon by other projects. For example, a Swiss-funded remote sensing project was able to build on the resource capability work to conduct further mapping and land use research.

6.3.5 Limitations of Resource Capability Studies

Few limitations exist in terms of past work, but prospects at present are not bright for the Land and Water Use Division. With the conclusion of the RRP, the Division lacks funding to continue research on land subsystems. Also, extension training on land classification does not appear adequate. DOA funds are sufficient to operate a soil and water project in Kandy, but not in other regions of the country. Training for extension on land resource capability is not currently adequate. The Ministry of Lands and Land Development is conducting work on land capabilities for agriculture for several foreign funded projects, but there appears to be minimal communication or coordination between the DOA and the Ministry of Lands and Land Development.

6.4 INSTITUTIONAL LINKAGES

6.4.1 Linkages Between Research - Extension - Farmers

Linkages between research and extension have been improved with the establishment of Regional Technical Working Groups (RTWG) and Research - Extension Dialogues in 1978/79 as a result of the World Bank Agricultural Extension and Research Project (AERP).

A research training working group (RTWG) is a group of technical officers from Research, Extension, Education and Farms divisions in an area. The group meets 150 days prior to each agricultural season to identify priorities in research, extension and education and prepare programs of action for the region. Research - Extension dialogues are held monthly at the regional research stations for the purpose of providing up-to-date communication between researchers and extension personnel.

The regions for the research-extension exchanges incorporate two or more districts and are centered at the following locations:

1. Maha Illuppallama
2. Angunakolapelessa
3. Gannoruwa
4. Bombuwela
5. Karadian Aru
6. Makandura
7. Bandarawela
8. Paranthan

The regionalization of research stations and the establishment of RTWG's provided a systematic, two-way flow of information between researchers and farmers through the medium of extension. Farmers' problems that cannot be solved by extension are brought to the attention of researchers. At the same time, researchers convey to extension their latest findings and recommendations for farmers. As a result of the meetings and dialogues, researchers are kept in regular contact with farmers' problems in the region. The regularization of the research - extension linkage has improved the two-way flow of information between farmers and researchers and therefore accelerated the transfer of technology to farmers.

6.4.2 Field Trials and Adaptive Research

Although the Field Trials Division essentially disappeared during the course of the project, previous evaluations suggested that the Field Trials program was incorporated into the World Bank's Agricultural Extension and Adaptive Research Project. The AERP recommended the establishment of adaptive research teams at eight regional centers and the establishment of 24 subcenters. The adaptive research program was to conduct trials on farmers' fields and to provide a link between research and extension. As new technologies emerged from the regional research stations, the adaptive research centers were expected to conduct field trials on new varieties, improve cultural practices, and use of inputs for all field crops. Unfortunately, the adaptive research centers are not performing anticipated activities. Although buildings have been constructed in various locations, often no personnel, vehicles or equipment are attached to the centers.

Farmers in the Mahaweli project often do not follow recommendations due to lack of water or lack of money. The irregularity of water supply, especially during Yala, has discouraged farmers from increasing cropping intensity and investing in costly inputs. Farmers' practices fluctuate with the availability of water.

6.4.4 Socioeconomic, Cultural and Agronomic Constraints to Adoption

Table 6.4 indicates various socioeconomic, cultural and water management constraints for the adoption of recommended practices. New improved varieties have been readily accepted by farmers in almost all the agroecological regions regardless of the socioeconomic position of the farmer. However, in specific climatic zones where cold, salinity, and floods are problematic; farmers continue to cultivate old improved or traditional varrrieties. Farmers have readily adopted the new varieties because the NIV's produce a similar quality grain as older varieties but with dramatically increased yields.

In the minor tanks, lack of cooperation among farmers has made water management difficult. Farmers who plant early or dry sow can not be assured of adequate water from irrigation or rain. Transplanting is another practice that farmers are reticent to adopt due to increased labor demand. Although farmers are aware of the benefits of transplanting for weed control, the additional labor demand is difficult to meet.

Socioeconomic, cultural and agronomic factors prohibit farmers from adopting various recommended practices. Farmers are unlikely to adopt changes that significantly alter their practices without guaranteeing increased income. The adoption of many of the recommendations developed at the research stations entails increased cash expenditures, increased labor, and in some instances greater uncertainty. Although farmers are often willing to experiment with new practices, they are unlikely to continue the new practices unless their food supplies and incomes are increased.

In contrast, early planting and dry sowing of rice are often not practiced by farmers due to increased labor demands, greater cash requirements, coincidence with chena production, and lack of a sure supply of water. Farmers in the cropping systems sites practiced dry sowing as long as researchers provided tractors, but without the resources to purchase or hire tractors, farmers returned to their previous practices. Dry sowing is a feasible practice with tractor power and an assured water supply, but without tractor power dry sowing is extremely labor intensive.

The new improved varieties require increased use of fertilizer, pesticides and herbicides. The majority of farmers use inputs. The government currently heavily subsidizes fertilizer, thus reducing the cost to the farmer. Despite the high costs of other inputs, the majority of farmers purchase the inputs in order to insure a sufficient yield. At present, input recommendations are based on maximizing yields rather than optimizing income. Farmers often lack the resources to purchase required amounts of inputs for all their crops. Farmers are less likely to use inputs for

TABLE 6.4: Socioeconomic, Cultural and Agronomic Constraints to Adoption of Selected Recommended Practices

Recommended Practices	Socioeconomic	Cultural	Agronomic
1. Short-age new improved varieties	Requires higher inputs	Water management	Salinity, lack of water, susceptibility to flooding
2. Dry sowing early planting	Involved in Chena Lack of money for tractor Increased labor demand	Water management	Lack of water, weed control
3. Transplanting	Increased labor demand		
4. Paddy Crop in Yala		Water management	Lack of water
5. Vegetables in Yala	Lack of money Lack of market High risk	Water management	Lack of water, quality of seeds, timing
6. Input use	Lack of money High risk Misinformation on input use	Land tenure arrangements	Lack of economically appropriate recommendations

chena crops and for high risk crops, such as paddy during Yala. In the production of rice during Maha or cash crops, farmers usually attempt to use recommended inputs. The high cost of inputs often requires borrowing money. Consequently, many farmers are in debt and some have had no alternative but to mortgage their land. Farmers' purchases of pesticides often occurs at retail outlets that do not necessarily provide the appropriate chemical or the correct recommendation for application.

Recommendations for increasing crop intensity are often not followed due to lack of water or uncertainty of a regular water supply. Farmers are unlikely to cultivate vegetables on paddy land without the assurance of favorable market prices and access to marketing opportunities. The high input costs necessary for vegetable cultivation limit the adoption possibilities for low resource farmers.

Constraints to adoption could be better addressed through regular contact between farmers and researchers. Although extension bridges the gap between researchers and farmers, researchers would benefit through more direct contact with farmers. Surveys of farmer practices are currently conducted by economists in each regional station, but researchers are rarely familiar with the results. An in-depth understanding of the rationale for farmers' practices and problems are essential for determining research priorities. Recommendations that optimize yields should be provided to farmers. Continuation of efforts in cropping systems, adaptive research and researcher/extension communication will contribute to appropriate recommendations.

7. IMPACT ON FARMS AND RICE PRODUCTION

7.1 IMPACT ON RICE PRODUCTION

Rice production in Sri Lanka increased from 70 percent to 85 percent self-sufficiency during the course of the project. In 1984, Sri Lanka was 100 percent self-sufficient in rice and imports were halted. Total production of rice was 119.1 million bushels in 1983 compared to 80.1 million bushels in 1977. Increased production is a result of higher yields and an increase in acreage under paddy cultivation. Average yield per acre increased from 49 bushels per acre in 1977 to 70 bushels per acre in 1983. The increase in paddy acreage cultivated was 1.7 million acres under cultivation in 1977 to 2.0 million acres in 1983.

Regional variations in area sown, total production and yield per acre are depicted in (Table 7.1). The environmentally stable areas in the dry zone have increased to 34 percent of the total area sown in 1983 from 28 percent in 1977. The extent of acreage sown has decreased in the intermediate and wet zones from 1977 to 1983. Stable areas in the dry zone produced 44 percent of the total bushels of paddy in 1983 compared to 35 percent in 1977. During the same time, total production increased in all regions. In 1983, yield per acre was highest in the stable areas in the dry zone with an average yield per acre of 89 bushels. Average yield per acre in other areas in 1983 were 68 bushels in the intermediate zone, 67 bushels in the mid and up-country wet zone, 58 bushels in other areas in the dry zone and

Table 7.1. Paddy Area Sown, Total Production, and Yield Per Acre by Region, 1977 and 1983.

Region	1977				
	Gross Sown Area ('000 Acres)	Percent	Production (Mn Bushels)	Percent	Yield Per Acre
Wet Zone - Low Country	431	21	11.2	14	33
- Mid and Up Country	349	17	15.1	19	53
Intermediate Zone	298	14	11.3	14	47
Dry Zone - Stable Areas	565	28	28.8	35	63
- Other Areas	402	20	14.5	18	45
Total	2045	100	80.9	100	49

Source: National Planning Division, Ministry of Finance and Planning, Colombo, Sri Lanka, National Agriculture Food and Nutrition Strategy, June 1984.

Table 7.1. Continued. Paddy Area Sown, Total Production, and Yield Per Acre by Region, 1977 and 1983.

Region	1983				
	Gross Sown Area ('000 Acres)	Percent	Production (Mn Bushels)	Percent	Yield Per Acre
Wet Zone - Low Country	313	15	12.0	10	48
- Mid and Up Country	316	16	17.1	14	67
Intermediate Zone	270	13	15.8	13	68
Dry Zone - Stable Areas	689	34	52.1	44	89
- Other Areas	449	22	22.1	19	58
Total	2037	100	119.1	100	70

Source: National Planning Division, Ministry of Finance and Planning, Colombo, Sri Lanka, National Agriculture Food and Nutrition Strategy, June 1984.

48 bushels in the wet zone. Yield per acre increased in all regions between 1977 and 1983.

Increased rice production can be attributed to increased yield per acre and increased acreage sown. The increased use of new improved varieties has resulted in major increases in yield per acre. The Rice Research Project supported the development of new improved varieties and encouraged intensified cropping systems in Yala. Rice production increased throughout the project period and is continuing to increase. But, as was observed in the end of project evaluation in 1982 while it is tempting to attribute increased rice production to the project, the impact of a single project on rice production is difficult to determine. Certainly the project has contributed to increased rice production through its efforts. But other factors have also contributed to increased rice production. These include: increased paddy land through the Mahaweli irrigation scheme, availability of inputs, previous breeding achievements, and favorable weather. Producer prices per bushel of paddy have increased from 41.84 rupees in 1975 to 73.25 rupees in 1984 (Table 7.2). The availability of inputs to farmers depends on the government's ability to import inputs as well as the farmer's ability to purchase the inputs. Due to increased government imports and heavy subsidation of fertilizer prices, fertilizer use increased from 87.1 m./tons in 1970 to 186.8 in 1984 (Table 7.3).

7.2 CROPPING SYSTEMS RESEARCH

Cropping systems research was designed to intensify cropping systems in various agro-ecological zones. The underlying rationale was that through the adoption of short-age new improved varieties, farmers would be able to cultivate two to three crops a year in their paddy fields.

Various levels of success have been achieved in different regions. The most successful sites are located in the intermediate zone where farmers are not constrained by water availability, marketing, or limited resources. A second site that has shown increased intensity is the Mahaweli irrigation scheme, where farmers are cultivating two crops in their paddy fields. Farmers in the Mahaweli scheme do not have access to chenas. In both of the successful sites, farmers are cultivating high cash value crops, potatoes and chilies, on their paddy fields. Unsuccessful sites are located where water management and marketing constraints prevail and farmers have access to highlands for chena cultivation.

Intensified cropping systems are more widely adopted by farmers with sufficient water, markets, and capital. For farmers in less favorable circumstances, increasing cropping intensity of paddy lands is not a viable option at present. Further cropping systems efforts should consider the importance of highland crops, water management, and marketing.

7.2.1 Impact of Cropping Systems at Five Sites

The RRP supported work at five sites through training, technical assistance, and the provision of equipment. A description of the five

Table 7.2. Producer Price Per Bushel of Paddy - Sri Lanka.

Year	Price (Rs./bu.)
1975	41.84
1976	37.37
1977	35.22
1978	40.74
1979	42.03
1980	51.01
1981	67.23
1982	71.15
1983	73.37
1984	73.25

Primary Source: Department of Census and Statistics.

Secondary Source: Data Bank - A.R.T.I.

Table 7.3. Use of Fertilizer for Rice - Sri Lanka.

Year	Amount ('000 MT)
1970	87.1
1971	95.4
1972	88.4
1973	125.5
1974	96.5
1975	48.7
1976	72.4
1977	122.9
1978	136.1
1979	130.6
1980	189.9
1981	155.6
1982	167.1
1983	162.1
1984	186.8

Primary Source: Ceylon Fertilizer Corporation - National Fertilizer Secretariat.

Secondary Source: Data Bank - A.R.T.I.

sites and the impact of the cropping systems program on farming patterns in each area is discussed below.

Dry Zone

Mahaweli Area - Walagambahuwewa: Work was conducted in both minor tank irrigation and fully irrigated condition in the region around the Mahaweli Area. The work on the minor tank system was supported primarily by IDRC. In the minor tank system, the major objectives were to increase cropping intensity and consequently to improve farmers incomes. Recommended practices included: (1) early planting, (2) use of short-age rice varieties, (3) dry sowing,and (4) planting a rice crop in Yala.

During the time of the project, many farmers followed the recommended practices and the extension service demonstrated the technology in 60 other villages in the dry zone. Early reports suggested the project was a success with farmers following the recommended practices and reporting increased rice yields from 1.2 tons per hectare in 1976/77 to 2.9 tons per hectare in 1980/81. However, a study of the impact of the project in 1980, based on a survey of 250 farmers in 25 villages reported mixed results concerning the success of the project. In the 5 tank schemes near the cropping systems site, a large number of farmers prepared their lands early as was recommended. However, in the other villages, the majority of farmers had not planted early. Although the cropping systems staff had recommended short-age varieties, 65 percent of farmers used long-age varieties (4-month). The majority of farmers did not use dry sowing as recommended and 100 percent broadcast seeds. Farmers explained that lack of financial resources, farm power and the influence of chena made them prefer wet sowing. Broadcasting is practiced because farmers consider it easier and cheaper to broadcast than to row crop or transplant. A further economic study of Walagambahuwewa reported that farmers' incomes did not increase substantially through a shift to earlier planting and dry sowing. Another survey reported that the majority of farmers in the Anuradhapura and Kurunegala districts are aware of the cropping systems program, but have not adopted the practices due to high risk.

Our visit to the project site at Walagambahuwewa indicated that farmers were not planting early or adopting the other recommendations. Discussions with farmers and the cropping systems research officer attributed the absence of early cultivation to lack of cooperation on the part of farmers in the village concerning water use.

Mahaweli Major Irrigation Scheme-System H

The site is located within the large irrigation scheme at Mahaweli. The irrigation project will include 400,000 hectares of cultivable land in the dry zone upon completion. Cropping systems activity began in the site in 1978 and is continuing at present. The major effort has been directed towards intensifying cropping systems through use of short-age varieties, transplanting, and encouragement of vegetable production in Yala. The major problem farmers face is lack of consistent water supplies. Therefore participant farmers were selected in two sites with different levels of accessibility to water. Two cropping patterns were suggested to encourage

higher yields among both low and high resource farms. For the resourceful farmers, a rice - chilies/onion cropping system was suggested, while farmers with less resources were encouraged to crop rice - cowpea/soybean. A visit to the field sites with the cropping systems officer revealed that farmers had followed cropping systems recommendations in their adoptation of short-age varieties followed by chili production. Although a benchmark survey was conducted, no evaluation has been undertaken concerning the adoption of recommended practices. A visit to the field sites with the cropping systems officer revealed that farmers had followed cropping systems recommendation in their adoptation of short-age varieties followed by chili production. Although a benchmark survey was conducted, no evaluation has been undertaken concerning the adoption of recommended practices.

Angunakolapellassa

Located in the dry zone in the South, the cropping systems effort began in 1979 to test the Walagambahuwewa concept for minor-tanks. Prior to the introduction of the cropping systems program farmers only planted one crop of rice in Maha. The recommendations suggested farmers increase their cropping intensity through the use of short-age rice varieties. The recommended cropping pattern was rice-rice-vegetables. Although farmers followed the practice in 1979 when power and inputs were provided, all of the farmers returned to their old system in 1980.

Under the RRP, Angunakolapelessa was targeted as a station to develop a rice-cotton cropping systems research site. Due to the lack of a government program insuring favorable markets and prices, no cotton is currently being grown in the region. On-station research is now being conducted on intercropping maize/cotton/chilies with legumes for highland fields. No evaluations of the extent of farmer adoption of recommended cropping systems had been conducted. At present no cropping systems work is occurring in farmers' fields. Economic resources are not a problem, but lack of sufficient and highly motivated staff limits on-farm work on cropping systems.

Paranthan

The site was chosen to represent rainfed rice in the dry zone. Originally a two-crop cropping pattern was recommended but given the lack of water during Yala, a rice - fallow system was the subsequent recommendation. An assessment of the project was not possible as a result of lack of communication and inaccessibility due to the current civil strife.

Karadiyan Aru

A cropping systems site was in the process of being organized at Karadiyan Aru in 1982, but all work at the station has ceased due to the ethnic troubles.

Intermediate Zone

Bandarawela

Compared to other cropping systems efforts, the Bandarawela cropping systems project has been extremely successful. A major difference between Bandarawela and other cropping systems sites is that farmers in Bandarawela were practicing intensive cropping systems on their paddy lands prior to the cropping systems program. Bandarawela farmers were producing a high value cash crop, potatoes, and had developed a marketing system for their produce. Due to their higher income levels and adequate water supply, farmers were able to take risks to improve their incomes. The cropping system program built on the farmers' existing cropping system and proved successful due to the introduction of a new improved rice variety, farmer cooperation, suitable environmental conditions, and the commitment of the research staff.

The Bandarawela cropping systems program is designed for farmers in the intermediate zone and was initiated during Maha 1978/79 at Adamagama, Uva Paranagama. Prior to the cropping systems project, farms cultivated a paddy crop followed by potatoes or vegetable and, to a limited extent, a second vegetable was planted on the paddy field. The problem for farmers was that they did not generally reap the full benefit of the third crop due to time limitations. The major objective of the cropping systems project was crop intensification including the cultivation of three full crops (paddy - vegetables - vegetables). Crop intensification occurred through the introduction of a shorter-aged new improved variety (Bg94-1/R) to replace the old improved variety (H-4) that the majority of farmers were cultivating. The objectives of the cropping systems project have been met in that almost all of the farmers in the project area as well as many other farmers in the vicinity are presently cultivating three crops (paddy - potatoes - vegetable) and are reaping the benefits of their third crop. The success of the project is attributed to the adaptation of the short aged rice Bg94-1(R) that has the following characteristics: (1) shorter age than the previously cultivated variety, (2) higher yield, (3) comparatively cold tolerant, (4) comparatively tolerant to disease and pests, and (5) a red type of grain preferred by local consumers.

An economic evaluation of the Idamagama site from 1978 to 1982 was conducted by the economist at Bandarawela. Cropping intensity increased from 1.5 in 1979 to 2.1 in 1982. One hundred percent of the farmers participating in the project grew a second crop and 80 percent cultivated a third crop in 1981/82. Yield increases occurred in rice (21%), potatoes (29%) beans (16%) between 1978 and 1982. Yields from the new improved variety were 101.33 bushels per acre compared to 79.09 bushels per acre from the old improved varieties. Farmers' incomes increased 10 percent between 1978 and 1982.

At present, two cropping systems officers are continuing their work at Idamagama and have initiated a new site at Bogahakumbura in 1983. Based on the success of their previous efforts, the new site was established to evaluate the intensified cropping system developed at Idamagama. The objective was to intensify the cropping system from a two-crop pattern (paddy - vegetable) to a three-crop pattern (paddy - potatoes -

vegetable). At the initiation of the project, only 8% of the paddy land had a third crop. Intensification was possible through the introduction of the shorter-age variety, Bg94-1 (R), to replace H-4. Rapid success was achieved in the project. Seventeen kilograms of the new improved variety were distributed to farmers in 1983 and within two years (1985), the entire cropping site area (5 hectares) and 50 hectares in neighboring villages have been cultivated with Bg94-1 (R). The entire seed supply originated in the cropping systems site.

Interviews with three farmers in the Bogahakumbura indicated that farmers were working closely with the cropping systems officers. All three farmers had changed to the new improved variety and were following the recommended practices. The high cash value of potatoes provided income to the farmers to purchase adequate inputs. Farmers' incomes have increased since the initiation of the cropping systems project.

7.2.2 Limitations of Cropping Systems Research

All efforts at improving cropping systems were aimed at intensifying cropping systems through the introduction of shorter-age high yielding varieties and accompanying practices. Although benchmark studies were conducted in all cropping systems sites, a lack of understanding and appreciation of farmers' rationale for their practices was a major limitation of the cropping system effort. The focus on intensive production of paddy lands did not adequately consider the importance of chena (highland) production for the farmers. Over time, farmers had adapted their practices to take advantage of water availability and to minimize risk. Although cropping systems researchers had adequate knowledge of rainfall patterns, the problems of water management were not fully understood and incorporated into the recommendations.

Due to low resources, farmers were not able to adopt recommended practices. Recommendations for earlier planting included the adoption of practices such as dry sowing. Farmers followed this practice only when the cropping systems researchers provided mechanical power. Farmers returned to the practice of mud sowing once tractors were no longer available. Recommendations were inappropriate to the level of technology available to farmers.

Intensification of cropping systems required greater cooperation among farmers in terms of water management and marketing. Cooperation was not always beneficial to the individual farmers. Also, some farmers' objectives were to minimize risks, while others' objectives were to increase yields.

Many of the farmers problems were not under the control of the farmers. Lack of adequate and regular supplies of water in the irrigation schemes discouraged the adoption of intensified cropping systems. Unfavorable marketing systems for vegetables crops discouraged farmers from intensifying production. Finally, the underlying assumption that increased yields and intensified cropping systems would increase farmers' income did not always prove to be accurate.

7.2.3 Designing of Future Cropping Systems Programs

The principal of designing and basing programs in different agro-ecological zones should be continued. Although benchmark surveys were conducted at each site, a more thorough understanding of the farming system is necessary. In addition to learning the timing and practices of farmers, researchers must understand the reasons for farmer' practices. Recommendations for changes in cropping systems must include an analysis of other necessary changes in areas such as: (1) water management, (2) marketing, (3) level of inputs, and (4) labor.

The focus of the cropping systems effort in Sri Lanka has been to intensify production on paddy fields. Further efforts must explore the interaction of highland production with paddy production. Although increasing cropping intensity may be accepted by the more advantaged farmers, more simple improvements should be developed for low resource farmers.

7.3 IMPACT ON FARM INCOMES

Although total production and average yield per acre of rice have increased over time, there is no assurance that the economic situation of farmers has improved. Costs of production per acre and per bushel have increased as prices and yields per acre have increased. In fact, available data suggests that farmer returns per acre of paddy has actually decreased from 1977 to 1982. Thus, although farmers have increased production and yield per acre, their incomes per acre have not improved. For the large number of small farmers with limited acreage, farm income from paddy has declined. The overall economic situation of farmers has not been improved through increased yields. For the farmer, limiting the costs of production would be a welcome improvement. Table 7.4 reports net returns and real net returns per acre for Maha and Yala for agro-ecological regions from 1978/81 to 1982/83. All indicators suggest a downward or stagnant trend in producer incentives for both the Maha and Yala crops. The downward trend is less evident in Yala than Maha. On irrigated land, net returns per acre have increased in Yala. Increases in paddy prices have been more than offset by increased cost of production per bushel.

Returns to family labor in relation to the wage rate has decreased from 1978/79 to 1982/83 in Maha paddy production (Table 7.4). Returns to labor have decreased across agro-ecological zones, although the returns remain highest in irrigated areas in the dry and intermediate zones.

Table 7.4. Paddy Maha Season: Summary.

	Net Returns*/Acre					Real Net Returns*/Acre				
IRRIGATED	78/79	79/80	80/1	81/2	82/3	78/79	79/80	80/1	81/2	82/3
WET ZONE LOW	904	-	2166	3324	3032	908	-	1466	1347	1400
MID	-	-	1762	2620	2566	-	-	117	1033	1306
HIGH	1883	-	2083	2220	1747	1808	-	1388	1346	870
INTERMEDIATE ZONE	1970	-	2288	2348	3074	1780	-	1837	1420	1636
DRY ZONE	1760	1412	1649	2356	2066	1760	1183	1103	1272	1039
ALL ISLAND	1898	1412	1813	2341	2143	1701	1115	1288	1410	1208
RAINFED										
WET ZONE LOW	838	701	1381	1571	1620	836	668	938	952	881
MID	1201	-	2068	2468	2303	1201	-	699	934	883
HIGH	2010	-	1264	2368	3174	-	1699	2077	2048	1787
INTERMEDIATE ZONE	1284	-	2147	1708	2131	1077	-	1442	1082	1132
DRY ZONE	44	-	1198	958	837	-	-	808	483	445
ALL ISLAND	1406	701	1833	1491	1442	967	937	1120	782	745

* excluding cost of family labour

	Ratio of Gross Returns : Total Costs					Returns to Family labour : Wage Rate				
IRRIGATED	78/9	79/80	80/1	81/2	82/3	78/9	79/80	80/1	81/2	82/3
WET ZONE LOW	1.8	-	2.6	3.3	2.6	2/3	-	3.1	3.1	3.1
MID	-	-	2.0	2.5	2.4	-	-	4.2	2.3	2.4
HIGH	4.4	-	2.4	2.4	2.0	3.2	-	3.6	2.5	2.0
INTERMEDIATE ZONE	2.6	-	2.8	2.4	2.7	5.0	-	5.1	3.4	4.6
DRY ZONE	1.8	1.9	2.0	1.9	1.9	6.0	5.5	5.4	4.7	4.9
ALL ISLAND	2.6	1.9	2.3	2.2	2.2	5.1	5.5	4.8	3.6	4.0
RAINFED										
WET ZONE LOW	1.9	1.8	2.0	1.9	1.9	4.2	3.5	2.4	2.5	2.7
MID	3.1	-	2.7	2.7	2.4	4.5	-	3.1	1.9	2.3
HIGH	3.7	-	1.9	2.3	2.2	4.1	-	1.2	2.0	1.3
INTERMEDIATE ZONE	2.2	-	2.7	2.2	2.4	5.4	-	2.7	3.4	3.0
DRY ZONE	1.0	-	2.1	1.5	1.4	0.5	-	3.5	2.1	2.5
ALL ISLAND	2.2	1.9	2.5	1.9	1.9	4.2	3.5	2.7	2.4	2.9

Source : Cost of Cultivation of Paddy 1978/79 - 1982/3 Maha Seasons
Div. Agricultural Economics

Table 7.4. Continued

	Net Returns*/Acre			Real Net Returns*/Acre			Ratio Gross Returns : Total Costs		
IRRIGATED	79	81	82	79	81	82	79	81	82
WET ZONE LOW	-	3753	3112	-	1850	1278	-	3.4	2.6
MID	1839	2488	1083	1839	1608	1201	9.0	3.2	1.9
HIGH	1038	2446	2092	1268	1608	1845	2.6	3.0	2.6
INTERMEDIATE ZONE	1082	2187	2333	1082	1409	1413	2.1	2.6	2.4
DRY ZONE	1187	2371	2476	1220	1603	1490	2.0	2.1	2.0
ALL ISLAND	1232	2374	2358	1206	1603	1488	2.4	2.3	2.2
RAINFED									
WET ZONE LOW	891	1202	1287	1146	787	764	1.8	1.8	1.7
MID	1059	1136	1381	1059	1281	617	2.8	2.3	1.8
HIGH	-	2617	3200	1776	761	745	3.3	2.0	1.8
INTERMEDIATE ZONE	1158	2604	1854	1158	1736	1129	-	-	-
DRY ZONE	-	-	-	-	-	-	-	-	-
ALL ISLAND	978	1692	1667	1236	1000	818	2.2	2.0	1.8

* Excluding cost of family labour

Source : Cost of Cultivation of Paddy 1978/82
Div. Agricultural Economics

7.4 RICE MARKETING AND PROCESSING

7.4.1 Marketing

Increased rice production has resulted in the near attainment of self-sufficieny in rice. GSL policy in regard to processing and marketing is not adequately prepared to manage further substantial increases in rice production.

The major GSL institution involved in processing and marketing is the Paddy Marketing Board (PMB). As a result of a shifting GSL policy in the past five years, the private sector has become the dominant influence in paddy purchasing, processing and marketing. PMB purchases of rice have declined from 42 percent of production in 1972 to 4 percent in 1982. The price of rice on the open market has increased as has the open market farm gate price for paddy. Open market farm gate prices have remained well above the price offered by the PMB. At present, the GSL is attempting to further develop the free market system and encourage private sector initiatives. Due to current conditions, problems of future price stability are imminent.

The possibility of future paddy surpluses, limited economic crop alternatives to paddy production, and limited opportunities for export production, pose problems for the farm sector. Paddy production is undertaken by approximately 1 million small farmers who have been encouraged to increase rice production by government supported paddy prices and irrigation projects. In the event of production surpluses, the open market farm price of paddy is likely to decrease dramatically. Due to a lack of alternative crops, the scenario for the future is likely to result in lower incomes for farmers. Economic policies should be adopted that ensure a smooth transition for farmers until markets for other crops can be established.

With the attainment of self-sufficiency in rice, the GSL is exploring options for adjusting to a surplus. Export options are limited in the near future due to low quality rice. The National Planning Division has recommended (1) improvement of local grading requirements, (2) improvement of milling performance, (3) improvement in storage capacity and (4) changes in pricing policy. As of yet, limited action has been taken.

7.4.2 Processing

GSL effort to improve rice processing has been minimal. Various foreign projects such as the USAID sponsored Paddy Storage and Processing Project have been undertaken to improve processing, but have not been especially successful. For example, Sri Lanka's rice milling industry is below the

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*Although surplus rice production seemed a certainty in 1984, the ethnic violence may severely curtail further immediate increases in production.

standards of other Asian countries and is characterized by low technology, low quality rice, and a high wastage rate. Investments in equipment and price incentives for improved milling have been suggested but not yet acted upon. Product development in rice has been negligible due to the low level of rice production in the past. More effort on the part of food scientists are needed to develop rice processing technology. Only a limited number of masters degree level scientists are working on food technology in the DOA, and the private sector is not developing new product technologies.

7.5 WATER MANAGEMENT ACTIVITIES

The RRP was not involved in water management research, but other programs are emphasizing water management. The importance of water management for farmers has been recognized and progress has been made on experiments for improving water management. The experiments have suggested that farmer management of water is essential. Efforts have been directed to organizing farmers to improve water management. USAID has funded the Gal Oya Water Management and Institutional Organization Project and has developed plans for a further project. The World Bank has also been involved in several efforts to improve water management including the Tank Irrigation Modernization Project and the Major Irrigation Rehabilitation Project. The GSL is shifting priorities towards improved water management in the Mahaweli scheme.

In the Gal Oya project, emphasis has been placed on improving water management through encouraging farmer participation and responsibility. Past efforts at centralization of water management control have been ineffective. The Gal Oya project has organized and trained farmers in water management. In this project, USAID has worked with the Agriculture Research and Training Institute (ARTI), and the Ministry of Land and Land Development. Efforts to organize farmers are reportedly successful and are expected to be expanded into other areas.

The Major Irrigation Rehabilitation Project of the World Bank is also attempting to organize farms at the field channel level. In the Mahaweli scheme, efforts to organize farmers have not been complemented by adequate water management of the irrigation system. However, policies are shifting towards an emphasis on water management.

Unfortunately, the Department of Agriculture has remained peripheral in efforts to improve water management through farmer organization. Coordinated efforts between the DOA and the Ministry of Lands and Land Development would facilitate both improved irrigation management and agricultural production. Continued cropping systems efforts would benefit from incorporation of the results of water management experiments.

8. APPENDICES

8.1 Scope of Work

I. Purpose and Timing of the Evaluation

1. The purpose of this evaluation is to measure the impact of the Rice Research Project on Sri Lankan rice production and on the intended beneficiaries: the Department of Agriculture, the production research farms, and the area paddy farms.

2. The Impact Evaluation will take place in early October 1985.

3. The findings and recommendations of this evaluation are intended to assist USAID/Colombo in its continuing interest in rice production research, especially the research results from the rice breeding and cropping systems programs, as they relate to the new Diversified Agriculture Research Project and USAID's long-term interests in the Accelerated Mahaweli Program.

II. Questions the Evaluation Team Will Answer

The report of the evaluation should answer the following major questions:

1. Institutional Development

- To what extent has the goal of strengthening the National Research System been achieved, with particular regard to regionalization? How are extension and field trials systems operating within the GSL Department of Agriculture decentralized program?

- Has the research system implemented during the project begun to pay dividends in the form of varieties and practices better adapted to the regional diversity of the country?

- How have the resource capability studies impacted on the Department of Agriculture/Research Division and has the project helped make regional recommendations possible?

- Have staff trained during the project returned to and remained at their posts and achieved their potential?

- The recent civil problems have caused field station personnel problems. Has the high attrition rate at field stations affected research?

- Has the breeding program been noticeably expanded and intensified through more trained manpower and improved and expanded facilities?

- How has the shortfall of trained PHDs in the project affected progress? What follow-up has GSL embarked upon to maintain training levels for new employees entering the system, and in-service type training?

- The GSL is in a very tight economic situation. How has this affected the rice research budget?

- Have adequate efforts and resources (trained manpower/finances) been spent on technology generation for rainfed areas in the dry zone? What has been the impact of such work in terms of technology, adoption and production?

2. Research, Technology Generation and Adoption

- What new varieties or technologies have been generated under this project?

- Have improved varieties, with additional disease and pest resistance and tolerance to environmental stresses emerged and continue to emerge from the rice breeding pipeline?

- Have agronomic recommmendations been developed to economically optimize yields and have these practices been extended by the T&V extension model and by the Mahaweli project?

- How has the Sri Lankan rice research capacity improved, and what impact has this had on paddy yields? How have rice varieties been better adapted to meet the wide diversity of conditions under which they would be grown?

- Are intensified cropping systems, which were expanded during the project, more widely adopted?

- Is technology transfer to the farmers accelerated by development of better linkages between research and extension? Are there linkages between research extension and the farmers? Are farmer concerns fed back to the researchers?

- It has been recorded that the recommendations made by the Mahaweli project are not being followed by the farmers. Is this because the recommendations are not appropriate or are there other constraints? Does the Mahaweli develop its recommendations at the MOA rice research stations?

- What are the socioeconomic, cultural and agronomic constraints to adoption? How could these be better addressed to increase adoption?

- The original logical framework indicated that a verifiable indicator of meeting project purposes would be that "varieties are developed in the life of the project so that 80 percent of the on-farm trials of the fifth year yield 20 percent more than the best alternative varieties in 8 of the 10 major edaphic regions under the same management practices at both low and high levels of inputs." Is this true now?

- Does the World Bank adaptation of the field trials coordinate effectively with the other systems developed in the A.I.D. project?

- To what extent has the project contributed to better research management?

3. Rice Production

- What changes in rice yields and cropping intensity have occurred in the country as a result of the project?

- What impact has the cropping systems program had on farm production in the project five sites (Mahaweli/Anuradhapura, Bandarawela, Paranthan,* Angunakolapellessa and Karadian Aru* areas), and what benefits have been realized and by whom? In particular:

- Have farming practices and production changed to affect the rate of adoption of recommended cropping practices? How?

- What steps, if any, have been taken by GSL to meet increased rice production with regard to processing and marketing?

- To what extent has the cropping system program influenced the farming patterns in each of the agro-climatic regions? How should future programs be designed?

4. Data Collection, Monitoring and Evaluation

- Were small scale surveys conducted over the project life to gather data on yield, cropping intensity, and production?

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* Due to communal violence in Paranthan, and possibly in Karadian Aru, these sites may not be visited.

- What should be done in follow-on projects to improve project data collection, monitoring and evaluation?

In addition, the following (secondary) questions should be answered:

- What impact has the project, and in particular, cropping intensification, had on employment?

- Using rapid appraisal techniques and efforts to collect primary data, what has been the impact on welfare of farming households? (in addition to farm level surveys conducted by the Cropping Systems Program and Division of Agricultural Economics and Projects) The August 1982 Evaluation, Appendix B, recommended that in Anuradhapura and Bandarawela areas, a survey be conducted on a sample of:

  10 farmers cooperating in the cropping systems program;
  10 farmers not cooperating, but farming in the same village; and
  10 farmers in a village in the same agro-ecological zone who receive extension services but are not aware of the cropping systems program.

- What provisions, if any, have been or should be made for the maintenance and repair of key equipment of the project, particularly where such service is not available within the country?

- Has there been any progress on water management research regarding delivery to farm and related drainage needs?

III. Team Composition

The Team shall be composed of two members as follows:

- 1 - Team Leader Agr/Research Institute specialist (US Contractor)
- 1 - Social Scientist (US Contractor)

In addition, USAID/Colombo will participate to the extent possible. The Deputy Director of Research, Department of Agriculture (and the GSL project manager for the project) will also participate. The USAID has agreed to make available to the team a Sri Lankan Agriculturalist on a part-time basis.

IV. Methodology and Procedures

The duration of the evaluation of the project will be approximately 26 days in country, beginning on or about October 15, 1985. The part-time agriculturalist will be expected to begin work approximately 2-3 days prior to arrival of the U.S.

contractors in country, to complete/prepare mission and GSL documents and data and to set up preliminary site visit itineraries in consultation with the USAID.

Contractors are expected to work six day weeks. Approximately two-thirds of the team's time in-country should be spent at field project sites, and the remaining one-third should be equally divided into review of documents and capital city interviews, and report writing. Thus, the team's schedule would approximate the following:

Oct 9	Part-time agriculturalist compile/prepare mission and GSL documents and data and set up preliminary site visit itineraries.
Oct 15	U.S. Contractors in-country and ready to start work, i.e., review of materials, firming up itinerary and evaluation strategy, meetings with USAID and GSL officials.
Oct 16	Further consultations and material reviews
Oct 17-18	Depart for field site visits
Nov 3-4	Return to Columbo for further interviews and compilation of field data, report writing
Nov 8	Present draft Evaluation to USAID for discussion and comments
Nov 9	Final draft completed, pouched to ANE/ASIA/DP/E
NLT Nov 21	AID/Washington debriefing.

The team will use the evaluation techniques as laid out in the A.I.D. publications Evaluation Guidelines and the A.I.D. Evaluation Handbook. The evaluation must meaningfully examine causal relationships between inputs, outputs, purpose and goal level objectives as well as the underlying assumptions about these causal relationships.

Changes from pre-project inception to present date will be measured through: review of project reports and evaluations; site visits to update existing data and gather additional data through farm level surveys (see "additional questions", section III); review of GSL records for rice production statistics, employment, incomes and other measures of welfare of farming households; review of data on the adoption rate of rice research technologies; as well as other data pertinent to measuring project impact.

The team shall review at minimum the following documents:

- The Project Paper--Sri Lanka Rice Research
- The first, second and fifth year evaluations
- The Project Assistance Completion Report

V . Funding

The evaluation will be funded through ANE/ASIA utilizing PD&S (Agriculture) funds. The approximate cost of the evaluation is $19,035 (see attached budget).

VI. Reporting Requirements

Format of the Report: The report will contain the following sections:

- Table of Contents
- Executive summary (following ANE Bureau Executive Summary Guidance to be provided to the team);
- Basic Project Identification Data Facesheet (see attached);
- Statement of conclusions (short and succinct with topic identified by subhead) and recommendations (corresponding to conclusions and worded, whenever possible, to specify who, or which agency, should take the recommended action);
- Body of report (which includes a description of the country context in which the project was developed and which provides the information on which the conclusions and recommendations were based); and

- Appendices as necessary (including, minimally, the evaluation's scope of work and a description of the methodology used and, possibly, methodological recommendations for future evaluations).

Submission of Report: The preliminary draft of the report will be presented to the mission 1-2 days prior to the completion of the field portion of the evaluation, where upon the final draft will be submitted. The team leader will be responsible for seeing the report through to timely, professional-level completion.

Debriefing: One or two U.S. team members (as the budget allows) will arrange to meet with appropriate ANE bureau staff for a debriefing in Washington no later than November 31, 1985.

8.2 EVALUATION METHODOLOGY AND RECOMMENDATIONS FOR FUTURE EVALUATIONS

Evaluation

The evaluation team was in Sri Lanka for approximately four weeks, commencing work on October 15, 1985 and concluding with a debriefing in Colombo on November 8, 1985. Prior to the arrival of the team, a member of the USAID staff set up the preliminary site visit itinerary. One team member began work on October 15th, but was informed that the original team leader would not be able to participate. With the assistance of USAID/Colombo, another qualified team member was located and began work on October 17, 1985. Also, the Deputy Director of Research of the DOA appointed a well-qualified and knowledgeable Sri Lankan agriculturalist to accompany and assist the team.

After making visits to the Department of agriculture the team visited eleven research stations in approximately two weeks. Several stations could not be visited due to the ethnic disturbances. Interviews were conducted with the Deputy Director of Research, research officers, extension officers, and farmers at the various locations. The questions directed to the directors and various officers are at the end of this Appendix. The questions were used as a guide, but were at times too detailed. In addition, three cropping sites were visited. At the DOA, the Deputy Directors of Research, Extension, Education, and Training and the Economics Division were interviewed. Relevant documents were obtained from all sites. Time series statistics were rapidly obtained from the Economic Division of DOA and ARTI.

Interviews with farmers were conducted at four sites. A total of fourteen interviews were conducted with farmers to assess changes in cropping systems, use of inputs, labor use, household composition, contact with extension and research, and constraints to adoption of recommended practices. The questionnaire is attached at the end of this Appendix.

Farmer interviews were conducted in the following locations:

Research Stations	Sites	Number of Farmers
Maha Illuppallama	Walagambahuwana	5
Maha Illuppallama	Kalawewa - Mahaweli C	3
Girandurakotte	Mahaweli C	3
Bandarawela	Bogahakumbura	3

The original scope of work had suggested interviews with 30 farmers at Bandarawela as a secondary activity. Due to the time limitations in each location, an effort was made to interview farmers at various locations rather than a concentrated survey at one location. Time limitations precluded the design and conduct of a systematic survey in a single

location. The rapid appraisal techniques utilized in the four sites were extremely useful for understanding farmers situations in various agro-ecological regions.

After the field visits, one week was spent in Colombo in report writing.

Time Table

October 15	Colombo/USAID
October 16	Peradeniya
October 17	Peradeniya International Irrigation Management Institute
October 18	Colombo/USAID
October 21	Batalagoda
October 22	Maha Illuppallama Walgambahuwewa Kalawewa
October 23	Maha Illuppallama
October 24	Girandurakotte
October 25	Central Agricultural Research Station, Peradeniya
October 29	Bandarawela Bogahakumbura
October 30	Ambalantota
October 31	Angunakolapeless
November 1	Bentota Bombuwela

Recommendations for Improving Future Evaluations

The evaluation team benefited from the experience and cooperation of the research officers, administrators and farmers. The assistance and depth of knowledge of the Sri Lankan agriculturalist was invaluable for the conduct of the evaluation.

Due to the fact that the major efforts of the project had been completed approximately 3 years before the evaluation, it was sometimes difficult to retrieve documents and information regarding the project. An effort on the part of in-country people to assemble appropriate documents prior to the arrival of the team would have been useful.

Household # District: Cropping Systems Village:

Cropping systems participant: 1. yes 2. no

Total acreage operated:
owned:
rented:
share:

PADDY

	MAHA			YALA		
	Chena	MadaIdama	Garden	Chena	MadaIdama	Garden
Acres						
Bushels per acre						
planting/ harvest date						
Fertilizer						
Used?						
Enough Available						
Source						
Rice Varieties						
Used?						
Enough Available?						
Source						
Pesticides						
Used?						
Enough available?						
Source						
Tractor						
Hire						
Own						
Borrow money						
Source						

What changes have you made in the above practices in the last 5 years?

Household #
83

Other Crops

Crops grown:

	Maha			Yala		
	Chena	Mada Idama	Garden	Chena	MadaIdama	Garden
Type of Crop						
# of acres						
Planting/Harvesting dates						
Purchased Inputs Used?						
Enough available?						
Borrow Money?						

If you are not cultivating all of your land, why not?

Number of people in household (eating from same pot)

	# in household	# working on farm	# working of?
Females 12 years +			
Males 12 years+			
Females <12 years			
Males <12 years			

LABOR AVAILABILITY

Type of Labor
1. Family
2. Family & Exchange
3. Family & Hired
4. Family/Hired/Exchange

Sex of Workers
1. Female
2. Male
3. Both

	Paddy	Other Crops
Land preparation		
Type		
Sex		
Transplanting		
Type		
Sex		
Weeding		
Type		
Sex		
Apply Fertilizer/ Pesticide		
Type		
Sex		
Harvesting/ Processing		
Type		
Sex		
Transport/ Marketing		
Type		
Sex		

How many times in the last year have you had contact with the following:

Location	Research Officer	Extension Officer	Cropping System
Own Farm			
Other Farm			
Group Meeting			
Elsewhere			

What practices did the research/extension/cropping system officers recommend?

Did you make any changes in your farm because of what was recommended? What changes? Did you alter their recommendations?

If you did not make changes, why not?

What are your major constraints or problems in agricultural production?

Are extension/research officers aware of your problems? What have they done to help you?

Has your farm income in the last five years
1. increased
2. decreased
3. remained the same

8.3 LIST OF PERSONS CONTACTED

USAID/Sri Lanka

Richard McLaughlin	Program Officer
Paula Bryan	
Michael Korin	Chief, Agriculture and Rural Development
Charles Uphouse	Agricultural Economist
Tissa de Soysa	Project Officer

Department of Agriculture - Peradeniya

Dr. W. Fernando	Director of Agriculture
Dr. Irwin Gunawardena	Deputy Director of Agriculture Research
Dr. Nimal Ranaweera	Deputy Director of Agriculture Economics and Projects
S. Wirasinghe	Additional Deputy Director of Extension
S. Wijegunawardena	Deputy Director of Education and Training
Dr. S. Somasiri	Head, Land and Water Use Division
Dr. M. Sikurajaphy	Deputy Director of Research/ Makundura

Post Graduate Institute of Agriculture - Peradeniya

Dr. T. Jogaratnum	Director - Post Graduate Institute of Agriculture

Batalagoda Research Station

M. P. Danaphala	Acting Deputy Director of Research/ Batalagoda
D. B. Wickramasinghe	Research Officer
M. Fahim	Research Officer
N. Dissanayake	Research Officer
L. Nugaligadde	Research Officer
T. Rajapaka	Research Officer

Maha Illuppallama

Dr. J. Fernando	Deputy Director of Research/MI
S. N. Jayawardena	Research Officer
H. Somapala	Research Officer
D. G. Kulatunge	Agricultural Officer/Mahaweli
C. D. Gangodewila	Research Officer
R. Banda	Research Officer
P.D.S. Tilakawandere	Stores Keeper
J. T. Gunwandere	Research Officer

Girandurukotte

Dr. S. H. Upasena	Deputy Director of Research/ Girandurukotte
L. Somadasa	Research Officer

Gannoruwa

Dr. W. Seneviratne	Deputy Director of Research/ Gannoruwa
Dr. S. Amarasiri	Head/Division of Agriculture Chemistry
Dr. G. Jayawandena	Head/Division of Botany
S. Samarasinghe	Economist
M. Gunatilaka	Research Officer
R. Peiris	Research Officer
M. Joseph	Research Officer
H. M. S. Vijayartne	Experimental Officer
G. Saparamadu	Agricultural Instructor

Bandarawela

Dr. S. P. R. Weerasinghe	Deputy Director of Research/ Bandarawela
M. N. J. Wahab	Research Officer
M. Hannifa	Experimental Officer
D. M. Gunasekera	Agricultural Instructor
J. M. P. Jayasendara	Research Officer
C. Wijesundera	Research Officer
W. M. J. Bandara	Research Officer

Rahangala

L. Herath	Research Officer in Charge

Ambalantota

S. W. Abeysekere. . . . . Research Officer in Charge
G. A. Ginadase. . . . . Research Officer

Angunakolapellasa

Dr. J. Handawela. . . . . Deputy Director of Research/ Angunakolapellasa
S. Dissanayake. . . . . Cropping Systems Assistant
M. deSilva. . . . . Research Officer
N. Senanayake . . . . . Research Officer

Labudvwa

M. Kumaraje . . . . . Research Officer in Charge

Bentota

H. D. Jayawickrama. . . . . Research Officer in Charge

Bombuwela

G. A. Gunatillaka . . . . . Deputy Director of Research/ Bombowela
D. L. Wickaramasingha . . . . . Research Officer
C. Wijesundera. . . . . Research Officer
W. M. J. Bandera. . . . . Research Officer
P. Dissanayake. . . . . Farm Manager
S. Abeysirwardere . . . . . Research Officer
P. Peiris . . . . . Research Officer
P. D. Hemadasa. . . . . Research Assistant

Kalutara Extension Office

M. L. P. Fernando . . . . . Assistant Director of Agricultural Extension

International Irrigation Management Institute

Dr. C. Pannabokke . . . . . Research Scientist
J. Cramer . . . . . Administrative Assistant

8.4 RESOURCE DOCUMENTS

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Ranaweera, N. F. C. and G. D. Siripala
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Somasiri, S., R. L. Tinsley, C. R. Panabokke, and F. R. Moorma
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USAID
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8.5 TRAINEES UNDER GSL/IRRI RICE RESEARCH PROJECT

1. Long-Term

Ph.D.

Mr. Mervyn Sikurajapathy, Research Officer
Mr. A. S. Vivekanandan, Research Officer
Mr. S. Ponnathurai, Research Officer
Mr. G. R. Jayaweera, Experimental Officer
Mr. P. A. Samarathunga, Agriculture Officer
Mr. T. J. A. P. Gunawardhana, Agriculture Officer
Mr. L. Nugaliyadde, Experimental Officer
Mr. S. Kandasamay, Research Officer

M.Sc. in U.S.

Mr. I. Balasooriya, Research Officer
Mr. V. Rasaiah, Research Officer
Mr. A. D. Somapala, Research Officer
Mr. D. L. Wickremasinghe, Research Officer
Mr. B. L. Fernando, Research Officer
Mr. D. S. de Z. Abesiriwardhana, Research Officer
Mr. K. D. S. M. Joseph, Research Officer
Mr. S. Logendran, Research Officer
Ms. K. K. S. Fernando, Research Officer
Ms. S. Sivasubramaniam, Research Officer
Ms. M. K. Gunatillake, Research Officer
Ms. S. Abeythunga, Research Officer
Ms. S. Logendran, Research Officer
Ms. G. Jeyendra, Research Officer
Mr. C. Kudugane, Research Officer
Mr. K. Kularatne, Soil Scientist

M.Sc. PGIA

Mr. M. T. Rajapakse, Research Officer
Mr. Michael deSilva, Research Officer
Mr. K. Jayaweera, Experimental Officer
Ms. S. Srilingam, Research Officer
Mr. M. J. Ravel, Experimental Officer
Mr. E. M. Balasubramanian, Experimental Officer
Mr. K. Wickramagaskoran, Subject Matter Specialist

Diploma - 12 months in U.S.

Mr. T. M. J. Bandara
Mr. K. G. G. R. Thillakapekera

2. Short-term

Cropping Systems (6 months duration)

Mr. J. Amarasena, Research Assistant
Mr. N. Kanaganayakam, Experimental Officer
Mr. K. D. Walter, Research Assistant
Mr. M. S. Perera, Research Assistant
Mr. A. Selvarajah, Experimental Officer
Mr. D. M. Gunasekera, Agriculture Instructor
Ms. G. R. Araserathnam, Experimental Officer
Mr. S. Rajakulendran, Agriculture Instructor
Mr. M. Selvarajah, Agriculture Instructor
Mr. S. N. Jayawardhana, Experimental Officer
Mr. K. A. Methananda, Research Officer
Mr. V. Gunasingham, Experimental Officer
Mr. M. Hanifa, Experimental Officer
Mr. N. Karalliyadde, Agriculture Instructor
Mr. C. Nillegoda, Agriculture Instructor
Mr. W. G. Dayarathne, Agriculture Instructor
Mr. M. Namasivayam, Agriculture Director
Mr. P. G. Thurairathnam, Agriculture Instructor
Mr. G. D. Gamini, Research Assistant
Mr. S. Sinnathurai, Agriculture Instructor
Mr. A. W. Dharmasena, Agriculture Instructor
Mr. A. M. H. P. Piyasena, Agriculture Instructor
Mr. N. Sivayogarajah, Agriculture Instructor

GEU (4 months duration)

Ms. G. Saparamadu, Agriculture Instructor
Mr. D. L. Wickremasinghe, Research Officer
Mr. S. Ponnathurai, Research Officer
Mr. R. M. T. Rajapakse, Experimental Officer
Mr. P. Hemadasa, Research Assistant
Mr. G. Jeyendran, Research Officer
Mr. K. D. S. M. Joseph, Research Officer
Ms. S. Sri Lingam, Research Officer
Ms. G. Rahael, Research Officer
Mr. C. D. Poornampillai, Research Officer
Ms. K. Jayaweera, Experimental Officer
Mr. A. D. S. de Soyza, Experimental Officer
Mr. N. Dissanayake, Research Officer
Ms. B. M. Dissanayake, Agriculture Instructor
Ms. C. Rodrigo, Experimental Officer
Mr. Mervyn Kumara, Research Assistant

Cropping Systems (6 months duration) - continued

Mr. L. B. Nimalarathna, Research Assistant
Mr. U. Chandrasiri, Research Assistant
Mr. S. W. Abeysekara, Research Officer
Mr. M. Pathinayake, Research Officer
Mr. M. Padmasiri, Research Assistant
Mr. W. M. A. D. B. Wickremasinghe, Research Officer
Mr. S. Arumugan, Experimental Officer
Mr. H. M. P. Jayasundara, Experimental Officer
Mr. R. Sumanadasa, Research assistant
Mr. D. P. P. Jayakody, Agriculture Instructor

Food Technology and Cereal Chemistry (9 months duration

Ms. C. Breckenridge, Research Officer

Special Training for Research Officers (1 month duration)

Mr. G. Jayawardhana, Research Officer
Mr. P. Yogarathnam, Research Officer
Mr. L. Balasooriya, Research Officer
Mr. G. A. Gunatillake, Research Officer
Dr. P. Ganeshan, Research Officer

Water Management (5 weeks duration)

Mr. H. Gamage, Agriculture Officer
Mr. P. Dayananda, Research Officer
Mr. A. A. Dharmasena, Agriculture Instructor
Mr. C. Thirunadarajah, Agriculture Instructor
Mr. W. D. L. Stanley, Research Officer
Mr. M. Sivapatham, Agriculture Instructor
Mr. H. A. Boyegoda, Agriculture Officer

Rice Agro-Econ Network (3 month duration)

Mr. K. D. Abeysinghe Banda, Economic Assistant
Mr. A. M. Jayatillake, Economic Assistant
Mr. P. B. R. Kumbaregama, Economic Assistant
Mr. H. D. Dissanayake, Economic Assistant
Mr. G. D. Siripala, Economic Assistant

Rice Production (4 months duration)

Mr. S. Blendia, Research Assistant
Mr. A. Wickremasinghe, Research Assistant
Mr. K. A. J. H. Fernando, Experimental Officer
Mr. S. K. Senevirathne, Agriculture Instructor
Mr. J. Dharmasena, Experimental Officer
Mr. H. Kumarasinghe, Agriculture Instructor
Mr. K. P. Alfred, Agriculture Instructor
Mr. S. Kotterachchi, Research Assistant
Mr. W. J. Walgampaya, Agriculture Instructor
Mr. K. B. A. Attanayake, Agriculture Instructor
Mr. A. M. Senevirathe, Agriculture Instructor
Mr. W. B. Yatiwella, Agriculture Instructor
Mr. W. M. Ubesena, Agriculture Instructor
Mr. P. D. Gunatilleke, Agriculture Instructor
Mr. W. B. Rambukwella, Agriculture Instructor
Mr. A. Dharmasena, Agriculture Instructor
Mr. W. A. Plagnadasa, Agriculture Instructor
Mr. K. P. A. Sunilchandra, Agriculture Instructor

Insfrer (4 months duration)

Ms. N. Gunapala, Experimental Officer
Ms. S. Marikkar, Experimental Officer
Mr. C. Wijesundara, Research Officer
Mr. A. M. Senevirathne, Research Assistant
Mr. H. M. S. Wijerathne, Experimental Officer
Mr. W. M. J. Bandara, Agriculture Instructor

Farm Management (4 months duration)

Mr. P. Dissanayake, Agriculture Instructor
Mr. T. B. Herath, Agriculture Instructor
Mr. K. K. Jayasekara, Agriculture Instructor
Mr. M. C. Wijewandhana, Agriculture Instructor
Mr. S. P. Dharmawardhana, Agriculture Instructor

Irean Special Training (2 months duration)

Mr. N. Weralugolla, Economic Assistant

Upland Rice

Mr. G. A. Jinadasa

Special Study Tour (1 month)

S. P. R. Weerasinghe, Research Officer
T. Sivalingam, Research Officer

Field Trials (3 weeks)

A. S. Vivekanda, Research Associate

Aerial Survey (1 year - Netherlands)

T. B. Samarakosi, Soil Surveyor
P. S. Wijesoriya, Soil Surveyor

Irrigation and Water Management

N. Heer Banda, Agriculture Instructor
S. Jayarajan, Agriculture Instructor

Irrigation, Water Management Drought Seasons

G. B. Kerthirathne, Research Officer

Zinc Deficiency

B. M. Nizar, Research Assistant

Use of Field Trials

S. Sri Kathan, Agriculture Officer
S. H. Charles, Agriculture Officer

Varietal Testing (26 Days)

T. Thavanesh, Experimental Officer

Grain Quality Testing (4 months)

K. D. Ariyarathne, Research Assistant

Breeders Programme (1 month)

D. Jayasekara, Research Officer
D. H. Mutukudaarachchi, Research Officer

Agriculture Engineering (2 weeks)

S. Wijesiri, Agriculture Engineer

Graphic Art (3 months)

W. Jayatillake, Draftsman/Artist

Printing Practices

S. Sundaramoorthy, Agriculture Officer

8.6 Representative List of Equipment Received Under GSL/IRRI Rice Research Project:

List of equipment referred to:

Division of Agriculture Economics

1.	System Test Manual	01	
2.	Bookshelf Books Holder	01	
3.	Blank tape cartridge	01	
4.	Booksnelf books holder		
5.	Spare fuses	08	
6.	Hewlett Packard lectronic calculator	02	
7.	Batteris 6 N 12	02	

Research Station, Angunakolapelessa.

1.	Climate and Rice	01	
2.	Soil and Rice	01	
3.	Kubota K 75 diesel tiller	01	
4.	Reversible plogh " Tramco "	01	
5.	Wet field wheels	01	
6.	Paddling wheels	01	
7.	Winnowing fans	01	
8.	Trailor	01	
9.	Tool box	01	
10.	Service book	01	
11.	Working manuel	01	
12.	Catalogue	01	

Research Station, Bentota:

1.	Climate and Rice	01	
2.	Rice Soil Water and Land	01	
3.	Soil and Rice	01	

Central Agriculture Research Institute, Gannoruwa:

1.	A 32 PH Strips (Box of 200)	01	
2.	Brush tufted large 1½ "	118	
3.	Culture Dish 100 X 15 mm (case of 500)	03	
4.	Buret 50 ml (case of one)	03	
5.	Buret syand	10	
6.	Condenser 300 mm (case of six)	02	
7.	Hand held calculator	12	
8.	Becher Griffin 50 ml (12 in a pkt)	08	
9.	Barium chloride	01	lb
10.	Manacalcium Phosphate	01	lb
11.	Activated charcoal	250	g
12.	Ethyl alcohal 1 gal bottle)	08	
13.	L Ascorbis acid - 100 g	20	
14.	Pottrsium Sulphate 5 lbs pack	12	
15.	Silica gel (case 4 X 5 lbs)	01	
16.	Sulphuric acid 9 lb bottles	30	
17.	Hydrocholic acid 250 g	15	
18.	Canada Balsam	02	
19.	Caslin - 500 g	01	
20.	Agar USP Granular Difco 1 lb	24	
21.	Aniline blue 25 g	01	
22.	Bromophenal blue - 100 ml	03	
23.	Brome thymol Blue - 100 ml	02	
24.	Cedar oil - 1 lb	01	

25.	Clove oil - 1 lb	01	99
26.	Ethyl Acetate Reagent - 1 pt	08	
27.	Ethyl Alcohol - 1 gl	04	
28.	Fushin Acid - 25 g	02	
29.	Glycerol - 1 pt	06	
30.	Hematoxylin - 25 g	01	
31.	Indantriona Hydrate 1 X 45 - 10 g	05	
32.	Ascorbic acid - 100 g	05	
33.	Methyl red - 100 ml	03	
34.	Orange G - 25 g	01	
35.	Paraffin 50 - 52, thermal	01	
36.	Periodic acid	01	
37.	Phenol red - 100 ml	03	
38.	Potassium Dichromate - 1 lb	04	
39.	Potassium Sulphate - 5 lb	01	
40.	Safranin O - 25 g	01	
41.	Yeast extract - 1 lb	01	
42.	Ethyl alcohol (case 4 X 1 gal)	02	
43.	Napthelene - 1 lb	08	
44.	Xylene - 8 ~~gal~~	04	

CRVT, CART., Gannoruwa:

1.	Olivetti Mannual English T / Writer 18 "	01	

Field Trials Division, Peradeniya:

1.	Beaker - 100 ml (pk of 12)	01	
2.	150 ml	01	
3.	250 ml (pk of 6)	03	
4.	400 ml	01	
5.	600 ml (pk of 4)	03	
6.	50 ml (case of 48)	05	
7.	150 ml	02	
8.	400 ml	05	
9.	Condensor 300 mm (case of 6)	04	
10.	Cork XXX size 12 (case of 100)	05	
11.	Jar 4 X 4 X 8 inches	03	
12.	Mortar/Pestle - 16 ozs - 5 ins	03	
13.	Calculator Hewlette Packard Full programmable HP 97 - Printing	01	
14.	Security cradle for HP 97	01	
15.	Blank Programme cards for HP 97	01	set
16.	Saffrere Colour coded set of 03	03	

Research Station, Karadian Aru:

1.	Climate and Rice	01	
2.	Rice, Soil, Water and Land	01	

Agric Research Station, Mahaillupallama:

1.	Soil Augurs	02	
2.	PH Kits	02	
3.	Staple removers	05	
4.	Pencil sharpeners	02	
5.	2 hole punctures	23	
6.	Push bicycles	04	
7.	Platignum electrode FNP design	05	
8.	Kubota K 75 diesel tillers	05	

Agric Research Station, Maha Illuppallama ... contd

9.	Reversible plough " Tracmo "	05	100
10.	Wet field wheels (without box) " Tracmo "	05	
11.	Rotary Plough (with rear wheels)	05	
12.	Trailors - One ton ordinary - Farmers model	05	
13.	Puddling wheels (without boss) " Tracmo "	05	
14.	Winnowing fan " Tracmo "	05	
15.	Tool boxes	05	
16.	Service books	05	
17.	Workshop manuals	05	
18.	Catalogues	05	
19.	Scanco - HYLN - 063 - 1000 ft each	01	box
20.	Mechanical Precision Balance	05	
21.	Standard Kubota Power Tiller	01	
22.	Canon Electric Calculator with AC adapter	01	
23.	VOLTAC Regulator/Stabilizer	01	
24.	Lettering Pen Size 08	02	
25.	Rain gauge	05	
26.	Air pump	01	

Research Station, Paranthan:

1.	Radio, Dual channel and antenna	01	
2.	Climate and Rice	01	
3.	Rice, Soil, Water and Land	02	
4.	Soil and Rice	01	

Resource Capability Survey (Land & Water Use Division) Peradeniya:

1.	Pencil sharpeners	02	
2.	Platignum, Electrode FNP design	10	
3.	Veribrom Paper (Kodak) 50.8 cm X 15 m	08	boxes
4.	Mechanical Balance Precision	01	
5.	A - 12 PH Test Set	13	
6.	A - 27 Soil Colour charts	12	
7.	A 26 Glzy soil charts	12	
8.	DR 760 M Water Level Indicator	01	
9.	DR 772 Water level carrying case	01	
10.	Kodak Carousel Slide Projector	01	
11.	Carousel - Slide Tray	04	
12.	Romote Control Power code	01	
13.	Dymo tape writer	02	
14.	Megaphone	01	
15.	Rear Projector Screen	01	
16.	Abney Level	05	
17.	Replacement timers	10	
18.	Disc - sul	02	
19.	Adjustable ship curve	04	
20.	Pentel Rolling writer	10	
21.	Pentel sharpener	04	
22.	Binocular	01	
23.	Adaptor cord for Megaphone	01	
24.	Lietz Topographic Abney Level	07	
25.	Compensating Polar Planimeters	02	
26.	Drawing instrument set	02	
27.	Transparent parelel rulers	02	
28.	Portable PH Meters	02	
29.	Sonco drawing board cover	02	
30.	Vemco Standard drafting machine	02	

Resource Capability Survey ... contd

31.	Vemco drafting machine scale	04	101
32.	Drafting lamp	02	
33.	Leroy lettering set	01	
34.	Leroy reservoir pen set	02	
35.	Leroy Reservoir pens	23	
36.	Designer Pickett Drawing table	02	
37.	Berco Drawing board cover	02	
38.	White Printer CL 148	01	
39.	White Printer CL 148 replacement lamp	06	
40.	Leroy Standard pens	44	
41.	Fire Extinguishers	03	
42.	Overhead Projector	01	
43.	Roll-atta W/Trays PL	01	
44.	Dyr la rs	02	
45.	Dust er for projector	01	
46.	Stand rd manmual typewriter 15"	01	
47.	Portable PH meters	02	
48.	Automatic Electronic dehumidifier	01	
49.	Woven tapes (30 meters)	03	
50.	White blade steel measuring tape	02	
51.	Electrode 5 X 30 Calref	06	
52.	glass	04	
53.	First aid kit	02	
54.	Dissecting cabinet	01	
55.	Distl APP	01	
56.	Heating element	01	
57.	Port calculator	02	
58.	Security cradle	02	
59.	Climate and Rice	01	
60.	Rice, Soil, Water and land	02	
61.	Soil and Rice	01	
62.	Thermometer	04	
63.	Transformer stepdown	01	
64.	Magnifiers	24	
65.	Conductivity Bridge	01	
66	Cell	01	
67.	24615 - 52 Vivid Carry Projector	01	
68	Crystel clear	12	
69.	Closed caddy rack	01	unit
70.	Soil sampler	02	
71.	Magnifier	06	
72.	Mortar andPestle	06	
73.	Manometer	03	
74.	Pocket transit	06	
75.	PH Tester	06	
76.	Aluminium Tally Sheet holder	06	
77.	Pocket area scale	10	
78.	Shield, 100 ml stainless steel	01	
79.	Rotor angle 50 ml	01	
80.	Cent tube	01	
81.	Beaker tall	01	
82.	Buret W/T plug	05	
83.	Support stand medium	02	
84.	Rub tubing	02	
85.	Centrifuge cabinet style	01	
86.	Brushes (pair)	01	
87.	Rotor	01	
88.	Trimming Ring	16	
89.	Metal Shields	16	
90.	Centrifuge tube	32	

91.	Rotor Angle	02
92.	Adaptor	12
93.	Beaker	07
94.	Glass rod E (Pkg of 10 Lbs)	01
95.	Thermometer	01
96.	Funnels	05
97.	Filter pump	03
98.	Filter pump coupling	02
99.	Crucibles	04
100.	Flasks	05
101.	Flasks filtering with side tubes	02
102.	Brush	11
103.	Buret	08
104.	Buret assemblies	01
105.	Balance analytical (pair) for 240 V	01
106.	Burner	04
107.	Flask volumetric with plastic cap	06
108.	Stop watch	01
109.	Supports tube	12
110.	Dessicator	06
111.	Spatula	06.

Office of the Deputy Director (Research) Peradeniya:

1.	Ford Falcon Car 6 Cyl 725	01
2.	Yamaha Ag 100 motor cycles	17
3.	Radio Telephones (with all accessories)	06
4.	Canon mini cartridges	10

ANNEX 8

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

Project Title & Number: Rice Research

Life of Project:
From FY 76 to FY 81
Total US Funding $ 2 million
Date Prepared: 7/75

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATION	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
GOL Sectorial Goals: Agricultural Development that: 1. Increases domestic food production, 2. Expands employment opportunities, and 3. Improves the small farmers standard of living.	1. Percent of total domestic rice production compared to total rice requirements (Base of CY 1973-75) 2. Percent of unemployed as compared to CY 1973-75. 3. Percent of agricultural income received by lower 60 percent of Sri Lanka's farmers.	1. Ministry of Agriculture's records 2. Monthly, annual and staff studies of the Central Bank of Ceylon 3. HARVA studies 4. Studies by APRI 5. Studies by IRRI/DRIP IRREM activities 6. Site specific studies by economists in the Cropping Systems and Field Trial Activities. *Studies referred to above in 3 thru 6 would be specific studies such as in Annex 3 and others more expanded that would identify and describe the parameters of change in regards to employment and welfare in the rice sub-sector.	1. Concomitant institutional and governmental policy support and co-ordination will be available to support anticipated technical break-throughs. Of particular importance are the assumptions that the level of effort implied in this project will be adequate and that government price policy will not negatively impact on paddy land farmers. 2. Farmers will be able to capture for their own benefit the increases in the productivity of their land and labor. 3. Technological innovations will complement and increase the productivity of Sri Lanka's relatively abundant resources, labor, rather than lead to labor displacement.

ANNEX _____

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

Project Title & Number:

Life of Project:
From FY_____ to FY_____
Total US Funding_____
Date Prepared:

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATOR	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
Project Purpose: Development of a technological base that permits increases in the productivity of paddy land thru: 1. Increased yields of paddy per unit area, and 2. Increased cropping intensity of paddy land.	1. Varieties developed in the life of the project that in 60 percent of the on-farm trials of the fifth year yield 20 percent more than the best alternative varieties in 8 of the 10 major edaphic regions under the same management practices at both low and high levels of inputs. 2. Alternative Cropping systems developed that: a. physically enable a second crop to be grown on paddy land where mono-cropping of paddy is the norm in 8 of 10 edaphic regions. b. in an economic sense enable increased paddy land use intensity to be both feasible and attractive to 70 percent of all paddy farmers.	1. Records of the Field Trials Division 2. Records of the Cropping Systems Work Group 3. Special Studies focusing on the physical and economic parameters of project developed innovations.	1. Genetic breakthroughs will be realized 2. Paddy lands are currently sub-optimally used and improved cropping systems to increase factor productivity in paddy areas can be identified and developed to fit into the various edaphic regions of Sri Lanka. 3. The improved capacity of the Research Division thru organizational changes which will enhance the output of the Division in such a way as to permit the realization of the project purpose.

ANNEX ____

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

Project Title & Number:

Life of Project:
From FY ____ to ____
Total US Funding: ____
Date Prepared: ____

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS

Inputs

A. U.S.

	Man Months
a. Technical Assistance	
1. Rice Breeder	60
2. Cropping Systems Agronomist	60
3. Field Trials Agronomist	60
b. Consultants	26
B. Training	
1. Short-term	Nos.
a. Rice Production and Applied Research	19
b. OFR	8
c. Water management	3
d. Cropping Systems	8
e. Resources Survey	2
f. IRRI	6
g. Small Scale machinery	2

2. Long-term	M.S.	Ph.D.
a. Rice Breeding	2	2
b. Agronomy	8	3
c. Entomology	1	2
d. Plant Pathology		1
e. Soils		1
f. Cereals Chemistry	1	
g. Agricultural Economics	5	1
h. Statistics	1	
i. Soil Survey	1	
j. Soil and Water management	1	

C.O.	Year 1	2	3	4	5	TOTAL
	($000)					
1. Technical Assistance						
a. Rice Research	67	57	62	69	76	331
b. Cropping Systems	67	57	62	69	76	331
c. Field Trials	67	57	62	69	76	331
d. Consultants	40	40	35	20	20	155
						1148
2. Training						
a. Short term	44	46	39	33	3	165
b. Long term	98	203	178	80	7	566
c. Workshops/ seminars	30	30	30	30	30	150
						865
3. Commodities						
a. Vehicles	232	90	5	5	7	359
b. Farm Equipment	67	22	2	2	2	95
c. Lab/Office/ Field Research Equipment	259	86	41	22	82	432
d. Supplies	64	64	52	36	36	256
						1192

ANNEX ____

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

Project Title & Numbers:

Life of Project:
From FY____ to FY____
Total US Funding____
Date Prepared:

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATOR	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
11. O.S.L. a. Staff 12000 man months b. Facilities 1. Stations 6 Research Stations a. Existing Buildings b. Existing Equipment	b. Contingency 53 36 29 24 20 162 5. Inflation (8% year) 63 91 122 138 420 6. Contractor Overhead (9.5%) 105 82 66 56 49 358 1224 944 772 648 573 4161 O.S.L.* Year 11 18 19 80 81 TOTAL 1.Salaries 229 254 264 280 330 1357 2. Travel 22 36 39 40 48 196 3.Consumables 112 121 134 139 165 661 4.Maintenance 46 39 41 43 52 221 5.Essential Services 19 29 31 31 38 150 6.Equipment 189 44 45 47 54 379 Buildings 341 207 Support Services for T.A. 31 25 27 10 31 153 966 553 581 612 718 3430		

* 1 equivalent with AH 13.71/81

ANNEX ____

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

Life of Project
From FY_____ to FY_____
Total US Funding_____
Date Prepared:

Project Title & Number:

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATOR	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
GOAL: (GO) I. Rice Research A. Expansion of rice research capacity B. OFU approach to rice varietal improvement work C. Co-ordinated rice and cropping systems research program D. Decentralisation/regionalisation of rice improvement work E. Varietal improvement field trials. II. Cropping Systems A. Expansion of cropping systems research capacity B. Systems approach to improving the productivity of the paddy farmer C. Co-ordinated rice and cropping systems research program D. Expanded involvement of farmers in rice and cropping systems research E. Cropping systems field trials. III. Field Trials A. Expansion of the field trials Division's capacity B. Expanded involvement of farmers in rice and cropping systems research C. Co-ordinated rice and cropping systems research D. Field trials on farmers field	I. Rice Research A. 1. Staff trained and assigned as per Annex A and B 2. Vehicles assigned as per Annex C by late 1977 3. Lab and field research equipment in place as per Annex C by mid 1978 4. Farm equipment assigned as per Annex C by mid 1978 5. Laboratories built as per Annex K by mid 1979 6. Staff Quarters built as per Annex K by mid 1979 B. 1. Interdisciplinary approach to formulation and implementation of rice varietal improvement work 2. Formation of rice research working group as described in Annex G by early 1977 C. Formation of the National Rice and Cropping Systems Research Committee that carries out functions as described in Annex F by late 1976. D. 1. Staff assigned to regional operations as envisioned in Annex A by mid 1979 2. Vehicles and equipment available and assigned to the regions as envisioned Annex C by late 1979 3. Relevancy of research experiments/ investigations to the particular region	1. Department of Agriculture Research's annual reports including field research leaders 2. Annual Reports of IRRI team members 3. UFAIDP records 4. Observational visits to Research Centers, cropping systems sites and trial plots	1. GOT allocates sufficient funds to replace increases in staff numbers 2. Sufficient numbers of qualified personnel can be identified and released for training 3. Existing functional sections within the Department of Agricultural Research can and will be mobilized in an interdisciplinary manner to rice varietal and cropping systems problems. 4. Traditional administrative arrangements will not inhibit meaningful decentralization 5. The Land use Division personnel currently under the administrative supervision of the Ministry of Irrigation will be available to carry out the Resource capability Survey

ANNEX _____

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

Life of Project:
From FY_____ to FY_____
Total US Funding_____
Date Prepared:

Project Title & Number:

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATOR	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
IV. Resource Survey A. Expansion of the land and water use Division's capacity B. Resource capability survey	E. To be determined by Yala Season 1977 and each crop season thereafter by the National Rice and Cropping Systems Research Committee and Rice Research Working Group. II. Cropping Systems A. 1. Vehicles available as per Annex C by late 1972 2. Farm equipment available as per Annex C by mid 1978 3. Office/lab/field Research equipment in place as per Annex C by mid 1978 4. Trainee returned and assigned as per Annex A and B B. Formation of cropping systems research working group as described in Annex A by early 1977 C. Same as I.C. above. D. Cropping systems sites selected collection of baseline data completed and agronomic research underway at sites in farmers fields by late 1977 E. To be determined by Yala Season 1977 and each crop season thereafter by the National Rice and Cropping Systems Committee and the cropping systems working group. III. Field Trials A. 1. Vehicles available as per Annex C by late 1977.		

ANNEX _____

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

Life of Project:
From FY_____ to FY_____
Total US Funding_____
Date Prepared:

Project Title & Numbers:

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATOR	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
	2. Office/Lab/Field Research Equipment available as per Annex C by mid 1978 3. Trainees returned and staff assigned as per Annex A and B B. Field Trials Division effectively carrying out trials in farmers fields in all regions and as called for by the National Rice and Cropping Systems Research Committee and the field trials working group. C. Same as I.C. above D. Same as I.D. above IV. Resource Capability Survey A. 1. Vehicles available as per Annex C by mid 1977 2. Equipment in place as per Annex C by early 1977 3. Trainees returned as per Annex B B. Resource capability survey of 300,000 acres of paddy land in the South and South Western Coastal Regions completed by the end of the third project year.		

Appendix 8.8.1. Targets of Area Under Improved Varieties (Hectares), 1984/85.

District	Season	New Improved Varieties																	Old Improved Varieties				Grand Total
		3 Months			3 1/2 Months					4-4 1/2 Months							6 Months		3 Months	4-4 1/2 Months			
		B.G. 34-8	B.G. 350-5	B.W. 372-68	B.G. 94-1	B.G. 98-2	B.G. 34-6	B.W. 207-3	B.W. 206-7	B.G. 1-11	B.G. 90-8	B.G. 400-1	B.G. 379-2	B.G. 380	B.W. 78	B.W. 300	B.G. 3-5	Total	69-355	H. 4	Others	Total	
Colombo	Maha	600	560	—	770	—	1,075	—	—	90	30	2,340	70	—	55	200	265	4,135	—	160	1,005	1,165	7,300
	Yala	1,070	700	—	1,100	—	1,000	—	—	35	—	180	35	—	20	10	20	4,170	—	60	1,400	1,460	5,630
Gampaha	Maha	1,600	920	—	1,120	—	—	—	—	1,130	—	8,420	525	—	—	495	1,270	15,510	—	—	1,620	1,620	17,130
	Yala	3,020	2,940	—	2,160	—	130	—	—	90	—	3,360	160	—	—	180	—	10,840	—	10	650	660	11,500
Kalutara	Maha	150	1,130	2,545	210	—	1,200	1,460	170	105	10	8,780	1,050	—	10	1,430	280	18,650	70	1,070	210	1,350	20,000
	Yala	500	1,320	2,690	300	—	1,780	1,435	250	140	—	2,000	3,385	—	30	1,120	—	15,020	50	740	1,640	2,430	17,450
Galle	Maha	300	300	3,000	2,800	—	5,500	300	—	—	—	2,500	250	—	—	—	—	14,150	—	500	6,350	6,850	21,000
	Yala	200	400	4,500	1,800	—	5,500	300	—	—	—	2,500	250	—	—	—	—	15,450	—	400	5,150	5,550	21,000
Matara	Maha	130	1,300	—	5,530	—	1,140	170	—	800	—	5,900	2,400	200	—	270	60	17,000	—	2,800	580	3,380	20,380
	Yala	125	800	—	4,000	—	1,500	350	—	1,000	—	5,500	2,500	150	—	500	—	16,425	—	2,575	500	3,075	19,500
Puttalam	Maha	1,875	1,910	—	75	50	—	—	—	1,970	100	2,310	225	890	—	—	445	9,250	100	100	1,350	1,250	11,500
	Yala	730	2,125	—	45	—	—	—	—	100	—	45	—	590	—	—	—	3,635	—	—	265	265	3,900
Kurunegala	Maha	21,240	15,900	—	4,735	400	2,880	—	—	5,670	2,100	9,420	1,895	—	—	—	190	64,430	231	340	—	1,070	65,500
	Yala	19,580	14,240	—	4,930	20	1,060	—	—	660	680	1,800	430	—	—	—	20	43,420	240	10	830	1,080	44,500
Kegalle	Maha	635	195	—	9,850	—	—	—	—	285	150	50	75	—	—	—	—	11,190	—	—	210	210	11,400
	Yala	985	595	—	8,735	—	—	—	—	150	100	—	50	—	—	—	—	10,615	—	—	85	85	10,700
Ratnapura	Maha	100	560	250	550	—	1,050	—	—	80	100	6,950	550	—	—	400	25	10,615	75	1,100	4,510	5,685	16,300
	Yala	75	1,750	200	1,350	—	2,800	—	—	25	20	3,200	200	—	—	150	—	9,850	110	405	4,835	5,350	15,200
Kandy	Maha	1,500	1,200	—	6,000	—	1,000	—	—	700	—	5,600	1,000	1,500	50	20	—	18,570	—	500	330	830	19,400
	Yala	2,500	1,500	—	6,000	—	1,000	—	—	300	—	1,000	500	1,000	—	—	—	13,000	—	300	800	1,100	14,100
Matale	Maha	1,000	3,500	—	1,000	—	200	—	—	1,000	—	4,500	400	300	—	—	—	14,300	—	200	200	400	15,100
	Yala	2,000	1,550	—	290	—	50	—	—	50	—	150	—	50	—	—	—	4,050	—	50	—	50	4,100

Appendix 8.8.1. Continued

District	Season	New Improved Varieties																	Old Improved Varieties				Grand Total
		3 Months			3 1/2 Months					4 - 4 1/2 Months							5 Months	Total	3 Months	3 1/2 - 4 1/2 Months			
		B.G. 34-8	B.G. 326-5	B.W. 272-88	B.G. 94-1	B.G. 94-2	B.G. 34-6	B.W. 267-3	B.W. 266-7	B.G. 4-11	B.G. 99-2	B.G. 400-1	B.G. 379-8	B.G. 380	B.W. 78	B.W. 109	B.G. 3-6		63-355	H. 4	Others	Total	
Nuwara Eliya	Maha	140	100	—	1,400	—	140	—	—	—	—	950	—	—	—	—	—	2,730	—	2,800	1,570	4,370	7,100
	Yala	350	—	—	1,000	—	300	—	—	—	—	100	—	—	—	—	—	1,750	—	1,000	890	1,890	3,640
Badulla	Maha	4,000	350	—	1,000	—	2,500	—	—	300	—	3,900	800	—	—	—	—	11,950	—	4,000	550	4,550	16,500
	Yala	2,000	—	—	1,000	—	1,000	—	—	—	—	500	—	—	—	—	—	4,500	—	1,500	—	1,500	6,000
Monaragala	Maha	2,400	1,300	—	1,000	—	1,800	—	—	1,000	100	3,000	300	—	—	—	—	10,900	—	500	900	1,400	12,300
	Yala	1,200	1,200	—	600	—	800	—	—	—	—	100	—	—	—	—	—	3,900	—	—	200	200	41,000
	Maha	—	5	—	100	—	4,200	—	—	30	—	60	—	—	—	—	—	4,395	1,000	4,000	1,415	6,415	10,800
	Yala	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Kilinochchi	Maha	540	900	—	520	500	16,440	—	—	105	120	1,370	—	—	—	—	—	18,595	1,900	1,150	405	3,455	22,050
	Yala	325	630	—	240	40	3,830	—	—	—	—	—	—	—	—	—	—	5,065	35	—	—	35	5,100
Vavuniya	Maha	1,200	1,200	—	295	—	1,965	—	—	5,940	100	2,530	160	—	—	—	—	13,890	400	2,200	10	2,610	16,500
	Yala	500	365	—	65	—	65	—	—	—	—	—	—	—	—	—	—	995	—	—	5	5	1,000
Mullaitivu	Maha	1,840	2,340	—	700	—	3,120	—	—	1,670	50	2,000	150	—	—	—	—	11,350	1,940	910	—	2,850	14,200
	Yala	340	920	—	250	—	590	—	—	—	—	—	—	—	—	—	—	2,100	—	—	200	200	2,300
Mannar	Maha	1,740	1,625	—	600	100	—	—	—	8,700	—	4,350	175	—	—	—	—	17,290	—	1,710	—	1,710	19,000
	Yala	310	270	—	—	—	—	—	—	—	—	—	—	—	—	—	—	600	—	—	—	—	600
Anuradhapura	Maha	9,500	3,900	—	2,750	—	3,000	—	—	19,010	—	14,500	800	500	—	—	—	53,950	350	7,700	—	8,050	62,000
	Yala	5,000	4,500	—	500	—	1,000	—	—	—	—	—	—	—	—	—	—	11,000	—	—	—	—	11,000
Polonnaruwa	Maha	6,500	2,650	—	1,750	—	110	—	—	2,900	70	11,600	11,300	1,600	—	—	—	38,500	—	—	—	—	38,500
	Yala	14,800	5,700	—	2,450	—	50	—	—	—	—	—	—	—	—	—	—	25,000	—	—	—	—	25,000
Trincomalee	Maha	5,500	3,800	—	9,070	—	60,50	—	—	1,140	—	9,300	1,200	—	—	—	—	38,010	225	4,905	910	6,140	44,200
	Yala	4,050	1,950	—	3,640	—	2,250	—	—	—	—	—	—	—	—	—	—	11,900	—	—	—	—	11,900

Appendix B.B.1. Continued

District	Season		New Improved Varieties																Old Improved Varieties				Grand Total
			3 Months			3 1/2 Months				4-4 1/2 Months							6 Months	Total	3 Months	4-4 1/2 Months			
			B.G. 34-6	B.G. 878-3	B.W. 278-88	B.G. 94-1	B.G. 84-2	B.G. 34-8	B.W. 867-3	B.W. 866-7	B.G. 1-11	B.G. 90-2	B.G. 400-1	B.G. 370-2	B.G. 360	B.W. 78	B.W. 100	B.G. 3-6		68 338	H. 4	Others	Total	
Bassicalus		Maha	3,600	1,550	—	33,650	—	5,500	—	—	270	—	1,730	980	—	—	—	—	46,780	—	4,300	120	4,420	51,200
		Yala	1,000	375	—	6,870	—	1,110	—	—	—	—	—	—	—	—	—	—	9,355	—	—	45	45	9,400
Ampara		Maha	2,970	—	—	46,700	—	1,380	—	—	—	—	—	—	—	—	—	—	51,000	—	—	—	—	51,000
		Yala	2,100	—	—	25,800	—	1,100	—	—	—	—	—	—	—	—	—	—	29,000	—	—	—	—	29,000
[illegible]		Maha	1,000	2,120	—	3,000	100	1,680	—	—	500	570	4,100	2,800	—	50	—	—	15,970	—	400	5,480	5,880	21,500
		Yala	1,050	3,300	—	1,850	30	1,850	—	—	100	110	700	1,600	—	—	—	—	13,290	—	35	1,785	1,810	15,100
Welawa		Maha	170	630	—	950	50	100	—	—	190	100	2,180	1,360	4,530	—	—	—	10,260	—	—	900	900	11,160
		Yala	4,080	2,410	—	3,800	100	470	—	—	190	—	480	470	630	—	—	—	9,830	—	—	1,020	1,020	10,850
Kaluwewa		Maha	7,000	3,250	—	3,450	—	—	—	—	10,000	—	5,000	—	250	—	—	—	28,950	—	50	—	50	29,000
		Yala	4,500	2,000	—	1,000	—	500	—	—	—	—	—	—	—	—	—	—	8,000	—	—	—	—	8,000
System 'L'		Maha	1,200	900	—	1,750	—	100	—	—	—	—	2,000	250	—	—	—	—	5,700	—	—	900	900	6,600
		Yala	1,650	3,200	—	1,850	—	900	—	—	—	—	—	—	—	—	—	—	8,800	—	—	—	—	8,800
SRI LANKA 1984 BS		Maha	80,940	54,095	5,795	140,595	1,200	60,470	1,930	170	65,195	3,600	123,440	28,715	9,770	165	2,865	2,535	581,130	6,845	41,475	29,390	77,710	658,840
		Yala	74,060	52,650	7,390	83,615	190	30,835	2,025	250	2,840	910	20,415	9,660	2,420	50	1,960	40	289,160	440	7,025	20,305	27,820	317,080
		Year	155,000	106,745	13,185	224,210	1,390	91,005	4,005	420	68,035	4,510	143,855	38,375	12,190	215	4,775	3,575	870,410	7,285	48,550	49,695	105,530	976,020
In Acres 1984/85		Maha	200,003	133,669	14,319	347,410	2,965	148,680	4,769	420	160,097	8,896	305,020	70,955	24,142	408	4,956	6,264	1,435,972	16,914	102,485	72,623	192,021	1,627,994
		Yala	183,002	130,098	18,261	206,613	469	76,193	5,427	618	7,018	2,249	50,445	23,870	5,980	124	4,843	99	715,619	4,087	17,182	50,124	66,743	781,752
		Year	383,005	263,767	33,580	554,023	3,434	224,873	9,896	1,038	168,115	11,145	355,465	94,825	30,122	532	11,799	6,363	2,150,581	18,001	119,667	122,747	260,764	2,411,346
	1982/83	Maha	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1,319,460	—	—	—	155,858	1,475,308
		Yala	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	614,545	—	—	—	15,562	630,107
Achievements (4t)		Year	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1,934,005	—	—	—	171,418	2,105,415
	1983/84	Maha	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1,318,444	—	—	—	159,533	1,477,977
		Yala	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	n.a.	—	—	—	n.a.	n.a.
Achievements (4c)		Year	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	n.a.	—	—	—	n.a.	n.a.