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SRI LANKA

RICE RESEARCH PROJECT

Report of a Project Evaluation
Conducted by:

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I. EXECUTIVE SUMMARY

Problem and Overview. Sri Lanka's largest agricultural crop is rice, but when the Rice Research Project began in 1977 the nation was importing about 30 percent of the total rice required for consumption. Insufficient production of rice was seen by the Government of Sri Lanka (GSL) as a major limitation to economic growth. Therefore negotiations were begun with USAID for a long term loan to finance a project designed to expand the technology base for increasing rice production and intensifying land utilization, with the ultimate objective of attaining self-sufficiency in rice production.

U.S. Assistance. Under Loan No: 383-T-016, USAID provided $3.8 million to assist the GSL Department of Agriculture through technical assistance, training, and commodity procurement. The project began in May 1977 and project activities ended June 30, 1982, except for a 2 year extension to June 30, 1984 for the training component. Specific objectives were to develop and implement a multi-disciplinary program of variety improvement, to expand rice-based intensive cropping systems, to give long and short term training to Sri Lanka staff, and to establish more effective linkages between research and extension through field trials program. The project was contracted between the GSL and the International Rice Research Institute (IRRI), and the Institute of International Education (IIE).

Purpose of Evaluation. Previous evaluations were held after 1 year (August 1978) and after 2 years (May 1979). Both evaluations noted problems with team leadership, delays in commodity procurement, delays in getting long term training started, and lack of progress on the field trials portion of the technical assistance program. The present 5 year evaluation was held to measure the progress of the project in meeting its purpose of expanding and extending the technology base for increasing total rice production through increased yield per acre and intensified land use. The methodology consisted of review of project documents, about 10 days of travel to major research stations and rice growing areas, and 2 days of discussions with Sri Lanka Department of Agriculture officials. Interviews were also held with farmers to measure the impact of the project.

Findings

- The technological base for rice research capability has significantly increased. Technical assistance and professional improvement provided by the project will have a continuing beneficial impact for many years to come.

- The rice farmers of Sri Lanka are already benefitting by the steadily increasing yields per acre of rice and greater diversity of cropping patterns. This produces more food per acre per year. However, the major impact of the project will occur over the next 5 years.

- The long term training program produced 2 technical degrees, 34 M.S. degrees, and 2 Ph. D. degrees; 0, 20, and 10, respectively, had been planned. The shortfall in Ph.Ds was due to difficulty in timeliness of finding qualified candidates.

- In the short term training, 85 people completed courses, mostly at IRRI; only 48 were planned. Also, there were 70 attendances at international workshops, conferences, and study tours. The extra short term training strengthened the technician grade staff and partially counter-balanced the Ph.D. shortfall, but more Ph.Ds are needed for basic research.

- Planned technical assistance was not fully utilized. Some 180 long-term man months of technical assistance were planned; but this was adjusted by GSL to 132 long-term months and 14 consultancy months before the contract was executed. Actual use was 108 long-term months and 7 consultant months.

- Interdisciplinary working groups for research and cropping systems were organized. These groups meet regularly and have expedited the rice improvement program dramatically. This concept is now being adopted by other crop programs in Sri Lanka.

- Twelve rice varieties were released during the life of the project, one of which (Bg 276-5) resulted from the project. It takes a minimum of 4 to 5 years to produce a new variety. Thus other varieties now in the pipeline as a result of the project will be released in coming years.

- The cropping systems program has been successful. It has moved forward in a positive and productive manner, with financial help from IDRC after the project specialist completed his assignment and departed in June 1979.

- The resource capability survey was completed. It permits better identification of specific agro-ecological zones and enables rice researchers to tailor improved varieties and practices for specific environments.

- The Field Trials Program was planned but was never implemented under the present project. The project paper planned for the establishment of regional field trial units to be coordinated by the existing national Field Trials Division. Regionalization was delayed until 1978. A revised regional plan drawn by a consultant under this project was subsequently implemented by a World Bank program on Adaptive Research. The latter program is working very effectively.

- Commodities have been acquired as planned. They have already made a significant difference in the productiveness and effectiveness of the scientists. A major subsequent constraint

will be in keeping many items in working order due to difficulty of getting in-country service and repair for U.S. origin products. Commodities were purchased as originally planned for the field trials program but some of these remain to be redistributed in keeping with the decentralized program now in force.

Communications were poorly handled by all parties (contractor, donor, and host country) in the project. The Project Advisory Committee as set forth in the contract was never constituted. This caused delays and misunderstandings. Better coordination on the part of all parties would have permitted the project to have more efficiently reached its goals.

Project Design and Policy Implementation. Training, commodity procurement, technical assistance, and communication and managment activities among USAID, the contractor, and host country were the most critical design and implementation elements in this project. In particular, more closely coordinated management procedures among USAID, contractor and host country were needed in order to minimize misunderstandings and delays.

Recommendation. An impact evaluation should be conducted in approximately five years in order to get a full assessment of the impact of the project on Sri Lanka rice production.

II. Basic Project Identification Data

1. Country: Sri Lanka
2. Project Title: Rice Research Project
3. Project Number: Loan No. 383-T-016
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
      Training - June 30, 1984
      Commodities - August 15, 1982
5. Project Funding:
   a. AID Bilateral 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.
   b. Contract between Department of External Resources (GSL) and the Institute of International Education.
   c. Direct Reimbursement Account.
7. Project Design: The Government of Sri Lanka and USAID/SL

8. Responsible Mission Officials:

   a. Mission Director(s): Mr. T. Arndt (AID Rep.)

      Ms. S.J. Littlefield

   b. Project Officer(s): Mr. C. Antholt

      Mr. T. Wilson

      Mr. J. Bonner

9. Previous Evaluation and Reviews:

   a. Project Review - August 3, 1978

   b. Project Review (2nd Year) - May 21, 1979

10. Cost of Present Evaluation:

a. Direct Hire:	$ 2,250
b. Contract:	$ 15,000
c. Other:	-
	$ 17,250

III. CONCLUSIONS AND RECOMMENDATIONS

A. Impact on Sri Lanka Rice Production. Rice production in Sri Lanka rose from an estimated 70 percent up to 85 percent of self-sufficiency during the project period. Total production was 80 million bushels in 1977 and 107 million bushels in 1981; average yields per acre were 49 bushels in 1977 and 58 bushels in 1981.

However, factors such as weather, higher prices for paddy and better availability of inputs make it difficult to quantify increases due solely to the project. More logically, the full impact of the project on Sri Lanka rice production is yet to come, as the following developments occur:

- The staff trained during the project return to their posts and achieve their potentials.
- The decentralized research system implemented during the project begins to pay dividends in the form of varieties and practices better adapted to the regional diversity of the country.
- The resource capability studies conducted during the project help make regional recommendations possible.
- Improved varieties, with additional disease and pest resistance and tolerance to environmental stresses, emerge from the rice breeding pipeline.
- Intensified cropping systems, which were expanded during the project, are more widely adopted.
- Technology transfer to the farmers is accelerated by development of better linkages between research and extension.

B. Strengthening of the National Research System. The originally proposed continuum of a resource capability survey, improved and intensified breeding, new and current cropping patterns, and variety evaluation under farmers' conditions is in place and working, although part of the last portion was achieved in an indirect way (see Section H, Field Trials, below). Before the project started, GSL had felt the need to decentralize the National Research System to better serve regional needs. The project provided the additional trained staff and equipment which made regionalization possible. By requiring the creation of interdisciplinary working groups for the rice breeding and cropping systems programs, the project also ensured the necessary coordination among regional centers.

As a result, Sri Lanka researchers are now developing varieties and cropping systems well adapted to the agro-ecological diversity of the country, which should lead to increased, more stable production of food crops. This sequence provides excellent linkage with extension. Further "fine tuning" will continue to add to its efficiency and effectiveness.

C. Training of Sri Lanka Staff. The increased training of Sri Lanka staff was a major achievement of the project. Two diplomas, 34 M.S and 2 Ph.D. degrees were or will be earned before June 1984 PACD on training; no diplomas, 20 M.S. and 10 Ph.D. degrees were planned. Some 85 short-term training courses, most of which were 4-6 months duration and were given at IRRI, were completed; only 48 were planned. Attendances at workshops, conferences, and study tours, which constitute in-service training, totalled 70; the original plan implied this type of training would occur but had not specified numbers.

The unfortunate shortfall in Ph.D production was partly due to a shortage of adequately qualified candidates, and partly due to delays in identifying candidates, which left insufficient time for Ph.D training before the end of the project. At this point the training component PACD was extended by two years to allow for 5 full years for training with Ph.D. candidates. It was felt that the large increase in short term trainees counterbalanced the Ph.D. shortfall for the present, but more Ph.D.'s will be needed in the future to staff the research program. Overall, the training program was very satisfactory.

Recommendation:

GSL should consider a continuod training program for Sri Lanka's scientists. This is needed in order to maintain the present level of training for new employees entering the system, and for in-service type training such as international conferences, workshops, and study tours for present employees.

D. Procurement of Commodities. Another important achievement was the procurement of slightly over $ 1 million of commodities, which enable Sri Lanka Staff to conduct their work more efficiently. Commodity procurement got off to a slow start because of changes in team leadership, but by August 15, 1982, nearly everything planned had been received or was in order. A 1982 USAID audit revealed deficiencies in commodity inventory records, but these have been corrected in the last few months through major efforts by GSL personnel. Source-origin requirements caused delays and problems in the procurement of a micro-computer and of vehicles which could be properly serviced in Sri Lanka.

Recommendations:

Host governments and contractors need to be kept informed and advised on USAID procurement requirements. Source origin requirements should be waived in cases where local service is poor or unavailable. USAID should consider training a host country officer to serve as procurement officer for USAID Projects as needed.

E. Rice Research . Technical assistance in rice research, which centered on breeding, was effective. The genetic evaluation and utilization program was strengthened by initiation of basic studies on inheritance and transfer of important characters, including gall midge resistance, brown planthopper resistance, thrip tolerence, submergence tolerance, and tolerance to bronzing. The basic research will have its greatest payoff in the years to come, as materials and techniques emerge from the plant breeding pipeline. Factors for pest and disease resistance and tolerance to submergence, cold, and adverse soils should buffer rice production against large fluctuations due to stresses. Twelve rice varieties were released during the contract period, one of which (Bg 276-5) was developed as a consequence of the project. Another important contribution was the organization of a very effective interdisciplinary rice research working group composed of all the principal rice researchers in Sri Lanka. The working group meets twice a year to review and plan programs. This and the cropping systems working group are still functioning, and the working group concept has even spread to other crops.

Recommendation:

Rice researchers are urged to continue their regionalized breeding efforts in order to better tailor varieties and management practices for specific environments. They are also urged to continue surveillance for potential disease and pest hazards to rice production.

F. Cropping Systems. This program is functioning effectively and is already resulting in cropping intensification at some sites. Benefits of the program are expected to be more fully realized in a few years, and will accrue on a continuing basis thereafter. It has a direct impact on farm production and also enhances the effectiveness of the research system by encouraging dialogue among agricultural scientists, economists, extension officers, and farmers.

Recommendations:

The program should be continued and expanded to additional sites as needed, but activities should be coordinated with the World Bank Extension and Adaptive Research Project and with the IDRC project to avoid duplication and to exchange findings. Coordination between the respective cropping systems working groups is important. GSL scientists are also encouraged to maintain their participation in the Asia Cropping Systems Working Group.

G. Resource Capability Survey. Technical assistance in the resource capability survey was very satisfactory. The survey concentrated on the wet and intermediate zones, with the objectives of identifying specific agro-ecological districts. Now that these districts are identified, researchers can begin the process of tailoring varieties and management practices to maximize rice production in each district. The survey information is also useful for training extension workers in the resource capabilities of the districts, thus enabling them to make more appropriate recommendations to their farmers.

H. Field Trials. Unfortunately almost no direct progress was made on the Field Trials component as such of the project. Much of the Field Trials Specialists' time was occupied by administrative duties as team leader; GSL was in the process of changing from a centralized to decentralized Field Trials program; and progress was hindered by personnel changes in contractor and GSL employees responsible for Field Trials. However, the format proposed by a Consultancy on this activity has been adopted and amplified by the World Bank Adaptive Research Program. It is considered to be successful. The project indirectly served as a catalyst to get this important dimension in motion and integrated into the decentralized program of the GSL Department of Agriculture.

I. Communication and Management. The project suffered from the three changes in team leadership during the contract. The initial team leader arrived after other members were "on site". The frequent changes in leadership disrupted and retarded the overall management and procedures in dispatching candidates for training; and purchase of commodities. The Project Advisory Committee as set forth in the contract was never constituted. There were misunderstandings, lack of clear and comprehensive communication between all parties (contractor, donor and host country) regarding many aspects of the contract.

Recommendations;

- The team leader should not be expected to provide major input into the technical assistance component of the program during the first phase of the project. This person should arrive well in advance of the planned technical assistance team to facilitate planning and logistics for the project.

- Future assistance projects should have a grant component to facilitate meeting the personal logistical needs of team members and for the establishment and operation of an office for servicing the project.

- Key administrators and officers of the contractor should pay visits in their respective roles of responsibilities at the outset, not after difficulties arise.

- A project Advisory Committee composed of host government, contractor, and USAID representatives must be organized at the beginning of the project and must meet on a regular basis to discuss any operational problems and to review and plan research. Many of the misunderstandings and delays incurred during the present project could have been alleviated by regular meetings of donor, contractor and host government personnel.

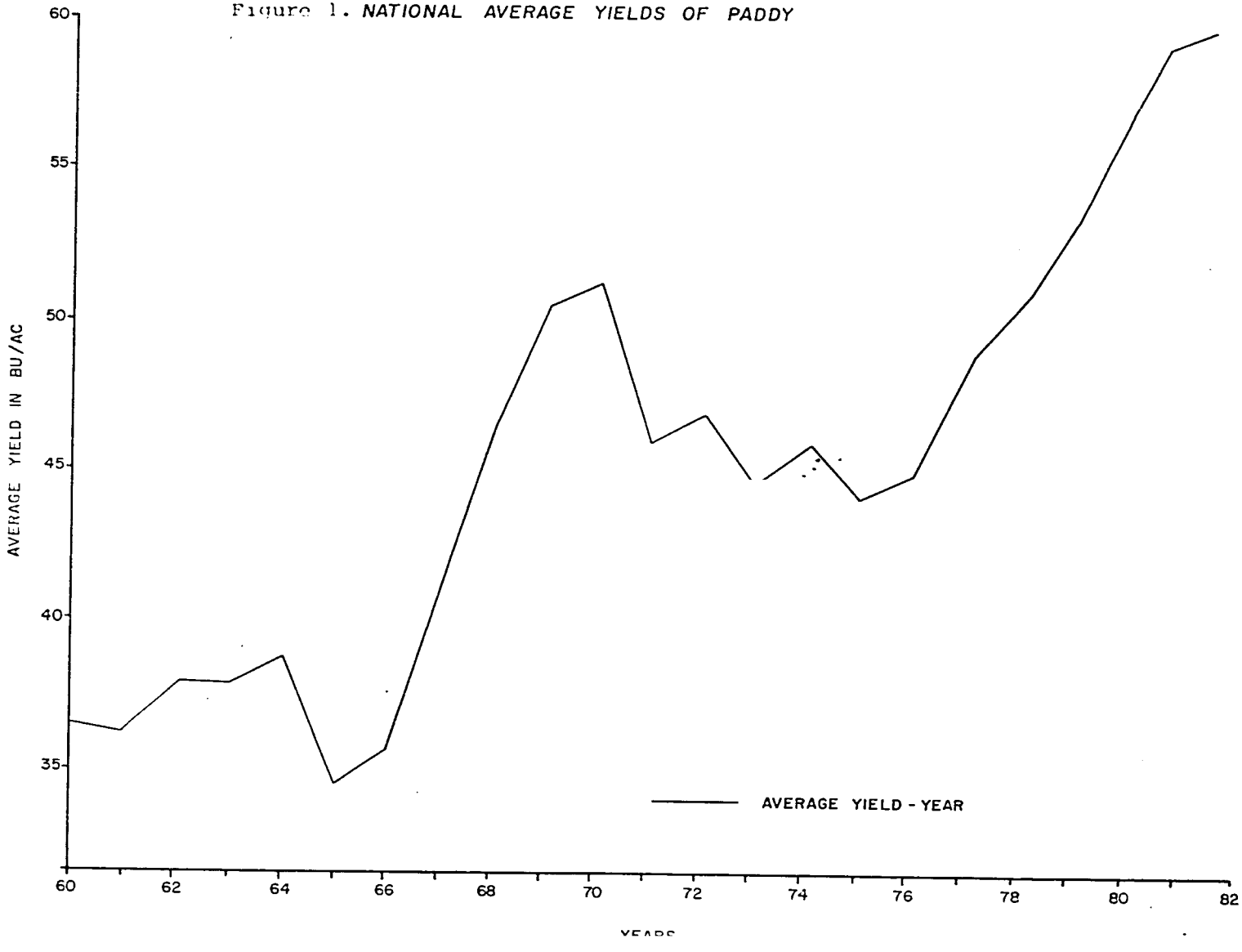
IV. RICE SITUATION IN SRI LANKA

During the last 20 years the capability of the Sri Lankan farmers to produce more rice per acre has improved significantly. The average production per acre in 1960 was approximately 36 bushels per acre whereas in 1981 it was nearly 60 bushels per acre. There was serious decline in output per acre during the period from 1971 -76, at which time there was a serious drought. The new high yielding short stature varieties were being introduced during this period, and a new policy was being formulated regarding inputs necessary to maximize the use of the new emerging technology. Due to improved agronomic practices, double cropping of rice made possible through use of shorter season varieties, greater availability of irrigation and improved availability of necessary inputs at an appropriate time, production capability began to improve by 1977 and surpassed previous records by 1979. It is interesting to note the continuous relatively greater increase in yielding capacity during the period 1975-1982 during the dry season (Appendix C) where the new technology is undoubtedly being used under irrigation. It has continued to climb and be maintained at new levels not previously achieved (Figure 1). During this time the research and extension programs have grown and improved. Some benefits were beginning to be realised from the expanded and intensified research program as a result of this project by 1982.

Sri Lanka now has the capability of producing approximately 85 percent of its rice needs. Momentum has been generated which could lead to self sufficiency in the near future. It is necessary that a strong research and extension program be maintained . During the last decade the acreage has increased from 1.4 million to approximately 1.7, while production has increased from 67 to 122 million bushels. The use of HIVs during Maha Seasoh is estimated to be used at over 72% for the country: varying from 25% use in some districts where major challenges still exist to provide a high yielding technology which would be suitable for prevalent conditions.

Current population growth rate is estimated to be 1.7%. Current per capita consumption of rice is at 104 kg/annum. The rapidly advancing use and interest in cropping systems provides a sound base in wise use and conservation of agricultural resources for maximising food production. Thus this project was most timely in the sequence of events designed to improve food production efficiency for a growing population. The research effort achieved must be maintained and increased through greater concentration of resources (human and material).

Figure 1. NATIONAL AVERAGE YIELDS OF PADDY



V. BACKGROUND & HISTORY OF PROJECT

Paddy production is a barometer which indicates the health of the GSL economy. During the early seventies production had been declining. Therefore GSL was anxious to abate this trend and to this end a proposal was made in 1976 for a major USAID loan to assist in improving GSL research capacity and capability. This in turn would be of direct assistance to extension in carrying out educational programs with farmers. In 1975 Sri Lanka was approximately 60 percent self-sufficient in rice production. The population growth rate was estimated to be 1.6 percent per annum, down from 2.8 per cent in 1953.

By the early part of the 1970s production increases were less spectacular than after the introduction of new technology. It was obvious that other aspects in addition to new varieties must be givencareful evaluation and consideration.

In the meantime Sri Lanka had developed a unique approach to more efficient land utilization through the Resource Capability Survey (RCS). This knowledge provided an excellent means of delineating the parametersof regions having similar agriculture potential. These surveys needed to be completed to facilitate the use of this concept to assist in identifying more homogenous agriculture regions.

The new technology then being used in variety development presented an entirely new opportunity for cropping patterns within a given water (rainfed or irrigation) regime. Hence cropping systems took on new dimensions for the Sri Lankan farmers. With the increase in pest damage as second generation challenges subsequent to the introduction of the new technology, greater cropping diversity needed to be explored.

With expanded irrigation facilities, particularly in the north, Sri Lanka was on the threshold of self sufficiency in rice. In the late sixties the common plant type was tall and often late maturing. Lodging and weeds were serious constraints. The Sri Lankans arose to the occasion and developed new short stature, high yielding varieties. One of the key reasons for their success was that they paid attention to the art as well as the science of plant breeding. Thus the stage was set to design varieties better adapted to the wide diversity of conditions under which rice would be grown. The breeding program needed to be expanded and intensified. This would require more trained manpower, improved and expanded facilities.

Research designed to generate agriculture technology will never be fully consummated until the farmer can take advantage of the findings. Sri Lanka had had for some years a field trials section as a function of its agricultural research division. The field trials section provided for research on the farmer's fields. It had been initially set up to evaluate the role of fertilizers, and seemed to be a natural mechanism to do the final evaluation of varieties and/or new germ plasm on a scale much greater than could be accomplished on the experiment station or field laboratory. Field trials could be organized within the framework of the districts being proposed as a result of the RCS and could serve as the vital connecting link between research and extension. To do this job the division needed to be re-organized and re-oriented to the new decentralized approach being implemented. It must be mobile. Hence within reason it needed transport and equipment necessary to efficiently conduct "off station" evaluation of germ plasm.

Thus there were four major components in the project package proposed: Resource Capability Surveys, Rice Research (Breeding), Cropping Systems, and Farmer Field Trials. This package needed to be undergirded with a broad spectrum of training plus appropriate equipment and supplies. Hence the project was initiated in 1977.

VI. IMPLEMENTATION OF PROJECT

A. TECHNICAL ASSISTANCE

1. Rice Research

The principal emphasis in the rice research component has been on developing high yielding rice varieties that have resistance to pests, diseases, environmental stresses, and that will fit different cropping patterns. The breeding goals were to be accomplished through organization of a multi-disciplinary program for varietal improvement, coupled with short and long-term training of the professional staff.

Background

Prior to the inception of the project, three different phases of rice varietal improvement were recognizable. First, beginning in the 1930s, pure line varieties were selected from indigenous rices. Second, by the 1960s, varieties were being developed by hybridization among local and introduced tall rice types. An example of these old improved varieties (OIV) was the tall, red rice variety H4, which is still being grown. In 1980-81 about 20 percent of the acreage was still being planted with the OIVs in the Maha season, and 6 percent in the Yala season. The third phase was the use of the semidwarf plant type to develop the high yielding new improved varieties (NIV), which are either of semidwarf or intermediate stature. The NIVs became available for general cultivation in the 1970s, and in 1980-81 were estimated to be grown on at least 72 percent of the acreage in the Maha and 79 percent of the acreage in the Yala season.

During the third phase, much attention was given to developing varieties of different maturity lengths, for adaptation to specific environments and cropping systems. Thus the most important current varieties, released in the 1970's, range in maturity from 3 to 6 months:

Bg 34 -8 (3 months)
Bg 94-1 (3 1/2 months)
Bg 11-11 (4-4 1/2 months)
Bg 90-2 (4-4 1/2 months)
Bg 3-5 (5-6 months)

The above NIVs perform best under the more stable environments where water, solar intensity, cold, and poorly drained soil are not limiting. Therefore much emphasis is being placed on developing new varieties that are disease and insect resistant. The combination of greater uniformity and intensified cultural practices had increased the potential for genetic vulnerability. Thus previously rather unimportant insect pests, especially brown planthopper and gall midge, became a serious problem. Fortunately, intensive breeding efforts have resulted in release of resistant varieties:

Bg 400-1 (4-4 1/2 months, gall midge resistant, 200 bushels/acre yield potential)
Bg 276-5 (3 months, gall midge resistant, 120 bushels/acre yield potential)
Bg 379-2 (4-4 1/2 months, brown planthopper resistant), 200 bushels/acre yield potential)

The combination of pest resistance, improved plant type, and 4-4 1/2 months maturity gives Bg 400-1 and Bg 379-2 extremely high yield potential. Bg 276-5 has lower yield potential than the other two, but is valuable because of its short maturity of just 3 months.

In current work emphasis is also being placed on development of suitable varieties for unstable environments where existing NIVs do not perform well, as in the low country wet zone. Five additional varieties were recommended for release in 1982:

Bw 272-6B (3 months)
Bw 267-3 (3 1/2 months)
Bw 266-7 (3 1/2 months)
Bg 407-2 (5-6 months)
Bg 745-2 (5-6 months)

Other recent releases include Bw 100 (4-4 1/2 months) and the very early maturing Bg 750 (2 1/2 months) wh ich is designed for a quick crop in zones with very short rainfall periods.

The principal yield breakthrough was achieved by the improved plant type, but the addition to current releases of disease and insect resistance, tolerance to environmental stresses, and adaptation to specialized environments, is expected to help stabilize yields at higher levels.

Favorable weather and use of OIVs led to high yields in 1970, but were followed by lower yields through 1976 in the last few years. Yields again are moving upwards (Figure 1). The Department of Agriculture feels that much of the credit for yield increases must be attributed to the new varieties and to concommitant improved management practices, since yields are moving upwards even in the face of adverse weather, restriction in fertilizer imports and rising production costs.

Technical Assistance Contributions

The technical assistance component was implemented by the arrival of the expatriate rice breeder in 1977. His job description was to assist in organization of a national rice genetic evaluation and utilization (GEU) program, to help prepare detailed annual research plans, to implement rice breeding activities, to organize and conduct a coordinated rice testing program, to identify individuals for training, and to assist with organization of a rice working group which will plan and coordinate rice breeding research in Sri Lanka. The contractors (IRRI) had planned to place an expatriate breeder in Sri Lanka for the 60 months of the contract. Following departure of the expatriate breeder after three years, GSL chose not to request a replacement although the contract was not amended to reflect this change. A short-term breeding consultant also visited the project on three occasions.

During his three years on the project, the expatriate breeder was successful in accomplishing most goals given in his job description. He strengthened the GEU program, especially by initiating basic work on inheritance of important characters: gall midge resistance,

brown planthopper resistance, thrip tolerance, submergence tolerance and tolerance to bronzing. He also began an upland variety screening program.

The GSL breeders had recognized the importance of the basic studies, but had been too busy with other activities to do the needed basic research. The general feeling is that the basic research begun by the expatriate breeder will have its greatest payoff in the years to come, as the techniques and materials he developed, emerge from the breeding pipeline. Twelve new varieties were released during the contract period, one of which (Bg 276-5) resulted from the project.

The expatriate was very effective in organizing the rice working group for planning and coordinating rice breeding research in Sri Lanka, Breeders and other scientists including pathologists, entomologists, agronomists and economists from all major research stations meet twice each year - after each major cropping season - to review progress and plan the next season's work. The group tours each of the major regional stations to observe and discuss their work. The two rice working groups (the research group and the cropping systems group have essentially the same membership, all of the rice workers in the nation) are still functioning very effectively. The concept of working groups has even extended beyond rice to other crops. In this respect the project served as a catalyst for the formation of the working groups and the regionalization of the research program.

2. Cropping Systems

Varietal imprvements alone are not sufficient to realise the full production potentials of Sri Lanka farms. Under conditions of great agro-ecological diversity and small land holdings, it is essential to assess the local cropping systems and seek improvements in cropping intensity and farming practices. Such a program was included in the rice research project to complement rice breeding. According to the terms of reference, the objective of the cropping systems program was"to develop viable new cropping systems that will allow for increased land use intensities in the different agro-climatic regions".

This was to be done on four sites. The research was to take local socio-economic conditions into account and to consider all crops cultivated by the farmers; it would be interdisciplinary. The on-farm cropping systems research methodology used at IRRI was suggested as a model.

The program would be led by a national coordinator for cropping systems, and was to receive the technical assistance of a cropping systems specialist provided by IRRI. In the project paper, 60 man-months of technical assistance had been planned, but this was reduced to 24 months in the contract at the request of GSL. This reduction in TA was unfortunate because of the long term nature of cropping systems work. In just 24 months the cropping system specialist was expected to train the site coordinators, select and open four research sites, conduct baseline surveys in each site, develop more efficient cropping systems, and test them for extension to the farmers. Furthermore, the Sri Lankan Coordinator would be out of the country for Ph.D. training during that period, so there would be little interaction between the two leaders of the program.

The IRRI specialist worked in Sri Lanka from July 1977 to June 1979. The national coordinator studied at the University of North Carolina for a Ph.D, returning in 1982. He is now Deputy Director of Research at the Maha Illuppallama Station as well as coordinator for the cropping system program.

While progress was at first a little slow, partly because of lack of experience by all concerned, the program has been fully developed as planned and one site (Bandarawela) has reached the promotion stage (see description of that site in section VII C).

The program benefitted from the fact that a cropping systems research program already existed in Sri Lanka- IDRC had begun research in 1976 in Katupotha, in the intermediate zone (irrigated agriculture) and in Walagambahuwa, in the dry zone.

Under the AID Project, work has been conducted in the following sites: (see maps Appendix p)

- Mahaweli Area, Anuradhapura: dry zone, tank based and fully irrigated agriculture.

- Bandarawela: Intermediate zone, rainfed or streamfed agriculture.

- Paranthan: dry zone, rainfed agriculture

- Angunakolapellessa: dry zone

- a new site is now being organized at Karadian Aru in the dry zone.

The new sites were selected to represent the main agro-ecological zones, with both rainfed and irrigated sites. The suggestions of the extension service and the expressed willingness of villagers to participate in the program were also taken into account.

The IRRI cropping systems specialist first conducted a 6 month training session for the site coordinators in Walagambahuwa, in Anuradhapura district. Each site is now staffed with one economist, one assistant economist and one or more field assistants. The cropping systems program staff has also benefitted from 14 short term training sessions, one Ph.D. and a total of 32 trips to conferences, cropping systems sites in Asian Countries, and meetings of the Asia/Regional Cropping Systems Working Group. Several M.S. Students now in training will return to the Cropping Systems Program. Training has also been provided under the IDRC project.

The National Cropping Systems Working Group was created as planned in 1977. It includes researchers, site agronomists and economists and extension officers, as well as administrators of the Department of Agriculture. The working group meets regularly twice a year after each crop season to assess findings and discuss work plans for the next season. Members of the National Cropping Systems working group have mentioned having benefitted from the systematic exchange of information between agricultural scientists, economists, and extension officers. The Sri Lanka Working Group is also very active in the Asia Regional Cropping Systems Working Group.

A baseline survey has been conducted at each site and testing of improved systems is under way. Farming practices and production are being monitored for the cooperating farmers in each site, and surveys on rate of adoption of recommended practices have been made. However, the Agricultural Economics Division charged with reviewing and analysing the data from each site is finding it difficult to handle all the information generated by this program. Processing and analysis of the data may be easier once the micro computer purchased under this project becomes operative.

3. Crop Production/Field Trials

The job description for the Crop Production/Field Trials Specialist called for him to assist in planning, organizing, and implementing simple field trials based on improved varieties and management techniques previously identified at research stations. He was expected to assist in development of linkages between research and extension, identify trainees, prepare summaries of recommended practices for use by extension workers, and organize field days. He also was to participate in the rice and cropping systems working groups. Not included in his job description in the contract, but of considerable importance in discharge of his duties, was the designation of the Crop Production Specialist, the most experienced member, as the IRRI Team Leader.

A Field Trials research program had been a function of the Department of Agriculture for many years prior to the initiation of this project. It had been used as a mechanism to evaluate the role of fertilizer in rice production under actual farmer's conditions. As a result a Field Trials Division was established and was operating on a national basis with its headquarters in Peradeniya at the beginning of the project.

The Government of Sri Lanka had decided that the activities of the Research Division should be organized on a regional basis. In August 1978, at a special working group meeting, the rice research staff discussed in depth how the Field Trials activity might be integrated into the proposed decentralized structure. The Deputy Director (Research) for Agriculture requested a short term Consultant from IRRI to study the then (1978) current status of the Field Trials program. He asked for recommendations how it could be organized within the proposed decentralized framework and provide an important and key linkage with Extension.

This consultancy was carried out in October 1978. The report which is on file, recommended that Field Trials be conducted as an integral part of the regional activities. The plan proposed was never effected by this project. The Field Trials phase of the project was fraught with many challenges, to a large degree due to personnel difficulties. The contractor and GSL had not clearly and concisely recognized the major nature of the assignment for the person expected to carry out both the role of a specialist on Crop Production/Field Trials and the administrative responsibilities as team leader. As a result, when the pressure was on, the administrative responsibilities received top priority.

- The initial team leader/field trials specialist arrived on site late. Most of his time initially was spent on administration. His counterpart was preparing to depart to pursue graduate studies overseas.

- In 1978 it was decided to decentralize the Field Trials program. The first specialist left. The second national coordinator departed for graduate study.

- The field trials program was left "in limbo" for several months.

- A new specialist arrived on site in July 1979. An agronomist was assigned as his counterpart later in that year.

- During the early part of 1980 the agronomist counterpart was reassigned to CARI. No subsequent action was taken to replace the counterpart.

In the meantime, the Field Trials program took another turn, and was incorporated into a World Bank project on Extension and Adaptive Research. The World Bank Project is following much the same format that was recommended by the IRRI consultant on field trials. Thus field trial functions are now being carried out by Adaptive Research Teams at eight regional centers, with 24 sub-centers under the World Bank project. The convoluted progress of the Field Trials apparently has resulted in a successful program, but most of the credit must be attributed to the World Bank project.

4. Resource Capability Survey

An understanding of the climate and geographic characteristics of different areas is helpful for developing and applying new rice and cropping systems technology. For example, rice production in the wet zones is lower than in the dry zones, partially because the NIV varieties were not accepted as readily in the wet zones. Specific varieties and management practices were needed for such areas, but better background information was required in order to tailor varieties and practices for local environments. Therefore studies were conducted in the wet and intermediate zones to (1) identify and classify valley and terraced slope systems, (2) delineate slope categories, and (3) complete soil surveys, characterization, and mapping.

The studies were conducted by short term consultants who had considerable previous experience in Southeast Asia. Most of the wet zone and intermediate zones were surveyed, and specific agro-ecological systems were identified. Particular emphasis was placed on identification of high potential areas in wet zones. This information is being used by the research and cropping systems working groups to develop varieties and management practices for the different systems identified in the survey. The survey information is also useful for training of village extension workers in the resource capabilities of their area, and enables them to make more appropriate recommendations to their farmers. Finally the surveys are expected to be useful for teaching purposes in the agricultural schools.

The principal impact of the resource capability studies is expected to be in increasing rice production in the wet and intermediate zones.

B. TRAINING

Training is one of the most useful components of any assistance program. It is an investment which can be expected to have continuing payoff over many years. A new crop variety on management practice may produce a large return over a 5 or 10 year period, but this can pale in comparison to the career output of a trained scientist.

Training was arranged under the project by two contractors, IRRI and the Institute for International Education (IIE).

1. IRRI Contract

The IRRI Team Leader and GSL implemented the training program, which had two elements, long-term and short-term training.

a. Long-term plans

i. Ten fellowships were to be provided for Ph.D. training, to Sri Lanka scientists holding the M.S. Degree. In most cases it was expected that thesis research would be carried out either at IRRI or in Sri Lanka, although course work might be completed in U.S. Universities or the Philippines.

ii. Twenty scholarships were to be provided for M.S. study for Sri Lankan scientists with B.S. degrees. M.S. training was to be undertaken either in the Philippines or another Asian Country.

b. Short-term plans

Non-degree research training and production type training courses were planned for 48 individuals. This "in-service" training was to be provided at IRRI, in courses generally of 4-6 months in length.

c. Results

Numbers of planned and completed trainees are shown on Table 1. The long-term training program got off to a slow start, but a two-year extension in the training component (to June 30, 1984) will result in achievement of the M.S. goals. Some frustration was expressed by GSL because several of their potential M.S. trainees were not accepted by the University of Philippines Los Banos. However, 19 students are expected to earn M.S. degrees under the IRRI contract, which is very close to the 20 planned, unfortunately ;only 2 Ph.D's will be earned instead of the 10 planned in the contract. Part of the shortfall was due to lack of adequately qualified candidates. There also was some misunderstanding relating to studies in the US, which indicates that more comprehensive briefings on training procedures should be held at the beginning of the projects.

Table 1. Summary of Planned and completed trainees

	Planned	Completed
Long Term		
IRRI Contract		
Ph.D.	10	2
M.S.	20	19
IIE Contract		
M.S.	9	13
Diploma		2
Long term totals	39	36
Short-term (All under IRRI Contract)		
Rice Production	19	13
GEU	8	20
Water Management	3	9
Cropping System	8	10
Resource Survey	2	2
IREAM	6	5
Machinery	2	1
Farm Management	-	5
INSFER	-	2
Zinc Deficiency	-	1
Use of Field Trials	-	3
Varietal Testing	-	1
Grain Quality Testing	-	1
Breeders Programme	-	2
Graphic Art & Printing	-	2
Special Training for Research Officers	-	7
Food Technology	-	1
Short term totals	48	85
Workshops, Conferences, Seminars & Study Tours		70

GSL regulations reserve leaves of absence to tenured employees and limit their duration, thus limiting the pool of potential candidates. Finally for an entomologist who earned an M.S. at Purdue there was insufficient time under the contract for him to stay on for a Ph.D. In retrospect, the projection of training 10 Ph.D,s in 5 years from a relatively small pool of possible candidates was overly optimistic.

The short-term training program was, by all accounts, a resounding success. Some 85 trainees, instead of the 48 planned were sent to IRRI for the short courses shown in Table 2. In addition to the short-term courses, there were 70 attendances at workshops, conferences, seminars and study tours. Funds for the extra short-term training workshops etc., were available from the unused funds for the Ph.D. training.

2. IIE Contract

Arrangements for training of 9 M.S. students at U.S. universities under the IIE contract proved very satisfactory. In fact, a total of 13 M.S. degrees will be earned by the June 30 1984 end-of-training period. This contract has also sent short-term participants.

Training Summary

Except for the shortfall in training of Ph.D.s the training program was felt to be excellent. Disappointment was expressed over the USAID policy that travel and expenses of dependents cannot be financed.

For the present, the extra M.S. and short term training, together with the workshops, etc., counter-balance the Ph.D. shortfall. However, GSL would like to get enough Ph.D,s trained so that more can be active in research, as present Ph.D,s assume more administrative responsibilities. A complete list of all trainees and meeting attendances is given in Appendix A.

C. COMMODITY PROCUREMENT

As part of its contract obligations, IRRI agreed to purchase research supplies and equipment that are not ordinarily available in Sri Lanka. Although the commodity procurement was delayed by the Team Leader changes in the early years of the project, virtually all of the commodities had been obtained or were on order by August 15, 1982, the end of the extension on purchasing for the project.

A 1982 USAID Audit revealed that inventory records on the commodities were incomplete. Following Herculean efforts by GSL personnel during the past few months the commodities have been satisfactorily located and inventoried. The commodities supplied to each station and office, up to the time of the present review, are given in Table 2. Another $15,000 of commodities are in the pipeline.

USAID source-origin requirements that commodities be purchased from US firms caused delays and inefficiencies, especially for the Hewlett Packard micro-computer and the IH Jeeps. The concern of the US Government on source-origin policies is appreciated, but if appropriate local service is not available for US-made commodities (as for the computer and IH Jeeps), the policy leads to great inefficiencies in project operations.

Table 2. Total cost of supplies and equipment under the project to various stations and offices

1.	Agriculture Economist	US $	40,937.42
2.	Batalagoda		122,826.43
3.	Angunakolapelessa		60,919.23
4.	Bandarawela		59,967.40
5.	Ambalantota		7,813.11
6.	Bentota		5,579.66
7.	Bombuwela		69,990.93
8.	CARI, Gonnoruwa		133,071.26
9.	DDR., Peradeniya		39,494.90
10.	Karadian Aru		58,140.14
11.	Land & Water Use Division		34,865.82
12.	Maha Illuppalama		117,117.93
13.	Makandura		41,935.88
14.	Paranthan		61,006.78
15.	Mannar		9,101.90
16.	Vanathavillu		22,123.45
17.	Central Workshop(spares)		30,362.65
18.	Ministry of Agriculture		2,331.51
19.	Giranduratotte		8,419.00
20.	Rahangala		8,952.00
	TOTAL		939,865.45

D. COMMUNICATION AND MANAGEMENT

It must be concluded that there have been many short-comings, misunderstandings and lack of efficient communication on the part of all parties (contractor, donor and host government) in this contract. In spite of these short-comings much has been accomplished for the good of the host government and the future welfare of its citizenry. This review team feels that much has been learned which could obviate, in the future, many if not all of the short-comings encountered here.

1. When negotiating the contract, provision should be made to have the representative of the contractor (Team Leader) report at least nine months and preferably a year before other expatriate members of the team would arrive. Simultaneous with his arrival in the country, it should be mandatory that a key administrator (preferably the Director General or equivalent) of the contractor travel with him and spend a minimum of a week or ten days meeting key host country officials, particularly those who will be directly involved in this contract and discussing the implementation of the project as set forth in the contractual arrangements. It is important that all responsible persons representing the contractor, host country, and donor thoroughly understand their respective committments and responsibilities.

   This would provide an opportunity for the contractor's representative to work closely with his host country counterpart. Logistics for housing, transport, etc., for other members of the team could be worked out in advance of their arrival.

   Details regarding training could be carefully studied. Persons could be identified and interviewed who are being considered for various professional improvement programs. Early during the project, the Director of Training of the contractor should make at least one trip to the host country.

   Details should be reviewed regarding procurement, if such is a part of the contract. A host country staff member should be identified to handle the logistics of purchase and in country clearance, thus relieving the contractor's representative of this routine but extremely important aspect (also see item 3 below). During this time the Purchasing Agent of the contractor should spend time in the host country familiarizing himself with the needs of the project and contractor's representative and his counterpart on a personal basis to discuss all the necessary steps in purchasing, country clearance, documentation upon receipt and formal release to the host country of purchases to be made.

2. Grant funds should be made available to the contractor to cover such costs as project office rental, equipment and personnel; rental of residence, utilities, maintenance etc. for the resident expatriate specialists and their domestic transport and international travel. Such a dimension of the contract should be negotiated with the host government but it should be the responsibility of the contractor to administer.

3. It would be desirable to encourage the host country to identify an administrative specialist who could be given a short course training in USAID and contractor administrative procedures. This person, who should already be familiar with host country regulations, would help bridge the procurement problems. Through his acquired training in USAID procedures the host country specialist would also become a valuable person for work on other contracts.

4. It is hoped that USAID Washington will continue to agressively seek modification of the requirement that all commodity purchases be of US origin. In many cases in order to comply with this regulation it is necessary to make inefficient and uneconomical use of the US taxpayers money. If purchases are made of equipment to be used in a country where no maintenance, services and repairs are available, then such will soon be idle because of difficulty or impossibility to have it serviced and/or repaired.

VII. IMPACT OF PROJECT

A. IMPACT ON RICE PRODUCTION

Sri Lanka rice production has gone from an estimated 70 percent up to nearly 85 percent of self-sufficiency during the contract period. Total production was 107 million bushels in 1981 compared to 80 million bushels in 1977, and average yields per acre were 58 bushels in 1981 compared to 49 bushels in 1977. Early estimates indicated that 1982 production would reach 120 million bushels, but dry weather has reduced actual production somewhat.

The increase in production since the early 1970's is a result of both higher yields and an increase in acreage for paddy cultivation, from some 1.7 million acres in 1977 to 1.8 million acres in 1981 (see Tables in Appendix C). The land use ratio, however, was still only 1.28 in 1980.

The OIV, which had led to increased yields in the 1960's, are now being replaced by the shorter, more disease, insect and lodging resistant NIV. The index of acreage under NIV, taking 1975-76 as base 100, shows a spectacular spread of the new varieties, especially during the Maha season (see Table 3).

Table 3
Index of Acreage Under NIV For The Maha and Yala Crops (1975-76 = Base 100)

	75-76	76-77	77-78	78-79	79-80	80-81
Maha	100	144	156	169	181	222
Yala	100	127	145	126	152	154

The ratio of NIV over OIV is usually higher in the Yala than in the Maha season, probably because the increase in NIV use during the Yala season is mostly on irrigated lands, as Yala cultivation of paddy on rainfed land is less reliable.

The rate of adoption of the NIV varies greatly among the 26 districts of Sri Lanka; by 1980-81, 10 districts had more than 80 percent of their land under NIV. Only six districts still have more than 15 percent of the land under traditional varieties in the Maha season. In 1980-81, the national figures are as follows: in the Maha season, 72 percent of the land was under NIV, 20 percent under OIV, and 8 percent under traditional varieties; in the Yala season, 79 percent under NIV, 6 percent under OIV, and 15 percent under traditional varieties.

The Rice Research Project is encouraging the farmers both to switch to NIV as varieties appropriate to local needs are becoming available, and to intensify their land use outside of the Maha season, by demonstrating the benefit from these changes in the farmers' fields, under their own management. While it would be tempting to attribute

the production increases to the current project, it is obvious that the long-term effects of a single research project would not be realized in such a short period. Rather, the project in the last few years undoubtedly has contributed in an additive fashion to other factors resulting in high production: cumulative breeding and management research over the last decade, higher prices for paddy, better availability of inputs, the opening of new irrigated land under the Mahaweli Scheme, and favourable weather. The full impact of the project on Sri Lanka rice production is yet to come, as the following developments occur:

- The staff trained during the project return to their posts and achieve their potentials. The training program described in section VI B has doubled the number of scientists at the six regional rice research stations.

- The decentralized research system, implemented during the project, begins to pay dividends in the form of varieties and practices better adapted to the regional diversity of the country. In addition to the Central Rice Breeding Station at Batalagoda, there are now active breeding activities on rice at Bombuwela, Maha Illuppallama, and Ambalantota. Examples of the regional approaches include breeding submergence-tolerant varieties especially adapted to the low country wet zone at Bombuwela, and varieties with increased salt tolerance at Ambalantota.

- The resource capability studies conducted during the project help make regional recommendations possible. These studies are already facilitating the development of specialized varieties for different areas, as noted above.

- Additional new improved varieties, with disease and pest resistance and tolerance to environmental stresses, emerge from the rice breeding pipeline. During the life of the project 12 varieties were released, although only one (Bg 276-5) was completely developed as a result of the project. However, new varieties are now being released at the rate of about one per year. The new varieties have the improved short plant type which is responsive to increased inputs. Two gall midge resistant varieties, Bg 400-1 and Bg 276-75, are now in use on over 170,000 acres. A brown planthopper resistant variety, Bg 379-1, has been released, and breeding efforts to combine gall midge and planthopper resistance are well under way. Many short season varieties have been developed in recent years, as part of the effort to tailor varieties to specific new environments.

- More intensive cropping systems are introduced. The cropping systems sites-four of which were created under this project - complete the research phase and introduce intensified cropping patterns for promotion by the extension service.

- Technology transfer to the farmers is accelerated by development of better linkages between research, extension and the farmer. This is being achieved both through the cropping systems program and through the World Bank Extension and Adaptive Research Project which is following a short-term consultancy recommendation made during the present project for the Field Trials program.

In summary, Sri Lanka rice production is expected to continue to increase and become more stable as the effects of the present project are more fully realized.

B. STRENGTHENING THE NATIONAL RESEARCH SYSTEM

Section V has described how and why the GSL had been planning to decentralize its research system and to emphasize research at the regional level.

The project paper recognized the need to decentralize research and assumed that GSL would establish five regional research centers as well as strengthen the existing national rice breeding center at Batalagoda. The project was to provide the training and commodities, without which such regionalization would not be possible.

This regionalization has indeed been effected with great success. In 1982, 8 regional research stations and 15 research stations are operating, in addition to the Central Rice Breeding Station. The total staff of the Research Division has more than doubled. While a few Sri Lanka Ph.D.'s are employed in key administration posts in the Research Division, all the trainees that have returned are employed in the area of expertise for which they were trained.

The rice and cropping systems working groups are meeting regularly. Their memberships overlap, and also with that of the Regional Technical Working Group (Extension and Adaptive Research Project). In this effective, if not official, fashion the coordination between the various groups is ensured.

The cropping systems program (as well as the IDRC and the World Bank Projects) has led to systematic feedback from the farmers to the researchers and has brought scientists, economists, extension specialists and farmers together into a working relationship that is beneficial to all. Through this program and a breeding program selecting for characteristics particularly well adapted to local conditions, the research capacity of Sri Lanka is much more fully utilized than before. The research system can now handle both basic research in breeding and problem-oriented research.

The project has also led to a greater emphasis on cropping systems research rather than a purely rice-oriented program. This is already bringing results at the farm level by maximizing land use throughout the year and by lowering the financial and biological risk inherent in crop specialization on subsistence farms.

The project will be bringing high returns to GSL and the farmers in terms of a larger, more effective research capacity for many years to come.

C. IMPACT ON FARMING HOUSEHOLDS

Tracing the impact of a specific project on the farming households in a country is always difficult, because the project interlinks with other development activities, and because farm production is influenced by many factors such as weather, diseases and pests, and the socio-economic environment. The impact of the Rice Research Project on farming households can be traced directly through two channels:

- The research component provides farmers with rice varieties that are shorter maturing and more disease and insect resistant than traditional varieties released earlier.

- The cropping systems units assess the constraints and potential of farms in four agroecological areas (as defined by the Resource Capability Survey), and develop more intensive cropping systems for extension.

In addition, the Extension and Adaptive Research Project funded by the World Bank will have a very positive impact on farming households, because it establishes a systematic two way information flow from farmers to researchers, through the extension service and back. In this way problems that cannot be solved by the extension workers are taken up to the researchers, who can either recommend a solution or set up a research program to find one. The farmers test the solution proposed so that researchers can take the farmers' assessment into account. The World Bank Project built upon and expanded the Field Trials units which had been created under the USAID Project.

Together, these three areas of activities have led to an unusually comprehensive utilization of the abilities of the national research system, with the researchers involved in varietal research, in comprehensive research to maximize local cropping systems, and in problem-oriented research on local, specific problems identified through the extension services.

Such a combination of activities provides the farmers with a broader choice of rice varieties adapted to local conditions, especially varieties of different maturity duration, with improvements in traditional cropping systems which can result in immediate increase in production through higher yields and more intensive use of the land from a broader food crop base, and with a much more efficient extension service.

The following discussion of impact at the farm level is based on data gathered by the Cropping Systems Units, and by the Division of Agriculture Economics, as well as on interviews with researchers, economists, cropping systems site staff, research and extension staff in the

Adaptive Research Project, and farmers (see Methodology, Appendix B). The impact of the project on rice breeding has been discussed in section VII A.

1. Impact of the Cropping Systems Program

The baseline surveys in each cropping site identifying the major constraints to production, and the subsequent exchange of information between economists, extension staff, the researchers and the farmers has led to research better suited to local conditions. The researchers are well informed of the traditional practices and local constraints, so the more intensive cropping patterns they prepare do not require drastic changes in the existing system and do not necessarily call for high level of inputs. The switch to a shorter maturity rice or a change in planting date can alone make a third crop possible, thus resulting in higher food production with little added cost.

Farmers also benefit from such an approach, as compared to commodity research, because the production increase is not limited to rice, and because a farm with a balanced cropping pattern is less vulnerable to pests and diseases, and makes a more efficient use of the natural fertility than a highly specialized farm.

Below are two examples of improved cropping systems already developed by the program.

- Anuradhapura: The area, located near Maha Illuppallama, in the Anuradhapura district in the dry zone, has been studied by the IDRC and the USAID project. Traditionally, the farmers planted a late Maha rice crop in December and left the land fallow the rest of the year.

  The researchers have demonstrated that the Maha rice crop was more likely to be successful if planted in October at the beginning of the rainy season, and grown using direct rainfall. A second rice crop can then be grown during the dry season using tank water. This had led to substantial increases in yields and production (see Table 4).

Table 4

Increase in Yields Under the Anuradhapura Cropping Systems (Adapted from Fernando, 1981)

Year	Cropping System	Paddy Yield bu/ac/year
Before 1976	Rice - Fallow	26
1976/77	Rice - Pulse	31
1977/78	Rice - Rice	70
1978/79	Rice - Rice	79
1979/80	Rice - Rice	93

By 1981, this improved cropping system was being promoted on 60 villages in the Anuradhapura district and a neighbouring district.

For the Anuradhapura District, the use of paddy NIV's increased from 55 percent of a total acreage (two crops) of 84,727 acres in 1975-76 to 69 percent of a total acreage (two crops) of 148,009 acres in 1980-81. The average yield in the district during the Yala season in 1981 was about 62 bushels per acre. Sixty four percent of that harvest was sold. The net return per acre excluding family labor was calculated as Rs.2,477.

- Bandarawela: Cold weather, high winds and lack of water are major constraints in the cropping systems site near the Bandarawela Station, in the Intermediate Zone of the Central Highlands. By switching from H4 to a shorter maturing variety, one month is saved making a third crop of vegetables possible during October to January.

Research has been conducted since 1978 in the village of Idamagama, about 26 miles from the Bandarawela Research Station. A socioeconomic survey conducted in June 1978 established that the most prevalent cropping pattern in the lowlands was paddy-potato, sometimes followed by vegetables, and potato-vegetable in the highland. The average paddy yield (Maha & Yala) was 67 bushels/acre. In this village of 116 families, 26 farmers are participating in the research since 1978.

Murphy interviewed the site coordinator, economic assistant, field assistant and nine farmers in or near the Bandarawela site. All nine farmers emphasized that the big breakthrough in yields in the area took place in the late 1950s and early 1960s, when the extension service first promoted transplanting of rice seedling over broadcasting of seed, and a few years later introduced the improved variety H4 (a tall, red variety which, at this altitude, requires over 5 months to mature). However, the major breakthrough in farm income was made in the mid 1960's by cultivating potatoes in the Yala season, when the GSL stopped importation of potatoes for consumption (seed potatoes are still being imported).

Six of the cooperating farmers were interviewed. All six explained that participation in the program had made them more careful and systematic in their practices. All were keenly interested in the varietal trials conducted on their fields but they differed in their conclusions. While all but one have abandoned H4, one is planning to switch back from NIV to MI273 (a short stature mutant of H4) and the four others are trying several NIV. No single NIV was preferred by all. The key factor in varietal adoption in this area is wind resistance, and red varieties are preferred.

Among constraints cited frequently were the high cost of fertilizer and insecticides, high cost and unreliable availability of seed potatoes, and insufficient labor force. A survey conducted by the cropping system program showed that only family labor is used for cultivation of potatoes and vegetables, for application of fertilizer and chemicals on rice, and for transportation and marketing of rice crops. Exchange labor and hired labor are used for the rice crop only, for land preparation, planting, weeding, harvesting and threshing.

The cropping site is located in the Badulla district, where the use of paddy NIV's has remained fairly stable, from 58 percent of a total acreage (two crops) of 50,580 acres in 1975-76 to 61 percent of a total acreage of 51,537 acres in 1980-81. The average yield in the district during the Yala season 1981 was over 70 bushels/acre. Seventy-five percent of that harvest was sold. The net return per acre excluding family labor was calculated as Rs.2,445.

2. Impact on Employment

The project paper expected a positive impact on employment through cropping intensification, with the speculation that should an additional 200,000 acres be cultivated in a second crop of paddy, some 50,000 man years of employment would be generated (at 70 man days per acre, 240 working days a year). In fact, paddy acreage has increased most during the Maha season (see Table 5).

Table 5

Total Paddy Acreage, 1975-76 and 1980-81
(in million acres)

Year	Maha Season	Yala Season	Total Year
1975-76	0.9	0.4	1.3
1980-81	1.2	0.6	1.8
Increase	+0.3	+0.2	+0.5

The total acreage increase of 500,000 acres between 1975-76 and 1980-81 would lead to an increase labor demand of some 100,000 person years, again assuming 70 man days per acre. The labor surveys now conducted in the cropping systems sites will show if these speculations are realistic. The Division of Agricultural Economics data reports smaller numbers of man days per acre in some areas.

However, the farmers interviewed did cite labor as a bottleneck. All but one could grow at least two crops on their entire holding, but family labor is not sufficient.

The traditional system of exchange labor is still strong; it enables related families in a village to pool their labor force to work on each others fields in turn. Problems arise when the cropping system becomes more intensive, as the timing of cultivation practices must be more accurate and everyone ends up needing additional labor at the same time. Hiring day laborers is expensive - the going rate in that area is Rs.20 to 22 per day plus tea and lunch.

At the Bandarawela site, hired labor is also not available in sufficient quantities, so that a farmer must retain the laborers he needs well in advance. Some farmers were unable to hire laborers, even though they had the necessary cash.

A survey of labor input is conducted by the Division of Agricultural Economics for every crop season. The more recent results for irrigated paddy in the Anuradhapura and Badulla districts are presented in Table 6.

Table 6

Labor Inputs Man-Day Per Acre on Irrigated Paddy in Two Districts, 1981-82 (based on Agricultural Economics Studies 32 and 33)

	Anuradhapura District			Badulla District		
	Hired and Exchanged Labor	Family Labor	Total Labor	Hired and Exchanged Labor	Family Labor	Total Labor
Yala 1981	26.83	18.80	45.63	48.80	36.62	85.42
Maha 1981-82	31.74	19.98	51.72	59.98	24.59	84.57
Total Season (double cropping)	58.57	38.78	97.35	108.78	61.21	169.99

It should be noted that the number of labor days per acre is very different for each district; the validity of the data would first have to be ascertained. In both cases, hired and exchange labor holds a predominant place. Figures for the Maha 1979-80 were available for the Anuradhapura district only; for that season, a total of 46.8 days of labor had been used to accomplish the same tasks per acre of irrigated paddy as are included in the 1981/82 total, with the work being about equally divided between family and outside labor.

These limited figures should serve to remind the economists that increased labor requirements do not necessarily mean employment generation; sometimes it just means more work for the farmers' families. The cropping systems economists are encouraged to study who provides outside labor as well as how much is provided. The recommendation to include a rural sociologist in the cropping systems program, made by the 1979 evaluation team, is hereby repeated.

3. Impact on Welfare of Farming Households

The impact of the project on the welfare of the paddy farming households cannot yet be measured, since much of the project activities are only now becoming productive. Measuring this impact will also necessitate more interviews with farmers (men and women) than could be conducted by this team. However, the surveys now being conducted by the Cropping Systems Program and by the Division of Agricultural Economics and Projects will be invaluable in assessing the impact of the project at the farm level, provided the mass of data currently generated is fully analyzed and written up.

Paddy yields and total production have been increasing steadily since the drought years of the early 1970s. For farming household, however, the net returns per acre and per unit of labor are more important than absolute yields. The impact of the project on farmers welfare is therefore influenced by factors such as farm gate prices and cost of production.

The prices for paddy were higher in 1981 than ever before, both under the Government guaranteed price scheme (GPS) and on the open market, with open market prices higher than GPS levels (see Table 7).

Table 7

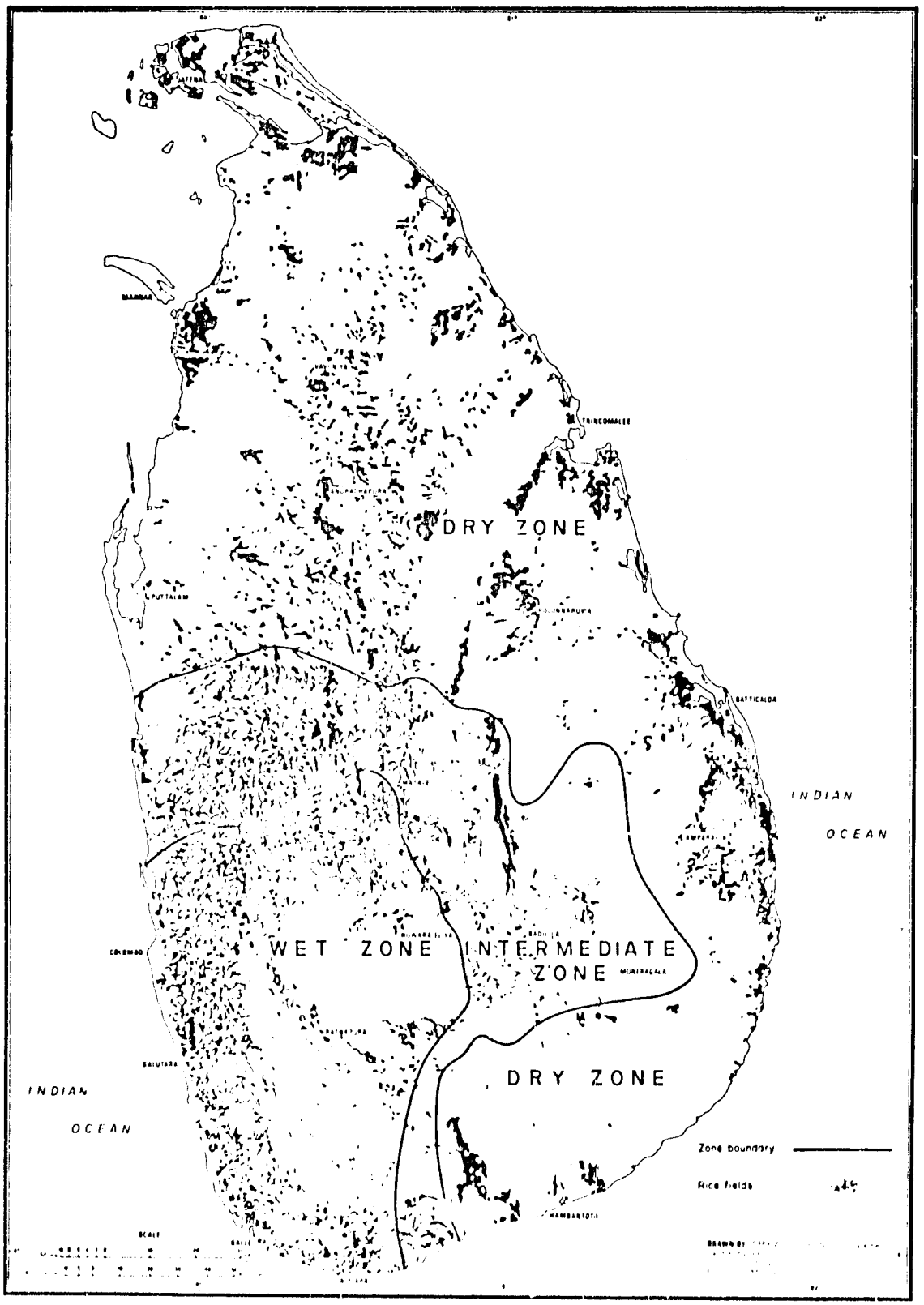
Producer Price Per Bushel of Paddy 1975-81, GPS and Open Market

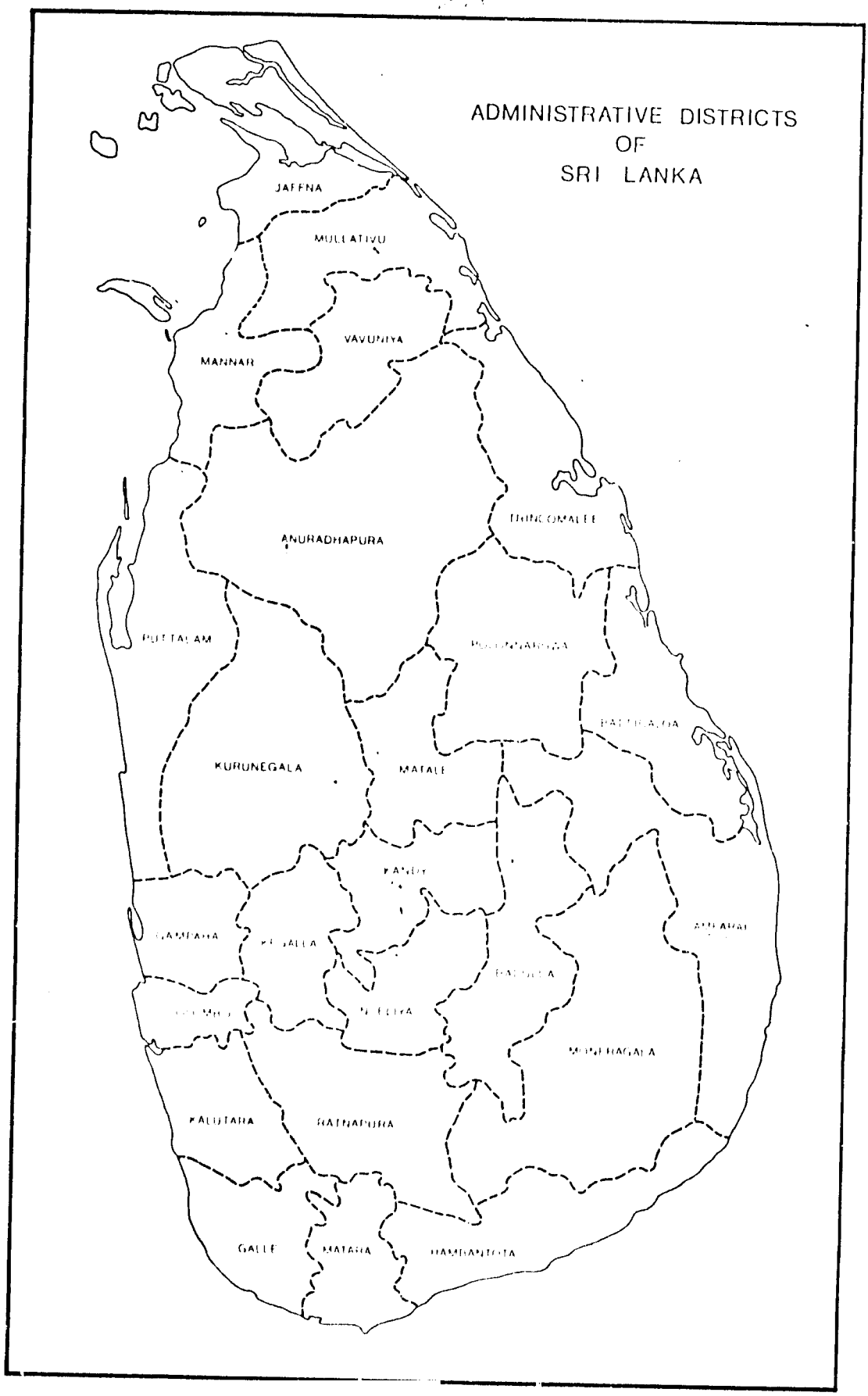
	1975	1976	1977	1978	1979	1980	1981	1982
GPS Prices (April-June)	33.0	33.0	33.0	40.0	40.0	50.0	52.5	57.5
Average Open Market Price	41.80	37.4	35.2	40.7	41.8	57.0	65.0[1]	-[2]

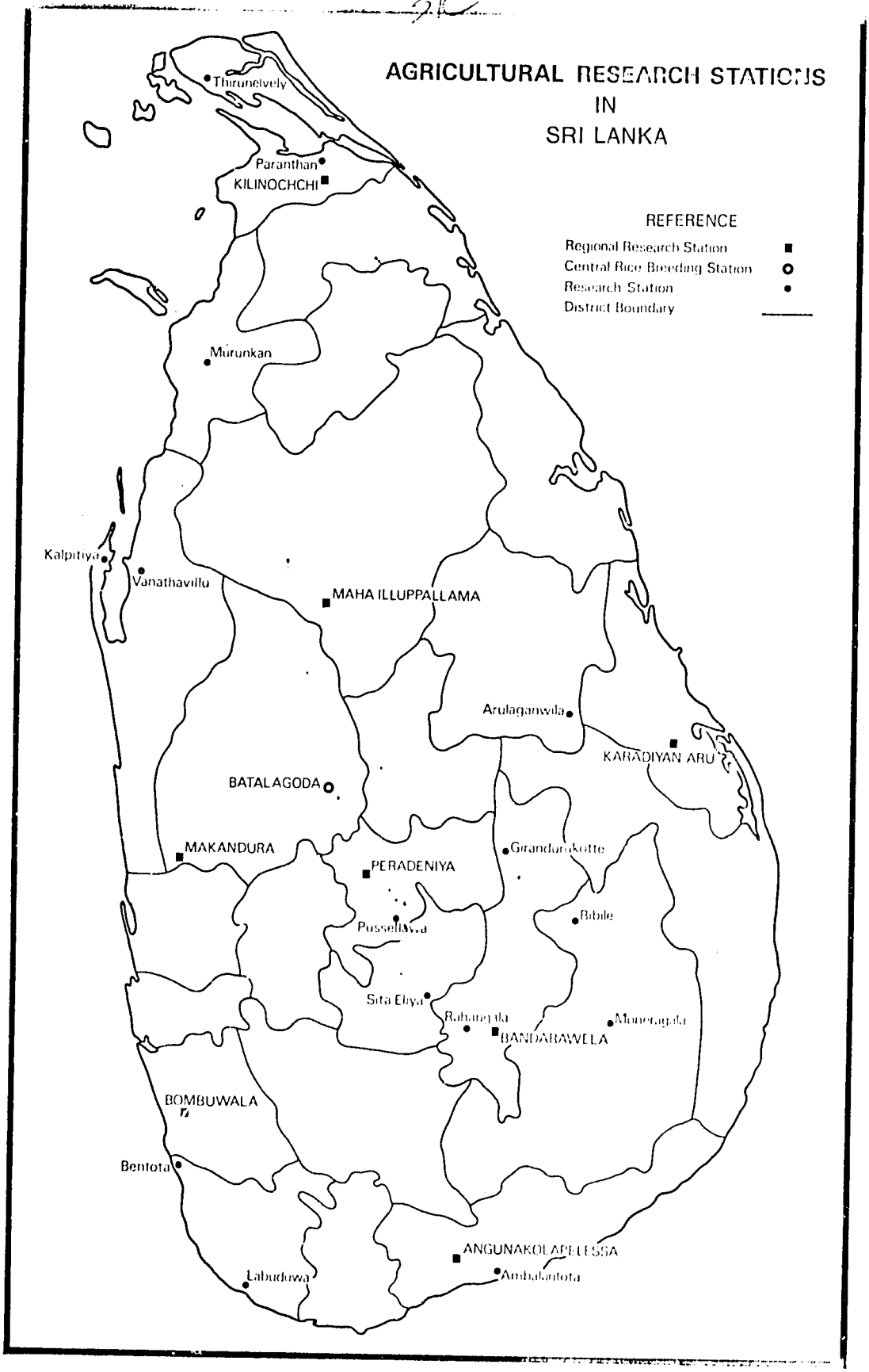
1) Estimate
2) Prices on local markets around Kegalle was over Rs.100 per bushel in mid-August 1982. (Cited in Ulsaker & Newburg, 1981.)

This increase in farm gate prices however is partly cancelled by increases in the cost of production. In 1980, Ranaweera et al reported an increase in the cost of production for paddy beginning around 1978, and due mostly to increased cost of labor. Since then, a partial phasing out of fertilizer subsidies has raised the cost of fertilizer as well. All the farmers interviewed expressed difficulties in obtaining all the inputs they would like to use, especially for labor and the high cost of insecticides and pesticides.

The Division of Agricultural Economics has compared the costs of cultivation of rice paddy for Maha 1980-81 and Maha 1981-82. For the nine districts for which complete information is available, the cost of cultivation per acre (including family labor) has increased everywhere


DRY ZONE
WET ZONE
INTERMEDIATE ZONE
DRY ZONE
INDIAN OCEAN
INDIAN OCEAN
TRINCOMALEE
BATTICALOA
COLOMBO
GALLE
Zone boundary
Rice fields


ADMINISTRATIVE DISTRICTS
OF
SRI LANKA
JAFFNA
MULLAITIVU
VAVUNIYA
MANNAR
ANURADHAPURA
TRINCOMALEE
PUTTALAM
KURUNEGALA
MATALE
KANDY
GAMPAHA
KEGALLA
NUWARA ELIYA
MONERAGALA
KALUTARA
RATNAPURA
GALLE
MATARA
HAMBANTOTA


AGRICULTURAL RESEARCH STATIONS
IN
SRI LANKA
REFERENCE
Regional Research Station
Central Rice Breeding Station
Research Station
District Boundary
Thrunelvely
Paranthan
KILINOCHCHI
Murunkan
Kalpitiya
Vanathavillu
MAHA ILLUPPALLAMA
Arulaganwila
KARADIYAN ARU
BATALAGODA
MAKANDURA
PERADENIYA
Girandurukotte
Pussellawa
Bibile
Sita Eliya
Rahangala
BANDARAWELA
Monaragala
BOMBUWALA
Bentota
ANGUNAKOLAPELESSA
Ambalantota
Labudowa

from an average of Rs.1,497 to Rs.2,720 in irrigated paddy, and from an average of Rs.1,810 to Rs.2,339 in rainfed paddy.

The net return per acre in irrigated conditions for the same nine districts increased from Rs.1,574 to Rs.2,069 if one includes family labor costs, from Rs.1,755 to Rs.2,760 if family labor costs are excluded. In rainfed conditions, the net return per acre increased from Rs.753 to Rs.1,093 including family labor costs, and from Rs.1,515 to Rs.1,793 excluding family labor.

As an example of farm income, data on net returns are given below for the two districts of Anuradhapura (Dry Zone, irrigated paddy) and Badulla (Intermediate Zone, highlands, irrigated paddy), the districts in which the AID sponsored cropping system programs are most developed (See Table 8 & 9). The Tables are based on data gathered during a single visit survey on a sample, conducted in Yala 1981 and repeated in Maha 81-82 by the Division of Agricultural Economics. The Maha 1979-81 is also available in one district. For comparative purposes, the standard rate for day labor in the Badulla district during Yala 1982 was Rs.20 to 22 plus lunch, so a laborer working 240 days a year would have a cash income of about Rs.5,040.

These limited findings show the farmers' net return increasing from 1979 to 1982 in most areas, in spite of a rather large increase in cost of production. However, returns per labor day for the Maha 1981/82 varied greatly among districts, from Rs.85 to zero in four districts. If these districts which had a complete failure are eliminated, the medium net return per labor day, which takes family labor into account, is Rs.22, similar to the current labor wage (except that the family members do not get a free lunch).

This should serve to remind researchers and development experts that, from the farmer's point of view, increasing production through more effective farming practices and better varieties while controlling the costs of production remains the most attractive improvement. The four components of the Rice Research Project - Breeding, Cropping Systems program, Resource Capability Survey, and Field Trials - have all been successfully implemented. Together they helped turn the Sri Lanka research system into an effective, regionally focused mechanism that is providing the farmers with the technological base most appropriate for achieving food security.

Table 8

Average Farm Income from Irrigated Paddy in Anuradhapura District, 1981-82

	Maha 1979-80	Yala 1981	Maha 1981-82	Total 1981-82
Yield (bu/ac)	70.0	61.9	70.9	67.0
Paddy Acreage	1.98	2.04	2.65	4.69
Total Paddy Production (bushels)	138.6	126.3	187.9	314.2
Market Price Rs./bu.	[GPS:40]	67.86	62.52	
Market Value of Harvest, (Rupees)	5,544	8,571	11,747	20,318
Cost of Production				
- including family labor	3,356	4,477	7,489	11,966
- excluding family labor	2,599	3,516	6,010	9,526
Net Return				
- including family labor	2,188	4,094	4,258	8,352
- excluding family labor	2,945	5,055	5,737	10,792
Net Return Per Acre				
- including family labor	1,105	2,006	1,605	1,781
- excluding family labor	1,487	2,477	2,163	2,301
Net Return Per Labor Day (Rupees)	24	44	31	

Source: Adapted from Department of Agriculture, Division of Agricultural Economics, "Cost of Cultivation of Agricultural Crops" for each season.

Table 9

Average Farm Income From Irrigated Paddy in Badulla District, 1981-82

	Yala 1981	Maha 1981-82	Total 1981-82
Yield (bu/ac	70.3	54.0	61.8
Paddy Acreage	1.65	1.80	3.45
Total Paddy Production (Bushels)	116.0	97.2	213.1
Market Price, Rs./bu.	62.18	65.00	
Market Value of Harvest (Rupees)	7,213	6,318	13,531
Total Cost of Production			
- including family labor	4,180	5,092	9,272
- excluding family labor	3,054	4,224	7,278
Net Return			
- including family labor	3,033	1,226	4,259
- excluding family labor	4,159	2,347	6,506
Net Return Per Acre			
- including family labor	1,840	681	1,234
- excluding family labor	2,523	1,163	1,886
Net Return Per Labor Day	21.54	8.05	

Source: Adapted from Department of Agriculture, Division of Agricultural Economics, "Cost of Cultivation of Agricultural Crops" for each season.

VIII. ISSUES NEEDING FURTHER ATTENTION

In anticipation of problems likely to arise in maintaining desired rates of increase in rice production in Sri Lanka, it is suggested that the following issues be taken into account in GSL planning:

- Rice quality and processing and rice marketing.
- Seed technology of the other crops in the rice-based cropping systems.
- Need for continuation of in-service training and professional improvements.
- Future maintenance and repair of key equipment where such service is not available within the country.
- Water management research regarding delivery to farm and related drainage needs.

APPENDIX A . LIST OF TRAINEES AND CONFERENCE PARTICIPANTS

IRRI LONG TERM (POST GRADUATE) TRAINING SCHEDULE

1	Mr C Kudagamage	Research Officer	MS	Purdue
2	Mr M Sikurajapathy	Research Officer	Ph D	North Carolina
3	Mr I Balasooriya	Research Officer	MS	Cornell
4	Mr R Kularathne	Soil Scientist	MS	Wageningen
5	Mr S Kandasamay	Research Officer	MS	UPLB
6	Mr TJAP Gunawardhana	Agric Officer	MS	UPLB
7	Mr P A Samarathunga	Agric Officer	MS	UPLB
8	Ms R Peiris	Experimental Officer	MS	UPLB
9	Mr S Ponnadurai	Research Officer	MS	UPLB
10	Mr N Senanayake	Research Officer	MS	UPLB
11	Mr G R Jayaweera	Experimental Officer	MS	UPLB
12	Mr L Nugaliyadde	Experimental Officer	MS	UPLB
13	Mr A S Vivekananda	Research Officer	Ph D	PGIA/Sri Lanka
14	Mr R M T Rajapakse	Research Officer	MS	PGIA/Sri Lanka
15	Mr S Samarakoon	Research Officer	MS	PGIA/Sri Lanka
16	Mr Michael de Silva	Research Officer	MS	PGIA/Sri Lanka
17	Ms K Jayaweera	Experimental Officer	MS	PGIA/Sri Lanka
18	Ms S Srilingam	Research Officer	MS	PGIA/Sri Lanka
19	Mr M J Ravel	Experimental Officer	MS	PGIA/Sri Lanka
20	Mr E M Balasubramaniam	Experimental Officer	MS	PGIA/Sri Lanka
21	Mr K Wickremabaskarn	Sub Matter Specialist	MS	PGIA/Sri Lanka

Nos: 19, 20 and 21 are now in the PGIA but Awards have still not come from IRRI

LIST OF TRAINEES UNDER IIE IN THE UNITED STATES

LONG TERM - POST GRADUATE (M.Sc)

1	V Rasiah	Research Officer
2	A D Somapala	Research Officer
3	D L Wickremasinghe	Research Officer
4	B L Fernando	Research Officer
5	K K S Fernando (MS)	Research Officer
6	S Sivasubramaniam	Research Officer
7	M K Gunatillake (MS)	Research Officer
8	D S de Z Abesiriwardhana	Research Officer
9	S Abetunga (MS)	Research Officer
10	G Jeyendran (MS)	Research Officer
11	K D S M Joseph	Research Officer
12	S Logendra (MS)	Research Officer
13	S Logendra	Research Officer

SHORT TERM - 12 MONTHS

1	T M J Bandara	Diploma in Geomorphology
2	K G G R Thillakasekara	Diploma in Geomorphology

SCHEDULE OF SHORT TERM TRAINEES - IRRI

TYPE OF TRAINING	DURATION	NAME OF TRAINEE	DESIGNATION	
Cropping Systems	6 months	J Amarasena	Experimental Officer	1
		N Kanaganayagam	Experimental Officer	2
		K D Walter	Research Assistant	3
		M S Perera	Research Assistant	4
		A Selvarajah	Experimental Officer	5
		G R Araserathnam	Experimental Officer	6
		D M Gunasekara	Agricultural Instructor	7
		S Rajakulendran	Agricultural Instructor	8
		M Selvarajah	Agricultural Instructor	9
		S N Jayawardena	Experimental Officer	10
Genetic Evaluation & Utilization	4 months	G Saparamadu	Agricultural Instructor	11
		D Wickremasinghe	Research Officer	12
		S Ponnuthurai	Research Officer	13
		G Jayendran	Research Officer	14
		R M T Rajapakse	Research Officer	15
		P Hemadasa	Research Assistant	16
		S Srilingam	Research Officer	17
		G Raphael	Research Officer	18
		K D S M Joseph	Research Officer	19
		K Jayaweera	Experimental Officer	20
		J R Poornampillai	Research Officer	21
		A D S de Soyza	Experimental Officer	22
		B Dissanayake	Agriculture Instructor	23
		M Dissanayake	Research Officer	24
		C Rodrigo	Experimental Officer	25

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Genetic evaluation and utilization	4 months	Mervyn Kumara	Research Assistant	26
		L B Nimalarathne	Research Assistant	27
		U Chandrasiri	Research Assistant	28
Farm Nanagement	3 months	P Dissanayake	Farm Manager	29
		T B Herath	Farm Manager	30
		K K Jayasekara	Farm Manager	31
		M C Wijewardhana	Farm Manager	32
		S P Dharmawardhana	Farm Manager	33
Special Training	1 month	J Jayawadhana	Research Officer	34
		P Yogarathnam	Research Officer	35
		I Balasooriya	Research Officer	36
		P Ganeshan	Research Officer	37
		G A Gunatillake	Research Officer	38
Water Management	5 weeks	H Gamage	Agriculture Officer	39
		P Dayananda	Research Officer	40
		A A Dharmasena	Agriculture Instructor	41
		C Thirunadarajah	Agriculture Officer	42
		W D L Stanley	Research Officer	43
		M Sivapatham	Agriculture Instructor	44
IREAN Special Training	2 months	N Weralugolla	Economic Assistant	45
Food Technology & Cereal chemistry	9 months	C Breckenridge	Research Officer	46
Rice Agro-economic network	3 months	K D Abeysinghe Banda	Economic Assistant	47
		A M Jayatillake	Economic Assistant	48
Agriculture Economics	2 months	P B R Kumburegama	Economic Assistant	49
		A M Jayatillake	Economic Assistant	50
Rice Production	4 months	A Wickremasinghe	Research Assistant	51
		K A J H Fernando	Experimental Officer	52
		S K Senevirathne	Agriculture Instructor	53
		J Dharmasena	Experimental Officer	54

Rice Production	4 months	H Kumarasinghe	Agriculture Instructor	55
		K P Alfred	Agriculture Instructor	56
		S Kottearachchi	Research Assistant	57
		P D Gunatillake	Agriculture Instructor	58
		S Blendra	Research Assistant	59
		W B Rambukwella	Agriculture Instructor	60
		A Dharmasena	Agriculture Instructor	61
		W A Fragnadasa	Agriculture Instructor	62
		K P A Sunilchandra	Agriculture Instructor	63
Irrigation, Water Management and Drought screening		G B Kerthirathne	Research Officer	64
INSFER	4 months	N Gunapala	Experimental Officer	65
		S Marikkar	Research Officer	66
Zinc deficiency	6 months	B M Nizar	Research Assistant	67
Use of field trials	1 month	S Srikanthan	Agriculture Officer	68
		S H Charles	Agriculture Officer	69
Special study tour	1 month	S P R Weerasinghe	Research Officer	70
		T Sivalingam	Research Officer	71
Field trials	3 weeks	A S Vivekananda	Research Officer	72
Aerial Survey (in Nederlands)	1 year	T B Samarakoon	Soil Surveyor	73
		P S Wijesooriya	Soil Surveyor	74
Irrigation and Water Management	6 weeks	N Heen Banda	Agriculture Instructor	75
		S Jayarajan	Agriculture Instructor	76
Varietal testing	26 days	T Thavanesh	Experimental Officer	77
Grain Quality Testing	4 months	K D Ariyarathne	Research Assistant	78
Genetic Evaluation & Utilization	4 months	B D Pathinayake	Research Officer	79
		S W Abesekara	Research Officer	80

Breeders programme	1 month	D Jayasekara	Research Officer	81
		D H Muthukudaarachchi	Research Officer	82
Agriculture Engineering	2 weeks	S Wijesiri	Agriculture Engineer	83
Graphic Art	3 months	W Jayatillake	Draughtman/Artist	84
Printing Practices	3 months	S Sundaramoorthy	Agriculture Officer	85

A.6

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SCHEDULE OF PARTICIPANTS IN WORKSHOPS CONFERENCES, SEMINARS and STUDY TOURS

Dr C R Panabokke	Director	Soil Symposium 1977	1
		IRR Conference 1980	2
Dr S Nagarajah	Chemist	Soil Symposium 1977	3
		IRR Conference 1979	4
		IRR Conference 1980	5
Mr G Pillainayagam	Engineer	Study Tour 1977	6
Mr J Handawela	Research Officer	Inputs Conference 1978	7
Dr S H Upasena	Research Officer	Cropping Systems 1978	8
		Cropping Systems 1980	9
		CS Working Group 1980	10
		CS Working Group Korea '80	11
		CS Working Group 1981	12
		CS Working Group 1981 in Indonesa	13
		CS Working Group 1981 in Burma	14
Dr G W E Fernando	Deputy Director (Research)	Cropping Systems 1978	15
		Cropping Sustems 1980	16
		CS Working Group 1980	17
		CS Working Group 1980 in Korea	18
		IRR Conference 1981	19
		IRR Conference 1982	20
Dr Nimal Ranaweera	Senior Economist	Cropping Systems 1978	21
		Constraints Conference	22
		Cropping Systems 1980	23
		Agro-Econ Visit 1981	24
		CS Working Group 1981	25
Mr T Senarathne	Research Officer	Cropping Systems 1978	26
Mr R Senevirathne	Research Officer	Cropping Systems 1978	27
Dr S Somasiri	Head, Land and Water Use Division	ASA Meeting 1978	28
		Remote Sensing WS 1979	29
		ISSC in Delhi 1982	30
Dr I Gunawardhana	Botanist	IRR Conference 1979	31
Dr (Mrs) N Wickremasinghe	Entomologist	IRR Conference 1979	32
Dr D Senadhira	Research Officer	IRR Conference 1979	33
		Rice Symposium 1979	34
		IRR Conference 1980	35
Mr J Jayawardhana	Research Officer	IRR Conference 1979	36
		CS Study tour 1979	37
		IRR Conference 1980	38
		IRR Conference 1981	39

Mr J Jayawardhana	Research Officer	Tidal Swamp WS in Indonesia 1981	40
Dr S Amarasiri	Chemist	IRR Conference 1979	41
		IRR Conference 1982	42
Mr G A Gunatillake	Research Officer	CS Study Tour 1979	43
Mr P Yogarathnam	Research Officer	CS Study Tour 1979	44
		IRR Conference 1982	45
Mr Michael de Silva	Research Officer	CS Study Tour 1979	46
Miss M Hassan	Research Officer	WMO Symposium 1979	47
Mr P Krishnarajah	Soil Conservation Officer	WMO Symposium 1979	48
		ISSC in Delhi 1982	49
Dr J Fernando	Research Officer	CS Conference 1980	50
		CS Working Group	51
Mr R Wijesooriya	Agric Officer	CS Conference 1980	52
Mr Paul Peiris	Agric Officer	Special Study Tour	53
Mr L Nugaliyadde	Research Officer	IRR Conference 1981	54
Mr Y Elikawela	Research Officer	IRR Conference 1981	55
Mr C A C de Silva	Economist	Agro-econ visit 1981	56
Mrs. T Wijesundera	Economic Asst	Agro-econ visit 1981	57
Mr P A Samaratunga	Agric Officer	Cropping Systems visit to Nepal 1981	58
Mr J A Lewis	Research Officer	Cropping Systems visit to Nepal	59
Mr C Mirihagalle	Research Officer	Cropping Systems visit to Nepal	60
Dr N Vignarajah	Research Officer	CS Working Group in Indonesia 1981	61
Mr C Kudagamage	Research Officer	CS Working Group in Indonesia	62
Dr C Jayasooriya	from IRRI	CS tour in Sri Lanka 81	63
Mr D Samarasinghe	Agric Officer	CS Study Tour 1981	64
Mr S T Padmanathan	Agric Officer	CS Study Tour 1981	65
Mr A A Fernando	Agric Officer	CS Study Tour 1981	66
Mr D M Piyatilicke	Agric Officer	CS Study Tour 1981	67
Mr T B Mawilmada	Projects Officer	Accounts verification 80	68
		Accounts verification 81	69
Mr W M K B Weerasekara	Accountant	Accounts verification 81	70

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APPENDIX B. METHODOLOGY

This report is based on information obtained by Dr. Rutger and Dr. Murphy with the assistance of Ms. Malini Ponnudurai, USAID/ Sri Lanka and Mr. T.B. Mawilmada, GSL, which is gratefully acknowledged.

Project documents, previous evaluations and publication from the Department of Agriculture were reviewed.

On August 11 and 12, the evaluators and Dr. James Bonner, USAID/ Sri Lanka met with the following Department of Agriculture officials for a very comprehensive review of all project components:

Dr. G.W.E. Fernando, Director of Agriculture
Dr. I. Gunawardhana, Project Director and Deputy Director for Research
Dr. (Mrs.) N. de Alwis, Deputy Director Research CARI
Dr. Nimal Ranaweera, Deputy Director Agriculture Economics and Projects
Dr. D. Senadhira, Deputy Director Research, Batalagoda
Dr. S. Somasiri, Head, Land and Water Use Division

The evaluators also visited a total of nine research stations as listed below:

4 August	Batalagoda	Mr. M.P. Dhanapala - Research Officer Mr. C. Kudagamage - Research Officer
5 August	Walagambahuwa (AM) Maha Iluppallama (PM)	Dr. Mervyn Sikurajapathy - DDR Mr. M.A. Ruhumage - Research Officer
6 August	Hingurakgoda Paddy Station (AM) Polonnaruwa Paddy Station (PM)	Mr. Pussella - Farm Manager Mr. R.C. Seneviratne - AD
7 August	Karadian Aru	Mrs. C. Manoharan, Research Officer
9 August	Ambalantota (AM) Bombuwela (PM)	Mr. S.W. Abesekara - Research Officer Mr. G.A. Jinadasa - Experimental Officer Mr. K.L. Miriharalle - Research Officer Dr. K. Anandarajah - Research Officer Mr. A.H.G. Mithrasena - Research Officer Mr. C. Wijesundera - Research Officer Mr. S.G. Wanigasooriya - Research Officer
12 August	Peradeniya	Mr. P. Krishnaraja - Soil Conservation Office (on Adaptive Research)
13 - 14 August	Bandarawela Station & cropping systems site	Mr. J. Wahab, Research Officer, Economic Assistant, Field Assistant, Farmers

Nine farmers interviews were conducted in and near the Bandarawela cropping systems site by Dr. Murphy with the assistance of an interpreter. The field assistant was present during four of the interviews. A checklist of questions had been prepared and tested,

covering current and past agricultural practices and production, farm characteristics, contracts with researchers and extension services, and the farmer's appreciation of the limiting factors on production and of changes in household welfare. No notes were taken during the interviews, but the answers were transcribed on to questionnaires immediately afterwards (see next page). The farmers interviewed were selected at random in the fields.

Should an evaluation of the impact of the project on farmers' welfare be conducted at a later time as recommended in this report, it is suggested that a similar survey but with more comprehensive questions on sources and costs of inputs, on family income, and on family labor (including that performed by women) be conducted in the Anuradhapura (dry zone) and Bandarawela (intermediate zone) areas, on a sample including in each area:

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

The first sample will show the rate of adoption of new varieties and practices by farmers who are in fact co-experimentators with the researchers. The second sample will show the spread of these changes through direct observation. The third sample will serve as a control group, showing what changes have been brought through the regular extension services.

FARMER INTERVIEWS - RICE RESEARCH PROJECT

Farm Code:
Location:
Contacts with Researchers:
Contacts with Extension Agents:

Date:
Present:

	Past	Maha 1981-82 Yala 1982	Cause for Changes
1. Agricultural Production			
- Cropping System			
- Rice Production			
-Seeds			
-Inputs			
-Outputs			
- Other Crops			
2. Farm Characteristics:			
- Land and infrastructure			
- Consumers			
- Labour Force			
- Equipment			
- Livestock			
- Off-farm activities			
3. - General - Production limiting factors			
- Ag information sources			
anges i all being			

RESOURCE DOCUMENTS

Beachell, H.M. - Notes on Sri Lanka Trip. January 15-21, 1981.

Cowan, J. Richie - Report on Review of Feild Trials Research Program of the Sri Lankan Department of Agriculture. October 17, 1978.

Fernando, W. - Impact of GSL - IRRI - USAID Project on Rice Rice Production in Sri Lanka.

Griffeth, W.L. - Special Progress Report at the End of Resident Technical Assistance by IRRI Scientists. May 23, 1977 - March 31, 1981.

Ranaweera, N.F.C., de Silva, G.A.C, and Samaratunge, P. - Policy issues relating to rice production in Sri Lanka. Paper presented at the Rice Symposium, 25-26, September 1980, Colombo, Sri Lanka.

Steinberg, David, et al - Sri Lanka: PL 480 Title I Food Assistance From Equity with growth to growth with Equity.

Suraweera, D.E.I. - Socio-Economic Factors Affecting Cropping Systems in a Selected Dry Zone Region. Division of Land and Water Use, GSL. (Undated)

Ulsaker, Norman and Richard Newberg - A review of recent agricultural developments in Sri Lanka, 1981 (draft), USAID/ Colombo; November 1981.

Project Paper - Sri Lanka Rice Research, AID-DLC/P-2189, June 22, 1976.

Terms of Reference, Sri Lanka Rice Research Project. Details of Services to be Provided by IRRI.

GSL Rice Research Project Review. August 3, 1978.

GSL/AID/IRRI Rice Reserach Project 2 Year Review. May 21-25, 1979.

Accomplishments of GSL/IRRI/USAID Rice and Cropping Systems Project. (late 1981)

Untitled Cropping Systems Report provided by Dr. Mervyn Sikurajapathy. (Undated).

Agricultural Statistics of Sri Lanka, 1951/52 - 1980/81, Ministry of Agricultural Development and Research.

GSL Department of Agriculture, Division of Agricultural Economics and Projects. Cost of cultivation of Agricultural Crops. Maha 1979/80, Maha 1980/81, Yala 1981, Maha 1981/82

Bandarawela Cropping Systems Site - Various unpublished surveys.

APPENDIX C. AGRICULTURAL PRODUCTION STATISTICS

Table 1. Paddy- Net Extents Harvested, Production and per acre yields

Table 2. Paddy - Consumption and Production Demand (1981 -1985)

Table 3. Paddy - Spread of Improved Varieties (1978 -1981)

Table: 1, Paddy - Net Extents Harvested, Production and Per Acre Yields

Year	Maha			Yala			Cultivation Year.		
	Net Extent Harvested mil Acr.	Production '000 Bu.	Per Acre Yield Bu.	Net Extent Harvested Mil Acr.	Production '000 Bu.	Per Acre Yield Bu.	Net Extent Harvested Mil. Acr	Production '000 Bu.	Per Acre Yield Bu.
1970-71	0.9	41,560	44.90	0.5	25,335	47.66	1.4	66,895	45.91
1971-72	0.9	42,327	48.09	0.5	20,574	44.54	1.3	62,901	46.87
1972-73	0.9	42,004	45.54	0.5	20,896	42.78	1.4	62,900	44.58
1973-74	1.1	52,629	47.72	0.6	24,165	41.74	1.7	76,794	45.66
1974-75	0.7	34,458	46.24	0.5	20,357	40.84	1.2	55,315	44.04
1975-76	0.9	42,278	47.17	0.4	17,756	40.30	1.3	60,034	44.31
1976-77	1.1	54,833	51.56	0.6	25,591	43.98	1.6	80,424	48.88
1977-78	1.2	61,626	53.02	0.6	28,979	46.61	1.8	90,605	50.70
1978-79	1.2	66,764	54.70	0.5	25,122	49.34	1.7	91,886	53.36
1979-80	1.2	69,653	58.23	0.6	32,584	55.99	1.8	102,237	56.80
1980-81	1.2	72,961	58.29	0.6	33,384	56.90	1.8	106,345	58.47
1981-82	1.1	66,215	60.38	0.7	38,868	56.33	1.7	122,299	59.47

Note: 1981-82 Maha Provisional figures, Yala target figures.

Source: Division of Agricultural Economic and Projects, Department of Agriculture

Table: 2 Paddy - Consumption and Production Demand

(1981 - 1985)

Year	Population '000	Consumption Demand Rice '000 Bu.	Consumption Demand Paddy Mil Bu.	Production Demand Paddy Mil Bu.
1981	14,850	53,175	108.5	121.0
1982	15,102	54,105	110.4	123.0
1983	15,359	55,000	112.2	124.9
1984	15 620	55,930	114.1	127.0
1985	15,886	56,895	116.1	129.1

Assumptions:

i. Rate of population growth 1.7

ii. Per capita consumption of rice at 104 kg/annum

iii. Seed paddy requirement at 4 Mil Bu/Year

iv. Losses at 7% of total production.

Source: Division of Agricultural Economics and Projects, Department of Agriculture

Table: 3 Paddy - Spread of Improved varieties
(1978 - 1981)

Percentage of sown Extent

District	MAHA						YALA					
	1978 - 79		1979 - 80		1980 - 81		1979		1980		1981	
	N.I.V	O.I.V	N.I.V	O.I.V	N.I.V	O.I.V	N.I.V	O.I.V	N.I.V	O.I.V	N.I.V	O.I.V
Colombo	55	8	63	14	N.A.	N.A.	37	9	60	14	85	2
Gampaha	-	-	57	6	78	3	71	5	88	1	95	0.4
Kalutara	18	10	19	13	30	19	26	7	19	5	38	8
Galle	20	7	21	4	25	4	17	6	20	3	31	4
Matara	47	34	2	0.6	53	22	47	51	54	25	61	19
Putlam	58	28	83	19	60	34	67	32	48	25	74	18
Kurunegala	72	17	78	14	89	10	89	10	92	6	91	2
Kegalle	83	16	94	2	93	7	93	0.5	95	0.2	98	-
Ratnapura	39	2	35	28	42	58	32	19	46	16	53	14
Kandy	62	11	65	18	72	28	74	15	66	20	92	6
Matale	65	24			92	8	81	18	78	15	85	9
Nuwara Eliya	37	63	39	58	47	53	62	37	67	33	38	52
Badulla	53	47	58	42	62	38	61	38	69	26	68	28
Monaragala	68	33	72	28	81	19	76	8	85	10	95	1
Jaffna	44	40	42		39	42	56	44	77	22	100	-
Vavuniya	50	49	67	33	63	37	89	3	95	2	95	3
Mullative	-	-	32	66	43	57	56	44	85	11	84	10
Mannar	81	19	84	16	83	16	100	-	100	-	100	-
Anuradhapura	69	3	76	2	64	34	85	2	97	0.5	95	3
Polonnaruwa	96	3	95	1	99	1	93	2	99	1	97	-
Trincomalee	52	35	63	31	78	22			97	3	99.8	0.2
Batticaloa	31	63	40	60	68	31	57	25	64	17	78	10
Ampara	83	8	96	4	99	0.1	98	0.3	99	0.1	100	-
Hambantota	87	6	89	4	88	1	90	2	85	1	98	1
Uda Walawe	84	3	86	2	82	1	83	4	86	2	N.A.	N.A.
Kalawewa	-	-	44	3	98	2	100	-	99	0.6	N.A.	N.A.
Sri Lanka	60	22	63	21	72	20	70	13	74	8	79	6

Source: Division of Agricultural Economics and Projects, Department of Agriculture.

APPENDIX D . MAPS

Map 1. Rice Production Areas in Sri Lanka

Map 2. Administrative Districts of Sri Lanka

Map 3. Agricultural Research Stations in Sri Lanka