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PROJECT COMPLETION REPORT

RICE RESEARCH IMPROVEMENT PROGRAM

Project No. 386-11-110-379

by

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I. INTRODUCTION

This report reviews the Rice Research Improvement Project for the six-year period ending June 30, 1973, which has been a dramatic time in the history of Indian agriculture. It was during this time that the country's economy took a momentous forward leap in foodgrain production. In this spectacular advancement the All-India Coordinated Rice Improvement Project (AICRIP), which was initiated in 1965, played a vital role.

The early activities of the AICRIP were sponsored by the Indian Council of Agricultural Research (ICAR) and some support was provided by the Rockefeller Foundation (RF), which provided the services of the Joint Coordinator, some temporary technical staff and strategic foreign equipment and supplies. The AICRIP central office is located at Rajendranagar (Hyderabad) in the State of Andhra Pradesh.

With the signing of agreements in 1967 between the USAID and the Government of India (GOI) on the one hand and between the AID/W and the International Rice Research Institute (IRRI) on the other, additional foreign assistance, four senior foreign scientists, and some local temporary technical staff and locally available equipment, were provided to the AICRIP. Associated with this contract was the agreement on the part of the GOI to supply foreign exchange for some strategic equipment not available in India and to construct essential office space and laboratory facilities at the AICRIP.

Initially the center devoted its attention exclusively to the coordination of research; later to applied research and more recently to the training of research and extension personnel. A direct linkage was established among the development agencies with an outreach program directed toward payoff in increased production. The Ford Foundation (FF) has been assisting the Center in the conduct of adaptative research in the cultivators fields since 1969.

II. BACKGROUND

Rice is the principal cereal crop of India, accounting for about two-fifths of the nation's foodgrain consumption. One-third of the world's rice area is in India but the total output is only one-fourth of the world production. This is evidently due to low average yields, being only 17.1 quintals of paddy per hectare in 1970-71 in contrast to 54 quintals in Egypt, 52.5 quintals in Japan, 52 quintals in USA and 51 quintals in Italy.

Until recently agricultural research in India had been primarily a state effort and because of overwhelming importance of rice in their cropping pattern, some states began research on this crop more than six decades ago. These early efforts right up to the "Fifties" were primarily confined to pure line selection. The varieties recommended to the farmers had been selected under conditions of low fertility with very low level of cash and technical inputs. They were vegetatively vigorous and tended to be somewhat tolerant to the environments in which they were grown. Under such conditions these varieties provided stabilized performance, fluctuating only as the rainfall, disease or insect pressure affected their limited potential. But when these varieties were grown on fertile soils or when fertilizers were applied to them, they produced relatively little additional grain.

Realizing the limitations of these varieties to increase production the FAO in 1953 proposed a regional program of crossing them with the Japanese varieties to introduce their high-yielding qualities into the rice varieties of the tropics. The Central Rice Research Institute (CRRI) at Cuttack, Orissa, was selected as the center for this activity in India. The objectives of the program were defined only in terms of increasing yields with no clearcut directive in respect of plant prototypes which could enable the objectives to be reached with certainty.

The International Rice Research Institute, in the early sixties explored the plant type concept as a means of creating more productive varieties for the tropics. As information on plant type became available, India recognized new horizons for increasing yields. The coordinated activity was selected as the means of quickly developing new varieties and other technology to adapt the new plant types to Indian conditions. To start with the identification of high yielding varieties and new selections from India, crossing programs became the major objective of the All-India Coordinated Rice Improvement Program. Along with plant breeding, the coordinated program involved other disciplines and existing research centers of the states to create a multi-discipline, multi-location approach to achieve the objectives of the programs. The Indian Council of Agricultural Research actively assisted the AICRIP in developing a closely-knit research program by strengthening the infrastructure and by coordinating the work at the more than 20 research stations in India (seven zonal centers, 12 regional stations and three testing centers). The change in the strategy for the crop improvement program coupled with the availability of new varieties, breeding material and experience from the IRRI, paid rich dividends.

The research work at IRRI had clearly shown that the varieties commonly grown (indica sub group) had limited yield potentials which stood in the way of stepping up rice production in the tropics. Of the world collection of numerous rice varieties, it was observed that there were some lines which had the capability of profiting from high soil fertility and intensive input management. Many of these varieties were of the japonica subgroup; they tend to be shorter, and less leafy with desirable plant characteristics. There were also some dwarf strains of the indica sub group. Thus a breeding program which involved the dwarf indicas with indigenous tall indicas appeared to offer the greatest scope for providing the Indian farmer with modern rice varieties. One of the groups, Taichung Native I, amply demonstrated its wide adaptability in India, but it succumbed to diseases. The breeding program was thus designed to correct this defect. The new varieties developed under the AICRIP have paved the way in achieving a breakthrough in the rice production in India.

III. PROJECT OBJECTIVES

The objectives and goals of this project were the same as to those of the AICRIP viz., (1) accelerating rice breeding and other research programs, (2) developing and providing advanced in-service training facilities for the local personnel which would lead to the improvement of varieties and cultural practices, (3) increase farmers rice production. The IRRI because of its experience in conducting rice research in the tropics was the most logical institution to assist in this work. The implementation and acceleration of the AICRIP goals by planning for the working of IRRI personnel with Indian scientists and other cooperators in designing and conducting research to suit Indian conditions, were the objectives of this project. Specific objectives included:

(1) Breeding high-yielding, still-strawed, fertilizer-responsive varieties acceptable to Indian consumers;

(2) Breeding programs to incorporate insect and disease resistance into agronomically desirable strains;

(3) Entomological research to determine more effective control measures for the major insect pests such as stem borer, gall midge, leaf and plant hoppers;

(4) Pathological research on bacterial, viral and fungal diseases of rice;

(5) Agronomic research in the utilization of fertilizers by the new varieties and selections under development and other factors necessary for maximization of yields and new varieties in farmers' fields; and

(6) Studies in plant physiology relating to vegetative development, yield components, light transmission, photosynthesis, and dry matter production of different dwarf *indica* varieties.

IV. FINANCIAL & TECHNICAL MANPOWER CONTRIBUTION (1966-73)

A. USAID

Dollars ($596,000)	Rs. 4,529,600 1/
Trust Fund Rupees	6,644,725

B. Government of India

ICAR	4,286,321
State Governments	N.A.

C. Other Agencies

Rockefeller Foundation	2,074,325
Ford Foundation	2,335,000
Total:	Rs. 19,869,971

1/ Conversion rate $1.00 = Rs. 7.60

Commodity Support to AICRIP

A. USAID

		$
Office Equipment	Rs. 48,000	--
Technical Equipment	500,000	50,000*
Vehicles	530,000	--
Books, Periodicals	--	10,000
	1,078,000	60,000

B. The Rockefeller Foundation

Office and Laboratory Equipment	25,000	50,000
Field equipment	50,000	60,000
Vehicles	--	10,000
	75,000	120,000

* Includes equipment worth $40,000 transferred from the Regional Pulse Improvement Project.

C. The Ford Foundation	Rs.	$
Equipment		1,500
Construction (Green House)	1,500,000	
D. ICAR		
Office Equipment	50,048	--
Laboratory and Field Equipment	35,586	--
Vehicles	98,330	--
	183,964	
TOTAL	1,336,964	181,500

All contributions by the USAID and other agencies, except Trust Fund, represent dollar input converted into rupees. The ICAR contribution included $125,000 provided in free foreign exchange, but was not realized in the project period. In the Fourth Five Year Plan, the ICAR provided Rs. 16.7 million of which Rs. 3.472 million were for the new center at Hyderabad and the remainder for the strengthening of the state and national centers by way of funds for higher level positions, buildings, equipment and some logistic support for travel and jeeps. The aim was to accelerate the research work already underway in the various states financed with their own funds.

The technical manpower input by each agency from January 1, 1966 to June 30, 1973 was as follows:

Agency	Coordinator mm	Staff No.	Staff mm	Total	percent
ICAR	86	13*	332	418	17.0
AID		33	712	712	29.0
RF	90	91	1182	1272	51.7
FF	-	4	56	56	2.3

*Eight posted in the last 12 months.

The manpower input includes trainees and others with B.Sc. degrees or above. Of the total input IRRI/AID provided 29% of the contribution, primarily of the leadership class, including foreign technicians as well as Indian staff (Appendix I and II). The list of consultants and their period of service is shown in Appendix III.

V. PROJECT ACTIVITIES UNDERTAKEN

The project activities covered all the major disciplines in the studies of the critical aspects of rice production - breeding, agronomy, entomology, pathology with a focus on new varieties as the vehicle for a breakthrough in rice production. With a modest beginning in 1967, the coordinating center at Hyderabad within a few years became an integral part and leader of the nationwide network of existing rice research stations. While active breeding research was conducted at Hyderabad and other main research stations, systematic trials of the new strains were conducted at the cooperating stations. These trials, besides new varieties, included agronomic practices, insect control and disease control. Some aspects of entomology and pathology required cooperative work at specific locations, depending upon the presence of personnel, presence of insects or diseases at epidemic levels or facilities for studies of life history, epidemiology, etc.

The main activities under various research programs were as follows:

(a) Breeding

The breeding program at the AICRIP was primarily oriented toward incorporating in a superior plant type, short stature, with short erect leaves and good tillering, a range of maturities, a high level of resistance to major diseases and pests and an acceptable quality of grain. Genetic crosses between traditional varieties from different rice producing areas of India (as well as from the world genetic stocks) possessing one or more of these desirable characters and short statured dwarf indicas from IRRI and Taiwan provided the rice breeders with biological material for the selection and development of new varieties. An enormous amount of breeding material has been observed by the breeders of the AICRIP from crosses made at the project headquarters and other cooperating stations and promising selections combining plant type with desirable characters were made and tested and evaluated. As soon as new progenies came from active

breeding programs they were subjected to a series of tests: the Initial Evaluation Trials (IETS) at a few locations, the Preliminary Varietal Trials (PVTS) at 25 to 30 percent of the better entries in the IET's at more locations and the Uniform Variety Trials (UVTS) at many locations throughout the country, wherever the maturity of the selections permitted. Concurrent to these variety trials, were screening trials where these same entries were evaluated for resistence to common insect pests and diseases. In each year 30 to 40 screening trials were conducted.

(b) Agronomy

Agronomy trials compared new selections with local varieties at first, but later on as the merit of the dwarf varieties became established, trials included only released dwarf varieties as standards of comparison.

The agronomic trials were conducted on an all-India basis, coordination being centered at the AICRIP. The main subjects studied included:

(i) Optimum times and rates of nitrogen application
(ii) Methods of incorporating a basal doze of nitrogen
(iii) Methods of top dressing nitrogen
(iv) Effect of spacing and nitrogen level on the yield
(v) Effect of NPK
(vi) Effect of micronutrients
(vii) Foliar application of urea
(viii) Effect of date of planting on growth and yields
(ix) Maximization of grain yield.

At regular intervals plant measurements were taken and the more important field trials were sampled for a detailed study on yield components of plants.

(c) Entomology

The rice stem borer, gall midge and the leaf and plant hoppers are the major pests causing severe damage to rice in India. Several of the most common and newer insecticides and formulations and times of application were studied. Some granular formulations were tested as additives to irrigation water for its efficiency in controlling pests.

The seasonal incidence and intensity of population during the year in various rice growing areas were studied. The numerous rice cultures collected from IRRI and other sources were tested for resistance to various pests. While the varieties susceptible to insect pests were discarded, others, after closer examination, were used to evolve strains which carry insect resistance.

(d) Pathology

Changes in rice culture which have accompanied varieties with the new plant type have created conditions in the crop making it more susceptible to most diseases, just as it has created conditions very favorable to most insect pests of the crop. The role of the pathologist has assumed much greater importance as a consequence. The team of pathologists has played a critical role in studies on bacterial leaf blight and rice tungro virus which have been recognized as threats to the rice crop in so long as susceptible varieties are grown. Fungal diseases have been likewise pursued but, fortunately, in the case of blast the introduced dwarf varieties have carried good levels of resistance and screening techniques have enabled breeders to develop strains resistant to the disease. Sheath blight and stem rot are other diseases for which resistance is being sought by the pathologists and breeders.

(e) Physiology

Research in plant physiology was developed at a few locations with emphasis on "production physiology" to better understand the behavior of the new plant type in different seasons and under other environmental factors including many aspects of management. The problems studied included those relating to (a) dry matter production during the ripening process and yield components, (b) light intensity for photosynthesis and growth, (c) light conditions and ripening process, (d) contribution of flag leaf to grain yield, (e) response of yield components to light and nitrogen in dwarf derivatives, and (f) physiological disturbances of rice growth in several soil conditions.

(f) Rice Machinery

New equipment, tillers, seeders, transplanters, weeders and threshers for rice which were designed at IRRI have been tested. India is a country with huge potential and a tremendous challenge in increasing land productivity. Even with unique constraints there is a vast scope for partial, if not complete, mechanization.

(g) Other activities

These included training of scientists and extension workers, seed multiplication, minikit demonstration programs and improvement of land, irrigation, laboratory and other building facilities at the AICRIP.

VI. EVALUATION OF ACHIEVEMENTS

The primary goal of this project was to assist and strengthen the AICRIP in conducting, promoting and coordinating problem-based research of immediate relevance to increased production. The accomplishments of the project in various fields have been indicated below:

(a) Coordination

Essential to the achievement of meaningful research results was the development of a team spirit within and among the various disciplines which recognized common objectives and accepted these objectives as those which could be achieved by a new unanimity of effort. A multi-disciplinary and multi-locational approach developed communications in planning, review and evaluation of results, replanning research trials and in dissemination of information.

To create conditions for effective coordination, workshops were held, first semi-annually and then annually since 1971. At these workshops over 100 rice research workers planned research for ensuing seasons and reviewed results of the previous seasons. In addition to the regular workshops, 10 other special and discipline workshops and seminars were held. The object of these meetings was to more closely identify problems and to develop research to provide solutions. Through these workshops, meetings and personal visits, the concept of a coordinated project was well established which enabled the creation of a team approach to the research objectives of the program.

The progress made in conducting coordinated trials is shown below:

Year	Varietal	Agronomy and Physiology	Pathology	Entomology	Total
1966	41	43	16	20	120
1967	95	93	3	23	214
1968	165	103	32	53	353
1969	310	198	41	114	663
1970	384	192	60	73	709
1971	204	207	45	71	527
1972	249	348	106	219	912
1973	548	311	119	192	1170

In addition to research results from coordinated trials, the research work at the coordinating centers and other locations also supplied material to feed new research into adaptive research programs and to stimulate still more research of this type in other centers.

(b) Research

Significant research achievement is the wide range of varieties which are now available to the Indian farmers. They are:

Jaya and IR 8	High yield potential and stability, coarse grain and medium duration
Vijaya	High yield, medium slender grain, and medium late duration
Ratna	Good yield, long slender grain, and medium early duration
IR 20	Medium slender grain, medium duration, and resistant to pests and diseases
Cauvery) Bala) Kanchi)	Fair yield, early maturity, coarse grain, moderately resistant to Helminthosporium
Krishna)	Fair yield, medium early maturity, medium slender grain
Sabarmati) Jamuna)	Fair yield, medium slender grain, with good cooking quality and medium duration
Pankaj	Good yield, coarse grain, late maturity

Jagannath	Good yield, medium slender grain, and later maturity
Padma	Coarse grain, medium early duration
Sona) Jayanthi)	Good yield, long slender grain and medium duration.

Apart from these, individual state rice research agencies, released about two dozen varieties between 1966-73 based on the results of coordinated trials in their states.

Research contributions to the project were to a large measure the result of the team efforts. Pathologists and entomologists worked with breeders in the identification of sources of resistance to the major diseases and insects. For instance, a number of dwarf gall midge resistant varieties were developed and were tested in 1972 and 1973 prior to their release. In the like manner, sources of tungro resistance were identified by the project staff and new strains were developed to combat the problem. Similar studies were also conducted for other major diseases and insects. They have contributed to an understanding of the inheritance factors for resistance to these pests and diseases.

Agronomic research included many factors of nitrogen and water management, their times of application in relation to paint growth, plant-pathagen relationships, correction of zinc and phospate deficiencies in soils, and other limiting factors affecting farmers' yields such as transplanting, direct seeding in mud, direct seeding in dry soil, weed control, etc. Physiological studies were primarily field oriented for better understanding of the culture of new dwarf varieties under tropical conditions. Special studies were pursued on iron chlorosis problems in upland nurseries and rice in high pH soils and zinc deficiencies associated with nitrogen and phosphorous fertilization. Agronomic and physiological studies formed the basis for developing practical packages of practices for crop culture which were widely distributed.

(c) Extension

With rapid success of the coordinated program in identifying new germ plasm, new management techniques through better fertilization and fertilizer management and new plant protection measures, the major constraint soon shifted from varieties and technology to the application of technology and availability of inputs. The development of a research base came at a more rapid rate than had been anticipated. New photo period insensitive varieties like IR8 and later Jaya, had a wide range of

adaptation and were suitable for many rice growing areas except highlands in the north and a few areas in the south. Management practices which could increase production near the potential of these varieties were soon identified. However, the information developed by the coordinated program did not spread rapidly. Management of the new varieties required more knowledge than was known to farmers and the extension personnel.

In 1969, AICRIP began a district level testing program to enable extension personnel to develop a first hand knowledge of the new varieties and better management when grown under local conditions. Trials at district level were organized to include commonly grown varieties and 4-6 new dwarf varieties. These varieties were grown at the state seed farms and on farmers fields. It was soon discovered that the district level trial program was not adequate to reach millions of farmers in a short time. The data from these trials were nevertheless highly valuable.

With the wealth of information thus gathered, the need to get as many farmers as possible to appraise varieties for acceptance and make each of these farmers a focus of spread for the variety of their choice, assumed great importance. This gave rise to the "minikit" program, which provided large contacts with limited supplies of seed. At the end of 1971, two new fine-grained varieties, IET 1991 and IET 1039 (released in June 1973 as Sona and Jayanti respectively) were distributed to about 4000 farmers in Andhra Pradesh, Mysore, Tamil Nadu and West Bengal. Each farmer was given 2 kilos of seed of each of these varieties. The acceptance favored Sona and in Andhra Pradesh alone seed stocks were mobilized to plant 33,000 acres in Kharif 1972. In all, over 40,000 minikits were planted in different states in Kharif 1972. A spread like this could hardly be expected with traditional methods of extension. Results of these minikit trials indicated wide adaptability of Sona and the comparable yield performance of fine grain dwarf varieties compared to the existing dwarf varieties. Special minikits were also prepared and distributed for gall midge tolerant varieties and of selections resistant to tungro virus. Evidence pointed out that two of these selections were highly desirable, especially for Aus Season (May-June to Sep.-Oct.) of West Bengal where good yield, earliness and dormancy, in addition to leaf hopper and virus resistance, should make this an excellent variety.

(d) Training

Several types of training were given during the course of the project. These included research and production training at the IRRI, study tours to the IRRI, Thailand or Taiwan, research training at the AICRIP and short training courses for research and extension workers at the AICRIP and other centers in India. The total number of participants trained outside India is given below:

	AID-Financed	Financed by Other Agencies	Total Trained
Production Training	3	20	23
Study Tours	7	8	15
Research Training	17	2	19
	27	30	57

In addition, on-the-job training was given at the AICRIP headquarters in Hyderabad to young Indian scientists who had just completed their M.Sc. degree. The objective was to absorb them in permanent research jobs after their training. During the period 1966-72, about 100 persons have received such training. AID contract technicians have played a significant role in conducting such training.

Another aspect of training included academic training. Students in M.Sc. programs at the Andhra Pradesh Agricultural University were assigned problems and the AICRIP staff served as guides in these programs. A total of 29 students obtained their degrees in this program.

The surveillance program jointly sponsored by the AICRIP, Ford Foundation, the Ministry of Agriculture, Plant Protection Directorate and the State Plant Protection agencies in five states provided an opportunity for the AICRIP staff to participate in training for specific diagnostic skills necessary to enable field technicians to be capable of discharging such duties.

(e) Institution Building

The AICRIP began without an established or permanent institution at the headquarter site. The regional research station of the IARI and Andhra Pradesh Agricultural University provided housing and the Department of Agriculture of Andhra Pradesh provided land. Given these resources and considering the needs prevailing, the immediate aim was that of a research program. As a consequence the rice project first built a program in order to achieve the objective of a breakthrough in rice production quickly.

The continuing success of the program depended upon the establishment of the institution with necessary staff and buildings such as offices, laboratories, green houses and service facilities on a permanent basis. The staff and activity soon outgrew the physical facilities provided by the regional research center of the IARI and additional space was provided by the Andhra Pradesh Agricultural University to enable the headquarters to function as a coordinating center. Steps to institutionalize the research center were undertaken by the ICAR in August 1971 and in 1972 a building program for housing the AICRIP staff was undertaken. Actions have also been taken to create facilities for training in research and extension by developing a communication center.

An important factor in institution building is the experiment station development in order to improve research capability. The land was shaped and it was divided into uniform blocks with irrigation and drainage facilities. Besides the overall development of the land by the Andhra Pradesh Agricultural University, the USAID through a contract with the Kansas State University, provided financial support (Rs. 1,100,000) for the development of a drainage system, a pipeline for irrigation and the Rockefeller Foundation undertook the land reshaping phase.

(f) Linkages

The project has received international attention. The West African Rice Development Agency has utilized the AICRIP experience in developing their program. Visits of scientists from several countries have provided opportunity for a coordinated approach which was advocated as an organizational technique. Through seed exchanges, selections of Indian breeding material have been provided to the IRRI, Indonesia, Malaysia, Nepal, Sri Lanka and Thailand. The international exchange of material on a systematic basis has been developed with the IRRI acting as the coordinating agency.

Nationally, networks have been developed to include the coordinated programs involving the center and state institutions and other agencies in common programs. For instance, the surveillance program started in 1970 in five states has continued for four years and has established a pattern which can prove very useful in an early warning system not only for tungro virus but for other rice production problems as well. The minikit program has developed a strong connection with the rice development agencies.

In sum, the dynamism and genius of the rice coordinator and joint coordinator were the driving force in the popularization of a nationwide program to a position of eminence in the brief period of six years. This leadership was responsible for the development of a spirit of coordination among the research staffs of the AICRIP and various states. This spirit enabled the development and exchange of breeding material, the nation-wide testing of newly developed selections, carrying out of agronomic trials concerning management, entomological research, screening of insects, and pathological research.

During this short period when support was provided by the AID, the AICRIP has made significant contributions to the increased rice production by developing and introducing IR8 and similar other high yielding varieties which are now grown over 20-25 percent of the area planted under the crop, has established a pattern of coordinated research activity which is a pattern for coordinated programs and has created a firm base for increased extension activity which can trigger a green revolution in rice.

VII. DIFFICULTIES AND PROBLEMS

The AID/GOI and the IRRI/AID contracts provided critical inputs of foreign technicians, consultancies, implementation, vehicles and other logistic support to AICRIP. All the equipment has been assigned to the project for providing continuous support with these valuable inputs. This support has permitted the rapid development of a research core at the coordinating center which by virtue of these attributes has attained a national stature. The AICRIP has attained a position through research, research leadership and products of coordinated efforts to effectively contribute to improved rice production. The inputs during the last six years are just now bearing fruits. Many difficult problems are still unsolved. The time has come for even greater output and expenditure of funds and efforts than had been provided in the past.

The assistance provided by the IRRI/AID contract can be viewed as a stepping stone to the still larger role which the AICRIP can play. To assume this role, external assistance in critical aspects is still needed to maintain the momentum of the project activities. A new system of channeling assistance is being developed by which the IRRI support could continue. Through this arrangement, the nature of assistance would include:

(i) Provision of short-term consultants to assist in the solution of specific problems and assessment of progress in specific areas of the program activity;

(ii) Provision of locally administered funds for maintaining the current strength of the local scientists for the continuity of the program at its present level. Various agencies have approximately provided $70,000 per year for this purpose. Needs for these funds will diminish when the Fifth Plan proposals are accepted by GOI and funds become available for additional staff;

(iii) Provision of funds for critical spare parts for existing equipment, new items, foreign journals, books and literature. Approximately, $555,000 worth of equipment provided by AID, Rockefeller Foundation and GOI is available in the project. (See Appendix IV) Spare parts to keep the equipment in use are a dire necessity.

(iv) Funds for post-doctoral training, production training and scholarships for academic training abroad. This is for supplementing the training available within India.

(v) Additional funds for financing Indian staff to attend international conferences.

Since the USAID project has phased out and arrangements with IRRI have not yet been finalized to provide the necessary technical and financial assistance for the continuation of dynamic rice research program, the greatest of all problems appears to be the urgency to generate funding from the ICAR. Originally it was thought that it would be taken care of in the Fifth Plan period. But as the project terminated earlier than anticipated, support must come immediately from the ICAR to tide over the period till the funds requested in the Fifth Plan become available. The present break in foreign financial and technical support is having a demoralizing effect on the staff and activities and interest have diminished.

A number of bottlenecks were also experienced in the implementation of the project. They were mainly concerning the delays in the appointment of staff and provision of physical facilities, selection of participants for training, element of involvement in making appointments, break in training programs and relationship of the headquarters with the coordinating centers. While some of the states tended to curtail their level of expenditure on the state coordinating rice research centers as the ICAR money became available, others were inclined to develop parallel research activities, one as a state program and the other as a part of the all-India program. Some of these difficulties were overcome with the combined efforts of the Headquarters staff. But quite a number of them arise out of the tardy administrative system peculiar to the country. To deal with them is a time consuming process.

VIII. RECOMMENDATIONS

It is recommended that:

(1) The ICAR should provide AICRIP with adequate funds for maintaining the current strength of staff and for the continuation of the activities in progress.

(2) The ICAR should provide additional support for the headquarters at Hyderabad and some research stations to enable them to tackle more and better research.

(3) As a means of increasing research output, improving competence and strengthening of the programs at various centers, the continuation of the training program is essential.

(4) The finalization of a system of providing the IRRI support in terms of short-term consultants and funds for critical activities, requires action at a top priority level.

(5) The Rockefeller Foundation involvement may be continued, as the Joint Coordinator on a continuing basis for five years more, will prove very useful in attaining organizational stability, both in the fields of research and administration. His presence exercises a healthy influence on the staff and decisions.

(6) The physical facilities available at various centers should be evaluated and a well-planned program should be implemented.

(7) The research, training and extension programs should be critically reviewed to identify weaknesses and bottlenecks, if any, and take measures to correct them.

(8) The rainfed rice in India, because of its vast acreage, should be given more attention. Besides development of suitable varieties, research on seeding, weeding and water management problems peculiar to these areas add new dimension to rice research work. As a priority, the improvement of rice yield in areas with controlled irrigation has received the first consideration. It is now high time to accelerate breeding and other programs for the uplands and other major rice growing areas.

(9) A well-designed seed house with an ample storage space should be provided at the AICRIP headquarters, and another at the Central Rice Research Institute at Cuttack (Orissa) for the safe storage of valuable germ plasm for 3-5 years. Similar facilities on a smaller scale are required at other stations.

(10) For the provision of a facility for processing breeders seed lots of the new varieties, which are being developed in an ever-increasing number, seed-processing units should be installed at all important centers in addition to one at the headquarters.

(11) The channels of communication should be strengthened to maintain a strong linkage with the idea of providing popular type research information to the extension workers and farmers.

(12) The efforts to bring about a close working relationship of the Center with the other research stations should be intensively continued with active technical assistance for finding answers to local problems. This is especially needed in some of the disciplines, like pathology, agronomy, and entomology.

(13) The administrative staff should provide gas, oil, batteries, tires and spare parts to vehicles and farm equipment in a timely fashion in order to provide the logistical support required for an efficient research activity.

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Appendix I

List of Technicians and Period of Employment at AICRIP

Name	Man Months	Date of Arrival	Date of Departure	Employed by
Dr. Wayne H. Freeman Jr. Coordinator	90	Jan. 1, 1966	To date	Rockefeller Foundation
Dr. John A. Lowe Entomologist	33	Dec. 10, 1967	Sep. 5, 1970	IRRI/AID
Dr. Harold E. Kauffman Pathologist	45	Feb. 22, 1968	Nov. 14, 1971	"
Dr. H. ten Have Agronomist	52	Feb. 28, 1968	Jun. 14, 1972	"
Dr. H. Okajima Physiologist	12	Jun. 1, 1968	Jun. 6, 1969	"
Dr. H. Sakai Physiologist	44	Aug. 12, 1969	Apr. 17, 1973	"
Mr. Ernest W. Nunn Agricultural Engineer	28	Mar. 10, 1971	Jun. 30, 1973	"
Dr. Reed C. Bunker Entomologist	18	Aug. 7, 1971	Feb. 16, 1973	"
Dr. Ivan W. Buddenhagen Pathologist	13	Oct. 16, 1971	Nov. 15, 1972	IRRI/FF
Mr. Vernon L. Hall Agronomist	17	Oct. 1, 1970	Feb. 10, 1972	Ford Foundation

Appendix II

List of USAID Indian Scientistists & Period of Employment

Name	Period of Employment From	To	Man Months
Dr. A. P. K. Reddy	Dec. 18, 1967	Apr. 9, 1970	27
Dr. N. P. Saxena	Apr. 1, 1968	Jun. 30, 1973	63
Mr. M. B. V. Narasinga Rao	May 1, 1968	Jul. 6, 1970	38
Mr. E. Ramiah	Jun 15, 1968	Dec. 16, 1968	6
Dr. N. D. Manikar	Aug. 13, 1968	Aug. 3, 1969	12
Dr. H. L. S. Tandon	Dec. 10, 1968	Dec. 4, 1969	12
Dr. R. Sridhar	Aug. 18, 1969	Aug. 20, 1969	-
Mr. M. N. Prasad*	Sep. 1, 1969	Aug. 10, 1971	24
Dr. V. T. John*	Sep. 1, 1969	Jun. 30, 1973	52
Dr. P. Srinivas Rao	Nov. 11, 1969	Jun. 30, 1973	50
Mr. G. B. Rajale	Mar. 2, 1970	Apr. 6, 1970	1
Dr. A. Anjaneyulu	Apr. 1, 1970	Mar. 31, 1972	24
Dr. K. Krishnaiah	Apr. 13, 1970	Oct. 31, 1971	21
Dr. C. S. Saraf	Jun. 1, 1970	Jan. 31, 1971	8
Dr. K. S. Amin	Jun. 1, 1970	Jun. 30, 1973	37
Mr. S. N. Kapoor	Jul. 1, 1970	Jan. 31, 1972	19
Dr. N. Narasimha Rao	Aug. 1, 1970	Feb. 28, 1971	7
Dr. Y. K. Arora	Jul 26, 1971	Aug. 21, 1971	1
Mr. S. F. Quader	Aug. 1, 1971	Mar. 31, 1972	10
Dr. G. S. Upadhya	Aug. 11, 1971	May 1, 1972	11
Dr. A. P. K. Reddy**	Oct. 4, 1971	Jul. 31, 1972	11
Dr. T. S. Sabnabis	Dec. 3, 1971	Aug. 30, 1972	9
Dr. H. S. Rao	Jun. 1, 1972	Jun. 30, 1973	13
Mr. B. Chitti Babu*	Jun. 1, 1972	Jun. 30, 1973	13
Mr. K. Prasad*	Jun. 1, 1972	Oct. 28, 1972	5
Dr. Syed Khasimuddin	Jun. 14, 1972	Jun. 30, 1973	12

* Transferred from RF payrolls

1) Mr. M. N. Prasad was on RF payroll from Nov. 1, 1967 to Aug. 31, 1969
2) Dr. V. T. John " " " " Dec. 1, 1967 to Aug. 31, 1969
3) Mr. K. Prasad " " " " Dec. 1, 1969 to May 31, 1972
4) Mr. B. Chitti Babu " " " " Jul. 1, 1970 to May 31, 1971

** Dr. A. P. K. Reddy was re-employed at AICRIP after a period of training at the University of Hawaii, USA, on USAID payroll. He was taken on ICAR payroll beginning Aug. 1, 1972.

List of Consultants and Period of Service

Name	Man Months	Date of Arrival	Date of Departure	Support
Dr. Hideo Okajima Physiologist	1-1/2	Aug. 18, 1967	Sep. 29, 1967	Rockefeller Foundation
Disease-Insect Survey Team:				
i) Dr. M. D. Pathak Entomologist	1	Oct. 9, 1967	Nov. 5, 1967	IRRI/AID
ii) Dr. K. C. Ling Virologist	1	"	"	"
iii) Dr. S. Yoshimura Pathologist	1	"	"	"
iv) Dr. T. A. Lowe Entomologist	1	"	"	"
Dr. Masao Goto Pathologist	2	Aug. 11, 1968	Oct. 7, 1968	IRRI/AID
Dr. M. D. Pathak Entomologist	1/4	Nov. 2, 1968	Nov. 7, 1968	"
Dr. K. C. Ling Virologist	1/4	"	"	"
Mr. Hank M. Beachell Plant Breeder	1/4	Apr. 2, 1969	Apr. 12, 1969	"
Dr. T. Ishihara Entomologist	1	Sep. 17, 1969	Oct. 26, 1969	"
Dr. Ivan W. Buddenhagen Pathologist	1/2	Oct. 10, 1969	Oct. 26, 1969	"
Dr. W. D. Guthrie Entomologist	2	Oct. 24, 1969	Dec. 20, 1969	"
Dr. Karl Maramorosch Pathologist	1/4	Feb. 4, 1971	Feb. 13, 1971	"
Dr. Ivan W. Buddenhagen Pathologist	1/4	Jun. 11, 1971	Jun. 13, 1971	"
Dr. (Mrs.) K. A. Gomez Statistician	1/2	Oct. 25, 1971	Nov. 5, 1971	"

Appendix IV

Equipment Support to the Rice Project, Hyderabad

	Rs.	$
A.I.D.		
Office Equipment	48,000	
Technical Equipment	500,000	50,000*
Vehicles	530,000	--
Books, Periodicals	--	10,000
	1,078,000	60,000
The Rockefeller Foundation		
Office & Laboratory Equipment	25,000	50,000
Field Equipment	50,000	60,000
Vehicles	--	10,000
	75,000	120,000
The Ford Foundation		
Equipment	--	1,500
Construction(Green House)	1,500,000	-
ICAR		
Office Equipment	50,048	--
Laboratory & Field Equipment	35,586	--
Vehicles	98,330	--
	183,964	
TOTAL	2,836,964	181,500

* Includes equipment worth $40,000 transferred from the Regional Pulse Improvement Project