INDIA'S RICE REVOLUTION

A
BEGINNING

THE ROLE OF
THE
ALL-INDIA
COORDINATED
RICE IMPROVEMENT
PROJECT

"SO FAR AS RICE IS CONCERNED,
INDIA IS THE MOST EXCITING PLACE
IN THE WORLD TODAY"

ROBERT F. CHANDLER, JR.

Quoted from "A Partnership to Improve Food Production in India" by CARROLL P. STREETER.

PREFACE

Rice is the most important cereal of India, contributing nearly 40 per cent of the country's food production. Systematic research on rice improvement started in India in 1911 with the appointment of a Special Botanist in the then Province of Bengal. Almost immediately afterwards, a Special Botanist for rice was appointed in Madras. Since then, rice research has gradually been taken up by all rice growing states, and at present about 80 research centers distributed all over the country are conducting research on this crop. Till 1930, however, Bengal and Madras were the only states which had full time Botanists for rice. The other major rice growing states had one scientist to coordinate research on all the cereals. This position did not change till the establishment of the Indian Council of Agricultural Research. From its inception, the ICAR had been sponsoring and promoting rice breeding and improvement projects in the various states. The state research institutions have primarily been breeding centers and have been mostly engaged in tackling breeding and agronomical problems related to the maturity and market quality requirements of a particular state.

The Central Rice Research Institute was established at Cuttack in 1946 by the Government of India to undertake research on all aspects of rice culture, to investigate such problems which have wide application in the country and to serve as a center of authoritative information on all matters relating to this crop. The CRRI and the state rice research stations have made important contributions towards the improvement of the rice crop. In the international field also, the Central Rice Research Institute played a pioneering role in servicing the *indica-japonica* hybridization project sponsored by FAO in 1952.

New vistas for rice development were opened up with the evolution and popularization of non-lodging plant types. The first dwarf variety to be grown in India, Taichung (Native) 1, raised both hopes and fears. Hopes came from the indication that the barrier to high yields has at long last been broken in *indica* rice, while disease problems such as bacterial blight and tungro virus, generated fears with regard to risks involved in the cultivation of this strain. The urgency of intensifying research leading to the development of locally acceptable technology was recognized immediately and resulted in the initiation of the All-India Coordinated Rice Improvement Project (AICRIP) in 1965.

The task of AICRIP was to speedily develop a unified national grid of cooperative experiments on all aspects of rice production. All the existing rice

research institutions and personnel were brought together to launch a frontal attack on poor rice yields. AICRIP has been discharging these responsibilities with distinction.

The importance of rice research demanded a closer linkage with the International Rice Research Institute on the one hand and with the national institutes and agricultural universities, on the other. The agreement with IRRI and USAID provided this opportunity and has helped to increase the pace of rice research. The accomplishments of this cooperative effort thus bring credit to our scientists and the collaborating scientists from other countries.

AICRIP is now functioning as a joint venture of 125 rice research stations all over the country. This national network provided the research base necessary for rapid field testing of material and the identification of varieties for different ecological and input-supply conditions.

This report, prepared on the termination of the ICAR-IRRI-USAID contract, provides useful information on the progress made through national and international cooperation. I am sure this will be found informative by all interested in rice research and production.

M. S. SWAMINATHAN
Director General
Indian Council of Agricultural Research

FOREWORD

It is a distinct pleasure to write a brief foreword to this report on the history and achievements of AICRIP during its first eight years. As the title of the report indicates, it is the basis of India's rice revolution.

Being at The International Rice Research Institute (IRRI), I had an opportunity to visit India frequently, and I attended many of the AICRIP workshops, particularly during the first five years of the project.

To me, the most significant change that took place during those years was the growth of the spirit of cooperation among the research workers from the states and from various other rice research organizations in India. At the beginning every unit, having been accustomed to operating independently, continued to view this coordinated scheme with considerable misgiving. However, each year you could see this feeling subside, and true interest in a national program developed.

Much credit is due the leaders of this effort, Dr. S. V. S. Shastry and Dr. Wayne H. Freeman, for their patient persistence in making this project work. In the early days the project was beset by a lack of physical facilities and generally inadequate financial support. Weaker men would have become disheartened.

I have read the manuscript of this report and I find it to tell a most exciting story of how a group of scientists, with freedom to work creatively, changed the face of the rice-growing parts of India. The task is not yet finished by any means, but the way now seems clear. If India can but control its population growth rate, its future looks far brighter today than it did a decade ago.

ROBERT F. CHANDLER, JR.

Informed national leadership promote rice revolution.

CONTENTS

		Page
Preface		i
Foreword		iii
Acknowledgements		v
Introduction		vii
Summary		viii

PART I — PROGRAM AND ACHIEVEMENTS

Background		1
The Situation		8
Accomplishments:	in coordination	10
	in research	12
	in extension	20
	in training	25
Institution Building		30
Linkages		34

PART II — ORGANIZATION AND SUPPORT

Organization		39
Status of Support:	IRRI-AID Contract	44
	ICAR-IRRI Memorandum of Agreement	44
	National Support	45

APPENDICES

I.	Rice Research Workshops, 1965-72	49
II.	Special and Discipline Workshops and Seminars	50
III.	AICRIP Coordinated Trials, 1966-73	51
IV.	Varieties released by the Central Variety Release Committee	52
V.	Varieties released by the State Agencies	54
VI.	AICRIP Publications, 1966-73	56
VII.	IRRI Rice Production Trainees from India, 1967-72	59
VIII.	IRRI Rice Research Trainees from India, 1968-71	61
IX.	APAU M.Sc. students under AICRIP staff guidance	63
X.	Existing and Proposed Staff for AICRIP headquarters	66
XI.	APAU Land Shaping and Irrigation	68
XII.	Foreign Technicians at AICRIP headquarters, 1966-73	69
XIII.	USAID Indian Technicians at AICRIP headquarters, 1967-73	70
XIV.	Consultants to the Rice Project	71
XV.	ICAR Professional Staff at AICRIP headquarters, 1966-73	72

ACKNOWLEDGEMENTS

Throughout the short life of the rice project what measure of success it has achieved has been the result of team effort: the wholehearted cooperation of staffs at more than 125 rice research stations throughout the country: the laborers in the field: the technical support of the professional staff: the administrative staff who have in addition to their regular duties, devoted long hours to bring out progress reports on time: and the financial strengthening provided by all the various agencies mentioned in this report whose support has been used in a complementarity of effort to achieve common objectives.

Special mention should be accorded to Dr. Robert F. Chandler, Jr., who provided inspiration and guidance and who made strong proposals of linkages of the project with development effort. Dr. A. C. McClung as the International Rice Research Institute (IRRI) administrator of the contract gave special time and consideration to the project. Likewise, Dr. D.S. Athwal who succeeded him has provided able guidance to the project. To the other IRRI staff who have provided time, inspiration, materials and guidance, we owe a large measure of our gratitude.

In Dr. B. P. Pal, Director General, Indian Council of Agricultural Research (ICAR), 1966-1971, we found a strong supporter and an ardent advocate of the rice project. Likewise, Dr. M. S. Swaminathan, the present Director General, ICAR, has strongly supported the project and broadened the vision of what the project could be and could do for rice and society.

Dr. A.B. Joshi and Dr. T. R. Mehta as Deputy Directors General (Crop Science), ICAR, have spent many hours in workshops listening patiently and providing guidance to resolve differences that were certain to develop in an "action" program.

Wise counsel and guidance have been provided to the project by Dr. K. Ramiah, Member of Parliament, as Chairman of the Scientific Advisory Committee, formerly Director of Central Rice Research Institute and formerly with FAO Bangkok; Dr. N. Parthasarathy, formerly Director of CRRI, and formerly Rice Expert with FAO, Bangkok; and Dr. S. Y. Padmanabhan, present Director of CRRI.

The Andhra Pradesh Agricultural University (APAU) has rendered vital assistance to the project. Although land was provided by the government of Andhra Pradesh, the housing of the staff was done in the major part by the sharing

of space by the APAU. Vice Chancellors O. Pulla Reddy, ICS, and M. R. Pai, IAS, and the Directors of Research, Dr. Ch. Krishnamurthy, Dr. T. V. Reddy, and Dr. A. Appa Rao, have made it possible to accommodate the rice project in its various buildings. Likewise, the Regional Research Center of IARI under the leadership of Dr. L. G. Kulkarni and Dr. N. G. P. Rao provided space for all the staff in the early stages of the project and later for portions of staff not accommodated elsewhere.

Dr. Clarence C. Gray III has been associated with the project from near its inception, first as Division Head of Agricultural Inputs of USAID New Delhi and later as Associate Director and Deputy Director, Agricultural Sciences, of the Rockefeller Foundation. His early support enabled technicians to serve as working members of a team of scientists and not as advisors. His concepts were very ably supported and carried out by his successor in AID, Mr. John S. Balis, up to the end of the IRRI AID contract. Their support and perception made the project one of the more unique of the AID contracts.

Dr. R. W. Cummings as Field Director of the Rockefeller Foundation, New Delhi, provided the blue prints of the original coordinated cereal improvement projects upon which the rice project was patterned. His support and the support of his successors, Dr. G. B. Baird and Dr. Ordway Starnes have provided to the project a measure of flexibility which, combined with other support, enabled the project to have necessary staff to make the multi-discipline team available from the early stages of the program.

Dr. Douglas Ensminger, Representative of the Ford Foundation, his successor, Mr. Harry E. Wilhelm, and Dr. A. A. Johnson, Program Advisor, Ford Foundation, have shown special interest in the project which enabled a broadening of AICRIP activity to include on-farm testing as district trials and minikits. Their support to the program of host plant resistance breeding in the form of glass house facilities will greatly accelerate this phase of the program.

Without all this support and good will, the project would have remained just another project. With this support, inspiration and guidance, the project has done much that a coordinated project is supposed to do — coordinate and serve. Much remains to be done which will demand the continued support and team work of all.

WAYNE H. FREEMAN
Chief of Party
IRRI/USAID NESA-303

INTRODUCTION

The period covered by this report, 1965-73, has been one of the most dramatic in the history of Indian agriculture. Beginning with two years of drought and serious food shortages, Indian agriculture has made momentous strides toward self-sufficiency in food production.

The term "Green Revolution" has been applied to this transition period—from one of despair to one of optimism based on conviction that great potentials are now available to the Indian farmer that did not exist a decade ago.

The All-India Coordinated Rice Improvement Project (AICRIP) has played a vital role in this transition period. The potentials of improving rice yields were thoroughly explored. New varieties and other technology demonstrated to the researchers themselves the potentials which could be made available to the farmer. The realization that the new technology was something which had to be "sold" came as a slow awakening to the other responsibilities that would have to be assumed to enable others in addition to researchers to embrace the new varieties and cultural practices.

The project has not only been a moving force, coordinating rice research, but has assumed additional responsibilities just as vital—linking products of research with farmers' resources through an active participation in extension activities through minikit plantings on farmers' fields which have united farmers, extension men and researchers in a truly green revolution in rice.

This brief report developed at the termination of the IRRI/USAID Contract Nesa-303 is not intended to be a comprehensive account of the activities of AICRIP but a chronicle of the project itself and a guide to other programs which have the same objectives to be achieved with limited resources and time.

SUMMARY

The All-India Coordinated Rice Improvement Project is one of a number of coordinated crop improvement projects initiated by ICAR in an effort to accelerate research and the application of research findings to increase production to meet the demands of the ever increasing population. The focus of research of several disciplines on the crop problems related to increasing production – breeding, agronomy, pathology and entomology – has enabled simultaneous improvement of a number of aspects affecting production.

Research concentrated on the introduction and breeding of new rice varieties having the new plant type which has provided the basis for substantial increases in potential production with varieties which were non-lodging, fertilizer-responsive, with good tillering potential, and erect dark green leaves. Involving all the major centers of the country in varietal evaluation enabled the rapid accumulation of station-years of data which proved invaluable in determining varieties to be released to farmers; for management practices to be used with the new varieties; and evaluation of selections and varieties for their reaction to insects and diseases.

During the eight years of its existence, the project has released 16 varieties through the Central Variety Release Committee and a greater number of varieties have been released by different states where these varieties appeared to have better local adaptation than the more widely adapted varieties released by the central government.

Of the varieties released by the state and center, nine have been introduced while all the others have been the product of breeding programs within the country.

Utilization of these varieties by farmers has moved at a moderate but steadily increasing rate from 1966 to the present time when between 20-25% of the entire rice area is planted to new varieties. The area in India is approximately one-half of the area now planted to the new varieties in all of the rice growing countries of southern and south-eastern Asia.

Substantial inputs in support of the coordinating center have been provided by assistance agencies with Rockefeller Foundation providing the more substantial manpower input and IRRI/AID providing over 50 per cent of the financial support.

The strong leadership in rice reasearch developed as a result of the concentrated efforts of all agencies has created an effective coordinated program in adaptive research. This has led to closely allied activities involving extension and training in order to more rapidly get farmer adoption of new varieties and practices.

The "minikit" as an extension tool proved highly effective in distributing new varieties to farmers and in introducing new practices. Productive research was creating new varieties at a rapid rate and the existing patterns of seed multiplication and extension promotion were not effective in keeping pace with the development of improved varieties. Evaluation was a process of research which no longer needed repeating by extension personnel. The problem then, after evaluation, was one of acceptance and change. The minikit program of distributing small lots of seed of new varieties to farmers was an extension tool enabling farmers to make a final choice among varieties.

Evolution of AICRIP has been in three directions: a diversification of function from coordination, to coordination with a research base, to participation in surveillance and then to participation in extension activities. At the same time, the program has diversified from "production" breeding to breeding for high-yielding high-quality rice, to the incorporation of built-in resistance to diseases and insects. The third direction was in the development of a highly motivated team of Indian scientists dedicated to research in rice. This development, significant in the level of research accomplishment per individual, is a demonstration of the competence of Indian scientists and their productivity when they are provided freedom, encouragement and facilities. Products of this research are now providing varieties with much greater marketability and other varieties with greater stability of production in areas where tungro virus and gall midge are serious hazards to production. Continued research in this direction is resulting in the development of varieties with "multiple" resistance along with high yield potential and good quality. These will provide the farmers yield stability and greater marketability as well.

During this period under report, the foundations of a green revolution in rice have been built. These foundations are expected to enable a sustained increase in national production and, supported with continued research effort, can be expected to continue to raise the levels of production potential.

PART I

Program and Achievements

BACKGROUND

The magnitude of the task of revitalizing the rice research and extension program in a country growing one-third of the world's rice justifies a dynamic leadership, a dedicated research staff, an environment for creative research and the best facilities that can be provided. This base has now been developed.

For India to make substantial increases in production of the magnitude attainable through the use of new varieties, packages of practices and cropping systems, require the highest of priorities. It might be said that India's agricultural and food production program rests upon what can be accomplished with rice.

The importance of a continuing expansion in production is illustrated in *Figure* 1 showing the GOI estimates of rice needs by the year 2000. The yield of 2,400 kg per hectare of milled rice seems an attainable target with existing varieties and technology. These new techniques, supported by continuing research and extension effort, could bring this target to realization even earlier.

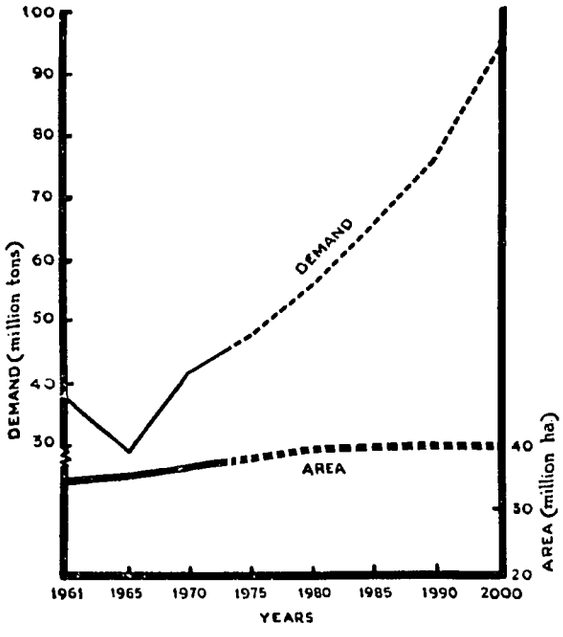


Fig. 1 Milled rice production and projection based on anticipated demand.
(Source: "Rice Development in India - problems and prospects", Report of Study Team on Rice constituted by the National Commission on Agriculture, Government of India)

The All-India Coordinated Rice Improvement Project has served many purposes during its short life history.

It has been a demonstration of the effectiveness of Indian scientists working in India when they are well motivated, facilities provided, and a necessary staff discipline developed. Assistance agencies have provided many of the funds for the headquarters program during this period which enabled the necessary manpower inputs to provide a multi-disciplinary effort that could not have been achieved otherwise during the Fourth Plan period.

AICRIP has wisely molded the assistance agency programs around one Indian program, achieving thereby a unity of purpose for the benefit of all concerned.

AICRIP was unique in being able to develop a research unit whose leadership like its personal Indian leadership, was based to a considerable extent, on merit.

AICRIP and its network of research scientists have creditable accomplishments in the development of new varieties whose use will increase rice production. It thereby demonstrated the importance and necessity of coordination supported by research.

It has developed, in conjunction with other agencies, an extension technique — the minikit, an adaptation of a program first named and used in the Philippines — which has created a sensation among administrators, extension personnel, researchers, and farmers because of its high degree of effectiveness.

The coordinated program has welded conservative research centers into a dynamic group with unity of purpose in tackling new objectives to create better varieties, agronomic practices, plant protection and problem detection.

The rice project has been unique among the coordinated programs because it has developed in a new environment where what was accomplished, or not accomplished, was open to all to see. It was not overshadowed by being a part of some already existing institution.

To preserve this successful operational pattern, it will be important that the Indian Council of Agricultural Research (ICAR) become aware of the subtle contributions which have enabled the project to make the accomplishments it has. The decision ICAR has taken regarding staff to replace those supported by assistance agencies as these agencies phase down needs time for implementation. The new headquarters, and buildings yet to come, provide an important step in enabling AICRIP to assume the responsibility of coordination, continue an active research base for coordination, research and extension training, and communication.

The pattern of spread of new varieties is illustrated in *Figure* 2. The magnitude of use of the new varieties in India rather overshadows the spread in most other countries (*Figure* 3) even though the percentage of coverage may be better in countries such as Malaysia and the Philippines. Within India, certain states have experienced an even more rapid spread. One reason for the variation in rate of spread in India is illustrated in *Figure* 4 which shows the spread of new varieties in relation to the percentage of the rice area under irrigation. This relationship is strong but does not override other factors which accounted for relatively poor rate of spread in Madhya Pradesh (12% in 1972-73) compared with Uttar Pradesh (20.3%), or in Andhra Pradesh (30.3%) compared with Tamil Nadu (76.9%). Irrigation facilities have not changed so very rapidly; so the fact that spread has occurred in the more advanced states indicates it was not a lack of irrigation which retarded spread in earlier years but rather it was other factors which inhibited spread or at least did not promote the use of new varieties.

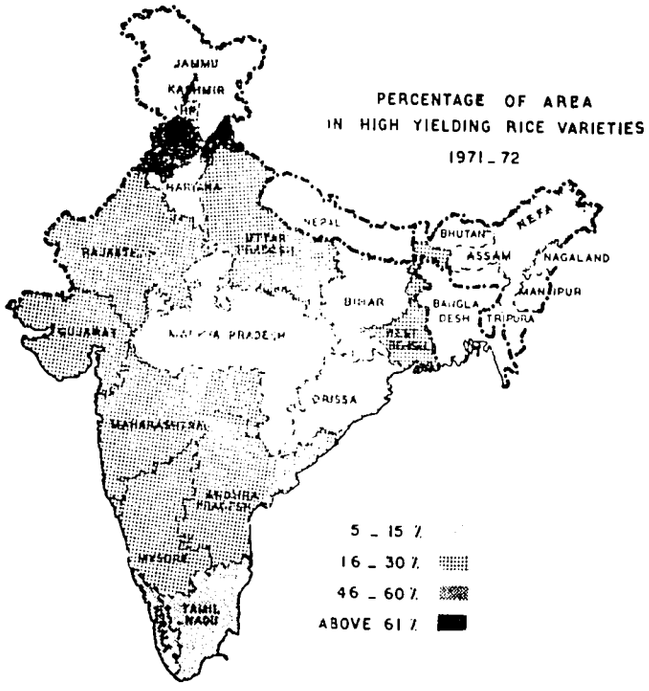


Fig. 2. Percentage of area in high yielding rice varieties by stages, 1971-72.

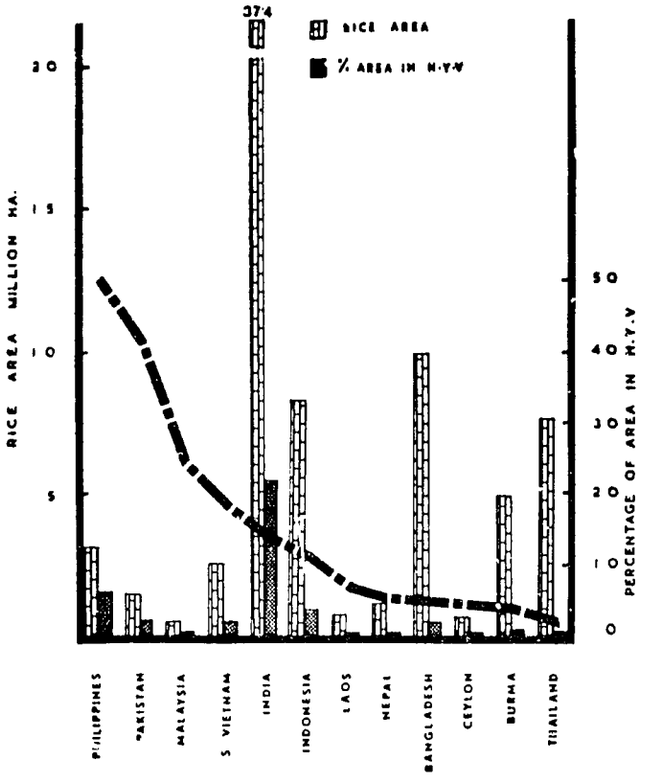


Fig. 3 India has approximately one-third of the world's rice acreage and approximately 50% of the world's area of new varieties. (*Source: Dalrymple,* 1972)

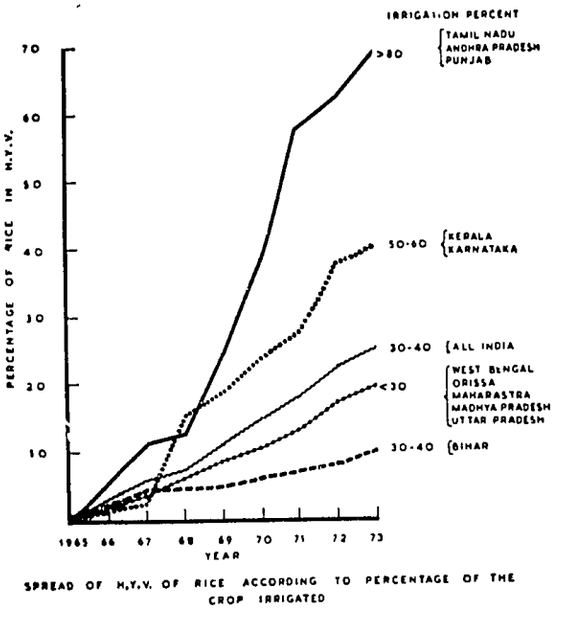
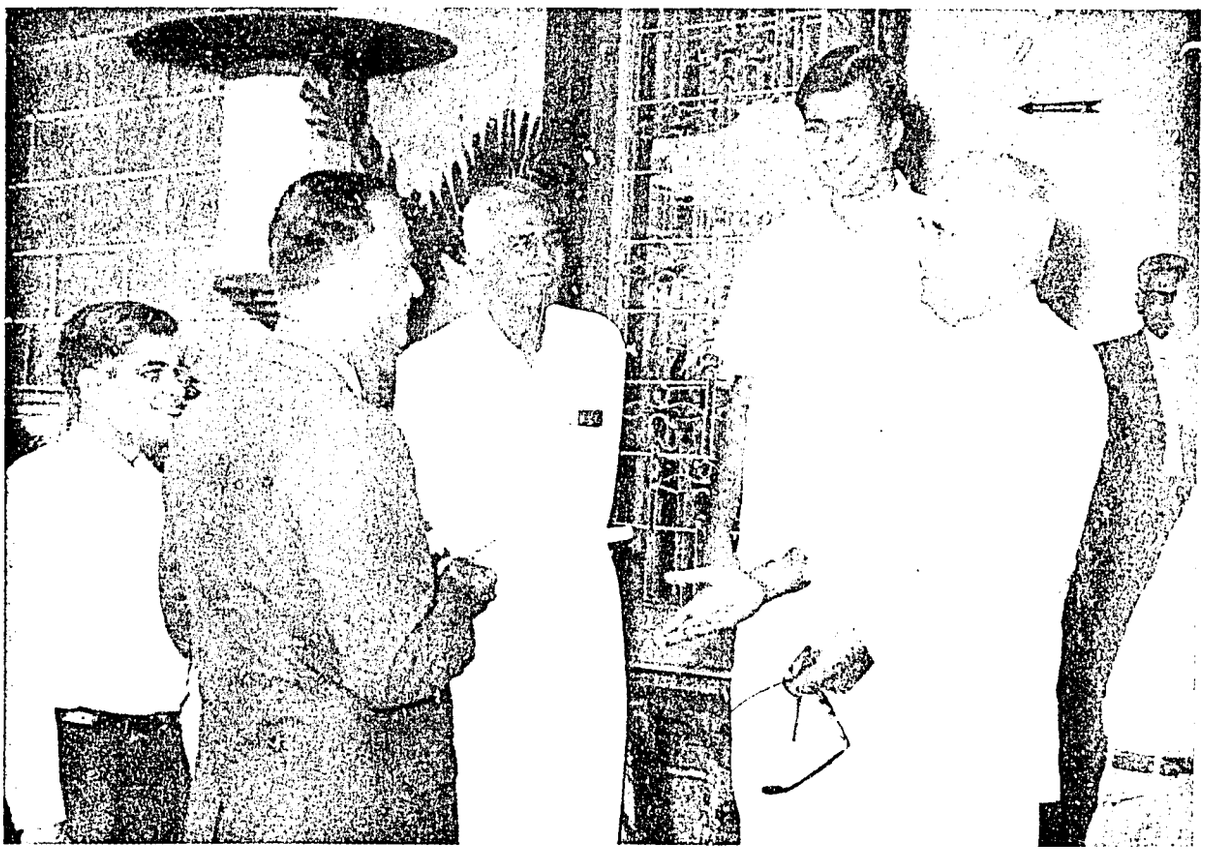


Fig. 4 Spread of high yielding varieties of rice according to percentage of the crop irrigated.

Guidance for AICRIP from nationally and internationally known rice scientists.



The difficulty in achieving targeted yields and production stems from natural as well as man-made obstacles:

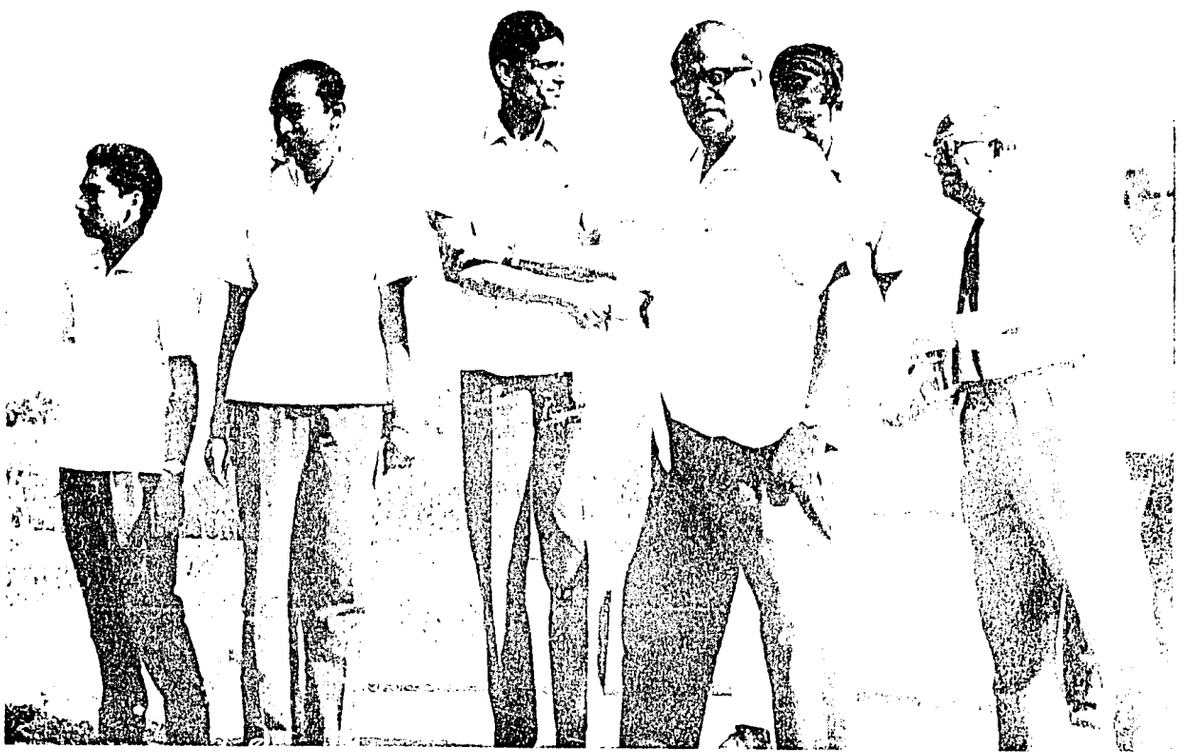
(1) The nitrogen response of the rice plant is lower in the monsoon than in the dry, sunny, *rabi* season. This imposes a limit on production which is still not fully understood. The possibilities of creating genotypes which can be more efficient under these conditions are just now being explored. Since 80-90% of the nation's rice crop is grown in the monsoon season, this phenomenon will continue as an obstacle until further advances begin to minimize these seasonal deficiencies.

(2) Dwarf varieties now being grown are primarily bold grained and lack good resistance to diseases and insects. New selections with good yield potential and much better grain quality are being released, thus removing poor marketability as a barrier to spread and production. These varieties, however, still need better levels of resistance to diseases and insects. Major disease and insect problems have been identified and programs are well on the way toward identifying new selections carrying these resistance factors. These selections, when in production, will have a higher level of stabilized yield performance.

(3) The massiveness of rice production in India — 25,000,000 rice farmers and 37 million hectares of rice — is in itself a reason for slow spread of new technologies and it demands different types of extension approaches than those used in more developed countries. The level of education, farm size, resources, and credit worthiness are all closely associated with the problem of number of farmers.

However, even the small farmers are showing trends in acceptance which are encouraging. Farmers in West Bengal where two crops can be grown on a part of the rice area, have made two significant changes. Rice in the dry season has increased from approximately 40,000 hectares in 1966 to 250,000 hectares in 1972 with a target of over 400,000 hectares in 1973. Along with this increase, which has been stimulated by the noticeable increase in availability of irrigation water, has been an increase of similar magnitude in area of wheat at the same time. Another change, perhaps more noteworthy, has been the increase in area in new varieties during the same season. In some of the districts of the state, as much as 90% of the rice acreage was in new varieties in 1972. In other words, many farmers are familiar with the merits of the new varieties and will use them where risks are less and the profitability of cash inputs is higher. Experience with the new varieties and related technology under these conditions will enable farmers to improve yields in the monsoon season by adopting the new technologies on more and more of the monsoon areas as they gain knowledge and experience.

The original goals of the project centered on the poor nitrogen response of varieties in the monsoon season and the shortcoming of the first dwarf varieties. The need to accelerate adoption of the new varieties and practices has involved the research staff. These men were the first to gain experience with the new varieties and were the strongest advocates for adoption of these varieties. Direct involvement in extension activities through seed distribution programs such as the minikit and indirect involvement through short courses and training programs for extension personnel has added a major dimension to the rice project. A natural evolution from research to product promotion has occurred so that extension has become a major additional discipline needed for the impact program to provide the necessary impetus to production.



Field discussions among rice scientists.

THE SITUATION

Rice is India's principal cereal crop, accounting in the early sixties for as much as 50 per cent of the cereal grain production and constituting about 40 per cent of the diet of the average citizen. It was grown on 30-40 million hectares by as many as 25 million farmers. One-third of the world's rice area is in India but production had been low, accounting for nearly one-fourth of world production. Long term trends in production are reproduced in *Figures* 5 *and* 6. Production increased about 3% per year from 1952-53 to 1964-65 with increased area accounting for perhaps 1.2% and increased yield only 1.1%. Production increases were not large enough to satisfy increased food demands caused by the continuous population increase of 2.2% annually.

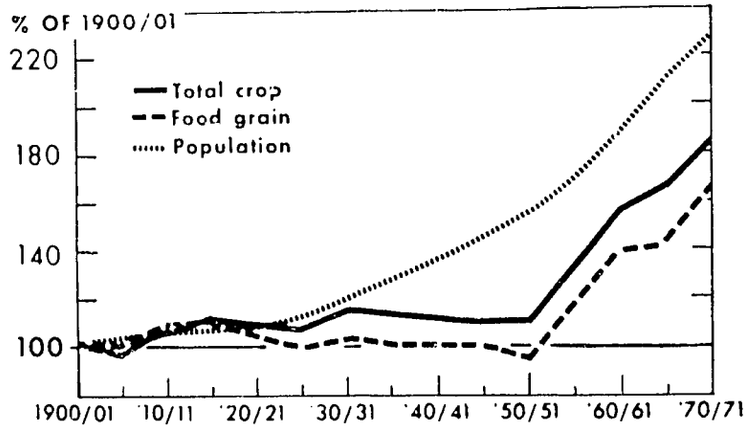


Fig. 5 Levels of production in 1900 were insufficient to supply needs of the expanding population well before mid-century.

(Source: Foreign Agricultural Economic Report No. 59, Economic Research Service, U.S. Department of Agriculture, May 1970)

The experience of the ICAR efforts aimed at stimulating production of maize, wheat, sorghum and millets through coordinated research led to a decision to pursue a similar approach with rice. Research had been primarily a state effort and in many states research on rice began long before research on other cereals—as early as 1911 in West Bengal and the erstwhile Madras State. By independence (1947), the early efforts, primarily in pure line selection, had provided the "improved" varieties being grown. These had been selected under conditions of low fertility with few cash inputs. Under such conditions, these varieties provided a stabilized performance, fluctuating only as rainfall, disease or insect pressure affected their limited potential. The yield potential of these varieties had definite limitations as farmers and researchers found in the 1960's when they attempted to improve yields with greater inputs of fertilizer, the "Japanese" method of cultivation, etc.

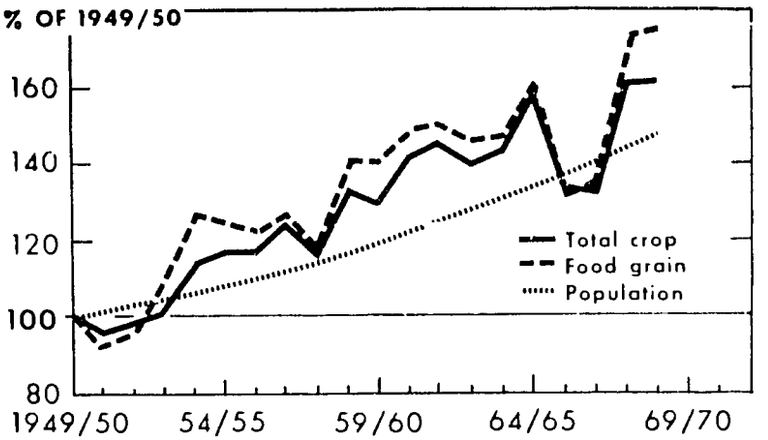


Fig. 6 Production at 1950 levels had increased primarily by an expansion in area and had not yet been affected by new technologies. (Source: Foreign Agricultural Economic Report No. 59, Economic Research Service, U.S. Department of Agriculture, May 1970)

Realizing the limitations of these varieties to increase production, Food and Agriculture Organization (FAO) in 1953 proposed a regional program of crossing to introduce the better yield performance of Japanese varieties into the rice varieties of the tropics. The newly formed Central Rice Research Institute (CRRI) at Cuttack, Orissa, became a center for this crossing activity. The objectives of the program were only defined in terms of increasing yields with no clear-cut plant prototypes which would enable this objective to be reached with certainty. In the early sixties, The International Rice Research Institute (IRRI), Manila, Philippines, basing its studies on earlier work in Japan and elsewhere, conclusively demonstrated the effectiveness of an improved plant type in increasing the yield potential of tropical rice.

As information on plant type became available, India recognized new horizons for increasing rice yields. The coordinated research activity was selected as the means of quickly creating new varieties and other technology to adapt the new plant types to Indian conditions. By 1965, it appeared that plant type was the major barrier to increasing rice yields and the identification of high yielding varieties from introduced materials and selections from Indian crossing programs became a major objective of the coordinated program. Along with breeding, the coordinated program involved other disciplines and the existing research centers of the state research programs to create a multi-discipline, multi-location approach to achieve the objectives of the program. Joint efforts by many scientists located at the rice stations throughout India conducting well-planned trials provided maximum results in a short period of time.

ACCOMPLISHMENTS

Accomplishments in 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 near unanimity of effort.

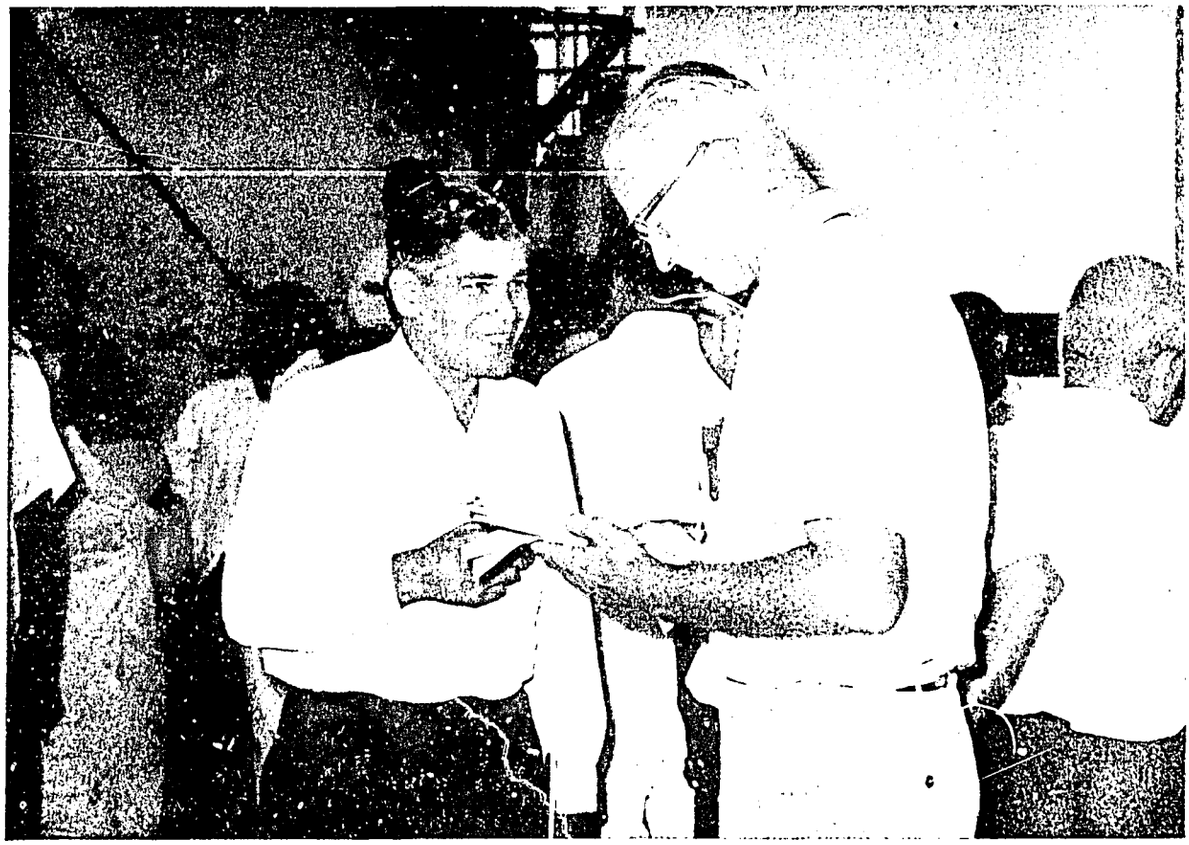
Coordination developed communications in planning, review and evaluation of results, replanning research trials, and in disseminating information.

To create conditions for effective coordination, workshops have been held, first semi-annually and then annually since 1971. At these workshops, research workers planned research for the ensuing season and reviewed results of the previous seasons which were presented in progress reports submitted to the workshop. A summary of workshops and significant accomplishments is presented in *Appendix I.*

In addition to the regular workshops, several smaller group meetings have been held and are summarized in *Appendix II.*

As the program developed, the importance of discipline workshops became more and more evident. The value of these workshops was explored in 1971 with a seminar on statistics at which Dr. Kwanchai A. Gomez of IRRI acted as consultant. In 1972, with the assistance of Dr. Ivan W. Buddenhagen, the pathology seminars were specialized into three core groups for fungal diseases, for bacterial diseases, and for viral diseases. The latter group met jointly with the group in entomology for a portion of the time. The objectives of these meetings have been to more closely identify problem areas and to develop research to provide solutions. The disciplines of pathology and entomology do not lend themselves to a blanket coordinated trial approach to adaptive research problems but instead, research must be more location-specific depending upon the level of disease or insect prevailing and its economic importance, available manpower, and availability of facilities and equipment. The success of these discipline meetings has indicated that similar meetings should be developed for other disciplines.

The staff has visited the various centers throughout the country since the beginning of the project. During 1966 and 1967, the coordinators travelled as a team which gave them an opportunity to discuss ideas, objectives and approaches to local problems, so that a mutual understanding was achieved in presenting the coordinated program to cooperators.



AICRIP Coordinators.

It was through visits with cooperators during the first 18 months that the concepts of a coordinated project were established which enabled the creation of a team approach to the research objectives of the program and upon which later research activity could be built and achievements quickly made.

Following this period, it was possible for the coordinators to increase their effectiveness by independent travel. AID technicians were to later add their support in making contacts with research stations throughout the country.

Progress reports were prepared semi-annually until 1971. These included summaries of data reported from the various centers conducting coordinated trials. The reports were not merely a tabulation of data compiled but an interpretation of the data as well. Kinds of data compiled by season are presented in *Figure* 7 and tabulated in *Appendix III* showing the scope of the program.

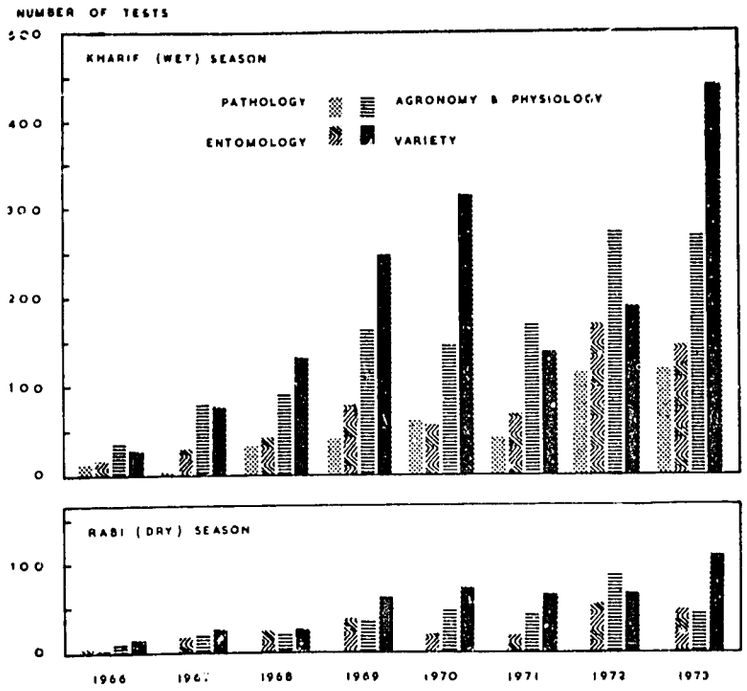


Fig. 7 Multi-location tests have increased each year enabling rapid accumulation of station-years of information upon which development decisions can be based.

In addition to the research results from coordinated trials, the research network at the coordinating center and other locations was summarized and presented in an effort to feed new research into the adaptive research program and to stimulate still more research of this type in other centers.

Accomplishments in Research

As conceived by the ICAR, the All-India program would involve active breeding research at the main stations which would provide strains for a systematic series of trials conducted at cooperating stations. These trials were to involve varieties, agronomic practices, insect control, and disease control. Other aspects of entomology and pathology were to require cooperative work at specific locations, depending upon the presence of personnel, presence of the insect or disease at epiphytotic levels, or facilities for studies on life history, epidemiology, etc. As soon as new progenies came from active breeding programs, they were subjected to a series of tests: the Initial Evaluation Trials (IET's) at a few locations; the Preliminary Variety Trials (PVT's) of 25 to 30 per cent of the better entries in the IET's at more locations; and the Uniform Variety Trials (UVT's) at many locations throughout the country wherever maturity of the

selections permitted. Concurrent to these variety trials were screening trials where these same entries were evaluated for resistance to the more common insects and diseases. These trials were made at as many as 15 locations for blast or at only one or two for stem borer. Ultimately, 30 to 40 screening trials were conducted each year.

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

In insect control experiments new insecticides, different formulations and times of application were studied. Similar studies were undertaken for the principal diseases where evidence indicated control might be achieved by fungicides, antibiotics or management.

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.

Significant research achievements have been the varieties which have been released (*Appendix IV*). In relation to testing, efforts expended in determining these releases are presented in *Figure* 8 showing the volume of entries tested in the various testing stages and the varieties emanating from this program. At the same time, varieties have been released by the respective states and are enumerated chronologically in *Appendix V*.

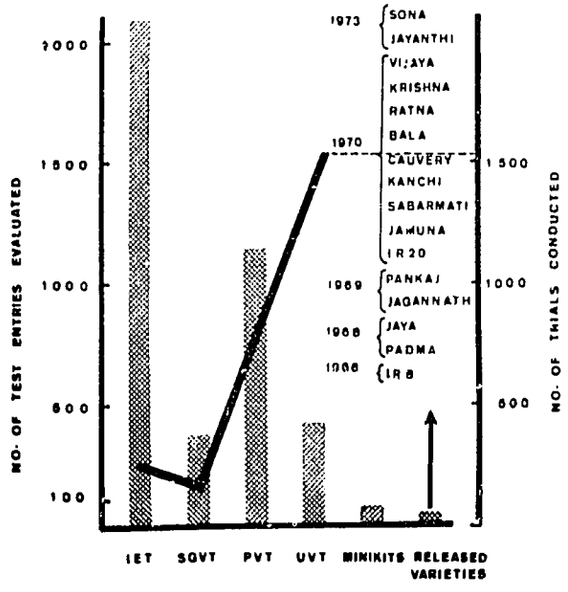
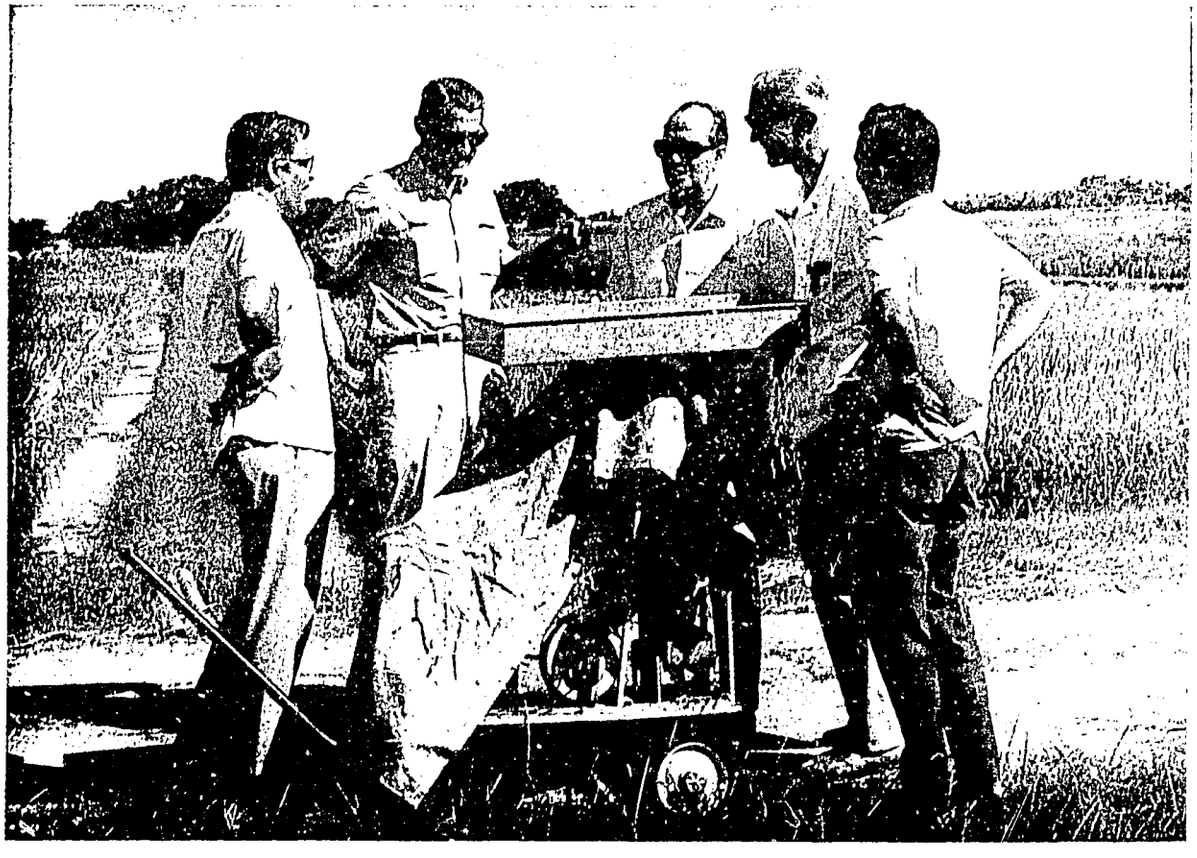


Fig. 8 *Over* 2000 *varieties tested in multi-location trials have led to the national release of* 16 *varieties.*

Appreciation of AICRIP by international agencies

enabled an early realization of research objectives.

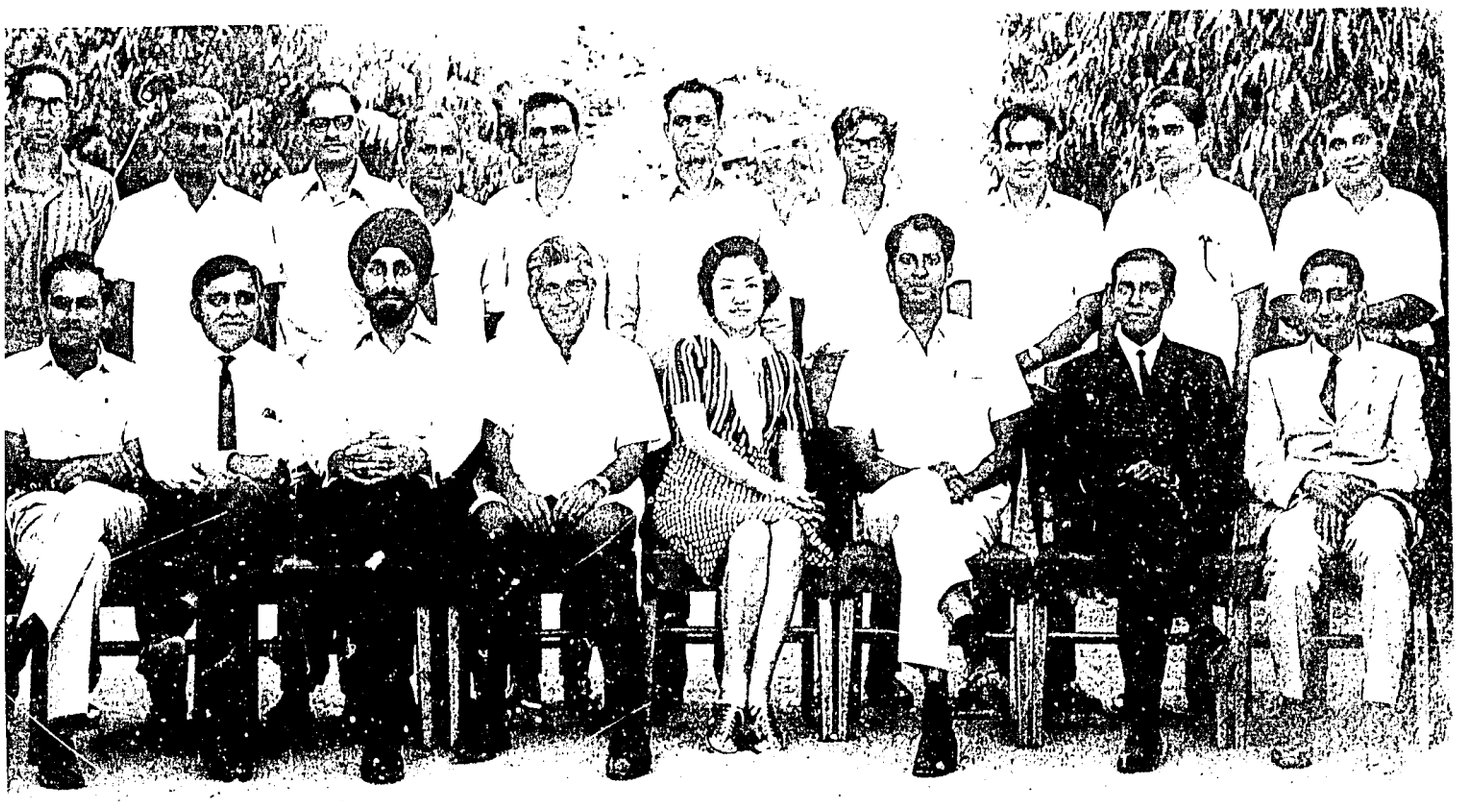


Research contributions to the project have been to a large measure the result of team effort. Pathologists and entomologists have worked with breeders in identification of sources of resistance to the major diseases and insects. Earliest to emerge from these team efforts was the utilization of sources of gall midge resistance which had been identified at CRRI and Warangal. In the early 1960's at Warangal the resistance of Eswarakorra had been incorporated into tall varieties which were of agronomic value as well as resistant to gall midge. Crosses made between these and other sources of resistance led to a number of dwarf gall midge resistant varieties which were in special gall midge minikits in 1972 and 1973 prior to identification for release. Because of the potential of these varieties to combat this insect and provide farmers dependable yields, these varieties are being utilized in pilot schemes in endemic areas.

A survey team supported by Rockefeller Foundation and IRRI/AID reported in 1967 generally satisfactory performance of the new dwarf rice varieties in most areas of the country. They observed tungro-like symptoms in rice in some areas. The project initiated programs to cross known sources of tungro resistance identified in IRRI with new dwarf varieties and to isolate other sources of resistance primarily from collections of Indian germ plasm available

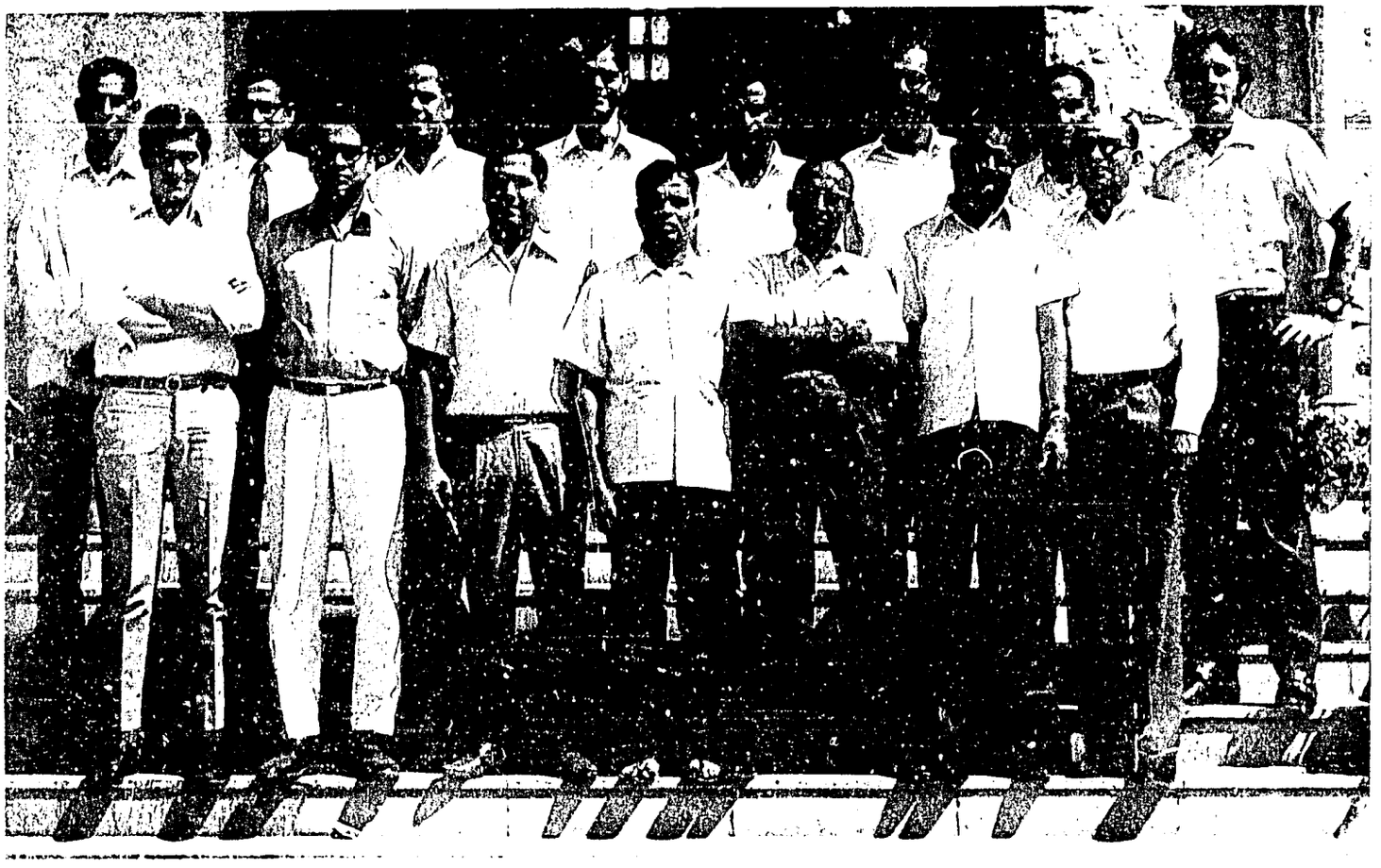
Coordinators as a team evaluate breeding material.

at the time. These efforts resulted in positive identification of six different sources and two of them, Latisail and Kataribhog, have been successfully used in transferring resistance to varieties of the dwarf type. An outbreak of tungro virus on epiphytotic proportions came in 1969 in the states of northeast India. The virus was positively identified by the project staff and crosses at that time were in the F_2 stage and from these have emanated selections which were used in minikits in farmers' fields in 1972 and plans are under way for more extensive testing and seed multiplication in order to be effectively prepared to combat the problem.



Small "working" workshops for various disciplines develop team spirit.

Similar activities have been under way to identify sources of resistance to bacterial leaf blight. Resistance from these sources, principally BJ 1, are being transferred to dwarf types carrying resistance factors to other diseases and insects such as those mentioned above.



Discipline seminars help develop coordinated research programs.

Stem borer resistance has been pursued and partial success has been achieved in the transfer of existing levels of resistance from TKM 6 and W 1263 to dwarf types.

New germ plasm collections from Assam and other areas became available for screening and additional sources of resistance for blast, bacterial leaf blight, rice tungro virus, sheath blight, stem rot, gall midge, stem borer, leaf and plant hoppers have been identified in this collection.

During the course of transferring various types of resistance, it has been possible to conduct studies on the inheritance of resistance to bacterial leaf blight, tungro virus, gall midge, and stem borer. These studies have contributed to an understanding of the inheritance of resistance to these diseases and insects.

Pathology studies have been pursued to determine host plant reactions and relationships to bacterial leaf blight, rice tungro virus, and blast. In the case of tungro, this has involved entomologists as well in order to determine relationships of the disease to the insect which transmits the disease from infected plants. Establishment of strainal variation of the virus in India and the variation of transmissibility of the different strains to different varieties have been major contributions to an understanding of the disease and its epidemiology.

Agronomic experiments have also played a role in understanding plant-pathogen relationships. In the case of tungro virus, the possibilities of recovery from infection are greatly enhanced if nitrogen fertilization is good. If infection is in the late tillering stages of the crop, the chances of recovery are good with the application of fertilizer. In the case of bacterial leaf blight, nitrogen management can increase susceptibility and damage in susceptible varieties. By smaller amounts as topdressing, damage may be held to a minimum while enabling the crop to produce a good yield.

Other agronomic research has included many factors of nitrogen management. Nitrogen is the principal cash input in enabling the new varieties to achieve high yields, but it is also exposed to rather severe losses due to mismanagement in application, water management, and times of application in relation to crop growth. Agronomic and physiological studies of these factors have been the base of a practical package of practices for crop culture which has been widely distributed.

Early on, the project became aware of severe deficiencies of phosphate in the soils of the AICRIP farm and in correcting these found related deficiencies of zinc. Both can be severely limiting of production in some soils unless adequate corrective fertilization is made.

As other management practices were improved, weed control became a more significant factor affecting farmers' yields. Extensive weed control trials have been conducted under three crop managements—transplanted, direct seeding on mud, and direct seeding in dry soil—to provide information on methods and chemicals for weed control.

Physiological studies have been primarily field-oriented research to better understand the culture of new dwarf varieties under tropical conditions. Studies have been extensive on growth analysis, the contribution of various yield components to yield performance under different levels of management, seasonal conditions, and levels of fertilization. In addition, special studies have been pursued on iron chlorosis problems in upland nurseries and upland rice in high pH soils and zinc deficiencies associated with nitrogen and phosphorus fertilization.

Research results which have accrued as a result of the coordinated adaptive research trials and of other research activities have been reported in progress reports, papers for scientific journals and popular articles on rice research and production (*Appendix VI*).

Accomplishments in Extension

The rapidity with which the coordinated program was able to identify new germ plasm, new management techniques through better fertilization and fertilizer management, and new plant protection measures was soon to shift the major constraint from varieties and technology to the application of the technology and the availability of credit for inputs such as fertilizers and plant protection materials and to the infrastructure for harvesting, processing and transport.

The development of a research base upon which to build an aggressive extension program came at a more rapid rate than had been anticipated. New photoperiod insensitive varieties like IR 8, and later Jaya, had a wide range of adaptation and could be expected to be suitable to many rice growing areas except the highlands in the north and a few areas to the south. Management practices which could increase production near the potential of these varieties were soon identified in course of the AICRIP adaptive research program. The new varieties were, by their growth habit, less susceptible to the stem borer than the taller lower tillering local varieties. The relatively minor insects such as leaf and plant-hoppers and leaf folders were to assume greater importance under these cultural conditions and the growth habit of the new varieties. Gall midge was an insect to which the new varieties, and old as well, were susceptible and which was a difficult insect to control by economical insecticide applications. Research experience indicated the futility of attempts at disease control by chemicals or antibiotics.

The extension activity faced several difficulties. One was that information developed by the coordinated program was not available in a form to be readily accepted. Knowledge about varieties did not spread rapidly. Management of the new varieties required more knowledge than was present with farmers and extension personnel. Failures were common and blame was placed on the variety rather than management. It is true that the earlier new varieties were bold grained and had lower marketability. However, it was often stated in the press and elsewhere that the new varieties *required* heavy doses of fertilizer and, therefore, were unsuited for the small farmer. Also, it was generally believed that all new varieties were susceptible to pests and diseases. Both of these statements are incorrect and show the need for an improvement in communication between the scientist, the government official, the press, and, of course, the general public.

In 1969, AICRIP began a district-level testing program to enable extension personnel to develop a first-hand knowledge of the new varieties and their merits when grown under local conditions. Trials at the district level were organized to include commonly grown varieties and four to six new dwarf varieties. These varieties were grown at the state seed farms and on farmers' fields. In

Tamil Nadu, Co 33 (Karuna) was recognized as a good early dwarf variety suited to the *kuruvai* season to replace ADT 27 which had been popularized in Thanjavur district a few years earlier. In Punjab, the district-level testing program was statewide and compared IR 8 and Jaya with the local varieties. These trials confirmed the superiority of both of these dwarf varieties over the local varieties and of the earlier maturity and higher yield of Jaya compared to IR 8. Other states have used the same technique but with limited success. While hundreds of trials were conducted, hundreds of thousands, even millions of farmers had to be reached. Obviously, the district-level trial program was not an adequate extension technique for reaching so many people in a short time.

The district-level trials were viewed by extension as a basis for recommending varieties whereas the AICRIP evaluation program had more thorough and reliable tests of varieties and the district-level trial could be only a prolongation of the decision-making process. While there may be instances and locations where the information accrued would be inadequate, the data from coordinated trials were nonetheless more complete and precise than evaluation could hope to be under less controlled test conditions such as district-level trials or other types of on-farm trials. Trials beyond the AICRIP research program could be viewed as tests for acceptance, not for evaluation of which one or the other was better. Evaluation had already been determined in comparisons of these few varieties with several hundred others during the course of the yield tests and screening programs. Further plantings were to become extension tools to popularize the new varieties and their management.

With the wealth of information available to the researcher, the need was 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.

Farmer acceptance could be more effective if larger numbers of farmers were contacted. The "minikit" proved to be the vehicle for this appraisal and spread of improved varieties.

This was an extension technique, not a research tool, first named and developed by the rice production and applied research unit at IRRI. The minikit as it was adapted in India included only seed. The technique proved highly successful and provided the necessary input for acceptance of the new varieties, changing farmers' attitudes and determination that the new varieties had potential which they could utilize.

This line of reasoning preceded proposals at the end of 1971 to take seed of two new fine grained varieties, IET 1991 and IET 1039 (released in June 1973 as Sona and Jayanti, respectively), of similar merits and performance and distribute the seed to as many farmers as seed supplies would permit. These proposals were accepted by ICAR and the Ministry of Agriculture in October 1971 and seed supplies were allocated to four states—Andhra Pradesh, Mysore, Tamil Nadu,

and West Bengal. Each one of 4,000 farmers received 2 kg of these varieties. The choice of varieties for "trials of acceptance" was most fortuitous. Farmers who were acquainted with the merits of high yielding varieties were especially impressed with the yield performance and the quality which would mean greater returns in the market place.

Acceptance favored Sona and, in Andhra Pradesh alone, seed stocks were mobilized to plant over 30,000 acres in *kharif* 1972, while spread in other states was primarily through more minikits. *Figure* 9 shows the varietal pattern of the minikit trials for the 1972 *kharif*, while *Figure* 10 shows the frequency of over 40,000 minikits planted in different states.

Results of some of the minikit trials (*Table* 1) conducted in two seasons indicate the wide adaptability of Sona and the comparable yield performance of fine grain dwarf varieties compared to the existing dwarf varieties.

Table 1 — Comparable data on grain yield of Sona and Jayanti and the farmer's variety from different states and districts, rabi and kharif 1972

State	*No. districts*	*No. farmers*	*Grain yield (kg/ha)*		
			Sona	Jayanti	*Farmer's variety**
		RABI 1972			
Andhra Pradesh	2	250	6363	6044	5559
Karnataka	5	14	7933	—	7820
Tamil Nadu	8	164	4242	—	3867
West Bengal	7	214	5369	—	5680
		KHARIF 1972			
Andhra Pradesh	2	200	6953	6649	5231
Haryana	1	317	4420	3713	4936
Karnataka	5	923	6236	5889	5565
Kerala	1	407	3613	3613	4092
Madhya Pradesh	1	376	3637	3251	3260
Maharashtra	1	393	3700	3471	3270
Orissa	2	88	4146	4105	4220
Punjab	10	57	5358	—	5456

* Most farmers' varieties were bold grained dwarf high-yielding varieties.

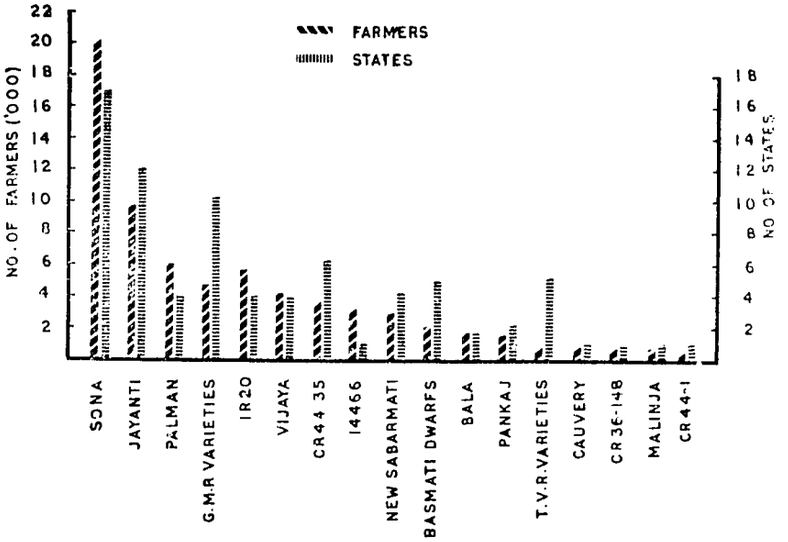


Fig. 9 Farmers and states participating in the minikit program, kharif 1972.

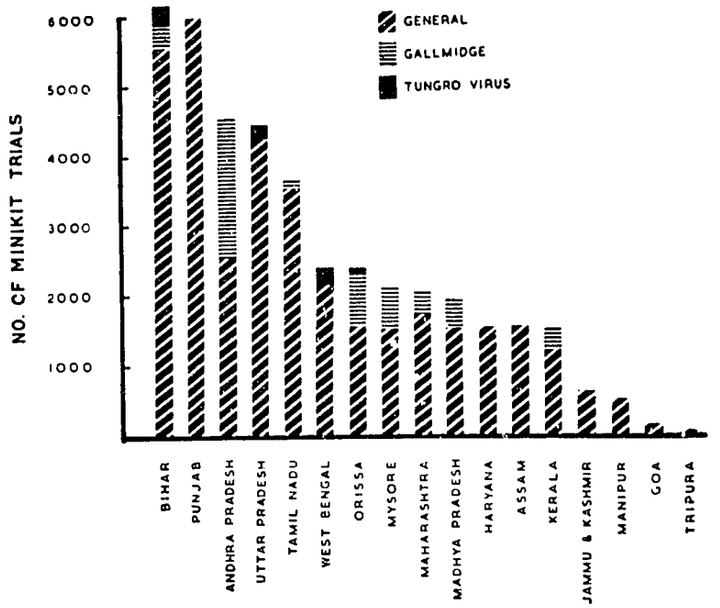


Fig. 10 Distribution of three types of minikits in different states, kharif 1972.

"Minikits"
the rapid-transit system to variety spread.

Indicative of the merits of the minikit plantings is that Sona was released by the state of Punjab in February 1973 prior to the time similar action was taken by the Central Variety Release Committee in June. Although release was based on data from coordinated and state trials conducted in Punjab, acceptance by the farmers provided added reason for the action taken by the state.

Special minikits have been prepared for gall midge resistant varieties. Although lacking agronomic information to the extent available for general purpose varieties, these varieties nevertheless had levels of resistance which justified their spread to farmer plantings while additional data were being obtained from uniform coordinated variety trials. Data indicated only 3 out of 29 were misclassified as resistant and were susceptible while any of the others were of similar levels of merit for resistance to the insect, but variations did occur from one state to another indicating the possibility of different biotypes of the insect. Varying levels of maturity gave farmers an extra opportunity to choose among the better selections. More uniform minikit programs of only a few gall midge resistant varieties are to be tried in 1973.

Similar procedures were used with a small number of selections resistant to tungro virus. These were concentrated in the north-eastern states where leafhopper and virus could combine to do serious damage to existing varieties. Data indicated that two of these were promising, one especially suited to the *aus* season of West Bengal where good yield, earliness and dormancy, in addition to virus resistance, should make this a suitable *aus* variety which could protect the subsequent *aman* crop by reducing inoculum levels which could build up on susceptible varieties if conditions for spread were favorable.

Perhaps of just as great significance to increased rice production has been the initiation of management minikits. These minikits serve to demonstrate the key factors of management whereby the farmers can exploit the potential of the new varieties primarily by management of their noncash inputs.

Accomplishments in Training

Several types of training have been given during the course of the project. Some examples: research training at IRRI, research training at AICRIP headquarters, production training at IRRI, study tours to IRRI and Thailand and short-term training courses for research and extension workers at AICRIP and other centers in India. The sources of support for these training activities have varied, with no single training activity supported solely by a single agency. The support has been primarily channeled through the coordinators who have used various funds to accomplish training in its totality.

Training at IRRI has involved primarily production training activity with 26 men receiving training over the past six years (*Appendix VII*). Research training, as well as training at the post-doctoral level and in all the major disciplines has been provided to 19 men during the same period (*Appendix VIII*). Since the training period was generally longer in research, total man-months devoted to research training was 202 while for production training, it has been only 138.

Two different groups of rice specialists and rice breeders undertook study tours to IRRI. These were as follows:

Year	*Name*	*From*	*Support*
1967	Dr. S.V.S. Shastry	Hyderabad	Rockefeller Foundation
	Mr. A.R. Hamdani	Khudwani	,,
	Dr. R. Seetharaman	Cuttack	,,
	Mr. C. Srinivasan	Coimbatore	,,
	Dr. N.N. Dikshit	Faizabad	,,
	Dr. D.N. Borthakur	Jorhat	,,
	Dr. S.K. Roy	Patna	,,
1971	Dr. W.H. Freeman	Hyderabad	Rockefeller Foundation
	Mr. V. Rajagopala Reddy	Rajendranagar	AID
	Dr. D.G. Bhapkar	Karjat	,,
	Dr. S.S. Saini	Ludhiana	,,
	Mr. N. Srinivasalu	Aduthurai	,,
	Mr. S.N. Ojha	Patna	,,
	Dr. R. Gopalakrishnan	Pattambi	,,
	Dr. H.K. Mohanty	Bhubaneswar	,,

Primarily, training at Hyderabad was supported by Rockefeller Foundation through on-the-job training programs for young Indian scientists, mainly those just completing their M.Sc. degree. One or two a year were trained early in the program, over 20 were trained in 1972. The objective of the training was to enable men to acquire research experience in rice and within 12 to 18 months to be absorbed in more permanent posts in the various centers of the rice project or in closely allied activities. During 1966-72, nearly 100 men were trained. These have been classified according to the positions accepted after training and presented in *Table* 2.

The local Indian technicians employed by AID enabled this training program to be expanded during the period of AID support since these Indian technicians were of a higher level of academic training or experience and could serve as supervisors of the junior staff along with the ICAR, AID and RF technicians in the program.

Table 2 — Classification of present and past trainees at AICRIP and IRRI.

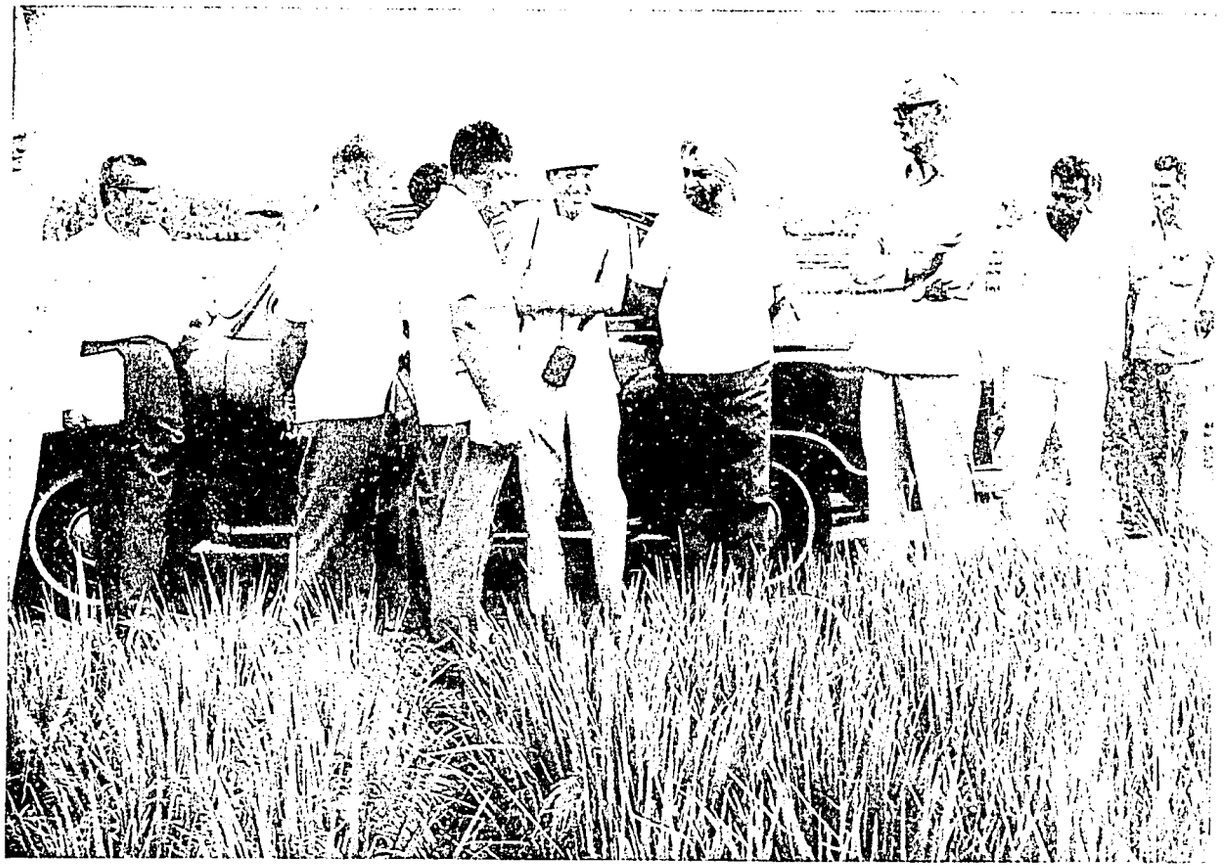
	Disciplines					
	Breeding	*Agronomy & Physiology*	*Pathology*	*Entomoiogy*	*Agri. Eng.*	*Total*
1. Those now employed by research institutions concerned with rice:						
(*a*) State Institutions ..	6	9	1	4	—	20
(*b*) Central Institutions ..	2	3	1	—	2	8
2. Commercial agencies concerned with rice production ..	6	5	2	5	—	18
3. Graduate students (Ph.D. India and abroad) ..	1	10	4	3	—	16
4. Total in-service men on M.Sc. Programs ..	—	2	—	—	—	2
5. Total in-service trainees from other states (3 months or more)..	13	—	—	—	—	13
6. Presently employed ..	4	6	4	2	—	16
7. Unclassified ..	5	8	—	—	—	13
8. Production training at IRRI ..	—	—	—	—	—	23
9. Research training at IRRI ..	7	7	2	3	2	21
TOTAL ..	44	50	14	17	4	152

Another aspect of training included academic training. Students in M.Sc. programs at the Andhra Pradesh Agricultural University were assigned problems and AICRIP staff served as guides in these programs. A total of 28 students have obtained their degrees in this program. A list of titles and students participating in this program appears in *Appendix IX*.

Some of the AICRIP staff participated in various training programs at IRRI and on return were effectively used in training programs along with the AID technicians, Ford Foundation staff and other personnel in conducting training programs.

Learning by doing — minikit training.

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



Discussions on training and research.

INSTITUTION BUILDING

Rice was unique among the coordinated projects in that it began without an established or permanent institution at the headquarters site. The regional research station of 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 of the project was a research program. As a consequence, the rice project first built a program in order to achieve the objective of quickly accelerating rice research which would lead to early expansion of rice production. A base which would justify institutionalization was created as a result of these efforts. Research undertaken has been a visible addition to the rice research landscape, creating a new awareness on the part of government of the potentials of rice and necessity for even greater reliance on AICRIP to achieve new breakthroughs in rice production.

Evolution of the project, in addition to coordination of adaptive research itself, was three-fold:

(*a*) creation of a research base upon which effective coordination could operate
(*b*) development of avenues for distributing products of research
(*c*) training, both research and extension.

Having created these facets of a dynamic program, the logical next phase would be to structure these into an institution, embodying these activities and preserving those features which have enabled the project to be a dynamic force in rice improvement. An organization so created can accept new challenges and new responsibilities as they present themselves and can be vital to the achievement of targets set for future rice production.

The success of the program has served to emphasize that coordination is effective in accelerating research and translating this research into increased production. Thus the task is a continuing one and staff and facilities are needed to build an institution around a program which had been created on a scheme* basis by ICAR. This would require that components provided by assistance agencies must ultimately be supported by ICAR and buildings which would provide offices, laboratories, green houses and service facilities would have to be created for the continuing program.

* Schemes contrasted with projects and institutions are not funded with the intent that they would be a continuing activity.

The staff and activity soon outgrew the facilities provided by the regional research center of IARI and additional space was provided by the Andhra Pradesh Agricultural University to enable the headquarters to function as a coordinating center. At present, the various departments are housed in six buildings supplied by three agencies in the Rajendranagar area. The headquarters office has moved at least six times in a six-year period.

Steps to institutionalize the research at the coordinating center were undertaken by ICAR in August 1971 by the creation of twelve additional research positions and the elevation of the coordinator to project director. In January 1972, a building program financed by ICAR for housing the AICRIP staff was undertaken which would further institutionalize the operation at Rajendranagar. Creation of these new facilities will augment the research activity and concentrate the personnel so that much better coordination of activities can be maintained at headquarters.

Following the decision in May 1972 to create a training facility at Rajendranagar, plans were submitted in September 1972 for the staff support for a training facility as well as extension positions in rice production and communications. Training in research and in extension had been done from the beginning of the project. The ICAR action took cognizance of this phase of the project and took steps to create facilities and formally provide training in research and in extension, and facilities and staff for translating research findings into extension publications, etc. It would also allow a closer liaison between the research program and the performance of rice varieties in the farmer's field through the activities of extension specialists and the impartation of training to extension personnel through the training facility to be established. Shortly thereafter, proposals were prepared and submitted for the rice project covering the Fifth Plan period. Staff proposed at different stages which would be operative during the Fifth Plan (1974–79) are listed in *Appendix X*.

During 1970, the Ford Foundation indicated its support of the research activity at Rajendranagar and committed finances for the construction of greenhouses which were to be used primarily for host plant resistance breeding and staff support for adaptive research activities in the districts. They later indicated their interest in supporting the development of a communication and training center and this commitment is expected to come to fruition during 1974. It is anticipated that funds will be available for the construction of a center and that the ICAR will provide the necessary funds for the construction of hostel facilities linked with the communication and training facility.

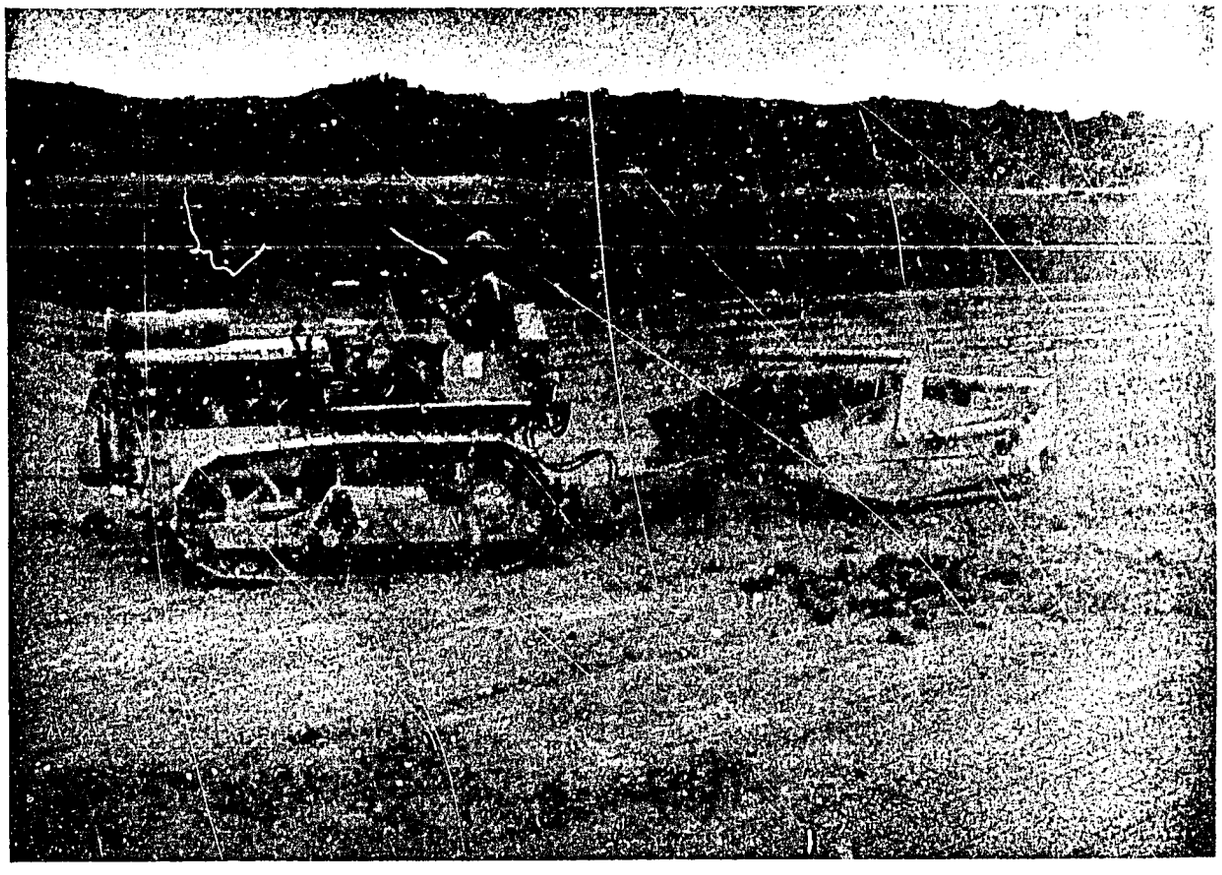
One important factor in institution building has been experiment station development at the AICRIP center. Experiment station development was a stated service objective of the coordinated program in order to improve the research capability of cooperating stations by improving land and water facilities. The development of the research fields created uniform blocks of one-quarter

hectare each with irrigation and drainage facilities for each block independent of every other block. This work was undertaken with the Rockefeller Foundation support.

Later the Andhra Pradesh Agricultural University undertook an overall experiment station development program which included drainage, irrigation and land development, and involved land used for rice research at the zonal center of AICRIP. USAID, through a contract with Kansas State University, agreed to provide financial support (Rs. 1,100,000) for the development of a drainage system and a pipeline for irrigation, and the Rockefeller Foundation undertook the land reshaping phases.

In 1971, the agricultural engineer provided by the IRRI/AID contract began work on the land shaping project. On the completion of the KSU AID contract, complete administration of the project for completion of the land shaping operations was transferred to the rice project. This activity was essentially complete by June 30, 1973. *Appendix VI* summarizes the developmental aspects of the project which included: (*a*) drainage system; (*b*) the irrigation pipeline; and (*c*) reshaping the research farm, and which was to serve as a demonstration of experiment station development for effective land use and water management.

APAU irrigation system before development.



Experiment station development to improve research capability.

AICRIP research plots following development.

LINKAGES

The rice project has received international attention. In 1970, Dr. Shastry was invited to undertake a review of rice research in Indonesia and recommend the structuring of research activity which would mobilize their research program. In 1971, a joint paper was presented at a meeting at IRRI of rice scientists from many countries entitled, "Rice Imrovement in India—The Coordinated Approach". The project has also been used by the Centro Internacional de Agricultura Tropical (CIAT), Cali, Colombia, as a model in developing a pattern of research collaboration in Latin American countries. The West African Rice Development Agency (WARDA) has utilized AICRIP experience in developing their program.

Visits of rice research scientists from Indonesia, Nepal, Sri Lanka, and Thailand have given an opportunity for the coordinated approach to be advocated as an organization technique.

Through seed exchanges, selections of Indian breeding material have been provided to IRRI, Indonesia, Malaysia, Nepal, Sri Lanka, and Thailand.

Gall midge resistant materials identified in AICRIP were reported resistant in Indonesia, Sri Lanka and Thailand, and have been utilized in breeding programs in those countries in the development of resistant varieties.

An outgrowth of these and other exchanges has been the development of international exchanges of material on a systematic basis with IRRI acting as the coordinating agency for all but the gall midge materials where India will act in this capacity since the insect does not occur in the Philippines.

The AICRIP staff participated in several international seminars at IRRI and elsewhere.

Nationally, networks that have developed include the coordinated program involving the center and state institutions and agencies in a common program. The activities of the project have been extended beyond the stations supported by ICAR funds and include more than 100 state research stations where trials are conducted to the mutual interest of the state and the national programs.

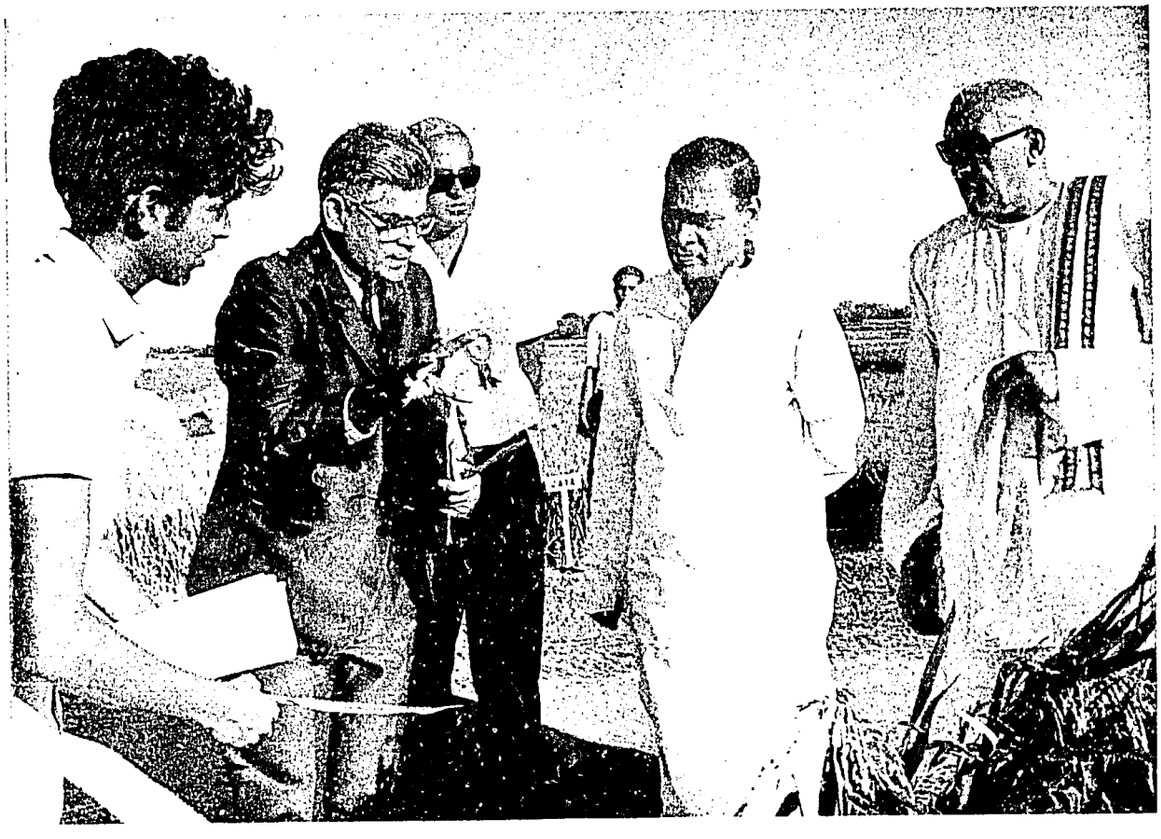
Another important national network is the surveillance program. It started in 1970 in a five-state area in northeast India following the tungro outbreak in this area in 1969. The entomology technician served as leader in the first few months of the program in 1970. Other staff were involved in training of the field observers in each of the states where the program was active. In addition, AICRIP served as the agency to make transmission studies to determine the actual presence of tungro in suspect areas. This program has continued for four years and has established a pattern of surveillance which can prove of value as an early warning system not only for tungro but other rice production problems as well.

The minikit program developed a strong connection between the rice development directorate and the various states which have participated in the program. These relationships have come to assume tremendous importance as state extension programs look to the project for guidance in variety selection and management practices to use with the varieties.

Administratively, using assistance funding for the general objectives of the project has enabled each agency to share in the success of the whole program while not participating in the support of all phases. This has proven most acceptable to the host agency under whose aegis all support is identified—as for instance the letterhead, the progress reports and research reports.

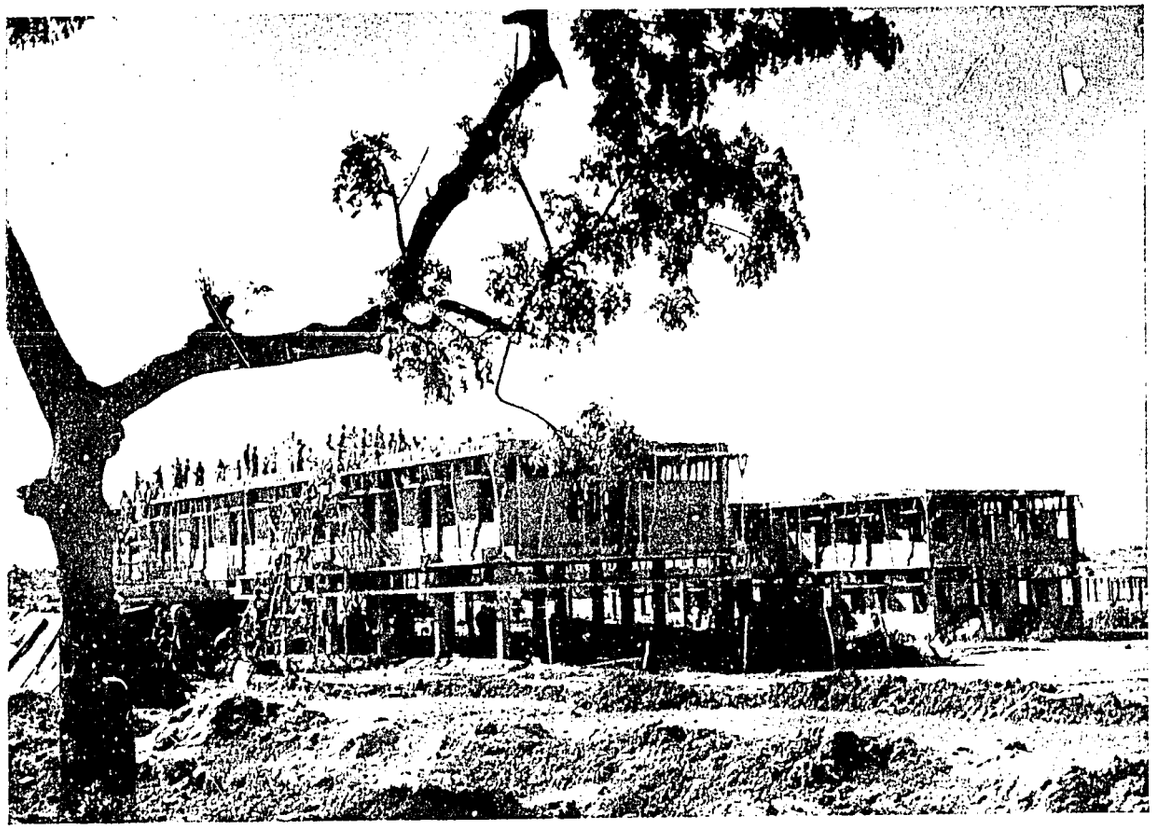
Farmers are eager for new rice technologies.

National and state leaders become acquainted with new technologies.



PART II

Organization and Support



Building complex for the All-India Coordinated Rice Improvement Project.

ORGANIZATION

With limited resources and many state programs, a nationwide system of adaptive research offered the most rapid means of providing station-years of information which could quickly identify new varieties, practices, and plant protection measures.

To achieve these ends in the shortest possible time required that all rice research workers become united in one cooperative effort. The organizational structure of the coordinated program required that this be achieved, not by administrative controls, but by leadership — and service — which would benefit local situations.

The All-India Coordinated Rice Improvement Project was established in 1965 and started with Mr. M.S. Pawar as coordinator. The first crop at the coordinating center at Hyderabad was grown on a small portion of the 30 acre seed farm which had been provided to the Indian Council of Agricultural Research by the Andhra Pradesh Department of Agriculture. The site had been selected as the coordinating center because of reliable supplies of water where two crops of rice could be grown annually, and its central location made it reasonably accessible from other parts of the country. This center was to become a part of a nationwide network of rice research stations involving the existing state research centers. The effort was to involve all the major disciplines in studies of the critical aspects of rice production—breeding, agronomy, entomology, pathology—with the focus on new varieties as the vehicle for a breakthrough in rice production.

In 1966, Wayne H. Freeman of the Rockefeller Foundation joined the program with the designation by the ICAR of joint coordinator. In addition to the services of the joint coordinator, the Rockefeller Foundation provided funds for the supply of critical imported equipment, some logistic support, and substantial funds for employment of young Indian scientists on an on-the-job training basis.

Mr. M.S. Pawar left in January to join FAO and in April 1966, the present project director, Dr. S.V.S. Shastry, joined the staff as project coordinator. Dr. Shastry had developed an international reputation as a rice cytogeneticist at the Indian Agricultural Research Institute (IARI) before assuming charge of the IARI sub-station at Pusa, Bihar, in 1962. He worked there for four years before accepting the position of coordinator for the rice project.

ICAR in the Fourth Five Year Plan was to provide support to the state research program by providing funds for higher scales of staff than were generally allocated for rice. The funds were for different disciplines so as to enable a commodity approach to rice improvement. In addition, funds for some logistic support and capital improvements were also provided. All this was to supplement funds already provided by each state and was not intended to start a new research program in a state.

The esven zonal centers, 12 regional centers, 3 testing centers, and 2 special centers of the project were to receive ICAR funds for higher level positions, buildings and equipment, and some logistic support for travel and jeeps. ICAR funds became available to the centers in early 1968. The aim was to accelerate the research work already under way in the various states. During the Fourth Plan, ICAR provided Rs. 16.7 million of which Rs. 3.472 million was to be spent at the new center in Hyderabad and the remainder (Rs. 13,228,000) used to strengthen the state and national centers. During this same period, the states provided an estimated Rs. 45,000,000 or 75% of the total funds available for rice research in the states.

The coordinated rice improvement project was approved in 1967 after original plans for the headquarters unit were drastically revised, reducing the research component at the coordinating center to a minimum which could be used only for seed multiplication, seed despatch, and data processing connected with trials to be conducted nation-wide.

Early in 1966, discussions were initiated with Dr. A.H. Moseman, then of AID, about the support which might be needed to give additional impetus to the rice project primarily through support to the new headquarters unit. During the ensuing 18 months, agreements between ICAR and AID, and AID and IRRI, brought AID into the project by 1968. Funds from AID together with those of the ICAR and Rockefeller Foundation enabled the development of a research component at Hyderabad. This research team involving six disciplines proved effective in creating breeding materials and research results and established leadership based on merit, service and results.

The initial AID commitment for an 18 month period involved $ 212,000 and Rs. 927,000. In late 1967, IRRI recruited four staff technicians and placed them at Hyderabad for research in agronomy, physiology, pathology and entomology. In addition, AID funds allowed Indian scientists as well as logistic staff to be employed and equipment to be purchased. Subsequent amendments increased staff positions to five, including an agricultural engineer, and financial commitments totaling $ 593,640 and Rs. 5,689,000.

Ford Foundation support for the rice project crystallized in 1968 and a research agronomist became associated with the AICRIP with responsibility for the district level testing program which was initiated in *kharif* 1969 in an effort to overcome some of the apparent weaknesses of the program. This assistance continued until February 1973. During this time, two additional Indian staff members

were provided by FF to support the agronomist, Mr. Vernon L. Hall, first in the district level testing program and later in the minikit program.

Through Ford Foundation, it was possible to secure the services of Dr. Ivan W. Buddenhagen, pathologist, for about one year during 1971-72. Dr. Buddenhagen had been a short-term AID consultant in 1969 and was familiar with rice diseases of the country. His appointment helped maintain the strong pathology research that had been started under Dr. H. E. Kauffman's leadership after Dr. Kauffman left in 1972. Dr. Buddenhagen's professional leadership was extremely valuable in developing coordination within the discipline of pathology and creating new concepts for this coordinated activity.

A summary of funding of the headquarters unit of AICRIP is presented in *Table* 3 and of the manpower input in *Table* 4. Total input for the period has been Rs. 18,283,661 of which 23.4% was from ICAR while the remainder was from other funding agencies. AID supplied 28.1% as rupees and 24.4% as dollars or a total of 52.5% of the total support. Dollar input from the three donor agencies has amounted to nearly 50 percent of the total funding input.

Table 3 — Summary of financial expenditures at the project headquarters by various agencies, 1966-73.

	*Assistance agencies**						
	IRRI/AID						
Year	*Rs.*	*$ in Rs.*	*RF***	*FF*	*Total*	*ICAR*	*Grand Total*
1965–66	—	—	55,000	—	55,000	69,213	124,213
1966–67	—	—	285,000	—	285,000	129,115	414,115
1967–68	169,585	417,400	315,000	—	901,985	171,513	1,073,498
1968–69	665,831	703,747	322,700	—	1,692,278	370,594	2,062,872
1969–70	919,806	694,093	330,875	—	1,944,774	364,767	2,309,541
1970–71	894,105	788,871	281,100	125,000	2,089,076	436,367	2,525,443
1971–72	1,257,285	1,031,107	240,750	250,000	2,779,142	581,352	3,360,494
1972–73	1,229,099	817,086	243,900	1,960,000	4,250,085	2,163,400†	6,413,485
TOTAL	5,135,711	4,452,304	2,074,325	2,335,000	13,997,340	4,286,321	18,283,661
PERCENT	28.1	24.4	11 3	12.8	76.6	23.4	100
		52.5					

* All except AID (Rupees) represent dollar input converted to rupees.

** Exclusive of support to the Joint Coordinator himself.

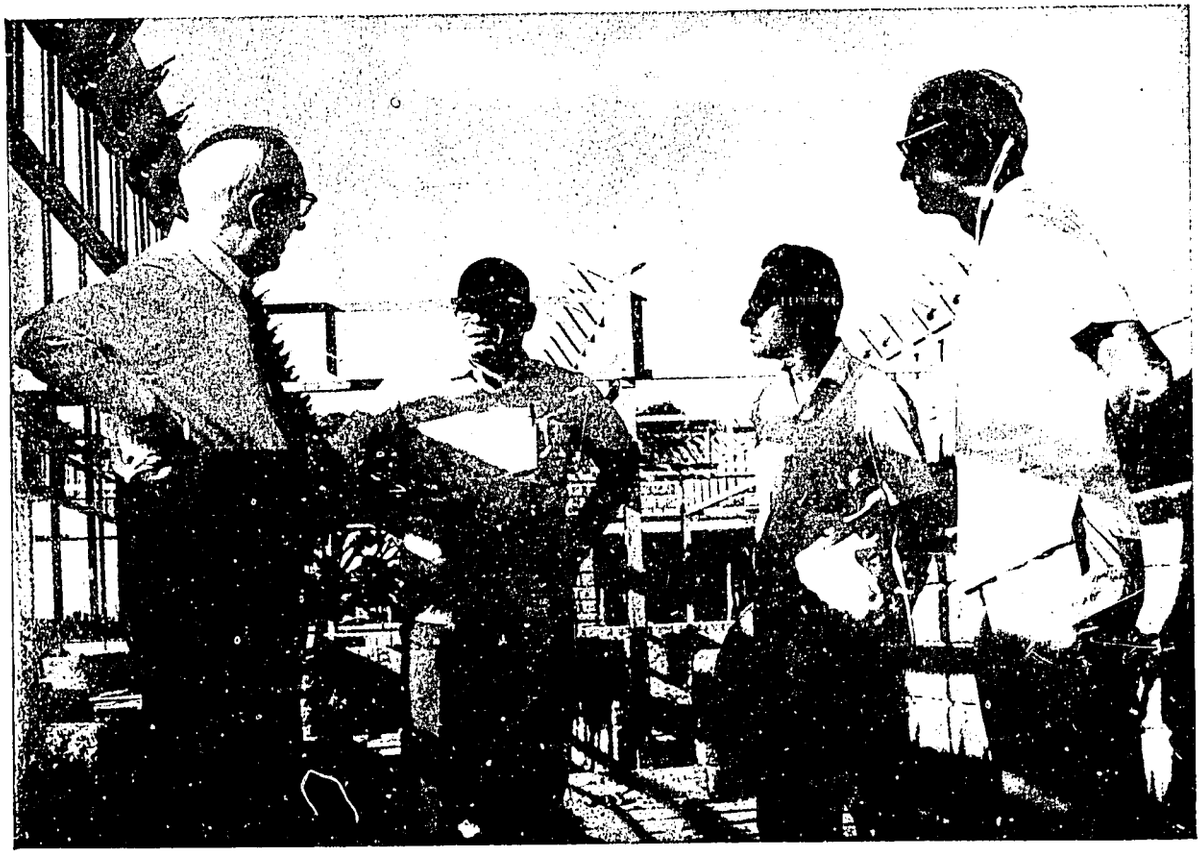
† Capital investment of Rs. 1,062,000. $ 125,000 has been provided in free foreign exchange but will not be realized during this period.

Table 4 — Manpower (technical) contributed by each agency to the headquarter's activities, January 1, 1966 — June 30, 1973.

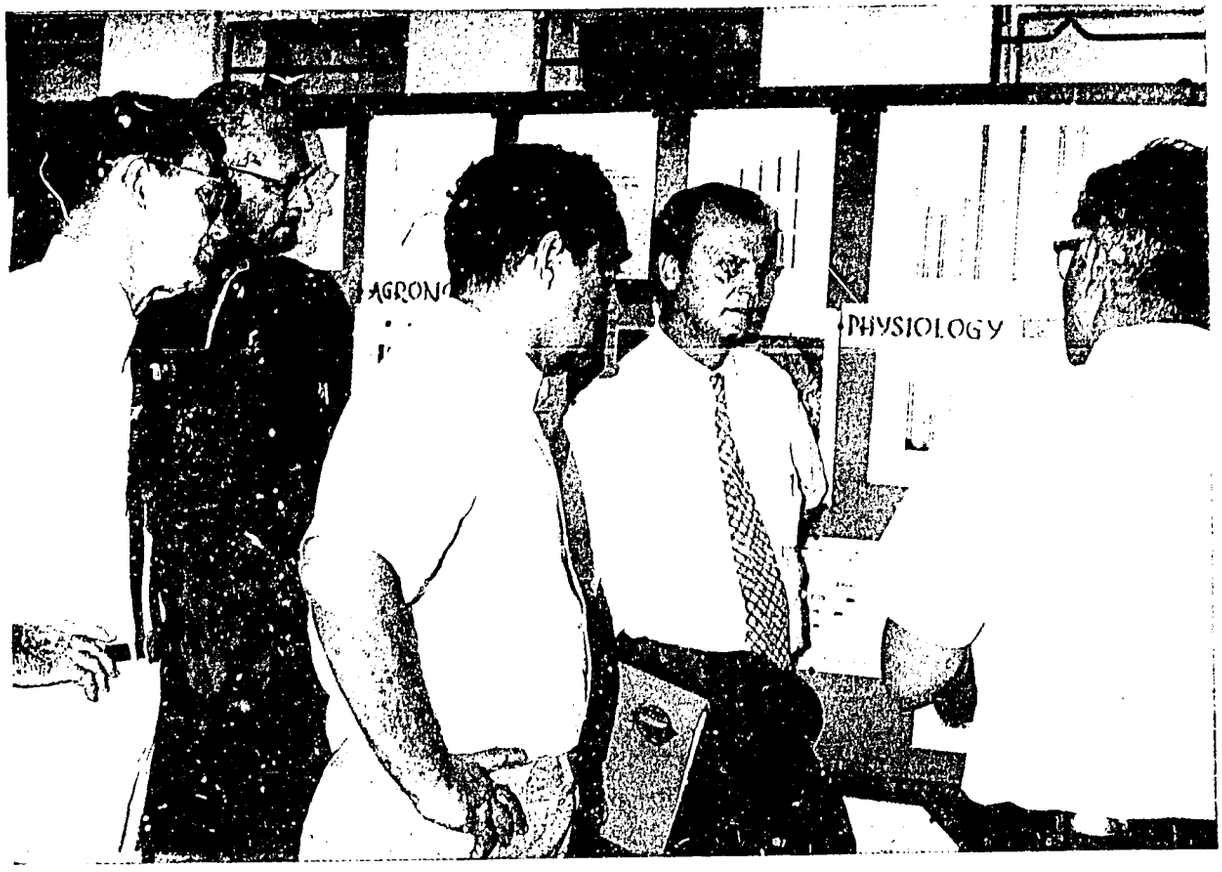
Agency	*Coordinators*	*Staff*		*Total man months*	*Percent*
		Number	*Man Months*		
Indian Council of Agricultural Research	1	13*	332	418	17.0
U. S. Agency for International Development	—	33	712	712	29.0
Rockefeller Foundation	1†	90	1182	1272	51.7
Ford Foundation	—	4	56	56	2.3

*Eight posted in the last 12 months.
† Also served as Chief of Party.

The manpower input, including trainees and others with B.Sc. degree or above, shows a different pattern of support. Of the total input, Rockefeller Foundation through its on-the-job training program for new graduates, has contributed 51.7% of the total. IRRI/AID provided 29% as the second largest contributor. This input was primarily in discipline leadership and included foreign technicians as well as Indian staff (*Appendix XII and XIII*). The short term consultants available to the project are listed in *Appendix XII*. The ICAR staff (*Appendix XI*) contributed 17% of the technical input but about 90% of all the sub-professional labor input which included field supervisors, mechanics, drivers, and casual labor which at times amounted to 100 people a day during peak labor periods.



International support has been



an important ingredient in progress.

STATUS OF SUPPORT TO THE PROJECT

The IRRI/AID Contract

The IRRI/AID contract has provided critical inputs of foreign technicians, Indian technicians, consultancies, implementation, vehicles, and other logistic support. All the equipment, etc., is to be assigned to the project to provide continuous support with these valuable inputs.

This support has permitted the rapid development of a research core at the coordinating center which at this time is attaining national stature by virtue of these attributes. The critical position of rice in the agricultural and economic status of the country focuses sharp attention on any successful effort to improve the production picture of this vital crop. AICRIP has attained a position through research, research leadership, and products of coordinated effort to effectively contribute to improved rice production. The inputs in the research program for the past five to seven years are just now bearing fruit. Many difficult problems are still unsolved. They will require even greater research effort. Continued research will be required if AICRIP is to be an effective agency in future improvements in rice production. The time has come for even greater output and expenditure of funds and effort than have been provided in the past.

*ICAR/IRRI Memorandum of Agreement**

A new system of channeling a portion of the needed support is now being developed between ICAR and IRRI. A formal agreement with the IRRI would enable support to be provided and managed so as to serve some of the needs of the program and be of mutual benefit to AICRIP and IRRI.

Through this new channel, the collaborative relationship would include:

(*a*) Research projects in which both agencies would be mutually interested and which could be done in India. These could include studies on epidemiology of diseases, ecological studies of insects, biotype studies of insects and strain or race variations of disease organisms to mention a few.

* Signed March 15, 1974.

(*b*) Short term consultants to work with AICRIP scientists for solution of specific problems in specific areas of program activity. Illustrative of the activities of consultants would be planning the communication-training facility; develop techniques for rearing and maintaining insect populations and for insect screening of breeding materials under artificial conditions; virus research; assess development of resistance to bacterial leaf blight; develop a quality control laboratory; ecological studies of the rice gall midge; or studies of predators and parasites of the rice gall midge.

(*c*) *Training:* Funds for post-doctoral training, production training and scholarships for academic training abroad would greatly supplement the training available within India.

(*d*) Additional funds for financing Indian staff to attend international conferences would be a valuable asset to enable the exchange of ideas, information and materials among Indian rice scientists from other countries and IRRI.

(*e*) Locally administered funds for use in short term appointments for on-the-job training and local scientists for specific program activities will need to be provided immediately to maintain staff strength for continuity of the program at its present level. Needs for these funds will diminish as proposals before ICAR are implemented and funds become available in the Fifth Plan period for additional staff support (*Appendix V*). At the present, it is essential that some funding be available for this purpose.

(*f*) Funds available for critical spare parts for existing equipment, new items of equipment as may be required, foreign journals, books and literature.

With the equipment provided by AID, RF and GOI foreign exchange, approximately $ 300,000 worth of foreign equipment is available to the project headquarters and other stations. Spare parts to keep the equipment in use for the life expectancy of the equipment will be a critical item of assistance funding.

National Support

In recognition of the termination of the AID support, and for other reasons, proposals for additional funding prior to the beginning of the Fifth Five Year Plan in 1974, amounted to a total of Rs. 1,970,000. This included "immediate strengthening" of staff and other funds; support for the minikit program; and support for the communications-training phase of AICRIP activity. At the termi-

nation of the AID support, no additional funds had been provided and it would be expected that by the time funds were approved only Rs. 1,000,000 would be needed for the balance of the fiscal year.

Fifth Plan proposals asked for a total of Rs. 43,061,300 for the rice project of which Rs. 17,514,200 would be spent for support of the headquarters activity. This, at full level of spending, would amount to Rs. 2,500,000 per year for staff and operations. This amount would be about 2.5 times the present level of ICAR support exclusive of capital investments.

Recent discussions have indicated that although rice enjoys a favored position, Fifth Plan funding can be expected to be cut because of the shortage of funds.

The value of the rice crop to the overall economy of India and the critical role it plays in India's food supplies; the foundations developed by the AICRIP for making substantial contributions to increased production; the expanding needs for additional increases; the major role rice can play in absorbing increases in farm labor; and the possibilities of this crop as perhaps the best base for the small farm production unit supplemented by other crops grown in rotation with rice, offer to the leaders of the project and to supporters alike an opportunity to develop a crop-focused program involving research, extension, education-training, agro-industries and socio-economies which could be a notable factor in stabilizing tensions that are apt to increase as the population continues to grow until family planning programs have an opportunity to effectively reduce population growth. This would mean that the rice crop, in addition to providing food, can play a most critical role in many other aspects of India's future.

The future program of the rice project could be viewed on a more greatly expanded basis than it has functioned in the past. From research, it has involved extension programs in a massive production effort. It can be expected to provide focus for involving related areas of activity associated with this key crop in the Indian economy.

Appendices

APPENDIX I

Workshops attended by over 100 rice research workers and significant results.

Date	*Location*	*Release and other actions*
Feb. 1965	Cuttack	Developed crossing programs for respective stations using new dwarf plant types.
Nov. 1965	Cuttack	Developed first all-India trials—variety, agronomy, pathology and entomology.
May 1966	Hyderabad	Review of data from first set of coordinated trials.
Nov. 1966	Cuttack	Recommended release of IR 8.
Apr. 1967	Bangalore	Presentation Report of *kharif* 1966.
Nov. 1967	Hyderabad	—
Apr. 1968	Hyderabad	—
Nov. 1968	Cuttack	Recommended release of Jaya and Padma.
Apr. 1969	Hyderabad	Recommended release of Pankaj and Jagannath.
Nov. 1969	Poona	25th anniversary celebration of rice research station at Karjat, Maharashtra.
May 1970	Cuttack	Recommended release of nine dwarf varieties.
Feb. 1971*	Hyderabad	—
Sep. 1971	Cuttack	Silver Jubilee of CRRI.
Oct. 1972	Kanpur	Recommended release of Sona and Jayanti.

* Winter workshop of 1970 postponed to February 1971.

APPENDIX II

Special and discipline workshops and seminars.

Purpose	*Year*	*Location*	*Number attended*
Hill zone	1967	New Delhi	10
Hill zone	1970	Hyderabad	12
Hill zone	1972	Khudwani (J & K)	10
Statistics	Oct. 1971	Hyderabad	16
Pathology	Mar. 1972	Hyderabad	22
Entomology	Mar. 1972	Hyderabad	18
Pathology	Mar. 1973	Coimbatore	40
Entomology	Mar. 1973	Coimbatore	23
Agronomy	Apr. 1973	Cuttack	30
Physiology	May 1973	Hyderabad	34
Breeding	May 1973	Hyderabad	35

APPENDIX III

Numbers of trials conducted each season for the duration of the project, 1966-73.

Year	*Season*	*Variety*	*Agronomy & Physiology*	*Pathology*	*Entomology*
1966	Rabi	14	6	5	4
	Kharif	27	37	11	16
1967	Rabi	21	16	—	9
	Kharif	74	77	3	14
1968	Rabi	30	16	—	12
	Kharif	135	87	32	41
1969	Rabi	60	35	—	44
	Kharif	250	163	41	70
1970	Rabi	72	47	—	19
	Kharif	312	145	60	54
1971	Rabi	65	43	—	11
	Kharif	139	164	45	60
1972	Rabi	64	79	—	51
	Kharif	185	269	106	168
1973	Rabi	108	44	—	49
	Kharif*	440	267	119	143

* Trials planned.

APPENDIX IV

Varieties released by the Central Variety Release Committee, 1966-73.

Year	*Originating station*	*Variety*	*Remarks*
1966	IRRI	IR 8	Bold grain, medium duration, moderately resistant to leafhoppers and blast. Introduced from IRRI.
1968	Coord. Center	Jaya	Bold grain, medium duration, resistant to blast and moderately resistant to leafhoppers.
1968	CRRI	Padma	Bold grain, medium short duration.
1969	IRRI	Pankaj	Bold grain, long duration. Introduced from IRRI as IR 5-114-3-1.
1969	OUAT	Jagannath	Medium slender grain, long duration.
1970	CRRI	Bala	Bold grain, short duration, moderately resistant to helminthosporium.
1970	Coimbatore and Coord. Cente	Cauvery	Bold grain, short duration, moderately resistant to helminthosporium.
1970	Coimbatore	Kanchi	Bold grain, medium short duration, moderately resistant to helminthosporium.
1970	CRRI	Ratna	Long slender grain, medium short duration, moderately resistant to stem borer.
1970	CRRI	Krishna	Medium slender grain, medium short duration, moderately resistant to helminthosporium.
1970	IARI	Sabarmati	Medium slender scented grain, medium duration, moderately resistant to blast.
1970	IARI	Jamuna	Medium slender grain, medium duration.
1970	IRRI	IR 20	Medium slender grain, medium duration, resistant to blast and moderately resistant to stem borer, leafhoppers, tungro virus and bacterial leaf blight. Introduced from IRRI.
1970	CRRI	Vijaya	Medium slender grain, medium long duration, resistant to leafhoppers and blast, and moderately resistant to tungro virus and bacterial leaf blight.

APPENDIX IV (*contd.*)

Year	*Originating station*	*Variety*	*Remarks*
1973	Coord. Center	Sona	Long slender grain, medium duration, moderately resistant to stem borer, leafhoppers and rice tungro virus. High grain yield for fine grain variety.
1973	CRRI	Jayanti	Long slender grain, medium duration, moderately resistant to bacterial leaf blight and leafhopper. High grain yield for fine grain variety.

APPENDIX V

Varieties released by individual state rice research agencies, 1966-73, based on results of coordinated trials in their states.

State releasing	*Year*	*Variety*	*Remarks*
Andhra Pradesh	1968	Hamsa	Long slender grain, special merit: earliness during *rabi* season when most other dwarf rices become extended in duration due to low temperatures in Deccan plateau, particularly in Telangana region.
	1970	Mahsuri	Medium slender grain, medium long duration, stable yield at moderate fertility level. Introduced from Malaysia.
	1971	Tella Hamsa	Long slender grain, and cold tolerance similar to Hamsa but earlier in maturity.
	1973	Kakatiya	Bold grain, short duration, gall midge resistant.
Kerala	1968	Annapurna	Short duration, suitable for the rainfed first crop season of Kerala. Bold red grain which is preferred in Kerala.
	1970	Triveni	Medium short duration. White bold grain.
	1970	Rohini	Medium short duration, early under direct seeded condition. White bold grain.
	1970	Aswathi	Medium short duration. White bold grain.
Madhya Pradesh	1972	Anupama	Medium slender grain, short duration.
Maharashtra	1972	K 184	Medium slender grain early maturity.
Karnataka	1970	Manila	Medium long duration, medium slender grain. Introduced from the Philippines.
	1971	Suma and Kusuma	Both varieties are medium short duration, medium slender grain.
	1972	Madhu	Short duration, medium slender grain.
Orissa	1972	Kumar	——
	1972	Rajeswari	Medium duration and bold grain.
	1972	Hemant	Medium duration and medium slender grain.
Punjab	1972	Palman 579	Medium slender grain, mid-early duration, from IRRI breeding material (IR 579-48-1-2), particularly suitable for late planted *kharif* crop in Punjab.

APPENDIX V (*contd.*)

State releasing	*Year*	*Variety*	*Remarks*
Tamil Nadu	1970	Karuna	Short duration, short bold grain. Recommended for *kuruvai* season in Thanjavur delta.
	1971	Ponni (Mahsuri)	Medium slender grain, medium long duration. Stable yield at moderate fertility level. Introduced from Malaysia. Indica — Japonica derivative.
Tamil Nadu	1972	Kannagi	Medium short duration, high yield potential, bold grain.
	1973	Bhavani	Selection of an introduced Philippine variety, C 4-63.
Uttar Pradesh	1969	Sarjoo 49	An introduction from IRRI variety collection, recommended for eastern Uttar Pradesh. Similar to T(N) 1 but with slightly better yield in Uttar Pradesh.
	1973	IR 24	Introduction from IRRI.
	1973	Saket 4	A sister selection of Ratna with long slender grain, slightly earlier than Ratna in Uttar Pradesh. Moderate tolerance to stem borer.

APPENDIX VI

AICRIP Publications, 1966-73.

Year	
1966	Rice needs of India and ways of meeting. S.V.S. Shastry. *Indian Farming*. Sep. 1966.
	New rice varieties have their limitations and prospects. S.V.S. Shastry. *Intensive Agriculture* Oct. 1966.
	Problems of rice research. S.V.S. Shastry. Economic Times. *Times of India*. Dec. 21, 1966.
	AICRIP Progress report. *Rabi* 1965-66. (pp. 54), Nov. 1966.
1967	High yielding paddy varieties and a seed certification system for their rapid multiplication and utilization. W.H. Freeman. National Seeds Corporation Supplement in newspapers. Aug. 1967.
	A survey of insects and diseases of rice in India. Pests and Disease Survey Team, IRRI/USAID ICAR. Oct. 1967.
	AICRIP Progress report. *Kharif* 1966. (pp. 141), April 1967.
	AICRIP Progress report. *Rabi* 1967. (pp. 121). Nov. 1967.
1968	Identification and characterization of tungro—A virus disease of rice in India. V.T. John. *Plant Disease Reporter*.
	AICRIP Progress report. *Kharif* 1967. Vol. 1 (pp. 172) and Vol. 2 (pp.256). April 1968.
	AICRIP Progress report. *Rabi* 1968. (pp. 264). Nov. 1968.
1969	Jaya and Padma — New high yielding varieties of rice. S.V.S. Shastry. *Indian Farming*. Feb. 1969.
	From unsteady infancy to vigorous adolescence — rice development. W. David Hopper, and W.H. Freeman. *Economic & Political Weekly*. March 29, 1969.
	Recent advances in agricultural research (rice). S.V.S. Shastry. ICAR Booklet on cereal crops. Sep. 1969.
	AICRIP Progress report, *Kharif* 1968. Vol. 1 (pp. 151), Vol. 2 (pp. 301), and Vol. 3 (pp. 335). April 1969.
	AICRIP Progress report. *Rabi* 1969. (pp. 173). Nov. 1969.
1970	Yellowing disease of paddy. V.T. John. *Indian Farming*. June 1970.
	Breeding dwarf rices in India. W.H. Freeman and S.V.S. Shastry. *American Society of Agronomy Abstracts*. 1970.
	AICRIP Progress Report. *Kharif* 1969. Vol. 1 (pp. 307) Vol. 2 (pp. 239). and Vol. 3 (pp. 189) May 1970.
1971	Some investigations on resistance to rice tungro virus. S.V.S. Shastry, W.H. Freeman, D.V. Seshu. and V.T. John. *Indian J. Gen. and Plant Breed.* 31 (3): 536-542.
	New high yielding varieties of rice. S.V.S. Shastry. *Annadata* (Telugu).
	Breeding high yielding varieties of rice. S.V.S. Shastry, Silver Jubilee Souvenir, Agricultural College, Bapatla, Andhra Pradesh.
	An easy and efficient method of transporting rice leafhoppers. D. Vital Rao and V.T. John. *Indian Phytopathology*. 24 (2): 408-410. 1971.

APPENDIX VI (*contd.*)

Year	
1971	Soil amendments to prevent and correct iron chlorosis in upland rice nurseries., N.P. Saxena, M. Jaganmohan Rao, H. Sakai. *Proc. of the International Symposium on Soil Fertility Evaluation, New Delhi.* Vol. 1, 1971.
	Nitrogen response of rice as influenced by varietal and seasonal differences. H. ten Have. *Fertilizer News.* 16 (5): 28-35. 1971.
	Optimum times of nitrogen application for transplanted rice. H. ten Have. *Fertilizer News.* 16 (2): 9-19. 1971.
	Optimum spacing and nitrogen levels for dwarf *indica*, tall *indica*, and *ponlai* rice varieties. H. ten Have. *Indian Farming.* May 1971.
	Management of the new dwarf rice varieties for high yields. AICRIP Booklet. Dec. 1971,
	Choose dwarf rices for better yields and bigger profits. AICRIP Leaflet. Dec. 1971.
	New dwarf rice varieties for India in the seventies. S.V.S. Shastry and W.H. Freeman. *Indian Farming.* Sep.-Oct. 1971.
	All-India Coordinated Rice Improvement Project — Organization and Program. S.V.S. Shastry. Seminar on National Agricultural Research Systems—edited by A.H. Moseman. Seminar sponsored by ICAR in cooperation with FAO and Agricultural Development Council, New Delhi, March 8-13, 1971. Published in September 1971.
	New sources of resistance to pests and diseases in the Assam rice collections. S.V.S. Shastry, S.D. Sharma, V.T. John, and K. Krishnaiah. *IRC Newsletter.* 22 (3). Sep. 1971.
	AICRIP Progress report. *Rabi* 1970 (pp. 221). Feb. 1971.
	AICRIP Progress report. *Kharif* 1970, Vol. 1 (pp. 264), Vol. 2 (pp. 189), and Vol. 3 (pp. 136), Sep. 1971.
1972	Minikit program with new high yielding varieties of rice. AICRIP Leaflet. Feb. 1972.
	IET 1991 and IET 1939. AICRIP Leaflet. Feb. 1972.
	Minikit program with gall midge resistant and tungro virus resistant varieties. AICRIP Leaflet. Feb. 1972.
	Germ plasm conservation and use in India. R. Seetharaman, S.D. Sharma, and S.V.S. Shastry. International Rice Research Institute. 1972. Rice Breeding Symposium, Los Banos, Philippines. (pp. 187-200).
	Rice Improvement in India—The Coordinated Approach. W.H. Freeman and S.V.S. Shastry. International Rice Research Institute. 1972. Rice Breeding. Los Banos, Philippines. (pp. 115-132).
	Breeding for resistance to rice tungro virus in India. S.V.S. Shastry, V.T. John, and D.V. Seshu. International Rice Research Institute. 1972. Rice Breeding. Los Banos, Philippines. (pp. 239-252).
	Host-plant resistance to rice gall midge. S.V.S. Shastry, W.H. Freeman, D.V. Seshu, P. Israel and J.K. Roy. International Rice Research Institute. 1972. Rice Breeding. Los Banos, Philippines. (pp. 353-365).

APPENDIX VI (*contd.*)

Year	
1972	Virulence patterns and phage sensitivity of Indian isolates of *Xanthomonas oryzae*. H. E. Kauffman and R.S.K.V.S. Pantulu. *Ann. Phytopatho. Soc. Japan.* 38: 68-74 (1972).
	Strains of rice tungro virus. A. Anjaneyulu and V.T. John. *Phytopathology*. 62 (10): 1116-1119. 1972.
	Factors favoring the incidence of tungro and methods of control. V.T. John and R.D.V.J. Prasada Rao. *Oryzae*. (In press).
	Cultural practices for high yields from transplanted rice. H. ten Have. *Indian Farming*. July 1972.
	Toward a rice revolution. S.V.S. Shastry. *Indian Farming*. Aug. 1972.
	Effect of nitrogen and spacing on bacterial leaf blight of rice. H. ten Have and H.E. Kauffman. *Indian Farming*. Jan. 1972.
	AICRIP Progress report, 1971. Vol. 1 (pp. 240). Vol. 2 (pp. 234), and Vol. 3 (pp. 225). October 1972.
1973	Analysis of high yielding ability of rice varieties in relation to growth and yield components. H. Sakai and N.P. Saxena. SABRAO Meeting. Feb. 22-28. 1973. IARI. New Delhi. (In press).
	Resistance to rice tungro virus. D.V. Seshu, V.T. John, S.V.S. Shastry. SABRAO Meeting. Feb. 22-28. 1973. IARI. New Delhi. (In press).
	Stability of yield performance of dwarf rice varieties. D.V. Seshu, S.V.S. Shastry, W.H. Freeman. SABRAO Meeting. Feb. 22-28. 1973. IARI. New Delhi. (In press).
	Rice development in India—Problems and Prospects. S.V.S. Shastry, N.N. Dikshit, S. Govindaswami, M. Mahadevappa, P.S. Bhatnagar, A. Subramanian, B.N. Chatterjee. Report of the Study Team on Rice, National Commission on Agriculture, Government of India. Feb. 1973.

APPENDIX VII

Rice production trainees from India trained in the six-month IRRI training program, 1966-72.

Year	*Name, title, and address of trainees*	*Support*
1967	Mr. T.E. Srinivasan, Asst. Botanist, AICRIP, Rajendranagar, Hyderabad 500030, Andhra Pradesh	RF
1968	Dr. S. Biswas, Rice Breeder, Rice Research Station, Chinsura 712102, Dist. Hooghly, West Bengal	IRRI
	Dr. B.N. Chatterjee, Professor & Head, Department of Agronomy, University of Kalyani, P.O. Mohanpur, District Nadia, West Bengal	IRRI
	Mr. C.R. Padalia, Jr. Research Officer, Central Rice Research Institute, Cuttack-6, Orissa	IRRI
	Dr. M.S. Chowdhury, Agronomist, CRRI, Cuttack (Deceased)	IRRI
	Mr. A. Subramanian, Head, Division of Plant Genetics and Plant Breeding, Tamil Nadu Agricultural University, Coimbatore-3, Tamil Nadu	IRRI
	Mr. R. Simhadri, Assistant Crop Specialist, University of Agricultural Sciences, Hebbal, Bangalore-24, Karnataka	IRRI
	Mr. P. Hanumappa, Extension Leader, University of Agricultural Sciences, Hebbal, Bangalore-24, Karnataka	IRRI
	Dr. J.S. Khara, Assistant Professor (Extension), Punjab Agricultural University, Ludhiana, Punjab	IRRI
	Mr. G. Babu Rao, Rice Breeder, Agricultural Research Station, Maruteru, West Godavari District, Andhra Pradesh	IRRI
	Mr. P. Ammiraju, Plant Manager, Seed Processing Plant, Maruteru, West Godavari District, Andhra Pradesh	IRRI
1969	Dr. P.P. Sharma, Professor of Agronomy, Jawaharlal Nehru Agricultural University, Raipur, Madhya Pradesh	IRRI
	Mr. K.B. Singh, Dy. Director of Agriculture, Durg, Madhya Pradesh	IRRI-AID
	Mr. S. Mahapatra, Subject Matter Specialist, Intensive Agricultural District Program, Sambalpur, Orissa	IRRI-AID
	Mr. C. Samantaraya, District Training Officer, Farmers' Training Center, Rangailunda, *Via* Berhampur, District Ganjam, Orissa	IRRI-AID
1970	Mr. J.D. Tripathi, Assistant Professor (Extension Education), Department of Extension, G.B. Pant University of Agriculture and Technology, Patnagar, District Nainital, Uttar Pradesh	IRRI-AID
	Mr. P.T. Patil, Agricultural Officer, Agricultural Research Station, Gandhiglaj, District Kolhapur, Maharashtra	IRRI-AID
	Mr. K.K. Sharma, Rice Breeder, Central Rice Research Station, Raipur, Madhya Pradesh	IRRI-AID

APPENDIX VII (*contd.*)

Month Year	*Name, title and address of trainees*	*Support*
1971	Mr. M.M. Bari, Plant Breeder, Agricultural Institute, Kosbad Hill, District Thana, Maharashtra	IRRI
	Mr. Sunil Kumar Das, Agronomist, Rice Production Training Institute, Fertilizer Corporation of India Ltd., Durgapur-12, West Bengal	FCI-IRRI
	Mr. S.K. Basu, Asst. Entomologist, *ibid*	FCI-IRRI
	Mr. N.K. Mitra, *ibid*	FCI-IRRI
	Mr. D.K. Gupta, *ibid*	FCI-IRRI
1972	Mr. D. Sarkar, Gramsevak Training Center, Department of Agriculture, Chinsura, West Bengal	IRRI
	Mr. K.P. Singh, Dy. Director of Agriculture, Hissar, Haryana	IRRI
	Mr. R. Singh, Extension Officer, Government Seed Farm, Gurdaspur, Punjab	IRRI

APPENDIX VIII

Rice Research Trainees from India in the IRRI Training Program, 1968-71.

Month & Year of initiation	*Name of the trainee*	*Specialization*	*Training period (months)*	*Support*
Aug. 1968	Mr. V.A. Kulkarni, Rice Specialist, Agricultural Research Institute, Patna-1, Bihar.	Breeding	12	IRRI-AID
April 1968	Dr. S. C. Modgal, Assoc. Professor (Agronomy), G.B. Pant University of Agriculture & Technology, Pantnagar, Nainital Dt., U.P.	Agronomy	9	IRRI-AID
Jan. 1969	Mr. A.R. Hamdani, Rice Specialist, Rice Research Scheme, Khudwani Farm, Khudwani, Anantanag Dt., J & K.	Breeding	6	IRRI-AID
June 1969	Mr. D.P. Talekar, Agronomist, Indo-Japanese Agricultural Demonstration Farm, Khapoli, Kolaba Dt., Maharashtra.	Breeding	6	IRRI-AID
Sept. 1969	Dr. G.N. Mitra, Junior Rice Breeder, Central Rice Research Institute, Cuttack-6, Orissa.	Breeding	12	IRRI-AID
June 1969	Dr. A.K. Bhattacharya, Reader (Agronomy), University of Kalyani, Mohanpur P.O., Nadia Dt., West Bengal.	Agronomy	12	IRRI-AID
Dec. 1969	Mr. M. G. Mane, Lecturer (Agronomy), Maharashtra Krishi Vidyapeeth, Poona-3, Maharashtra.	Agronomy	18	IRRI-AID
Sept. 1969	Mr. Raj Pal Puri, Research Assistant, Indian Agricultural Research Institute, New Delhi-12.	Breeding	12	IRRI-AID
June 1969	Mr. N.N. Kakati, Asst. Agronomist, Assam Agricultural University, Central Rice Research Station, Titabar, Assam.	Agronomy	12	IRRI-AID
July 1970	Dr. M.B. Kalode, Entomologist, All-India Co-ordinated Rice Improvement Project, Rajendranagar, Hyderabad-500030, A. P.	Entomology	12	IRRI-AID
May 1971	Mr. S.M. Ghufran, Asst. Plant Pathologist, Agricultural Research Institute, Kanke, Ranchi, Bihar.	Pathology	9	IRRI-AID

APPENDIX VIII (*contd.*)

Month & Year of initiation	*Name of the trainee*	*Specialization*	*Training period (months)*	*Support*
Jan. 1971	Mr. V.M. Khaire, Entomologist (Rice), Agricultural Research Station, Karjat, Kolaba Dt., Maharashtra.	Entomology	4½	IRRI-AID
Jan. 1971	Dr. K.C. Agarwal, Rice Pathologist, College of Agriculture, Raipur, Madhya Pradesh.	Pathology	9	IRRI-AID
Jan. 1971	Dr. M.L. Bhendia, Assistant Professor, Division of Agronomy, Indian Agricultural Research Institute, New Delhi-12.	Agronomy	12	IRRI-AID
April 1971	Mr. K. Dhirendra Singh, Agricultural Officer, Rice Research Station, Wangbal, Manipur.	Breeding	8½	IRRI-AID
Jan. 1971	Mr. B.N. Phukan, Farm Manager, Regional Research Station, Titabar, Assam.	Agronomy	6	IRRI-AID
Nov. 1971	Dr. S.S. Sajjan, Entomologist (Rice), Punjab Agricultural University, Ludhiana, Punjab.	Entomology	6	IRRI-AID

APPENDIX IX

Students who completed their M.Sc. thesis problems on rice with the guidance of AICRIP staff.

Year	*Name of student*	*Thesis problem*	*Guide on AICRIP staff*
BREEDING:			
1969	Mr. K.V.L.N. Dutt	Inheritance of resistance to rice stem borer (*Tryporyza incertulas* Walker).	S.V.S. Shastry
	Mr. C. Baskar Rao	Evaluation of some sources of plant type in rice	"
1970	Mr. D. Jayaraj	Studies on inheritance of resistance to bacterial leaf blight in rice (*Oryza sativa* L.)	"
	Mr. K.V.L. Narasimha Rao	Inheritance of resistance to rice gall midge (*Pachydiplosis oryzae*, Wood-Mason).	"
1971	Mr. P. Vasantha Krishna	Studies on inheritance of resistance to bacterial leaf blight in rice (*Oryza sativa* L.)	"
	Mr. B. Rajiah	Genetic studies in some intervarietal crosses on rice.	"
	Mr. K.V. Subbanna	Inheritance of resistance to rice stem borer.	"
1973	Mr. E. Sathyanarayana	Inheritance of resistance to gall midge.	"
	Mr. K. Krishnamurthy Baktha	Inheritance of resistance to green leaf hopper.	"
	Mr. Ch. Panduranga Rao	Genetics of resistance to rice tungro virus.	"
AGRONOMY & PHYSIOLOGY:			
1969	Mr. B.S. Prabhakar	The effect of leaf removal after heading on the dry matter production and grain yield of rice (*Oryza sativa* L.).	W.H. Freeman
1969	Mr. A. Krishnamurthy	Effect of cultural conditions on dry matter production and its contribution to grain yield in rice (*Oryza sativa* L.)	"
	Mr. M. Jagan Mohan Rao	Studies on the seedbed management and iron chlorosis of rice seedlings in high pH upland nurseries.	"

APPENDIX IX *(contd.)*

Year	*Name of student*	*Thesis problem*	*Guide on AICRIP staff*
1970	Mr. D. Niranjan Rao	Studies on the methods of nitrogen incorporation in relation to fertilizer efficiency and yield of rice (*Oryza sativa* L.)	W.H. Freeman
	Mr. V. Subba Rao	The effect of mutual shading on the dry matter production and grain yield in rice (*Oryza sativa* L.)	"
	Mr. K. Pratap Reddy	Studies on the effect of age of seedlings on yields of two photoperiod insensitive high yielding rice varieties (IR 8 and Tainan 3)	"
	Mr. G. Krishnaiah	Some agronomic studies on six dwarf *indica* rice varieties (*Oryza sativa* L.) with different expressions of yield components.	"
1971	Mr. K.P. Puranik	Single plant hills as a means of evaluating the yield potentials of rice selections.	"
	Mr. K. Surender Reddy	Studies on the performance of six rice varieties under irrigated-dry conditions in *kharif* and *rabi* seasons.	"
	Mr. S. Raghuvardhan Reddy	Studies on the effect of planting patterns in combination with times of nitrogen application on production of rice (*Oryza sativa* L.) variety IR 22.	"
	Mr. B. Vittal Rao	Studies on the effect of age of seedlings, spacing, nursery and field fertilization on the rice variety Cauvery.	"
1973	Mr. N. Venkat Reddy	Studies on the effect of sources of nitrogen, times and methods of application in relation to the efficiency of use and yield of rice IET 1991.	"
	Mr. M.J. Wilson	Impact of minikit program of All-India Coordinated Rice Improvement Project on rice production in Andhra Pradesh.	"

APPENDIX IX (*contd.*)

Year	*Name of student*	*Thesis problem*	*Guide from AICRIP staff*
PATHOLOGY:			
1969	Mr. D. Vittal Rao	Some investigations on tungro disease of rice with emphasis on breeding for disease resistance.	V.T. John
1970	Mr. R.S.K.V. Pantulu	Virulence and lysotype studies of *X. oryzae* isolates.	H.E. Kauffman
1971	Mr. B.J. Thapa	Host and chemical induced virulence changes in *Xanthomonas oryzae* (Uyeda and Ishiyama) Dowson.	"
	Mr. Mohd. Sultan Mohiuddin	Virulence and multiplication studies of selected *X. oryzae* isolates.	"
	Mr. R.D.V.J. Prasada Rao	Alternate hosts of rice tungro virus, its vector and other related insects.	V.T. John

APPENDIX X

Existing and proposed staff for the coordinating center at Hyderabad.

Designation of Post	*POSTS*					
			Proposed			
	*Sanctioned**	*Requested to be sanctioned immediately*	*Minikit Program*	*Communication Training Center*	*Fifth Plan*	*Total*
TECHNICAL AND SCIENTIFIC STAFF :						
Project Director	1	—	—	—	—	1
Project Coordinator	—	—	—	—	1	1
Regional Coordinator	—	—	4	—	—	4
Senior Agronomist	1	—	—	—	—	1
Senior Entomologist	1	—	—	—	—	1
Senior Plant Pathologist	1	—	—	—	—	1
Senior Plant Physiologist	1	—	—	—	—	1
Senior Rice Breeder	1	—	—	—	—	1
Senior Soil Scientist	1	—	—	—	—	1
Production Specialist	—	—	1	—	—	1
Agricultural Economist	—	—	—	—	1	1
Information Officer	—	—	—	—	1	1
Communication Specialist	—	—	—	1	—	1
Subject Matter Specialist	—	—	4	—	—	4
Rice Breeder	1	3	—	—	—	4
Rice Breeder (Seeds)	1	—	—	—	—	1
Rice Breeder (Quality)	—	—	—	—	1	1
Agronomist	1	1	—	—	—	2
Physiologist	1	1	—	—	—	2
Soil Scientist	1	—	—	—	—	1
Plant Pathologist	1	2	—	—	—	3
Entomologist	1	3	—	—	—	4
Statistician	1	—	—	—	—	1
Agricultural Engineer	1	—	—	—	—	1
Agricultural Meteorologist	—	—	—	—	1	1
Research Officer (Jr. Breeder)	1	—	—	—	—	1
Junior Breeder (Seeds)	1	—	—	—	—	1
Junior Breeder	—	2	—	—	—	2
Junior Agronomist	—	1	—	—	—	1
Junior Pathologist	—	1	—	—	—	1

APPENDIX X (*contd.*)

Designation of Post	*POSTS*					
			Proposed			
	*Sanctioned**	*Requested to be sanctioned immediately*	*Minikit Program*	*Communication Training Center*	*Fifth Plan*	*Total*
Junior Entomologist	—	1	—	—	—	1
Junior Statistician	—	1	—	—	—	1
Assistant Botanist	2	—	—	—	—	2
Senior Research Assistant	2	—	—	—	—	2
Senior Research Fellow	—	—	—	10	—	10
Junior Research Fellow	6	—	—	20	—	26
Foreman	2	—	—	—	—	2
Senior Photographer	1	—	—	—	—	1
Senior Artist	1	—	—	—	—	1
Bulldozer-cum-Grader Operator	2	—	—	—	—	2
Computor Assistant	3	—	1	—	—	4
Senior Field Assistant	2	4	—	—	—	6
Senior Laboratory Assistant	—	4	—	—	—	4
Mechanic	2	—	—	—	—	2
Field Assistant	4	4	—	—	—	8
Jeep-cum-Tractor Driver/Driver	5	8	5	—	—	18
Printing Press Operator	—	—	—	1	—	1
Mazdoor	10	—	—	—	10	20
Sub Total	60	36	15	32	15	158
Administrative & Ministerial staff	11	8	1	1	14	35
Messengers, Watchmen, etc.	7	8	—	—	—	15
TOTAL	78	52	16	33	29	208

* Posts already sanctioned, include those under the scheme "Production and Maintenance of Nucleus Seed".

APPENDIX XI

APAU Land shaping and irrigation.

Main Project Operation	*Work Item*	*Accomplishment*
IRRIGATION SYSTEM	A) MAIN LINE: 7904 m (4.9 miles)	
1971-73		
(RF, KSU AID, IRRI AID)	30" Pipe	1292 meters
	24" "	1257 "
	21" "	1431 "
	15" "	1303 "
	9" "	1520 "
	B) LATERAL LINES: 8078m (5.0 miles)	
	15" Pipe	1319 meters
	12" "	1920 "
	9" "	515 "
	6" "	3770 "
	18" "	51 "
	C) STORAGE RESERVOIRS: 3 — 23,000 cu. meters	
	Military Tank	12,340 cu. meters
	Lucky Tea Stall Tank	7,404 "
	Dairy Farm Tank	3,085 "
LAND SHAPING (201.9 ha)	Agricultural Research Institute	90.4 ha.
1966-73	Student Farm	22.2 "
(RF)	AICRIP	16.1 "
	IARI Regional Research Station	13.0 "
	Old Sorghum Area	24.2 "
	Gramsevak Training Center	4.0 "
	College Farm	20.2 "
	Central Plant Protection Training Institute	6.8 "
DRAINAGE SYSTEM (5590 m)	Main Drain	1128 meters
1966-69	East-West Drain	1300 "
(RF, KSU AID)	Kotacheru Drain	3162 "

APPENDIX XII

List of foreign technicians and period of employment at AICRIP headquarters.

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

APPENDIX XIII

List of USAID Indian scientists employed in support of the AICRIP headquarters research program and period of employment.

Name	*Period of employment*		*Man Months*
	From	*To*	
Dr. A.P.K. Reddy*	December 18, 1967	April 9, 1970	27
"	October 4, 1971	July 31, 1972	10
Dr. N.P. Saxena	April 1, 1968	June 30, 1973	63
Mr. M.B.V. Narasinga Rao	May 1, 1968	July 6, 1970	38
Mr. E. Ramiah	June 15, 1968	December 16, 1968	6
Dr. N.D. Manikar	August 13, 1968	August 3, 1969	12
Dr. H.L.S. Tandon	December 10, 1968	December 4, 1969	12
Dr. R. Sridhar	August 18, 1969	August 20, 1969	—
Mr. M.N. Prasad**	September 1, 1969	August 10, 1971	24
Dr. V.T. John**	September 1, 1969	June 30, 1973	52
Dr. P. Srinivasa Rao	November 11, 1969	June 30, 1973	50
Mr. G.B. Rajale	March 2, 1970	April 6, 1970	1
Dr. A. Anjaneyulu	April 1, 1970	March 31, 1972	24
Dr. K. Krishnaiah	April 13, 1970	October 31, 1971	21
Dr. C.S. Saraf	June 1, 1970	January 31, 1971	8
Dr. K.S. Amin	June 1, 1970	June 30, 1973	37
Mr. S.N. Kapoor	July 1, 1970	January 31, 1972	19
Dr. N. Narasimha Rao	August 1, 1970	February 28, 1971	7
Dr. Y.K. Arora	July 26, 1971	August 21, 1971	1
Mr. S.F. Quader	August 1, 1971	March 31, 1972	10
Dr. G.S. Upadhya	August 11, 1971	May 1, 1972	11
Dr. G.S. Salunkhe	December 3, 1971	August 30, 1972	9
Dr. N.S. Rao	June 1, 1972	June 30, 1973	13
Mr. B. Chitti Babu**	June 1, 1972	June 30, 1973	13
Mr. K. Prasad**	June 1, 1972	October 28, 1972	5
Dr. S. Khasimuddin	June 14, 1972	June 30, 1973	12

* Dr. A. P. K. Reddy was re-employed at AICRIP after a post-doctoral at the University of Hawai, U.S.A.
He was taken on ICAR payroll beginning Aug. 1, 1972.

** Transferred from RF payroll:
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 " " " July 1, 1970 to May 31, 1971

APPENDIX XIV

List of Consultants to the Rice Project and period of service.

Name	*Discipline*	*Man Months*	*Date of Arrival*	*Date of Departure*	*Support*
Dr. Hideo Okajima	Physiology	1½	Aug. 18, 1967	Sept. 29, 1967	RF
Disease-Insect Survey Team:					
Dr. M.D. Pathak	Entomology	1	Oct. 19, 1967	Nov. 5, 1967	IRRI/AID
Dr. K.C. Ling	Virology	1	"	"	"
Dr. S. Yoshimura	Pathology	1	"	"	"
Dr. J.A. Lowe	Entomology	1	"	"	"
Dr. Masao Goto	Pathology	2	Aug. 11, 1968	Oct. 7, 1968	"
Dr. M.D. Pathak	Entomology	¼	Nov. 2, 1968	Nov. 7, 1968	"
Dr. K.C. Ling	Virology	¼	"	"	"
Dr. H. M. Beachell	Breeding	¼	Apr. 2, 1969	Apr. 12, 1969	"
Dr. T. Ishihara	Entomology	1	Sept. 17, 1969	Oct. 26, 1969	"
Dr. I.W. Buddenhagen	Pathology	½	Oct. 10, 1969	Oct. 26,1969	"
Dr. W.D. Guthrie	Entomology	2	Oct. 24, 1969	Dec. 20, 1969	"
Dr. Karl Maramorosch	Pathology	¼	Feb. 4, 1971	Feb. 13, 1971	"
Dr. I.W. Buddenhagen	Pathology	¼	June 11, 1971	June 21, 1971	"
Dr. (Mrs.) K.A. Gomez	Statistics	½	Oct. 25, 1971	Nov. 6, 1971	"

APPENDIX XV

ICAR professional staff at AICRIP headquarters, 1966-73.

Name	*Title*	*Period of employment* *From*	*To*
Dr. S.V.S. Shastry	Project Coordinator	April 1966	To date
Dr. D.V. Seshu	Asst. Botanist	July 1966	July 1971
,,	Research Officer	July 1971	May 1972
,,	Sr. Rice Breeder	August 1972	To date
Mr. T.E. Srinivasan	Asst. Botanist	July 1966	To date
Mr. J. Ramakrishna Rao	Asst. Botanist	June 1966	May 1971
,,	Asst. Botanist	December 1971	To date
Dr. A.V. Rao	Statistician	September 1972	To date
Dr. U. Prasada Rao	Research Assistant	August 1969	June 1972
,,	Research Assistant	September 1972	To date
Dr. K. Gopalakrishna Pillai	Agronomist	July 1972	To date
Dr. B. Venkateswaralu	Physiologist	August 1972	To date
Dr. J.C. Katyal	Soil Scientist	September 1972	To date
Dr. M.B. Kalode	Entomologist	November 1972	To date
Dr. A.P.K. Reddy	Pathologist	August 1972	To date
Mr. G.C. Dohare	Farm Superintendent	February 1973	To date
Mr. B.T. Shankara Gowda	Research Fellow (Breeding)	August 1972	To date
Mr. Kasi Viswanadham	Research Fellow (Entomology)	August 1972	To date