Irrigation Research and Management Improvement Organization
Central Water Commission

United States Agency for International Development

WATER RESOURCES MANAGEMENT AND TRAINING PROJECT

ACTION RESEARCH COMPONENT REPORT

Louis Berger International, Inc.
Water and Power Consultancy Services (India) Ltd.

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FOREWORD

This report has been prepared by Louis Berger International, Inc. and Water and Power Consultancy Services (India) Ltd. on behalf of the Irrigation Research and management Improvement Organization, Central Water Commission, and the United States Agency for International Development under the Irrigation Management and Training Program of the Water Resources Management and Training Project (WRM&T) No. 386-0484.

A major component of the Water Resources Management and Training Project has been the establishment of Action Research Programs at the 11 Water and Land Management Institutes: WALMI,Anand, Gujarat; WALMI, Aurangabad, MAHARASHTRA; WALMI, Bhubaneswar, Orissa; WALMI, Bhopal, Madhya Pradesh; WALMI, Dharwad, Karnataka; WALAMTARI, Hyderabad, Andhra Pradesh; CWRDM, Kozhikode, Kerala; IMTI, Kota, Rajasthan; WALMI, Okhla, Uttar Pradesh; IMTI, Tiruchy, Tamil Nadu; and WALMI, Patna, Bihar.

This report is the final component report on action research, compiled by Dr. John C. Baxter and Dr. A.B. Pattanaik, LBII/WAPCOS Resident Team members who mainly coordinated and guided the Action Research efforts at the State Training Institutes.

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ACTION RESEARCH COMPONENT REPORT

INTRODUCTION

Action research, as a component of the Water Resources Management and Training Project, has been given considerable support as a means of improving quality of training at the state training institutes (STIs) or Water and Land Management Institutes (WALMI) and as a means of improving the operation and management of irrigation systems. This report has been written to present a broad overview and evaluation of the action research program.

This component report discusses elements of the action research program that have proved to be successful or unsuccessful, and the reasons for success or failure. We have not tried to recapitulate all action research activities that have taken place at the 11 participating institutes, though we have listed (Table 1.) each of the STIs and the name of the irrigation project in which action research is or has been conducted. Information contained in the annex of this report briefly discusses action research activities at each of the STIs and was part of a status report prepared on action research at the end of 1991.

The basic concept of action research and expected benefits were initially described in the 1983 USAID/India Project Paper, "Irrigation Management Training".

> "The concept of action research involves essentially a long-term, on-site case study of an irrigated area sufficiently large to be representative of a complete system. Action research studies result in identification of problems constraining optimal irrigated agricultural production on the system being examined; the formulation and implementation of corrective actions; the monitoring and evaluation of their impact, and potential for broader application; the preparation of analyses reporting these findings; and, the holding of on-site demonstrations, seminars. and workshops."

The benefits of this type of program were listed as follows.

a. A more thorough and accurate understanding of actual irrigation problems;
b. Personnel assigned to the study would develop a sounder and more comprehensive understanding of irrigated agriculture and the problems facing functioning irrigation systems, thus would be in a better position to make more informed decisions and higher quality professional contributions;
c. Farmers living in and near the study areas would benefit directly and immediately from system improvements, and from new technologies and procedures.
d. Formulation of site specific corrective actions that, if effective, could be adapted for broader application on other systems.

Table 1. Listing of each STI with the name of the action research site.

State	Action Research Project Site
Andra Pradesh	1. Sri Rama Sagar - Dakatiya Canal 2. Shameerpet Project
Bihar	1. Sone Canal System - Paliganj Dist. 2. Gandak Project - Jamunia Branch
Gujarat	Mahi Right Bank Canal - Borsad Branch
Karnataka	Malaprabha Project - Right and left bank canals
Kerala	1. Kuttiadi Project 2. Gayatri Project
Madhya Pradesh	1. Halali Project-Samrat Ashok Sagar Project
Maharashtra	1. Pus Medium Irrigation Project 2. Nazare Project
Orissa	1. Mahanadi Delta Irrigation Project - Atala & Delang Minors 2. Kuanria Medium Irrigation Project
Rajasthan	Gudha Medium Irrigation Project
Tamil Nadu	Cauvery Delta Irrigation System - A class channels
Uttar Pradesh	1. Agra Canal System - Jait Minor 2. Sarda Sahayak Pariyojana - Sarda Canal System

e. The use of study sites for shorter term field work by technicians and professionals receiving training at STIs. This would serve to retain through practice on real systems the concepts introduced in the classroom.

f. The preparation of case-specific reports and articles and the holding of on-site demonstrations and workshops to begin the process of technology transfer. Findings and analyses would be distributed throughout the state irrigation and agriculture departments, including the extension service, and to the central training facility and STIs for widespread, systematic dissemination."

The WALMI's training mission is to involve staff and trainees in the process of managing and researching real-life community development issues; to blend the technical and practical aspects of water and land management to produce training programs that are not only grounded in scientific principles, but also to teach the practical aspects of water and land management. Action research can and should be one mechanism by which new and effective training materials are identified and developed. The objectives of action research as a WALMI activity could be summarized as follows:

- To provide a means by which trainees and faculty can obtain "hands on experience" in different aspects of land and water management in order to enhance the development of professional competence.
- To increase WALMI staff's understanding of the dynamics of irrigation management. To provide information vital to the development of relevant curricula in land and water management.
- To provide case studies that can be used in the WALMI's teaching programs.

The Irrigation Management and Training Project was initially established because it was realized that there was a need to develop a well trained cadre of irrigation professionals within the irrigation and other government departments involved with irrigated agriculture. It was recognized that university training was not designed to meet the specific needs of the irrigation professional; thus, there was a need to develop training institutes that could train professional irrigation managers. Because the WALMIs are all relatively young as institutions, they have concentrated their efforts towards construction of WALMI infrastructure and the development of course materials. For new institutions, whose primary responsibility is training, this emphasis has been justified. And generally it could be said that the WALMIs have done a good job in developing course materials and farmer training programs. However, as yet, they have not utilized action research to learn about irrigation or to provide information for their teaching programs. It could be said, that there is an attitude of "what needs to be known, is known".

EVALUATION OF THE ACTION RESEARCH PROGRAM

One method of examining how effective or ineffective the action research program has been is to examine the expected benefits as outlined in the project paper (and listed on pages 1 and 2). The first two benefits (a and b) underscore that personnel involved with action research would gain a more thorough understanding of irrigation problems and thus would be in a position to make better decisions later in their careers. For the most part, we believe this to be true. Virtually all personnel involved in action research have expressed the opinion that actual management of an

irrigation system is far more complex and difficult than they had realized. Additionally, most action research personnel have become cognizant of the difficulties of measuring water, or for that matter, the difficulties of measuring almost any irrigation performance parameter.

While action research personnel have received a "real life" education, there is very little evidence that this practical knowledge is being transferred to anyone other than those few individuals directly involved. This is due to several reasons. First, very few STI faculty are directly involved in action research. In most instances senior level personnel are responsible for the research, but they do virtually none of the actual work, none of the data collection, none of the report writing, and participate in very little of the learning. Action research efforts at most STIs has been given to junior personnel; thus, those capable of documenting, reporting, and incorporating anything learned, into training programs, have been effectively eliminated from action research activities. Part of this problem is related to the fact that almost all action research sites have been very poorly selected, and are at considerable distances from the WALMI campuses; thus, traveling to the action research sites does, in most circumstances, represent a severe problem. However, the larger problem is a cultural one. Individuals involved in research simply have a lower social status than those who teach. This fact is true throughout virtually all Indian university and research institutions; thus, it is usually the case that only junior personnel are assigned research responsibilities.

The role of action research within each WALMI needs to be clarified and perceived as an important component of the WALMI's training activities. Presently, action research is perceived as little more than an

THINGS THAT STIs SHOULD DO TO ENCOURAGE ACTION RESEARCH.

1. Incorporate the objectives of action research into the objective statements of each STI as part of their training program.

2. Insure that there are STI policies in place which define the role of the action research unit. These policies should encourage action research within the irrigation departments, CADAs, state agricultural departments, and other agencies which may impact water and land management.

3. Each STI should clearly define statements as to what, how, and where research results will be utilized in training and course materials.

4. Establish job descriptions and minimum qualifications for action research personnel an strengthen inter-disciplinary character of core faculty conducting action research.

administrative function. For example, at Aurangabad there are two Joint Directors, one handles course-faculty development issues, while the other handles administrative issues, action research is assigned to the administrative joint director. The fact that action research has been perceived as an administrative function has contributed to the low status of action research within many of the WALMIs. Action research can not be conducted by junior personnel who have little irrigation management training or experience. Interested core faculty need to be actively involved in action research.

The third benefit listed in the project paper addresses the fact that farmers living in and near action research sites would benefit directly. For the most part, farmers directly involved in action research activities have been benefitted. They have received many training programs, which could only have had a beneficial effect. They have also received various subsidies, usually in the form of rehabilitated irrigation delivery systems, which has probably led to increased water flows; though, in some cases water flows have simply increased - a phenomena euphemistically referred to as "dedicated water". In some cases direct cash contributions have been made to encourage farmers to initiate water user associations. All of these activities have benefitted local farmers, but in reality, very few of these benefits are replicable on a broader scale.

One of the expected benefits of action research, was that successful interventions would be replicated and adopted on a broad scale to other irrigation systems. One means of accomplishing this is obviously the publishing of articles and reports. Most of the STIs have published or are in the process of publishing results from their action research activities. Documentation concerning observed problems regarding physical infrastructure of irrigation systems are, for the most part, adequate. All of the reports, as a part of their diagnostic activities, detail plans to remove the observed problems. However, action research activities end after describing the problem and conducting a planning exercise to remove identified irrigation and agricultural production constraints. No WALMI has measured water flows, either prior to, during, or after action research activities. No WALMI has examined factors to determine if irrigation water is being utilized more efficiently, equitably, or productively as a consequence of action research activities. No WALMI has examined main system management (beyond a theoretical water balance study) or implemented a main system management plan. While there has been a considerable amount of effort regarding adaptive research, there has been no analysis of adoption rates by farmers or analysis of reasons for non-adoption. All of the STIs, however, have reported that their action research programs have been successful. And this brings up the central problem or issue with all of the action research efforts carried out to date.

The basic concept of action research was to test various interventions to determine what worked and what did not. Action research serves no purpose if all interventions are judged successful, regardless of ground based realities. As advisors to the action research efforts, we initially came to the conclusion that those involved in action research were poorly trained and thus had difficulties implementing and monitoring action research activities. While there is some truth to this conclusion, this turns out to be a simplistic answer. The reality of the situation is far more complex and is hidden in the culture of government bureaucracies.

Action research is carried out by the WALMIs under difficult circumstances. The circumstances are difficult because there are competing forces operating on and influencing the researchers. The least complex issue is one of simple honesty. To point out that research data is frequently made up, manufactured, or misused to satisfy superiors, or to insure "success" and enhance a researchers reputation, is not a new problem, nor is it unique to India. The pressure to report that various interventions are successful, has led to the situation in which projects which have demonstrated no positive benefits, are reporting that they have been successful. This problem is not unique to the Water Management and Training Project, and has been reported by others[1]. What we have found to be unique to the Indian situation is that frequently researchers are not permitted the freedom to report what we refer to as ground based truths. To site an example, at several different research sites we determined that action research personnel were very reluctant to report the actual irrigated cropping pattern. Fields that were obviously sugarcane were being reported as jowar or wheat, the action research personnel were extremely reluctant to document this fact because this information had the possibility of being used against irrigation department personnel. The same personnel that could possibly be responsible for their transfers and promotions at a future date. Another example was at a site where water flows were recorded for one irrigation cycle. After this first cycle the flows became remarkably uniform, all outlets flowing at the designed discharge. The truth of the situation was that flow measurements were actually discontinued, primarily because this information could have been used against someone.

State irrigation departments can be perilous places to work. Political and personal animosities can be easily acquired, and one never knows how an animosity may hurt him at some future date. In a similar manner, an individual can gain the favor of another,

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1. See R. Chambers. 1988. Managing Canal Irrigation. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, Bombay, Calcutta. Chambers discusses a number of action research irrigation studies in which demonstrated "success" was more important than learning the truth.

obviously favors are more desirable. We have had junior personnel relate to us that they could not possibly report what was actually happening in the field. They had been transferred into the WALMI (under extremely short notice) as punishment, and they didn't desire further punishment.

Rewards and sanctions for the quality of work accomplished by WALMI and irrigation department personnel are management issues that need to be addressed by the irrigation departments. This is an area that is beyond the influence of the WALMIs, and has been addressed as an issue under the operational and procedural changes (OPC) component of the Water Management and Training Project. We continuously came back to the conclusion, that management changes within irrigation departments were required, before action research activities could ever have a positive effect on irrigation management. Action research starts with the premise that irrigation departments (and other governmental departments) want and will do the things required to manage irrigation systems more effectively; however, at this point in time, this statement may not be true. This issue leads one to the question as to which comes first, action research or OPC (the chicken or the egg)? We have concluded that OPC must come first.

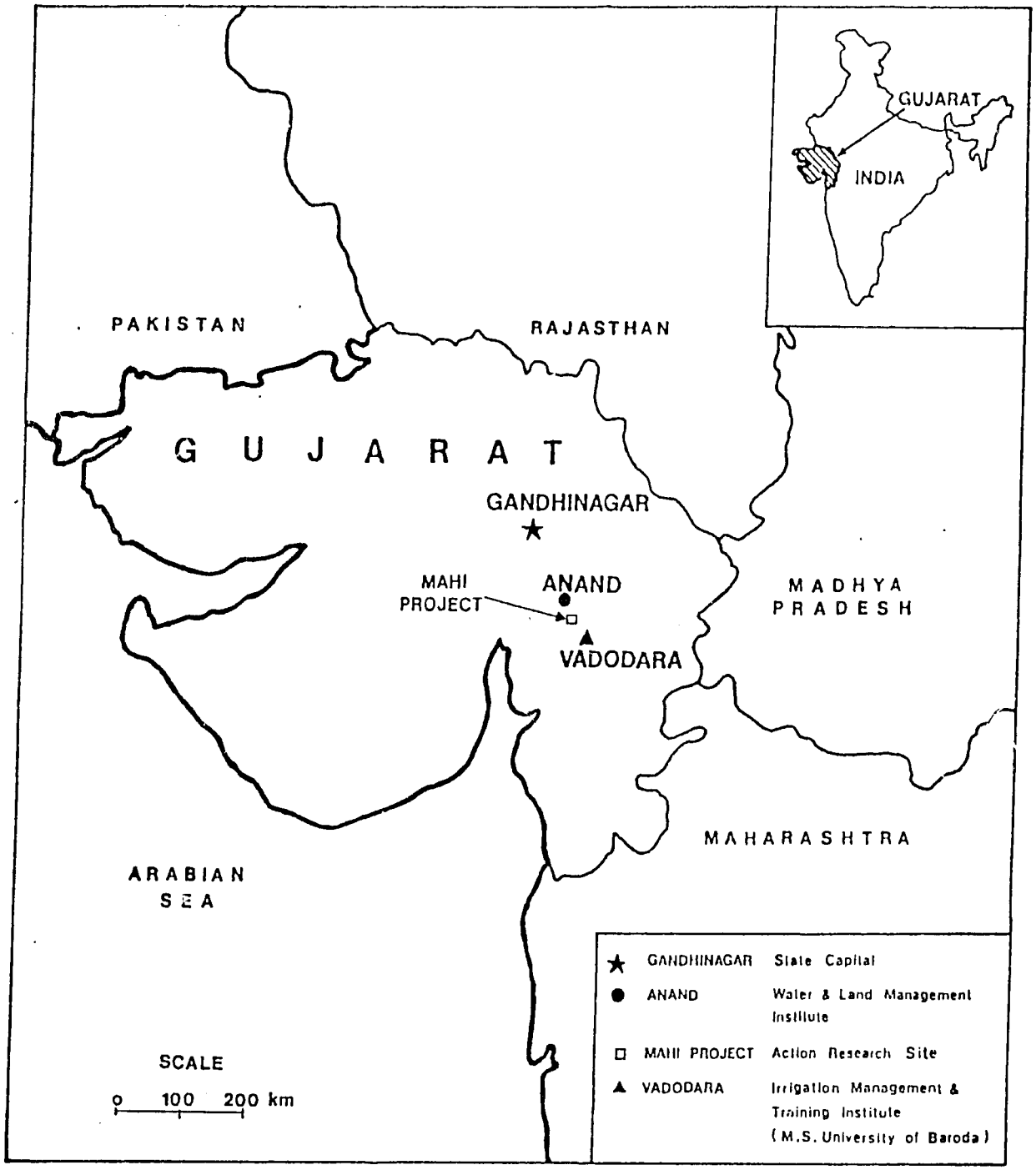
One consequence of the above factors has led many of the WALMIs to concentrate their action research activities in the area of water user associations, frequently to the exclusion of other irrigation management activities. However, efforts to organize and train farmers are not likely to have much success, if water user societies and cooperatives can not be assured of adequate and reliable supplies of water. A number of the WALMIs have claimed considerable success in organizing farmers and improving irrigation efficiencies and agricultural productivity; however, no WALMI has any reliable evidence to support those claims.

CONCLUSIONS

To date there is no clear evidence to suggest that the action research programs have had a significant impact on irrigated agriculture; however, the same could be said of the WALMIs as a whole. When the WRM&T Project was initially conceptualized it was realized that there was a great need to develop a sense of professionalism within all government personnel involved with irrigation management. The concept of "professionalism" is probably the single largest problem facing the GOI, state governments, irrigation departments, and the STIs. By professionalism we are referring to the ethical values and behavior that is dominant among irrigation professionals. We believe that the STIs have an important role in teaching professionalism in their education and training programs, and that they are accomplishing this. However, the "system" as it presently exists, is and will be, difficult to change. The WALMIs through their programs are a first step to accomplishing this task.

ANNEX

WATER & LAND MANAGEMENT INSTITUTE
ANAND, GUJARAT



Action Research was initiated in 1985 on the Adas and Anklav distributaries of the Borsad branch of the Mahi Irrigation Project. Diagnostic Analysis (DA) of these two distributaries was completed in 1985. Under the Action Research program, the capacity of Adas distributary was increased from 140 to 200 cusecs. Other improvements have included redesign of field channels and chaks and removal of unauthorized outlets. Farmer irrigation groups were formed at the sub-chak level (5 to 8 ha).

Description of the Mahi Irrigation Project

The Mahi river is a major river of central Gujarat. Completion of Kadana reservoir, 1,470 Mcm of live storage, provides irrigation through all three seasons. The total Culturable Command Area (CCA) and Irrigable Command Area (ICA) of the project is 2.12 lakh and 1.86 lakh ha, respectively. The total irrigation potential envisaged on this project was 2.60 lakh ha. The maximum actual irrigation achieved has been 1.34 lakh ha in 1982-83, which was only 52% of the total irrigation potential created.

The Government of Gujarat recommended Mahi Project for the Action Research Program based on the following considerations.

i) There was reliability of water as the reservoir fills almost every year.
ii) The response of the farmers and government officials in all disciplines was favorable and encouraging.
iii) There was scope of increasing water utilization with minor improvements in canal systems as well as operational methods.

iv) There was a good possibility of conjunctive use of surface and ground water.

v) Improvement in utilization of created irrigation potential on this project would have a large impact in improving the overall picture of the state.

vi) The area selected for Action Research comprising 37,140 ha under the Borsad branch is distinctly separate and did not involve technical or financial assistance from any other foreign agency.

vii) Funds required for undertaking works on the existing system and on-farm facilities to make them function adequately, could be budgeted within the planned funds.

viii) There was no water allocation dispute with any other state; therefore, there was freedom to modify releases and operation of the reservoir.

ix) The site was easily and quickly approachable to the Action Research Unit, being about 115 km from WALMI Gandhinagar.

x) Earlier no interdisciplinary approach had been implemented fully on this project.

xi) The site was located in representative soil types in which other agencies are not involved.

xii) The project represented the general cropping pattern of the region in which improved management had not been tried.

A study of the Mahi Right Bank Canal system attributed shortfall in irrigation mainly due to the following factors.

i) Inadequate capacity of canal systems to supply water in the tail end command during the period of peak demand.

ii) Insufficient control structures, particularly in distribution systems.

iii) Poor and deferred maintenance of on-farm development works.

iv) Inadequate maintenance of drains.

v) The actual area under wheat and other Rabi crops was only 14,807 ha against 68,583 ha proposed in the project.

vi) Practically no cotton crop was grown in the command area as envisaged in the project proposal (17,166 ha).

vii) A number of other reasons like efficiency of physical system, management efficiency, management practices, availability of credit and market facilities, fluctuation of market prices, and lack of participation by farmers also contributed to the short-fall in actual irrigated agriculture.

Details of Pilot Project Selected for Action Program

The area selected for Action Research studies comprises about 37,140 ha of CCA under the Borsad branch of the Main Right Bank Canal project. This branch takes off from the tail of the main canal. The design capacity of the main canal at the tail is 1,500 cusecs and is fully lined. The controlling point for release of water in Borsad branch is at R.D. 2,22,000 ft on the main canal which is situated about 7,000 ft upstream of the off-take point of Borsad branch. Borsad branch was designed for a discharge capacity of 1,345 cusecs in an unlined section. The branch is 23.8 km long and was totally lined subsequently with a CCA of 37,148 ha with actual irrigation of about 18,000 to 20,000 ha.

Action Research studies were comprised of two components:

i) Organizational, procedural and operational problems of the main system for which an area of 12,000 ha. under

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Adas and Ankalav distributary of Borsad branch was selected. However, for effective regulation of water deliveries the entire command of Borsad branch was brought under the Action Program.

ii) For studies relating to on-farm facilities, farmers organization, operation and maintenance of facilities within the outlet command, an area of about 1,145 ha under the command of Ankalav sub-minor (sub-minor of Adas distributary) was identified.

Adas distributary takes off from ch. 7,180 ft of Borsad branch and is controlled by a cross regulator provided on the downstream side at 7,800 ft, while Ankalav distributary takes off from ch. 21,727 ft and is controlled by a cross regulator on the downstream side at ch. 22,600 ft of Borsad branch. The details of the two distributaries are given below:

Item	Adas Distributary	Ankalav Distributary
CCA	6660 ha	7449 ha
Length of:		
a. Distributary	8.04 km	11.67 km
b. Distribution System	50.21 km	47.91 km
Designed Discharge	3.92 cumecs	3.45 cumecs

The maximum actual irrigation observed during 1981-84 was 1,992 ha on Adas distributary and 3,119 ha on Ankalav distributary in the year 1981-82, which was very about 30% and 58% of their respective CCA. The details of the Ankalav sub-minor selected for study of on-farm facilities are:

1. CCA = 1145 ha
2. Length = 9.2 km
3. Designed discharge = 0.61 cumecs.

Maximum irrigation achieved in 1982-83 was only 460 ha (40% of the CCA).

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Constraints Identified in the System

The diagnostic studies carried out for the main system and operation of canals indicated the following constraints.

i) Inadequate carrying capacity of the canal.

ii) Heavy seepage losses in some vulnerable reaches.

iii) Water not reaching the tail end due to absence of rotational water supply (RWS).

iv) Area under paddy cultivation increasing though soils are not suitable.

v) Inadequate control structures and measuring devices.

vi) Poor maintenance of field channels and structures.

vii) Lack of extension activities of the Agriculture Department.

The following corrective interventions were implemented.

i) The capacity of the Adas distributary was increased from 138 cs to 200 cs after modifying of the cross section by raising the FSD by one ft. and 9 out of 15 C.D. works and repairs to other C.D. works where necessary.

ii) Total number of outlets on Adas distributary were reduced from 40 to 27 based on topography.

iii) The capacity of Ankalav sub-minor was increased from 21 cs to 30 cs by raising its FSD by one foot and modifying 7 of 15 C.D. works by inserting 2' to 3' diameter pipes.

iv) The actual CCA of the Ankalav sub-minor was 500 ha against the design CCA of 1145 ha. By conducting field to field survey of the command area and carrying out modification works, an additional area of 500 ha was brought under command. The number of outlets were reduced from 52 to 39. these modifications enabled water to reach the tail end of the 26,000 ft long Ankalav sub-minor.

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Implementation of Rotational Water Supply

Regarding rotational water supply, the following three methods were being tried on different systems selected for micro-planning of O.F.D. works:

i) In case of Ankalav sub-minor, water delivery schedules for various outlets were prepared for the 1987-88 Rabi season considering the depth of watering at plan equal to 82.91 mm and that at outlet equal to 121.92 mm with a total of six irrigations. The stream size considered in this case was one cs for each outlet.

ii) Regarding the 310 ha under sub-minor 9/R ex-Ankalav distributary, the outlets were provided proportional discharge according to chak size. In this case, the period of rotation of all the outlets was kept constant, with variable discharge in different outlets in accordance with the respective sizes of the chaks.

iii) The Kinkhlod minor, with an area of about 1,175 ha, was subsequently selected for micro-planning. It was planned to take up rotational supply only after the farmers had come forward with a clear understanding, in writing, that they would maintain the field channels themselves and would form pipe committees (group of farmers). They would also agree to enforce a system of turns from outlet to outlet and farmer to farmer based on the principle that each farmer will get his share of water proportionate to his land holding within the command.

Extension Activities

Under this activity, farmers' education and training on

"on-farm water management practices" was undertaken through different methods such as:

a) Adaptive trials
b) Group meetings and discussions
c) Farmers' training
d) Farmers' water users' associations
e) Generating extension literature
f) Film shows.

a. Adaptive Trials

Adaptive trials were planned and are being carried out on the fields of farmers themselves in respect of the following topics:

i) At present sowing is very late in the area therefore trials of early sowing of paddy to facilitate a second Rabi crop.
ii) Presently only well water or well and canal water is being used for tobacco, therefore trials using exclusive canal water is being tried.
iii) Trials with packages of practices for hot weather groundnut.
iv) Trials with mustard crop in Rabi which is a less water consuming crop.
v) Alternative furrow irrigation in cotton to minimize water use.
vi) Proper land preparation and irrigation methods for crops like wheat, mustard, etc.

b. Farmers' Water User Association

The extension staff of the Action Research unit have encouraged farmers to form a Water User Association. The farmers now understand that in order

to get assured water supply from the department, the best way is to be represented collectively by a Water User Association. This will also help in solving other problems related to irrigation and agriculture. Pipe outlet committees and a sub-minor committee presently exist on the Ankalav sub-minor.

c. Extension Literature

Pamphlets on the following topics were reported to have been prepared in the local language for circulation among the farmers of the command area in order to guide them properly in their day to day activities of irrigated agriculture.

i) Importance of water in command area
ii) Methods of irrigation
iii) Importance of mustard crop
iv) Irrigated wheat cultivation
v) Potato cultivation in command area.

Soil Testing

In order to acquaint farmers about the soil condition in the fields and to guide them properly about the use of fertilizers, a mobile-van with soil testing laboratory from the Department of Agriculture was arranged at Ankalav village. Soil samples were taken from the command area and after analysis, reports were made available to the farmers with due recommendations for fertilizer doses.

Adaptive Research

In addition to adaptive trials, adaptive research studies in the following broad areas have been initiated.

a) Studies on proper dose of irrigation water for crops like paddy, banana, wheat and groundnut.

b) Studies on irrigation methods for various crops like wheat, groundnut and cotton.

c) Studies with optimal and sub-optimal doses of fertilizers under canal irrigation for various crops.

d) Studies with sub-optimal doses of canal irrigation water for different crops viz. paddy and wheat.

e) Studies on introduction of crops like mustard, tomato, summer mung bean, fennel and others.

f) Studies on inter-cropping with banana.

This work was taken up during the year 1989-90 covering the crops banana, wheat, cotton, tobacco and paddy. A report detailing the results of these activities was published by the Department of Agronomy, Gujarat Agricultural University in 1991.

Progress to date

WALMI Gujarat recently contracted with the Sardar Patel University to conduct an interim socio-economic survey of the action research area. This publication entitled "Action Research Programme an Interim Evaluation (A Case study of Mahi Kadana Irrigation Project)" was recently released (fall, 1991). The publication attempts to make comparisons of the action research areas to that which existed at the beginning of the program. Data within the report (Chapter VI) would suggest that agricultural productivity (through increasing irrigation intensities) has increased significantly. Additionally, measured irrigation efficiencies would appear to have improved dramatically, particularly in the micro-planned action research area where the

WALMI has been working to organize farmers. An examination of this area by the LBII/WAPCOS staff revealed that the action research area was receiving more than twice the amount of designed discharge. This fact tends to throw doubts on claims of any benefit accrued to this area.

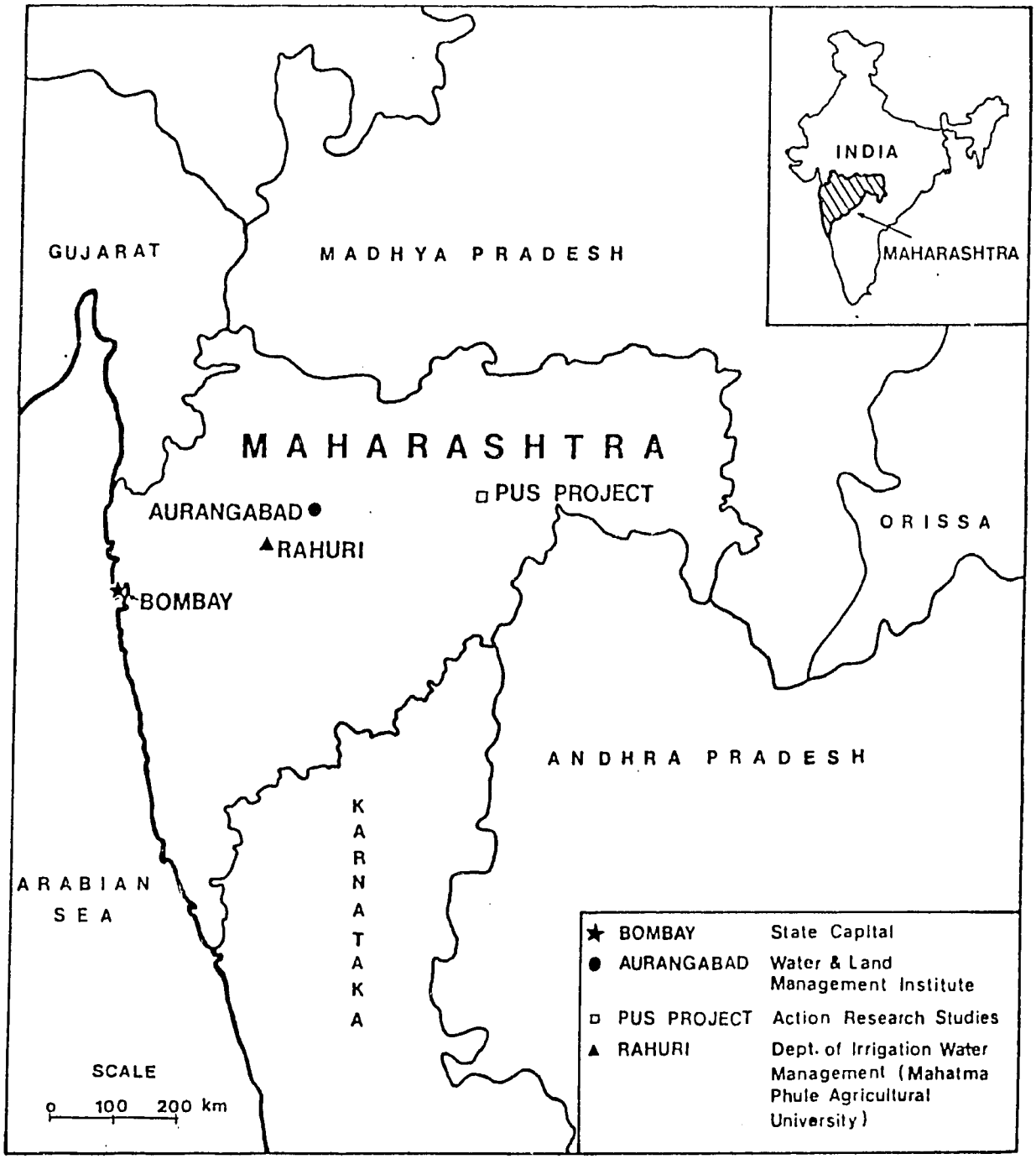
CONCLUSIONS

The Action Research program has carried out a significant amount of extension work and has published a number of booklets on irrigation and crop technologies. Adaptive trials have also demonstrated successes, i.e. tumeric and ginger inter-cropped in banana.

Water is now reaching tail areas which had not previously been irrigated. This has been accomplished by increasing water flows. Irrigation intensities over the entire project and particularly in the action research area have increased. Thus, agricultural production has steadily increased in this area since 1987.

The Action Research program at Anand has shown considerable success, particularly in the area of farmer organization. The WALMI is presently assisting the farmers to form a water cooperative and is expanding its activities to other distributaries. These activities have led the state government to consider legislation through which irrigation water in the Sardar Sarovar Project will be supplied on a volumetric basis to farmer irrigation groups.

WATER & LAND MANAGEMENT INSTITUTE
AURANGABAD, MAHARASHTRA



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Action Research was initiated at the Pus Medium Irrigation Project in 1984. Four minors with a total command area of 1473 ha are being studied. Diagnostic Analysis (DA) of these minors was carried out in 1984-85 and a series of DA workshops were held in 1986. In 1987 an "Action Research Programme for Pus Project" was developed. The plan laid out a series of actions to be taken at the project. These actions consisted primarily of rehabilitation and improvement of the irrigation delivery system, introduction of rotational water supply, and to revive defunct outlet and minor level irrigation committees. Reports of these activities were published in 1988 and are briefly described below.

Pus Project

The Pus project consists of an earthen dam across the Pus river and a pick-up weir 2 km downstream in the Pusad Taluka of Yavatmal District. The reservoir has a live storage of 3,223 mcft. Two canals take off from the weir, one on the left bank and the other on the right bank. The total CCA of the project is 13,679 ha and the irrigable area is 8,215 ha. The command covers area in Pusad and Mahagaon talukas of Yavatmal district. The project was completed in 1971 at a total cost of Rs. 509.8 lakhs. The maximum irrigation achieved was 4,308 ha in the year 1981-82. The Government of Maharashtra selected the Pus Medium Irrigation Project for Action Research studies with the objective of increasing agricultural production and efficient use of water. The following were the main considerations in selecting the project under the Action Research Programme.

(i) The project was representative of medium projects in the state where irrigation utilization was less than 50%.

(ii) The physical system of the project and on-farm facilities were in reasonable condition.

(iii) No technical and financial assistance from any foreign agency was needed for this project.

(iv) An inter-disciplinary approach had not been tried or implemented on this project.

(v) It was possible to implement the findings of the studies on a reasonable area and show the results.

For detailed studies, the following four minors in different soil types and different reaches of the canal were selected.

1) Bhojala Shiv Minor - Head reach of RBC
ii) Pokhari Minor - Tail reach of RBC
iii) Itawa Minor - Head reach of LBC
iv) Hudi (2) Minor - Tail reach of LBC

The details of the minors are:

	Length (km)	Discharge (cusecs)	ICA (ha)	No.of outlets	No.of cultivators	Av. outlet size (ha)	Av. holding (ha)
1. Bhojala Shiv	2.73	10	273	17	133	16	2.1
2. Pokhari	4.05	10	400	33	220	12	1.8
3. Itawa	6.2	12	416	21	181	20	2.3
4. Hudi (2)	4.68	10	384	39	174	10	2.2

Action Programme Initiation

After selection of the project and minors, a workshop was held at Pus project site in october 1984 with a view to apprise the personnel connected with the programme regarding the objectives of the action programme and further lines of action. It was decided in the workshop to collect detailed data on the following topics as a Bench-mark survey of the project.

i) Irrigation system - Evaluation of main system up to the outlet and on-farm system below the outlet.
ii) Soil - Collection of past data on soil survey and carrying out of soil survey on selected minors.
iii) Agriculture - Collection of crop details, land use, yields etc. of all the crops in the command and evaluation of existing T&V system.
iv) Ground water use - Collection of irrigation data on wells.
v) Drainage - Collection of data on existing natural drains in the command and surface drains in the field.
vi) Irrigation - Organization, procedure, water allocation, water charges, recovery etc.
vii) Cooperative credit - Data on present status.
viii) Social and economical - Carrying out socio-economic survey of four selected minors.

The data was collected by an inter-disciplinary team which included engineers from the WALMI and Irrigation Department, agronomists from the WALMI and Agricultural University, sociologist from the WALMI, extension experts from Agricultural University, and research workers from the Directorate of Irrigation Research. The data collected was analyzed and priorities for improvements and modifications were then fixed.

Constraints Identified in the System

As a result of diagnostic analysis carried out by the multi-disciplinary team, the following main constraints were identified in the main canal system and the selected minors:

A. Physical System

i) There was silt deposition in the canals resulting in the reduction of discharge capacity.

ii) First 2 km of LBC passing through deep rock cutting was not lined which resulted in passing low discharge.

iii) No continuous service road existed along the canals or minors.

iv) There were no cross regulators and escapes on the canals.

v) There were heavy leakages at some structures.

vi) There was lots of vegetative growth in the minors resulting in reduction of discharge capacity.

vii) There were no measuring devices in the minors, the sill level of outlets were higher than bed levels of the minor.

viii) The pre-cast outlets were in very bad condition and the lift type gates were not functioning properly.

The deficiencies below the outlet were:

i) The field channels were silted and needed renovation.

ii) There were no division boxes, turnouts, or measuring devices on field channels.

iii) There were no field drains and field channels were not connected to natural drains.

iv) There were no farm roads.

B. Water Use

i) The requirement of water at distributary head assumed in the project planning was inadequate.

ii) The transit losses, assumed at 15% in kharif and 20% in hot weather, were low. Actual measurement in 1986 showed the following losses on the main canals, minors and field channels.

RBC & LBC	- 41 to 64%
Minors	- 20 to 30%
Field Channels	- 20 to 40%

iii) Hot weather groundnut crop, which was not considered in the planning stage, was being irrigated on a large area and sown in January. This requirement needed to be considered in Rabi as well as summer season.

iv) Lands were not properly leveled to receive the water and night irrigation was not being practiced.

C. Agricultural Extension

The T&V system was in operation in the command since 1984. The effectiveness of the system was evaluated and the findings were:

i) The messages given by T&V staff were only in the use of recommended varieties of chemical fertilizers; thus, there is a need to incorporate in the messages modern irrigation management issues. For this purpose training of existing staff was required.

ii) No separate messages were given for irrigated agriculture.

iii) The T&V officials should inform the farmers about the duties of system and their expectations from the farmers. The visits of the grass-root workers should be made known to the farmers.

iv) Selection of contact farmers should be done carefully and the farmers to be informed about their duties so

that the contact farmers are able to play an effective role in technology transfer from farmer to farmer.

v) The deficiencies spelt out by a majority of farmers were that too many farm families were attached to grass-root workers, the information advice given was untimely and the quantity of seeds provided was insufficient for conducting crop demonstrations.

D. Socio-Economic Study

No socio-economic survey of the project was carried out either before or after commencement of irrigation. Therefore, such survey was carried out for the area served by the four selected minors to serve as a Bench-mark survey. The main findings of this study were:

i) The benefits of irrigation in terms of productivity, farm profits, market surplus and development of dairy development were positive.

ii) The farmers were not aware of scientific methods for inter-cropping.

iii) Inadequate supply of water with improper time schedule for irrigation have affected yields.

iv) Farmers apply nutrients much below the recommended levels.

v) Inadequate supply of short term and medium term credit has resulted in low level of adoption of technology.

vi) The factors which caused under utilization were undulating land, faulty location of gates, non-maintenance or absence of field channels, inadequate and untimely irrigation water supply, etc.

vii) Farmers indicated that the decline in soil fertility was due to irrigation.

Work done under the Action Research Programme

The various constraints identified in the system were discussed in the workshop held in April 1985 and July 1986 and priorities for different actions to remove the constraints were decided upon. Accordingly, physical system improvements/modifications of the three minors viz., Bhojala, Itawa and Pokhari along with OF works were carried out.

The modifications/improvements carried out on the Left and Right Bank main canals are shown below.

Desilting of Canals

i) Since the start of irrigation in 1971-72, no maintenance nor repairs of the canals had been undertaken, hence 0.3 to 1.0 m depth of silt had deposited which reduced the discharge capacity of the canals. This silt was removed from both the canals (70 km length).

ii) Some of the damaged structures on the main canal which leaked heavily were repaired and leakages reduced considerably.

iii) Two SWFS on canals were not in working condition. These were redesigned and modified. Similarly on the straight lengths of canals 95 gauge posts were installed.

iv) Continuous service roads with murum topping wherever required and seven causeways were provided.

The modifications/improvements on Bhojala, Itawa and Pokhari minors including OFD works were:

i) Resectioning of minors and repairs/reconstruction of structures thereon.

ii) Providing screw type gates in place of damaged pre-cast gates and reconstruction of outlets wherever necessary.

iii) Measuring devices at the head of the minors.

iv) Service road along minors with murum topping.

v) Selective lining wherever necessary.

vi) Resectioning the existing field channels and providing new field channels (45 km length).

vii) measuring devices for each outlet head.

viii) New Control structures such as falls, division boxes and turnouts and crossings etc. were provided in 45 km length of field channels in 38 chaks.

As regards the Hudi (2) minor, the fourth minor under the action research programme, only modifications of the main minor were carried out without any OFD works.

Cropping System

It was decided in January 1985, after detailed discussions among the concerned officers of Irrigation and Agricultural Departments, Punjabrao Krishi Vidyapeeth, and seventeen progressive farmers of the Pus command, that in addition to wheat crop, all out efforts should be made to introduce Rabi sunflower. Accordingly, intensive efforts were made for growing this crop as a result of which the area under Rabi sunflower increased from 7 ha in 1985-86 to 250 ha in 1986-87 to 1,170 ha in 1987-88. From the response received from year to year it was expected that the area may increase to 2000 ha in 1988-89. Surprisingly, the area in 1988-89 was reduced drastically to 200 ha because of the following reasons:

a) Sudden fall in sunflower price from Rs. 800-900 per quintal to Rs. 400-500 per quintal.

b) Poor yield of sunflower in 1987-88 due to non-availability of certified seed.

c) Increase of wheat price.

d) Availability of sufficient water for hot weather groundnut.

The above events indicated that market prices affect the cropping sequence.

Rotational Water Supply

RWS was introduced in the Rabi season of 1987-88 on Bhojala and Itawa minors. The supply was based upon the crop water requirement of different crops determined by climatic factors using the modified Penman method. Due to a shortage of water in the reservoir, the Irrigation Department had decided to give 5 irrigations in Rabi at 21 days interval and no irrigation in H.W. season. The schedules were prepared accordingly and given to management staff and group leaders of outlet committees for implementation. It was observed that due to late sowing of Rabi sunflower the crop needed one watering in H.W. season. The Institute's staff persuaded the concerned officers of the department and arranged the extra watering to the needy farmers which saved a lot of sunflower area from damage. The RWS was continued along similar lines during 1988-89 on the two minors with certain modifications in light of experience from 1987-88. The following main changes were affected during the year and were followed for the whole project:

a) The rotation period of 21 days, followed by the Department for many years, was reduced to 14 days after the first two irrigations.

b) The Rabi period followed in the state is from 15th October to 28th February. This period was changed to 1st November.

c) Due to heavy rains which continued until the end of october, sowing of Rabi wheat crops was delayed up to the middle of December 1988. Suitable modifications of the schedules for watering were carried out to apply proper watering at different stages of crop growth.

During the monitoring of the RWS the data on soil moisture content before and after irrigation in each rotation on selected fields is collected. The discharge at the minor head and through each outlet is monitored and information collected. This data

however is yet to be analyzed to see how the modified RWS has improved the use of water in the system.

Farmers Participation

In order to involve the farmers in irrigation management a number of meetings were held with the beneficiaries of the selected minors to establish outlet and minor committees. Many farmers had expressed the view that they should be convinced about the importance of being organized. Initially the farmers were not ready but after constant persuasion they eventually came together informally and assisted the irrigation staff in implementation of the rotational schedules and distribution of water below outlet. Accordingly, outlet committees on all the four minors have been formed and the farmers have chosen outlet leaders. The outlet leaders of Bhojala and Itawa minors helped allot during 1987-88 Rabi in water distribution below the outlet. The farmers on Pokhari and Hudi (2) minors were consulted before improving the minors. The efforts made in involving the farmers in the management are reported to be encouraging and the same were continued during 1990-91 on all the four minors.

For maintenance of field channels by farmers, the Irrigation Act of Maharashtra provides that the field channels are to be maintained by farmers, but it is not clear about the extent or jurisdiction of farmers to maintain lengths of field channels relative to their area. There were complaints from the farmers that they were required to maintain a major portion of field channel lengths, against a smaller area being irrigated by the canal, whereas there were many farmers who were required to maintain quite a short length of field channel, but had a large area under irrigation.

A method of collecting money from farmers on the basis of area irrigated and to pool proportionate labor from them was also tried, but was not successful. The money collected was not

properly utilized and the labor proposed to be pooled was not made available by most of the farmers, resulting in non-maintenance of the field channels.

Considering the difficulties faced by the farmers a new procedure for allocating a specific length of field channel to each farmer in a chak proportionate to his area under irrigation has been tried. It was observed that this method was 80% successful on Bhojpur minor and 60% on Itawa. It was decided by the group leaders that the farmers who do not maintain the allocated lengths of field channels should be issued notice by the Department to clear the same within a reasonable period, failing which the channel would be maintained by the Department at the farmer's cost.

Recently one Water User's Association, Ambikadevi Aregaon Loni Water Sahakari Sanstha at Loni for the Itawa minor, has been formed. The society was registered in January 1990 but has not started functioning. The bye laws of the society are yet to be received by the Irrigation Department and the WALMI. The society has been formed by selling shares to the beneficiaries valued between Rs. 11/- to Rs. 101/- each. The total share value collected by the society is about Rs. 2,500/-. The object is to supply the water to the society on volumetric basis and hand over the management and distribution of water in the command to the society. The office bearers of the society expressed that the Department should fix up gates, measuring devices and structures on the minor and they would take over the operation thereafter only. The Department has to assess the cost involved in bringing the minor in good shape so that the society becomes operational.

Other works taken up under the programme

i) Setting up of Agro-Meteorological Laboratory

A full fledged agro-meteorological laboratory was set up in 1985 at the site with the following equipment:

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a) Ordinary and automatic rain gauge
b) Maximum and minimum thermometers
c) Dry and wet bulb thermometers
d) Sunshine recorders
e) Anemometers
f) Wind vane
g) Thermo-Hygrograph
h) Class A - Pan Evaporimeter

Data is collected daily and consolidated on a weekly and fortnightly basis. From this the ET is calculated and the rotation wise crop water requirement is arrived at for preparation of water delivery schedules. This has continued from the Rabi season of 1987-88.

ii) Crop Economic Survey

In some of the fields of the selected minor, crop economic data during the years 1986-87, and 1987-88 has been collected. The data collected consists of date of sowing and harvesting, number of irrigations with intervals, seed rate, fertilizers applied, farm activities, actual expenses on various items, etc. The data is under analysis. In addition, the area of different crops under cultivation from various sources like rainfall, canal irrigation, well irrigated, and crops on lifts are being actually measured season-wise.

iii) Training and Transfer of Technology

The following training classes were conducted:

a) Three days training for lower staff of T&V and Irrigation sub-division in January 1987 attended by 30 persons.
b) Four days training for farmers of selected minors in January 1987 attended by 43 farmers.

c) Four training classes each for 3 days for group leaders were arranged in September and October 1988 in which 109 group leaders participated.

The participants were shown films on RWS and maintenance of field channels and taken to Punjabrao Krishi Vidyapeeth, Akola to show them various activities.

iv) Publications

a) A booklet in Marathi, the regional language, on sunflower cultivation was prepared and distributed among the farmers.

b) A booklet in Marathi, giving information about the suitability of crops to soils in the command, water requirements of crops, growth stages of crops, water application and irrigation interval with depths, doses of fertilizers, etc., was prepared and distributed among the farmers. The crops included were jowar, wheat, groundnut, cotton, potato, cane, paddy, banana and gram.

c) Farmer's diaries were distributed amongst selected farmers to note down day-to-day activities along with details of expenditures and difficulties faced. Inspite of training to write down the diaries, the response from the farmers was not encouraging.

v) Ground Water Survey

A survey of the main drainage of the entire project and a groundwater survey has been completed. The data from daily monitoring of water levels in the wells of the command has been taken from 1986 to 1989. Along with the well levels, data of crops cultivated by different sources and their areas have been collected to assess conjunctive use of water. Analysis of the data collected so far is in progress.

Lessons Learned

i) The major reason for under utilization has been the development of new cropping pattern which is an entirely different from the planned one. The new cropping patterns has developed due to availability of canal water, climatic conditions, market demand, etc. The cropping pattern needs certain changes for extensive irrigation, for which training and strengthening of Agriculture Extension staff to motivate the farmers to adopt the changes is required.

ii) The farmers in the command are irrigation minded, enthusiastic and are ready to accept changes provided they get timely and assured water and technical guidance.

iii) Physical system constraints are not the major reasons for under utilization of irrigation potential. After improvement of the physical system and assurance of timely and adequate water supply, additional areas can be brought under irrigation.

CONCLUSIONS

Since 1987 a considerable amount of money has been spent on rehabilitation works, and monitoring of water flows; however, no reports other than the diagnostic analysis and base-line surveys have been published. No evaluation of action research activities has taken place since 1987. WALMI Maharashtra probably has the best trained and qualified core faculty of any WALMI in India. However, none of these trained faculty members are presently involved in the action research program.

Individuals located at the WALMI and responsible for action research have little irrigation management experience and no research experience. Action research personnel are on deputation from the Irrigation Department; thus, their tenure at the WALMI is short. This has meant that there has been little continuity of staff. None of the present action research staff were involved with the DA or development of research plans.

Another liability of the Action Research Program is that Pus is located a days drive from the WALMI; thus, most action research activities are carried out by junior field staff. It is unlikely that the Pus action research site will ever serve as a demonstration and learning site for WALMI students, due to the distant location. The WALMI is presently planning on curtailing activities at Pus and shifting to the Navare Project which is located west of Pune. Thus, this new site will also be located at a great distance from the WALMI.

The above problems are indicative of the fact that the WALMI as an institution, has not defined how action research should fit into their institutional objectives and activities.

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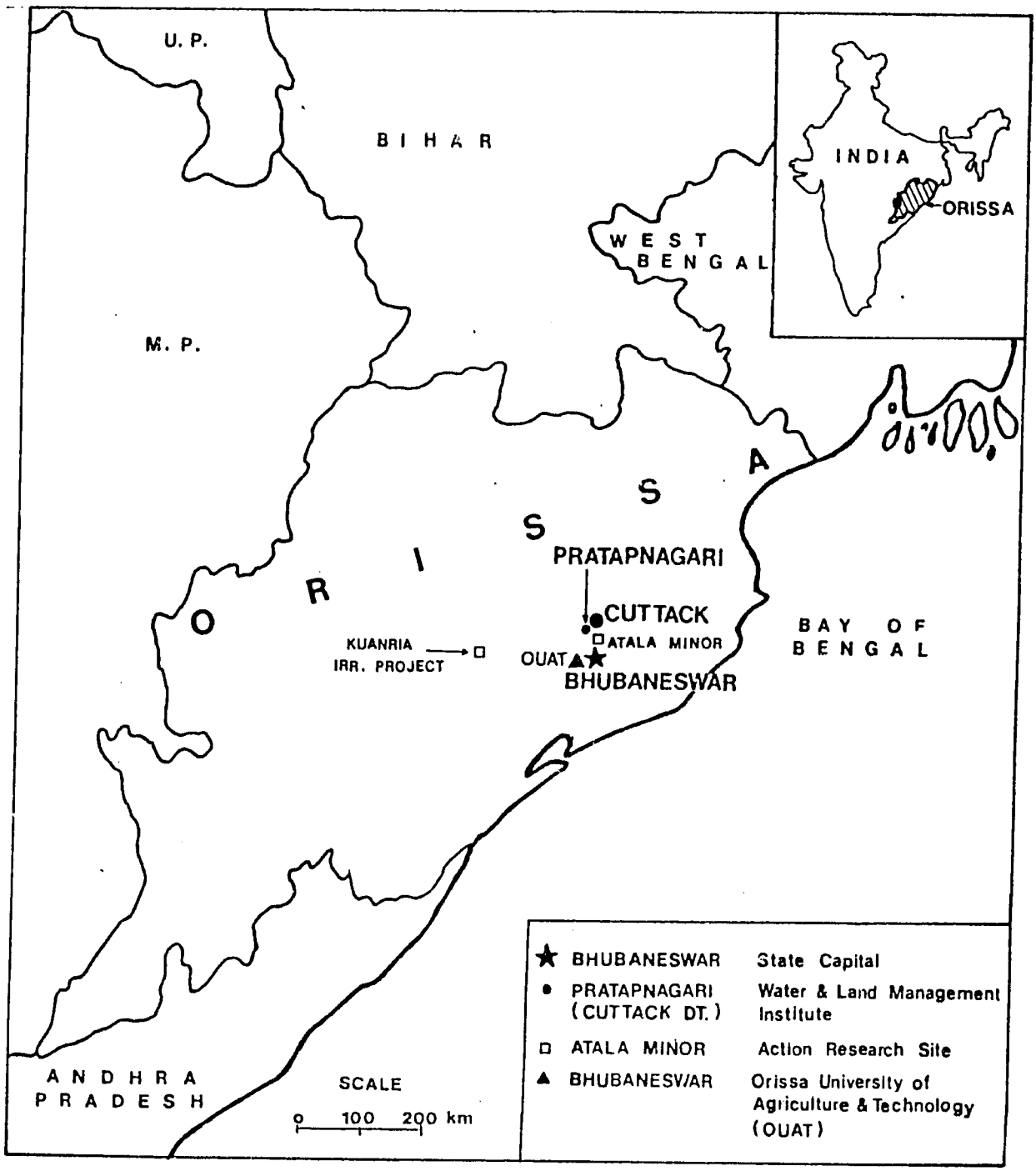

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Action research activities in Orissa were initiated in 1988; however, there has been relatively little activity until quite recently. The WALMI has recently developed plans to establish 4 adaptive research stations and one action research station in addition to the WALMI headquarters in Pratapnagari. As a part of this effort the WALMI has sanctioned 36 positions (6 per research site). At present the following numbers and categories have been filled:

6 Assistant Engineers
3 Junior Agricultural Officers
3 Junior Engineers
5 Junior Statistical Assistants
2 Irrigators (field workers)
1 Village level worker from the Agricultural Dept.

The two action research sites are the Kuanria Medium Irrigation Project and the Atala minor of the Mahanadi Delta Project. The Kuanria project (reservoir system) is one of 18 World Bank assisted projects in Orissa and is located approximately 150 km from the WALMI. It has a command area of 3600 ha with a designed micro-system. The Atala minor (1500 acre command) is part of the Mahanadi Project, a large river barrage system that is 100 years old. The Atala site is particularly well suited for action research since it is only 5 to 7 km from the WALMI. Baseline surveys of the Atala minor and the Kuanria Project were published in 1989 and 1990.

Few research activities have actually taken place since 1988, and no activities have been documented. The WALMI has encouraged the use of high yielding rice varieties (HYV) in the Kuanria Project and appears to have had some success. Most farmers have not been willing to use HYVs primarily due to seasonal drainage problems. Dr. Patra is examining and

proposing to implement some actions to remove these constraints.

A considerable amount of flow data for the Kuanria Project has been collected, however, this data has not been summarized The WALMI needs to develop a coherent plan as to what management practices they can implement using this data. They are obviously thinking about the problem, but are having difficulty matching an action plan with the Irrigation Department and farmer participants.

To date the WALMI has not examined irrigation problems from an inter-disciplinary perspective. They need help in formulating research plans, work plans, and objectives. All personnel, and particularly new personnel, are relatively inexperienced in irrigation management and research methodology. Because they are young, and have just begun their activities, they possess the potential to accomplish much. But they need to be encouraged and provided sufficient training to enable them to define and document action research activities.

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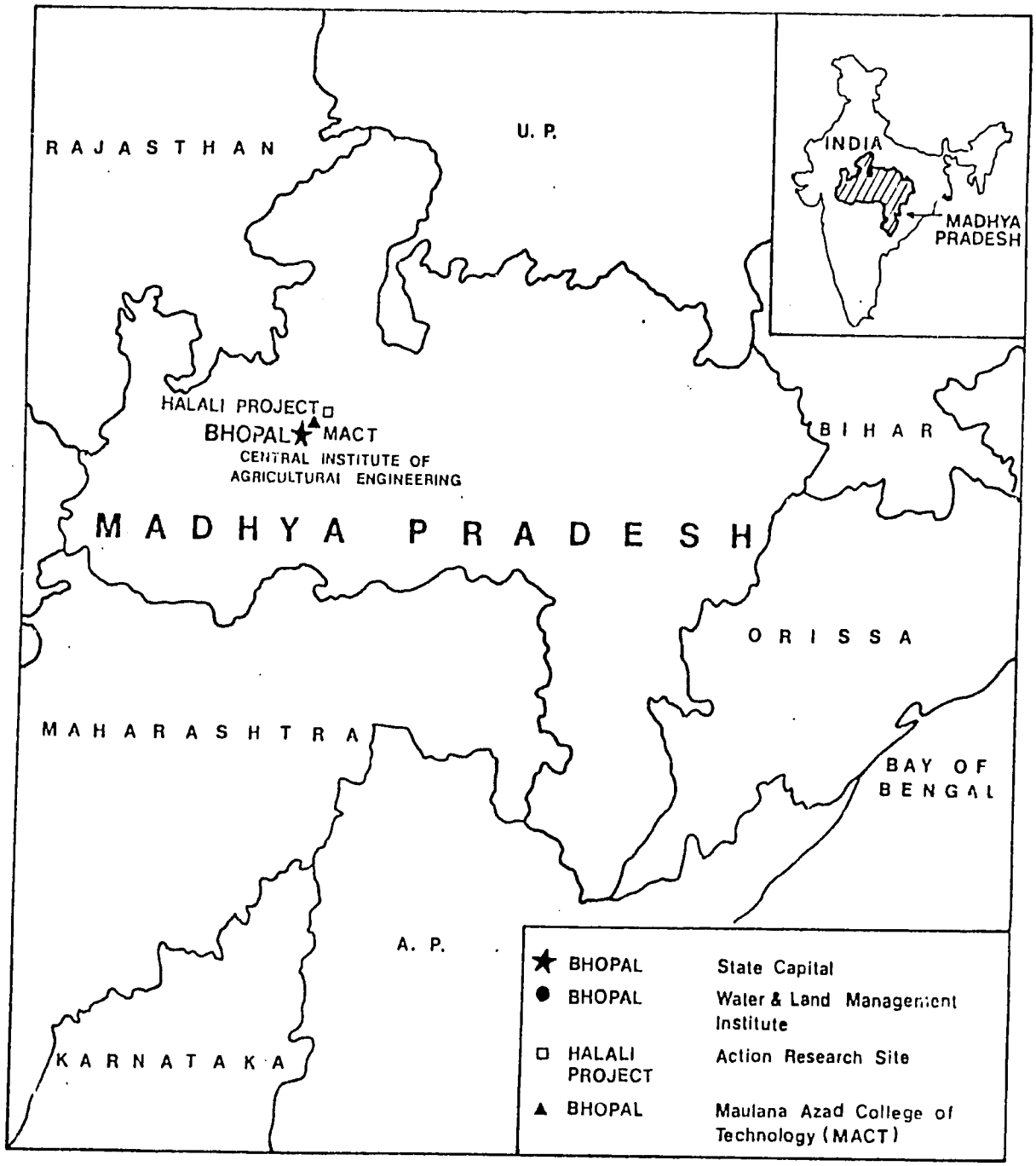

Action Research activities are taking place at 5 different sites located at the Halali Project in Vidisha-Raisen district; Ghorapachhar Tank Project in Bhopal district; Tawa Project in Hoshangabad district; Bargi Project in Jabalpur district; and Badera-Mohari Tank in Jabalpur district. The last three sites have been taken up this past year. In addition to action research a considerable amount of adaptive research is being conducted at the Halali Project. The following report describing action research activities was obtained principally from the diagnostic analysis activities which were carried out on the Halali Irrigation Project.

The Halali Irrigation Project

The Halali Irrigation Project is a major storage project on Halali river, a tributary of Betwa river. The project was approved by the Government of Madhya Pradesh in the year 1963 for Rs. 404.25 lakhs to irrigate 37,636 ha of land. The latest revised cost of the project is Rs. 1,582.68 lakhs. The project comprises an earthen dam 945 m long with 29.57 m maximum height above foundation level, and a live storage capacity of 226.09 Mcum. An unlined 3.29 km main canal, with a designed discharge of 670 cusecs, takes off from a sluice gate located on the left bank 3 km from the dam. 670 cusecs. Thereafter, the main canal bifurcates into two branches forming LBC and RBC with lengths of 17.43 km and 23.80 km, respectively. The designed discharge of LBC and RBC is 485 and 185 cusecs respectively. The total length of LBC system is 138 km and that of RBC system is 81 km. The total CCA proposed for irrigation under the project is 27,924 ha with an annual irrigation of 37,636 ha, giving an irrigation intensity of 135%.

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The project as a whole was selected under action research programme for the following reasons:

i. The project is near to Bhopal, approximately 60 km.
ii. The capital account of the project was open for further construction investments.
iii. There has been irrigation in part of the command for the past 10 years.
iv. An interdisciplinary approach had not been attempted on this project; thus, it was possible to implement the findings of the studies to a reasonable area and demonstrate the results.

Constraints observed

The constraints were identified on the basis of diagnostic analysis. The analysis was done by an inter-disciplinary team, comprising of experts from the Irrigation Department and WALMI officers. The team included an Irrigation Engineer, Agronomist, Soil Specialist, Economist, and Sociologist.

The physical system improvement was carried out by the Superintending Engineer (O&M), Bhopal and Halali Project, Vidisha. The on-farm works were carried out by the Executive Engineer, Vidisha on CADA funds. The T&V and extension work was carried out by the Agriculture Department. WALMI Bhopal is monitoring the overall program as well as suggesting changes to be carried out during implementation.

On Farm Development

The studies on outlets, micro-distribution system, drainage and scope of land shaping in the command of the D-2 distributary were carried out during the diagnostic analysis. These indicated

that there were 65 chaks covering a command of 1,100 ha. It was further seen that minor LM1 of Distributary D-2 had been constructed only to 0.54 km to cover an area of 33 ha, while the tail minor of this distributary falls in the flooding zone of the Betwa river; therefore, there was no irrigation in this area.

The outlets are 9" to 12" R.C.C. irrigated pipes provided in the canal embankment. APMs or other free flow type outlets were not seen in the command. The details of the outlets are:

Channel	Outlet (numbers) Design	Actual	Unauthorized	Total at Site
D-2 RBC	7	5	8	13
LM 1	23	2	4	6
LM 2	7	7	-	7
LM 3	20	12	2	14
LM 4	3	2	7	9
LM 4 A	6	3	5	8
	65	31	26	57

The reason for the lesser figure appearing under actual is due to non-completion of structures in minor LM 1. The length of LM 1 is 0.63 km, but structures at 0.52 and 22 km were incomplete; hence, irrigation is restricted to 0.52 km. Only six of 23 designed outlets were actually found.

The other conspicuous observation from the above table is that 46% of the outlets were unauthorized. Farmers had shifted the designed position to other places to serve their own interests. It was generally noticed that the outlets were not properly installed and a number of them were placed above the full supply level of minors; therefore, farmers take water by putting obstructions in the canal to irrigate small patches which are otherwise out of the command. Additionally, there is unauthorized direct pumping from the canal between 0 to 1.82 km of D-2 RBC.

In the command area the micro-distribution system is incomplete. Only in some parts have water courses and field channels been constructed by the Irrigation Department, while in other areas farmers have constructed water courses and field channels. In all, nearly 52% of the length of water courses and 61% of W.C. and F.C. have been constructed by farmers. It was also noticed that proper alignment had not been followed and the condition of the physical system was very poor since channel sections had not been maintained. As per design criteria water courses should have a full supply depth of 0.30 m and a free board of 0.15 m, but this design had not been followed.

The micro-distribution system could not function properly. There were no measuring structures,, turnouts, farm gates, or village road bridges.

The slope in the command area varied between 0-1%. In large areas along the canals and roads, rain water filled low lying areas during the monsoon, as a result the farmers were unable to take any Kharif crop. Field drains were totally absent, resulting in stagnation of water and salinity in some areas of the command.

Farmers were irrigating their fields by wild flooding. Border strip, check basin or furrow method of irrigation can develop only after the farmers are sure of water supply. A warabundi system of water distribution can be adopted only after construction of a complete micro-distribution system.

All weather roads are insufficient for the command area. The command is inaccessible in the rainy season where even walking is difficult. Due to non-completion of culverts, there are drainage problems in the command area.

The command of the project is predominantly Rabi crop with the major area under wheat and gram with some lentil and linseed. The major Kharif crops are soybean, jowar, and arhar. Soybean occupies a major portion and is increasing due to better price and potential in the command. From a total of 27,924 ha only 10,790 ha is used in Kharif and 26,800 ha in Rabi.

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Crop production is low due to low fertilizer consumption and improper water management. Farmers are not aware of soil testing, which is an essential part of modern day irrigated agriculture. The application of weedicides in the command area is negligible. This increases the weeding cost and reduces fertilizer and water use efficiency. Plant protection measures are inadequate. Farmers apply dusting or spraying only in gram and arhar.

About 20% of the farm families have holdings up to 1 ha while 39% constitute holdings from 1 to 5 ha. Forty % of the farm families have holdings above 5 ha. This requires chakbundi program to be undertaken in the command.

The production in general is low in the command when compared to production potentials exhibited by demonstration. There is great scope of increasing productivity and thus income of farmers. Water management, seed treatment and proper crop varieties need to be introduced.

There has been a gradual increase in the consumption of fertilizers over the years, but less or even lack of fertilizer use in oil seeds and pulses is common. More demonstrations in use of fertilizers and irrigation for oil seeds and pulses will increase productivity.

In the project area 14 primary credit societies exist with two Central Cooperative Banks, one Primary Land Development Bank, 10 commercial banks and one Kshetiya Grammine Bank. As such good infrastructure exists in the command area. Small, marginal S.C. and S.T. farmers are receiving attention for credit through substantial subsidies.

Farmers involvement for better maintenance and operation of the system through formation of active and functional panchayats is necessary. Water control system could be developed and an area approach could be implemented for assured irrigation through irrigation panchayats. In the command, village Madha has a unique example of developing a water distribution by lottery system. A group of farmers have organized themselves, and every year they decide the turn for water distribution by drawing lotteries. The

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distribution system was developed and is maintained by the group of farmers. Only the basic material was provided by the Irrigation Department, i.e. pipe line, the manpower and other material was arranged by the farmers themselves. Irrigation Panchayats should be activated to make recovery of water charges. A fixed proportion from the revenue may be given to the panchayats to help in better function and maintenance of the system.

CONCLUSIONS

To date Action Research activities that have been conducted by the Madhya Pradesh WALMI have not been viewed positively by the LBII/WAPCOS staff. The WALMI has not developed clear objectives for its action research programs, nor have they issued any reports concerning their activities aside from brief summaries or work plans.

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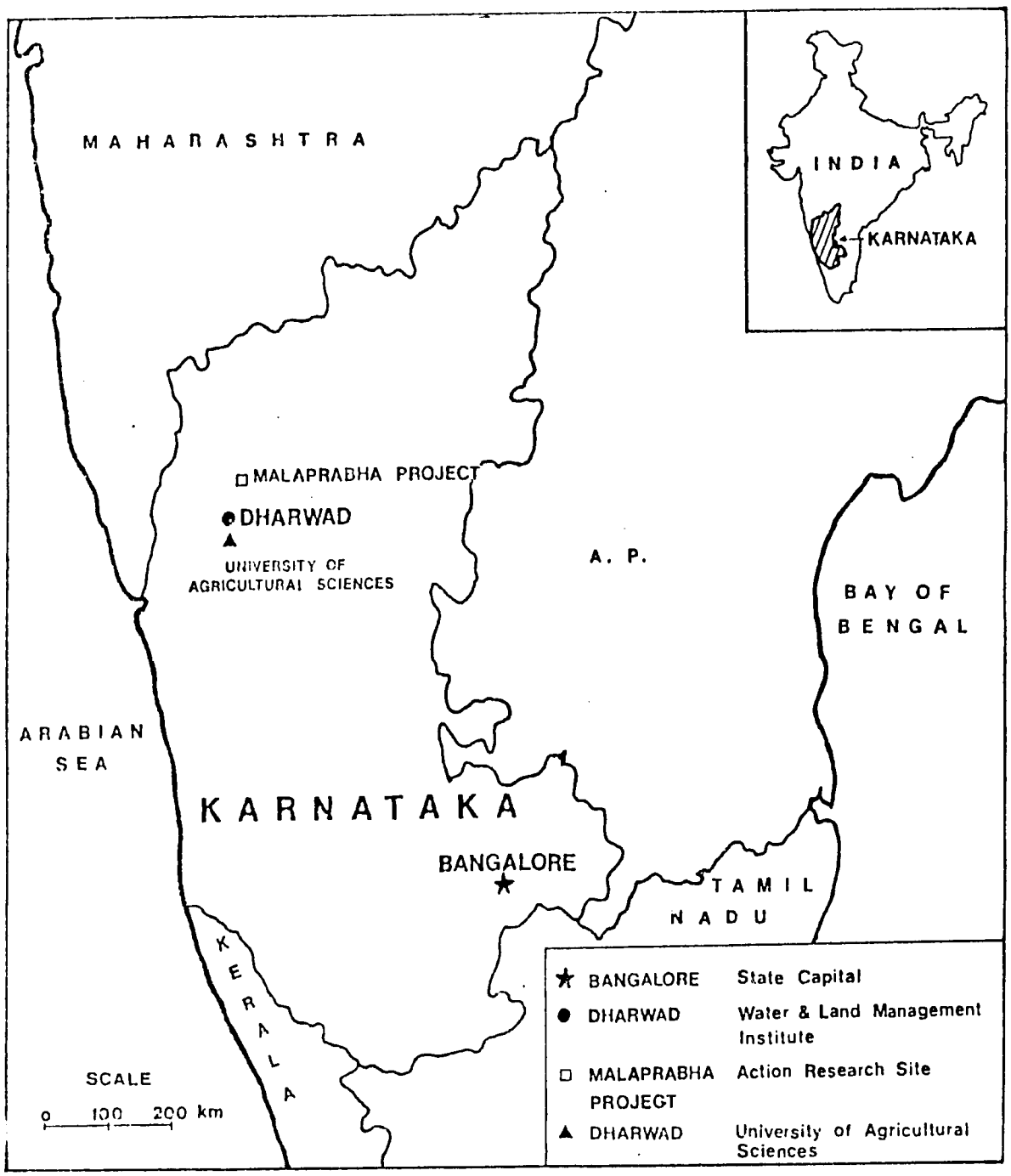


Action research activities at WALMI Karnataka were initiated during the spring of 1991. The Malaprabha Irrigation Project with an eventual command estimated at 214,984 ha has been selected for study. The Malaprabha system is approximately 2/3rd complete. The lower third being in a more arid and agriculturally poor region. Reservoir capacity is reached in only one year in five; thus, there are presently water shortages in most years (neglecting the lower third of the system which has not been constructed as yet). If and when the system is completed, there will be severe competition for the limited water resources.

Two sites have been tentatively selected, one on the right bank and one on the left bank. The left bank is characterized by red sandy soils (about 40% of left bank command) which have high infiltration rates and low fertility. The red sandy soils grade into black cotton soils (60% of left bank area). Ground water tends to be saline. There appear to be typical irrigated agriculture problems, i.e. poor maintenance (at least below outlet), poorly designed field channels, un-level fields, water not reaching tail of outlets, some limited areas of water logging.

Agriculture on the right bank appears to be relatively good. The right bank is characterized by black cotton soils. Land holdings appear to be larger than on the right bank, but this may be a misperception. Cotton is the preferred crop, and has been giving good yields (7 to 10 quintals/acre), though the yields have been decreasing after years of continuous cotton. The high yields and relatively good appearance of the crops may be due to the influence of the University of Agricultural Sciences, Dharwad research station, which is located in the command of the right bank.

The U.A.S. research station is conducting water management studies in wheat, cotton, hybrid maize, jowar, safflower, sunflower, chili, and grams. There is a need to coordinate main system irrigation management activities of the Irrigation Department with

this agricultural research station. At the present time there is no communication between the two institutions; thus, some of the recommendations made by the research station do not take into consideration actual limitations as to when water is available in the reservoir and canals.

There is a large scope for action research activities within this project. Main system management on this long system (130-160 km) will be difficult, particularly so, because it passes through very different rainfall zones.

Farmers at the head of this system probably see few, if any, benefits to organizing. Agriculture is already successful, with the head-end farmers receiving all the water they need, at least when available in the dam. Demonstrations to limit excessive water application will probably have some success, but organizing farmers in general will be difficult. There is presently one small water users cooperative on the right bank. This water cooperative has been receiving subsidies for the past three years. Subsidies are to be withdrawn this year. It will be interesting to see if this organization can sustain itself without government subsidies. The Chairman, Mr. G.H. Neelappagondas, felt that the subsidies were necessary to keep the organization functioning.

At the present time, night irrigation is generally not practiced, although it was stated that some tail-end farmers do irrigate at night since they are unable to obtain water during the day. Night irrigation is being practiced by the water users cooperative utilizing paid irrigators, but this practice will probably cease when the government subsidies are discontinued.

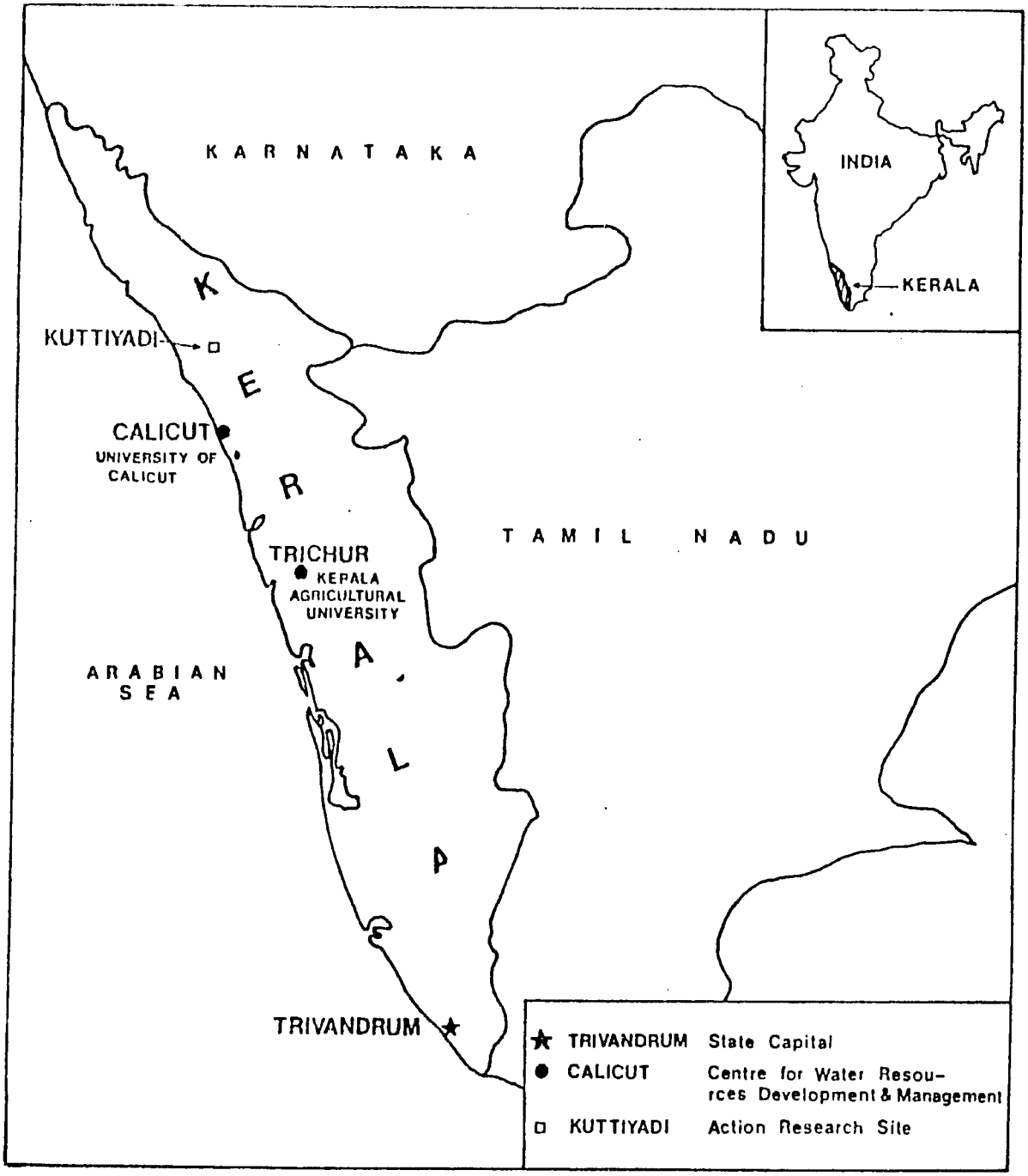
WALMI Karnataka has not as yet identified a research program. They are proceeding with a careful analysis of the existing situation, and plan to develop a research plan at the conclusion of their present studies. They have gone to considerable efforts to involve other institutions (Irrigation Department, CADA, Agricultural University) directly into their present investigative activities and plan to work directly with these institutions

during the "action" phase of the research. During 1991 and 1992 they plan to accomplish the following tasks:

1) Conduct a diagnostic analysis (DA) utilizing an inter-disciplinary team from the WALMI, CADA, and Irrigation Department.
2) Evolve an action research program from the DA. The WALMI appears to have established good working relationships with the Irrigation Department, CADA and the University; thus, they are attempting to develop a program through consensus building among these institutions as to what questions should be examined.
3) Schedule an Action Research workshop to discuss the DA and proposed research plans with representatives of all concerned government institutions. Additionally, they plan to invite two or three irrigation experts from outside the state. Based on this workshop, action research plans will be revised.
4) They are also examining alternative means of organizing farmers, such as utilizing NGOs.

The systematic approach being employed by Karnataka, and their efforts to include other institutions into the action research process, appears to be more appropriate to the methodology originally perceived as the action research process or model. They have obviously learned from the mistakes of other action research projects.

CENTRE FOR WATER RESOURCES DEVELOPMENT & MANAGEMENT, CALICUT, KERALA



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Action research activities were initiated during 1990 in the command areas of Narath and Ichannur distributaries of kakodi Branch Canal of the Kutyadi Irrigation Project. Out of a total project command of 14,000 ha, 557 ha comes under the action research study.

The Center for Water Resources Development and Management, Calicut, initiated action research within the Kutyadi Irrigation Project in 1979. In 1979 these activities were funded under what was called the Operational Research Project. Initial efforts were to develop "group farming" activities. Group farming activities enabled the purchase of seeds (through cooperative subsidies) hiring of machinery, and theoretically, would permit easier water management because all farmers would be prepared to receive water at the same time. Conflicts were minimized at harvest since all crops were harvested at the same time.

This program started with 56 farmer outlet groups, but was later formed into 7 groups. As a part of this ORP activity, the farmers constructed 20 km of irrigation ditches and 20 km of drainage ditches. Primary reason for establishing drainage ditches was to enable production of 3 paddy crops per year instead of the two originally planted in Kharif (Virtipu) and summer (Punja). However, the net effect was to shift the cropping season from Kharif to Rabi (Mundakan), which has better yields than Kharif. Other activities of the group farming proved to be quite successful. The ORP activities ended in 1986.

As a part of the action research activities, which were initiated in 1988, the ORP area was examined. This examination revealed that ORP benefits and efforts had fallen apart in the intervening 2 years. Thus, Dr. Jayakumar concluded that what had been holding the farmers together was the influence of the CWRDM. Because of this experience, Dr. Jayakumar has been trying to reduce the activities of the CWRDM in direct interventions with the farmers.

Dr. Jayakumar's experience with ORP and its subsequent failure is the central problem that should be addressed in all action research activities throughout India. The question becomes, "How can a WALMI (or CWRDM in this case) change the activities of farmers and governmental units in order to sustain improvements in production or water management after the influence of the WALMI is removed?"

The approach that Dr. Jayakumar has taken seems to be appropriate, and is an example of what "action research" should be. Realizing that the CWRDM cannot maintain its influence in the area on a permanent basis, efforts are being made to inculcate or institutionalize responsibility for maintaining productivity and water management directly into the Irrigation Department, Agricultural Department, and the Cooperative Department. As a part of these efforts 2 committees were formed, an Action Research Working Group and an Action Coordinating Committee. The Action Research Working group is responsible for implementing activities and actions in the field. The Action Coordinating Committee supervises and monitors the activities of the AR Working Group. The AR Working Group is composed of 5 assistant engineers from the Kutykadi Irrigation Project, a representative from each of the 5 Krishi Bhavans (Ag. houses) in the area, and technical advisors (when needed) from the CWRDM staff. The Action Coordinating Committee is composed of the Superintending Engineer from the Kutyadi Project (who acts as chairman), the Joint Director of Agriculture, the Joint Registrar of Cooperation, and Dr. Jayakumar from CWRDM serves as secretary for this committee.

Action research activities are presently concentrated on the Ichannur Distributary. This distributary is 3.5 to 4 km long. The Irrigation Department is responsible for maintaining 2 km of this distributary (2 km have been defined as "field bothi" which is the responsibility of the farmers). The Irrigation Department presently gives the farmer groups Rs. 500/km (Rs 1,000) to maintain the irrigation department's portion of the distributary. CWRDM has been contributing another Rs. 1,200 to maintain the

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field bothi portion of the distributary. The tail-end portion of the distributary was originally defined as field bothi but is owned by the irrigation department; thus, the farmers feel that it is the irrigation department's responsibility. There are 5 farmer groups located on this bothi, each farmer group has been assigned about 500 m to maintain.

There were large losses of water from 3 UTs (under tunnel drains). These structures were lined using plastic sheeting purchased at a cost of Rs. 2,000 by the CWRDM and installed by the farmers themselves. There are also heavy seepage losses from raised portions of the distributary where it crosses some low lying land. Farmers are lining portions of the distributary utilizing funds rom CADA.

Whenever funds are received from CADA or the Irrigation Department, 10% of the estimated construction costs are withheld from the farmers because this 10% is normally considered profit to a contractor, but since the farmer groups are not contractors, their profit margin is deducted from the maintenance or construction costs. Prior to these lining activities water was not reaching the tail outlet.

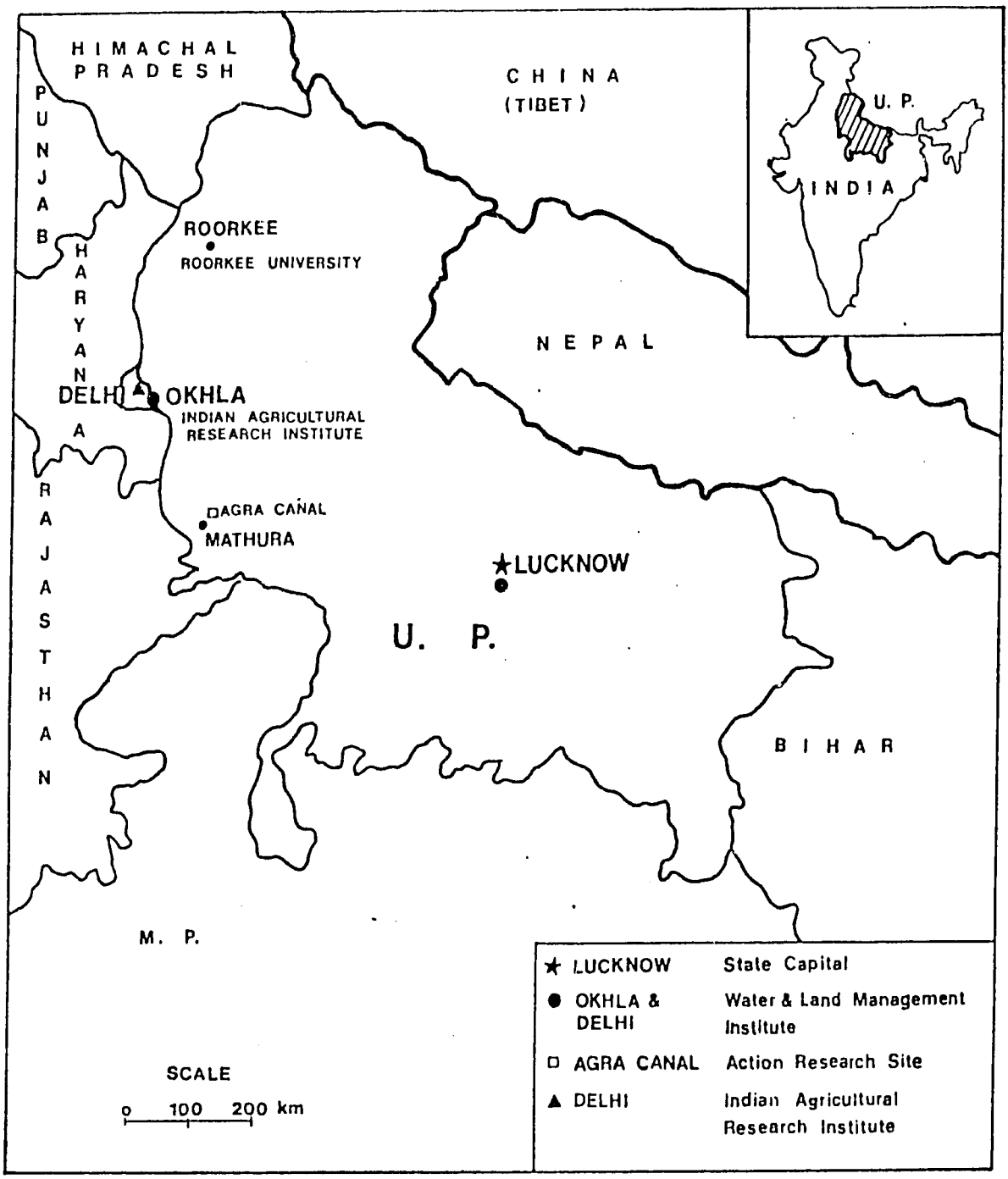
There are still problems of getting water to the tail outlet. The present problems are due to the fact that an influential or large farmer owns low lying land adjacent to the raised portion of the canal which has high seepage rates. Apparently this farmer bribes the khalasi of the irrigation department to close the distributary gate early in order to prevent excessive seepage onto his land; consequently, the tail-end outlet rarely receives water due to the early closing of the distributary gate.

Group farming has been introduced into 10 ha blocks. This activity is coordinated by the Ag. Department. Normal subsidy programs provide about Rs. 30/ha for group farming. Outlet committees receive additional subsidies for seeds, pesticides, etc. from the Cooperative Department.

The central problem that CWRDM now has, is to devise some means to sustain the present cooperative effort between governmen-

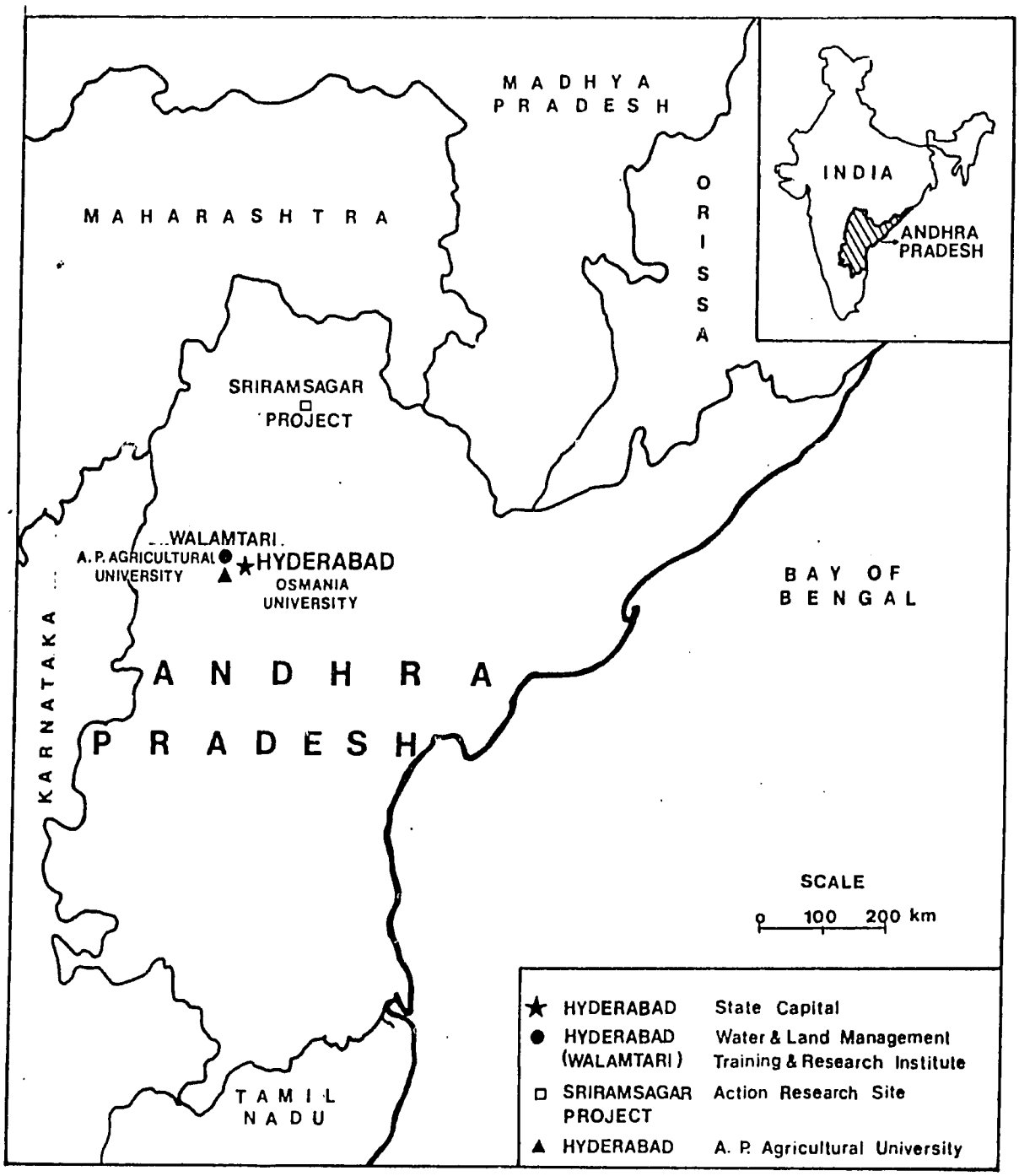
tal agencies once the influence of the CWRDM is removed. This is the central question that all action research programs should address.

WATER & LAND MANAGEMENT INSTITUTE
OKHLA, U. P.



As detailed in the 1990-91 work plan, WALMI-UP is conducting action research at two sites within the Shergarh distributary of the Agra Canal system. Chanderi minor and Jait minor which are located in the head and tail reaches of the distributary are under study. Base-line survey and collection of irrigation data are proceeding. Work on a preliminary socio-economic survey has been completed. One consultant has been appointed and with the assistance of another sociologist it is expected that detailed socio-economic studies will begin.

WATER & LAND MANAGEMENT TRAINING & RESEARCH INSTITUTE, HYDERABAD, A. P.



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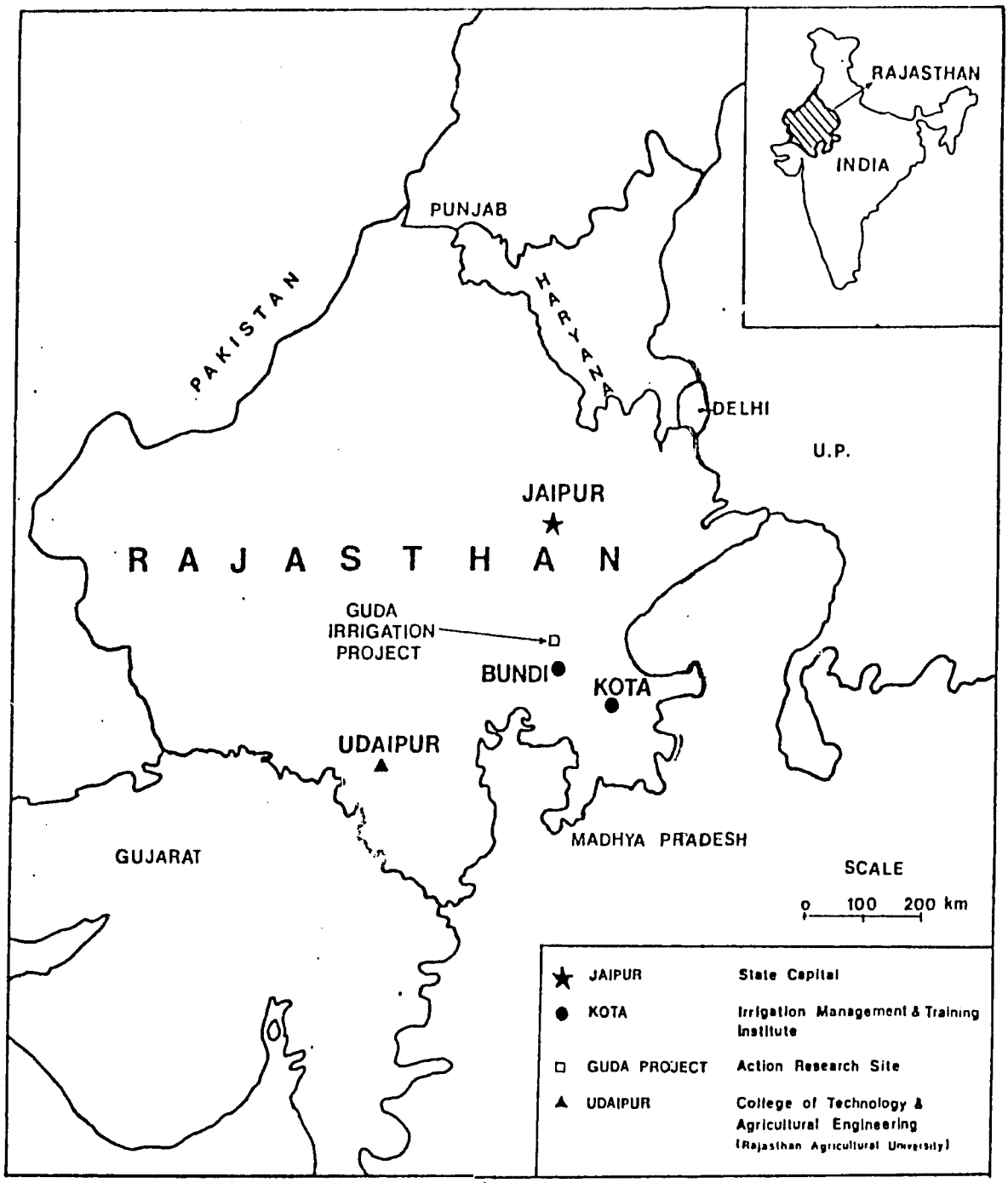
The WALAMTARI has not initiated an action research program as yet. They have made some initial investigations into two sites, the Sriamasagar Project, which is located at a considerable distance from the WALAMTARI, and a minor tank system located 30 km from Hyderabad near Shameerpet Village. LBII/WAPCOS consultants have recommended that the Sriamsagar site not be used for action research because of its distant location. Proposed activities at these two sites for the 1991-92 year has been to initiate diagnostic analysis, bench-mark surveys, and development of a plan of action.

IRRIGATION MANAGEMENT & TRAINING INSTITUTE, KOTA, RAJASTHAN



IMTI, Kota began action research activities in 1985. The Guda Medium Irrigation Project, located 60 km from Kota in Bundi District, was selected as a research site. The project has a total CCA of 10,860 ha. Two minors with a total CCA of 1,000 ha were chosen for action research activities.

A diagnostic analysis of the entire Guda Project was carried out in 1985-86 and a socio-economic survey was conducted by Sukhadia Agricultural University. Results from these efforts were presented in a series of 3 workshops held through the years of 1985-87.

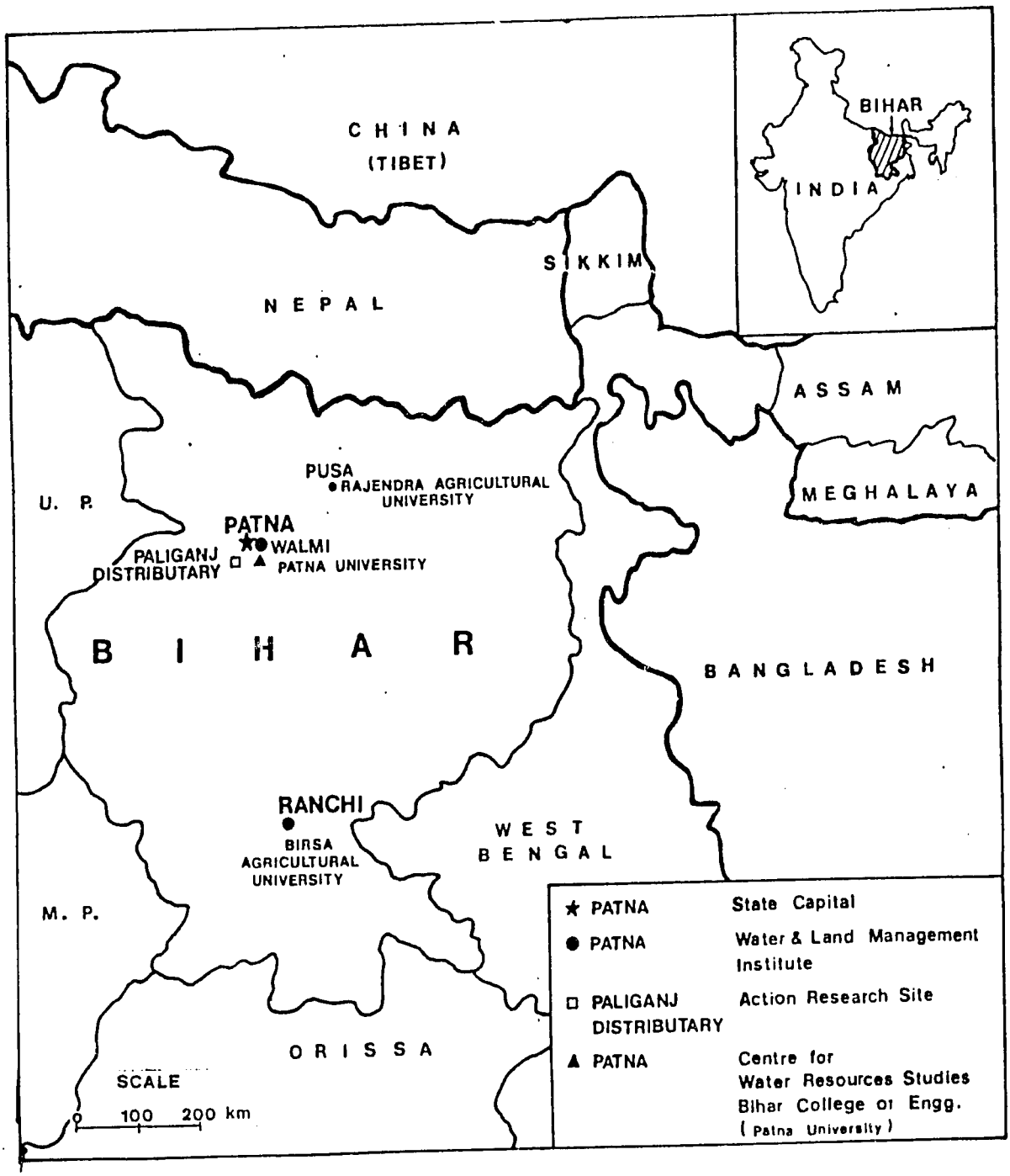
A number of physical problems within the system were identified. Most of the physical problems pertaining to the main system such as desilting, lining, and remodelling of structures have been completed. Development of a micro-network and removal of unauthorized outlets has yet to be accomplished.

Some efforts have been made to create water user associations on selected outlets within the system. Warabundi and osrabundi plans had been established, though visits by LBII/WAPCOS staff has indicated that few farmers are actually adhering to any schedule of irrigation turns.

The IMTI has been conducting a number of adaptive agronomic studies, and a considerable amount of success has been reported with tail end farmers adopting peas; however, this or other activities have not been documented.

Action research personnel are all on deputation from other departments, as a consequence of the continued turnover there has been no continuity within the program. Additionally, the IMTI has had numerous administrative and financial problems, which has severely affected moral.

WATER & LAND MANAGEMENT INSTITUTE
PATNA, BIHAR



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Action research activities were initiated in 1988 within the 115 year old Sone Canal System. A distributary (Paliganj) located 60 km from the WALMI campus, was selected for intensive studies. The Sone Canal System is a river system with a barrage at Indrapuri. The barrage feeds the 76 mile long Patna Canal. The Paliganj distributary off takes from the Patna Canal at mile 46. Paliganj distributary has a culturable command area of 12,000 ha, a length of 40 km, and 76 villages located within its command. The Paliganj distributary and the Sone System in general are dominated by paddy culture. Consequently, field channels tend to be very short with field to field irrigation dominating the command.

Action Research efforts have centered around the development of a water users association covering the entire length of the distributary. The WALMI has demonstrated remarkable success in establishing this organization. The organization is presently composed of a minor or distributary committee which is composed of representatives from 20 villages which are scattered throughout the length of the command. Thirteen more villages are joining this organization this year. Because of the relative non-existence of a field level distribution system, outlet committees have not been formed, but instead were developed at the village level.

The water users association has implemented an operational plan for the distributary. Water within the distributary is rotated down the distributary within three principle blocks or zones. After head-end farmers receive their water, which is accomplished by creation of "illegal" check structures within the distributary, the water is released to the next zone. This method is superior to the previous situation in that head-end farmers now voluntarily remove their "illegal" check dams, which they hadn't been doing for the past decade. The principle beneficiaries of this operational plan have been the middle zone farmers, but water

is also occasionally reaching tail-end areas that had not previously received water.

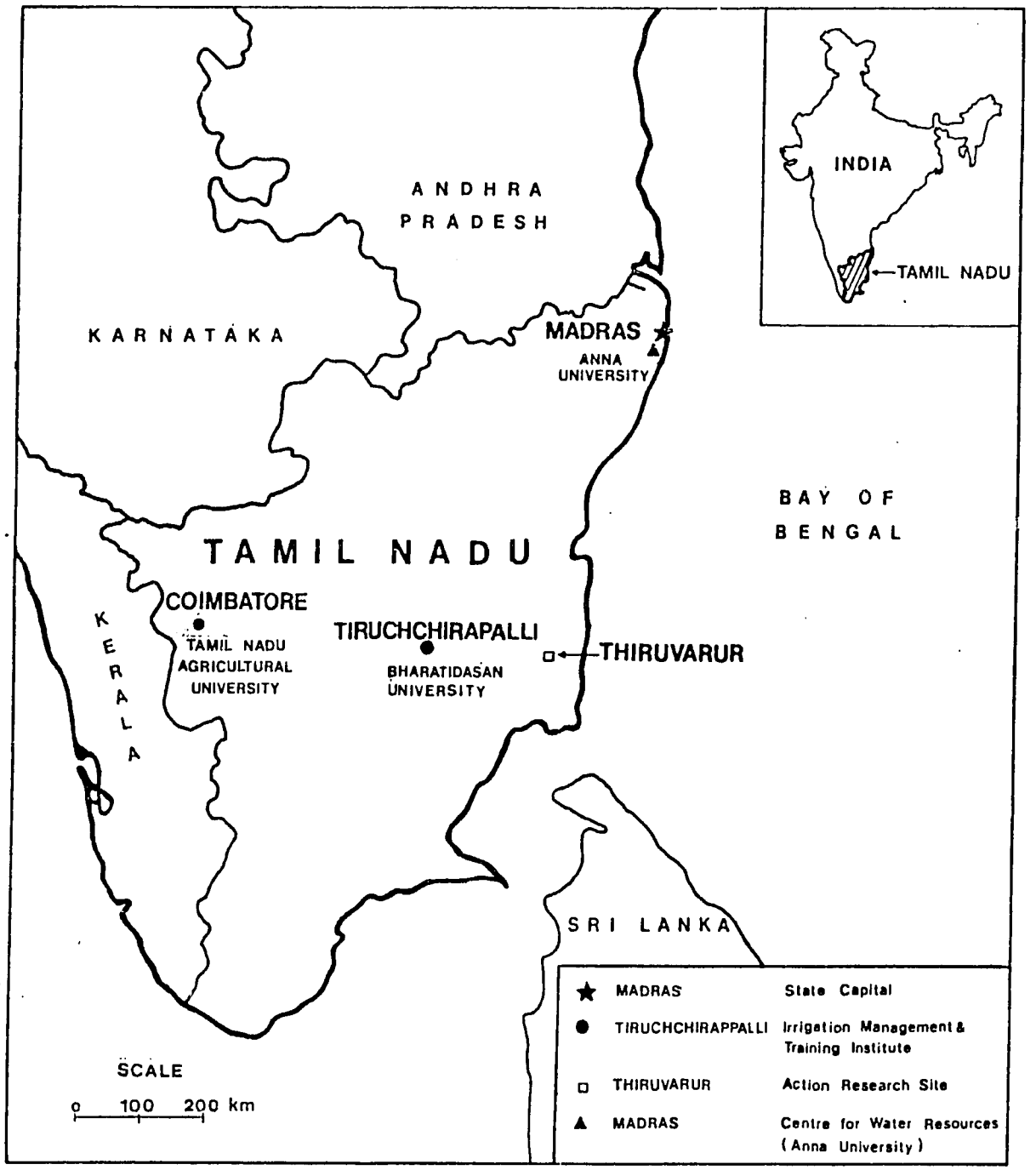
This area, prior to WALMI involvement, could be characterized as irrigation anarchy. Irrigation Department personnel did not enter the distributary because of the real threat of physical harm. Irrigation Department personnel and the water users association are now cooperating to the extent that maintenance work (which had been neglected for years) is now mutually prioritized. The distributary committee is said to also have an active role in overlooking Irrigation Department contracted repairs.

The WALMI has been monitoring water flows at five strategic points within the command, though this data has not been summarized.

The success WALMI Bihar has had in organizing the water users association bears continued scrutiny. Previous recommendations by the LBII/WAPCOS staff to Bihar and other WALMIs has been to start organizational attempts at a smaller level, not at the distributary or minor level; however, their success may indicate that organizational efforts covering an entire minor rather than smaller areas may be more appropriate. This strategy may in fact be more sound. Farmers may perceive that the larger minor level committee can effect real changes in water delivery procedures; whereas, smaller sub-distributary or outlet committees cannot.

The action research activities of WALMI Bihar should be viewed favorably. This program appears to be the only WALMI in which the research activities have been "initiated" by the participants with the WALMI providing assistance to accomplish what the farmers perceive as practical. Thus, this is one of the few action research programs which has been operating "within" a system to improve irrigation, rather than "on" it to improve irrigation.

IRRIGATION MANAGEMENT & TRAINING INSTITUTE, TRICHY, TAMIL NADU



The action research program was started in 1985 at the Cauvery Delta. The IMTI's stated objective is "to serve as a field lab for in-service as well as farmer trainees and to intervene in a sample command and study the impact as to replicability in other parts of the command". The area under investigation (ca 4,000 acres) is served by 4 channels coming from the Valappar River, which is located in a tail end area of the Cauvery Delta.

The IMTI has conducted a socio-economic survey of the area which they published in May of 1988. A report detailing results of diagnostic analysis of the area was published in January of 1987, and a soil survey report was published in 1988.

The action research unit has also published a report on "Monitoring Water Regulation in Valappar River System in Cauvery Delta in the Year 1989-90". This report is primarily a diagnostic analysis of water flows. Results indicated that the water supply was unreliable and that head-end farmers used water to the detriment of tail-end farmers. An operational plan was prepared as a part of this study, but was impossible to implement due to non-cooperation of head-end farmers.

Development works that have been completed under the action research program include:

1. development of 4 wheel drive dirt roads on channel banks;
2. channel lining of the entire length of two irrigation channels;
3. deepening and widening of drainage channels;
4. installation of venturi and parshall flumes;
5. deepening of 20 village ponds (used for irrigation as well as domestic purposes), at a cost of Rs. 2.50 lakh;
6. community paddy nurseries were established to off set delayed release of canal water;
7. development of 5 concrete thrashing floors;
8. introduction of goat rearing scheme;
9. introduction of fish culture in deepened ponds;

10. introduction of mushroom production;
11. crop demonstration plots using HYVs of rice;
12. formation of village level water user associations (WUA) with matching WALMI funds of 100 Rs/acre being deposited into WUA bank account (interest used by WUA for maintenance work);
13. construction of wind mill on river bank to demonstrate use of wind energy; and,
14. various farmer training programs and workshops.

From the above it is obvious that the IMTI has initiated many activities and views action research primarily as a development effort. The IMTI has been slow to evaluate and document it's activities. The IMTI needs to define an action research program, one that can be used to enhance training activities.