COMMAND AREA DEVELOPMENT AUTHORITIES FOR IMPROVED WATER MANAGEMENT

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ABSTRACT

The Command Area Development Authority (CADA) in India is an organizational strategy for improving the performance of irrigation projects through improved project management. CADAs are the administrative mechanism where all departments of government work under a single administrative command. A number of strategies for improved project management and a number of improvements in project operation have resulted from using the CADA model. The priority needs for improved CADA operation are as follows:

1. Development of a unified administration for all departments operating in an irrigation project to replace current coordination mechanisms.

2. Development of a career structure for water management through the establishment of a water management department.

3. Implementation of training centers in each state for focused training of a cadre for water management.

Implementing a more effective strategy for initiating project improvements is most important in improving project performance. Basic to this strategy is the establishment of project objectives that focus efforts on improved water control, enhance the productivity of services and inputs, provide resource conservation, improve the returns on irrigation investments and develop farmer participation.

With an improvement strategy, objectives are translated to goals, and studies of the operating system are used to identify constraints, develop and test successful solutions to the constraints and then implement the improvements over the project area by working with farmers. Training centers provide trained personnel for all the activities and the unified administrative command implements each program. Successful water management improvement programs have been the result.

PREFACE

The Water Management Synthesis Project's purpose includes identifying technologies that can improve water management, and providing handbooks for implementing these technologies in countries that need them. An organizational structure known in India as Command Area Development Authorities (CADAs) has the potential to be a successful organizational structure for improving irrigation project management. This report provides information by which CADAs in India, and similar organizations in other countries, can be used to improve the management of irrigation projects.

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THE NEED FOR COMMAND AREA DEVELOPMENT

Introduction

Massive efforts are underway in India to create irrigation facilities. As a part of rural development programs, irrigation systems can help meet the food and other agricultural needs of a fast growing population and can increase the purchasing power of the rural people. India plans to add 15 million hectares of potential irrigated land during 1980-85 as part of the Sixth Plan investment activities.

India is currently budgeting about $3 billion per year for irrigation development. According to the Asian Development Bank, investments for irrigation in India have exceeded 95 percent of the total public investments in agriculture every year since 1970.

This paper provides information about Command Area Development Authorities in India for countries interested in alternative, improved approaches to irrigation project operation. Section I reviews the circumstances that led to the establishment of Command Area Development Authorities (CADAs) in India. Section II describes the operation of CADAs in various states in India including some strengths, weaknesses and approaches to improvement. The authors present in Section III some strategies for improving CADA operation for the consideration of those who use the CADA approach to operate irrigation projects. A summary and recommendations are given in Section IV.

Status of Irrigation

Surface water resources dominate Indian irrigation. The total surface water in the country is about 180 million hectare-meters — of which about 66 million hectare-meters are considered usable. Ground water resources for irrigation have been estimated to be 26 million hectare-meters. Together, surface and ground water resources could irrigate 113 million hectares. Since March 1980, 57 million hectares of irrigation potential has been developed utilizing about 27 million hectare-meters of surface water and 14 million hectare-meters of ground water.[1] Thus, the potential for surface water development remains at 59 percent while 49 percent of the ground water potential has been developed. In terms of the volume remaining for development, surface water supplies are 3.25 times that of ground water. A major part of the developed ground water potential is in the hands of the private sector, but surface water for irrigation is entirely owned and operated by the public sector. The public sector consists of the local self-government institutions such as the district *Panchayatas* (locally elected village governments), or by the state government, depending upon the size of the service area.

The private sector has been relatively more efficient at using ground water resources than the state-operated tubewells (wells using ground water).[2] The norms for judging this performance were made by comparing the supply of water per hectare with use of water per hectare, and the cost recovery and net incomes generated per hectare. Since the public sector uses less ground water, the costs imposed on society are less in absolute and relative terms for ground water development.

Evaluation studies indicate that water use efficiency, utilization of potential, and realization of cropping patterns are poor in surface water irrigation projects that are completely state owned and operated. Low water use efficiencies have been traced to the loss of water in transit from the head of the canal system to the field. Estimates reveal that water losses are approximately 70 to 80 percent.[3]

A major difference between public water supply and private tubewells, as indicated by the Mellor and Moonti[2] studies, is the higher degree of water control achieved with private tubewells. This control has led to more irrigated area, higher cropping intensities, and increased use of fertilizer. The result is more crop production from the increased irrigated area and from the higher yields per hectare.

Utilization of potential ranges from 60 to 100 percent from state to state.[4] The latest estimates place the average utilization at 84 percent of the water potential. Though the trend is encouraging, there is certainly room for improving the intensity of irrigation and water use efficiency.

The lack of significant changes in cropping patterns and crop yields after a project starts functioning has been attributed to uncertainties in the water supply and the associated risks.[5] Though the water supply in the canal may be relatively certain, the water supply at the field may not be because of the condition of the field channels, the farmer's method for providing access to the water, and/or the social conflicts among the farmers. Predictability and control of the timing and quantity of the water supply are the key factors which influence the farmer's choice of crops and farming practices, whether the crops are water intensive or not, and whether they are dependent on technology or not. Fluctuations in water supply and the resultant risks lead the farmer to settle for the usual drought-resistant, low-yield varieties which are grown as if under rainfed conditions with a poor technology package. As a result, crop yields and net incomes per hectare have been disappointingly low even though these areas are located in the command of an irrigation project.[6]

Causes of Poor Performance

Technical appraisals of the Indian irrigation projects, old and new, by various international financing agencies[7] have found the following reasons to be chiefly responsible for underutilization:

(a) the technical inadequacy of the irrigation system arising from deficiencies in planning, design, construction, operation and maintenance of the projects;

(b) unrealistic assumptions about the available water supply, the crop-water requirements, the losses in transit, and seepage leading to a significant overestimation of the area that could be irrigated with available water;

(c) lack of on-farm development works such as field channels to supply water from the government outlet to each farmer's field, field drains to remove excess water, and land leveling and shaping so that water reaches each corner of the field in an even manner;

(d) lack of agricultural support services such as credit and extension;

(e) lack of coordination between agencies involved in the development of the area under irrigation; and

(f) lack of farmer organizations for system operation and maintenance.

Accurate measurements are crucial to making realistic projections rather than assumptions about water supply and water loss.

The first two causes relate to irrigation engineering. In many projects, the annual flow into the reservoir, and thus the area that could be commanded, have been overestimated. Similarly, the assumed seepage losses in unlined canals, and especially field channels, are less than the actual losses by three or four times. Further, the water requirements for most crops and the losses in field application have been underestimated. This is especially true for projects planned before the introduction of high-yielding varieties. Also, most projects do not provide technical assistance to farmers for the design and construction of effective field units for water application. As a result of optimistic planning assumptions, irrigation potential often has been significantly overestimated.

The other causes of poor irrigation system performance relate to organizational aspects. Organizational components were subjected to critical analysis by two national commissions set up by the Government of India (GOI): the Irrigation Commission (1972) and the Agricultural Commission (1976).[8] The GOI is now more concerned about preparing organizations for implementation activities, improving institutional support services and inputs for farmers, and the need for more farmer participation.

Evolution of the Command Area Development Authority

Traditionally, the state irrigation departments have been concerned with the canal systems up to the government outlet discharging one cusec (cubic foot per second) of water to supply a command area of 40 hectares. The development of the area below the outlet was left completely to the initiative of the farmers.

Construction of field channels and field drains, land leveling, and land shaping below the outlet is generally known as On-Farm Development (OFD) works. Often farmers failed to execute the works by themselves because they did not have the technical skills or the resources and services for such tasks. Further, the farmers were not motivated to construct the OFD works because a number of physical structures in the construction of field channels and field drains would be community owned. Thus, there was a delay in building the OFD works. Farmers still have not organized for effective operation and regular maintenance of field watercourses.

The commissions and various committees also stressed the need for reducing the time lag between the development of the area below the outlets and the construction of canals. Consequently, a policy decision was made in 1972 that the government should assume the responsibility for developing the command area. Special efforts were to be made to provide extension with seed for more high yielding varieties (HYV) of crops. Credit was to be provided for buying the inputs needed for irrigated agriculture. These efforts were made to insure that the desired cropping patterns would result.

The GOI also formulated a Command Area Development Authority (CADA) model for adoption by the state governments. The model would set up a CADA with a full time administrator of rank equal to a Secretary to the Government, with control over the heads of all constituent departments such as Irrigation, Agriculture and Cooperation. The idea behind this organizational concept was that the senior level officer would have appropriate influence and control over the personnel working in the command area of the project to insure coordination among various department personnel.

The CADA model is an attempt to meet increasing food and fiber needs.

The CADA was also to have a separate allocation of funds for OFD works independent of the constituent department budgets. Each CADA was to have a board of representatives from official and nonofficial interests to supervise and review the program. The Authority was given the responsibility for developing the command area, operating the irrigation system, promoting the cropping patterns, strengthening extension, training farmers, demonstrating improved practices, ensuring credit flow, supplying inputs such as seeds and fertilizers, developing roads and market facilities, and organizing the farmers.

The CADA concept was an attempt to meet the increasing food and fiber demand of an expanding population. The concept resulted from a continuous and agonizing appraisal over time of the failure of irrigation projects to meet their expected and needed performance. CADAs today (1981) are functioning in the states in forms varying somewhat from the original CADA model.

CADA also represents a new concept in rural development strategy. Instead of separate departments, each having its own autonomy, the new strategy is an administrative unit based on a natural resource activity that cuts across the usual administrative boundaries. Further, it is a special program, federally sponsored with the state's active participation. More significant is that all departments work toward the common objective of reaping maximum returns from the irrigation projects.[9]

Section II

OPERATION OF COMMAND AREA DEVELOPMENT AUTHORITIES

Introduction

This section deals with the functions and organizational arrangements of CADAs in various states in India in general and with the CADA in Gujarat State as a case study. The strengths and weaknesses of the various models and some of the operational difficulties are discussed. The major part of the discussion is based upon a study of organizational strategies for CADA by Singh.[10] Experiences and lessons learned from introducing an experimental rotational water supply system are also reviewed. Based upon these analyses, several improvements in the CADA concept are suggested.

CADA Functions and Administration

The CADAs established in 1974-75 were formed through one of the following procedures:

(a) executive order of the state government,

(b) statutes passed by the state legislature, or

(c) assumption of special functions by an existing department such as Irrigation or Agriculture.

Procedures (a) and (c) established CADAs in Gujarat, Maharashtra, Andhra, Pradesh, and Rajasthan. This did not necessarily result in any significant departure from the normal and routine administration of Government development efforts. Uttar Pradesh conferred a special legal status on CADA (procedure *b*) enabling faster and more flexible administrative action since autonomy was the key ingredient of the statutory body.

Whatever the form of the CADA, funds were allotted by the state legislatures. The functional responsibilities assigned to the CADA, either by executive orders or by legislation, included the following:

(a) modernization, maintenance and efficient operation of the irrigation system up to the outlet of one cubic feet per second capacity.

(b) development and maintenance of the main and intermediate drainage system.

(c) development of field channels and field drains within the command of each outlet.

(d) land leveling on an outlet command basis.

(e) consolidation of holdings and redrawing of field boundaries.

(f) enforcement of a proper system of *Warabundi* (roster) and fair distribution of water to individual fields.

(g) development of ground water to supplement surface irrigation

(h) selection and introduction of suitable cropping practices.

(i) supply of inputs and services including credit.

(j) development of marketing, processing, and communication facilities.

(k) preparing individual programs of activities for small farmers, marginal farmers and agricultural labor.

(l) diversification of agriculture and development of activities like animal husbandry, farm-forestry and poultry.

The responsibilities given to the CADAs are formidable. The complex gamut of irrigated agriculture, equity, and social justice for small and marginal farmers has been assigned to CADAs. To implement the above functions, financial resources alone were not the critical requirement. Finances were available from the GOI to the state governments upon request under the centrally sponsored scheme of special financing. The critical requirement was that the human and technical resources be provided through clear assignment of staff to the CADA from various disciplines. Also, there was a need for unified control and regulation of the activities in a project so that the declared objectives could be achieved.

In their preoccupation with OFD works, however, the state governments placed only the agricultural staff and the budget for OFD works under the CADA. Irrigation personnel in charge of operation and maintenance of the irrigation system were left under the control of the Chief Engineer at the Secretariat. Irrigation personnel in charge of construction and operations were still under the control of the Chief Engineer (projects), also located at the Secretariat. In both cases, the CADA did not have any administrative control over the irrigation personnel. The CADAs were able only to coordinate their program with Irrigation Department personnel through informal channels and through the project committee meetings that were attended by the department heads functioning in the command area of the project.

The administrative coordination with Irrigation Department personnel was adequate only when the CADA happened to be placed under the direct authority of the Irrigation Department itself, as in the state of Maharashtra. In Gujarat State, where the CADAs functioned under the Agriculture Department, or in Andhra Pradesh, where CADA is a separate department at the State Secretariat, coordination with Irrigation personnel has not always been effective. In the absence of a formal, structured arrangement, personal relationships between the CAD Commissioners and Irrigation Department heads were very critical.

In the states (Gujarat and Maharashtra) where the decentralized, democratic administrative system has been operating for a while, the CADAs receive agricultural extension assistance from the local self-government institutions. For example, in Gujarat State, the district *Panchayat*, an apex body in a three-tier system of decentralized local self-government, is responsible for preparation and implementation of agricultural production plans, extension, and supply of inputs and services (including credit) to farmers. The new Training and Visit scheme of extension is entirely the responsibility of the district *Panchayat*. Therefore, the CAD Commissioner has to seek and secure the cooperation of the extension personnel to transfer information on irrigated agriculture to farmers in his area. He succeeds primarily because of his senior status over the chief executive of the district *Panchayat*. Both belong to the same civil service branch known as the Indian Administrative Service.

Among all the state CADAs in India, the Rajasthan State model, according to Singh,[10] seems to have a more self-contained and unified chain of command. The CADA staff represent the Irrigation, Agriculture, Cooperatives, and Revenue departments, but still does not include agricultural extension. With staff from different disciplines within CADA, and in the absence of a genuine willingness to function as a interdisciplinary team, personnel tend to pull in opposite directions. Over time personnel become frustrated and attempt to leave CADA to rejoin their respective mainstream departments.

Understanding irrigated agriculture requires an interdisciplinary approach with a full-time staff of water management personnel.

The solution to the human and organizational problems of departmental cooperation seems to lie in having a full-time, unified cadre for water management housed permanently in a single department. Before examining such a solution, we will review the essential components of CADA in Gujarat State with which the senior author is closely associated.

Organizational Operation of CADA in Gujarat

Figure 1 presents the organizational structure of CADA and related organization in Gujarat State. The CADA is headed by a commissioner of the same rank as Secretary. The CAD Commissioner functions under the Agriculture Department of the state, which has responsibility for CADA programs. Funds for each fiscal year are voted by the state legislature. The Commissioner reports to the Secretary of the Agriculture Department on all policy matters.

Gujarat was one of the first states to comply with the GOI's advice to set up CADAs. The lag in construction of OFD works below the government outlet naturally resulted in placing agricultural personnel directly under the CAD Commissioner for the construction of field channels, field drains, and land leveling or field shaping. Agricultural personnel were headed by a Joint Director of Agriculture who in turn controlled the three Deputy Directors of Agriculture, also known as Divisional Soil Conservation Officers (DSCOs). Each DSCO has five Sub-Divisional Soil Conservation Officers (SDSCOs). The SDSCO executes the OFD work assisted by five agricultural supervisers and 25 agricultural assistants (Figure 1).

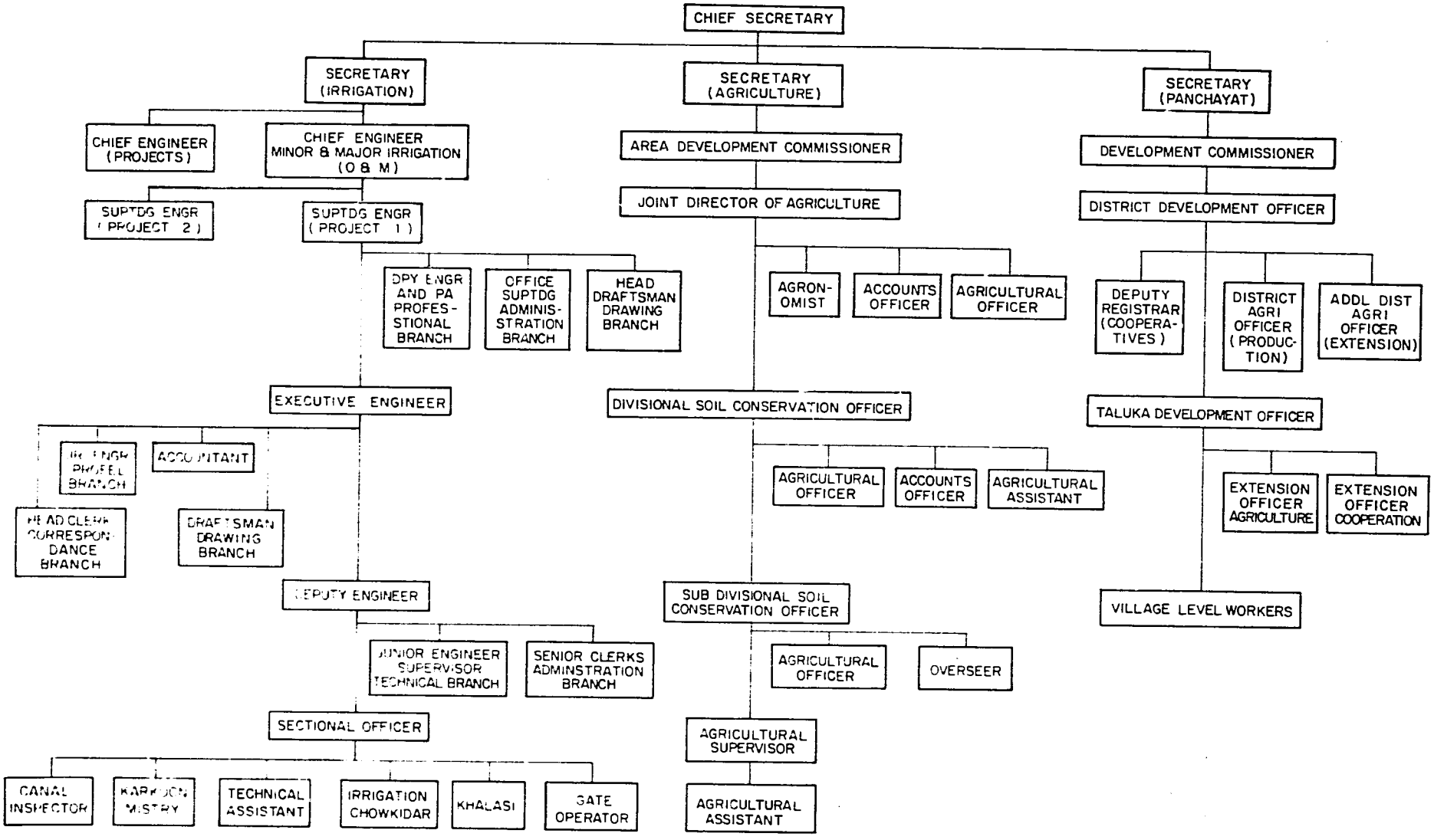


Figure 1. Organizational structure for CADAs in Gujarat State.

Agricultural personnel obtain the base maps of each outlet area after the outlet location has been established by the Irrigation Department. Execution of the OFD works is carried out under the Bombay Land Improvement Schemes Act in Gujarat. This requires obtaining the consent of not less than 51 percent of the farmers occupying not less than 51 percent of the land area on a given outlet command before entering their lands to prepare a detailed survey and improvement plan. The plan and cost estimates of the field channels and drainage works are publicized in the villages. Farmers' suggestions are considered also. Thereafter, the works are constructed.

Normally the completed works are exposed to one monsoon so that the farmers feel satisfied that the field channels and drains can withstand heavy rainfall. When further repairs are needed, they are carried out by the agricultural personnel. After testing the field channels during an irrigation season, they are handed over to the farmers for future maintenance.[11] The expenditures incurred in the construction are pro-rated on a per hectare basis and each farmer pays the cost with interest over an 11 year period. Annual payments are established by the designated financing agency and are paid at either a land development cooperative bank or a nationalized commercial bank. Banks also assess the total credit needs of the farmers prior to the start of each crop season through the extension personnel of the district *Panchayat* who act as a liaison between the farmers and the banks (Figure 1).

In addition, personnel from the Department of Agriculture and the Revenue Department, consisting of an assistant consolidation officer and appropriate staff support, are placed under each CADA (Figure 1). Their responsibility is to consolidate the fragmented holdings of a given outlet command. Land consolidation is a delicate land reform measure. GOI policy of stressing land consolidation for realignment of field boundaries to reduce the length of field channels has not been successful due to the strong attachment farmers feel for their lands and the conflicts that are created between farmers. As a result, the land consolidation personnel are not very effective.

Experience shows that farmers do not give consent for the construction of OFD works unless they are convinced that water will reach their fields. The suspicion that they might not get water has been learned from unfortunate past experiences. Unpredictable and uncertain water supplies caused by malfunctions in the canal distribution system and field channels have been frequent. The high cost of OFD works is usually the major reason given for farmers' unwillingness to give their consent for OFD works. Personal experiences of the senior author suggest that farmers do not feel overburdened by the potential debt but rather they are skeptical about timely deliveries, adequate supplies and water control. These are also the major reasons why farmers have neglected the maintenance of field channels and structures that regulate the water supplies in the outlet command areas.[12]

Irrigation Department Organization

Let us now examine the organization of the Irrigation Department and its main functions when command area development is the prime objective of the CADA. The CADA coordinates activities with the Irrigation Department personnel since they are not under the direct control of the CADA.

The Irrigation Department consists of two major wings: 1) construction and design, and 2) operation and maintenance (O&M). Each unit is controlled and guided by a chief engineer in the state Secretariat, but both function under the overall control of the Irrigation Secretary (Figure 1). Traditionally in India and other countries, design and construction has been more prestigeous and prosperous than operation and maintenance. Therefore, O&M has been thought to be the less desirable career alternative.

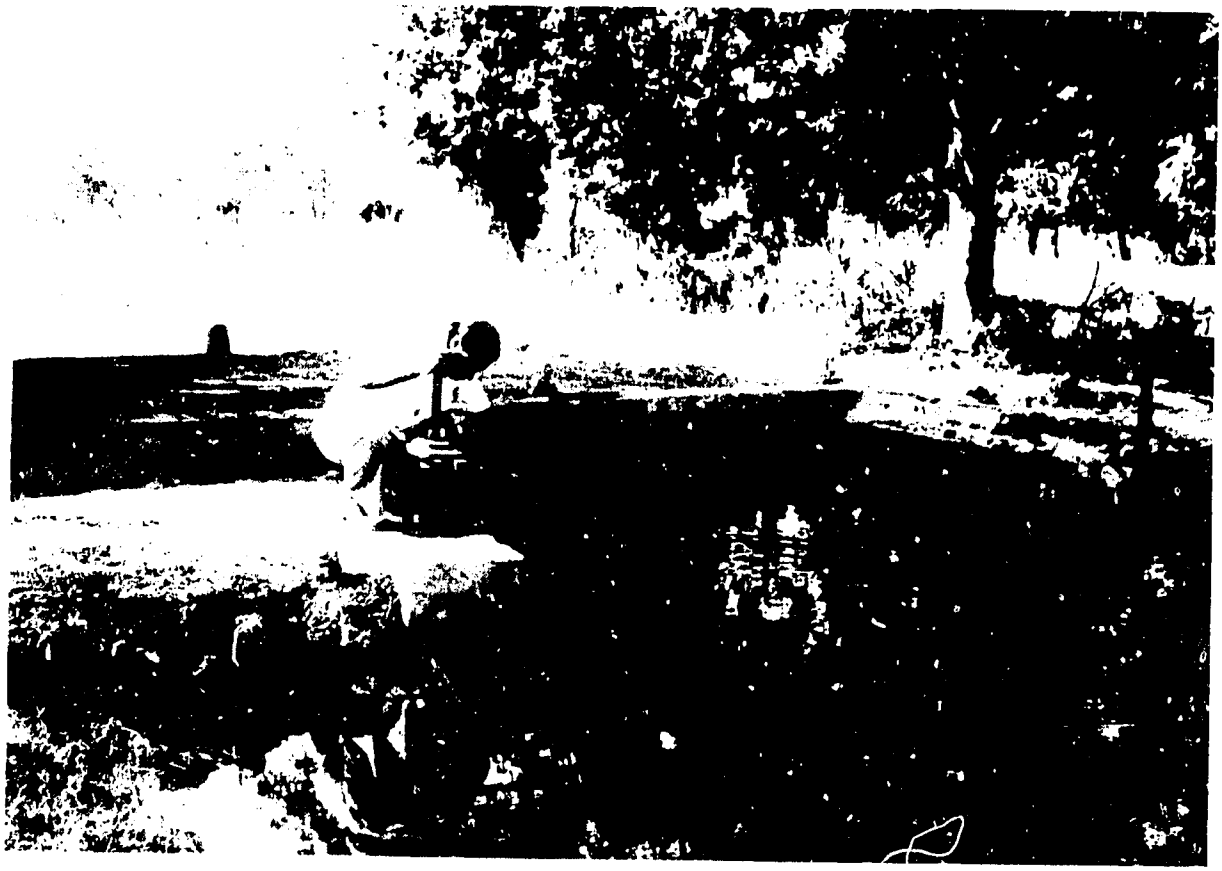
Traditionally, farmers have been expected to construct conveyance structures below the government outlet.

In a completed project, construction work is minimal and limited to lining the system wherever needed and whenever funds are made available by the legislature. Lining is done by the O&M wing in addition to its operation functions. Thus, the CADA has to coordinate only with the O&M personnel in a project area.

The project area is headed by a superintending engineer. There are four to five divisions under the superintending engineer, each headed by an executive engineer. Each division is further divided into five sub-divisions, controlled by a deputy engineer. Each sub-division has four sections and each section is under the control of a section officer (Figure 1).

Presently, the major functions of the O&M wing of the Irrigation Department are:

1. rotation of canals and distributaries for irrigation water supply;
2. receipt of applications for irrigation water from farmers;
3. review of payment of past irrigation dues;
4. settlement of complaints and disputes over water status;
5. checking for unauthorized irrigation by farmers who have not made application for the irrigation supplies and other extra-legal activities; and
6. maintenance of the distribution system including major repairs and lining of the system.



Water management should become the responsibility of CADA.

The Irrigation Department's main concern is the delivery of water to the canal outlet and not with the delivery of water within the outlet command area to the farm. The tendency to ignore the function of water delivery to the farm results from a traditional philosophy that farmers will use the water efficiently because it is in short supply; the attitude that channels are small, therefore simple, and that farmers can correctly design, construct, operate and maintain their own channels; and reluctance to get involved in the complex social and organizational problems encountered at the farm level.[13] It takes time to change attitudes and train engineers how to intervene effectively at the farm level.

CADA, OFD Roles

Within the CADA, the OFD personnel view their main function as the construction of farm works, which include field channels, drains, and land leveling. The agricultural personnel of the district *Panchayat*, working somewhat isolated from the OFD staff, are entrusted with the preparation of production plans. Extension personnel view their function almost solely in terms of promoting the adoption of improved varieties, correct planting rates, and application of fertilizers and insecticides; not that of improved water allocation. Therefore, the farm level irrigation water management function is not that of the engineers, agronomists or extension staff.[14] Since the CADA does not have its own extension personnel, the CADA's only function is to construct OFD works below the government outlets. Construction of facilities for water management has become the CADA role since no one has responsibility for water management. Nor does the above staff have the responsibility for organizing the farmers. Therefore, operation and maintenance of OFD works are lacking.

Rotational Water Supply Improvement

A recent improvement program involving the introduction of a rotational water supply (RWS) at the farm level has resulted in closer coordination among the irrigation engineers, soil conservation staff and extension personnel of the the district *Panchayat*. Under the RWS, crop water requirements were computed to determine the design discharge and duration of flow for each outlet.[15] Data used included:

1. agronomical studies of crop consumptive use conducted at the local state agricultural university;
2. the soil properties in the project area;
3. the area commanded by the outlet, and
4. the prevalent cropping patterns of the command area.

Along with more equality of water supplies for all farmers, it was important to assure equity of access to each farmer. The water conveyance losses, as well as the time required for water to reach the next portion of the command area, were taken into consideration by adjusting the time for water supplies at each point in the command area of the outlet. The details of the day, time of day and duration of each rotation period for a particular farm, the land identification number from the revenue records, and the owner's name were displayed on a large board located near the canal outlet so that all the farmers were aware of their particular turn time. The rotation schedules were also discussed with the participating farmers so that they were involved in setting the actual rotation turns. Mutual understanding and agreement on the appropriate turn times by the CADA staff and the farmers helped to ensure acceptance of the RWS program.[16]

Other basic improvements in the system accompanied the introduction of the RWS. These included the following:

1. measuring devices at the head of each minor or sub-minor and outlet;
2. additional structures (such as division boxes) at junctions of the field channel;
3. lining an initial portion of the watercourse outlet; and
4. rehabilitation of field channels.

These were simultaneously undertaken by the Irrigation and Agriculture Departments. The new approach has resulted in staff working more as a team on a single program of RWS. They are now learning to understand and appreciate different approaches and points of view as they strive to improve water delivery to each farmer's fields. The staff has also begun to use the expertise and advice of agronomists working at the nearby agricultural university.

With this new approach, irrigation engineers, CADA agricultural personnel, and the district *Panchayat* officials also worked together more. They jointly met with the farmers in each of the RWS villages and discussed the implications of a more disciplined operation of the farm delivery system. The village meetings included discussion and agreement by the farmers to allot additional time per hectare to provide the tailenders with the estimated water losses resulting from longer transit time from the outlet to the tail of the command area.

The introduction of a rotational water supply system taught staff from different disciplines and departments to work together to determine such things as crop water requirements, design discharge, and duration of flow at each outlet.

As well as working towards increased equity and economic benefits for the farmers,[17] the CADA organization gained in organizational capability and in its ability to meet stated objectives in the following ways:

1. Agronomists, extension specialists, engineers and agricultural personnel entrusted with the OFD works learned to work toward the shared, stated goal of implementing the rotational water supply and improving water control for farmers.

2. The basic objective of the CADA (improving water use) can only be attained when farm level distribution is the primary goal of all involved.

3. Such a goal can only be effectively achieved when all the necessary personnel are either placed directly under the CADA or are linked together through adequate coordination of services.

4. CADA personnel realized that they needed further training and that there was a need for better monitoring and evaluation of projects by all the disciplines. Monitoring and evaluation of organizations over time is needed to further improve operation, reduce costs and improve benefits.

5. There was growing awareness of the need to integrate all the CADA personnel into a single organization for water management to more effectively achieve the command area development program goals.

6. The value of farmer involvement has become more apparent because it is a basic ingredient for successful project operation.

7. Under the new experimental approach, farmer participation was another benefit that came when farmers cooperated with the implementation of the rotational water supply delivery system. They also gained the benefits of improved water control. As a result, regular maintenance of the watercourses and structures has improved. Increased water control for farmers included a more adequate, dependable supply, increased equity in distribution and decreased potential for farmer conflict through a system of equal access.

CADA Improvement Needs

Experiences with different modes of CADA organization, a study of their actual operations, and recent experience with the introduction of an experimental rotational water supply system suggests several significant improvements in the CADA concept can be made. A unified, interdisciplinary cadre of water management professionals is a priority. To accomplish this reorganization, present attitudes, philosophies and behaviors need to be changed. A major innovation would be to separate the construction and design functions of the Irrigation Department from the maintenance and operation functions and form two separate organizations. The Department of Irrigation could continue to handle project construction and design, and the Command Area Development Department would have the function of water management in the completed projects. Both departments could be coordinated effectively under a single state minister (Figure 2).

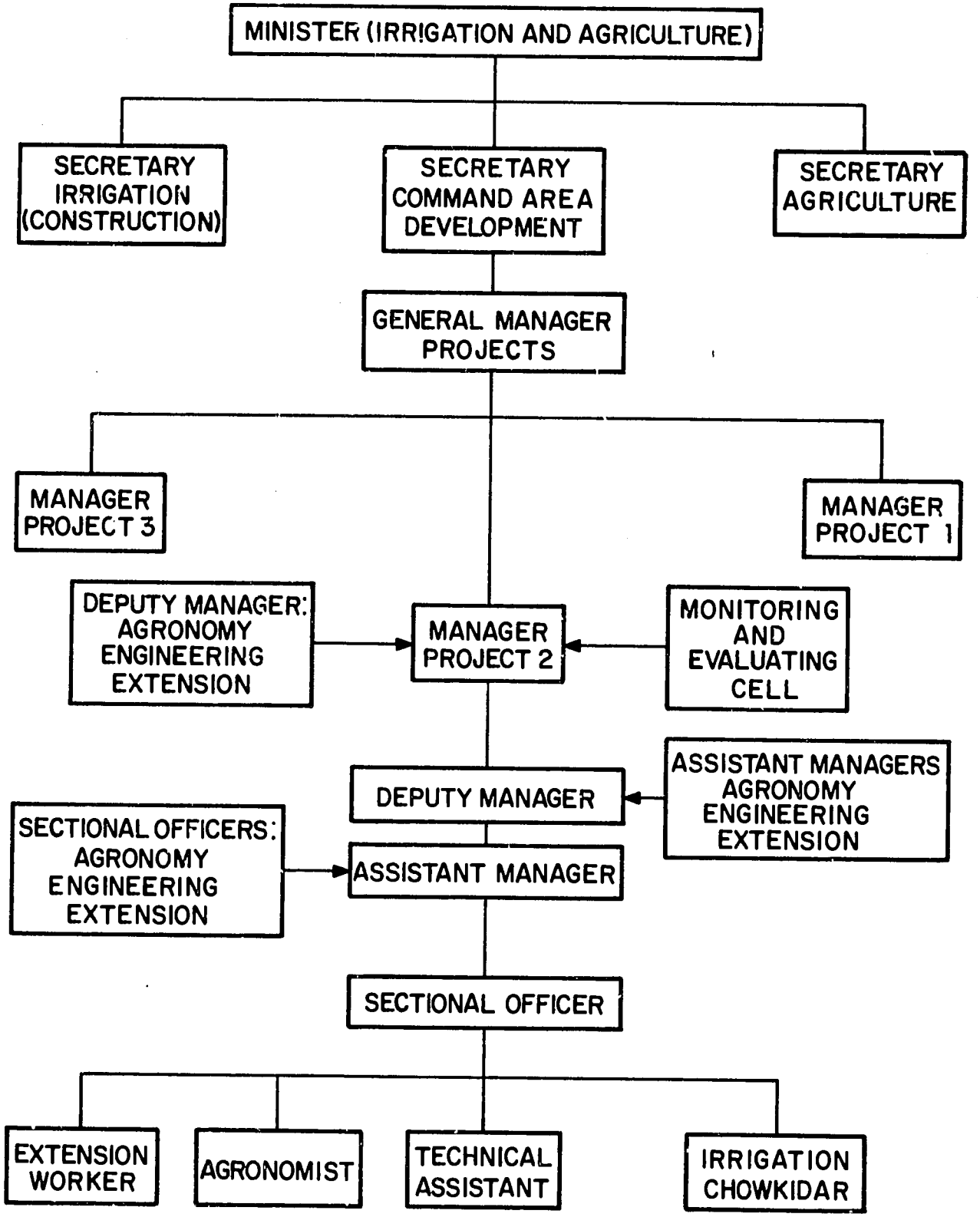


Figure 2. A suggested organizational improvement for CADAs.

The Command Area Development Department should consist of a department of water management which would be composed of all personnel presently operating irrigation projects. These include irrigation engineers, agricultural personnel, extension specialists, and those personnel of organizations providing inputs, services, and credit. Their function would include the present inputs and services, but also include the operation, maintenance and management of the main system through to the farm system. The water management commissioner should be an individual from one of these areas. The water management personnel should also be provided adequate incentives including a career structure for advancement and training opportunities for professional development.

Each project should be headed by a manager with the equivalent rank of a superintending engineer, but the designation "engineer" would no longer need to be retained since the manager could be from any discipline. The manager would be assisted by an interdisciplinary team of officers with the ranks of executive engineer, deputy director of agriculture, and deputy director of economics and statistics; each with the title of deputy manager. The deputy managers would perform carefully planned staff functions. A lone officer, also known as a deputy manager, would be in charge of the division replacing the executive engineer. He would also be assisted by an interdisciplinary team of officers known as assistant managers.

This organizational approach would provide project managers throughout the system with interdisciplinary team assistance. In the new career structure, personnel would spend their entire career in irrigation project development doing activities related to the operation and management of irrigation projects and the implementation of improvements in those projects. They would not be transferred into and out of other departments.

Currently, due to increased ferment for change, the GOI is seriously examining the feasibility of introducing rotational water supply to all surface irrigation projects and establishing a separate water management cadre similar to that described above. There is little disagreement about the advisability of implementing rotational water supply in projects. However, there are differences of opinion about the need for a separate water management department. Questions need to be asked concerning the organization and location of the organizational control mechanism - should it be in

1. the Irrigation Department,
2. the Agricultural Department, or
3. an entirely new, independent Water Management Department in the state Secretariat.

These complex issues will not and should not be resolved overnight because they require considerable thought and examination throughout the administrations of the state governments and the GOI.

Two major steps could be taken, however, to improve the performance of the CADA programs in the short run. These are (a) training project personnel in water management; and (b) establishing a water management monitoring and evaluation cell in each CADA.

These two innovations relate to the fostering of specific interdisciplinary skills that are critically needed to improve water management in CADAs and to develop monitoring skills for project evaluation and improvement on the farm, outlet, distributory and the main system.

Section III

IMPROVEMENT NEEDS IN CADA

Introduction

Improving technical and interdisciplinary skills and establishing a water management cadre are the important needs in CADA. Therefore, this section will focus on CADA management objectives within the context of a clear need for professional development in an organized training effort. A strategy is also suggested that will provide a long-term focus on training for improvement activities and better operation and management of the irrigation systems.

Project Water Management Objectives

Organizational procedures and operational strategies for improved project performance require establishing a clear set of objectives. Without objectives to guide programs, as Abraham Lincoln once said, "If we only know where we are going, perhaps we will get there."

An approach to project objectives has been suggested.[19] These objectives have been more frequently related to specific project activities than general project objectives. Lowdermilk[20] has suggested six objectives for the improvement of irrigation systems:

1. Provide a predictable water supply to all farms,
2. Insure productivity of the water used,
3. Maintain equity of delivery and access to water for all farmers,
4. Conserve the soil and water resources,
5. Attain cost effectiveness and a productive return on investments, and
6. Provide the organizational means and incentives for effective farmer participation in system operation and maintenance.

Accomplishing an objective requires establishing specific goals. Goals need to be translated into specific performance criteria so that the performance of the project can be measured. Performance criteria also provide the basis for selecting operation parameters that can be monitored regularly to measure and improve project performance.

For example, if having predictable water supplies is the objective, then a goal could be to have water available at farm A, outlet B, minor C, and branch canal D. Performance could be measured in a range of flow rates at the farm, and water levels and/or flow rates at the outlet, minor and branch canal. An acceptable level of performance would be an agreed-upon, minimum percentage of the time the desired flow rates and/or water levels were present as scheduled. Specific goals and measurable performance criteria would be similarly developed for all objectives derived from Lowdermilk's six management objectives.

The six management objectives cover the physical, biological and social needs of an irrigation project. Predictable water delivery requires appropriate design, operation and maintenance, but it also assumes improved operation and maintenance of the farm system below the outlet. This requires an appropriate farmer organization as suggested under objective six, as well as an adequate information system about the availability and delivery of water to reduce farmer risk.

To achieve water productivity requires better knowledge, information and skills, and timely, reliable inputs and services that are packaged and delivered to the farmers. The integration of services and coordination of personnel are important because a missing input can become a limiting factor for production. For example, farmers often are not able to make investments when a key input or service is missing because without it, the risks become too high.

Equity is a major objective and includes delivery of water, water control, availability of inputs, and knowledge of the availability of a service. Equity is necessary because of the agrarian structure and social systems present in India which create different classes of farmers with varying degrees of power and influence. Also, water is usually differentially available at the heads and tails of canals, minors and watercourses, creating more equity problems. Specific objectives to insure equity along these units should be carefully analyzed, planned for, and implemented. Access to water, inputs, and services needs to be managed to insure that the rural poor, including marginal farmers, tenant farmers and minority groups with little power, also have equal access. Without this, predictability of water supplies and overall water productivity are negatively affected.

Irrigation projects can severely deteriorate the physical and social environment. Irrigation productivity may be constrained at a low level or may decline because of environmental degradation and negative inputs. Therefore, specific project objectives should be formulated to deal with the potential negative effects of

- waterlogging and salinity,
- soil erosion,
- ground water deterioration,
- reduced soil fertility,
- health hazards, and
- other social and environmental concerns.

Project performance needs to be evaluated over time in each of the above areas as appropriate.

Cost effectiveness and a productive return on irrigation investments is an objective often not met by irrigation projects because planning did not focus on the objectives discussed above. Subsequent investments are often made to improve the system without a basis for knowing whether they will be profitable or not. As a result, most irrigation projects achieve much lower levels of performance and returns on investment than planned.

Finally, the objective of providing farmers the legal framework and incentives to organize irrigation associations is completely lacking on most systems. The traditional approach has been to consider this a minor action and in many places irrigation staff hope farmers will organize on their own or they assume that more strict laws and codes and new technology will suffice. The "Achilles heel" of most irrigation systems is the lack of viable irrigation associations for farmer participation and for the on-going operation and maintenance of the farm system. Without a voice in the operation, maintenance and improvement programs, farmers will not provide the maintenance that is necessary; which, in turn, makes water more productive, helps protect costly investments, and conserves scarce resources. In the next section, a strategy for systematically involving farmers will be suggested.

Equity in water supply and control should be a major project objective.

CADA Improvement Strategies

Effective implementation of the management objectives requires trained personnel from several disciplines who also have a systems understanding of water management and the ability to work in teams. Presently, different disciplines are located in different departments with only a coordination mechanism linking department activities to the CADA. One strategy would be to train personnel in one department (one discipline) to perform all the skills needed by an irrigation project. This has proven ineffective because it assumes that one individual can acquire the skills of two or more disciplines effectively. Since a generalist approach is not feasible, the option of having the necessary disciplines working as teams located in one department should be given high priority.

Until the water management department can be institutionalized in a career structure, another strategy would be to train all disciplines in the skills necessary to achieve specific project goals and management objectives. The personnel would need to understand the management objectives and the essential skills contributed by other disciplines to implement project objectives. Past experiences suggest that training personnel should be a top priority for each project. Training, therefore, must not remain a marginal project component if the goal is to help farmers improve water management for increased agricultural production.

Training Centers

Training centers for improving project personnel skills in water management are currently being established in a number of states in India. The centers are located in a representative area of an irrigation project and are responsible for training all project personnel for the state — from recently employed graduates to senior personnel. Suggested objectives for training centers include the following:

1. Train personnel in each discipline to improve the basic skills necessary to achieve specific project objectives.

2. Develop and improve the planning and management skills of all disciplines to aid working together as a team in the project.

3. Train for and implement a systematic strategy of project improvement.

4. Train all personnel in the knowledge, skills and attitudes needed for working effectively with farmers and farmer organizations.

The international institutions that finance irrigation projects in India have been stressing the need to provide water management training. For example, financial assistance agreements in 1979 and 1980 between the World bank and two states of India have specific provisions for establishing a water management training center.

Such a center should be headed by a senior superintending engineer or a joint director of agriculture with at least 10 years experience in operating and managing irrigated agriculture. Preservice training should include nine months of hands-on training to improve the knowledge and basic skills of new recruits and to create new attitudes toward irrigation and working with farmers. The course content should include soil science, agronomy, basic irrigation engineering, social and organizational methods for working with farmers, farm management economics and effective methods for transferring technology to farmers. After training, these personnel should be appointed deputy engineers, subdivisional soil conservation officers, and water management extension personnel.

In addition to the preservice training program, the center should also conduct a joint, eight-week, in-service program for middle level personnel such as executive engineers and deputy directors of agriculture. There should also be a one-week orientation workshop for senior personnel and for officers who are to be promoted to superintending engineers or joint directors of agriculture.[21]

Training activities to achieve specific objectives would be developed to improve operation and management of the system. Training activities would involve organizing farmers for operation and maintenance, farm demonstrations and other needed activities such as training farmers. Strategies for better information systems, farmer involvement, and access to institutional inputs and services should also be included.

The disciplinary skills which are needed to meet the project objectives should be clearly stated in the training objectives. General skills can be improved, but specific skills such as design and construction of field channels and subminors, water measurement, farm agronomic trials, farm budgets, farm surveys, farmer organization, and extension methods should be carefully delineated and developed.

Training will improve the knowledge, skills and attitudes of project personnel.

The basic skills, knowledge, and attitudes acquired early in an individual's career form a basic level of professional expertise which can continuously improve the quality of project management and convince project personnel to grow and develop professionally. Specific disciplinary skills, knowledge, and professional attitudes should be a primary focus. However, general management skills and approaches should never be considered unimportant.

Developing planning and management skills for project personnel first requires concentration on the current departmental responsibilities. Supervising personnel, monitoring and evaluating personnel and system performance, and planning effective programs for farmers would receive adequate attention if personnel from different departments and disciplines were brought together in a learning situation. For example, implementing a rotational water supply for the *rabi* (winter) wheat program provides valuable learning experiences. Other programs should be coordinated to provide experience and to meet the needs of trainees. Experience also indicates that the most useful training takes place on a living system.

Project Improvement Strategy

The CADA would first establish the management objectives and specific goals previously suggested plus others deemed appropriate for the specific project. The next step would be to establish the development model[22] as the strategy for improving the irrigation project. A short workshop (two weeks) for training senior and intermediate level project administrators in concepts, principles and procedures is suggested. A monitoring and evaluation cell within the training center or within the project is the next step. A workshop[23] on "Diagnostic Analysis of Farm Irrigation Systems" can initiate the activities of this cell. The trained teams can continue the diagnostic analysis studies begun during the workshop.

Once priority problems have been identified, solutions can be tested in a research program on the project area. Monitoring and evaluating the tests can be continued to establish the value of the improvements, the changes that enhance the improvements, and the organizational requirements such as training, technical assistance to farmers, and resources needed for implementation. Some adaptation may be necessary if farmers are to accept the improvements. Some improvements may be implemented within an existing organizational structure, such as a new fertilizer practice. Visible results that have major benefits for the farmers are best. Farmer involvement is an important part of all these activities.

Once one or more improvements are assessed and deemed valuable for implementation, the training center can provide the training for organizational implementation of the improvement in the project area. The monitoring and evaluation cell determines the value, further training needs, and changes needed for continued successful implementation of the improvement.

The functional relationships of the various activities are shown in Figure 3. The CADA programs continue as presently defined. The monitoring and evaluation cell formulates important improvement needs, tests solutions to meet these needs, and defines the implementation program. The CADA sets up the improvement unit, defines the program, obtains trained personnel from the center or uses retrained personnel from an existing CADA unit. Eventually, all farmer programs would come through the implementing unit. Existing programs could continue as they are or until the needed improvements were specifically defined and evaluated. The monitoring and evaluation cell would continue to look at project needs as new improvements are implemented.

Coordination and program definition are important parts of Figure 3. The monitoring and evaluation cell provides definition for CADA of the new improvement programs and project needs, and also defines training needs for all operations within the project. The training center provides personnel for all project units based on needs defined through monitoring project operations, the monitoring and evaluation cell and CADA policy decisions. CADA provides the coordination policy inputs to the implementing unit, the monitoring and evaluation cell and the training center. Needs are defined by monitoring farmer outputs in terms of the previously defined project management objectives.

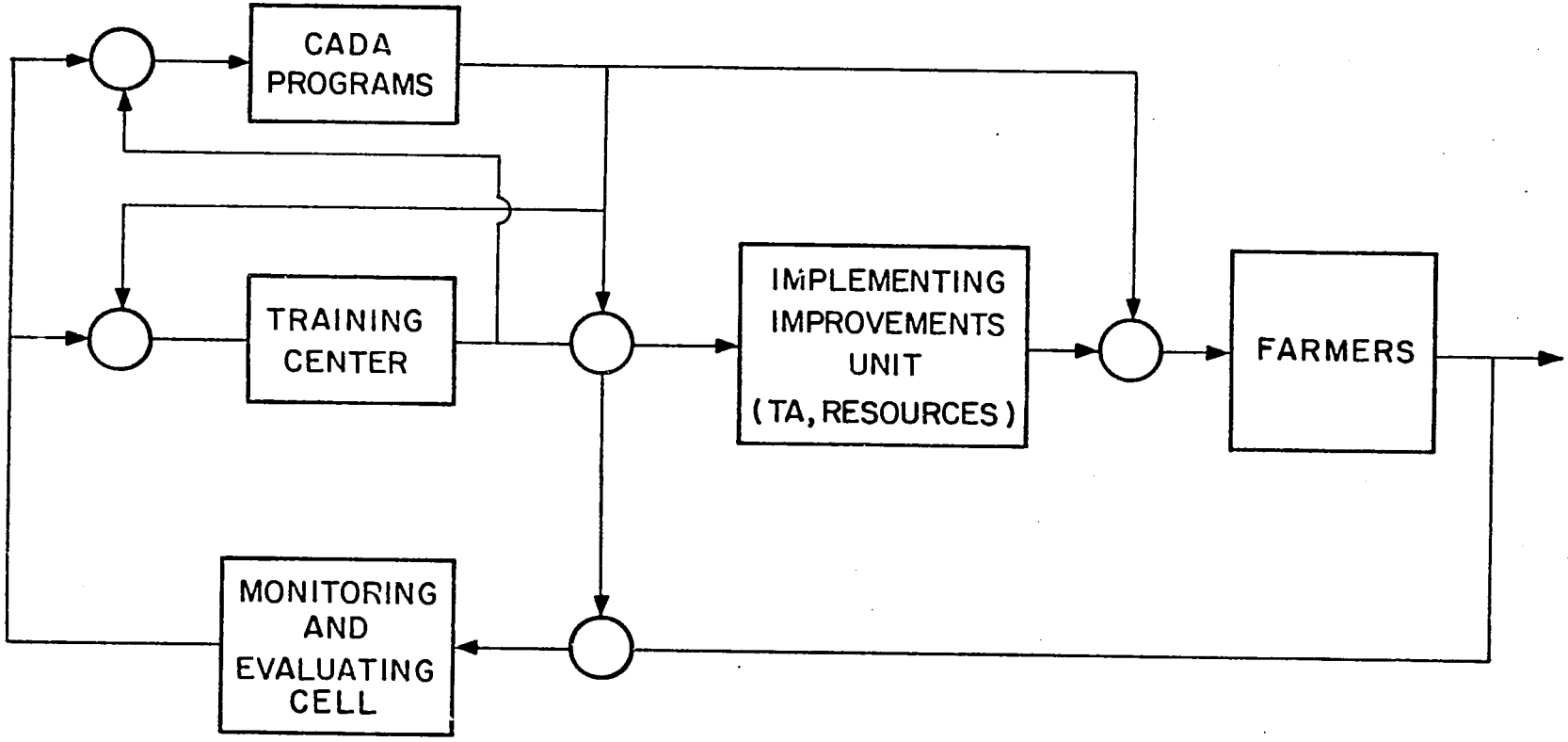


Figure 3. An improved CADA organizational relationship for irrigation projects.

Section IV

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The CADA model is an organization strategy for reducing the large gap between the irrigation potential and the actual irrigated area achieved on Indian irrigation projects. An objective of the CADA model was to obtain higher returns from the costly investments made in irrigation projects. The CADA experiment has not been a total success as an organizational mechanism, but it does have some of the important elements needed to improve project operation. Some CADA commissioners have displayed special individual initiative for improving system operation and thus have been successful at achieving the program objectives.

The reasons for lack of top performance to date are basically structural. Notable among these is the absence of a unified cadre of water management personnel responsible to one organization. The current division of responsibilities between the two major, and often competing departments (Irrigation and Agriculture), has resulted in neither organization being responsible for managing farm level irrigation. Much of the CADA Commissioner's time is wasted because of the cumbersome, time consuming procedures needed to attain coordination among the various departments. Often the personal appeals of the commissioner to all units and his very senior status are the only means for achieving coordination. Consequently, most of the CADAs have settled for constructing on-farm development works only.

Because of lack of support and coordination, CADAs have neglected the more difficult activities such as scheduling water distribution, providing institutional support and services for farmers, and creating the farmer organizations needed to make the other investments more effective. Further, personnel serving in the command area and belonging to the various departments do not have an adequate understanding of the various problems associated with irrigation at the farm level, especially that of organizing and working closely with farmers. Problems such as inadequate conveyance systems, poor land development and inefficient water distribution, which are often beyond the control of farmers, have often been ignored. These problems result in uncertain, uncontrolled water distribution, inefficient water use, inadequate water to meet the crop-soil water requirements, ineffective extension methods, few or no farmer organizations, and a lack of support services. All of these are needed to provide farmers with new and improved production possibilities.

Achieving better water management in irrigation projects in India requires more emphasis on:

- Availability and transfer of knowledge and technology.
- Acceptance by the farmers.
- Appropriate institutions and support services.
- Formal irrigation associations to maintain improvements.

Gaps in knowledge can be bridged by setting up centers for hands-on, in-service training for various personnel from different departments serving in the project command area. Short duration, intensive field training programs can rapidly improve the skills of personnel in their respective disciplines. For a time at least, all new projects should emphasize training, especially for the managers and field staff. For too long, training has been left as a marginal component of irrigation projects and programs. Skilled manpower makes management more effective. This is probably one of the most cost-effective components of a project. An integrated and unified approach towards solving irrigation problems may be fostered to the fullest extent if a deliberate effort is made to apply an interdisciplinary approach rather than the current single-discipline focus.

A development model for improving water management can be implemented as an irrigation improvement strategy.[22] A training center can impart the skills, knowledge, and attitudes specifically needed for team implementation of the development model while upgrading the technical skills of the respective departments. Under the development model described, members of different disciplines learn to function as a team while studying an irrigation subsystem.[23] They identify the problems and their causes that affect the present level of irrigation utilization. The team develops understanding of how to solve the priority problems. Under a program of project improvement, alternative solutions are examined, implemented, tested and refined. The final set of solutions appropriate to the specific local situation are developed while working with farmers.

The evolution of appropriate local technology is the result of such a process. Knowledge gained over time is applied by the project authorities and systematically transferred to the farmers. The farmers' acceptance of new knowledge and useful technologies is made easier by the process itself. Teams of professionals work at the farm level, learning from the farmers who have more knowledge and resources to offer than has previously been realized. The farmers have ample opportunities to observe experiments conducted over time, and they become the most effective extension transfer mechanism for convincing other farmers.

Developing the appropriate institutions and organizations to provide support service to farmers, though an objective of CADA, has been neglected in the actual implementation process because of a preoccupation with on-farm development works. The objectives of support services and farmer participation become easier to achieve when the development model described is used. The CADAs give their time and attention to the important elements of a well-conceived program rather than only to engineering aspects. In fact, farmers in an improved environment of predictability, controllability, and assured adequacy of irrigation supplies are provided visible incentives for creating irrigation associations. They will not, and cannot, organize themselves effectively without adequate incentives and assistance. With visible incentives through appropriate interventions and the commitment of government to legal organizations, farmers will respond and participate in improvement programs, and will maintain and operate the farm system.

If farmers can see visible improvements, they will be more likely to participate in improvement programs and to maintain and operate the farm system.

In the short run, the development model can prepare personnel for developing a monitoring and evaluation cell in the CADA itself. Today, too much irrelevant information is collected and transmitted to the government. Such information is primarily physical and financial and is not adequate or useful to project authorities for improving their own project performance. Also, different departments often collect information for their own uses that is not synthesized or made available to other departments. Therefore, diagnostic analysis of a subsystem at the minor, subminor, or outlet level implemented by an interdisciplinary team provides more useful internal monitoring and evaluation.

The internal monitoring and evaluation cell should be placed directly under the CADA commissioner so that data can be used as a management tool for project improvement on a regular basis. The cell could be located either in the office of the CADA commissioner in the present organization or in the office of the project manager as in the suggested organizational structure (see Figure 2).

The person in charge at the monitoring and evaluation cell, however, should report to the CADA commissioner directly to ensure that he has access to the findings to use in management decision making. The monitoring and evaluation cell also needs the support of the commissioner to assure that administrative and technical support and budget allotments are adequate for conducting studies and processing results in usable reports. The monitoring and evaluation cell should consist of an executive engineer, a deputy director of agriculture (OFD), a deputy director of agriculture (extension), a deputy director of agriculture (agronomy), and a deputy director of economics and statistics. If all of the senior personnel have comparable pay scales, the most senior or experienced individual functions as the team leader if other qualifications are adequate for the post. What is most important is to assure that they actually operate as a team because the components evaluated include the physical, biological, economic, social and organizational dimensions.

The following are recommendations for improving CADAs:

1. The CADA is recognized as the most important available organizational strategy to improve the performance of irrigation projects, but CADA implementation requires the evolution of a unified career structure for water management. Serious consideration should be given to the development of such an organization as soon as possible.

2. A training center should be established in each state to operate training programs on a continuous basis to impart skills, strengthen specialized knowledge, and to develop positive attitudes about the functions, responsibilities, and methodologies of other disciplines involved in irrigation.

3. Irrigation project personnel should be trained to function as members of an interdisciplinary team. Live subsystems should be used to provide training in diagnostic analysis and to provide data which can also be used for project improvement programs.

4. As an interdisciplinary team, the trained personnel should form the nucleus of a monitoring and evaluation cell in each CADA.

Monitoring the progress of improvements is essential for prolonged success in a project.

5. Monitoring and evaluation cells should implement the development model by conducting year-round studies of the farm irrigation subsystems and system management. Improvement alternatives should be tested and successful improvements implemented in a project improvement program.

6. Study results should be used to improve training programs and should be made available to the appropriate technical and non-technical audiences throughout India who are concerned with making India's vast investments in irrigation more profitable for the nation and for its farm families.

7. Though not addressed in this paper, much of the empirical data collected on irrigation systems throughout India could be used to improve the curricula and training materials in colleges and universities which would also produce better graduates and have a long-term effect on manpower development for irrigation.

FOOTNOTES

1. Panday, Kedar. 1980. Inaugural address to the third Afro-Asian Regional Conference of the International Commission on Irrigation and Drainage. October. New Delhi.

2. Mellor, J. W. and T. V. Moorti. 1971. Dilemma of state tubewells. Economic and Political Weekly. 6(27).

3. Wade, R. E. 1975. Water to the fields: India's changing strategy. South Asian Review. 8(4):301-321.

4. *Ibid.*

5. Jayaraman, T. K. 1980. Determinants of cropping patterns in Mahi-Kadana Irrigation Project. Afro-Asian Regional Conference of the International Commission on Irrigation and Drainage. October. New Delhi.

6. Reidinger, R. S. 1974. Institutional rationing of canal water in north India: conflict between traditional pattern and modern needs. Economic Development and Cultural Change. 27(2):79-104.

7. These include several Staff Appraisal Reports for the World Bank on various Indian irrigation projects financed in recent years.

8. India, Government of. Ministry of Irrigation and Power. 1972. Report of the National Commission on Agriculture. Vol. 5.

9. Wade, R. E., *op. cit.*, pp. 301-321.

10. Singh, K. K. 1978. Alternative organizational strategies for command area development. Proceedings of the Commonwealth Workshop on Irrigation Management. Commonwealth Secretariat London.

11. Jayaraman, T. K., R. K. Arora (ed.). 1979. Peoples participation in Command Area Development. Peoples Participation in the Development Process. H.C.M. Institute of Public Administration, Jaipur. pp. 43-50.

12. Jayaraman, T. K. 1979. Some new strategies for Command Area Development. Development Policy and Administration Review. 8(2).

13. Jayaraman, P. and T. K. Jayaraman. 1981. Attitudes of the irrigation bureaucracy towards water management tasks in India. Zeitchrift Für Ausländische Landwirtschaft. Quarterly Journal of International Agriculture. 20(3):279-292.

14. Elman, A. O. (ed.). Proceedings of the Commonwealth Workshop on Irrigation Management. Commonwealth Secretariat, London. p. 2.

15. Jayaraman, T. K., K. K. Singh, (ed.). 1981. Implementation of warabundi (rotational water supply): A management approach. Warabundi for Irrigated Agriculture in India. Central Board of Irrigation and Power, New Delhi. pp. 23-31.

16. *Ibid.*

17. Jayaraman, T. K. 1981. Impact study of rotational water distribution at the farm level in Mahi-Kadana Irrigation Project in Gujarat State, India. Public Administration and Development. 1(3):(forthcoming).

18. Jayaraman, T. K. 1981. A case for professionalization of water management in irrigation projects in India. Public Administration and Development. 1(3):235-244.

19. Bromley, D. W., D. C. Taylor, and D. E. Parker. 1980. Water reform and economic development: institutional aspects of water management in the developing countries. Economic Development and Cultural Change. 28(2):365-366.

20. Lowdermilk, M. K. 1981. Social organizational factors of irrigation systems. Government of India Diagnostic Analysis of Farm Irrigation Systems Training Course in Water Management. Anand, Gujarat, India. Feb.-March, 146 p.

21. Jayaraman, T. K. 1981. Training programs for better water management in surface irrigation projects in India. Water Supply and Management. 5(3):261-272.

22. Clyma, W., M. K. Lowdermilk, and G. L. Corey. 1977. A research-development process for improvement of on-farm water management. Colorado State University, Fort Collins. (See also: Clyma, W., M. K. Lowdermilk, and D. Lattimore. 1981. On-farm water management for rural development. Agricultural Engineering. 62(2):14-15.

23. Lowdermilk, M. K., et al. 1981. Diagnostic analysis of farm irrigation systems. Monitoring and Evaluation Manual. Vol. I. Water Management Synthesis Project, Colorado State University, Fort Collins, CO 80523. 185 p. (See also: Water Management Synthesis Project. 1981. Diagnostic analysis of farm irrigation systems. Monitoring and Evaluation Manual. Vol. II. Colorado State University, Fort Collins, CO 80523. 349 p.)