

**Paper No. 2**

**INSTITUTIONAL AND ORGANIZATIONAL ASPECTS  
OF IRRIGATION MANAGEMENT**

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# **Institutional and Organizational Aspects of Irrigation Management**

## **I. INTRODUCTION**

Irrigation-project management can be defined as "the process of operating an irrigation project according to a specific plan with the purpose, objectives, and goals specially defined in terms of measurable variables and computable performances." (Mohamed, 1983). In contrast, administration of a system is the operation of the system according to a set of rules regardless of outcome. Management of the system allows flexibility because of the embedded continuous evaluation of the method and/or outcome. Management allows resetting of priorities according to the set objectives and identification of means of attaining these objectives.

The Gezira Scheme was selected for this presentation because:

- 1) It is the largest irrigated project in Sudan and hence the largest user of irrigation water.
- 2) It constitutes the model according to which other irrigated projects are designed.
- 3) The scheme constitutes the backbone of the Sudanese economy in terms of cash and food crops.

Organizations involved in the irrigation management of Gezira Scheme are of two categories:

- 1) Directly involved organizations:
  - Sudan Gezira Board (SGB)
  - Ministry of Irrigation (MOI)
  - Tenants' Union (TU)
- 2) Indirectly involved organizations:
  - Ministry of Finance and National Planning (MFNP)
  - Research and Training Institutions (R&T)

## **II. SUDAN GEZIRA BOARD**

At the top of the management pyramid presides a Board of Directors consisting of 15 members and a Chairman. Five of the members represent the tenants, two represent the SGB laborers and officials, and the other eight are mainly professionals representing the relevant Ministries and Corporations.

In addition to the Board of Directors, which sets the general policies, the SGB is divided into divisions, groups, and blocks each having its own management/administration. There are also sets of councils and committees which deal with the management of general production. They include a joint committee, group-production councils, block-production councils and village production councils. Tenants are well represented at all these levels.

On the executive side, the Managing Director is at the top of the pyramid assisted by a deputy and four main administrators in Agriculture, Finance, Engineering, and Administrative Affairs. There are some units and departments (Socioeconomic, Research, Auditing, Information, Legal Administration, etc.) directly responsible to the Managing Director because of the nature of their duties that serve all the above mentioned administrations. The rest of this section will concentrate on the Agricultural Administration because it is directly involved in the irrigation management of the Scheme.

### *II.1 The Agricultural Administration*

The Scheme is divided into 14 Groups and 107 Blocks located over an area of 2.16 million feddans.<sup>1</sup> The Director for Agricultural Administration is assisted by a deputy at the headquarters and two others, one for Gezira and the other for Managil. Each of the latter deputies is responsible for 7 Groups and about 53 Blocks. In each of the 14 Groups, there are 7-9 Blocks and in each Block there are 1-4 Inspectors; the most senior being the Block Inspector (BI). On the technical side, there are 7 Departments: Crop Protection, Seed Propagation, Agricultural Extension, Animal Production, Horticulture, Tenants Affairs and Administration, and the Services and Budget Department. In addition to the above, the Agricultural Administration is also responsible for the Pilot Farm.

### *II.2 Responsibilities of Irrigation Management*

The Field Inspector (FI) is responsible for irrigation of different crops in the area under his supervision. He indents water to satisfy the requirements of the crops in the rotation. The volume of indented water is determined in a crude way by multiplying the number of Field Outlet Pipes (FOPs) to be opened by 5000. This caters for only 50 percent of the cropped area which is to be irrigated at any time. In indenting water the FI passes his estimate to the BI who consults with the head Ghafeer to make sure that the water indent corresponds to needs in time and place. The water indent can be changed daily during the rainy season, and weekly after that. Indent changes at mid-week are accepted.

The Agricultural Administration holds discussions with the Ministry of Irrigation, once a year, to decide on the area of the wheat crop. The Agricultural Director meets with the Under Secretary for the Irrigation Operations General Directorate to discuss the sowing dates for summer crops and calculate the water needed for these crops including wheat.

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<sup>1</sup>Feddan = 0.42 hectare = 1.038 acres.

### *II.3 Constraints to the Water Indent*

1. Canals are mostly in bad shape and therefore the field staff tend to indent the maximum water to secure irrigation of crops in the rotation.
2. The first irrigation for either summer or winter crops usually requires more water, taxing the system capacity as a result of:
  - a) shortage of rainfall during the past few years, and
  - b) changes in sowing dates. These changes are recommended by the Agricultural Research Corporation while other changes are practiced by the tenants. The net result of these changes is an overlap of crops resulting in water bottlenecks, especially during October.
3. There is a widespread belief among field staff that if the indent is reduced from the maximum to a realistic value, affected canals will not get the required water on time if the indent is increased later.

### *II.4 Problems Related to Irrigation Management*

1. Though the tenant is the first to feel the water shortage, his voice is either not heard or is given very little consideration by the technical staff. Under these circumstances, tenants tend to look for political backing for the solution of the technical problems.
2. The intensification and diversification plans have set sowing dates for the different crops previously grown. However, these sowing dates are no longer applicable because:
  - a) New sowing dates are recommended due to changes in cultivars.
  - b) The rotation has been changed from an eight-course rotation -- where Dura and Groundnuts were in different serials -- to a four-course rotation that combined both crops in one serial. Accordingly tenants tend to delay sowing of Dura to avoid splits in land preparation and irrigation periods.
  - c) The vegetable area has increased in the absence of knowledge of their water requirement.
3. Siltation has increased as a result of:
  - a) The erosion caused by removal of vegetation cover due to prolonged drought in the Ethiopian Plateau.

- b) The advancement of sowing dates of summer crops which required the early release of water into the canals.
  - c) More water being carried by the canals in the absence of rainfall.
4. High infestation of water weeds due to shortage of labor, water-borne diseases, lack of funds for manual and mechanical operations, and lack of research to combat this problem.
  5. Certain canals are desilted annually or twice a year (e.g., the Tabub canal) while others rarely require this operation.
  6. Sand movement into the scheme, especially in the North-West and Tahamid Groups, has resulted in high spots in fields and in sand- filled canals.

### **III. MINISTRY OF IRRIGATION**

#### *III.1 Responsibilities*

The Ministry of Irrigation (MOI) is the Government agency entrusted with surface-water management and works. Consequently it is involved directly or indirectly in:

1. Irrigation water management
2. Hydropower
3. Navigation
4. Flood control
5. Erosion control
6. River training

It is anticipated that a few extra responsibilities like river pollution control and enforcement of water laws would be assigned to MOI in the near future.

However, irrigation water management including the construction of irrigation works remains the primary day-to-day responsibility.

#### *III.2 Organizational Structure and Human Resources*

In order to perform its duties eleven General Directorates (GDs), two Corporations and a Permanent Joint Technical Committee (PJTC) were formed (see the attached organizational chart).

The main duties of these units concerning water management can be summarized as follows:

## General Directorates

- 1-3. *Irrigation operations*: irrigation water management.
4. *Mechanical and Electrical*: Maintenance and/or construction of gates, valves, maintenance of pumps, vehicles, and repair equipment for roads and banks .
5. *Projects*: Remodelling of canals, drains, and structures; new extensions; renewals; rehabilitation and extensive land-surveying works.
6. *Dams*: Water releases, reservoir management, and storage.
7. *Water Resources*: Forecast of Nile-water yields, investigation of ways and means of increasing water yield and preparation of data and proposition of policies for negotiation with riparian countries.
8. *Nile Water*: Measurement of river water level and discharges, and calibration of gates.
9. *Planning*: Collection, analysis, and appraisal of data necessary for horizontal and vertical expansions. Submission of follow-up reports for new extension, rehabilitation, and modernization programs.
10. *Finance and Administration*: Preparation of budgets, control of spending, staffing, reporting industrial relations, and staff training.
11. *Hydraulics Research Station (HRS)*: Refer to page 49.

## Corporation

1. Earth Moving Corporation (EMC): Desilting, irrigation, and drainage networks.
2. Irrigation Works Corporation (IWC): Construction of irrigation structures and buildings.

The following Table shows the numbers and qualification of the Technical Staff of the MOI.

Table 1. Manpower of the Ministry of Irrigation (MOI)-.

	Post-Graduate	BSc	Dipl. KHT.I.	Dipl. Polytech.	Technicians
1 - GDs	102	240	128	157	310
2 - EMC	8	37	19	14	43
3 - IWC	15	52	6	11	22
4 - Total	125	329	153	182	375
5 - 50% of total	62	165	76	91	187

More than 10,000 laborers are employed by the MOI and Corporations. About one-third of them are highly skilled labor (by Sudanese standards).

Areawise, Gezira and Managil comprise about 50 percent of the irrigated sector in Sudan. Hence it can safely be said that the fifth row of the above table depicts the quantity and quality of engineers and technicians involved in water management in Gezira and Managil.

The General Directorate is divided into 2 directorates (for Gezira and Managil), 7 divisions, 23 subdivisions and 78 sections each having 20-30 skilled laborers and some casual laborers.

#### IV. AGRICULTURAL RESEARCH CORPORATION (ARC)

The ARC is a research and consultancy institution whose role in the area of irrigation is specified as:

"Defining a sound crop rotation in accordance with economic, political, strategic, and self-sufficiency goals."

The specific objectives related to irrigation are:

1. Optimum use of available water resources.
2. Balanced water use to avoid peaks of demand and troughs of surplus.
3. Specific plant-growth stages from sowing to harvest.
4. Determination of water requirement for crops grown in the rotation and coordination of their irrigation.
5. Conduction of studies to make the crop rotation flexible and interactive with changes in influencing-factors and responsive to national, sectoral, and individual requirements (such as introduction of new crops or technology).

6. Recommendation of agricultural practices -- through various technical committee -- after conducting research in stations or farmer-fields in cooperation with national and/international agencies.
7. Obtaining of feedback for further assessments.
8. Cooperation with research institutions, international organizations, and other specialized bodies.

#### *IV.1 Main Constraints to Irrigation*

1. The number of researchers in this field is very small.
2. Lack of technical facilities.
3. Scarce local and foreign funds.
4. Supporting staff are not trained.
5. Field-level studies are scarce.

### **V. HYDRAULICS RESEARCH STATION (HRS)**

#### *V.1 Introduction*

The HRS is an under-secretariat of the Ministry of Irrigation and Water Resources. It was established as a joint project of the Sudan Government and UNDP/UNESCO in 1974. The Sudan Government provided the buildings, local material, and staff, and the UNDP provided the technical experts, necessary equipment, and limited training abroad for some engineers and technicians.

#### *V.2 Objectives*

The main objectives of the HRS is to assist the MOI, through applied research, in developing Sudan's water resources and in operating, maintaining, and managing irrigation schemes in the most economical way. It is also aimed at increasing the level of the knowledge in hydraulics and irrigation engineering among the MOI engineers and technicians and relevant institutes through training courses.

#### *V.3 Organizational Structure*

The organization structure of the HRS consists of eight research units, seven of them already established and the eighth unit [Soil Mechanics] to be established when staff is available. Each of these units has its



objectives and functions clearly stated in the HRS documents. Besides the above mentioned main research units, there are about seven assisting units, and six supporting-staff units.

The HRS has a Council of Research which is a scientific and technical working forum to assist the HRS in planning and supervising the process of research activities and assessing the quality of results, studies, and research reports. The Council of Research is headed by the HRS Under Secretary and consists of the under Secretaries of MOI, undersecretariats and representatives of KU, GU, ARC, SGB, and NCR, heads of units of the HRS, and the Secretary of the Council of Research.

#### *V.4 HRS Activities*

1. Research in the field of hydrology and better usage and optimum utilization of water resources.
2. Research in the fields of hydropower, river training and flood protection, river navigation, and other relevant engineering works.
3. Study of irrigation performance and water management at farm level.
4. Discharge calibration of hydraulic structures within the irrigated schemes.
5. Research on movement and deposition of sediment within irrigated schemes and the interaction between the sediment and weed control, for better water management.
6. Research on operation of dams and sedimentation of reservoirs.
7. Upgrading the knowledge in hydraulics and irrigation engineering in the country.
8. Cooperation with relevant institutions in joint integrated research programs to solve problems of mutual interest.
9. Cooperation with other relevant institutes to establish the priorities of scientific research in the country.
10. Consultancy and technical training assistance.
11. Planning and conducting of training programs.

#### *V.5 Interaction With Other Institutions*

The HRS works closely with other MOI undersecretariats to study and recommend solutions for many irrigation-related problems within the existing schemes. Within the country HRS extends its cooperation to many relevant institutes like the GU, KU, SGB, SSA, NCR, etc. Internationally it conducts joint-research work

with the Wallingford Hydraulics Institute, Sir McDonald and Partners, UD, Ford Foundation, Sir Alexander Gibbs and Partners, Demas, Delft Hydraulics Ltd., and others. HRS holds training courses in different irrigation disciplines.

## **VI. UNIVERSITY OF GEZIRA**

The University of Gezira was established by a Presidential Decree on November 1975. Its charter states that the University will concentrate its curricular activities and research on the rural environment and community by adhering to the following objectives and guidelines:

1. Training of graduates capable of utilizing the rural resources.
2. Training of technicians and extension staff and admission of applicants with prolonged work experience if they have minimum academic qualifications.
3. Graduates should be capable of utilizing resources to satisfy human and animal needs without harming the natural resources.
4. Teaching of industrial sciences to improve agricultural production.
5. Conduct research to transfer technology to development.
6. Teach medicine, sociology, economics and management with emphasis on the rural (Sudanese) environment.
7. The university should maintain strong relations with its graduates for feed-back and continuous evaluation of its curriculum.
8. Study problems of guidance and education and train people engaged in work involving guidance and education.

The University Council during its first meeting approved, among others, the following goals and guidelines:

1. Field training should be part of the curriculum to integrate theory with practice and to graduate students who are acquainted with the actual work environment.
2. Build and maintain strong and healthy relationships with other universities inside or outside the Sudan, research centres, agricultural and industrial institutions, both public and private, --especially

in the areas of teaching, training, research, and exchange of experience -- to emphasize the role of the university in the service of development.

3. Decentralize the decision-making process to suit academic institutions. This requires that departments and units exercise the greatest autonomy while central governing bodies in Faculties of the University are dealing with planning, coordination, and follow-up.
4. Develop precise evaluation procedures for the performance of the University including staff, students, and administration to develop a university of international caliber.

One of the strongest areas of the university is its staff with a diversity of members specialized in diverse fields and with the ability to accommodate the high number of credit hours required by student to qualify for graduation. Moreover, the availability of a non-depletable source of equivalently trained and cooperative part-timers from the ARC, HRS, SGB, and MOI strengthens the university-training programs. The university solicits the participation of these organizations not only because there is need for them but also because this is embedded in the philosophy of the University. The university also supplements its meager resources by utilizing resources available at these institutions.

The University conducts several courses in water-resources and field-water management in addition to an agricultural-economics course which includes production economics, farm management, and natural-resources economics. There is also a training unit, under development, in the Faculty of Agricultural Sciences. The unit has already conducted several training courses for Field Inspectors, Technicians, and farmers.

The human resources of the above organizations are presented in Table 2. Numbers under the columns of SGB and MOI represent only those who are directly involved in the management of water in the Gezira scheme. Laborers and civil servants are not included in these numbers.

*Table 2. Manpower of the Organizations.*

Qualification	SGB Ag. A	MOI G&M	HRS	ARC	UG
=+ MSc	4	14	24		217
BSc	166	17	11		64
Polytechnic	99	66	-		-
Others	70	55	-		-

## **VII. INTERFACES BETWEEN ORGANIZATIONS**

### *VII.1 Bureaucracy-Bureaucracy Interface*

The points of interaction between organizations in the sphere of water management are numerous. Without receiving adequate operating and investment funds from the Ministry of Finance and National Planning all units would fail to perform their duties successfully.

The matching of water demands and supplies depends on the MOI-SGB interface. Although the aggregates of releases and indents during a complete season are not significantly different down to the minor canal head, there are usually medium-term fluctuations. The causes and reasons for this discrepancy are inaccurate indenting, inaccurate calibration of discharge-measuring devices, poor maintenance, and inadequate training and working conditions.

The SGB and the MOI play the roles of research and training institutions in irrigation management. Researchers seek the best ways of managing water for better utilization while training institutes train a cadre capable of undertaking the responsibilities and duties incumbent upon them and necessary for an efficient performance.

### *VII.2 Bureaucracy-Farmer Interface*

The Night Storage System (NSS) constitutes the basis of the SGB/MOI-Farmer interface. The NSS had evolved an arrangement to overcome farmers' resistance to night watering. However, the new arrangement is a comparatively sophisticated system that needs thorough understanding by managers and attendance by farmers. A host of reasons aided in the gradual abandoning of the NSS arrangement. Main among these were the social and political changes, economic pressures, intensification, inadequate power to punish abusers and, changes made to concrete pipes.

## **VIII. CONCLUSIONS**

The first section of this report has examined the institutions dealing with irrigation in the Gezira Scheme, either directly or indirectly. After thorough discussion the group has identified the following points:

1. The boundaries of responsibility towards irrigation management are clear for each institution. The Ministry of Irrigation is accountable for the delivery of water to the minor head while the SGB is responsible for the equitable distribution of water in Abu XXs of each minor and tenants organize the use of water within Abu XX.
2. The night storage system is not strictly practiced in the Gezira Scheme except for specific periods like the first irrigation of wheat and cotton picking periods.

3. Although tenants are aware of the consequences and penalties of adhering to practices such as night watering they continue to do so.
4. The irrigation network of the Gezira Scheme is decaying with time.
5. MOI engineers are not operating the system according to the "downstream satisfaction first" principle.
6. The SGB field staff are not trained enough to manage the water in the canals under their command.
7. Recommended sowing dates of crops have changed from those in the original agreement of diversification and intensification. These changes were made to generate high yields, regardless of water management.
8. Due to economical and practical reasons tenants delay the sowing of groundnuts to coincide with the sowing of sorghum.
9. Tenant involvement in the system is only within the SGB and does not extend to the MOI.
10. On-the-job engineers-field staff interaction is not up to the desired level.
11. Awareness among tenants has increased dramatically and they are well organized. The Tenants' Union is one of the strongest trade unions in the country.
12. Tenant involvement in water management has extended substantially beyond its domain.
13. The system is no longer operating in the originally envisaged way. There are new realities while the operational rules date back to the first half of the century.

## **IX. RECOMMENDATIONS**

1. Involvement and participation of MOI engineers in the production- council activities at block, and group levels.
2. Before the start of the season, agencies should set and discuss objectives to minimize divergence and to eliminate conflict.
3. Training of field MOI engineers in irrigation agronomy so that they understand the objectives outlined by the agricultural corporations and appreciate the role of water management in crop production.

4. Training of field staff in irrigation and hydraulics to upgrade their level of understanding in these matters and to help them manage canals under their command. Communication between the two parties will be enhanced by such training.
5. Strong and efficient extension services would bolster conveyance of information to tenants.
6. Encourage on-farm research.
7. Training of tenants in basic agriculture and irrigation-management concepts.
8. On higher education, more emphasis should be given to water management in the curricula of colleges that graduate students in subjects related to this.
9. Training middle and top managers in these organizations to enhance their managerial skills and capabilities.
10. Establishment of a data bank for use by researchers in all concerned institutions/corporations.
11. Monitoring should be an integral part of irrigation management. A unit should be initiated in the Ministry of Irrigation for this purpose.
12. Regulations on accountability require revision to cope with the new realities.