Regulation and management of water in irrigation canals and water saving irrigation methods and technologies

Bruno Voron

Water Department
BRL-GERSAR

I ■ FIRST PHASE ■

Within the framework of the development of the GAP project, in July 1989, the Government of the Republic of Turkey entrusted BRL-GERSAR of Nîmes, France, with the task of carrying out a study on « Regulation And Management Of Water In Irrigation Canals And Water-Saving Irrigation Methods And Technologies ».

This is considered as the Phase 1 Study.

After analysis in a first step of the solutions traditionally used in Turkey for the management of irrigation water, the various solutions which can be envisaged to save water throughout the project were listed, discussed and selected for detailed, comparative study in a second step.

1.1 First step : identification

During the first step, several decisions were taken :

— the regulation study will concern the Harran canal. Execution has just started and the results of the present study will therefore be applied in practice very rapidly,

— construction of the regulation works for the canal will be postponed until the end of the regulation study,

— study of the irrigation network and field equipment will cover a pilot zone in the Urfa area,

This pilot zone will be supplied by the secondary canal UY2. It is close to Urfa and has been considered as to be representative of all the perimeters as regards both morphology and soils.

— works in the pilot zone will be postponed until the end of the agreement with the contractor.

The first step was completed by an Interim Report which gave a synthesis of the existing schemes main characteristics, and propositions for solutions to be analysed later.

Main conclusions of this first step of the study were the following :

— the present main canals are regulated from upstream in all the perimeters visited.

Constant upstream level regulators are fitted with gates and manual cross regulators to adjust the upstream level.

Intake discharges at the heads of secondary canals were to be regulated by double gating, but the initial principle is not applied owing to difficulties in using the system. As a result, there is poor knowledge of the discharges taken off and wastage or temporary shortage of water.

— All the canals are operated by DSI personnel as far as the heads of watercourses (tertiary canals), after which the water is managed by groups of farmers, sometimes assisted by GDRS.

— The rotation system on the watercourse canal (tertiary canal) is not always used, and operator who does not possess an accurate schedule of water requirements for the coming weeks must allow a safety margin (extra discharge) to ensure that demand is met. This method of operation also leads to substantial loss of water.

— Until recent years, saving water was not a major preoccupation, but recent droughts together with problems of rising ground water and increased soil salinity result in lower farming yields and have made network operators and users aware of the problem.

It should be noted in particular that because of last years drought, voluntary saving of water in the Lower Seyhan perimeter resulted in a decrease of the consumption by 25 % while the agricultural yields increased greatly (by 20 %).

Economizing water can be justified for other reasons :

— releasing a complementary volume for the Ataturk hydro electrical power plant and for the dams downstream,

— reduction of drainage water volumes and hence economy of collection and treatment infrastructures.

All the canals visited had classic concrete linings. The many cracks which have appeared in these linings are accounted for by several reasons :

- joint spacing too great (shrinkage),
- uplift caused by water behind the lining (sharp variations in the water level in the canal caused by the method of regulation used).

None of the canals visited had a drainage system between the concrete lining and the soil. Such a system would reduce risk of uplift when the canal is empty or contains very little water ; and shrinkage joints and construction joints in the canal lining would reduce risk of cracking and give better adaptation to any soil movement (heavy soils with a tendency to swell and considerable shrinkage were seen in certain zones).

1.2 Second step : solutions analysis

The main basic data taken into account were the following :
— the present advanced state of the works on Harran canal (and the consequence : no change in the discharge sizing) is a constraint for the choice of the regulation for the main canal and even for the distribution network (size of the area/cropping pattern — changes allowed in upstream main structures),
— the necessity of a good acceptance of proposed operation techniques by the staff in charge of the operation of hydraulic structures and of proposed irrigation techniques by farmers.

This second step study lead to the determination of the more suitable solutions for both HMC and UPZ.

* Proposed solution for the Harran main canal

The solution finally recommended as it is well-suited to the Harran canal combines the three types of regulation *(fig. 1)*.

The canal is divided into three sections :
— the upstream one, from KP 0 to KP 56 equipped with automatic upstream constant level gates (like AMIL gates),
— the intermediate one, from KP 56 to KP 74, in which three mixed gates enable to create a storage capacity to ensure the good functioning of the downstream part and avoid losses.
— the downstream one, equipped with automatic downstream constant level gates (like AVIS or AVIO gates).

This is the best suited alternative of regulation for the present situation, both for construction and operation reasons.

A general remote supervision system is also recommended for the whole length of the canal to obtain data at all times on the main hydraulic operating parameters of the canal (discharge and water level at various points). The decisions required for head gate control operations can be taken immediately. This remote management is indispensable to achieve reliable and efficient water management and to avoid the losses which could be large from a canal which is to convey a large discharge (up to 80 m^3/s) for a great distance (120 km).

Canal management must also use computer facilities for calculation and flow modelling to anticipate hydraulic phenomena (water demand and the stopping of irrigation) as much as possible and above all to handle their consequences with regards to the amounts of water conveyed at all points along the canal.

This avoids the risk of loss of water.

* Proposed solutions for Urfa Pilot Zone (UPZ)

The UPZ will be divided into four sub areas with different irrigation systems.

Solution A' : area with initial adapted project : 806 ha.

This alternative corresponds to the project planned by DSI on the whole area. The distribution network under upstream control is composed of flumes : no strict water rotation is foreseen in the watercourses. The global efficiency is low according to the difficulties to manage the discharge inside the canals and of an irrigation only during the day out of the peak months.

The system will be equipped with baffle distributors in order to obtain a better discharge control.

Solution B : Adapted surface distribution alternative (flume distribution) : 832 ha.

This alternative is based on :
— the solution of standard watercourse unit (area watered by a tertiary canal) with a discharge of 30 l/s,
— the elaboration of a strict water rotation inside this watercourse,
— the installation of flumes for the distribution network under upstream control.

Solution D : area with Californian distribution network : 501 ha.

The water regulation for this alternative is downstream control. The general layout is organised around the installation of a watercourse unit of about 12,7 hectares watered with a discharge of 15 l/s. In comparison with alternative B, this solution is more flexible (it allows irrigation during the day out of the peak month without losses) and presents a good efficiency.

Solution E : area with pressurised distribution network : 639 ha.

This alternative proposes the installation of a pressurised network under downstream regulation : this network of high efficiency needs a pumping station. The water distribution at field level will be pressurised distribution (sprinkler or drip) instead of gravity irrigation.

II ■ SECOND PHASE ■

In 1991, the GAP regional administration entrusted BRL-GERSAR with the task of carrying out the detailed studies of part of the Harran Canal and Urfa pilot zone.

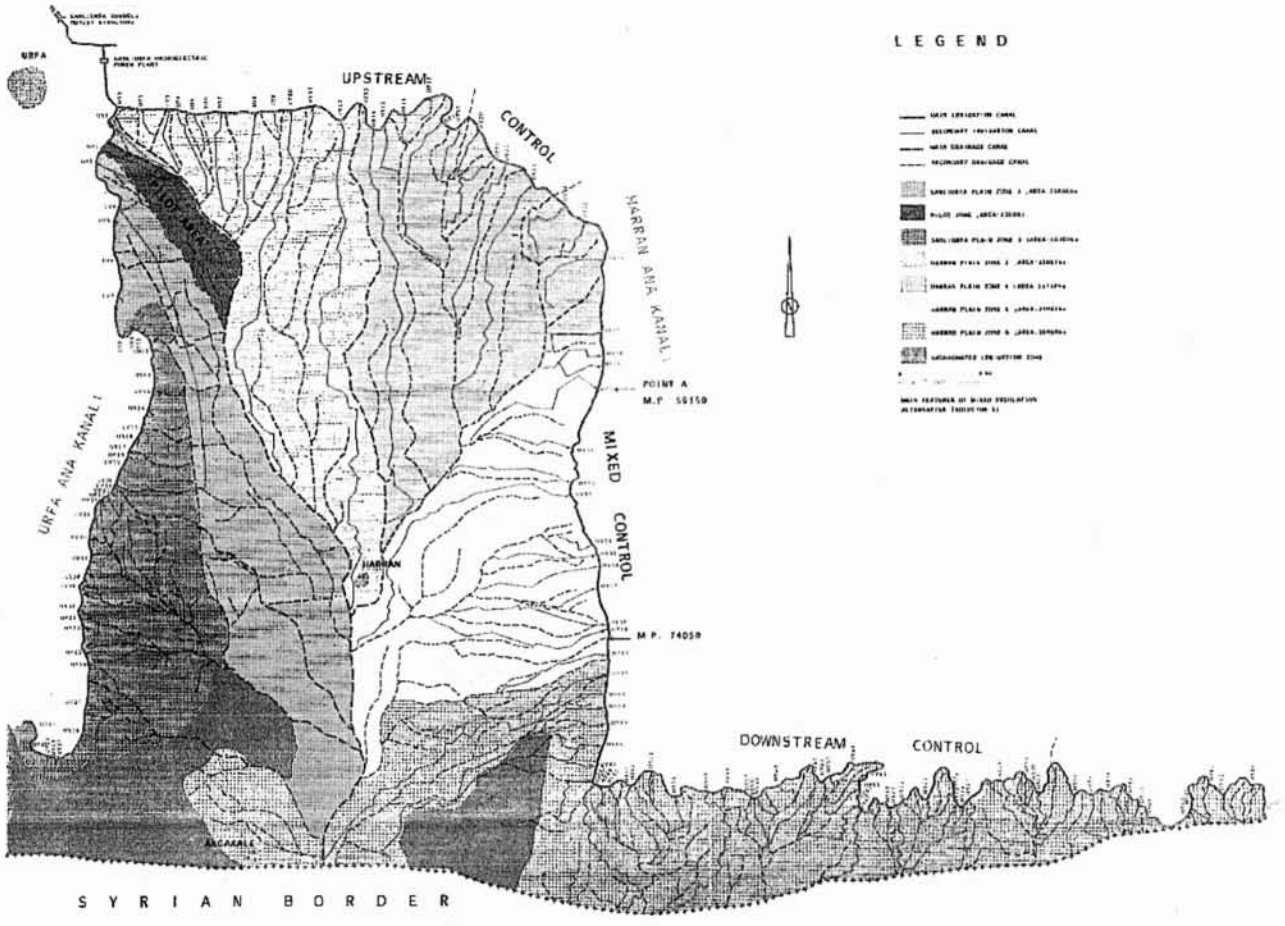
This is considered as the Phase 2 study.

This study consists mainly in :
— for Harran main canal :
• hydraulic analyses and computations,
• detailed design for current section from KP56, 150 to the end,
• detailed design and application drawings for structures,
• pre detailed design for remote control,
• Maintenance, Operation and Management system.
— for Urfa pilot zone :
• All hydraulic and irrigation structures and equipment detailed study and application drawings.
• Maintenance, Operation and Management system,
— and, for both, a monitoring and evaluation system and a technology transfer program.

The final report gathers all the technical data, calculations and results obtained during the study, and element concerning management, operation and maintenance, monitoring and evaluation systems, and sectorial study on remote control.

Other documents were produced during the study, among which the main ones are :
— application drawings for HMC current section (medium and downstream part),
— application drawings for Regulators, Safety and Dewatering structures for HMC,
— application drawings for irrigation networks, pumping station, regulation tank, UY2 canal, for Urfa pilot zone.

At least, an important technical exchange has been done through Technology Transfer missions (3 for Turkish staffs in France and the last in Turkey, with BRL Specialists).



1. Main features of mixed regulation alternative.

2.1 Harran Main Canal (HMC)

The main characteristics of the regulation are pointed out on the following hydraulic longitudinal profile *(fig. 2)*.

The general setting of the canal was done first by mathematical simulations of the hydraulic operation of the canal for a typical rare case (unsteady flow calculations). This led to size the necessary volume for regulation (medium reaches), taking into account the previous solution n° 5 general frame of equipment. Then, the hydraulic setting of the downstream part was done by uniform flow calculation.

These calculations led, for the storage reaches (HMC medium part), to a double trapezoidal typical cross section. For that kind of typical cross section, a drainage system under the lining was recommended.

2.1.1 Remote control

The first part of the regulation is made of the remote control system.

The « remote management » function is based on the notion of « stations » connected by a transmission system. The points in the system for the installation of measurement and local control equipment will be referred to as secondary stations (SS) in contrast with the central station (CS) for monitoring or control. The secondary stations are connected to a central station by a transmission network which is a radio link in this case.

The exact site of the central is not known but it will doubtless be near Sanli Urfa.

The secondary stations have been placed at what are considered to be the most strategic sites (regulators, large intakes, reservoir reaches, upstream siphon heads, etc...). There are 14 of these secondary stations *(table 1)*.

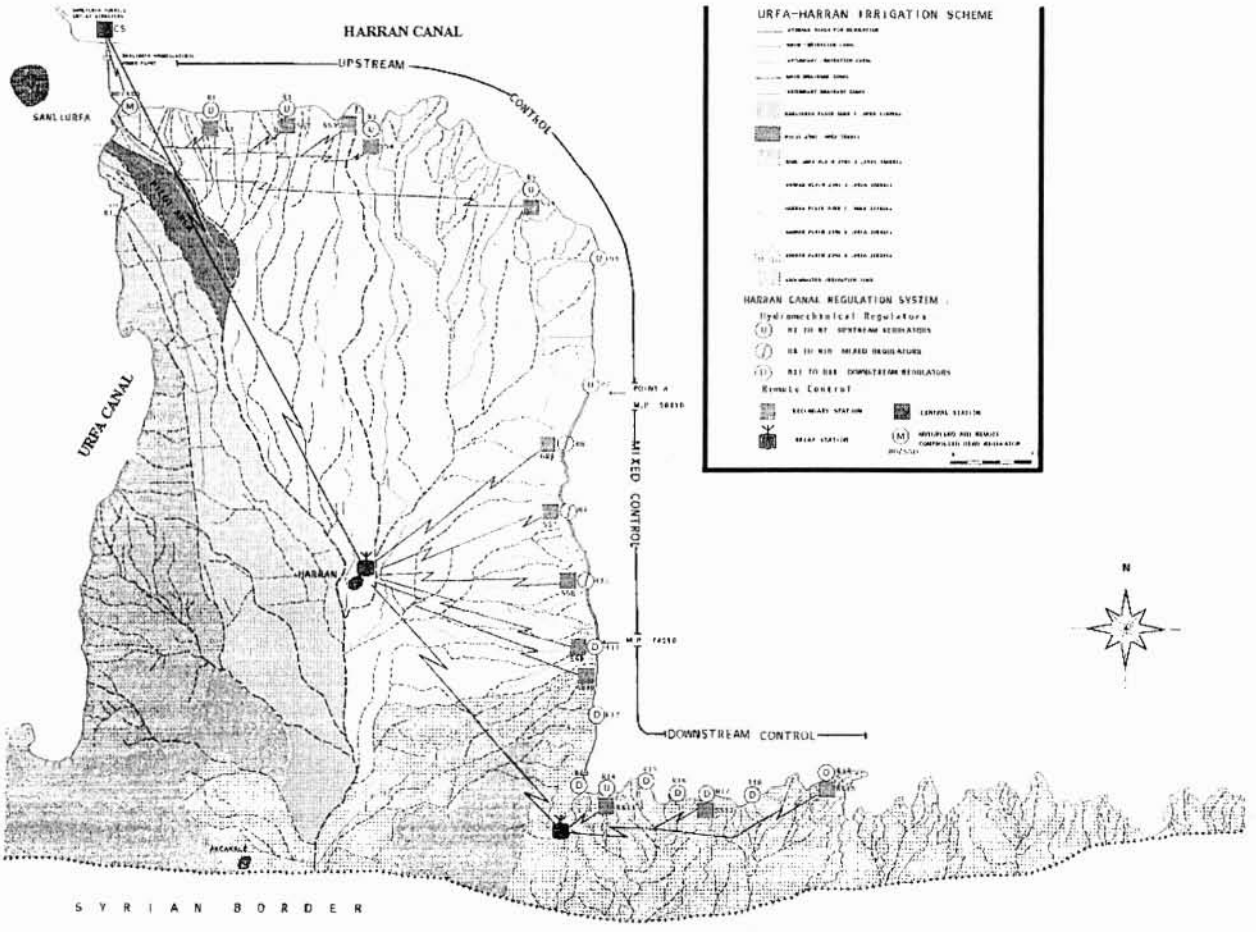
The secondary stations consist of sensor apparatus to record the upstream and downstream levels at one or more gates and the extent of opening. This will provide data on the flow through the gate(s) and the levels in the 2 neighbouring reaches, and/or possibly the heads of the main secondary canals.

Flow calculation can be replaced by direct flow measurement (depth by pressure detection, velocity by ultrasonic sensor) at the heads of the secondary canals concerned if their hydraulic characteristics are suitable.

Secondary stations SS1 to SS13 thus gather data. SS0 (Head Regulator - not part of this study) gathers data and also has a gate control function.

The whole HMC regulation system will have autonomous, automatic operation in normal functioning. It must be integrated in the overall regulation system of all the hydraulic infrastructures running from the Urfa tunnels.

HMC regulation should be considered as operating « on request » within this overall system. The HMC system



2. Urfa-Harran Irrigation scheme.

Table 1. — Secondary stations of the HMC remote control.

Secondary station	Site
SS 0	Head Regulator
SS 1	R 1
SS 2	R 2 + HY 10
SS 3	HY 12
SS 4	R 3 + HY 14
SS 5	R 5 + HY 23 + Siphon
SS 6	R 8
SS 7	R 9 + HY 33
SS 8	R 10
SS 9	HY 38 + HY 39 + Siphon
SS 10	HY 41
SS 11	R 13 + HY 48
SS 12	R 17 + HY 55
SS 13	R 19 + end

must therefore provide the overall system in real time with the main hydraulic characteristics of the Harran Canal, data on head regulator manœuvres and consumption forecasts on different time scales.

Finally, in the light of the sizing adopted for the HMC, the overall system cannot have any security features along the latter. In particular, the storage planned for canal regulation cannot be used as buffer resources in case of unforeseen operation cases in the upstream common branch : i.e. the common hydraulic structures between Ataturk Dam and the beginning of the 3 main canals (Mardin Ceylan Pinar, Urfa and Harran).

As a conclusion of the remote control study, it is recommended to analyse the common branch regulation in close link with the downstream main canals regulation.

This global regulation must take into account the various purposes, interests and personals involved in the water management, and the necessary priorities and hierarchies of the different users.

There are different regulation levels from the local on to the general one (common branch) through portions of canals, canals...

The levels having to be considered in priority from the downstream to the upstream in the present case.

There are different time steps :

— strategic management (seasonal storage especially for Mardin),

— daily variations of the demands

— current regulation (5 to 15 mn).

There are different (multipurpose) users :

— to each of which must be proposed the convenient tool (central or intermediate station) to let them be able to exercise there rights or duties in the easiest manner.

The architecture and hierarchy of the general remote control system downstream Urfa Tunnels must be concei-

ved to be very close to the hydraulic architecture and hierarchy and on a multi-users concept (conflicts management) : hierarchy of priorities.

The second part of the HMC regulation is composed of hydromecanical equipments : automatic hydraulic gates and associated safety and dewatering system.

2.1.2 Regulators

For Upstream part, Amil (constant upstream level) gates, were chosen. In order to standardize the equipments, the seven regulators are equipped with the same type of gate, the number of gates decreasing from 4 to 2 according to the discharge to be transited.

An economical and qualitative analysis led to that solution.

For medium part, the regulators R 8 to R 10 are with 2 composite gates each, which were chosen taking into account the hydraulic constraints : mainly the required regulation volume of about 500 000 m^3.

A by-pass system through the structure of these regulators allows to maintain a low discharge along the canal even if the gates are out of use and closed.

For downstream part, R 11 to R 19 are with one Avis or Avio (constant downstream level) gate - only R 11 has 2 gates.

All the Regulators of the canal are equipped with upstream and downstream stoplogs in order to facilitate the maintenance by dewatering the structure *(fig. 3)*.

For sluice gates (composite and Avio ones), an upstream grid is fixed in the structure.

The choice of the gate and it's setting, for each regulator of the canal, was done taking into account the hydraulic constraints (levels and discharge) and respecting the sizes given by the manufacturer (fabrication constraints).

2.1.3 Safety and dewatering system

The aim of the safety system is to avoid overflows on the banks of the canal, which lead to local destructions.

For upstream regulators, the extra discharge due to an Amil gate locked in open position generates a level increase which remains inside the lined freeboard.

For closed position locking case, it had been verified that the level increase upstream the concerned check remains inside the lining freeboard for 4 or 3 gates checks. For 2 gates checks, a lateral safety siphon of about 7 m^3/s is needed.

Another safety siphon has been proposed upstream the KP 40 longitudinal siphon in order to divert the extra discharge when 1 of the 3 pipes is blocked.

These safety structures are equipped with a slide gate for dewatering when there location is appropriated.

For the medium part of the canal, the whole discharge can pass through only one gate remaining inside the lined freeboard limits, so that there is no need of safety siphon on these reaches.

For the downstream part, a lateral emergency siphon is proposed upstream each check in order to prevent overflows in case of opened locking.

In case of closed position locking of a gate, the upstream one will close, and so on, and the safety equipment is not used.

A dewatering system is needed at each reach.

2.1.4 M.O.M. and M. & E. Systems

In this part of the study are developed the general aspects of operation and maintenance of the HMC : filling of the canal, emptying of the canal, normal functioning, monitoring of the installation, safety and dewatering equipments use.

A review of malfunctioning cases is done, with examples (levels too high or too low).

A list of everyday maintenance tasks and procedures, preventive maintenance procedures is given.

Repair procedures and special recommendations for renovation and cleaning are analysed : field equipment is reviewed.

For detailed operation and maintenance of each equipment, the operator will use the manufacturer catalogue.

Monitoring and evaluation of the Harran Canal must be performed to cover two aspects : operation and hydraulic functioning.

With regard to operation, the system will consist principally of drawing up a report at the end of each intervention on the canal, whatever the type of job (maintenance or operation) on the hydromechanical equipment or civil engineering installations.

An annual balance will then be drawn up and used for identifying malfunctioning points ; this may make it possible to adapt intervention methods.

Hydraulic monitoring will consist mainly of « input/output » balances and estimates of losses (type and quantity). The characteristics of the remote control system mean that all real time measurements of inflow, flow conveyed by the canal and outflow at the main intakes will be made automatically.

This will provide a log of flows at all the strategic points and a record of detectable anomalies (level too high or too low).

The computer programs at the central station will publish operation balances and hydraulic balances when required.

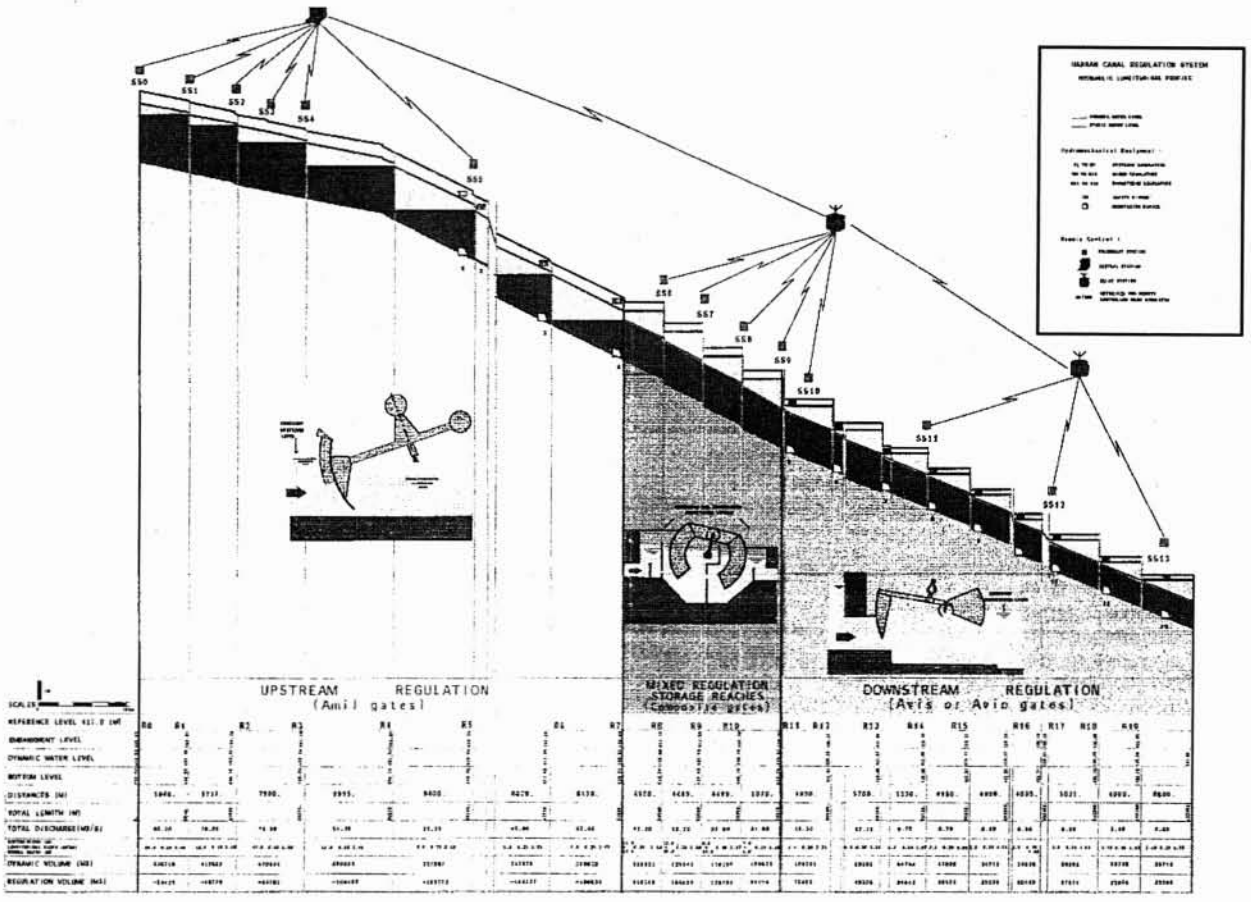
2.2 Urfa pilot zone (UPZ)

The general view of the area is given on the following map *(fig. 4)*.

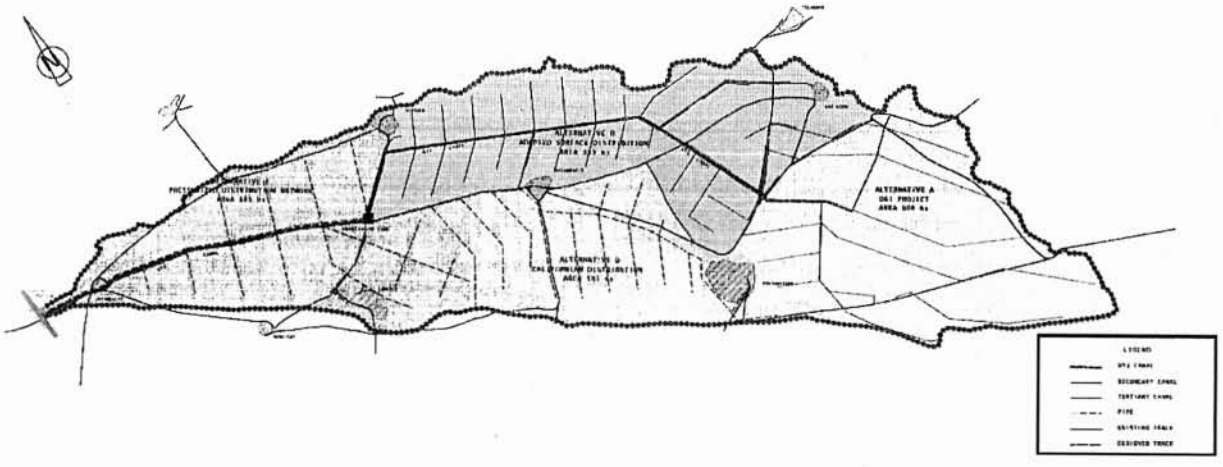
2.2.1 Irrigation subareas

For each subarea *A'*, *B*, *D* and *E*, are shown the distribution principles, the discharge calculations from the field to the main canals or pumping station, the principles of setting and sizing of the equipments, the layout with location of the standard units, and the different kinds of networks.

Then, all the technical characteristics, setting and sizing calculations, quantities and technical specifications for



3. Harran canal regulation system.



4. URFA pilot zone : detailed design.

each kind of equipment are given in the detailed design. The general principles for each sub area are exposed here below :

Alternative *A'*

Alternative *A'* is the project drawn up by DSI for the whole zone. Water is distributed to the fields by a canal network operating by upstream control. The lined main canals convey water to the network of flumes (minors and watercourses) which distribute water to the fields.

The distribution canals do not have a fixed length and their flows depend on the area supplied.

Irrigators take out water for their crops by means of small portable PVC siphons fixed to the edges of the flumes. Furrow irrigation is used in the fields.

No water rotation is organised among irrigators ; they can each take out water at any time on request to the

perimeter management. In the initial project, flume regulation is by an orifice type regulator (slide gate) at the head of each canal combined with a duckbill weir on the main canal. As this design is fairly sensitive to variations in upstream water levels in the canal and since it is difficult to know the precise flow discharged by the sluice opening, it was decided to modify the works by replacing the orifice by a more accurate device, a baffle distributor, which can set the flow at a predetermined volume.

The upstream control network is managed on the basis of a crop declaration drawn up by irrigators before the irrigation season. These declarations enable the management organisation to programme the irrigation season and guarantee water rights corresponding to farmers' requirements.

During the irrigation season, the irrigator or a group of irrigators must apply to the management organisation for water, 2 days before the irrigation date. The information is then passed on to secondary and main canal operators who will supply sufficient flow on the day concerned to meet the requirements of all the irrigators (taking canal losses into account). The flow is allocated to the farmers for a minimum of one day.

The portion of the flow not taken out by the siphons is then lost into escape ditches at the end of the canal.

Alternative *B*

Water is distributed in Zone *B* by a network of flumes operating by upstream control and supplied by canal UY2. Unlike zone *A'*, only the watercourses convey water to the fields. The minors only convey water to the watercourses.

Fields are supplied by taking out the whole of the watercourse flow for a pre-established period of time which depends on the area to be irrigated. A weekly schedule is therefore drawn up and irrigators have the right to take water in turn. This schedule will be referred to as the « Rotation ».

The flow taken out by each irrigator is therefore constant throughout the zone and referred to as the « farm stream ». The farm stream is fixed at 30 l/s, which is a flow easily handled by irrigators.

Each irrigator has a hit-or-miss turnout at each high point on his land which delivers the farm stream. The network of quaternaries canals required to supply the irrigation furrows downstream of the hit-or-miss turnout is provided by each irrigator.

Alternative *D*

In Alternative *D*, water is distributed by a network of buried low pressure pipes (Californian system) operated by downstream control. This type of distribution enables high water distribution efficiency, great flexibility of use for farmers and a high level of automation of farms.

Each farmer has one or more turnouts at the edge of his field and which can supply, during the irrigation season, the flow required for irrigation at field level. Each turnout is fitted with a low pressure flow limiter to reduce the effect of pressure variations on the pressure delivered.

The field watering method is the same as in Alternative *B* (furrow irrigation).

The distribution system is regulated from downstream, that is to say that the flow allocated to each farmer is available to him 24 hours a day. Operating the field turnouts controls the network flow.

The network is put under head by gravity from the level in a regulation reservoir.

Alternative *E*

In Alternative *E*, water is distributed by a network of buried pressure pipes operated by downstream control. This type of distribution enables high water distribution efficiency, great flexibility of use for farmers and a high level of automation of farms.

Each farmer has one or more turnouts at the edge of his field and which can supply, during the irrigation season, the flow required to irrigation at field with a pressure compatible with conventional field equipment. Each turnout is fitted with a flow limiter and a pressure reducer to enable the satisfactory hydraulic functioning of the system and a meter for billing purposes.

The field water method can be chosen by the farmer. He can use the pressure available and opt either for conventional sprinklers on fixed or mobile pipes, a micro-irrigation system or a system such as skid-mounted sprinklers if the pressure is high enough.

The distribution system is regulated from downstream, that is to say that the flow allocated to each farmer is available to him 24 hours a day. Operating the field turnouts controls the network flow.

The network is put under head by a pumping station whose regulation system can continuously adapt to the flow demanded in the network.

2.2.2 Drainage network

The design of the drainage network has been done in order to collect the water from tertiary ditches and surplus irrigation water discharged by the escapes in the irrigation network.

The network consists of :

— existing ditches,

— new ditches running into existing ditches.

Flow calculation were done using Macmath's formula for run off.

Setting and sizing of the equipments were performed by the method used for the existing ditches.

Existing ditches were included in the new drainage network.

2.2.3 Management Operation and Maintenance (M.O.M.) for Irrigation networks

A description of Management, Operation and Maintenance for each Irrigation Network was done, on a general hydraulic point of view.

It includes a presentation of the network, and of the different types of structures, with a schematic layout. The functioning of the network is then analysed, taking into account all kinds of operations : filling, dewatering and monitoring of the current running, modification of the irrigation flow (reduction and increase).

An example of water rotation organisation is shown.

For pressurised networks, incidents are identified, and instructions for operating every kind of equipments are given.

A particular attention had been paid on the monitoring and evaluation system.

The aim of the system is to measure water supply at the upstream point of each area, or subarea of UPZ, and waterlosses at the drainage diverting points.

All supply will be totally known, (monitoring baffle distributors operation, measuring pumped discharge, using flow meter for zone *D*,...) however, it is impossible to measure drainage discharges corresponding to each subarea, because most part of drainage canals are common for UPZ and other neighbouring areas. Then, it was necessary to identify some small areas for which it was easier to measure the drainage discharges. Also, water loss by infiltration and percolation is analysed.

The amounts of water collected in the drainage ditches are estimated by recording the level and calculating flows and volumes for the related small areas.

The percolation can be estimated by measurement of soil moisture (tensiometer, neutron probe, quarry sampling, etc,...). The installation of piezometer tubes is also recommended to monitor the movement of ground water levels in the test zones and in zone *E* during the irrigation period.

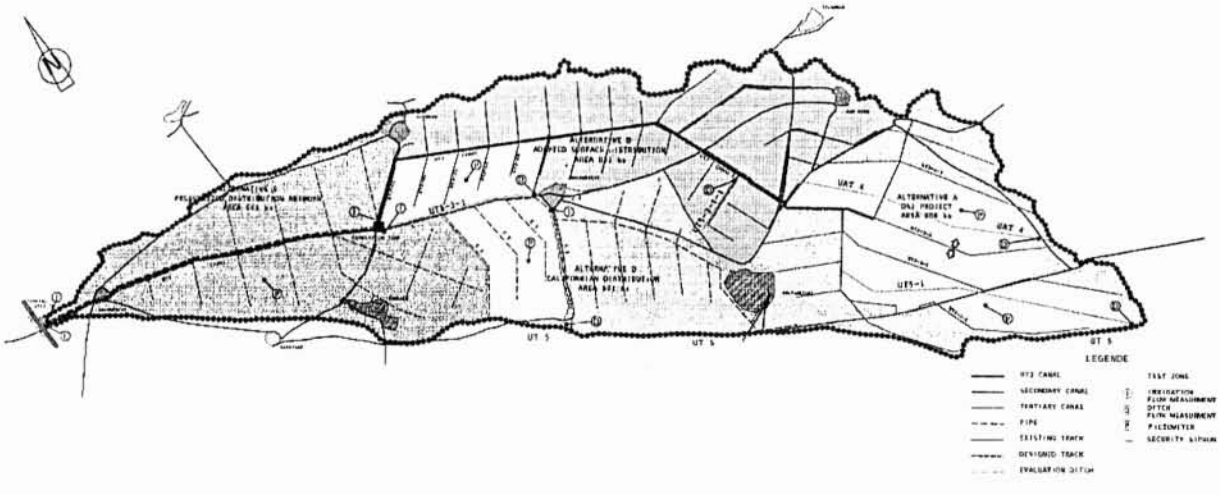
Four test zones (one in each sub area) have been chosen (each drained by a ditch) for estimation of losses (see the following map).

2.2.4 M.O.M. and M. & E. for pumping station

These systems are proposed to be based on a structural organisation.

For maximum works operation efficiency, the design of the development is based on grouping at the same site all the works required for putting water under head and supply the network.

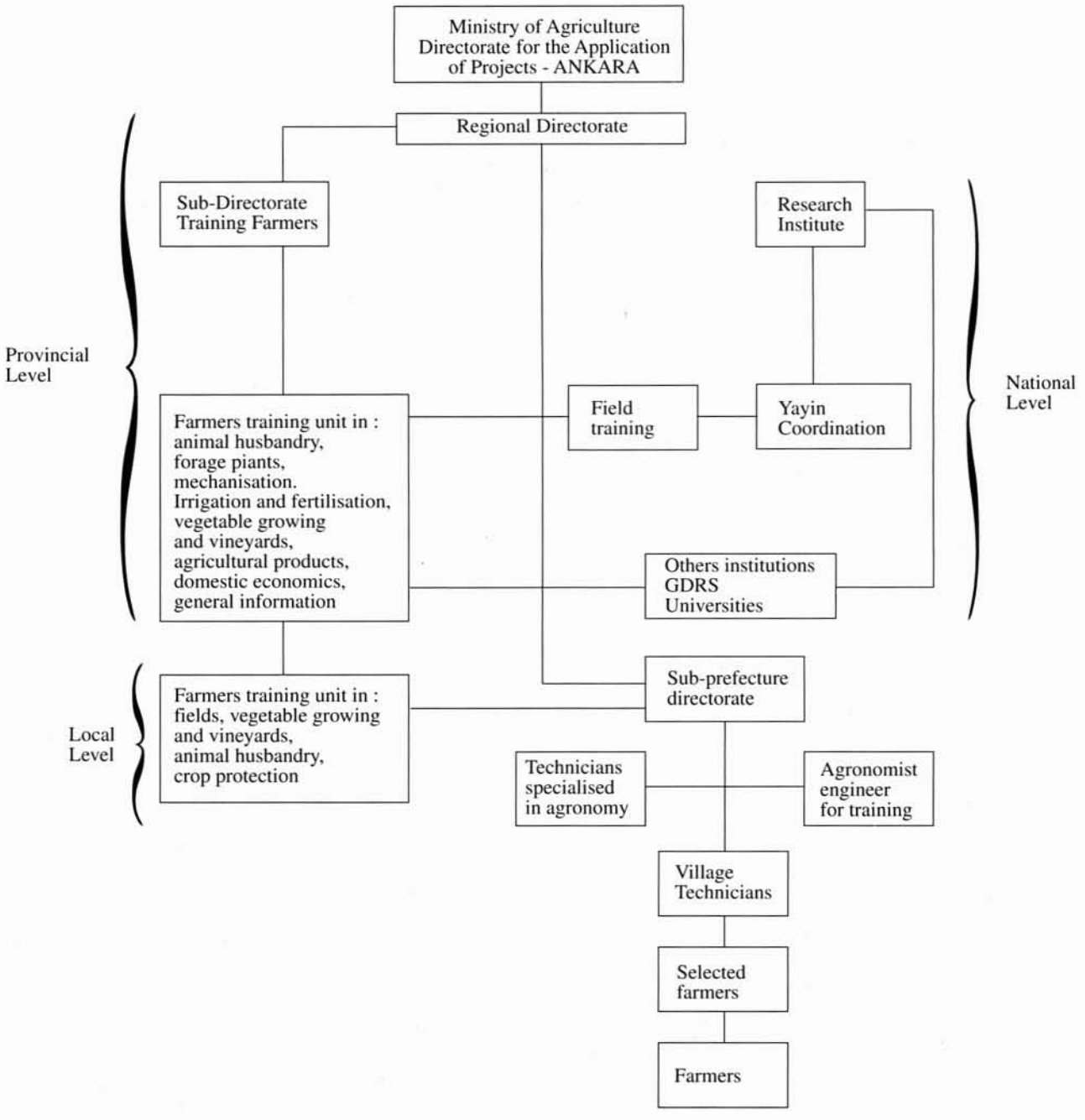
Operation is proposed to be organised around the functions of the installations to ensure that each functional unit



5. URFA pilot zone : monitoring and evaluation.

Table 2. — The functional units.

Functional Unit	Function
a. Intake on Urfa canal	Mobilisation of the water resource and bar rack
b. Filtration system	Fine filtration and putting under head
c. Pump sets and related equipment and infrastructure	Putting under head and meeting demand from the network
d. Electrical and control equipment the corresponding rooms	Power supply for the installation and automatic operation
e. By-pass between the inlet chamber and station outlet	Filling and keeping the network filled
f. The valve chamber downstream of the station and the hydromechanical equipment	Metering the pumped volumes and flows, surge protection
g. Connection with the irrigation network	Connection with the water supply system



6. Organisation Diagram.

provides optimum performance in terms of monitoring, maintenance and repairs.

The works are divided into functional units in order to structure the running of works in automatic operation.

The breakdown is as on the *table 2.*

The principles of operation are then shown in details, for each functional unit, in automatic functioning or in secondary functioning (special uses or failure cases). A table describes the functioning for each main case of failure or incidents.

Main characteristics of operation and maintenance (at different levels) are then described.

The M. & E. System is included in the automated operation of the station.

2.2.5 Farmers Organisation Analysis

The purpose is to use existing structures to propose management organisation for the UPZ and to ensure that the whole of the system proposed is well-integrated in the existing socio-agricultural framework, especially as regards the existing system of farmer training, agricultural input supply, agricultural credit, co-operatives, marketing, etc.

DSI is the government agency in charge of the management of the irrigation equipment. It was therefore first analysed how DSI operates today, and then, proposed application to the case of the UPZ, taking the special features of the zone into account.

For on farm irrigation and rural development, several structures exist and interfere with each other (GDRS, prefecture (province), sub-prefecture, co-operatives, banks, etc...). Brief analysis of these is followed by examination of the conditions of operation of these structures in the case of UPZ.

A special analysis was done for present training system for farmers, summarized by the following diagram.

The aspects of agricultural production selling and agricultural credit for inputs are also examined.

Then, an organisation is proposed :

1. For networks management :

It appeared desirable that the UPZ should be managed by a special organisation (staff with a high technical level) as the technical characteristics (sophisticated equipment, varied equipping) and objectives (demonstration, large-scale trials, etc,...) are totally different to the rest of the Urfa Harran plain (all supplied by classic gravity systems).

This special organisation (UPZ management unit) should be directly connected to the regional management of DSI because of its specific features and geographical proximity. The link will facilitate exchange and intervention of specialists in the various professional sectors concerned (hydraulics, agronomy, maintenance, etc,...). It will also enhance the development of the demonstration and promotion of techniques for an audience of agricultural socio-professional organisations.

2. For farmers :

The organisation must take into account the special characteristics of the pilot zone, and local socio-economical characteristics for which insufficient data are available till now.

A special staff of technicians used with water rotation organisation and pressurised irrigation equipment is indispensable.

This staff must be directly connected with the Regional Directorate for Agriculture, because of its specific features and geographical proximity.

Part of the tasks of this special unit will be the same as those of the present training units of the regional directorate for Agriculture, but adapted to the specific constraints of UPZ.

This special unit will be also in charge of on farm equipment issued to the farmers and will manage the spare parts store.

Besides this special unit, one water users group will be created for each sub-area, in order to favour information transmission, organisation of irrigation inputs buying and produce marketing, co-operation between farmers,...

For system of incentives and agriculture credit, the existing structures can be used by the UPZ farmers, but a special system must be done to minimise the farmers financial loads generated by on farm equipment buying (spare parts for sub-area E -if the farmer equipment is the « standard » one or the whole equipment (with subsidiaries), in uncommon case- or other type for the other sub-areas).

For sale of produce, a special effort must be done for produce marketing especially if new crops are cultivated in order to keep a high motivation among the farmers.

Abbreviation :

GAP : Güneydogu Anadolu projesi (South east Anatolian project)

GDRS : General Directorate of rural services (KHGM : Köy Hizmetleri Genel Müdürlüğü)

DSI : Devlet su işleri (State hydraulic works)

HMC : Harran Main Canal

UPZ : Urfa Pilot Zone

KP : Kilometric Point.