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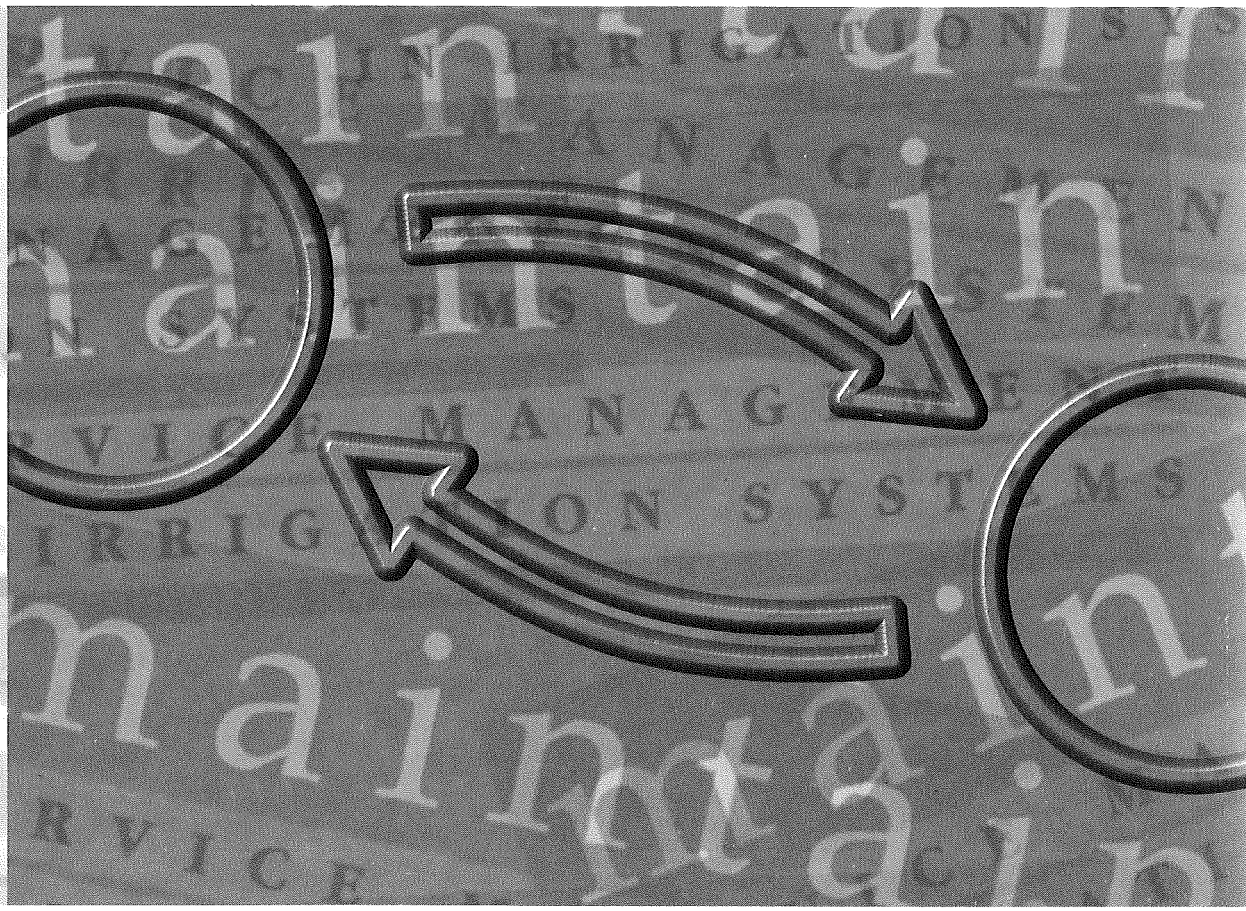

Walter Huppert, Klaus Urban

Institutional Analysis of Water Delivery and Maintenance Service Provision in Irrigation: The Example of the Jordan Valley

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Abbreviations

JVA	Jordan Valley Authority
O&M	Operation and Maintenance
O&M-Directorates	Operation and Maintenance Directorates
FTAs	Farm Turnout Assemblies
MCM	Million Cubic Meters
MOWI	Ministry of Water and Irrigation
WAJ	Water Authority of Jordan
KAC	King Abdullah Canal
JVD Law	Jordan Valley Development Law
JD	Jordan Dollar
M&I	Municipal and Industrial Uses

Equivalents for measures

10 dunums 1 hectare (ha)

Preface

The purpose of this study is twofold: First, it tries to shed light on some of the root causes of problems of irrigation water delivery and maintenance in the Jordan Valley. Second, the study has been conducted as a case study within the framework of new conceptual developments by the "Maintain" project of GTZ.[1] As such, the intention of this case study is also, to introduce theoretical concepts that have not been used widely in irrigation analysis and planning so far, but which – according to "Maintain" – may contribute substantially to a better understanding of institutional issues in irrigation. The case of water delivery and maintenance in the Jordan Valley thus is used to illustrate the application of such concepts and theories to irrigation practice.

This double focus of the study needs to be kept in mind by the reader. It means that more space is given to the discussion of theoretical backgrounds, conceptual arguments, analysis and diagnosis than would normally be the case in a field study. Hence, according to his or her particular interest, the reader may concentrate more on the theoretical or the practical part of the study or the combination of both. The authors have tried to help readers in this choice by adding an Annex that gives more details about some of the theoretical arguments put forward in the study.

The following text is an outcome of a series of round table meetings and workshops, which took place in Amman and in different locations in the Jordan Valley between April and September 1998. In all these events the main focus was on service provision by the Jordan Valley Authority (JVA) with respect to water delivery and maintenance of the Jordan Valley irrigation system. A first report presenting an overall analysis of the services provided by JVA in this field was prepared by the economist Dr. Yaser Sara, with the support of the GTZ advisory assistance project and its chief advisor, Gert Soer (cf. Yaser Sara 1998). The second document presented here focuses on deficiencies in the service relationships among actors in the 'multi-actor service delivery system' for irrigation water delivery and maintenance. We believe that this addresses some key root causes of operation and maintenance (O&M) problems for irrigation in the Jordan Valley.

[1] "Maintain" (GTZ PN 92.2076.5) is a research and development project that concentrates on the issue of institutional arrangements for maintenance in irrigation.

The document makes use of the findings of the first report and is based on field visits by the authors and two days of intensive round table discussions on August 31 and September 1, 1998 with most of the JVA management staff responsible for Operation and Maintenance (O&M). It was in these round-table discussions that the institutional problems and constraints referred to in this study were put forward. The authors only provided guidance with respect to the methodology and to the step-by-step procedure of the diagnosis. The problems relating to service relationships referred to in the text were identified exclusively by the JVA staff in the meetings mentioned before. Moreover, JVA staff clearly indicated that such problems constitute key disincentives or constraints for them to be able to manage irrigation effectively and efficiently. The information provided by JVA was placed into the framework of "Principle-Agent Theory" by the authors. Hence, the related analytical considerations and the ensuing recommendations are of the sole responsibility of the authors.

As far as the methodology is concerned, this report draws on ideas and instruments elaborated by 'Maintain'. The approaches of 'Maintain' refer in many ways to the work of Herder-Dorneich (cf. e.g. Herder-Dorneich, 1986), as far as governance mechanisms are concerned, and to a separate thematic paper of 'Maintain' dealing with the theoretical background for "Principal-Agency Analysis", used in this study (Wolff and Huppert 2000).

The physical data used in the study were supplied by the GTZ Advisory Assistance Project to JVA (AAP-JVA 1998), unless stated otherwise.

The authors would like to thank all the participants of the workshops and round table meetings that contributed to the findings elaborated in this paper, above all Dr. Bilal Al Bashir, University of Amman (at the time of this study Assistant Secretary General, JVA) and to Eng. Avedis Serpekian, Secretary General, JVA (Assistant Secretary General at the time of this study), who were leading the discussions and to Dr. Yaser Sara, Consultant who organized the major workshops and meetings.

Thanks also go to the following major contributors (titles refer to positions held in autumn 1998):

Eng. Yousef Hasan - Director Technology Development
Eng. Samira Tarazi - Director Irrigation Directorate
Eng. Qais Owais - Director O&M North

Eng. Tayseer Ghezawi - Director O&M Middle
Eng. Farouq Kana'an - Director O&M South
Eng. Abdullah Hamarneh - Director O&M Ghor Safi
Eng. Tayseer Masalha - Director Central O&M Directorate
Eng. Khaled Qsous - Director Central Workshop
Eng. Ziad Shehadeh - Deputy Director Dams Directorate
Eng. Yousef Al Sakran - Head Irrigation Division North
Eng. Sameer Fadda - Head Irrigation Division Middle

Special thanks go to Mr. Gert Soer, GTZ-consultant to the project "Advisory Assistance to JVA".

The authors also wish to express their gratitute for useful comments on the study to Dr. Douglas Vermillion, Dr. Mark Svendson, Dr. Ruth Meinzen-Dirk and Dr. Waltina Scheumann.

"Water may become a test-bed for economic reform, liberalization and accountability."

FAO, 'Reforming Water Resources Policy', 1994

Summary and Introduction

When the internal renewable water resources in a country or region are less than 1000 m^3 per capita/year, water availability is considered to be a severe constraint on socio-economic development and environmental protection. With 209 m^3 per capita/year, Jordan disposes not even of 21% of this amount (IWMI 1998).

It is against this background that this study has been undertaken. With the agricultural sector accounting for more than 70% of the total water use in Jordan, the question how to economize on water use in agriculture and how to increase irrigation efficiencies has become a key issue with respect to Jordan's development policy. This is why the Jordan Government supported by the international donor community has converted water application techniques for irrigation in the Jordan Valley – the largest continuous irrigated area in the country – from surface irrigation methods to pressurized pipe systems, mainly with drip irrigation equipment. The disturbing fact however is, that this conversion, which has been finalized recently, has not brought about the expected water savings so far. Application efficiencies for irrigation water have not improved significantly, and distribution efficiency remains remarkably low. To this adds the fact that attempts by the organization responsible for operation and maintenance of the conveyance system for the irrigation water, the 'Jordan Valley Authority' (JVA), to balance out the available – and increasingly scarce – water resources with the existing demands, proves to be more and more difficult.

The distribution of water between the Deir Alla Pumping Station that pumps water from the Jordan Valley for municipal and industrial use to Amman, and between three so-called "Operation and Maintenance Directorates" (O&M-Directorates) that supply water to different irrigation areas in the Jordan Valley has become a highly politicized issue, which has caused many conflicts within and outside of JVA. These conflicts have repercussions on the overall operation and on the maintenance of the irrigation system. Amongst other problems, farmers perceive irrigation water delivery to be unreliable and therefore take excess amounts of water if they can get it. And JVA has a constant

struggle to maintain and defend the farm turnout structures, the so-called 'Farm Turnout Assemblies (FTAs) against farmers who continuously damage these turnouts in order to get hold of their 'fair share of water'. The FTAs are a major part of the water delivery infrastructure.

Under these circumstances JVA is looking for ways to improve the economic and technical efficiency of its water service. Moreover, JVA is trying to modify the institutional arrangements for this service, so as to solve the above-mentioned problems.

This study supports these intentions by analyzing the institutions for water allocation, water delivery and maintenance in the Jordan Valley irrigation system.

The insights and problem analysis relating to institutional issues in Jordan Valley irrigation, which are presented in this study, are the outcome of the round-table discussions with senior decision makers of JVA in Amman at the end of August 1998.The methodological approach used in these discussions and reflected in this study centers around the following focal points:

- *Use of a broadened service perspective*

  Apart from looking at water allocation, water delivery and maintenance as services to be provided by JVA, the internal processes of JVA are conceptualized as provision of *services* between different units (*actors*) that support the water allocation and maintenance service.

- *Use of a multi-actor perspective*

  We consider service provision, to be part of a system of multiple actors and multiple service relationships, which must be considered when examining water supply and maintenance issues.

- *Focus on service relationships and governance mechanisms*

  Particular attention is given to the mechanisms that are needed to make the relationship between a service provider and service recipient/customer work.

- *Accentuating the double-edged nature of the water-related service to be provided by JVA*

  It is stressed that JVA has both to *acquire* water resources and to *allocate and distribute* them. Above all, this means that JVA has to handle the delicate task of distribution of 'water scarcity'.

The study concentrates on three main aspects of service provision:

1. The overall water allocation and distribution implemented by JVA.
2. Water delivery and operation of the secondary system.
3. Maintenance of the secondary system and pumping stations.

For each of these fields the study identifies the major actors involved and the 'services' provided among these actors. Then, for the most essential service relationships, the study analyses in a systematic way:

- the nature of the services to be provided
- the corresponding returns
- the mechanisms that make sure, that such services and return services can be exchanged in a way that is perceived to be effective and efficient by both partners of a service relationship and thus create positive incentives and clear accountability. Such mechanisms include laws, contracts, rules and regulations, procedures and common practices and are called "governance mechanisms" in this text.

This study reveals that in most cases the governance mechanisms for water allocation, water delivery and maintenance in the Jordan Valley irrigation are either deficient or non-existent altogether. For instance, there are no clearly established mechanisms to secure an efficient allocation of water among the Deir Alla Pumping Station that pumps water for municipal and industrial use to Amman and the three O&M-directorates that demand water for irrigation. The criteria for allocation decisions are not transparent to the parties involved. The same is also true for the water delivery and operation of the secondary system as well as for the maintenance of the secondary system and pumping stations. These deficiencies have serious consequences for the incentives of the involved parties. The main actors, JVA staff and farmers, have few incentives to strive for efficient service provision. On the contrary, the governance defects identified in the study allow major actors to pursue individual goals to the detriment of an efficient

and reliable water distribution and delivery service. Consequently, it is not surprising that some of the major role players have little incentive to change the rules of the game. It may actually be in their best interest to maintain the existing inefficiencies in the system.

The study analyses the prevailing governance defects with reference to the' Principle-Agent Theory'. This theory deals with problems that typically arise in employer/employee or employer/contractor relationships. Some of the main problems explained by Principle-Agent theory include "moral hazard", "hidden information", "adverse selection" and "hold up". These are defined in the annex and are used here to illustrate and explain the behavior of some of the actors in the JVA.

Furthermore, the study provides a simple methodology for the analysis of service systems, that could be used in future organizational change processes foreseen by JVA. Subsequently, problem solutions suggested by Principle-Agent theory are translated into practical recommendations for improvements in the service delivery system for irrigation in the Jordan Valley.

However, while the study focuses on governance aspects of water allocation, water delivery and maintenance services, it also touches upon underlying structural aspects that are at the roots of the managerial problems. The lack of financial autonomy for JVA, the undermining of management authority of JVA staff by influential stakeholders and the low level of legal security are given special attention.

It is argued that solutions to poor water delivery and maintenance in the Jordan Valley can only be expected if changes in the above-mentioned institutional arrangements are achieved. We believe that step-by-step-improvements in governance mechanisms for service provision will work towards solving these problems.

1. The Environment: Water Use and Irrigation in Jordan

1.1 Water Use in the Regional and National Context

The "Treaty of Peace between the State of Israel and the Hashemite Kingdom of Jordan", signed in October 1994, determines the use of the different water sources in the *regional context*. According to the Treaty, Israel is allowed – in addition to a withdrawal of 25 MCM (million cubic meters) of Yarmouk river water – to pump 20 MCM of Yarmouk water into lake Tiberias in winter. In summer, this same amount of water is to be released to Jordan. Jordan will be supplied an additional 10 MCM by desalinating saline springs around Lake Tiberias. Until the water treatment plant is operational, Israel will supply this latter quantity to Jordan from Lake Tiberias directly (Libiszewski 1997; AlKloub and Abu-Taleb 1998). The practical challenges of implementing the agreement have proven to be quite difficult so far. In practice this means that actual water acquisition by JVA from Lake Tiberias is still quite unpredictable (see section 4.3).

In the *national context* a rising tension is noticeable above all between municipal and agricultural water use. A number of scientists have long been arguing against intensifying Jordanian agriculture in the Jordan Valley as well as in the uplands (North of Amman). A major problem is a gross overexploitation of groundwater. In 1993, some 530 MCM were exploited compared to available resources of about 320 MCM (Shatanawi and Al-Jayousi 1995). Contrary to official policy, pumping groundwater for agricultural use in the uplands has been spreading continuously.

Instead of using most or all of this groundwater for local municipal use, the Water Authority of Jordan is pumping water out of the Jordan Valley and feeding it into the Amman water supply system. This bridges a height difference of about 1,000 meters. The maximum capacity of the pipeline used for this supply is 60 MCM per year, the actual use approx. 40 MCM per year. The capacity of the pipeline is at present extended to 90 MCM (Soer, GTZ, personal communication). Therefore, it seems reasonable to assume that in the future more water will be pumped out of the Jordan Valley to Amman. Moreover, the number of private pumping stations has also increased in the Jordan Valley. Large amounts of fossil water from the Disi region in the South of Jordan that could be used for domestic consumption are being used for irrigation. It is argued that, in order to secure Jordan's water resources, agricultural water use should be reduced and, above all, overexploitation of wells should be prevented (Shatanawi and Al-Jayousi 1995). This would involve restricting the use of wells in the uplands and

the Disi area. It would also require more efficient use of water for irrigation in the Jordan Valley.

1.2 Irrigation and Water Use in Jordan

Irrigation in Jordan accounts for more than 70 percent of all water use. Individual farms in the highlands are irrigated by groundwater from private wells. The publicly managed 36,000 ha surface irrigation system in the Jordan Valley uses mostly surface water and recycled wastewater. Irrigation in the highlands expanded from 3,000 ha in 1976 to about 33,000 ha in 1997 and accounts for about 60% of groundwater use (The Hashemite Kingdom of Jordan 1997). An additional 5,000 ha is irrigated by fossil groundwater in the Disi area, mostly by center-pivot irrigation for relatively low-value cereal crops. Because of over-abstraction, new licenses for pumping groundwater for agriculture have been officially restricted in the recent years (cf. The Hashemite Kingdom of Jordan 1997). The quantity pumped from existing wells is presently not regulated, but the Government has begun a program to reassert control over the resource. Doubts exist whether or not this control will be implemented more rigorously than has been the case so far. Details about irrigated agriculture in the Jordan Valley are given in chapter 2.3.

1.3 Governing Water Use: The Institutions

Three public agencies are vested with responsibility for the water sector of Jordan: the Ministry of Water and Irrigation, the Water Authority of Jordan and the Jordan Valley Authority; each one is headed by a Secretary General reporting to the Minister of Water and Irrigation. All agencies are subject to the provisions of the Civil Service Commission, the Audit Bureau, the Bureau of Supervision and Inspection, and Government procurement regulations (cf. The Hashemite Kingdom of Jordan 1997).

Ministry of Water and Irrigation:

The Ministry of Water and Irrigation (MOWI) is the most recently established of the three entities. Unlike the service agencies whose responsibilities are defined under laws of the parliament, the MOWI is empowered with a by-law (No. 54 of 1992) under Article

120 of the Constitution issued by the Government's executive. It is responsible for the formulation and implementation of water and wastewater development programs. Its main functions, according to its mandate, are to formulate policies and strategies, plan water resources development, carry out research and development, conduct socio-economic and environmental studies, procure financial resources, monitor water and wastewater projects, implement human resource development and public awareness programs, and establish information systems (some of which are already transferred by law to other agencies).

Water Authority of Jordan:

The Water Authority of Jordan (WAJ) has two principle functions: provision of water and sewerage services, and water resources management. The Law 18/1988 has created the WAJ as a national government agency with its principle responsibilities being to monitor water resources, regulate groundwater use, and provide water supply and sewerage services. It is directed by a board of government and private sector representatives.

Jordan Valley Authority:

The Jordan Valley development is governed by the Law 19/1988 - an extension of the Temporary Law No. 18/1977, which created the Jordan Valley Authority (JVA). It is the successor to four organizations previously responsible for overall development of the Jordan Valley. The 1988 Law gives JVA the legal mandate for developing the Jordan Valley and the area South of the Dead Sea. JVA's responsibilities within this area include:

- development of water resources (irrigation, domestic, industrial and municipal);
- development of towns and villages;
- design and construction of road networks, domestic water supply, electricity, and telecommunications networks;
- and the provision of tourist facilities.

The Law also empowered JVA to implement social development infrastructure such as schools, health centers, housing, government buildings, streets, marketing centers,

processing factories, laboratories, etc. According to the Law, JVA will hand over projects to the appropriate regional or municipal authorities after the projects are completed.

The Law describes the Authority as "an autonomous corporate body" with "full authority" to determine the allocation and usage of all surface and groundwater, as well as to establish water charges. In reality, however, JVA is a standard government agency lacking key aspects of autonomy. It lacks the power to hire and fire staff under its own conditions - at present civil service rules and pay scales apply. It also lacks financial autonomy, and has no freedom to set its own budget and to retain its revenues. Moreover, its accounting system is not business-oriented. JVA uses the classic government receipts and payment system.

2. Irrigation in the Jordan Valley

2.1 Irrigation Infrastructure

To meet peak water demand during the summer, which coincides with a surface water shortage, a considerable hydraulic development program has been carried out in the Jordan Valley over the last forty years. It comprises storage, transport and water distribution structures. Figure 1 illustrates a schematic view of the irrigation water distribution system.

The overall system includes the following levels:

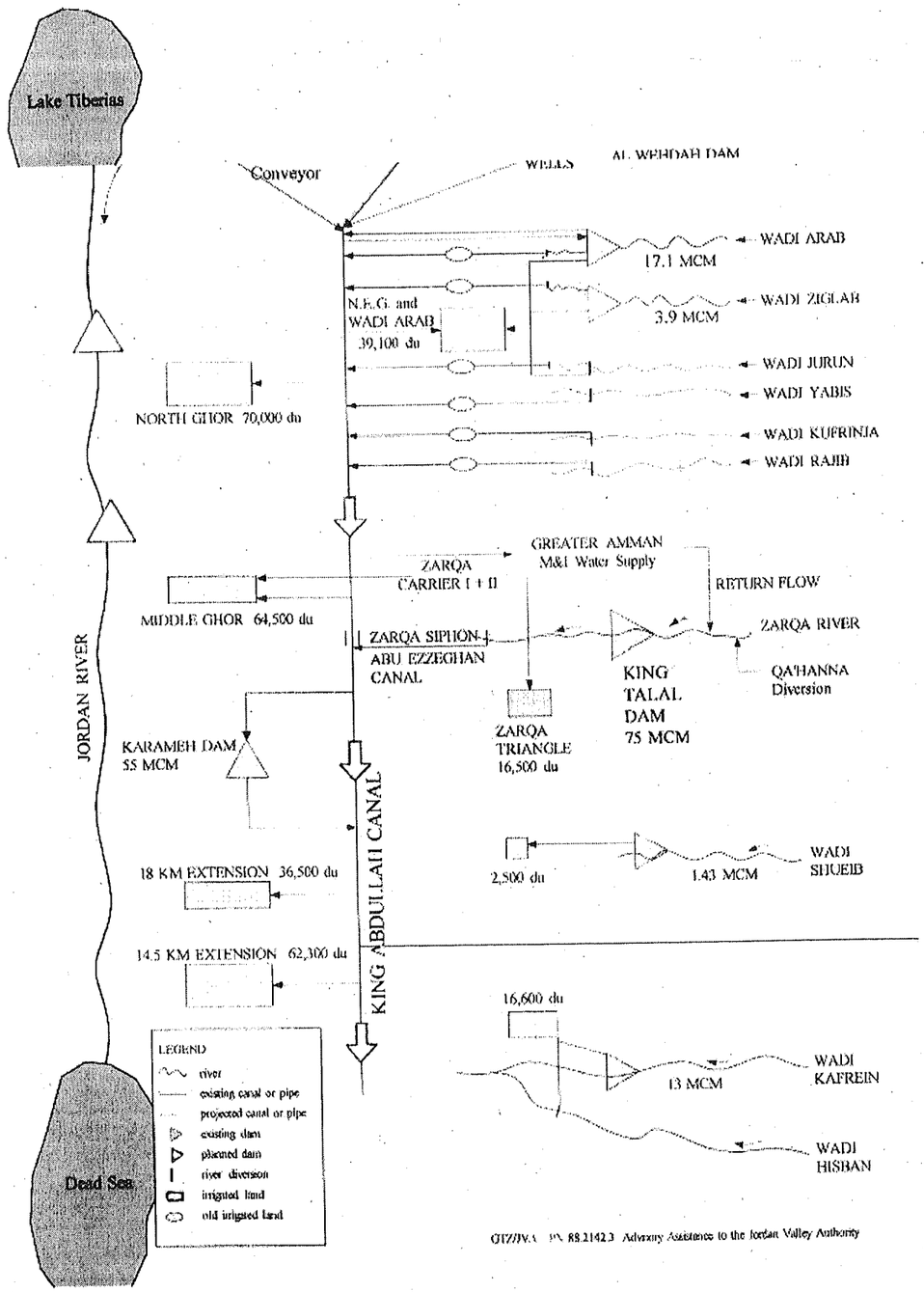
1) Dams
2) Main Conveyance System
3) Secondary System
   a) Pumping Stations
   b) Secondary Canals and Pipes (to the farm turnouts)
4) On-Farm System (responsibility of farmers)
5) Drainage System

The King Talal Dam, situated on the Zarqa River, is the main water storage structure. Its current capacity is estimated at 75 MCM. Other storage structures are the Wadi Arab reservoir (20 MCM), the Wadi Ziglab reservoir (4 MCM), the Wadi Shueib reservoir (2.5 MCM), the Wadi Kafrein/Hisban reservoir (13 MCM) and the Karameh reservoir (55 MCM) (Soer 1998). The Karameh reservoir is an intermediate storage reservoir that stores water from the King Abdullah Canal (KAC), the main conveyance canal in the Jordan Valley. It then pumps water back into the same canal downstream.

The King Abdullah Canal (KAC) forms the backbone of the scheme along the Jordan River for a length of 110 km. It is the main water conveyance structure in the Jordan Valley. It is supplied from the North by the Yarmouk River, the Mukheibeh wells, and more recently (July 1995), by the KAC North Conveyor. The canal head capacity is 20 m^3/s. It crosses the Zarqa River through a 12 m^3/s siphon.

Figure 1: Jordan Valley Irrigation Water Distribution System

Source: Soer 1998



GTZ/JVA PN 88.2142.3 Advisory Assistance to the Jordan Valley Authority

Immediately downstream from this siphon, the canal receives water from the King Talal Dam via the 7.5 m^3/s Abu Ezzeghan canal. The KAC is currently operated by 36 cross-check gates. The other main conveyance structures are i) the Zarqa carriers I and II, ii) the connection between the KAC and the Wadi Arab dam, and iii) a pipe and a series of pumping stations which supply water to Amman City from the KAC at Deir Alla (Data supplied by AAP-JVA 1998).

The main distribution structures are irrigation networks. Most of the systems (approximately 65%) were built as open channel networks and were later converted into high and low pressure networks. Today, the entire network consists of pressurized systems. These networks can be supplied either directly from the KAC, from one of the reservoirs or from a river offtake. A number of them are supplied from several sources with predefined criteria for priority allocation of water.

2.2 Land Tenure

Irrigation in the Jordan Valley was developed by the Jordan Valley Authority and now includes an irrigable area of approx. 29,000 ha out of which 21,200 ha were cultivated in the season 1996/97. Another 4,500 ha are located in the Southern Ghors, south of the Dead Sea (Soer 1998).

Land tenure in the valley was reorganized by the Jordan Valley Development Law (JVD Law) No. 19 of 1988. It was issued originally in 1959 and has been amended several times since then. The Law limits all farm units in the Jordan Valley to no less than 3 to 4 hectares in size, regardless of the number of owners on each unit. Under no circumstances should the farm size be fragmented into smaller sizes. The maximum total farm size that can be owned by one person is supposed to be 20 ha, or the equivalent to 6 farm units.

The efforts of land reform led to some deconcentration in landownership in the Jordan Valley, although to a lesser extent than anticipated. Before land reform the land was possessed mainly by a small number of large family clans. In view of the reform, several of them decided to split the land among family members. Thus land tenure data is difficult to interpret. Even though formally the large landholdings have been subdivided, at least some of them continue, de facto, to exist undivided.

Recent data show that farm sizes in the Valley vary from 0,1 to almost 150 ha. The average farm size is 3,7 ha with a minor increase from north (3,3 ha) to south (4,1 ha) (Soer 1998). The real size of larger landholdings owned by family clans is probably larger than 150 ha. These unequal sizes of landholdings, and the politically influential wealthy landowners in the Jordan Valley, have a strong impact on the functioning of the system of water allocation and delivery in the Valley.

Many of the farmers do not own the land they are working on, but share the costs and benefits with the landowner according to sharecropping and fixed rent contracts. Investments in infrastructure are generally paid by the owner, while the cultivator/lessee has to pay either part or all of the water charge.

2.3 Land Use and Crops Grown

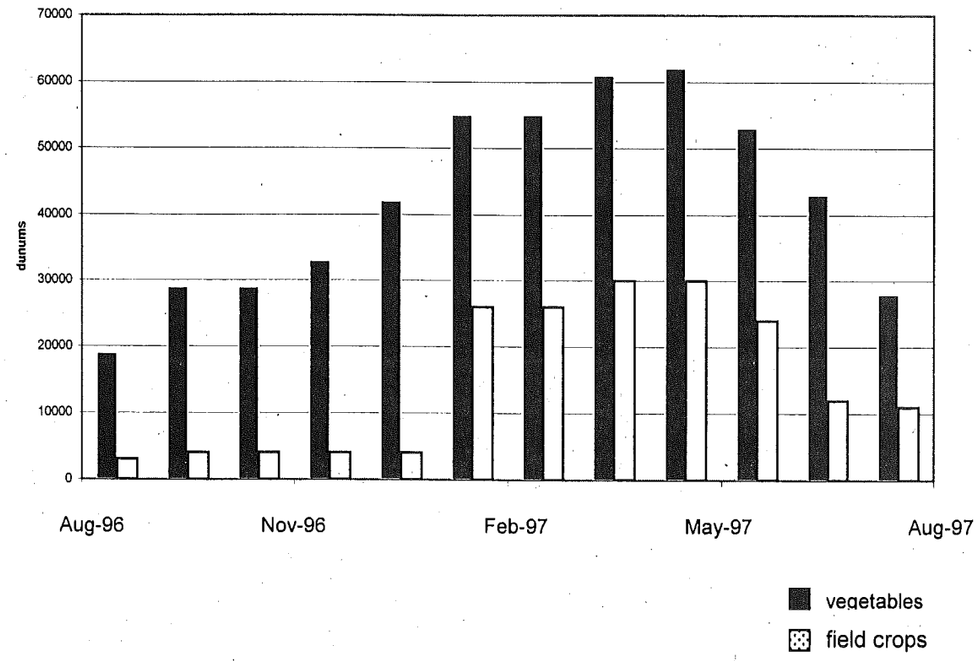
The dominant form of land use in the Jordan Valley is irrigated agriculture, which has undergone dynamic transformations, partly as a result of integrated social and economic development programs in the valley.

In the Jordan Valley a broad range of farm types exists. There are large and small size farms that are efficiently organized and productive, and are located beside large numbers of smaller farms, which barely manage to produce enough for the families to survive. A large number of the first group uses modern technology in a highly productive way, although its further expansion is limited through scarce water resources. Capital-intensive agriculture uses drip irrigation mainly for the production of vegetables (e.g. tomato, cucumber, aubergine, etc.). Vegetables and fruit (mainly bananas) are produced mainly for the domestic market and for Saudi Arabia and the Gulf states. The EU market is not very important for Jordan at present.

The relative importance of vegetable growing in the Jordan valley is demonstrated in Fig. 2. While vegetable cultivation occupies approx. 50% of the cultivated area, field crops account for ca. 20% and fruit trees for ca. 30% of the total (Soer 1998).

Figure 2: Area of Vegetables and Field Crops Grown at Different Times of the Year; Jordan Valley; Irrigation Season 1996/1997; Cropping Pattern data from Dirar

Source: Soer 1998



10 dunums = 1 hectare

3. Operation and Maintenance of the Jordan Valley Irrigation System

3.1 Present Situation and O&M Problems

Water delivery in the Jordan Valley has been converted from surface irrigation to pressurized pipe systems. This conversion has been completed only recently. At present, most irrigation water application is done by drip irrigation. However, surprisingly, there is little difference in irrigation efficiency today, compared to previous surface irrigation. Substantial water savings, which were expected to result from the conversion to pipe systems have not materialized so far.

This finding is particularly pronounced with respect to the irrigation of vegetable crops. Field application efficiencies for such crops actually score only around 30%. Contrary to what one would expect, the technology level so far does not seem to have any effect on application efficiencies for vegetables. By comparison, studies indicate that field application efficiencies for field crops and fruit trees are higher with 50% and 80% respectively (Shatanawi et al. 1994; Soer 1998). Given the fact that vegetables are the most important crop in the Jordan Valley, this constitutes a very serious drawback.

Socio-economic surveys indicate, that one of the reasons for such low efficiencies is the fact that the farmers consider JVA's water supply to be unreliable and when water comes they over-irrigate to store water in the soil (which automatically leads to high losses). On the other hand, these low application efficiencies point to the fact that there is a high potential for water savings in vegetable growing. The amount that might be saved is estimated at 40 million m^3/year. With such savings, it would be feasible to grow two vegetable crops per year on average (Soer 1998).

These facts draw attention to the roots of the problems in operation and maintenance and need to be addressed urgently, given the growing water scarcity faced by Jordanian agriculture.

With respect to maintenance, the following observations can be made:

Inspections carried out in the course of the "Study for the Recovery of Operation and Maintenance Costs of Irrigation Water in Jordan" (GITEC/CEC 1993) showed that Operation and Maintenance (O&M) of the dams and the maintenance of the main conveyance infrastructure normally did not pose any great problem. The dams and the conveyance canals were generally in good condition. However, the condition of the drainage canals varied from project to project. Some of the drains required desilting and removal of vegetation. Major damage of underground pipelines, which could only be identified through high soil moisture at the ground level, was also not found. One common problem identified was that many of the valves or Farm Turnout Assemblies (FTAs) had been damaged intentionally by farmers and needed to be changed, if the JVA was to restore the scheme to its original design standards for distributing water.

The FTAs consist of an air valve, a pressure regulator (if required) and a flow meter for recording the volume of water supplied to the farm unit. Many farmers manipulate these structures in order to get more water or to pay for a smaller quantity than they actually receive. Consequently, the flow meters are damaged almost everywhere, and only a few were working at the Wadi Arab Irrigation Project and in the Middle Ghor Project at the time of this study.

Interviews conducted in the course of two missions in 1998 confirm that the general trends of the GITEC analysis continue to be valid. According to these interviews, the overriding O&M problems relate to the following three interconnected aspects of irrigation management:

a) Operation of water allocation
b) Physical condition of the secondary water delivery infrastructure (especially FTAs)
c) Water delivery to farms and water application in the fields.

a) *Operation of water allocation*

There are general difficulties in balancing out water distribution between the O&M Directorates in the valley and the municipality of Amman (served through the Deir Alla pumping station). The water supply for Amman has priority and its timing and amount is often unpredictable. Consequently, the resulting allocation of available

water to the three O&M Directorates, i.e. to the three major irrigation areas, is characterized as unreliable and unpredictable. During times of water scarcity, an O&M Directorate cannot be sure about how much water to expect until a very short notice. This seriously impedes the programming of irrigation turns, undermines trust toward JVA as a reliable provider of water service and creates a constant source of conflict between water users. This also causes continuing disputes among the three O&M Directorates, and in various instances the Directorates tend to suspect that they may have been disadvantaged with respect to their 'fair share'.

b) *Physical Condition of the Secondary Water Delivery Infrastructure*

The major constraint here consists in the low level of functioning of the Farm Turnout Assemblies (FTA's). This has immediate repercussions with respect to amount, timing and reliability of water delivery. It also translates into substantial water losses.

Although the condition of the FTAs has improved following a large-scale renovation campaign, the condition of many of these crucial structures is still far from adequate.

The maintenance and repair of water meters seems to be a particularly 'hopeless' case. At the time of the discussions in the framework of this study, JVA had practically abandoned any effort to ensure maintenance and repair of water meters.

Another problem consists of the fact that clogged and broken pipes in the secondary water distribution system often are not maintained or repaired on time. This results in site-specific water delivery problems and corresponding inefficiencies.

As a general rule, preventive maintenance is not done. This holds true for the pumping stations and for the secondary conveyance system itself. It not only decreases the potential service time of the hydraulic infrastructure, but also increases repair frequency and hence interferes with operational efficiency.

c) *Water Delivery to Farms and Water Application in the Fields*

The serious deficits in irrigation efficiency for vegetable growing, mentioned above, most probably have their roots in the unreliability of water delivery that stems from deficits in water allocation and in maintenance, as described before (Soer 1998).

Moreover, in many parts of the irrigation system, even after the conversion to pressurized pipes, farmers go on using the same amounts of water for leaching as

they did before the introduction of drip irrigation.[2] This drastically reduces field application efficiencies.

A large amount of the supplied water is actually "not accounted for" ("administrative losses"), meaning it is not billed to the farmers. These "losses" (i.e. part of this water that is probably used but not paid for) have gradually decreased during the last 5 years, from 20% in 1995 to 15% in 1998. Still, this amount is an indicator of serious management problems in the system (Soer 1998).

It appears that attempts to improve irrigation efficiencies, which solely concentrate on conveyance efficiencies, (especially in the main conveyance system) will not be cost effective in the Jordan Valley, unless improvements in the above-mentioned problems are also made. The following considerations contribute to ongoing efforts at JVA to achieve improvements in these problems (except for the leaching problem, which is not addressed here).

3.2 Responsibilities for Operation and Maintenance in Jordan Valley Irrigation

Presently, O&M of the Jordan Valley irrigation system, from the source to the Farm Turnout Assembly (FTA), is under the sole responsibility of the JVA. Within the JVA, responsibilities for different components of the system are spread among various Directorates (see Figure 3). O&M responsibilities for the dams lie within the Dams Directorate. Responsibility for the main conveyance system and for O&M of the secondary systems within the three regional O&M Directorates (Fig. 3) lies within the Water Management Directorate in Amman headquarters. However, in spite of this formal division of responsibilities, experiences show that in reality lines of authority can be overruled by informal processes.

[2] The soils of about 10 to 20% of the farms units are subject to salinization, which is mainly due to the lack of drainage and/or the lack or wrong application of leaching water. The salinization problem is concentrated in the southern part of the Jordan Valley, while in the northern part sufficient winter rains and reasonable natural drainage prevent this occurrence (Data supplied by AA-JVA 1998).

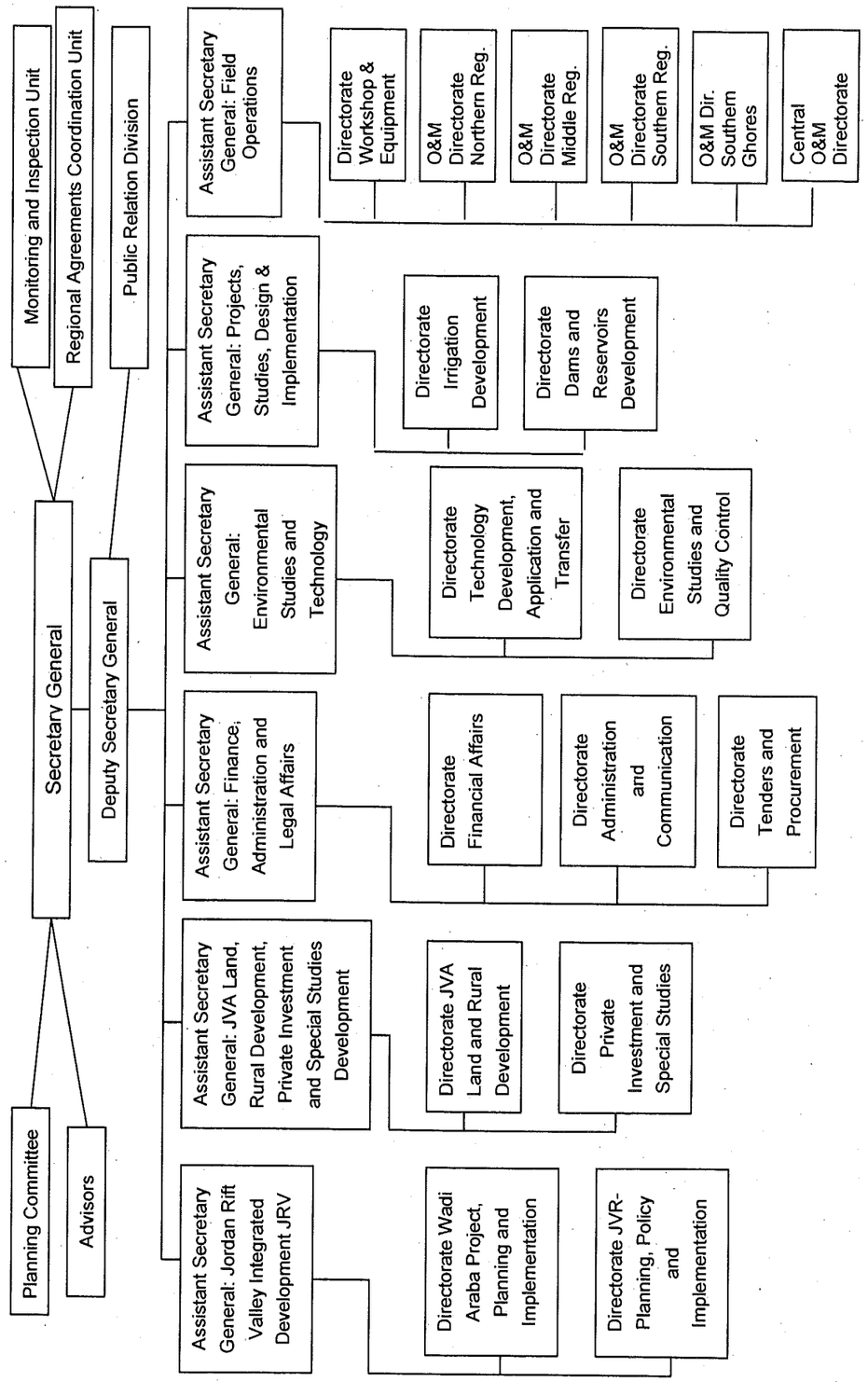


Figure 3: Organisational Structure of JVA

4. Governance Mechanisms for Water Allocation and Maintenance Services in the Jordan Valley Irrigation System

4.1 Methodological Approach

The purpose of the workshops and round-table discussions with JVA, which form the basis for this study, was to shed light on some of the institutional causes behind the malfunctioning of operation and maintenance of irrigation in the JVA. This should provide direction for how to make improvements in management, especially in maintenance of infrastructure.

Discussions in Amman and in this study have the following four-pronged focus:

1. *Use of a broadened service perspective*
2. *Use of a multi-actor perspective*
3. *Focus on service relationships and governance mechanisms*

Additionally, one feature of service provision by JVA has been given particular emphasis:

4. *The double-edged nature of the water-related service to be provided by JVA*

We now describe these points in more detail.

1. *Use of a broadened service perspective:*

   Water allocation, water delivery and maintenance are herein considered as *services* to be provided by JVA. The provision of these services is made possible by the provision of a multitude of supporting services, which are mainly internal services provided by a given unit within JVA to another unit. The term *service,* as it is used here, goes beyond the meaning usually referred to in the context of irrigated agriculture, when it is related to water supply, agricultural extension, fertilizer supply, marketing etc. *Services* here are all provisions and/or activities that are directed toward a certain person, group or unit - or all goods and/or activities that are the object of a process of exchange between a provider (the agent) and a receiver (the client or principal). Hence, in the context of 'service' provision as it is referred to

here, services can be of a very diverse nature: information provision, issuing orders, doing repairs, moving machinery, submitting demand schedules, etc. These can all be looked upon as 'services' or 'supporting services' besides services such as water supply or maintenance.

Why such a change in terminology? Why not talk about tasks or functions, as is the case normally in bureaucratic organizations? Concentrating on services and those tasks or functions that are directed toward a certain receiver or client adds an important dimension to the analysis of activities and planning in organizations. It helps direct the attention to the client, to his or her needs and preferences and to the interaction or service relationship needed to ensure an effective and efficient service provision.

2. *Use of a multi-actor' perspective:*

As explained above, using a service perspective will mean that a multitude of different actors has to be considered when examining those involved in the provision of a service, including all necessary supporting services. Final or primary services such as water provision are hence understood to be the result of a whole chain or network of supporting service providers and receivers. The provision of the final service can only function in an effective and efficient way if this network can function as a whole without the weak links of deficient supporting service provision.

3. *Focus on service relationships and governance mechanisms:*

When analyzing and improving such service networks, it is crucial to look at each and every bipolar service relationship. It is essential to identify the laws, procedures, contracts and/or common practices that are the basis for this relationship, or that govern the relationship. Such laws procedures, contracts and common practices are referred to as *governance mechanisms* in the following text.[3] Analysis and

[3] During discussions with JVA, the term ‚co-ordination' has been used instead of ‚governance'. However the term ‚governance' is preferred here. While ‚co-ordination' is to be understood as a function of management, the term ‚governance' is based on a wider concept that extends to relationships that are no longer ‚managed' by one person or unit with directive powers. Service relationships are such a case in point. To conceptualize even hierarchical relationships as a governance mode directs the attention not only to management functions like planning, controlling, organizing, leading, decision making etc. but also to the fundamentals of the employer-employee relationship such as contracts, incentives etc. ‚Governance' is by now a common term used to describe a field of study and activity that is closely related to government but has developed meaning well beyond this area. During the early 1990s, the concept of governance has expanded further with greater attention to the processes of participation and consensus building which occur in civil society, and hence also between partners in commercial and non-commercial service provision. This is why the term ‚governance' in this study has replaced the term ‚coordination' that has been used in the discussions and workshops with JVA.

improvement of these governance mechanisms (as far as they relate to the service networks for operation and maintenance of irrigation systems in the Jordan Valley) constitute the core of the present study.

4. *Accentuating the double edged nature of the water service to be provided by JVA:*

In the provision of water to irrigated farms in the Jordan Valley, JVA has to take into account two competing requirements. On the one hand, as with any other service provider, it has to satisfy the demands of its primary clients, the farmers, and supply water according to crop water requirements. On the other hand, JVA has the difficult mandate to provide a service that may be contrary to the interests of individual farmers, but may be considered as a service to the general public: to distribute water scarcity (i.e. to allocate water in such a way that growing differences between demand and supply are balanced out in an equitable manner). The water delivery service of JVA is hence both demand and supply driven. In this respect water service provision for irrigation in the Jordan Valley is fundamentally different from a purely commercial and solely demand driven service. This study places particular emphasis on this characteristic of JVA service provision.

The methodology used for this analysis was developed by the research and development project "Maintain" of the "Deutsche Gesellschaft für Technische Zusammenarbeit" (GTZ), which focuses on service provision in the maintenance of irrigation systems. The case studies implemented so far by the "Maintain" project indicate that a major reason for maintenance problems lies in the malfunctioning of governance mechanisms established to regulate service provision between different participants. Therefore, "Maintain" concentrates its analysis on the governance mechanisms underlying service provision.

Three main questions need to be answered when analysing the service delivery system:

- Who provides which service(s) for whom?
  - Which services are being provided?
  - Who is offering/producing them?
  - Who is receiving them?
- What is being provided in return for each service (or "return service")?
- Who or what is making sure that these primary services and returns are actually being provided in a way that suits those concerned? In other words: What kinds of

governance mechanisms are on hand for service delivery? To what extent can service providers influence the recipients or, conversely, the recipients influence the service providers, when it comes to upholding their respective commitments and obligations? What incentives do the respective sides have to act "in conformity with the system"? Or what induces them to behave in an opportunistic manner?

These are the questions that were posed during round-table discussions with JVA staff and that are at the core of the analysis. For readers with only a general interest in this field, it is less important to delve into the details of how each of the services is produced and provided. It is more important to see that every individual service has to relate to one or more governance mechanisms in order to ensure that service provision meets the demands made of it by the providers and recipients (not to mention the overarching requirements of the system as a whole).

This study of irrigation in the Jordan Valley is structured such that it attempts to answer the above-mentioned three core questions in each of the main service areas:

1. Water allocation practiced by JVA
2. Operation of the secondary system
3. Maintenance of the secondary system and pumping stations

As a guide through the service relations in complex networks of this nature, and to identify problems in such interrelationships, we attempt to summarize this information in the form of graphs (following the approach by Herder-Dorneich 1986). These graphs are used throughout the text as follows:

- The actors concerned (organizations, groups, and individuals) are presented as ovals.
- Services (and support services) are symbolized by a straight (red) arrow complete with an S plus a letter and/or figure as an index.
- Returns, especially financial returns and information provisions are indicated by a (blue) arrow marked by an f or an i respectively.
- Governance mechanisms between two actors, i.e. the way in which service provision between two actors is coordinated/regulated, is depicted using a

(green) line, plus a rhomboid shape containing either a number that is explained in the text or a direct description of the mechanism.

4.2 Water Allocation Practiced by JVA

4.2.1 Actors and Services

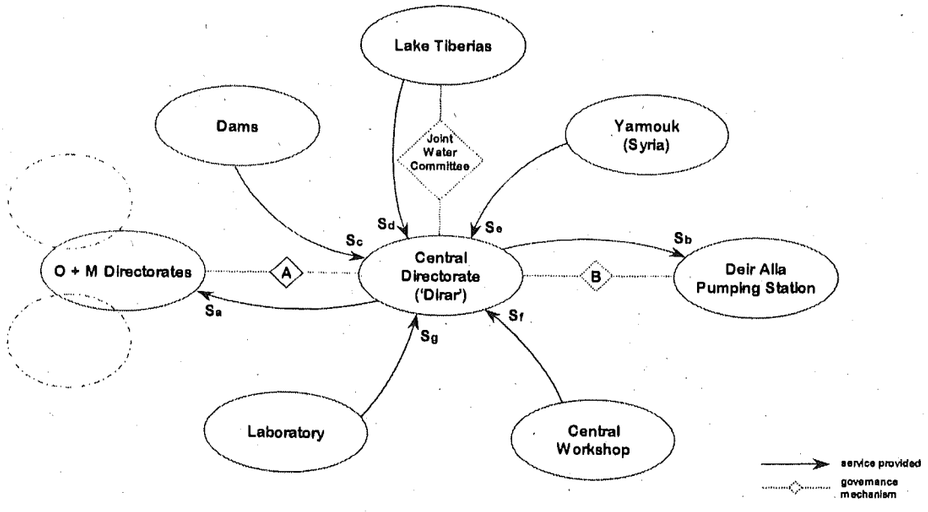
The Central O&M Directorate Dirar is the entity responsible for the overall operation of the Jordan Valley irrigation system. (In the following we refer to this Directorate as the Central Directorate). Figure 4 depicts the major services the Central Directorate supplies and receives. The services S_a and S_b refer to the allocation of water deliveries (to O&M – Directorates and to Deir Alla) and to water inflows into the system (from Israel and Syria). These services thus correspond to actual flows of water.

Figure 4 makes clear that *one main objective* of the Central Directorate is balancing out demand and supply between the different clients involved. On the demand side, the Central Directorate has to satisfy the water needs of irrigation put forward by the three O&M directorates in the Valley (to be satisfied by supply S_a). The Central Directorate has to respond to the municipal and industrial water demand of Amman (which is being served through the Deir Alla pumping station, which receives the supply S_b). This balancing out is a difficult task since the water supply available in the Jordan Valley not only depends on the runoff coming from the dams controlled by JVA (S_c) and the Yarmouk river (S_e), but also on the water provided from Israel (S_d). The latter are regulated through the Joint Water Committee. There are also further sources of unpredictability, such as illegal connections in the valley and unpredictable withdrawals by individual O&M directorates.

The task of balancing out water supply and demand means that JVA has to manage a complex water delivery system and a complex water acquisition system. Supply must match demand as closely as possible and water shortages supposed to be handled in a way that is acceptable to the various constituencies involved.

Finally, there are additional services that are necessary for the functioning of water allocation. The Central Workshop provides services in the technical operation of the irrigation system (S_f) and the Laboratory makes regular checks of water quality (S_g).

Figure 4: The Central Directorate as a Service Provider and Service Receiver



4.2.2 The Services S_a and S_b: Allocating Water to Irrigation and to Municipal and Industrial Use

a) Services and Returns:

The services S_a and S_b to be provided by the Central Directorate relate to the allocation of water (or allocation decisions) to the regional O&M Directorates on the one hand and to the Deir Alla pumping station on the other hand. To be able to provide these services, the Central Directorate is dependant on information provided by these two clients. This information is perceived as a return to this service.

In order to operate the system, the Central Directorate relies on a highly sophisticated computerized system. Based on estimated runoffs and water supplies on one hand side and the expected demand on the other (calculated on the basis of the water requirements of crops and area requested to be planted by farmers), water delivery is simulated in advance for the whole year. This simulation is successively refined as the different parameters become clearer. The final plan for water delivery

is continually adjusted until one day in advance - when the farmers hand in their exact water requirements. While this system allows last minute adjustments, it makes it difficult to fulfill the overall aim of balancing out water delivery between the three O&M directorates. This is because the Directorates do not base their calculations on accurate information on cropping patterns, area planted etc. Instead, theoretical cropping patterns are used to make these estimations, which can deviate considerably from the actual situation. On the other hand, the farmers' demand for water is not based on actual crop water requirements, but on what they think they can use. This causes unpredictable gaps between theoretically calculated water requirements and actual demand. It also prevents a priori transparency on real water requirements in the different Directorates. This is complicated by the fact that water availability in the dry season is often seriously deficient. In the discussions for this study, O&M Directors claimed that the real day-to-day water demand in their region is practically unpredictable and that conflicts between the different Directorates over water division occur frequently.

b) Governance Mechanisms and Incentives:

As the discussions with JVA have shown, there is no clearly established governance mechanism underlying the service relationship between the Central Directorate and the Deir Alla pumping station, which supplies water to Amman for municipal and industrial (M&I) uses. Actual demands may be issued on an ad-hoc basis and no clear rules of information exchange have been established between the Central Directorate and the Deir Alla pumping station so far. This means that the governance mechanism <B> in Fig. 4, i.e. the rules and procedures that are supposed to govern the relationship between the Central Directorate and Deir Alla, is practically inexistent. In practice, M&I water demands for Amman have priority over agriculture in the Jordan Valley. However, a formal regulation on the distribution between irrigation and M&I requirements does not exist. Arrangements are made on an ad-hoc basis through informal coordination between the Central Directorate and Deir Alla. From the viewpoint of the Central Directorate this requires frequent and difficult on-the-spot decision making and speedy adjustments in supply schedules for irrigation.

Given this weak service relationship between the Central Directorate and Deir Alla and the uncertainties of supply to be given to Deir Alla, the question was raised as to what governance mechanisms have been established that allow the O&M directorates to influence and stimulate effective provision of the water service by the

Central Directorate, and what mechanisms there are to ensure adequate information provision by the O&M Directorates to the Central Directorate (governance mechanism <A> in Fig. 4).

Officially, this governance mechanism consists of the authority given to the Central Directorate by the JVA to make allocation decisions on the basis of comparisons between demand and supply data. Hierarchically within JVA, the Central Directorate and the O&M Directorates are at the same level (see Figure 3). The participants of the round-table discussion agreed that under the given circumstances, such a governance mechanism might create problems for both the provision of the service (water allocation by the Central Directorate to the O&M Directorates) and for the provision of the return (information provision by the O&M Directorates to the Central Directorate). These problems were examined separately by discussing:

b.1) The Governance of Service Provision by the Central Directorate to the O&M Directorates and

b.2) The Governance of Information Provision by the O&M Directorates to Dirar.

b.1) Governance of Service Provision by the Central Directorate to the O&M Directorates:

The discussions brought to the fore that the existing service relationship contains serious information asymmetries among the actors. It is important to realize that such asymmetries may lead to so-called 'moral hazard' problems as described in detail in Annex[4] (cf. Wolff and Huppert 1999). Such problems are frequently encountered in employer-employee and employer-contractor relationships. They are also common in service relationships between clients and service providers.

A *moral hazard* problem arises in service relationships where the customer cannot be informed about every action taken by the service provider and so cannot control everything the provider does. The particular circumstances mentioned refer to situations where information asymmetries occur *when actions of the provider are subject to various unpredictable external influences which cannot fully be perceived or appreciated by the client.* Unless well functioning governance mechanisms are in place (e.g. particular contract agreements, special control mechanism, mutual trust etc.) the client faces certain risks: the service provider

[4] These and the following discussions that make use of the so-called ‚Principal-Agent-Theory' refer to a separate thematic paper that has been written in the context of the ‚Maintain' project. See Wolff and Huppert (2000).

may exploit this difference in available information in order to pursue personal interests that are not in line with the agreement about the service to be provided. Because of such opportunistic behavior by the service provider, benefits from the service may fall well below the level expected by the client (on the basis of the initial agreement). However, the service provider cannot be held accountable for this by the client (see Annex).[5]

Using these concepts, the information asymmetry contained in the service relationship between the Central Directorate and the O&M Directorates, and its consequences, can be described as follows.

We consider the O&M Directorates to be the clients (or the Principals) which expect the service of water allocation to be provided by the Central Directorate (or the Agent). In this case the discussions with JVA pointed to particular information asymmetries that exist between the Central Directorate and the O&M Directorates.

First, it is only the Central Directorate that has detailed knowledge about the supply to be expected from various sources. This includes the supply from Israel, which is based on the decisions of the Joint Water Committee. These supplies are highly variable, depending on external influences such as rainfall-runoff conditions, demands on the Israeli side, and so on.

Secondly, it is almost exclusively the Central Directorate that is informed about short-term requirements for the water supply to Amman, which has clear priority. These demands on the Deir Alla Pumping Station, that pumps water to Amman, are highly unpredictable, as noted above. Thus, the amount of water to be drawn

[5] A popular case of a moral hazard problem in everyday life is the contract given by a private person to a stockbroker to speculate on the stock market with a given amount of money. The client cannot be informed about how and why the broker pursues particular actions on his behalf. He lacks both the time and the expertise to appreciate every step taken by the broker. In fact, this is the very reason he hired the broker in the first place. However, since this situation is coupled with high unpredictability due to fluctuations of stock prices, he faces a specific risk, which is a 'moral hazard' problem. The broker may use the money and his insider knowledge for private gain, while pretending that a loss for the client is due to unpredictable developments in what had appeared to be highly promising stocks which he bought for the client. The dilemma for the client is that the provider disposes of hidden information to which the client does not have access. Moreover the client cannot hold the provider accountable for the failure, since the actual behavior of the stock market is beyond the control of the broker. Unless there are special governance mechanisms (examples are external control by a third party and mutual trust, when aiming for a long-term relationship), his moral hazard problem cannot be solved.

by Deir Alla can vary substantially with only short notice to the Central Directorate.

Under such conditions the individual O&M Directorates face the risk that the Central Directorate may act in an opportunistic way and use the information intransparency to give preferential treatment to a particular region and O&M Directorate. The supply service for the other O&M Directorates will then be below their expectations. This can occur without a risk for the Central Directorate being held accountable. Hence, the above-mentioned Moral Hazard problem applies. Circumstances are so complex and unpredictable that it is impossible for the O&M Directorates to find out in a particular case whether or not supply shortages announced by the Central Directorate correspond to reality or are the result of information manipulation by the Central Directorate. According to Principal-Agent theory, rent-seeking behavior can be a basic driving force for such tactics.

While this does not imply that the O&M Directorates and the Central Directorate actually engage in such tactics, it is apparent that, in the absence of adequate governance mechanisms, information asymmetries are such that it will be difficult for actors involved to avoid being drawn into them.

b.2) Governance of Information Provision by the O&M Directorates to Dirar:

We will now look at the same situation as described above, but *from a different point of view*. We now look at the returns provided *by* the O&M Directorates *to* the Central Directorate.

As has been mentioned, the Central Directorate has to play the role of balancing out water supply and demand. The Central Directorate takes decisions about the distribution of water scarcity between the three O&M Directorates in case the supply available cannot match the demand.

One problem in this situation is that the information needed by the Central Directorate for water allocation cannot be provided adequately by the O&M Directorates. These are only in the position to estimate and predict about 80% of their demand. The information about remaining demand has to be provided by the O&M Directorates to the Central Directorate on the basis of the final cropping patterns (and subsequent water demand) throughout the season. However, this data cannot be obtained in a reliable manner, as mentioned above, since the O&M

directorates do not have the conditions (financial and human resources) to provide this kind of data. Consequently the final water requirements are *estimated* by the O&M-directorates and passed over to the Central Directorate. Since there are no particular governance mechanisms in place, another serious problem of information asymmetry creeps in and causes a common occurrence to service relationships: the problem of adverse selection (cf. Wolff and Huppert 2000).

In a situation of *adverse selection*, there are marked information asymmetries between service provider and client. This is coupled with highly unpredictable external influences. In conditions of Adverse Selection, the client is induced to make a sub-optimal choice about the most beneficial selection of a service provider . This is due to information asymmetries between the client and a number of applicants for the service provision contract. A particular applicant may exaggerate the quality of the product he/she will provide or overstate his/her potential performance capacity in order to win the contract against the competitors. In case he/she wins the contract but does not perform adequately later, he/she will be able to blame eventual under-performance to unforeseen external influences. Hence, the provider (or agent) cannot be held accountable for under-performance by the client (see Annex , Box 2; also Wolff and Huppert 2000). Unless particular governance mechanisms are in place that help counteract or minimize this problem, the client will have to bear the consequences of the underperformance.[6]

A problem of a similar sort may arise in JVA due to the information asymmetry between the O&M Directorates and the Central Directorate. We now consider the Central Directorate assuming the role of the client (the *Principal*) which expects to enter into a service relationship with the O&M Directorates (the *Agents*). The service to be provided by the Agents is the provision of accurate water demand information that allows the Central Directorate to make proper water allocation decisions.

However, from the point of view of the Central Directorate, the O&M Directorates may possess hidden information. For the Central Directorate it is impossible to judge whether or not an individual O&M Directorate plays a poker game and

[6] A well-known example of Adverse Selection from everyday life is the purchase of a used car. A certain car dealer may be able to praise the qualities of his car in a more convincing manner than his/her competitors. This may induce the buyer to engage in an adverse selection. He faces the risk that the dealer may dispose of hidden information about some technical defects, which he does not mention. These may be defects that cause problems only after the buyer has driven the car for hundreds of miles. It will then be difficult to hold the dealer accountable, since the dealer can point to unknown influences beyond his control that could have occurred in the meantime with any car.

intentionally overestimates the amount of water required (exceeding the amount justified by the cultivated area) in order to secure for itself a larger share. The Central Directorate does not have access to this "hidden information" and hence cannot be sure whether or not the information provided is correct or whether it has been manipulated for opportunistic reasons. According to Principle-Agent theory, such information manipulation ("influence activities") presents typical opportunities to engage in rent-seeking activities. The agent (an O&M Directorate) takes advantage of the lack of information on the side of the principle (the Central Directorate) to extract more than his fair share of water. The agent gives preferential treatment to an influential farmer and collects compensation from them.

Thus the Central Directorate may fall prey to the O&M Directorate, which can play this game best. It may engage in sub-optimal selection by giving priority in the allocation of scarce water resources to the O&M Directorate least in need. The Central Directorate (the Principal) has thus made an adverse selection of the Directorate (the Agent) to be served with the most water, relative to need. However, the O&M Directorate in question cannot be held accountable for such overestimations, since its financial and human resources are such that it can only predict about 80% of the demand accurately, while the rest has to be estimated. Such over-estimation can hence be said to be due to unpredictable external circumstances.

Here again, it is not the information asymmetry in itself which constitutes the problem, but the lack of an effective governance mechanism in this relationship, as was stated by the participants of the JVA round-table discussion. This allows such asymmetries to be used in ways that are not conducive to the efficient functioning of the system.

4.3 Water Delivery and the Operation of the Secondary System

Although the study originally should have focused on maintenance, it became apparent that it was necessary to take a look at the *operation* of the secondary system. This is because in the JVA maintenance problems are closely linked to operational deficits. Hence, this part of the study examines the operation of the secondary system.

4.3.1 Actors and Services

The actors involved in the operation of the secondary system are (1) O&M Directorates, (2) "stage" offices, (3) ditch riders, (4) pumping operators and (5) farmers. The objective

of service provision at this level is to ensure efficient water delivery through the secondary canals to farmers. The individual services required to reach this objective are the following:

S0: identify irrigable area and cropping pattern
(service provider: ditch riders, stage office),
S1: file irrigation orders (by farmers),
S2: aggregate irrigation orders and prepare irrigation schedule
(service provider: stage office),
S3: approve of schedule and monitor all activities
(service provider: O&M directorate),
S4: daily assignment of tasks to ditch riders
(service provider: stage office),
S5: technical orders to pump operator, monitoring of the system,
reports (service provider: O&M Directorate),
S6: information about timing of pump operation
(service provider: stage office),
S7: operate pumps (service provider: pump operators),
S8: open and close gates and report back to the stage office on problems
(service provider: ditch riders).

Since the adequacy and timeliness of water delivery to farmers was found to be one of the major management constraints in the whole system, the analysis has focused on the effectiveness of the existing governance mechanisms at this level.

These are discussed with respect to the following services (see Figure 5):

1. Services S2 and S3 (development and approval of schedule) and governance mechanism <1> between O&M Directorate and the stage offices;
2. Service S1 (filing for orders) and governance mechanism <4> between stage office and farmers;
3. Service S8 (opening and closing the FTA valves) and governance mechanisms <2> and <3> between stage offices and ditch riders, and between ditch riders and farmers.

4.3.2 Services S2 and S3: Allocation and Distribution of Water within the O&M Directorates

a) Services and Returns:

Service S2 consists of the preparation of the irrigation schedule. Service S3 amounts to the approval of this schedule at the level of the relevant O&M Directorate.

The stage offices process the incoming water demand and develop irrigation scheduling options that try to match supply expectations with projections of water requirements. As outlined above, such projections are supplied to the O&M Directorate on a monthly basis and are later refined with respect to the daily demand. On this basis daily allocation orders are issued by the Directorate.

b) Governance Mechanisms and Incentives:

The governance mechanism which is supposed to coordinate such service provisions (mechanism <1> in Fig. 5) consists of the authority delegated to the O&M Directorate to take allocation decisions on the basis of given supply and demand projections and of the hierarchical rules and procedures between the O&M Directorate and the Stage Offices.

However, this mechanism is embedded in a serious "cloud" of information intransparency. On the demand side, accurate information is dependent on the filing of orders by farmers (service S1). However, JVA has practically no means to ensure that the users file orders in a proper way. Unofficially, some influential farmers have access to water whenever they short-circuit the official management entity and ask for water from higher political authorities. This means that the rules and procedures that are supposed to govern the relationship between the Stage office and the farmers, i.e. governance mechanism <4>, are ineffective. Actually, it should be in the collective interest of the farmers to comply, but if at least some of them have unlimited access to water, then they don't see the need to file orders for it.

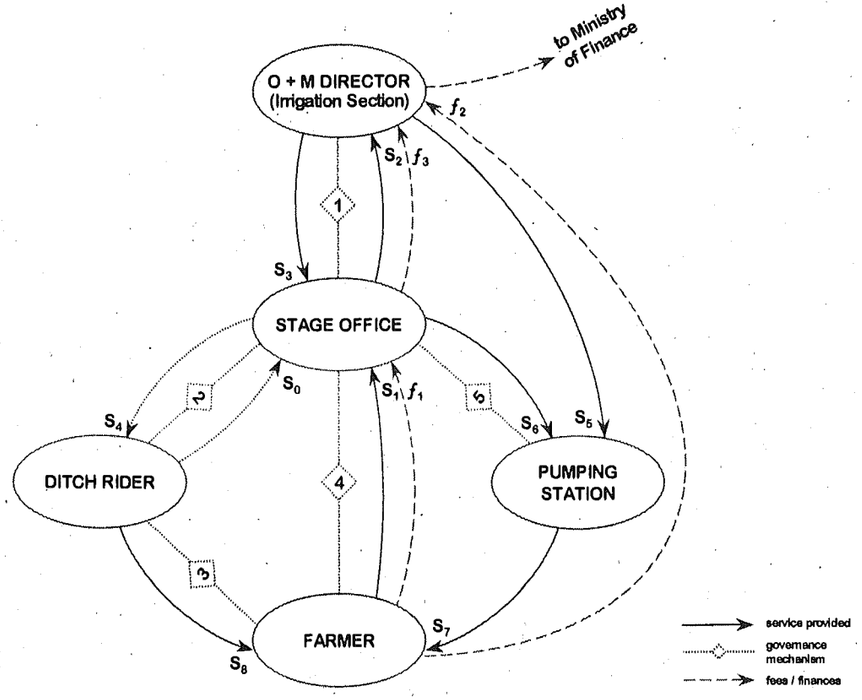
The functioning of governance mechanism <1> depends firstly on accurate information about the water that can be expected to be allocated by the Central Directorate. As has been mentioned above, this type of information is likely to be inaccurate and may be

subject to manipulation by the Central Directorate. Hence, the O&M Directorate can point to such unpredictable decisions of the Central Directorate and justify suboptimal allocation decisions to the Stage Office without being held accountable ('Moral Hazard' problem).

Secondly, governance mechanism <1> also depends on the identification of planned and actual irrigated area and cropping patterns. As has been explained in chapter 4.4.2 (a), this type of information is deficient due to the limited possibility of reliable data collection. Here again, information manipulation can be a problem. In fact, information asymmetries and related moral hazard problems may extend further down the hierarchy to the ditch-riders. Both the stage office and the ditch-riders face the temptation to use such hidden information to allocate water partially on a preferential basis, in order to extract side-payments (or "rents"). While it is difficult to establish to what extent this really happens in Jordan Valley irrigation, one has to be aware that a multi-level hierarchical system of coordination as it exists in JVA is chronically prone to such rent-seeking efforts. Information asymmetries exist and the corresponding governance mechanisms (in this case weak control capacities and sanctioning powers) are deficient or non-existent.

Even though formally the JVA Directorates possess the authority to sanction default, it is rarely applied in practice. Some sanctioning arrangements have been established in the past (especially the establishment of monitoring groups) but they have proved to be ineffective

Figure 5: Internal Service Provision for Water Allocation and Distribution (secondary system)



4.3.3 Service S8: Supplying Water to Farmers

a) *Services and Returns:*

Service S8, shown in Fig. 5, implies that the ditch riders are supposed to open and close the valves at the FTAs according to the approved schedule in order to deliver water to the different irrigation units.

The return, which farmers are supposed to provide, consists of reporting back on problems, filing of orders (S_1), and the payment of water charges (f_1, f_2).

b) *Governance Mechanisms and Incentives:*

The governance mechanisms in this case are vague. Clear water rights (rights that can be sued for, with respect to amounts and timing of water delivery) do not exist. Hence the only official governance mechanism is the authority delegated by JVA to the stage office and its ditchriders to supply water according to the irrigation schedules approved by the respective O&M Directorate. This official governance mechanism reveals a specific deficiency that is quite common in service relationships. If a customer has already undertaken substantial investments in a service relationship with a certain provider prior to a particular service provision, there is a risk that the provider may use this dependence in an opportunistic way to its advantage. This risk will be particularly high if it is combined with pronounced information asymmetries between both parties. But it also exists in circumstances where such asymmetries are non-existent. Deficiencies of this kind are called "hold-up" problems in Principle-Agent theory (cf. Wolff and Huppert 2000).[7]

Farmers asking for water in the Jordan Valley face a 'hold-up' problem of a particular type. They have invested in the on-farm irrigation infrastructure and most recently many have installed drip irrigation equipment. Moreover, before the onset of an irrigation season, farmers invest money and labor into land preparation as well as in the purchase of seeds and fertilizer. Thus they are heavily dependent on the service of water delivery for fear that they might risk loosing part of these investments. This risk has even increased with the introduction of drip irrigation methods. Weekly intervals of water application were sufficient in most parts of the Jordan Valley when surface irrigation was used. However, drip irrigation requires that small amounts of water be applied with shorter intervals on a timely and reliable basis.

The stage offices and ditch-riders who are supposed to ensure this water delivery face considerable constraints in doing so. First, the diverse cropping patterns in the Jordan Valley imply that a very complicated scheduling for the opening and closing of the valves at the FTAs needs to be followed. This proves to be difficult to follow due to the restricted number of staff available. Further, the unpredictability of the water supply requires ad-hoc allocation decisions in order to distribute an unforeseen water scarcity in an optimal manner. The fact that farmers do not have access to the information

[7] An everyday example of such a hold-up problem may arise when the owner of a house with distinctive architectural features asks the same architect to plan an extension of the building. The previous engagement with this architect (the "pre-investment") creates a dependence of the client on the service provider, the architect in question. This is so since it will be difficult for the house owner to find another architect who will be able and willing to plan and construct the extension in the same style as the original building. Unless particular governance mechanisms can prevent this, the owner faces the risk that the architect will use this dependence to his advantage and ask for unusually favorable terms in the subsequent contract.

related to such allocation decisions constitutes an information asymmetry and compounds the above-mentioned problem of dependence of farmers upon the water service provider. Many farmers who fear that they may loose their investments tend to suspect that the service provider intentionally withholds water delivery, so they try to take extra water whenever they need it. They destroy the FTAs and operate the valves at times when it is not their official turn.

The reaction of farmers to such situations (e.g. damaging of the FTAs) has serious consequences. Pressure distribution in the pipe system changes and when other farmers have their official turn for water withdrawal they cannot receive the water with the pressure needed to supply the intended discharge. This in turn undermines confidence in the reliability of the allocation system and introduces a dynamic that favors opportunistic behavior on both sides. Even though regulations exist to sanction water theft, the sanctioning powers are not strong enough. This is because some of those who break these regulations are politically too influential to abide by regulations set by JVA. Also, in view of a relatively insecure legal situation (see chapter 4.7), it would be quite unwise for a farmer to follow the legal process and go to court when he does not receive his fair share (especially if he is not very influential). This could mean that in the future he might be unofficially punished with minimum delivery of water.

On the other hand, farmers with strong political and/or economic influence may prefer this kind of situation to another situation with a more "efficient" water allocation between all farmers.

Under such circumstances, what is seen as a problem from the viewpoint of the functioning of the overall system may appear to be quite advantageous for some influential actors. Hence, it is likely that they will try to perpetuate this situation. In this way the problem (in this case the malfunctioning of the FTAs) is perpetuated because of malfunctioning service relationships and deficient governance mechanisms.

Once they become established, these kinds of principle-agent problems have the tendency to consolidate in a way that will be difficult to uproot. Since the key actors in such situations may benefit from profitable rent seeking opportunities, there may be little interest and commitment to change things in the general interest of improving the technical efficiency of water allocation. Hence, the information asymmetries and lack of information transparency combine with deficient or insufficient governance mechanisms to jeopardize well-intentioned efforts to improve water service delivery in the Jordan Valley.

4.4 Maintenance of the Secondary System and Pumping Stations

4.4.1 Actors and Services

The major actors involved in the maintenance of the secondary system and pumping stations are the same as mentioned above, with the exception that the Central Workshop plays an important role here.

The most important services are the following (Figure 6):

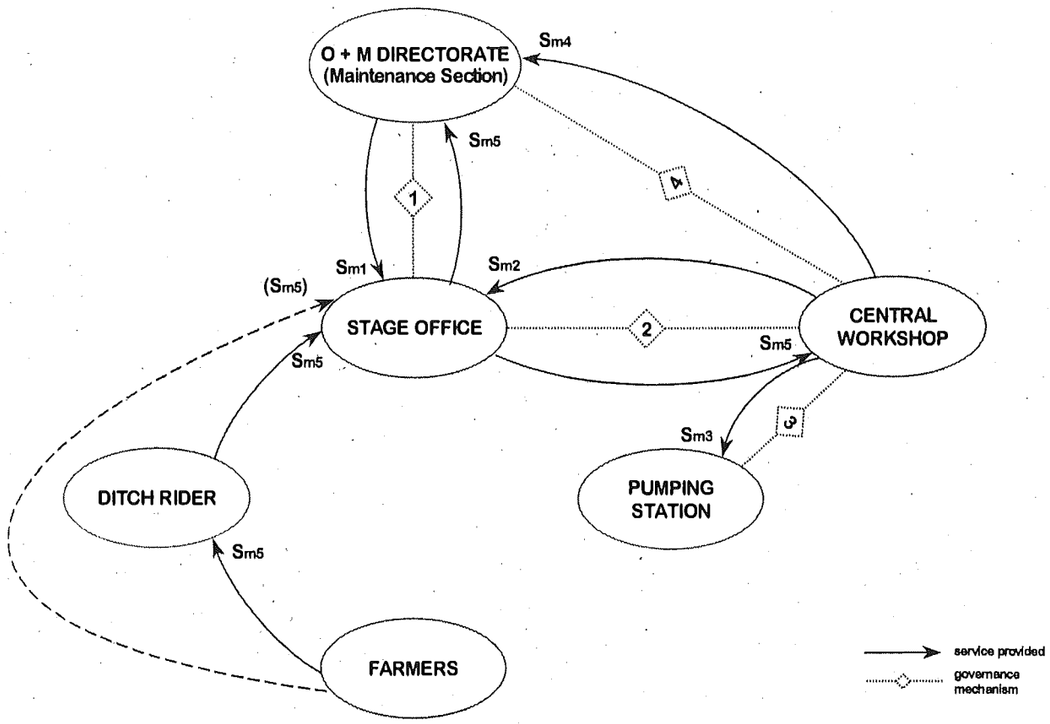
S_{m1}: Install new FTAs, repair clogged and broken pipes,
repair FTAs, reinstall water meters
(service provider: O&M Directorate, maintenance section)

S_{m2}: Calibrate and repair water meters
(service provider: Central Workshop)

S_{m3}: Routine maintenance of pumping stations
(Service Provider: Central Workshop)

Provision and governance of each of these services are discussed next.

Figure 6: Internal Service Provision for Maintenance (Secondary System)



4.4.2 Service S_{m1}: Maintenance of Secondary Water Delivery Infrastructure

a) *Services and Returns:*

The service S_{m1} is a JVA internal service provided by the maintenance sections of the O&M Directorates to the stage offices. It relates to the installation, maintenance and repair of the Farm Turnout Assemblies (FTAs) and to the repair of clogged and broken pipes in the secondary system. The term "maintenance" as used by JVA for the secondary system has the meaning of "corrective maintenance" in the sense that it is supposed to be triggered by insufficient or interrupted service delivery. The term 'repair' describes interventions to correct a partial failure or breakdown of a particular piece of infrastructure. 'Preventive maintenance' (meaning maintenance that is provided on a regular and predetermined basis to reduce the probability of infrastructural failures or

deterioration) is not part of the maintenance portfolio of JVA with respect to the secondary system.

An important precondition to assure the provision of corrective maintenance is a timely and reliable damage reporting system. Damage reporting can be perceived as a return to be provided by farmers to ditchriders or directly to the relevant stage office, after which the information should be transferred from the stage office to the related O&M Directorate (S_{m5}).

The other important return is the payment of user charges by the irrigation farmers. So far these charges have no real connection to the services provided, since the maintenance budget available is independent of the fees collected.

b) *Governance Mechanisms and Incentives:*

The official governance mechanism for maintenance of the secondary water delivery infrastructure is the authority delegated by JVA to the O&M Directorates to arrange maintenance on the basis of an established system for reporting maintenance needs. In Fig. 6 this governance mechanism is indicated as <1>.

As soon as a problem arises, the relevant information S_{m5} has to be reported to *either* the O&M Directorate (and its maintenance section) *or* to the Central Workshop in the case of problems with water meters that relate to the service S_{m2} (calibration and repair of water meters).

Unfortunately, the deficiencies in service relationships mentioned above for system operation also constitute a major influence on maintenance performance. The discussion in sub-section 4.3.3 has shown that there is no strong interest among farmers to repair and maintain FTAs. Lack of information about repair and maintenance needs helps to perpetuate this situation.

There is no systematic reporting system for the repair of clogged and broken pipes. Farmers' complaints and observations by ditch riders are the primary sources of information available. Timely repair of clogged and broken pipes is necessary in order for farmers to avoid failing to get their returns on pre-season investments due to insufficient or delayed water delivery. However, such dependency, in combination with the fact that maintenance services by the O&M Directorates are constrained by limited

staff and insufficient machinery, opens the door for potential hold-up strategies by the Directorates or lower level units. Maintenance services may be delayed or be provided on the basis of preferences, so the providers can potentially reap extra benefits from farmers who are able and willing to pay extra "speed money". Complaints by disadvantaged farmers can be answered by pointing to the capacity constraints of the maintenance service.

4.4.3 Service S_{m2}: Maintenance and Repair of Water Meters

a) *Services and Returns:*

Service S_{m2} (see Fig. 6), which is provided by the Central Workshop to the stage offices, consists of repair and calibration of broken or malfunctioning water meters. Here again, the reporting of breakdowns or damages (S_{m5}) is a 'return' that is needed by the service provider. In some cases, the services of repair and calibration of water meters are provided to the O&M Directorates (S_{m4}), and not to the stage offices directly.

A further return is supposed to consist of budget allocations from the O&M Directorate, allocations that, given the constant lack of resources in JVA, often tend to be diverted to more urgent uses in the system.

Another problem related to the provision of this service is that workshop personnel are not always qualified to do the required work. The workshop often does not install the kind of water meters needed for local conditions. High sediment content in the water damages meters that are designed for clear water.

b) *Governance Mechanisms and Incentives:*

The Central Workshop operates under the Directorate 'Workshop and Equipment' and hence is not in the line of hierarchy of the O&M Directorate (see Figure 3). The main governance mechanism for the service relationship between the Central Workshop and the Stage offices is therefore the responsibility given to the Workshop to maintain and repair water meters as requested by the stage offices governance mechanism <2> (in Figure 6). Additional hierarchical directives from one side to the other can only be applied indirectly by 'detour' through the O&M Directorate (governance mechanism <4>) and the Directorate 'Workshop and Equipment'.

However, it was observed that at the time of the discussions with JVA in this study, no such requests were pending. There was unanimous agreement among participants that all efforts to bring about continuous maintenance and repair of the water meters would be to no avail. In fact, JVA had already abandoned its water meter repair efforts. The general impression was that none of the concerned actors had a genuine interest in having the water meters in working condition.

This state of affairs confirms the principal-agent analysis discussed above. First, the water meters are property of the JVA and even if sanctions are imposed for damaging meters, it would be difficult for JVA staff to trace the culprits and prove that damages were not due to other causes.

Most importantly, however, deficiencies in the service relationships creates an incentive system that makes maintenance and repair of water meters run counter to the real interests of most of the actors involved.

Since they do not depend on revenue from metered charges, the O&M Directorates have no pronounced interest, to have the meters repaired. Therefore, also the ditch-riders, stage offices and higher-level units of the JVA are apparently not highly interested in having accurate data available on quantities of water actually delivered, even if they want to provide a "good" service to farmers. Instead, temptations arise, to exploit the intransparency of information in order to provoke principle-agent problems described above and allow the possibility for rent seeking to emerge.

Farmers themselves have little incentive to have their water withdrawals recorded accurately:

- Farmers who receive or expect preferential water delivery will have little interest to see these informal deliveries noticed and billed.
- Farmers who feel they are subject to hold-up attempts by stage offices or ditchriders will want to be able to manipulate the FTA's, to compensate for their losses due to the hold-up situation. Hence they will prefer to have non-functioning water meters.
- As is often the case elsewhere in the world, farmers tend to prefer to see non-functioning water meters in the hope of being charged less than the amount they actually owe for the quantities of water withdrawn.

Unless the governance of water allocation and distribution, and the related incentive structures are changed, there will be little chance of seeing functioning water meters in the Jordan Valley irrigation system.

4.4.4 Service S_{m3}: Maintenance of Pumping Stations

a) *Services and Returns:*

The maintenance of pumping stations (service S_{m3} in Figure 6), mainly involves repairs after failures of the pump and the replacement of pumps and spare parts that have surpassed their functional lifespan.

Discussions with JVA staff during this study revealed that limited technical qualifications of staff sometimes hinder effective service provision. The diverse origin of the manufacture of pumps and spare parts seriously hampers efforts to provide high quality maintenance and repair work. Nevertheless, it was stated that the routine functions of repair and replacement of parts at pumping stations was generally provided in an acceptable manner.

As mentioned above, preventive maintenance in accordance with a predetermined time schedule for maintenance tasks is not done.

Returns for pump maintenance consist of reports on maintenance and repair needs and budget allocations by the O&M Directorate. Given the crucial importance of pumping operation to the functioning of water delivery in the secondary system, both returns, without being satisfactory, are provided in a better way than those for the other parts of the secondary system.

b) *Governance Mechanisms and Incentives:*

The main governance mechanism is the responsibility and authority given by the Ministry to the Central Workshop to take over maintenance of the pumping stations (governance mechanism <3> in Figure 6). The major monitoring and control mechanisms for this service are complaints by farmers in case of pump breakdowns.

The fact that no preventive maintenance is provided (which is similar to other irrigation systems all over the world) can be interpreted as a typical case of deficient governance mechanisms and information asymmetry, with the resulting structure of management disincentives:

If the Ministry of Finance makes funds available for preventive maintenance it will have difficulty to control whether such funds are used for that purpose or whether they have been diverted to other "more urgent" tasks. The information asymmetry between the unit which would ask for preventive maintenance (the customer or Principal) and the unit providing this internal service (the service provider or Agent) repeats itself through the multi-layer hierarchical structure. Again and again the superior level decision makers will have high control costs to make sure that the next lower level commits itself to preventive maintenance. Under circumstances where funds are chronically scarce, as is the case in JVA, incentives are unfavourable for provision of effective preventive maintenance services.

4.5 Financing Operation and Maintenance Services

Discussing governance mechanisms for water allocation, water delivery and maintenance of irrigation systems in the Jordan Valley means looking for ways to ensure efficient and sustainable exchange relationships in the multi-actor service delivery system. Financing of such services constitutes the key return and hence is the "engine" for adequate service provision.

Cost recovery for the supply of irrigation water in the Valley amounts to only about 50% of the O&M costs for irrigation. An increase of the water charge has been continuously demanded by various international organisations, but has been implemented only reluctantly, mainly apparently for political reasons.

The total cost for government of the irrigation system in the Jordan Valley, in terms of O&M plus capital costs, amounted in 1997 to approximately 10.4 million JD (Sara 1998).

Water tariffs have been at a low level of 0.003 JD/m^3 till May 1990. Today they are at 0.015 JD/m^3. In order to achieve full cost recovery this level should be to be raised to 0.045 JD/m^3 (Soer 1998).

The *level* of the water charge has been subject to constant debate in recent years, the hope being that increased levels of water charges will per se bring about increased efficiency of water use in the Jordan Valley. The institutional aspect of financing has been touched upon less frequently.

One of the basic principles of any sustainable or long lasting service relationship is that the relationship contains a closed feedback loop between services and returns (or finances) for each service. In case such a closed feedback loop does not exist (i.e. where services are provided but not compensated for) the chances that this service can be provided reliably in the long run are dim or will depend on external financial inputs to cover the costs for the service in question. This is why Small and Curruthers make the important distinction between "irrigation financing" and "irrigation cost recovery". Irrigation financing "is the generation of funds that are specifically used to pay for the costs of providing irrigation services." Cost recovery, on the other hand, "refers to the funds that flow into public agencies as a result of irrigation, regardless of whether or not these funds are used to pay for the costs of providing the irrigation services." (Small and Curruthers 1991).

Taking into account this distinction, we conclude that some cost recovery exists in the Jordan Valley, but there is actually no *financing* of irrigation services. User charges for the services provided go to the Ministry of Finance and into the general government revenues rather than being used as a 'quid pro quo' for services actually provided by JVA. Doing so, an important governance mechanism that could help to make the overall service delivery system function in an effective way is foregone. Since there is no direct connection between the services provided and the budget allocated, the incentive-creating potential of irrigation financing from water charges, as compared to cost recovery, remains untapped. Hence, the kind of cost recovery actually in use does not function as a governance mechanism that can help steer the delivery system towards an efficient O&M service provision.

4.6The Problem of Hierarchical 'Short-circuiting'

Service delivery in Jordan Valley irrigation is provided through the multi-layered hierarchical structure of the JVA organization. The governance mechanisms in place between the different levels may be diverse but all are designed to be subject to hierarchical decision making. The higher level defines the objectives and the internal

services to be provided by lower levels. They also allocate the financial means needed and monitor progress. Broadly speaking, the lower level is supposed to provide the internal services asked for (or delegate their provision to an even lower level) and report as to the state of their completion. Such a multi-level hierarchical system is critically dependent upon a functioning system of responsibility and accountability. Each actor needs to have a clear perception of the task or service to be performed, of the level of performance expected, of the authority given to achieve this level and of the person or unit to which he/she is accountable when doing so (Organisational theory holds that there needs to be a congruence of tasks, authority and responsibility). The system starts to crumble once the kind and scope of the task or service, the responsibility and the accountability become vague and subject to interpretations. Such is actually the case in JVA.

In section 2.3 a rough sketch of the land tenure situation in the Jordan Valley was given. This description indicates that there are large de facto differences in land holding sizes. These differences are compounded by substantial discrepancies in political influence of different stakeholders. Some landowners that hold property in the Jordan Valley belong to a highly influential elite with direct access to decision makers at the highest levels of government, and even to the King. For such high level politicians, these "farmers" are an important constituency whose loyalty is of eminent importance to them. Hence it is a common experience for JVA staff, whatever their position, that influential farmers ask high level decision makers to ensure that particular services of water delivery, repair or other works are provided quickly. Often, such services are not foreseen in JVA planning. Orders are then given "from high above", or even directly by some farmers to certain operational levels, without respecting the decision making authority and responsibility of the unit in charge of such operations.

Such "short-circuiting" of the official hierarchy has a tendency to upset the incentives and motivation of staff at different levels. Lower levels complain about ad-hoc changes in their work program and higher levels get upset about 'unauthorized' deviations by their staff from preset working schedules. Internal service relationships are negatively affected, mutual distrust emerges and internal governance mechanisms, however well established, lose their effectiveness. In this case, the political objective of securing the loyalty of an influential constituency collides with the objective of providing efficient irrigation services by the JVA. This politicization of irrigation service provision in the Jordan Valley imposes overwhelming deficiencies in governance mechanisms.

4.7 Legal Insecurity

A factor with enormous consequences for the functioning of service relationships in the water delivery system of the Jordan Valley is the low level of legal security. Legal security and the availability of an impartial legal body are important "secondary" governance mechanisms that make service relationships function. In the Jordan Valley legal security for service providers (JVA staff) and clients (farmers) is low - unless one can appeal for help to high levels of political power.

If JVA staff tries to sanction unauthorized water withdrawal and shut off water delivery, they will not be able to do so if this withdrawal is done by or for an influential farmer. Applying a sanction or fine for illegal water extraction seems impossible under current circumstances. Hence, illegal offtakes abound in the Jordan Valley. On the other hand, if small farmers try to sue JVA staff for preferential allocation of water to large farmers, they run the risk of incurring service 'hold-up' activities in the future.

There is no strong and impartial legal body that can apply sanctions irrespective of the economic and political status of the offender. This places severe constraints on governance of the service delivery system for irrigation in the Jordan Valley.

5. Improving the Service Delivery System for Water Allocation and Maintenance in Jordan Valley Irrigation

5.1 General

The discussion so far has underlined the crucial role of service relationships and of governance mechanisms that make them function. Improving the service delivery system of water allocation, water delivery and maintenance in the Jordan Valley will therefore require, above all, a reform of these institutional relationships.

The *absence of financial autonomy* for the JVA plays an important role in this respect. If the JVA has no connection between services provided and the corresponding financial 'return services' needed to cover the costs (or at least a substantial part thereof) for such services, the highly distorted internal incentive structure in JVA will be difficult to correct.

The undermining of the management authority of JVA staff at different levels through the 'shortcircuiting' of decision-making is another main constraint. One has to be aware that politicization of the service delivery system inevitably has serious negative effects on the overall economic and technical efficiency of the system. With increasing water scarcity, *it seems inevitable that the trade-off between the political costs of impeding such a 'short-circuiting' and the costs of economic and technical inefficiencies caused by it will have to be dealt with straight on as a high priority.*

Last but not least is *legal insecurity.* This will continue to have a negative impact no matter what other institutional changes may be introduced in the future. Given the large differences in economic and political status of landowners, recent attempts to devolve decision making for water allocation at the secondary level to the farmers may not yield the desirable results. Nevertheless, it seems to be unavoidable that JVA should try to establish new organizational procedures and local conflict resolution mechanisms among farmers to complement and support the existing legal system.

However, the following recommendations about service relationships in water allocation and maintenance in the Jordan Valley cannot be seen in isolation. Their interlinkages

with the general institutional context must be taken into account. Hence, long lasting positive impacts of recommended reforms can only be expected if they are coupled with improvements in these 'external' political and legal conditions. On the other hand, efforts to bring about improved service relationships using the methodology proposed in this study can also be an important contribution to the process of striving for changes in the overall institutional setup in which JVA has to operate.

5.2 Improving Service Relationships in Jordan Valley Irrigation – the Process

It will be difficult for outsiders to propose the 'proper' ways in which improvements are to be achieved. In a multi-actor service system where different interests need to be coordinated, improvements can only be brought about through discussion and negotiation between different stakeholders. However, such negotiations and change processes can be supported by a methodology, which, if based on the approaches used in this study, can help answer the question whether or not viable service relationships can be expected. Hence, whatever organizational setup is chosen in the future, as long as service relationships are not well coordinated and governance mechanisms are not functional, effective and efficient O&M cannot be expected to emerge.

The main recommendation of this study is that the JVA should enter into in-depth discussions with representatives of all key stakeholders about how to improve the existing service relationships, based on an analysis of institutional problems similar to the one presented in this study. Proposals for organizational changes should be based on assessment of who are the key actors involved, about the primary services, internal services and the returns to be provided and the service relationships and governance mechanisms needed to make the delivery system function as agreed in a consensus among stakeholders.

This process may involve the following steps:

1. *Identification of services and supporting services to be provided.*

   A methodology similar to that used in the workshop on "Service Interaction Analysis", held at JVA, can be followed.

2. *Identification of critical services that are not supplied in a satisfactory manner.*

   Here, "strength and weakness profiles" may be used, rating the different services or supporting services according to the perceived performance level (see Huppert and Urban 1998).

3. *Identification of the actors involved in the provision of each service in question.*

   The graphical representation of the "landscape of the actors", as demonstrated in the figures in this paper may be of help.

4. *Analysis of service relationships between actors.*

   This analysis should answer in details the following questions:

   - What makes up the exchange relationship? Or: What is the service provided and what is the return or compensation for this service, that makes the relationship function in the long run?
   - There are three key questions from the perspective of the client: (1) In a worst case scenario, What may be the hidden self-interests of the service provider that might induce it to take actions that deviate from the official service provision? (2) What new incentives may minimize such deviant behavior by the provider? and (3) What new governance mechanisms could induce the provider to deliver the expected service?
   - From the perspective of the provider, one may ask three other questions: (1) What may be the hidden self-interests of the client to exploit the service relationship to his/her advantage or to avoid paying the expected return? (2) What new incentives might minimize such opportunistic behavior? and (3) What new governance mechanisms could be introduced into the situation to induce the client to act in the way expected by the provider (and agreed by both parties)?

Working through all the bi-polar service relationships in the given multi-actor network will then reveal whether or not an effective service provision can be expected and if not, where the major constraints are located.

A process of systematic analysis and development of governance mechanisms has rarely been followed in the irrigation sector so far. Yet it has the advantage that it can be done in a participatory and transparent way through discussions and negotiation between all relevant stakeholders. The method for finding solutions to problems in service relationships will mainly be similar to such a negotiation process. Use of expert consultants to provide assistance about the range of potential governance mechanisms that might be adequate in a given situation may help facilitate such a process.

The following recommendations should only be taken as rough indications about the direction in which discussions and negotiations might evolve.

5.3 Towards a Solution of Principal-Agent-Problems

5.3.1 Practical Orientations for JVA

Table 1 in the Annex summarizes the different types of principle-agent problems, which may arise in service relationships and presents recommendations for their solution. These are further explained in the Annex. The following are six guiding principles for applying principle-agent analysis in a participatory process to improve management of O&M of the JVA, or other irrigation agency.

a) A first point of concern should be the technical system of water supply and distribution in the secondary system. As it is operated at the moment, the system seems to be far too complicated and opens the door to information asymmetries at different levels. The attempt to estimate water demand of crops under conditions of widely varying cropping patterns and continuously changing crop water requirements throughout the season may be justified under a condition of ample water availability and of high data collection and processing capacities. With limited staff available at JVA and with increasing water shortages, ways have to be found to base water allocation on simpler, even if cruder, ways to determine water demand. Ongoing discussions in JVA to introduce simpler systems of "block demands" for particular user groups and using simplified demand calculations (such as not distinguishing between fruit trees and vegetables) should be further pursued. A major challenge for JVA is to make the basis for water demand more transparent for the major actors involved. Such a step is crucial in order to overcome information asymmetries and their effects.

b) A simplified system of demand projections and supply determination may have potential to improve *transparency and credibility between the O&M Directorates*. It may help eliminate the problem of 'adverse selection' faced by the Central Directorate in its attempt to distribute scarce water resources in an equitable way.

c) A simplified system of demand projections and supply determination may solve the problem of inconsistent filing of orders by the farmers. *Allocation may then be made*

on a simplified basis, such as on the basis of pre-established wholesale amounts for a particular group of farmers, such that individual filings may no longer be needed.

d) The risk faced by the O&M-Directorates to receive intentionally a suboptimal service provision when they are confronted with the allocation decisions by the Central Directorate ('Moral Hazard', see chapter 4.2.2) may be overcome with a *'team-approach'*: If supply and demand information is not only available to the Central Directorate alone, but if it is shared between the Central Directorate and the O&M-Directorates, the 'Moral Hazard' dilemma may be overcome.

e) Farmers tend to perceive that they face a high risk of not receiving their fair share of water, while having incurred high costs for land preparation and purchase of agricultural inputs. This leads to repeated destruction of Farm Turnout Assemblies. A solution to this may be sought in two different ways.

- One approach to a solution is *'vertical integration'*. This is where the client and the service provider are brought together under one organizational 'roof' so that their interests coincide. In the case of water allocation at the FTAs, this may be achieved through 'wholesale' supply of water to groups of farmers. Farmer groups will receive water allocations. But they will have to distribute water amongst themselves and may thus be more inclined to want to have functional FTAs in order to ensure equitable distribution of water and water charges.

- A second solution to hold-up problems as proposed by Principal-Agent theory, is *the so-called 'taking of hostages'*. The Agent hands over some kind of security to the Principal as a guarantee that he will provide the service as foreseen. Here again, possible options have to be adapted to local conditions. For example, a voucher system could be followed whereby farmers receive vouchers in advance for planned water delivery turns. They would hand over a voucher to the ditch-rider only when deliveries have been done in a correct way. The salary (or premium) of the ditch-riders will then be based on the number of vouchers they receive from the farmers as proof of effective implementation of water delivery.

f) The problem of disfunctional water meters depends primarily on the question of whether or not existing incentive systems can be *altered in such a way that major actors have a genuine interest in having volumetric water measurement take place*.

- A 'whole sale approach' to supplying water to user groups may help solve this problem. There is only one water meter at the off-take for the group. This water meter may become the property of the group. A group with a non-functional meter may then not be supplied at all or be charged a higher price in case the

withdrawal has to be estimated ex post (depending on the particular sanction adopted).

- Such an approach may also be chosen in the case of individual FTAs if the JVA has sufficient authority to apply such sanctioning powers.

In general, however, financial autonomy for JVA with its resulting incentives to collect water fees, appears to be the best way toward incentive creation in this respect.

5.3.2 Legal Framework

As has been noted, there is little power to apply sanctions against economically and politically influential farmers. The system operates under conditions of high legal insecurity. This limits the possibility to improve irrigation management in the Jordan Valley. Since governance mechanisms (laws, rules, regulations, contracts etc.) are highly dependent on enforcement capacity, *efforts to improve the legal environment will be of prime importance* and may be more cost-effective than technically-oriented attempts to improve irrigation performance.

6. Conclusion

Looking at the complex service delivery system for water allocation and maintenance in the Jordan Valley irrigation system, one might ask: Should this service delivery system really be "improved"? Or: Should it be changed in a way that irrigation efficiencies increase? At first glance, this seems like a rhetorical question. The need for such improvements appears to be obvious, given increasing water scarcities and given low irrigation and distribution efficiencies that prevail throughout the system. However, irrigation systems cannot be regarded exclusively as technical systems but need to be seen as *socio*-technical systems. This is to say that people use such systems to achieve certain goals and pursue certain interests. The level of *socio-economic* efficiency achieved (as compared to a purely technical or economic efficiency) will thus depend on the extent to which major actors can achieve their individual goals and satisfy their personal incentives ("incentive compatibility").

The spectrum of goals and interests that has to be somehow satisfied by JVA is wide, even if one restricts the focus to the 'services' of water allocation, water delivery and maintenance. Among these various purposes the following will be predominant:

- Allocating and delivering water to irrigation farmers in the Jordan Valley in the most efficient way possible, thereby satisfying crop related water demands of different farms.
- Distributing water scarcity, meaning confining demand-based water allocations to different farms in a way that takes into account increasingly restricted water availabilities and growing needs for domestic water use in Amman ('balancing out' supplies and demand).
- Serving the group of politically influential farmers in the Jordan Valley, so that this constituency does not feel negatively effected or disadvantaged in any way.

The achievement of these objectives is supposed to be reached:

- with a large body of grossly underpaid – and hence poorly motivated – staff
- with a multi-layered hierarchical structure with restricted responsibility and accountability at different management levels
- without an autonomous system of service-related financing
- in an environment of high legal insecurity.

It is obvious that such a set of goals will be difficult to achieve under the given circumstances while at the same time maximizing technical and/or economic efficiencies of water allocation. In contrast, it may well be, that, given the conflicting goal orientations and the mentioned constraints, the existing system operates on a level of optimal socio-economic efficiency and incentive compatibility. In other words, the above discussed information asymmetries and governance deficiencies may help to provide rent-seeking possibilities to poorly paid JVA staff, may help to distribute water scarcity in an environment of low legal security, may help to give preferential treatment to influential landowners, and may help to achieve all of this with a minimum risk for the responsible professionals to be held accountable. At the same time, the system maintains a level of irrigation efficiency that is just high enough to avoid substantial farmer discontent.

However, the dynamics of increasing water scarcity and the professional insight of progressive JVA decision makers may soon upset this balance. This is why JVA may be well advised to continue its initiatives for successive system changes. The government may establish and involve water user groups and outsource some functions to them. It may provide financial autonomy to JVA. It could provide a well-defined performance contract to the JVA or make further steps toward privatization. Whatever approaches are pursued, it is apparent that there will be no substantial improvements in the functioning of the multi-actor system of irrigation water provision in the Jordan Valley until more effective governance mechanisms are established. We hope that the methodology used in this study will serve as a starting point for the analysis and design of future proposals for change.

References

Al-Kloub, B. and M. F. Abu-Taleb 1998: Application of Multicriteria Decision Aid to Rank the Jordan-Yarmouk Basin Co-riperians According to the Helsinki and ILC Rules. In: Water International, No. 23, pp.164-173.

GITEC/CEC 1993: 'Study for the Recovery of Operation and Maintenance Costs of Irrigation Water in Jordan', GITEC-Consult and Consulting Engineering Center (CEC). Düsseldorf/Amman.

Hashemite Kingdom of Jordan, October 1997: Water Sector Review, 2 Vols. Amman.

Herder-Dorneich, Philipp 1986: Theorie der sozialen Steuerung – Die Theorie der Scheine. Nomos Verlagsgesellschaft, Baden-Baden, Germany.

Huppert, W. and K. Urban 1998: Analysing Service Provision. Instruments vor Development Cooperation illustrated by examples from Irrigation. Schriftenreihe der GTZ, No. 263. Universum Verlagsanstalt, Wiesbaden, Germany.

Huppert, W. and K. Urban 1994: Service Analysis in Irrigation Development. In: Quarterly Journal for International Agriculture, Vol. 33, No. 3, July-September 1994.

IWMI 1998: World Water Demand and Supply. Research Report No. 19. Colombo, Sri Lanka.

JVA 1995: Water Management Information System. Pilot Evaluation Report, ERNO/ GERSAR-SCP/SMS, December 1995. Amman.

Libizewski, Stephan, March 1997: Integrating high and low politics: Lessons from Israeli-Jordanian Water Regimes. Water International, Vol. 22, No. 1, pp. 6-15.

Sara, Yaser 1998 : Service Interaction Analysis. Phase One: Organizational chart and Major Responsibilities of Units of the Operation and Maintenance Directorates in the Jordan Valley, Commissioned by the "Deutsche Gesellschaft für Technische Zusammenarbeit" (GTZ). Amman.

Salameh, Elias 1996: Water Quality Degradation in Jordan. Impacts on Environment, Economy, and Future Generations Resources Base. "Friedrich-Ebert-Stiftung" and the Royal Society for the Conservation of Nature. Amman.

Shatanawi, Muhammed R. 1994: Irrigation Management and Water Quality in the Central Jordan Valley: Winter Cropping Season. Jordan Valley Authority.

Shatanawi, Muhammad R. and Odeh Al-Jayousi 1995: Evaluating Market-Oriented Water Policies in Jordan: A Comparative Study. Water International, No. 20, pp.88-97.

Small, Leslie E. and Ian Carruthers 1991: Farmer-Managed Irrigation. Cambridge University Press.

Soer, Gert, December 1998: Study on Strategical Aspects of Irrigation Water Management in the Jordan Valley. JVA/GTZ.

Wolff, Birgitta and W. Huppert 2000: Governance by Contractual Rules. Improving Service Relations in Irrigation. Maintain Thematic Paper No. 10.

Annex

Principal-Agent Problems and Approaches to Solutions According to Theory

1. Description of Major 'Principle-Agent' Problems

The following boxes provide a more detailed description of the major 'Principle-Agent' problems than has been given in the preceding text of the study. Reference again is made to Wolff and Huppert 2000.

Box 1:
'Moral Hazard' and 'Hidden Information': Inherent Problems in Service Relationships

'Principal-Agent theory' provides insights into problems that can emerge in situations where two or more actors are involved in an employer-employee, an employer-contractor, or a service provider-client relationship. One such problem may arise when the client (the Principal) cannot fully control the actions of the service provider (the Agent). This happens especially when these actions are subject to various unpredictable external influences, which also cannot be fully known by the client. A suboptimal service may be provided due to such external influences, even though the provider makes all efforts needed to fulfill the client's expectations. However, failures in service provision may also be due to opportunistic behaviour of the provider who may reduce his efforts of service provision and use the relationship to further other 'private', often remunerative, interests. The risk is serious for the client, since it is only the provider who knows about his/her real inputs and about the real impact of external influences on service provision. From the point of view of the client, the provider possesses hidden information. With this information asymmetry between the customer and the provider, the customer will have difficulties to judge the performance of the provider. The service provider cannot be held accountable for any suboptimal service, since he/she will always be able to argue that this was due to circumstances beyond its control.

Box 2:
'Adverse Selection': The Problem of Choosing the Right Supply Alternative

The problem of 'Adverse Selection', as described by Principal-Agent theory is a problem related to information asymmetries that exists *prior to* the making of a service agreement, or, more broadly, a service relationship. The employer or client (the Principal) does not have access to sufficient information to be able to judge the true preferences of the potential contractor or the service provider that applies for a contract (the Agent). This situation may be a temptation for the potential provider to play a 'poker game'. He or she may try to present the potential benefits of the relationship to the customer in an overly optimistic way. Such a temptation will be particularly strong in circumstances where a lower-than-expected service result may be caused by external influences that are outside of the control of the Agent. Excuses for future under-performance will be easily at hand.

Box 3:
'Hold-up', a Particular Deficiency in Service Relationships

'Hold-up' problems arise in service relationships in which the potential service recipient has engaged in prior, significant investments in view of the service to be expected. In such situations, the potential recipient is heavily dependent upon service delivery and on the service provider. In case the client (the principal) does not receive the expected service, all his investment might be in vain. The danger exists that such a unilateral dependency may be exploited by the service provider in order to extract particular favours ('sidepayments') from the client. This danger is particularly high if strong information asymmetries exist between supplier and recipient and if external conditions beyond the influence of the provider may cause high uncertainty about the level of service that will be provided. The provider can then blame these conditions as an excuse in case of non-delivery or sub-optimal provision of a service.

Orientations for Solutions as Proposed by Theory (cf. Wolff and Huppert 1999)

Attempts to improve service relationships that by solving Principle-Agent problems generally take two directions. First, they either try to minimize the existing information asymmetry or they strive to bring about a coincidence of interests between the principal and agent through changes in the incentive systems. In most cases attempts to minimise information asymmetries will entail high monitoring costs. In many situations such attempts may upset existing divisions of labour and responsibilities and hence create greater inefficiencies. Changing incentive systems such that they bring about adjustment or coincidence of interests may also result in substantial costs. The basic idea of incentives in service delivery systems is to reward providers in direct relation to their contribution to the service provision process so that it is in their personal interest to make improvements in service provision. This is why a full or partial financial autonomy seems to be of prime importance. The question then is to find governance mechanisms that bring about motivation for the provider to "search for excellence" in service provision.

Basic Principles for the Solution of Principle-Agent Problems

> "The Principal can try to prevent the Agent from deviating from the Principal's interests and intentions through the creation of incentives for the Agent and by investing in control costs, trying to minimise "diverging" actions of the Agent. Moreover, in some situations it may be good tactics from the point of view of the Agent, to offer a security as proof that he/she will not engage in actions that may be to the detriment of the Principal...In most Principal-Agent-relationships both the Principal and the Agent will invest in control costs and warranties (in both pecuniary and non-pecuniary form). In all cases however, there will remain certain deviations between the decisions of the agent and the decisions that would maximise the benefits for the Principal" (Jensen and Meckling, 1976, p.308, cited in Richter and Furubotn, translation by the authors).

Origins and orientations for possible solutions with respect to Principle-Agent-Problems are summarised in Table 1.

Table 1 : Types of Principle-Agent Problems and Solutions in Service Relationships

(adapted from Wolff and Huppert 2000)

	'Adverse Selection'	'Moral Hazard'	'Hold up'
Type of Problem	Risk of a suboptimal selection of a service provider/Agent by the client /Principal	Risk of insufficient service provision due to opportunistic behaviour of the provider / Agent, who, however, cannot be held accountable	Particularly strong risk of 'Moral Hazard' due to pre-service investments incurred by the client / Principal and resulting crucial dependence of the client from the service provision
Origin of Problem	Information Asymmetry	Information Asymmetry	Information Asymmetry coupled with one-sided dependency caused by specific pre-service investments
Causes behind Information Asymmetry	Qualification of service provider / Agent and quality of service provision not known	Detailed activities of provider / Agent and external influences on these activities not known	Detailed activities of provider / Agent and external influences on these activities not known
Time when Problem is Acute	ex ante	ex post	ex post
Theoretical Approaches to Problem Solution	Create/improve selection mechanism	Create/improve incentive systems that counteract 'Moral Hazard'	Vertical integration or creation of mutual dependencies
Examples	- 'Signaling' or exposing proof of qualifications or information on service delivery	- Improve return/ compensation for service delivery - Team building - Manipulation of 'Outside Options'	- Create joint property of resources for agent and principal - 'Exchange of hostages' or handing over security to Principal

According to Principal-Agent theory the major paths for solutions to problems in service relationships are elaborated below.

1. *'Adverse Selection': This is the risk of sub-optimal selection of a service provider by the client due to information asymmetries.*
   - 'Signaling' Activities
     To avoid 'adverse selection' of a service provider (Agent) on the side of the client (Principal), the provider may try to engage in 'signaling' activities. He/she can try to provide proof of his/her ability to provide a service or may try to make the quality of his/her service provision transparent to the client
   - 'Screening Mechanisms'
     While the costs of 'signaling' activities are borne by the Agent, the Principal may proceed to collect information on the qualifications or service provision capacities of the Agent. He/she may do this using so-called Screening-Mechanisms. He/she may look for references from third persons, carry out tests or indulge in other information collection activities.

2. *'Moral Hazard': This is the risk of insufficient service provision due to opportunistic behaviour by the provider, who however cannot be held accountable by the client.*
   - 'Performance Compensation'
     In this case the client/Principal tries to couple the level of returns/compensations for the service to verifiable indicators or other facts that can be influenced by the provider/Agent. One way may be to agree upon individual performance levels, as is the case with approaches to 'Management by Objectives'.
   - 'Tailoring' the scope of the service to be provided
     In cases where a provider/Agent is supposed to provide several services that make use of the same pool of resources, he/she may be tempted to find excuses for a sub-optimal level of service provision by pointing to problems with the provision of another service. He also may have an interest in diverting resources from the provision of one service to that of another. This can be counteracted by 'tailoring' well-defined service orders and allocating corresponding budgets to them.

   - 'Team-Building'
     Information asymmetry may be avoided through team-building efforts where team members each have an interest in preventing 'moral hazard' actions by others. Social pressure and control can thus bring about an efficient provision of service.
   - 'Decentralisation of Ownership'
     The idea here is, that in cases where a local actor is the owner of certain resources, he/she may treat these resources with more care than he/she would do otherwise. Hence, one may try to transfer certain critical resources to the ownership of this actor.
   - 'Efficiency Pricing'
     In cases where a client (Principal) can get a hold of services on the basis of agreements for returns that do not reflect the scarcity situation for the respective service, he/she will tend to waste scarce resources. Hence 'efficiency prizing' is needed to prevent such 'Moral Hazard' problems.
   - Manipulation of 'Outside Options'
     In this case, the client/Principal tries to squarely stop undesirable 'side-actions' by the provider/Agent that may have an effect on the service in question.

3. *'Hold-Up' Problem: This is when there is a particularly high risk of 'moral hazard' due to pre-service investments incurred by the client and resulting dependence by the client on the service provider.*
   - 'Joint ownership of resources'
     The dependence of the client/Principal upon the agent may be avoided through the creation of joint ownership of resources. Thus, both partners will be mutually dependant on a functioning service provision (see section 4.4.2).
   - 'Exchange of hostages'
     The provider/Agent may hand over some kind of security to the client/Principal to convince him/her of his good intentions and to transfer the unilateral dependency into a mutual one.