Participatory water management and cultural heritage in Palestine: the case studies of Al-Muruj scheme and Al-Auja spring

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PARTICIPATORY WATER MANAGEMENT AND CULTURAL HERITAGE IN PALESTINE: THE CASE STUDIES OF AL-MURUJ SCHEME AND AL-AUJA SPRING

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SUMMARY – This paper exhibits two models of participatory irrigation management at two different scales. The first model is about Participatory Water Management in Small Groundwater Irrigation Scheme in Almuruj area near Qalqilya, in the West Bank. The area of the irrigation scheme is 17.6 ha and it is divided into about 27 plots. This model itemized the existing water organization structure of the project, the land tenure and distribution, the storage facilities, the existing irrigation techniques, water distribution and allocation and their problems, winter and summer irrigation, priority of water supply, flexibility of irrigation water, operation, maintenance and cost recovery and water pricing. The second model is about Participatory Irrigation Management in Al-Auja Spring, where an irrigated area of 886 ha is located in and around Al-Auja village in the Jordan Valley, some 10 km north of the City of Jericho in the West Bank (Palestine). This model shows the climate of the area, surface water resources, irrigation infrastructures, water rights, Al-Auja Agricultural Cooperative, operation and maintenance and irrigated agricultural production systems. Water management in Palestine has been affected greatly by the political conditions and the lack of awareness of the benefits of participatory water management. The lack of effective participatory water management coupled with the scarcity of water and the deterioration of its quality is a major driving force for many social, environmental and physical setbacks like food insecurity, water use inefficiency, soil degradation and pollution.

Key words: Palestine, participatory water management, irrigation scheme, water rights, Almuruj, Al-Auja.

INTRODUCTION

Palestine, represented currently in the West Bank and Gaza Strip, has a unique geographic location at the intersection between three continents, Africa, Asia and Europe and between very different ecological zones (Irano-Turanian, Mediterranean, Saharo Arabian and Sudanian), which results in a variety of ecosystems.

The West Bank and Gaza Strip (W&G) are located east to the Mediterranean Sea between 29° and 33° North Latitude and between 35° and 39° East Longitude (Fig. 1). The total area of W&G (including the Palestinian part of the Dead Sea) is about 6245 km^2 (365 km^2 in Gaza Strip). It is populated by more than 3.5 million Palestinians, according to the Palestinian Central Bureau of Statistics 1997 survey. The Gross Domestic Product was estimated at around 4173 million US($) dollars, and the income per capital is estimated at 1500 $. It is an Israeli-occupied area with current status subject to the Israeli-Palestinian Interim Agreement; permanent status has to be determined through further negotiation between Israel and the Palestinian National Authority (PNA).

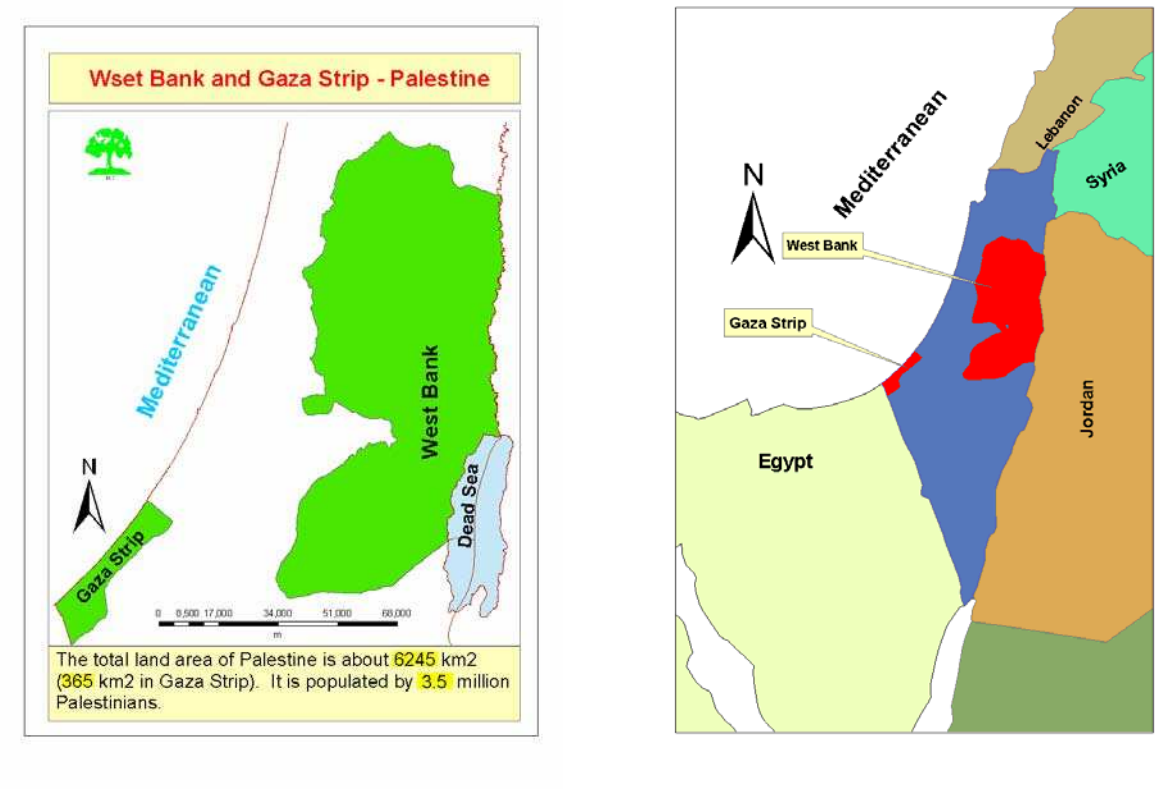

Fig. 1. West Bank and Gaza Strip – Palestine

The pressure on the Palestinian natural resources is very high due to many factors as they are: absence of management for Palestinian natural resources for the last 36 years, high population growth rate (3.5-5.0%), centralization of peoples in smaller spots of land – as a result of the Israeli occupation, Israeli colonizing activities like colonies construction, bypass roads and military bases, etc. This, among others, has resulted in a comparatively high rate of soil degradation. However, this paper concentrates only on Palestinian successful experiences in participatory water management in the past taking in consideration that Palestinians do not have control over their natural resources. This trial is made while adhering to the optimistic forecast for a justice and lasting peace in this region.

Palestine is an area with very limited natural resources. The geographic, political and socioeconomic uniqueness of this area imposes additional pressure on these resources. Although there is a deep understanding and appreciation of the importance of water management in Palestine, there are hardly any available records or documented material about PIM, nor are significant parameters systematically monitored. The few existing published work is unconnected and mainly descriptive and qualitative.

WATER RESOURCES AND ASSOCIATED PROBLEMS

Palestine is among the countries with the scarcest available water resources per capita due to both natural and artificial constraints, amounting to only 100 cubic meters per capita per year. Present knowledge and understanding of the water resources situation in Palestine is greatly hampered by the amount and quality of data and information available and used in making the estimates of both water supply abstractions and demand. Under the existing regime, except for rainfall data, there is very little other data that has been collected on an on-going basis.

Available estimates of the water resources are, therefore, snap-shots based on project related data collected over one to two-year intervals and generally over long intervals of time, (i.e. Palestinian Weather Forecasting Stations).

Deterioration in water quality would effectively result in the reduction of available fresh water resources and the necessary control measures must be put in place to prevent this. Rehabilitation to recover this water would take a long time and would be costly.

This paper will not go into details on how the water is managed at the national level due to the political complications. On the other hand, at the farm or catchments scale, there is no general trend of managing the water distribution. However, the following case study is representative to a large degree of the situation related to participatory irrigation management. Other examples would be highlighted briefly in the presentation.

WATER LEGISLATION

Before the Israeli occupation of the West Bank and Gaza Strip and specifically in the Jordanian time, the Jordanian rule was governing drilling of artesian wells. The Jordanian rule stated that any citizen has the right to drill a well to utilize it in irrigation under a condition that it is not to affect the existing neighboring wells.

After the Israeli occupation, and just in the early days of the occupation, Israel started to impose military orders aiming to restrict pumping water from Palestinian wells while they are drilling wells for their purposes.

Israeli policies in relation to the wells in the occupied territories seem to be based on the following major guidelines:

1. Imposing a quota on all irrigation wells and subjecting violators to heavy fines. After Oslo Agreement people who are in need of water started abstracting over the quota and they feel that more privileges have been given for the Palestinians in the water subject. Actually it seems to be that Israeli authorities look at the total abstracted water for the district as a whole and for the individual wells.
2. No permits are issued for new wells destined for irrigation purposes.
3. The rehabilitation of existing wells is made subject to procuring licenses from Israeli authorities. This may prove difficult, and nearly impossible if further deepening is required, as in the vast majority of wells.

In the year 1976 Israeli occupation imposed the quota system on the Palestinians groundwater wells, and start subjecting heavy fines to the violators. The system is implemented by the Water Department in the West Bank located near Ramallah City (Bet Eil) subordinating the Civil Administration that is part of the Israeli occupation authorities in the occupied Palestinians territories .

The Water Department installed water meters at the outlet of each well in Palestine to measure the quantity of the abstracted water every year. At the beginning of every first month of the year the Water Department sends their employees to read the meters installed at the wells and record them and consequently at the end of the year they look at each well if it complies with the permissible quota or not. These Israeli practices take place only for Palestinian wells not for settler's wells.

CASE STUDY N° 1: PARTICIPATORY WATER MANAGEMENT IN SMALL GROUNDWATER IRRIGATION SCHEMES

The fieldwork for this study was conducted over two months period in October and November 1997. Four categories of people were interviewed: farmers, well operators, farmers Committee and agricultural engineers from the Ministry of Agriculture (MOA). Two questionnaires were developed for farmers and well operators.

Description of the Existing Irrigation Scheme

Al-Muruj irrigation scheme involves irrigation by groundwater wells in Qalqilya District in the West Bank, Palestine. The area of the irrigation scheme is 176 dunum (1 dunum = 0.1 ha) and it is divided into about 27 plots with average size of 6 dunums in open agriculture and 1dunum in green houses. Crops cultivated in the area can be classified into two main divisions; vegetables and perennial trees. These two main divisions are subdivided into four categories, which are vegetables (open agriculture) 96 dunums (55%) of the total area and greenhouses with an area of 28 dunums (16% of the total cultivated area). Perennial trees subdivided into two subdivisions; a perennial fruit like Guava which covers 4 dunums (2%) and 48 dunums (27%) were covered with citrus (Table 1).

Table 1. Number of farms and different cultivated areas in Al-Muruj system

Number of farms	Total area (dunum)	Vegetables (dunum)		Perennial trees (dunum)	
		Greenhouse	Open field	Citrus	Fruits
27	176	28	96	48	4

In this irrigation scheme water is used only for irrigation purposes, a great shift from open agriculture to greenhouses is noticeable in the command area. In 1996, greenhouses covered only18 dunums, during the year 1997, 10 dunums were constructed which means that about 36% increase in greenhouses acreage in one year. During field trips in the area and interviews with farmers most of them prefer cultivating under protected agriculture (greenhouses) but due to the high investment cost of greenhouses those people have not yet started in such agricultural type.

The annual permissible amount of water imposed by the Water Department (subordinating Israeli occupation authorities) is 79,000 cubic meter per year, but the actual abstraction exceeds this figure and it was 122,000 m^3 in the year 1996 (WBWD, 1997) which means that abstracted water was about 7000 m^3 per hectare (700 mm per year). Intensification of agriculture is very noticeable in the study area, greenhouses are cultivated about 10 months yearly and also open agriculture about three agricultural rotations during a year or generally about 9 months yearly. Storage tanks were not found in this irrigation project at all.

Existing Water Organization Structure

From field investigation and interviews with farmers and well operator it is found that establishment and development of such irrigation schemes in the area is almost the same, people established their schemes during the same era and within a small area. The existing organization structure is established by a group of neighbouring farmers, forming a type of agricultural cooperatives. The farmers themselves locally manage the existing irrigation schemes. The perception of establishment, components and development of these organizational structures is the first issue to be understood in order to overcome any potential problems in the future.

In the study area all wells are private. Most of them are owned by a group of farmers usually neighbours, who have their land within an area of about 200 dunums. Those farmers agreed upon drilling a well to use the discharged water for irrigation. Also they formed a type of committee (which generally consists of rich and influential people) to accomplish well drilling mission.

In order to secure money to fund the proposed scheme, the committee collects money according to the shares of the farmers, shares are proportional to how much shareholder paid money irrespective of their land size. These shares were distributed according to the capability of the farmer and according to the size of the land to be irrigated and usually farmers who own big shares own large land. After the committee finishes collecting money for the initial cost necessary for drilling and purchasing the necessary devices, it starts looking for contractors and makes communications in order to start drilling. After finding the suitable contractor with suitable price they start their drilling work.

After establishment of excavation, particularly when drilling reaches a reasonable depth below the

water table testing of the productivity and reliability of this water resource (well) must take place. Testing can be done by applying pumping test, which is usually to pump water 24 hours continuously. If only minimal changes in the quantity of discharged water occurred the test is considered being satisfied otherwise extra excavation is needed. It is common that when people see the water it become more attractive for them to share in the scheme if there were extra shares left.

The developed cooperative consists of a number of shares (24 shares in the surveyed irrigation schemes) and the shareholder might have one or more shares or even less than one share. It is worth noting that share price differ from one irrigation scheme to another and nowadays it also differs from one person to another depending on supply and demand. The cooperative can sell water for irrigation or any other purpose if there is excess water and if the productivity of the well exceeds the demand of the shareholders. If a farmer buys water from the cooperative and starts agricultural practices in his land then he has the right to irrigate even if he is a water right holder. This process need approval from shareholders that have to decide on such issues, usually influential shareholders make such decisions. Non-share holding farmers pay the same price for irrigation water as shareholders. Non-shareholders right to irrigate is usually a verbal commitment and it is rarely written in a form of a contract. For more clarification schematization chart is developed (Fig. 2) to show the organization structure for the existing systems and brief explanation about each component in the system.

There is no election system for the committee, farmers are meeting together and agreed upon the committee, usually, and influential farmers take the role of that committee in decision-making process. Well operator has a distinctive role in this system; he deals with the farmers and he makes the required operation and maintenance on behalf of shareholders. Also, he deals with the accountant and he collects bills from farmers. Well operator with the intended farmer limit irrigation water quantity and irrigation schedule especially in the case of fixed irrigation for each farmer and farmers request water from him and he fixes the time of irrigation with cooperation of the farmer himself.

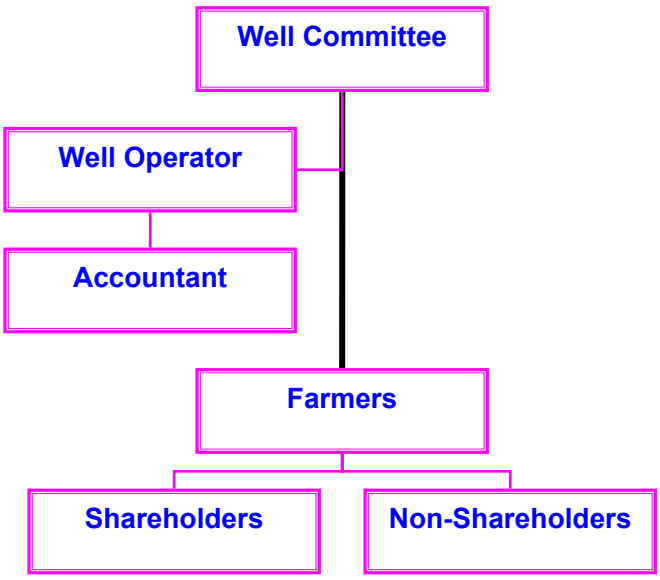

Fig. 2. Schematization chart for system organization structure.

Accountant usually does the accountings related issues more details in the payment system. Share holding farmers and non-share holding farmers represent farmers in the existing irrigation scheme. In the current situation it is very difficult to take water from the existing irrigation scheme because of water limitation policy imposed by the Israeli occupation.

Land Tenure and Distribution

Farm size and distribution is an important indicator that gives an idea about the number of farmers working in irrigated agriculture and may indicate the percentage of employment in agricultural sector.

There are two types of farming in the study area:

- Open agriculture, which enclose all crops cultivated in the study area with different percentages of crop types;
- Greenhouses in which vegetables are usually cultivated mainly cucumber and tomato. Farm size in green houses is generally one dunum (0.1 ha) in average, while in open agriculture it is different, about 5 dunums.

Storage Facilities

Storage facilities are only used for irrigation purposes in greenhouses in the study area. Storage facilities are usually concrete elevated tower and mostly, metal tanks with volume ranges from 10 up to 35 m^3, and in average it is about 12- m^3 volume. Storage tanks are filled with water directly from the main network. They are capable to irrigate greenhouses several times and this issue depends on the tank volume and irrigated acreage. Storage tanks to some extent raise the level of flexibility and reliability of irrigation water supply during a part of the growing season. Storage tanks with 12 m^3 volume can irrigates one dunum greenhouse cultivated with cucumber 4 days during summer and 8 days or more in winter. This means that storage tank act as on-demand system for individual farmers in that 4 days and the owner of the tank can irrigate whenever he needs when there is available water in the storage tank.

Distribution of Water Rights

Through interviews with farmers it is found that in the study area there are two ways in which a resident can become a water right holder:

1. By inheritance, whereby in most cases the water right associated with land is passed down from father to son and this is the most dominant way of being a water right holder.
2. By buying a land with its associated water right and this process can be accomplished in the court and no farmers can object to this way of acquisition.
3. There are also two ways in which a tenant can be a temporary water right holder firstly; when he rents a land from a water right holder, in such case the tenant has the right to take water from the well as long as he is farming that land. The second way can be occurred when a farmer was allowed to irrigate (according to paying certain fees) without sharing in the original investment of the project then he started planting his land after the approval from the shareholders and usually that approval extends with time.

Through interviews in the field with farmers, it appears that most of the farmers are water right holders and they have had this right either by inheritance or by purchasing of land with its associated water right. Acquisition of water usually follows the acquisition of land when transferring from one person to another. In this irrigation scheme, farmers who have permanent water right are 80%, this percentage shows that the majority of the farmers are shareholders and less of them (about 20%) are not. Water allocation and distribution process is influenced by the number of farmers irrespective if they are shareholders or not because increasing in the farmers number increasing water allocation difficulties.

Existing Irrigation Techniques

From the field survey concerning irrigation techniques, two main irrigation methods were found in the study area:

1. Surface irrigation (basin) method, covers 3% of the irrigation scheme.
2. Micro-irrigation system that can be subdivided into two subdivisions:
    a) Micro-sprayer that is similar to sprinkler, usually used for perennial trees. In this irrigation

scheme, this method covers 27% of the surveyed area.

b) Micro-irrigation techniques including drip and trickle irrigation methods. This technique is common in open vegetables and under greenhouse farming. In this irrigation scheme these techniques cover 71%. This high percentage reflects the high abundance of vegetables.

Water distribution and allocation

In the existing situation in the surveyed systems and even in all systems in the study area, the same type of water distribution and allocation methods are predominating and some differences may occur in the percentages of farmers who adopt this or that way of water distribution and allocation. Usually farmers who grow citrus have their allotment of irrigation water in the case of fixed irrigation and duration type and they do not negotiate that allotment every year. In all cases of water distribution individual farmer negotiate his date and duration of irrigation (hours) with the well operator to reach agreement upon this issue and that process may be finished within minutes. Such negotiation depends on the status of the farmer and some criteria govern such negotiation like; number of farmer, shares, relation between farmer and the well operator.

In all irrigation schemes farmers irrigate citrus 14 times a year, usually, starting from second half of April up to the first half of November. Exceptional cases may occur, for example in drought years farmers have to irrigate up to the beginning of rainfall, while in a good rainfall season, which sometimes starts at the beginning of October, there is no need for irrigation after October. It is found that, in average, irrigation interval is 3, 6 and 10 days in greenhouses, vegetables (open) and fruit trees respectively. The main methods used in water distribution in the study area can be stated as the following:

1. On-request type: This is the most common system of water distribution in the study area that is common in use in vegetables in both open and protected agriculture. Farmer requests the water from the well operator who in turn makes the necessary arrangement to accommodate it with the demands of other farmers within the limited capacity of the well and operating hours. If the demand can be met, the well operator responds to the farmer with an indication of the time of his turn. In piped irrigation system, where there is the ability to deliver water to the farmer within a short time if the arrangement is possible, this thing usually happened in winter (low demand). In summer this may take (1-3 days) where low flexibility and high demand for water occur. The amount to be supplied to the farmer is usually fixed in relation to the request of the farmer but, when the demand is high, the farmer can not irrigate as he is willing to, he has to negotiate this issue with the well operator. The advantage of this system is that it is easy to control irrigation turns and duration. Another advantage is that it operates well in peak months (summer time) or during exceptionally dry years. The disadvantage of this system is that cost is high especially in winter (low demand) especially when it is operated for a short period of the time to irrigate one or two dunums of greenhouses.

2. Rotational system (fixed rotation): In this system, farmers receive water at pre-set time and usually at fixed irrigation duration. In such system, the water is distributed by pre-set turns agreed upon at the beginning of the year. The farmer receives the water on a fixed day (bi-weekly) with almost fixed duration. This system operates in summer or when there is no rainfall and it is common for perennial trees. Under warmest summer conditions exceptional irrigation may occur, in which the farmer can receive water once or twice extra irrigations in the year if it is possible. This method of irrigation may represent the simple way and it is widely used in citrus farms. However this method gives every water user an amount of irrigation water proportional to the size of his farm but this is not the case always. Under scarcity circumstances, this method may be quite efficient as the farmer may adapt his cropping pattern to the fixed turns and fixed duration.

Winter and Summer Irrigation

From field survey it is found that irrigated agriculture in the existing situation can be divided into winter and summer irrigation. During these two periods the area irrigated, allocation, arrangement and distribution of water is some how different. In winter, arrangements are rather loose, since demand for water is small because of rainfall and the low temperature that reduces the demand for water and in this season some farmers are willing to grow rain-fed crops because rainfall replaces irrigation on December up to March. In summer; water allocations arrangements are strict. Scarcity of water and increased crop water requirements raise the peak rate of demand and the fear of exceeding the quota leads to greater competition for water.

Problems Related to Water Allocation

Farmer's share in irrigation water can be computed based on a proportion mainly defined (as the ratio of individual to total investment), this definition is suitable for people who are originally water right holders and not the temporary water right holders. Major problems that may face water allocation in the field under the circumstances of the existing situation could be the following:

1. Fragmentation of water rights.

Fragmentation of water rights largely coincided with fragmentation of the land that occurred as a consequence of inheritance, buying and selling, etc., with every division of land, the water related to the land also divided into smaller portions. Fragmentation of water rights causes the problem of increasing the number of irrigators and the number of plots to be irrigated, irrigators may wish to cultivate different crops varieties which means different crop water requirements and different irrigation intervals. Thus, fragmentation of water rights complicates the system of water allocation and distribution because of increasing in farmer numbers. From the field survey it appears that in this irrigation scheme the number of farmers in 1997 is 27, while, 20 years ago, they were about 20 farmers. This issue indicates that farmer number increased by about 30% during the last 20 years, on the contrast no increase in agricultural acreage were noticed.

2. Greenhouses.

Shifting from open agriculture to intensive agriculture increases water allocation problems because greenhouses need frequent and short interval irrigation. Consequently, daily or day after day irrigation instead of weekly or bi-weekly irrigation (in vegetables and citrus farms) increases the problem of irrigation scheduling. Greenhouses fragment the agricultural land into more plots, this issue increases irrigation rotations and turns and consequently complicate water arrangement and water allocation process.

Priority of Water Supply

Priority of water supply amongst existing crops during periods of water shortages is an important issue. In the operation of supply and distribution system, well operator on behalf of shareholders has to decide together with farmers through negotiation between them to which crop water will be provided at the time of water shortages which may occur in one of the following cases:

1. In the case of technical damage;
2. During dry years;

The first case is the most important and critical case because it may result in serious shortages of irrigation water. In such case usually farmers receive water from neighbouring schemes. Case two increases pressure on the irrigation system. In the existing situation, generally priority of water supply is given for vegetables particularly to greenhouses and not for citrus trees because of high economic value of vegetables comparing to the current economic value of citrus trees. Also, vegetables are sensitive to water deficit much more than citrus trees.

Flexibility of Irrigation Water

In the study area, significant part of the farmers irrigate their crops according to fixed interval and also some of them use fixed duration. Fixed interval is generally used for perennial trees and to some

extent for vegetables. In perennial trees case, fixed interval is used much more than in vegetables, indeed fixed irrigation duration is applied to perennial trees. However, to simplify the operation of supply system and to reduce administrative difficulties in water supply arrangement and distribution in the irrigation schemes, fixed irrigation intervals are used. Since crop water requirements vary over the growing season, the use of fixed intervals and/or fixed duration of irrigation causes either over- or under irrigation during the different stages in the growing period. Which in turn, leads to inefficient use of water or causes reduction in crop yields as explained in the example below. So, fixed irrigation and duration method reflects mismanagement in water distribution and allocation, and consequently it affects negatively farm production.

Usually irrigation starts in the second half of April and ended at the first half of November, usually at this time effective rainfall is below irrigation requirements and in summer time it is zero. In terms of water management this means that allocation of the available water (limited quantity) but controlled can be directed and planned toward meeting full water requirements of citrus during flowering and fruit set stages (summer months) which are considered the most sensitive growing periods. For example, in summer time (especially from June up to August) in which fruit set occur in citrus irrigation requirements must be fully met. On the other hand, there will be no danger if applied irrigation do not meet irrigation requirements in September or in October because it is not sensitive stage to water deficit and the yield will not be seriously affected.

When to irrigate and how much is an important question in the questionnaire and the answers reflect to what extent the system is flexible. In the field survey it appears that two types of farmers exist depending on irrigation flexibility (Nofal, 1998):

- The first type is the farmers comprising well operator, his relatives, his friends and a part of the influential farmers. Well operator facilitates irrigation turn for this part of farmers and gives them the priority for irrigation.
- The second type is the farmers where irrigation rules and scheduling imposed strictly upon them.

The distinction between those two parts of farmers occur in peak months (summer time); if farmers who are from the second part have to wait many days (some times up to one week), in winter the situation is different and this problem is not clear.

Available water in the study area can be addressed under limited water supply and fully controlled supply at headwork. General features of the situation concerning agriculture and water can be summarized in the following points:

- Water supply is fully controlled;
- The irrigated land doesn't extend because of the Israeli occupation and the imposing of water abstracting restrictions;
- There are great changes in the cropping pattern;
- Agricultural intensification exist in the area (about three agricultural rotations a year).

Operation, Maintenance and Cost Recovery

In the study area, maintenance is designed to accomplish two main purposes: permanent water supplies by keeping pumping equipment in good condition in order to pump water whenever farmer needs; keeping conveyance system (metal pipes) in sufficiently good conditions to minimize losses and keeping other water control infrastructure in working conditions.

The existing irrigation schemes in the study area are private and locally managed, they depend on themselves in bearing any potential maintenance or rehabilitation costs, and thus any excess in maintenance cost are collected from shareholders. Usually, when the cost is high and the farmers can't afford, the well committee can take a loan and the value of the loan should be included in the price of water. Therefore, in the study area, it can be stated that fees collected from farmers cover the operation and maintenance cost under the existing circumstances and prices.

The well operator is officially responsible for maintaining a file that includes the name of the farmer, the time of receiving, the time of finishing of water supply and hence the duration of irrigation

can be determined. This process is happening many times everyday and the well operator has a special form for writing down the name of the farmer, the duration of irrigation and the date of irrigation.

At the end of each month, the well operator gives his accountings data to a special accountant to process them and return them back to the well operator with every farmer on the well and against to him two columns. The first column includes the total irrigation time in hours and minutes and the second column includes the money required from that farmer. This is a ready bill in the hands of the well operator to start requesting the required money from farmers. Farmer who fails to pay on time is warned to pay; otherwise, the well operator will not provide him with irrigation water. This warning is enough to oblige every farmer to pay, because the farmer has no alternative, usually such problem does not occur and no farmer mentioned that such problem occur.

Water Pricing

Pricing water is an essential task of the committee that is responsible for the well at the early beginning of establishment. Water pricing process tae in consideration the following: well operator salary, fuel and oil used for the engine, maintenance, labor, equipment, spare parts, etc. Any developed price depends on operation and maintenance cost. Water price may vary from time to time according to operation and maintenance requirements.

Shareholders or influential farmers appoint a meeting to decide the increasing of the price and the percentage of this increase. This happened in this irrigation scheme. Three years ago, the farmers faced a serious problem in the engine of the well and they obliged to change it and for this purpose they took a loan from an agricultural corporation to cover this cost. Irrigation water in the study area is priced in terms of unit money per unit time (hr). Water prices vary from one irrigation scheme to another.

Table 2. Water prices in the surveyed irrigation scheme

Irrigation Scheme	Average Discharge [m^3/hr]	Water Price [US$/hr]	Water Price [US$/$m^3$]
Al-Muruj	50	8.45	0.169

In the discussion of water pricing, some noticeable points deserve to be mentioned in this field:

1. Shareholders indirectly pay less money for water than non-shared farmers do. At the end of each year the accountant makes his accountings for the whole year, if it is found that water revenues exceed the expenditures they distribute the excess money for shareholders proportionally to their shares.
2. Within the same scheme, if the variation in well discharge in terms of volume units (i.e. m^3/hr), as a result of topographic level changes, the observer can realize the difference between farmers and variations in well discharge and price.
3. Water priced in terms of time units.

CASE STUDY N° 2: PARTICIPATORY IRRIGATION MANAGEMENT IN AL-AUJA SPRING

Introduction

The Al-Auja irrigation project, with a reported irrigated area of 886 ha is located in and around Al-Auja village in the Jordan Valley, some 10 km north of the City of Jericho in the West Bank in Palestine. The village has a resident population of about 3000 people (PCBS, 1997), whose main source of income depends on irrigated agriculture.

Irrigated agriculture, which is by far the most important economic activity in the Jordan Valley, benefits from highly favorable climatic conditions. Winter vegetables together with grapes and bananas are the most important commodities. Together with favorable soils and topographic conditions it makes the Jordan Valley a high potential area for irrigated agriculture. The major limiting factor is the availability of water.

Climate

The climate in the project area follows the Mediterranean pattern. There are two clearly defined climatic seasons, a wet winter and dry hot summer. The average annual rainfall in the Jericho area is about 200 mm.

Surface Water Resources

The Al-Auja irrigation system depends for its water supply almost entirely on the flow of the Al-Auja spring. There are 10 groundwater wells in the area of the project and some of them are not operational.

The spring is located 8 km west of Al-Auja village at an elevation of 35 meters above sea level or about 275 meters above village level. It draws the higher parts in the Cenomanian aquifer, explains the large fluctuation observed in the spring discharge, varying from 0 to over 2500 m^3/hr.

The average annual discharge is 9.2 million cubic meters per year or the equivalent 1052 m^3/hr. The period of highest discharges are during the months of February, March and April. The spring discharges into the Al-Auja Wadi, which occasionally also carries water resulting from direct runoff of the catchment area. The catchment area is about 62 km^2 and the direct runoff is estimated to be in the order of 2 million m^3/year, or approximately 30 mm or 20% of the average rainfall of 600 mm over the upper parts of the catchment area.

Irrigation Infrastructure

A diversion weir was constructed in the Al-Auja Wadi in the early fifties of the last century, some 600 m downstream the spring. The entire spring flow in the wadi is diverted into a lined canal.

After approximately 7.2 km the canal reaches the first distribution, near the Al-Auja village at a level of 225 m below sea level. Between the intake and the distribution box there are only a few farm inlets. At Distribution Box 1, the flow is split into two equal parts. One half flows into a canal of about 3.5 km length, the other is half enters into a canal where the flow is further controlled by means of two more distribution boxes. The total length of the canal network downstream Distribution Box 1 is approximately 12 km. Part of this network is also lined.

In most cases the water from the canal network is led into privately owned ponds. The total number of ponds in the project area is 40. The average capacity of ponds varies considerably from one case to another. The total average capacity of all ponds together is in the order of 200,000 m^3. There are 4 water right holding families that have no ponds. Many ponds have plastic sheet lining. From the pond the water is distributed to the fields, mostly by pumping from the pond in the case of drip irrigation, or by gravity in the case of surface irrigation.

Water Rights

There are 35 water right holding families or clans in the project area. These rights were fixed long ago on the basis of land ownership at that particular point in time. Each clan consists of a number of nuclear families. The total number of nuclear families is 235 of which 39 live outside the project area. The water rights are registered, however, in the name of the clan.

Technically speaking, the flow of the spring is divided into two equal parts. The share of the water right holding families is expressed in terms of hours and minutes. The clan is entitled to half of the spring discharge during a rotational period of 8 days. The total water right units are therefore 2 x 24 x 8 = 384 hours.

At any point in time there are two families that simultaneously receive half of the spring flow. Minor adjustments are required as some off-takes are above Distribution Box 1 and water rights are not

exactly equally distributed over both channels below the box.

Al-Auja Agricultural Cooperative

The cooperative also acts on behalf of the water management committee of water right holding families in operating and maintaining the irrigation system. For these services it directly bills the 235 water right holding families through their representative.

The cooperative has 321 members and includes nuclear families of water right hold entities as well as sharecroppers. As there are 39 of the 235 water holding nuclear families that live outside the project area, the number of sharecropper members should be in the order of 125.

The Al-Auja Agricultural Cooperative renders tractor hiring services, the tractor hire services functions relatively well. The cooperative renders these services also for non-members.

Operation and Maintenance

The actual opening and closing of the gates is done by a canal operator (or ditch rider) who is the payroll of the Al-Auja Agricultural Cooperative, which acts on behalf of the 35 water holding entities and their informal Water Management Committee.

Also maintenance works are carried out by the Cooperative at the request of the Water Management Committee. In 1993, each water right holding family paid 28 US $ per water right hour. The total budget for operation and maintenance in 1993 was therefore equal to 384 x 28 = 10,752 US $ or an amount of 10,752/886 = 12.14 US $ / hectare. This amounts includes the salary of 4,200 US $ for the canal operator. Subtracting the amount from the total, there remains an amount of 7.40 US $/ha for maintenance purposes only. This amount is far below actual needs.

As a result of limited resources, the system suffers considerably from lack of maintenance. In particular, the 12 km of channels and branches downstream Distribution Box 1, and channels, connecting the ponds to the distributor channels are in advanced state of degradation.

Irrigated Agricultural Production Systems

The cropping patterns in this project are similar to cropping patterns in the Jordan Valley. Existing crops according to the area occupied can be classified as follows; cereals (winter only), vegetables (winter only), bananas (year around) and citrus (year around). The high percentage for cereals is certainly linked to the large variability of the Al-Auja spring flow and cereals only play a secondary role in irrigated agriculture. Supplemental irrigation is practiced only if and when additional water is available.

Most of the production (except for tree crops) takes place through sharecropping relationships in which land and water is provided by the owner. Expenditures for seeds, fertilizers and other recurrent costs are shared between the owner and sharecropper on a fifty – fifty basis. The sharecropper's main input comes in the from family labor.

It should be noted that the word "owner", as used above, means the entire land and water right holding entity or family clan. In the line with traditions, there is, however, always one person who acts as head of the family. Many of the nuclear families belonging to one of the water right holding entities are sharecroppers at the same time.

CONCLUSIONS

The water deficiency problem is part of the water dilemma in the Middle East. This problem is magnified in Palestine due to the abnormal political situation.

West Bank and Gaza Strip, as parts of historical Palestine, are characterized with very limited

natural resources. The political and socio-economic conditions of this area impose additional pressure on those resources. Although there is a deep understanding and appreciation of the water scarcity problem in Palestine, the complicated political situation is standing as a serious obstacle toward an efficient integrated management of the available water resources (Jayyousi, 2001). Palestine is among the countries with the most stressed per capita water availability in the world (100 m^3/year). It is worth mentioning that Palestinians have very restricted access to their groundwater resources and no access to surface water represented mainly by the Jordan River due to the current political situation, and the Israeli imposed restrictions.

The following conclusions can be drawn with relevance to the exhibited material:

- Palestinians have not yet obtained their rightful shares from their national and international water sources.
- The imposed restrictions by Israelis on the water availability and use for Palestinians have limited the possibility of developing adequate water participatory management.
- The groundwater user cooperatives need more institutional capacity buildings and they need proper bylaws and regulations.
- The proposed water institutional setup by Palestinian Water Authority can't be implemented under the current Israeli occupation.

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