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Pricing the irrigation water in the Jordan valley as a mean of water saving in Palestine

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PRICING THE IRRIGATION WATER IN THE JORDAN VALLEY AS A MEAN OF WATER SAVING IN Palestine

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Abstract: Palestine consists of the West Bank and the Gaza Strip. The proclaimed state of Palestine has a land area of 6,657km³.

Water is always considered as an essential factor of life and development in arid and semi-arid countries. In Palestine the total per capita water consumption is 139m³.

The total available water for Irrigation is 239 MCM which is responsible for irrigating only 330,000 dunums out of 2,314.000 dunums cultivated that can be irrigated if water is available i.e. 5% of the total cultivated land.

The average rainfall is 450mm and unfortunately there isn't any water harvesting structures i.e. dams, most of this rainwater flowing towards the Dead Sea or the Mediterranean Sea as waste. So harvesting this water in individual farmer land and using this water for supplementary irrigation to irrigate olive trees, almonds, grapes and cereals will be of a great impact on the Palestinian land for feed production. It should be noted that there are few farmers who practice supplementary irrigation for production of vegetables that are planted in summer as individual initiative. The quantity and quality of production that they have is extremely tangible.

Irrigated area in the Jordan valley constitutes of more than half of the irrigated area in the whole country Palestine. In addition to that more than of 50%of the irrigation water in west bank is consumed in the Jordan valley.
Most of the irrigation water in the Jordan valley is due to springs where the water is flowing by gravity and the farmers have access to this water free of charge , so farmers irrigate his crop without taking into consideration the value of the water where they add water as well as they want and they select any crops such as banana (the most water consumption plant)without taking into consideration the amount of water needed especially the evapotranspition in Jordan valley is the biggest in the world since the location of the Jordan valley(Jericho)is the lowest point in elevation in the world

Background

It is foreseen that the world's food production has to be doubled in the next 25 years, and thus, the agriculture continues to be an important sector in the 21st century. Meanwhile, the agriculture sector remains the largest user of the water resources, and it is evident that there is a decline of agricultural water due to increasing demands from cities, industries, and hydropower utilities in the developing countries such as Asia. Much of the water has to come from irrigation water savings.

Population and economic growth in many developing countries of Asia have created serious problems, such as the shortage of food, the scarcity of water, and the deterioration of the environment.

Some of the irrigation and drainage projects have been seriously criticized due to their high-cost and low-efficiency for the construction and maintenance. The concept of maximum yield is now changing to optimum yield for creating an efficient irrigation schedule. The water saving is the most sustainable conservation; because it reduces the new construction needs to meet the increased water demand. The major issues of agricultural water are how to increase withdrawals about 15 – 20% by water saving, how to increase storages 10 – 15% by new irrigation facilities, and how to conserve the water quality of irrigation.

I. Introduction

Historical Palestine is located between the Mediterranean Sea and the Jordan River, as well as to the Red Sea from the south. The present proposed Palestinian state consists of West Bank and Gaza Strip. The other part of Palestine is occupied by Israel in 1948. This study focuses on the West Bank and the Gaza Strip. The proclaimed state of Palestine has a land area of 6657 square kilometers (Kateeb 1993). Population senses has been taken place recently by the Bureau of Statistics early 1998. It is reported that the population of the West Bank is 1571571 and Gaza Strip is 963026 where the total population of the Palestinian people is 2534598 people.

Ground water is the main water source in the country. It is recharged by rainfall. Rainfall varies from 100mm in the south east to 800 mm in the north. The average rainfall is 550mm (Sbeih - 1995). Where the average rain fall in Jordan Valley is from 100 mm to 270 mm/year (Zaru - 1992), and in Gaza is 200 - 400 mm/year (Abu Safieh - 1991).

Not all the rainwater is available to the Palestinian due to Israeli Military orders. Water is abstracted from the ground water through 340 wells in the West Bank and 1781 wells in Gaza. In addition to that springs contribute a lot, where half of the irrigation water in the West Bank is due to springs.

The quality of the available water varies from almost rain water to brackish water. In the Jordan Valley where it is the lowest point in the elevation in the world where temperature is very high in this area especially in summer. As example, the chloride content is reaching 68 mg/l and the SAR reaches 11.7 where the TDS reaches 5000PPM. Still the utilization of this saline water is not as efficient and environmentally safe as it should be where further utilization of this water could play a major role in developing the area where still the irrigated area consists of not more than 6% of the cultivated area in the West Bank.

It should be mentioned that not only saline water does already exist and utilized improperly, but it also seems to be that the additional water that can be allocated for irrigation is also saline water which is going to be from:

1. The Eastern aquifer to be used in Jordan Valley
2. From the treated waste water from different cities and villages in the West Bank

Water sources in Occupied Palestine

a) West Bank

Two main water sources are available for Palestinian in the occupied Palestine (West Bank and Gaza Strip) for agricultural, domestic and industrial use. These are rainfalls and ground water sources - Palestinians consume water mainly through ground water wells and springs (where rainfall is considered the main recharge). The total annual water springs discharge varies according to the rainfall. The total annual flow of the 113 fresh water springs in the West Bank ranges between 24 MCM (as in the year 1978/79) to 119.9 MCM (as in the year 199/92) and with an average of 52.9 M.C.M. as calculated from the annual flow in the past 24 years. Around 86% of the total annual flow of these 113 springs is within the eastern drainage (in/or toward the Jordan Valley), while the other 14% is within the western and south-west (Nusseibeh 1995) where the total estimated annual water discharge from ground wells is 60 M.C.M. (Awartani 1992). So that the total annual water available to Palestinian is 113 M.C.M. In addition to that there is another 2.5 M.C.M. is collected directly from the rainfall in cisterns in Palestinian houses. So that the total available water is 116 M.C.M./year, for more information see Table No. I.

b) Gaza Strip

Water situation in Gaza Strip is very critical. The Gaza Strip lies on top of two water strata. The upper is fresh water, the lower carries saline water. The annual consumption of water is at present in the vicinity of 100 M.C.M. These aquifers get replenishment of some 60% leaving a deficit of 40 M.C.M. of water (Shawwa 1991).

Even the Gaza water is lower in quality than West Bank, but due to the complication of the situation there and due to the geographic location where my work is more in the West Bank. This paper will address West Bank issues more clearly.

Basic land and water indicators for Israel and the Occupied Palestinian and other Arab territories

(1dunum = 1,000 m2)

	West Bank	Gaza Strip	Israel
Total area (dunums)	**5 573 000**	**360 000**	**20 000 000**
Population (1988)	**900 000**	**600 000**	**4 300 000**
Area of land cultivated (dunums)	**2 100 000**	**214 000**	**4 250 000**
Area of land irrigated (dunums)	**110 000**	**120 000**	**1 850 000**
PERCENTAGE OF TOTAL IRRIGATED LAND	**5**	**56**	**44**
Percentage of total land cultivated	**38**	**59**	**21**
Annual water consumption for irrigation (million m3)	**95**	**80**	**1320**
Annual water consumption for households (million m3)	**27**	**21**	**325**
Annual water consumption for industry (million m3)	**3**	**2**	**125**
Total annual water consumption (million m3)	**125**	**103**	**1770**
Total per capita water consumption (m3)	**139**	**172**	**411**
Per capita water consumption per household (m3)	**30**	**35**	**75**
Per capita water consumption for industry (m3)	**3.3**	**3.3**	**29**
Per capita water consumption for irrigation (m3)	**106**	**133**	**307**

Source: Israeli land and water policies and practices in the occupied Palestinian and Arab territories, unpublished study in Arabic (Economic and Social Commission for Western Asia, Baghdad, 1990), p. 8

<u>Irrigated areas in the occupied Palestine</u>

In Palestine, being a semi arid country, we are confronted by a demographic growth, and agricultural development as well livestock and industrial development. Thus in essential growing water requirement makes the rational management of water resources supremely important in order for development to be lasting and for environment to be served.

On a global basis at least 60% of all water abstracted at present is used for agricultural production. In Palestine 70% of all water consumed is due to agriculture.

Here in Palestine, agriculture is considered to be one of the main national income. Agricultural production contributes 47.61% of the total national income in 1970.

The potential for irrigation to raise both agricultural productivity and the living standards of the rural poor has long been recognized. Irrigated agriculture occupies approximately 17% of the world's total available land but the production from this land comprises about 34 % of the world total.

In Palestine, irrigation is considered to be the spinal chord of plant production for the following reasons:

1. Palestine is considered as a semi arid region where some of the crops cannot be grown without irrigation (example, citrus).

2. In the Jordan Valley, which constitutes the main agricultural production for the country, irrigation is a must due to low rainfall and high temperature.

3. With irrigation the same plot of land can be planted up to three times per year while it cannot be planted more than two times with dry farming.

4. Different varieties and crops can be planted in any region due to the availability of water i.e. more flexibility of planting several crops at different regions in different times of the year.

5. **Job creation:** Since the labor requirement per irrigated durum is more than double that of job required per dry farming per one season. This has now become more vital due to continuous of closures of the West Bank and Gaza Strip where the number of laborers that are working in the Palestinian part that occupied in 1948 is sharply reduced.

6. Agricultural production is much higher for irrigated farming than for dry farming per dunum per season. As example average tomato production per dunum is as follows:

- Dry farming: 2-3 ton per dunum per season.
- Irrigated (open land) 6-8 ton per dunum per season
- Irrigated (greenhouse) 12-16 ton per dunum per season

7. Net income per dunum of dry farming does not exceed $150 while from irrigated area the net income can exceed $1500 per dunum

8. Especially in Palestine, where the horizontal expansion in agriculture by increasing the total cultivated area due to the Israeli occupation, and shortage of water. The vertical expansion could be the main parameter to play with. Irrigation will be the main element in this formula. So that providing extra water for irrigation to irrigate as much as possible of the cultivated area is a must. This implies that Palestinian should use any drop of water. Regardless the quality of that water practically and efficiently: Table no. 2 shows the irrigated area in each district in Palestine where the total irrigated area in 1993-94 was 217,000 dunum (PSBS 1996).

<u>Available area that is ready for irrigation</u>

Where in Gaza Strip the irrigated area could be doubled or tripled in terms of topographical situation but due to the limitation of the water both quality and quantity it is very difficult to increase the irrigated area while in the West Bank the area that could be irrigated in terms of topographical conditions estimated to be 535 thousand dunums (Awartani 1991) as in table 3.

Table 1
Distribution of area that could be irrigated in the West Bank

Location	Dunum
Plains in Jenin and Tulkarem	**99,600**
High land	**277,40**
Eastern slopes	**64.6**
Jordan Valley	**93.5**
Total	**535.1**

Source (Awartani 1991)

Where in the study conducted by PWA in 1992 in order to develop a plan for the western Ghore the following locations could be the most suitable area to be ready for irrigation:

1. <u>Northern Ghore</u>

The areas suitable for irrigated agriculture in this region include:

18000 dunums in Ein Al Beida, Bardalla villages
5300 dunums in the Ghore
3500 dunums in the Ghore

But the Ghore and Zhor areas are mostly closed by the Israeli Military orders.

2. El-Bique Valley

This is a large flat area to the west of the hills of northern Ghore. This area includes about 18500 dunums of fertile smooth deep soil. The Palestinian farmers as rainfed excluding 5500 dunums where the two settlements their (Baquat and Roi) are occupying cultivate all this area.

3. Upper El Fara' valley area (Semi-Ghore)

In this area, there are 13100 dunums that are suitable for irrigation and can be easily irrigated as follows:

Sahl Tubas	3600 dunums
Sahel Tayassear	900 dunums
Sahel Tammun	1900 dunums
Sahel El Fara'	5000 dunums
El Nassarieh (additional)	1700 dunums

Where there are another 7000 dunums, which are already irrigated.

4. The middle and south Ghore

This region extends from approximately grid north 180 (northern of Marj Najeh) in the north to the Dead Sea in the south and from the Jordan River in the east to the feet of the west-bank mountains.

The total area that could be ready for irrigation in this area is 145500 dunums. In summary, the total area that can be used in irrigated agriculture in the western Ghore will be:

Northern Ghore	26800	dunums
Biquia valley	18500	dunums
Semi-Ghore	201000	dunums
Southern Ghore	145500	dunums
Total	210900	dunums

Where about 44000 (PCBC 1991) dunums of this area is currently irrigated. So the total additional area that could be irrigated in the West Bank is (210900 - 44000 + (535,100 - 93,5000) = 608500 dunums.
It should be mentioned that the Jordan Valley produces more than 59% of the vegetables produced in the West Bank. It also produces 100% of the bananas produced in Palestine.

Cases where water is used for irrigation of almost free of charge

Al Nweimeh Irrigation Project

1. Project Site

The project area is located in the Jordan Valley about 4.5 km to the north of Jericho City. The Nuweimeh village has an elevation of about 75 meters below the mean sea level. The project area presents a very favorable environment for irrigated agricultural production. In general, the project site has a flat topography. Nuweimeh lands are formed of Nuweimeh Al Fuqa and Nuweimeh Al Tahta, which is adjacent to the abandoned Nuweimeh Refugee Camp to the east. Tall As-Sultan Camp is located to the south of the village. Wadi Al Nuweimeh passes near the village. The Nuweimeh village local grid reference is 192.900 East and 144.350 North. The Nuweimeh village is one of the small villages in the Western Ghor.

2. Area and Irrigated Land

Currently, the irrigated area is about 2,200 dunums, which is equivalent to 41% of the potential irrigated land area in Nuweimeh village that is about 5,240 dunums. This is attributed to the limited resources of water available in the area, the poor conditions of the canal, the great losses of spring water, and other financial problems.

It is reported by the Agricultural Department in the City of Jericho that the total agricultural (irrigated) lands of the Nuweimeh village is about 2,182 dunums. 1,097 dunums (50.3% of irrigated land) are planted with banana, 1,018 dunums (46.7% of irrigated land) are planted with different types of vegetables. The remaining area (3%) is planted with other field crops. The discharge of the spring is 316m^3/hr.

3. Existing Irrigation Systems

The Nuweimeh Spring is located in the eastern slopes of the West Bank. Nuweimeh irrigation system is located in and, around the village of Nuweimeh. The lack of maintenance and rehabilitation of the existing canal reduce significantly the canal conveyance efficiency. The people are the owners of the land and they have rights to the water of the Nuweimeh Spring feeding the existing irrigation system. The source of the spring is located about 2km to the north of the Village and is accessible through a pathway that is around 300 meters away from the paved road. The spring has an average flow of around 316 m^3/hr. The water is distributed to the farms free of charge where the spring water is owned by the people.

The existing irrigation system consists of the main canal, which flows through the land of the upper and lower Nuweimeh, branches from the main canal; the branches convey the water from the main canal to the irrigated farms. Each branch serves many farms through intake canals constructed on the branch canal by the farmers themselves. Most of the time, the water from intake canals is stored in an open storage ponds to be used later for irrigation.

4. Existing Main Canal

Main Canal: The existing irrigation system can be best described as follows: water from the spring flows through an earth canal for the first sixty-seven meters and then flows through a concrete canal. The concrete canal has a rectangular cross section of about 40x50 cm. The dimensions are not fixed along the canal and they vary from part to part due to the irregular maintenance carried out through the years and due also to scouring activities in the canal itself. After running for 289 meters from the source, the canal has then to cross a wide deep valley. The water crosses a wadi via a 16" diameter steel pipe over a length of 35.5 meter. The pipe has been constructed after the damage of the ancient bridge over which the canal used to pass. After crossing the wadi, the canal then goes through Al-Amarah Park where the canal is used for tourist activities. After the park, the canal starts to cross the land of the Duyuk village. However, the farmers there have no rights to the use of the water of the Nuweimeh Spring. The canal crosses the main street, which connects Jericho with Ramallah, near the Village Council building to go through the upper Nuweimeh land. In this section of the canal, two branches carry the water to the farmers there. The main street, which connects Jericho with Nablus, divides the land between the Upper and Lower Nuweimeh. The canal crosses this main road to go through the Lower Nuweimeh land. In this part of the canal there are three other branches that carry the water to the farmers there. The last few tens of meters of the canal are earth canals. The totoal length of the main canal is about 5,528 meter.

The water of the spring used to flow through natural path to join the Wadi of Nuweimeh. By the end of the 1930's, a cemented canal had been built to convey water from the source of the spring through an ancient bridge over the wadi to the center of the recent village. In the 1940's. the rest of the recent main canal had been constructed to supply water to the rest of the land of Nuweimeh. The last part had been implemented after one of the families agreed to fund the construction of the canal. Since that time, many rehabilitation activities have been done on the canal, the major and final rehabilitation was in the 1970's, when the ancient bridge was damaged by the flooded wadi of Nuweimeh. The open canal over the bridge was replaced by a hanged pipe crossing the wadi instead of the damaged bridge.

5. Existing Branches

Branches of the Canal: The existing irrigation system used in the Nuweimeh village is a very old one. The branches have the same cross section as the main canal, which ensures proper distribution of the water in accordance to the prevailing rotation system of irrigation. There are five branches along the main canal, and each branch supplies water to several farmers through their own private canals.

6. Existing Resources (Nuweimeh Spring)

Water resources in the Western Ghor area are very limited. Springs in the area are the outlets of the aquifers and are considered as the major source of water. The existing public resources, which supply the village irrigated service area, include only one spring, which is, Nuweimeh Spring.

In the surrounding area of the Nuweimeh village, there are three springs, which are Duyuk, Nuweieh and Shoseh springs. The source of the three springs is few meters separated from each other and they yield from the same aquifer i.e. Lower Cenomanian. Table 2.1 gives basic information about the springs. The information includes the Palestinian local grid reference, altitude and the aquifer that the springs yield from.

Table 2.1
Basic Information of the Springs in the Project Area

Spring	Grid Reference (E/N) km	Altitude MSL	Aquifer
Duyuk	190.050/144.660	-115	Lower Cenomanian
Nweimeh	190.040/144.720	-110	Lower Cenomanian
Shoseh	190.000/144.800	-110	Lower Cenomanian

Source: West Bank Water Department/Hydrology Division

The drilling of wells in the West Bank is not allowed without the permission of the Israelis, and since 1967 few licenses have been given. In Nuweimeh there are only two private wells located in the farms, one of them is not functioning any more in the recent time, while the other is only used by the owner alone for irrigation purposes, the approximate abstraction from this well is $70m^3$/hour.

7. Major Problems of the Existing Canal

(A) Losses: Losses in the canal are due to the following reasons:

1. Leakage from the canal is remarkably high, the canal is very old and no maintenance has been done since the 1970's, many parts of the canal have cracks, this is clearly observed in different places. No measurements have been carried out by the village council to estimate the water quantities lost through cracks. While in a test done by ANERA, it is found that 4% of the water is lost due to vaporization and leakage from the canal. Also, there is high rate of vegetation growth around the canal, which occurs due to the cracks, and high rate of evaporation.

2. Evaporation: The monthly evaporation ranges from 59 mm in December to 298 mm in July. If the evaporation of the running water in the canal is considered to be the same as settled water, the rate of evaporation along the canal of length 5,528 meter will range from 4.1 m^3/ to 26.2 m^3 per day. This amount of losses due to evaporation contributes a percentage from 0.05% to 0.32% of the annual discharge of the spring.

(B) Damages: Along the irrigation main canal and branches, two types of damages have been observed:

Damages caused by boulders and sediments due to natural and human activities. This type of damage disturbs the free flow of water and decreases its efficiency of conveying water, and causes flooding of water at the sides of the canal.

There are other similar cases such as:

1. Al-Auja Spring, discharge 1000m^3/hr, irrigation 4000 dunums.
2. Al Nweima spring, 316 m^3/hr irrigate 2000 dunms.
3. Al Duyuk spring
4. Ein es-Sultan spring
5. Al Fara' spring where citrus, bananas are the dominant crops in these projects where springs are the main source of water.

IRRIGATION CHARGES

1. INTERNATIONAL PERSPECTIVES

It is instructive to examine other approaches to the issue of charges for irrigation water to compare experiences and current thinking. Dinar and Subramanian (1997) provide a valuable compilation of water pricing experiences over twenty-two countries. This work presents a discussion of the methodology of pricing water for irrigation, urban and industrial uses, including data on the current charges.

In agriculture, authorities generally calculate charges by dividing the average cost of service by the area irrigated, often adjusting the results by season, type of crop or type of technology used. Charges are not generally adjusted by region even though regional variations in water availability may be responsible for differential costs of supplying water and for technology.

In almost all countries the systems employed for irrigation charges are under review, as they do not reflect the conservation and cost recovery objectives which are now coming to the fore throughout the industrialized and developing world. An example of this is the current water reforms underway in the state of New South Wales in Australia (Box 1).

The range of charges associated with irrigation water is illustrated in Figure 1. Note that the figure includes both surface and groundwater sources.

0.5
0.4
0.3
0.2
0.1
0.0
Argentina Australia Brazil Canada France Israel Nambia Portugal Spain Tanzania Tunisia USA

Figure -1- Price ranges for variable irrigation charges in selected countries (1997)

Source: Dinar, A and Subramanian (1997)

Water Reform in New South Wales

In February 1994 all Australian governments agreed on a program of water pricing reform. In the past water charge systems have not been devised either to provide incentives for the efficient allocation of water resources or to cover costs. The focus of water pricing reform in the state New South Wales has been the work of the Independent Pricing and Regulatory Tribunal. This Tribunal has been charged with the responsibility of determining the prices for water which reflect the costs of efficient storage and supply. The costs of managing surface water and ground water are also to be reflected in the water price.

In relation to irrigation water, the Tribunal has recently recommended that a two-tiered system of water charging is to be developed. An access charge will be imposed to recover fixed costs and will be based on the water entitlement regardless of usage. A usage charge will be levied based on the amount actually used.

Another component of the water reform is the development of the NSW Groundwater policy. The framework document is guided by eight principles. These are:

1. A practical ethos for the sustainable management of groundwater resources to be encouraged in all agencies, communities and individuals who own, manage or use groundwater resources.
2. Non-sustainable resource uses should be phased out, for example the disposal of insufficiently treated sewerage into permeable coastal sand aquifers.
3. Significant environmental and/or social values dependent on groundwater should be accorded special protection.
4. Environmental degrading processes and practices should be replaced with more efficient and ecologically sustainable alternatives. E.g. the cap and pipe bores scheme for the Great Artesian Basin.
5. Where possible, environmentally degraded areas should be rehabilitated and their ecosystem support functions restored. This is particularly relevant to reserves affected by urban communities.
6. Integration of surface and groundwater resources where appropriate.
7. An adaptive approach to groundwater management to account for increasing understanding of the resource and changing community attitudes and needs.
8. Integration of groundwater management with wider environmental and resource management and policy development.

Launch of the policy sees the immediate activation of a statewide risk assessment of groundwater reserves to prioritize implementation of the policy. This will see a range of strategies put in place including development of:

- Groundwater management plans

- Guidelines for Local Government and industry
- Aquifer availability and vulnerability including extensive scientific analysis
- Education strategies
- Improved licensing arrangement

Source: http://www.une.edu.au/cwpr.Newsletter 10.html

OVERVIEW OF POSSIBLE CHARGE STRUCTURES

Fixed-Charge-Only

The fixed-charge-only structure is the simplest form. The charge comprises a per dunum fixed charge that would be based on the intended area of irrigation stated in the water license for example. In this method all land users pay according to their area regardless if they use water that year or not. The form of this levy structure is defined below and depicted in Figure 2.

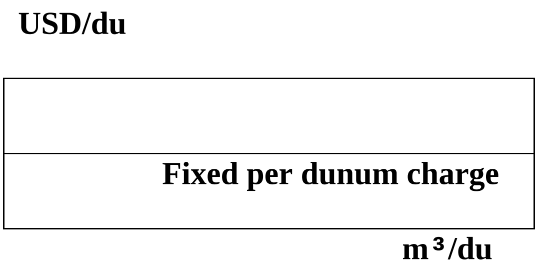
Fixed Charge = Required Revenue/Total Area

The required revenue would be dependent on the objectives of the tariff and the area of application. The objectives of the tariff could be to encourage conservation and to cover administrative costs associated with the operation of the tariff. The area of application could refer to an agricultural district.

The points to note with this structure are as follows:

- The average price per cubic meter decreases from the farmers perspective as the fixed price is spread over more units; and,
- There is no incentive to manage water because a reduction in water drawn does not reduce the water bill.

Figure 2. Fixed-Rate-Only Tariff



As a consequence of the above, this charge would not promote conservation and is not recommended.

Water-Rate-Only

With a water-rate-only structure farmers pay a specific water rate per cubic meter of consumed water. Under this scheme each additional unit of water is subject to the same rate. For the tariff application area the water rate is determined by the required annual revenue and the total annual water consumed.

The form of this structure is defined below and depicted in Figure 3:

WATER RATE = REQUIRED REVENUE/TOTAL ANNUAL WATER CONSUMPTION

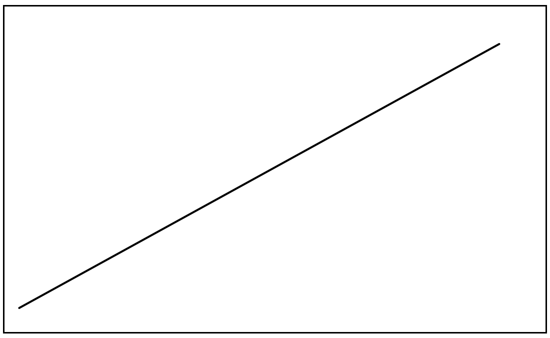
The points to note with this structure are as follows:

- This rate structure promotes efficient use of water as the farmers pays an additional amount for each extra unit of water.

- From the perspective of the charging authority this rate does not promote a stable revenue stream. However, in water short areas such as Gaza and the West Bank the issue is important should not be cost recovery but sustainability. The actual price is a secondary issue, what is important is to set the charges at a level that will ensure sustainable aquifer extraction. It should be noted also the State does not bear any of the fixed and O&M costs, which in the case of Palestine, are borne by the private sector.

Figure 3. Water-Rate-Only

USD/du



m³/du

As this charging structure encourages conservation it is recommended as an element in the charging system.

Combination Water Rate

When using a combination rate, a portion f the revenues comes is generated from fixed charges and a portion from the usage rate. The portions are a variable that can be set by the authorities according to specific objectives. Under this rate revenue can be derived independently from water consumption.

The form of this structure is defined below and depicted in Figure 4:

FIXED CHARGE = % FROM FIXED CHARGE X (REQUIRED REVENUE/AREA)

WATER RATE = % FROM WATER RATE X (REQUIRED REVENUE/ANNUAL WATER CONSUMPTION)

Note that with this structure farmers are billed according to usage but the effect of using more water is not as direct as in the water-rate-only. A variation on this model is to implement a fixed charge with a free block as well as a water rate. This structure is depicted in Figure 5.

Figure 4. Combination Rate Tariff

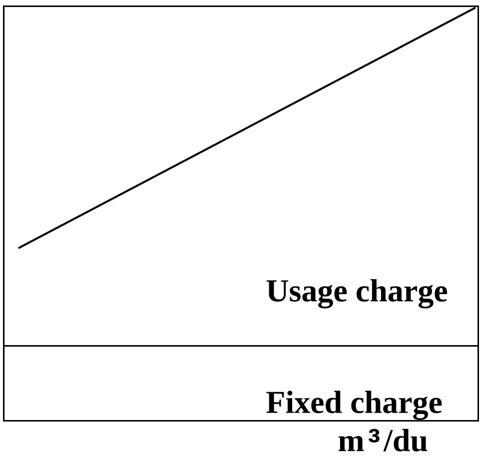
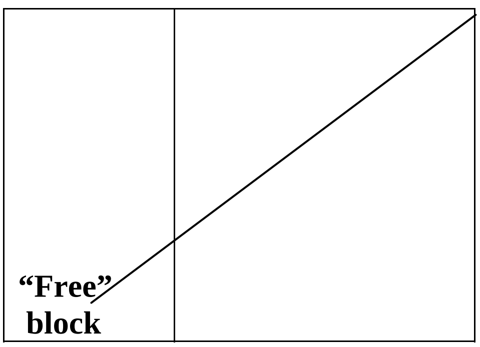


Figure 5. Free Water Block



m^3/du

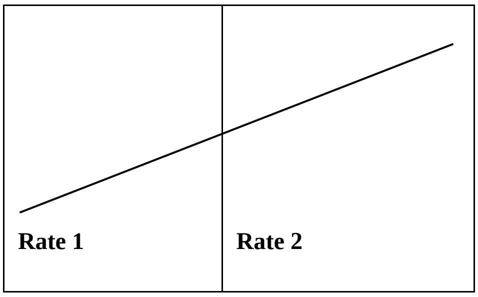
In situation where the revenue requirements are not realized as a result of this free block one option would be to increase the fixed charges. Another option would be to establish a tiered tariff structure.

Tiered

In a tiered system the farmer receives a specific allotment of water for the payment of their fixed charges. Subsequent consumption beyond the first block is charged at a higher rate. A second higher rate can be adjusted to achieve revenue objectives where required. This structure is depicted in Figure 6.

Figure 6. Tiered Levy

USD/du



m^3/du

Comparison Of Levy Structures

The advantages and disadvantages of the various tariff structures described in the previous section are illustrated below. The ticks indicate the degree of conformance in each of the criteria.

Table 1. Pros and Cons of Different Levy Structures

Tariff Type	Under-standable	Flexible	Revenue Stable	Encourages Efficiency	Equitable	Requires Measurement & Scheduling System
Fixed Charge Only	✓✓✓	✓	✓✓✓			
Water Rate Only	✓✓	✓✓	✓	✓✓✓	✓✓✓	✓
Combination	✓	✓✓	✓✓	✓✓	✓✓	✓
Combination with Free Water Block	✓	✓✓	✓✓	✓✓	✓✓	✓
Tiered	✓	✓✓✓	✓✓✓	✓✓✓	✓✓	✓

Source: US Department of the Interior Bureau of Reclamation, April 1997. Incentive Pricing Handbook for Agricultural Districts.

Existing Irrigation Water Price

It should be noted that the source of water in the West Bank is either ground water wells or springs.

1. Ground water wells:

This is found to be classified as follows:

a. An individual who drilled a well in his land prior to 1967 and irrigated his private land in this case he is responsible for covering the cost of pumping and maintenance of his well, engine, the pump and the pipes. Sometimes he sells the water to his neighbors. The cost is that he charges is 10-25 unit per m^3 of water.
b. A group of people formed an agricultural cooperative and cooperate together and drill a well and the well used to irrigate their land. In this case, the cooperative is responsible for covering all of the expenses such as diesel and electricity, but the depreciation cost is not covered. In addition to that the maintenance of the pump, engine, well is not covered, while when the engine is broken, the whole system is stopped and the farmers start to collect money in order to repair the engine. Even sometimes they have to replace the pump or the engine, they brought a used one so that the efficiency will be very low and the cost that they have to pay is much more than it should be since the operation cost of this engine will be very high. All of the above is valid for the first system (individual wells). In addition to that none of them pay the cost of water against using this water as commodity.

The price that they charge is summarized as follows:

1. More groups especially when the well is operated by electricity divided the bill of electricity over the irrigated area and this is the whole price that they pay.
2. Others in the case where the engine is operated by diesel, designed in a way that each farmer or group of farmers purchase the diesel in advance, before operating the well and operate the well to irrigate their land, this is the whole price that they pay.
3. Some of the farmers group charge the water per time, where each farmer use the whole water well for a set of time at this stage, they pay for a set of time. As example, Jayyous cooperatives charges J.D. 10 (Jordanian Dinars per one hour (80 m^3 of water). The range of payment per time is from 10–20 JD./hr. (1,2-2,5) JD/m^3 or $.15-.31 per m^3, depending on the discharge of the well. Again this only covers the operation cost. (Maintenance cost is not covered totally, no depreciation cost, no cost for water as commodity).

The Result from the above are:

1. Farmers did not pay the actual cost of water.
2. Farmers use a lot of water more than needed.
3. Many pumps and engines have been broken and the agricultural area has been damaged.

4. Many areas are left without irrigated since there is enough water to irrigate the land.
5. The over-whole irrigation efficiency is less than 50%, the application efficiency is also less than 50% as well.

2. Springs

This is the most important source where the water appears on the surface without any pumping. It should be mentioned that half of the irrigation water in the West Bank is due to springs and about 80% of the irrigated area in the Jordan Valley is totally depending on springs.

The price of the spring water for irrigation use is as follows:

a) In case of individuals where the spring is developed at individual land, the farmer utilized all the water and he is responsible for irrigating his land and for covering all the expenses. Of course the farmer didn't pay the cost of water as commodity. In this case water costs zero while if pumping is needed he will install his pump and will be responsible for operating all the system.
This kind of springs are found in all of the West Bank, but not limited in the Jordan Valley. Usually the spring discharge of this system is in the range of 1–25 m^3/hr.

b) Group of Farmers

This is the major water source in Jordan Valley. In this case the spring is developed in the village land and all the spring water is owned by the whole farmers. In this case the water is distributed to the farmers by time. The spring water is divided into a circle (round) of 5-7 days each round. As example Ein Al-Auja spring is divided into 5 days rotation. Therefore, 5 days x 24 hr = 120 hrs. then the ownership is 5 hr. or 10 hr. or ½ hr. of the whole spring water depending on his land or sometimes the spring water is divided between the families in each village where each family owns the spring water for the whole day.

The major springs in the Jordan Valley are operated in this way. These major springs are:

1. Al Auja spring, 1000 m^3/hr discharge, irrigate 4000 dunums
2. Al Nweima spring, 316 m^3/hr discharge, irrigate 2600 dunums
3. Ein Al Sultan spring, 700 m^3/hr discharge, irrigate 3000 dunums
4. Al Fara' spring, 1500 m^3/hr discharge, irrigate 8000 dunums, while the whole available land that has right in the spring water is 16,000 dunums.

In this case water is transported by closed pipe or open concrete canal to the farmers – usually farmers did not pay any cost except:

1- when there is a damage of the canal, the farmers collected the expenses required and repair it. Here it should be mentioned that the canal or even the well as mentioned previously will be of out of work for days or even weeks. In the case of spring, the water well be discharged to the wadi, and imagine what will happen to the plants especially if we know that the Jordan Valley (Jericho) is the lowest point in elevation in the world (- 392m below sea level) i.e. most of the crops will die.

The Impact of Using Irrigation of Water Free of Charges

1. Since the price of irrigation water is almost free of charge the farmers did not hesitate to use the water for any purpose: in the Jordan Valley especially Jericho, banana trees are found in this area, where 100% of the bananas in the West Bank are found in the Jordan Valley. As it is indicated from the Table 3 the irrigation water consumed by banana is 6000m^3/year/dunum and it is the most water consumer crop in Palestine. In addition to that, citrus is also found and the irrigation water requirement is 1300m^3/dunum/year.

   The irrigation water requirement of banana is four times than that required for date palm, and 7-4 times more than the irrigation water requirement of squash, tomatoes, cucumbers and potatoes.

   Banana is considered as fruit and the need for this crop is not so essential. Farmers used to grow banana and citrus even they required a lot of water due to the low price (free of water) since the source is springs.

<u>The Question Here?</u>

What is the income from banana to the farmers, in comparison to other crops. Farmers planted and used to export bananas in the 1970s to Jordan and the Gulf area where these countries did not plant banana so in the 1970s farmers used to get good income from bananas, (where they used to export water indirectly but at this moment exactly after 1995 where the export was forbidden by the Israeli Government). The average production of banana is 6 ton/dunums/year.

The actual price that the farmers are selling the banana is $400/ton. The total expenses excluding the water price is $2000 per dunum. Thus the total profit is $400 per dunum without the cost of the water and the fare of the farmer as labor; but the banana consumed 20m^3/dunum/day or around 6000 m^3/year, since irrigating banana from October to February is reduced due to the availability of rainfall. Usually farmers pay around $.3/$m^3$ cost of pumping if the farmers pay the price of water; he has to pay 6000 x $.3/$m^3$ = $1800 per dunum. This indicates that if banana farmers pay the cost of water similar to those farmers who are using groundwater wells (which he still did not pay the cost of water as commodity) he will loose money and pay from his own pocket ($1400) per dunum. It should be mentioned that each one kg. of banana requires one cubic meter of irrigation water.

The case of citrus is the same as of Banana whereas citrus requires less amount of water than banana, but the income of citrus is much less than that of banana; thus farmers in the Jordan Valley did not activate planting citrus any more.

Price of Water

The efficiency of application of the water is very low as the conveyance efficiency is less than 50% where water is transported by open deteriorated canal area (leakage and evaporation losses) exceeds 4%. In addition to that, farmers did not have the intention to repair any damage that occurs in the canal since he did not pay any cost against using this water.

In addition to that, the distribution efficiency of the water by drip irrigation is less than 70%, and the farmers are happy of that where during our visits to the farmers, we found several small ponds of water in the field as a result of pipe broken or damage and the farmer did not pay any attention to that since they did not pay any cost of water.

Conclusion and Recommendations

1. In Palestine the total cultivated area is 2,314,000 dunums, while the irrigated area is 230,000 dunums, so any effort for increasing the productivity of the cultivated area should be considered due to the large area, while the production of the irrigated area is on its maximum.

2. Providing of extra water or even to sustain the existing water for both irrigation and domestic purposes is questionable due to the increase demand for domestic purposes first and due to the Palestinian-Israeli water conflict.

3. There is no set of irrigation water price in Palestine. Due to that farmers are using the water without any care and any intention to conserve water.

4. The efficiency of the irrigation systems is not exceeding 50%. This implies not only wasting the water but also wasting the nutrients and creating environmental problems.

5. The authority especially Palestinian Water Authority started to establish water price for all water usage's in Palestine, still this has not been implemented yet.

6. Applying irrigation water price could lead to increase the availability of water that will lead to increase the irrigated area; this can be achieved by changing the crop pattern. Banana and citrus trees should be not plated any more where banana trees should be reduced even if the exporting banana is allowed since if farmers export banana he will be exporting water.

7. The irrigated area only represents 6% of the cultivated area, where the land that can be easily irrigated is estimated to be 608,600 dunums. In the West Bank only, which is 6 times the land that is already irrigated but water is needed.

8. The salinity of the ground water is deteriorated by time, due to over pumping, sea intrusion and the low rainfall especially in the Jordan Valley and in the Gaza Strip, so providing fresh water for irrigation is questionable.

9. The additional water that will be available for the Palestinians will be either from: a. Eastern aquifer, b. Jordan River, c. Treated wastewater
   Where all of this water is saline water, where there are another source such as the mountain aquifers, but this seems to be difficult to be secured soon.

10. The early possible of expansion in irrigation will be in Jordan Valley where the existing water wells and the future water that might be available is saline. But if pricing has been implemented water will be saved and can be used for irrigating additional land.

11. Shifting planting banana to other crops that consume less water will not only increase the food production but will also create additional jobs to the Palestinian farmers.

12. The existing irrigated area is already exhausted since this land used to be planted two or three times a year where the other land used to be cultivated once a year even it kept fallow on some years.

13. Palestinian Agricultural Ministry and Palestinian Water Authority should recognize the situation and consider irrigation water price as a major element for food supply.

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