Efficiency of Irrigated Agriculture in the West Bank

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Abstract

Irrigated agriculture in the West Bank constitutes less than 6% of the total Palestinian cultivated areas. There is a great potential to increase the areas under irrigation once Palestinians get their water rights from the West Bank aquifers and the Jordan River. Israel has restricted Palestinian access to their water resources and is already exploiting more than 80% of the Palestinian water resources. Palestinians in the West Bank are being limited to use 125 MCM of their water resources per year for all purposes. Of these, 89 MCM are used for agriculture which is the backbone of the Palestinian economy. Thirty nine percent of the total water quantities used for agriculture are being extracted by the Israeli settlements in the West Bank. Despite the Israeli restrictions, Palestinian farmers have been able to adopt new technologies for water conservation by using modern irrigation techniques, agricultural ponds, and rainfall harvesting. This study will asses the efficiency of water use for agriculture in the West Bank.

Introduction

Agriculture is the backbone of the Palestinian economy contributing close to one third to the GNP. Land and water are the two essential determinants of agricultural development and at the same time they are the core source of the Israeli Palestinian conflict. Immediately following the Israeli occupation of the West Bank, about 70,000 dunams adjacent to the Jordan River bank were completely sealed off. In addition, the Israeli army demolished 140 water pumps on the Jordan River which Palestinian were using to irrigate their land. Israeli settlements, on the other hand, have drilled new wells that are extracting 65 MCM of water annually.

The Jordan basin is the only source of surface water but Palestinians have no access to its water because of military closure of the areas adjacent to the river as well as the divergence of its water upstream. Under the Johnston Plan, the proposed West Ghor Canal would have supplied 150 MCM from the River to the West Bank, but plans were never carried out. Israel is also using the lower Jordan River as a dumping site for saline water from around Lake Tiberias, as well as for polluted and industrial waste water.

Groundwater is the most important source of fresh water supply in the area and consists of the main aquifer systems that are located and recharged from rainfall in the West Bank. The annual rainfall in the West Bank is estimated at 2,597 MCM. Around 600-650 MCM of this rain is estimated to infiltrate the soil to replenish the aquifers annually. The remainder is lost either through surface runoff or evaporation. The system of aquifers under the West Bank comprises several rock formations from the Lower Cretaceous to the Recent geologic age. The system is divided into western, eastern and north eastern aquifers (Fig 1.)

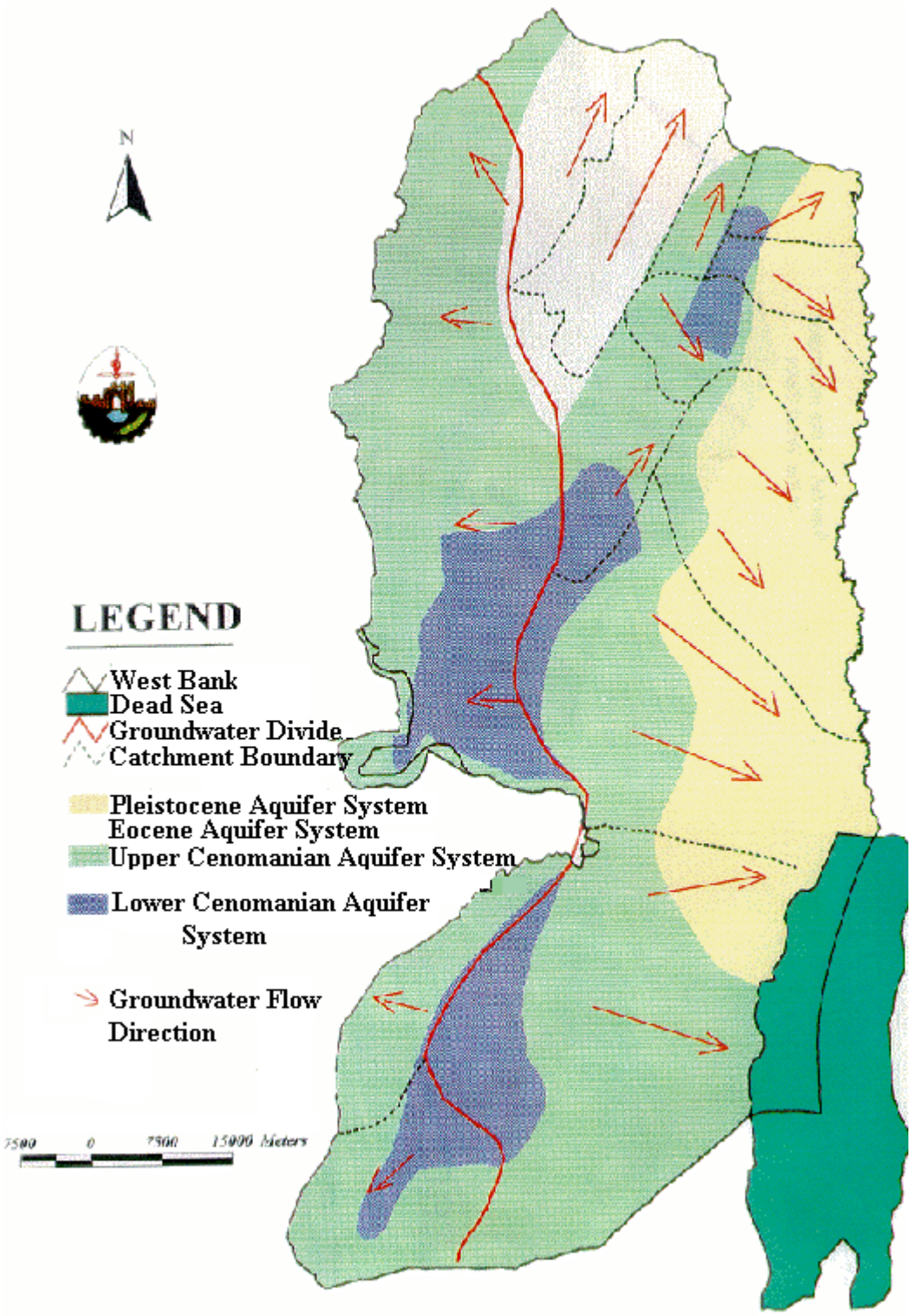

Figure 1: shows the water allocations from these aquifers as outlined in the Oslo 2 agreement.

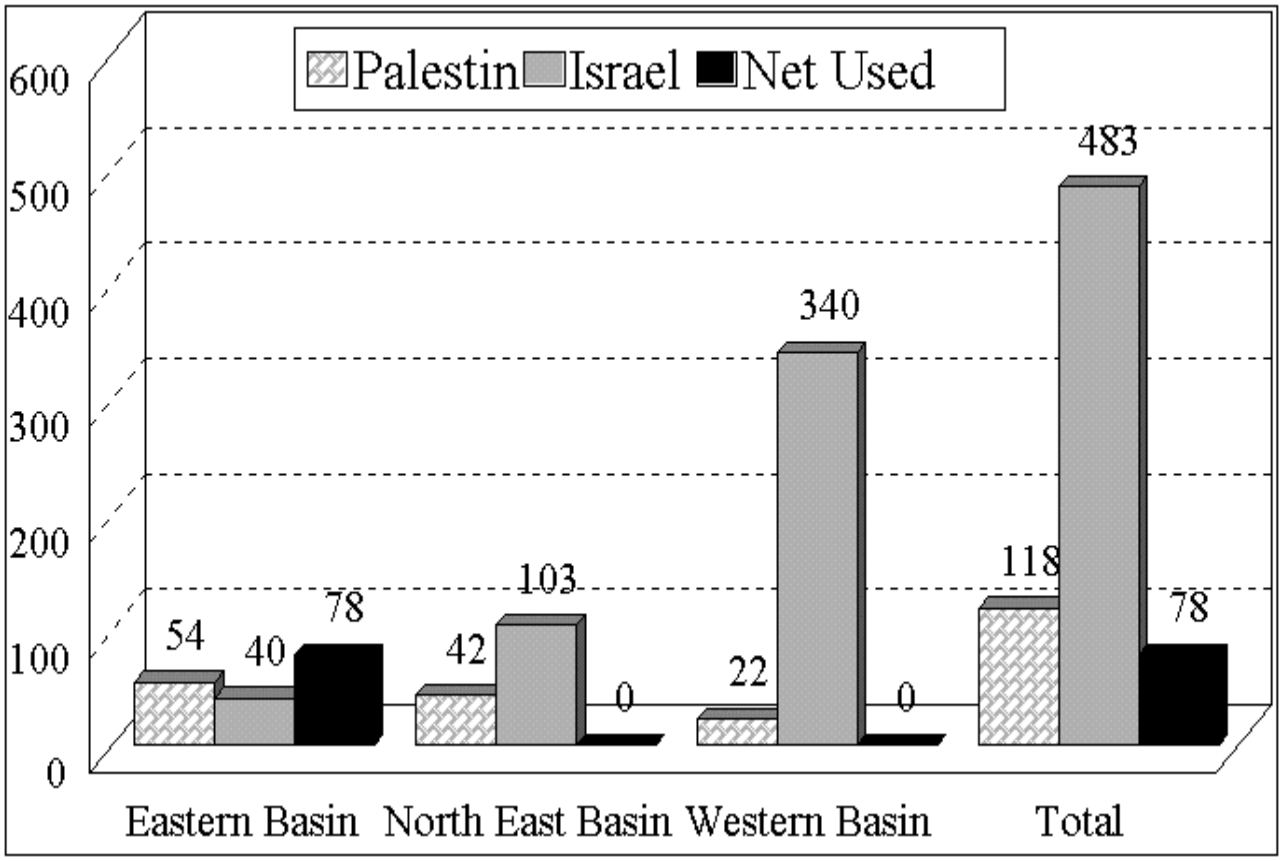

Figure 2: Current water allocations from Palestinian West Bank Aquifers

The current water allocations have not been negotiated, but rather taken by force. Thus, a major step that is needed for arriving at a just, comprehensive and lasting peace in the Middle East is to arrive at a settlement to the Palestinian and Arab water rights based on the principles of international law. At the same time, integrated water management should be promoted to ensure optimum utilization of this valuable resource. Optimization of water use for irrigation is an effective tool for proper use of water in the water-scarce area of the Middle East. Fig 3 shows the percentage of irrigated areas in selected Middle East countries which indicates that Palestine, despite water availability, has the lowest percentage because of Israel's practices.

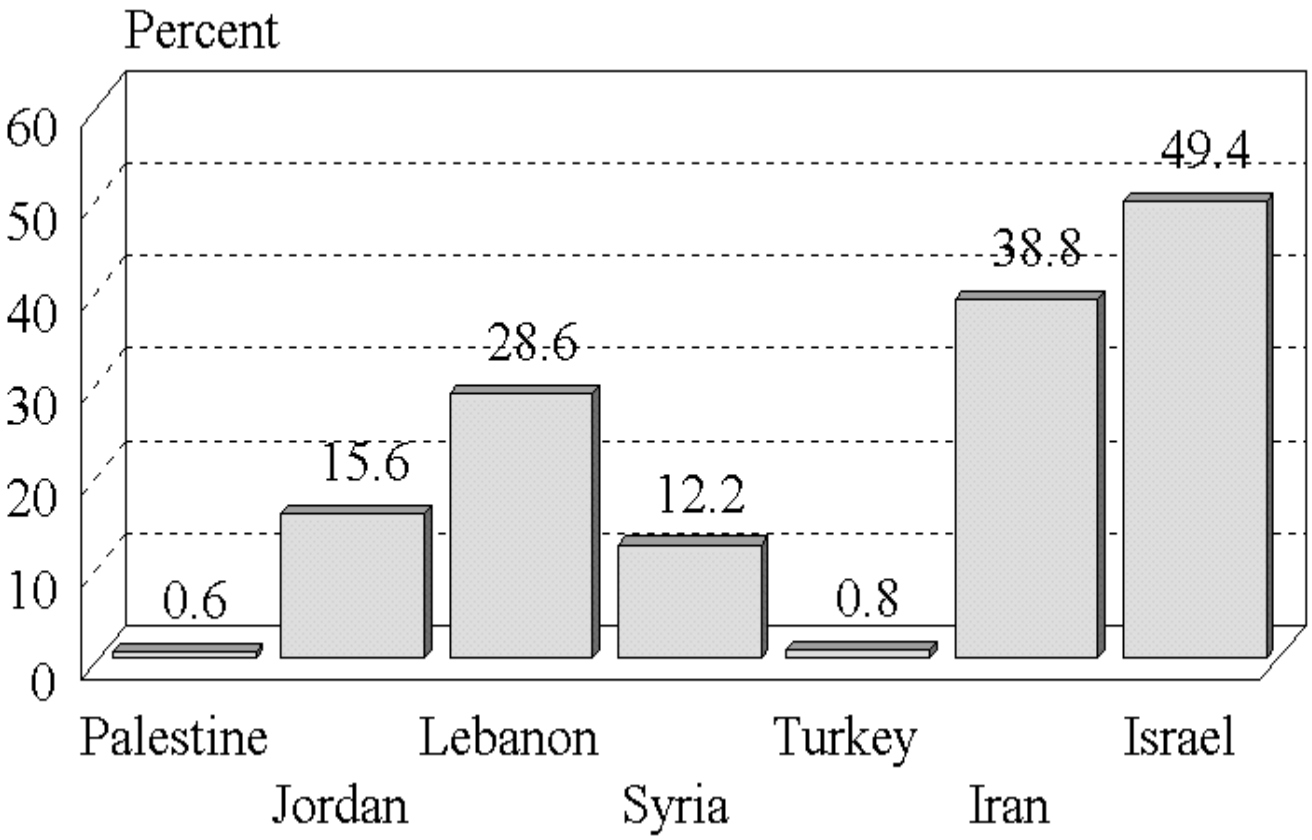

Figure 3: Percent of Irrigated agriculture in selected Middle East countries.

Irrigated areas and water use in the West Bank

The total area of the irrigated lands in the West Bank is 101615.5 dunums (1993/1994 growing season). Table 1 shows the distribution of these irrigated areas and the total quantities of water extracted from the West Bank Aquifers in different districts.

Table 1: Distribution of the irrigated lands and the Palestinian actual water use for agriculture in the West Bank, 1993/1994 (Isaac et al, 1995)

District	Area (Dunum)	Wells (MCM)	Springs (MCM)	Palestinian water use (MCM)
Jenin	11779	4.04	0	4.04
Tulkarm	29345	16.62	0	16.62
Nablus	4639	2.73	11.92	14.65
Northern Jordan Valley	28961.5	6.65	10.63	17.28
Jericho	24194	7.67	27.17	34.84
Jerusalem	Negligible	0	0	0
Ramallah	890	0	1.17	1.17
Bethlehem	814	0	0.37	0.37
Hebron	993	0	0.17	0.17
Total	101615.5	37.7	51.43	89.13

** This quantity includes pumpage in all Jordan valley.*

Source: Agricultural Departments in the West Bank.

Almost 92.7% of the total irrigated areas are concentrated in two agro-ecological areas; Semi-Coastal Region (Jenin, Qalqilya, and Tulkarm areas), and the Jordan Valley. The success of agriculture in the area is related to the combination of its location below sea level, year round weather that produce natural green house and the availability of water (from springs and wells). Citrus, Bananas, Palm trees, vegetables and field crops and forages constitute the major crops in the Jordan Valley. Vegetables constitute 64.5% of the total irrigated areas in the West Bank. About 80% of this area under open field, 11% under low plastic tunnels, 1.2% under high plastic tunnels and 7.9% under plastic houses. Fruit trees forms about 28% of the total irrigated lands in the West Bank, while the field crops constitute 7.4%.

Water Use Efficiency

Water use efficiency, which indicates how much food and/or fibre a cubic meter of water can produce, is an acceptable criterion to evaluate the usage of water. To assess water use efficiency in the West Bank, the following points have been taken into consideration:

1. Agricultural water demand in different districts of the West Bank
2. Areas and production of different irrigated crops
3. Actual water quantity consumed by the agricultural sector

- Agricultural water demand

This study looked at the crop irrigation requirements in different districts of the West Bank. Many factors were taken into consideration in calculating irrigation requirements such as leaching requirements based on the average salinity for each district. 250 different water sources in the various districts of the West Bank representing 75 % of the total water sources were analyzed at the labs of Al-Quds University. Figure 4 shows a map of the locations of the sampled Palestinian water wells and springs in the West Bank.

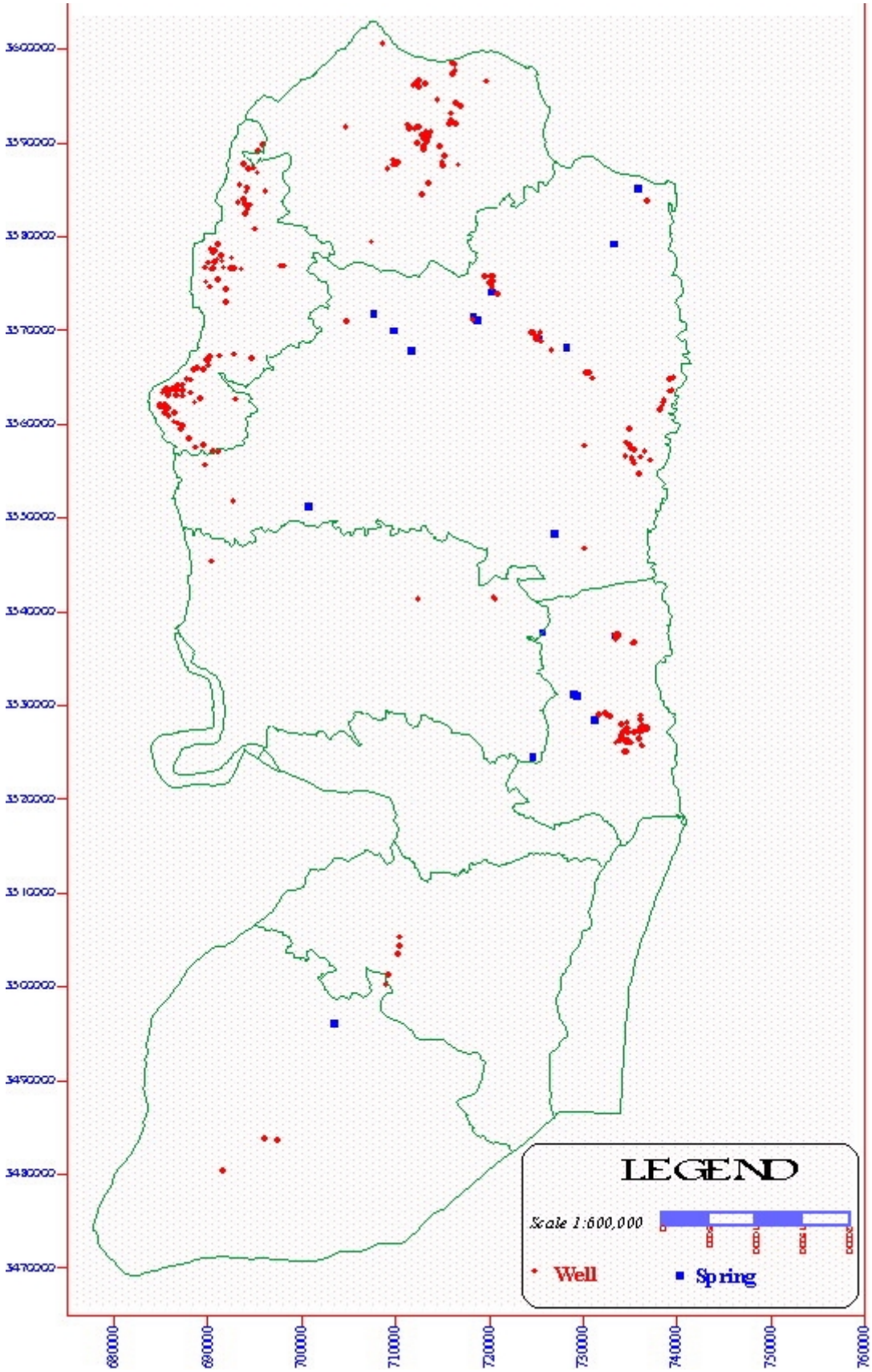

Figure 4: Locations of the sampled Palestinian water wells and springs in the West Bank.

Modified Penman-Monteith method was used by CROPWAT software to estimate crop water requirements based on different monthly weather parameters (average temperature, humidity, sunshine hours).

Table 2 shows the breakdown of actual and optimal water use for different agricultural patterns.

Table 2: Breakdown of actual and optimal water use for different agricultural patterns.

	Actual water use	**Optimal water use**		**Actual water use**	**Optimal water use**		**Actual water use**	**Optimal water use**	
		Without LR	With LR		Without LR	With LR		Without LR	With LR
	(MCM)	(MCM)	(MCM)	(MCM)	(MCM)	(MCM)	(MCM)	(MCM)	(MCM)
District	**Open Field**			**Fruit Trees**			**Field Crops**		
Jenin	2.80	6.98	7.40	1.07	2.66	2.96	-	-	-
Tulkarm	2.51	3.35	3.47	8.81	11.77	11.77	0.15	0.19	0.19
Nablus	7.73	1.72	1.76	6.80	1.51	1.51	-	-	-
North JV*	9.33	5.68	6.91	4.17	2.54	3.25	3.18	1.94	2.03
Jerusalem	0	0	0	0	0	0	0	0	0
Jericho	10.01	7.23	7.98	20.89	15.07	33.15	1.62	1.17	1.23
Ramallah	0.69	0.41	0.43	0.43	0.26	0.26	-	-	-
Bethlehem	0.36	0.40	0.40	-	-	-	-	-	-
Hebron	0.12	0.22	0.22	0.05	0.09	0.09	-	-	-
Total	33.55	25.99	28.57	42.21	33.91	5.99	4.95	3.30	3.45
District	**Low Plastic Tunnels**			**High Plastic Tunnels**			**Plastic Houses**		
Jenin	-	-	-	-	-	-	0.18	0.44	0.44
Tulkarm	0.34	0.45	0.49	1.40	0.89	0.92	4.14	5.53	5.54
Nablus	-	-	-	-	-	-	0.12	0.03	0.03
North JV*	0.40	0.25	0.30	0.03	0.02	0.03	0.16	0.10	0.12
Jerusalem	0	0	0	0	0	0	0	0	0
Jericho	2.25	1.62	1.69	0.00	0.02	0.02	0.04	0.03	0.04
Ramallah	-	-	-	-	-	-	0.06	0.03	0.03
Bethlehem	-	-	-	-	-	-	0.01	0.01	0.01
Hebron	-	-	-	-	-	-	0.01	0.01	0.01
Total	2.99	2.32	2.48	1.43	0.93	0.97	4.71	6.18	6.21

**Northern Jordan Valley*

Vegetables planted under open field constitute about 80% of the total vegetable's irrigated areas. These areas consumed about 37 % of the total irrigation consumption to produce 111911.2 tons of vegetables or 65.5% of the total vegetable's production in the West Bank . Through proper management, about 5 MCM can be saved from this sector that can be used to expand the agricultural areas. On the other hand, production of vegetables under plastic houses in the West Bank forms 21% of the total production of vegetables occupying an area of 7.9 % of the total irrigated vegetable's area. This sector consumed 4.71 MCM which represents 5% of the total water consumed in irrigation. In the plastic houses, there is a need to irrigate with more water to achieve optimal yield for the current cropping patterns. However, the availability of water and marketing potentials are two essential elements that need to be taken into consideration. The table shows also that the current usage of water for irrigating fruit trees is 8 MCM more than the actual requirements if the water quality is good but is 11 MCM less if the water quality is bad. Thus, farmers have to adapt their irrigation requirements according to the water quality available.

Table 3 shows the total agricultural water demand in relation to the actual water use for agriculture in different districts of the West Bank

Table 3:Total agricultural water demand in relation to the actual water use for agriculture in different districts of the West Bank.

District	Total area (Dunum)	Actual Water Use (MCM)	Optimal Water Use (MCM)	Water Loss/Surplus (MCM)
Jenin	11779	4.04	10.082	- 6.042
Tulkarm	29345	16.62	22.193	- 5.573
Nablus	4639	14.65	3.252	11.398
Northern Jordan Valley	28961.5	17.28	10.524	6.756
Jerusalem	0	0	0	0
Jericho	24194	34.84	25.138	9.702
Ramallah	890	1.17	0.708	0.462
Bethlehem	814	0.37	0.411	0.042
Hebron	993	0.17	0.322	0.152
Total	101615.5	89.14	72.631	6.508

It is clear that there is a water deficit in Jenin, Tulkarm, Bethlehem, and Hebron where more quantities of water are needed to achieve the optimal crop yield. However, Hebron is basically a mountainous region and irrigated agriculture is negligible in this district. In Jericho, more water quantities are needed to overcome water salinity problems to achieve optimal crop yield. In Nablus and the Jordan Valley, more quantities of water can be saved since the optimal water use is much

lower than the water applied for irrigation. In general, these figures indicate that Palestinian farmers are using water wisely for irrigation

Potentials of Development

The potential exists for horizontal expansion of irrigated areas in the West Bank. Large areas in the Jordan valley, Tulkarem and Jenin can easily put into operation once Palestinians get their water rights. The West Ghour canal, once built will provide enough water to irrigate a minimum of 150,000 dunams creating job opportunities for 300,000 Palestinian workers.

Agricultural water management

In light of the current constraints imposed by Israel on Palestinian farmers, they have adopted a series of measures and technologies aimed at optimizing the use of the water resources.

Modern irrigation systems

Modern irrigation techniques (Sprinklers and Drip systems) have been adopted since the seventies. In Jericho and Nablus districts, 97% of the vegetables are irrigated by the drip systems, and 2.4% are irrigated by sprinklers. In citrus orchards, majority of the area is served by the modern irrigation methods. All of bananas' areas are irrigated by the drip systems. In the other hand, in the semi-coastal region,70.5% of the vegetables are irrigated by drip systems, and 28% are irrigated by the sprinklers. While in the citrus orchards, large areas are still irrigated by the basins methods especially in Tulkarm district. Almost 98% of the field crop and forage areas in the West Bank are irrigated by the sprinklers.

The use of the new methods save at least 25-35 % of irrigation water while productivity also increases. The average productivity of the citrus increased from 2.4 tons/dunum by using basins method into 3 tons/dunum by using sprinklers and 3.5 tons/dunum by using the drip methods. So the productivity increased by 146% by using drip system compared with basins' method. Another important advantage for the introduction of the modern irrigation methods is that 87% of the farmers in the Jordan Valley, and 38% of the farmers in the semi- coastal region cultivate their fields more than one time per year.

Needless to say, the Palestinian farmer has been able to adopt and harness the new technologies despite the continuos Israeli repression and practices.

Agricultural Ponds

The agricultural ponds are a water storage technique which allows improving the conservation and efficiency in water use in the irrigation water delivery.

The first agricultural pond was constructed in the 1970 as a demonstration at the Jericho agricultural station with a capacity of 1650 CM. The positive results achieved by this pond encouraged the farmers to build these ponds. Some agricultural ponds have been constructed in the Jordan Valley since 1977 in order to overcome water shortage and to facilitate the irrigation scheduling process. These ponds are being fed from springs and/or rainfall where water is conveyed through open concrete or earth canals to be used at the time of irrigation. Water losses occurred through evaporation and seepage in such old networks. Soil agricultural ponds with plastic covers are the most dominant in the West Bank.

The so called civil administration imposed constraints on building more ponds unless after getting a license for any new irrigation pond.

Agricultural ponds have played an important role in irrigated agriculture through allowing better control of water irrigation management and improving the water use efficiency. Many farmers in the Jordan Valley (Auja area) used the ponds to improve the water quality by mixing the saline water comes from the wells with good water quality from the springs in order to decrease the water salinity

Rainfall harvesting by the plastic houses

Intensive irrigated agriculture is often covered with plastic sheeting. Large area of the vegetables is planted under plastic houses and high plastic tunnels. The majority of this area is located in the semi coastal region (Tulkarm & Jenin) where the average annual rainfall is relatively high. Some Palestinian farmers are using the plastic houses to harvest rainwater in cisterns and/or ponds. This method is of high potential, but most farmers have no sufficient money to construct such ponds with their conveying network, so financial support is needed. Table 6.1 shows potential water harvesting from the total area of plastic houses and high plastic tunnels based on average rainfall annual amounts in different districts of the West Bank. The total potential in the West Bank is estimated at an efficiency of 80 % to be 3 MCM/Yr. (Table 4).

Table 4: Potential Harvest from High plastic tunnels and Plastic houses.

District	Average Rainfall	Total Area	Total rainfall volume	Harvested rainfall volume (efficiency 0.80)
	(mm/Yr.)	(Dunum)	(CM/Y)	(CM/Y)
Jericho	144.4	62	8952.8	7162.24
Jenin	528	377	199056	159244.8
Tulkarm	641.7	5340	3426678	2741342
Nablus	642.6	144.5	92855.7	74284.56

Ramallah	722.6	25	18065	14452
Bethlehem	579.8	7	4058.6	3246.88
Hebron	602.1	8	4816.8	3853.44
Total		5963.5	3754483	3003586

Conclusion

The ultimate objective from the current peace process is to arrive at a comprehensive, just and lasting peace in the region where all the peoples of the area can join their efforts to develop the area and promote progress and prosperity in the region. Water will certainly be a major issue in the peace process. It is regrettable that the recent political changes in Israel has brought into power those who are obsessed with "water security" and are advocating the retention of Arab waters in Israel's control. While in principle, the resolution of the Middle East water allocations and disputes will be based on the principles of international law, there is no mechanism for this issue to be institutionalized. If the issue of water allocation continues to be addressed with an eye for might rather than justice, Arabs will remain the thirsty partner to an unjust peace. And, as is so often pointed out, an unjust peace is no peace at all. Meanwhile, Palestinians have been forced to deal with suppressed water demand situation in all sectors and this situation has to be changed for feeling the dividends of peace which all the people of the area are aspiring for.

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