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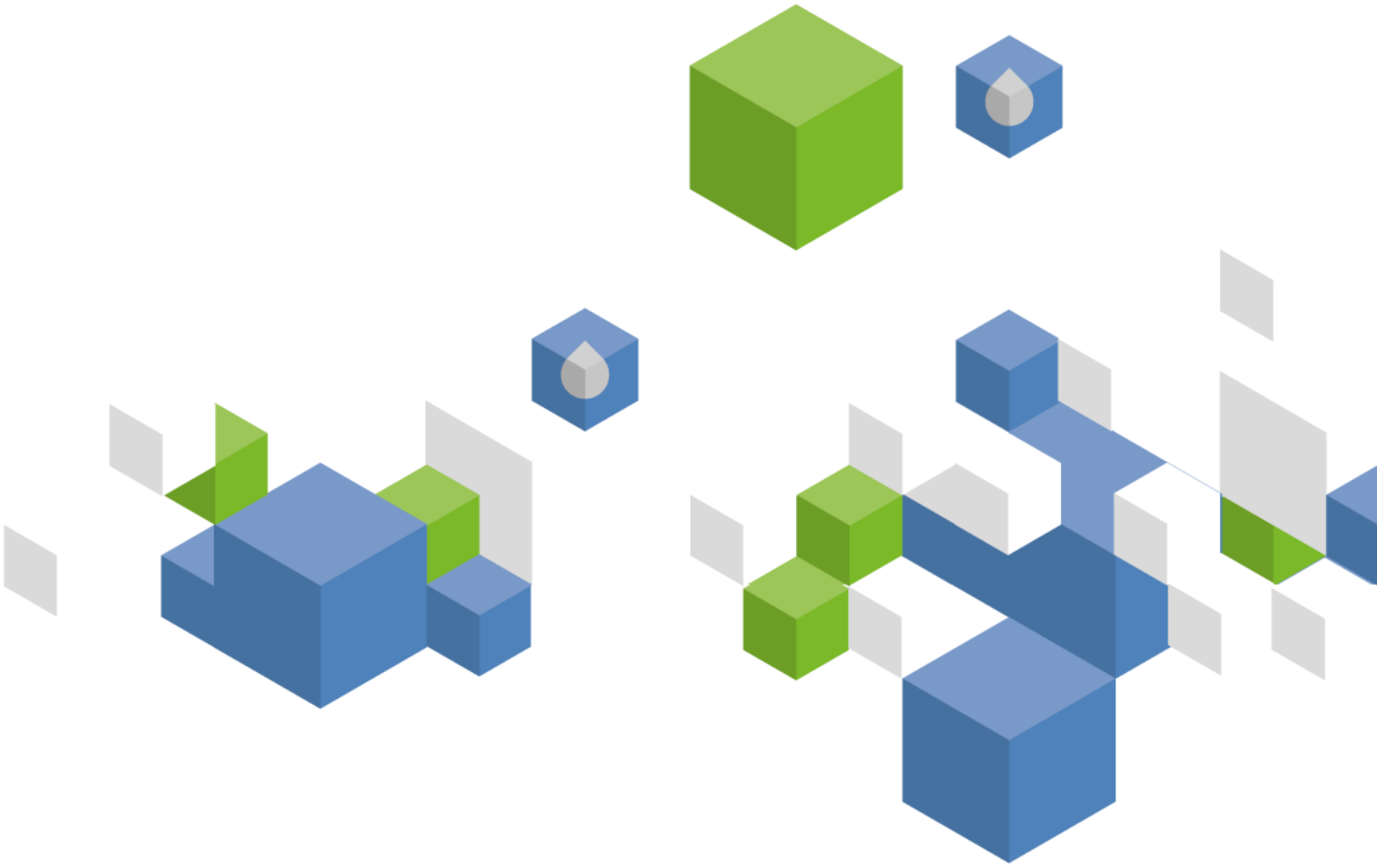

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Occupied Palestinian Territory

GEOGRAPHY, CLIMATE AND POPULATION

Geography

The Occupied Palestinian Territory has a total area of 6 020 km^2 (Table 1). The West Bank is a landlocked territory on the west bank of the Jordan River with a total area of 5 655 km^2, surrounded by Jordan to the east and Israel to the south, west and north. The Gaza Strip is a narrow coastal strip of land along the Mediterranean Sea with a total area of 365 km^2, bordering with Egypt to the south and Israel to the north and east. It takes its name from Gaza, its main city. Under existing arrangements (2008) the Occupied Palestinian Territory is not recognized as a fully sovereign state and it only has full control of parts of the West Bank and Gaza Strip. The fully controlled part, known as Area A, comprises the Gaza Strip and all of the eight largest West Bank municipalities, except 20 percent of Hebron which is under Israeli control. These municipalities include Ramallah, Jenin, Tulkarem, Nablus, Hebron, Bethlehem, Jericho and Quaqilye. Area B includes about 100 separate areas of rural land, delineated in the "Oslo Accords" maps, in which the Palestinian Authority has control over civil administration but the Israeli Authorities have control over all aspects of security. The Israeli authorities remain in full control of Area C, which amounts to about 59 percent of the West Bank.

TABLE 1
Basic statistics and population

Physical areas			
Area of the territory	2005	602 000	ha
Cultivated area (arable land and area under permanent crops)	2005	222 000	ha
• as % of the total area of the territory	2005	36.9	%
• arable land (annual crops + temp. fallow + temp. meadows)	2005	107 000	ha
• area under permanent crops	2005	115 000	ha
Population:			
Total population	2005	3 702 000	inhabitants
• of which rural	2005	28.1	%
Population density	2005	615	inhabitants/km^2
Economically active population	2005	1 066 000	inhabitants
• as % of total population	2005	28.8	%
• female	2005	27.4	%
• male	2005	72.6	%
Population economically active in agriculture	2005	108 000	inhabitants
• as % of total economically active population	2005	10.1	%
• female	2005	71.3	%
• male	2005	28.7	%
Economy and development			
Gross Domestic Product (GDP) (current US$)	2007	4 010	million US$/yr
• value added in agriculture (% of GDP)	2000	9.5	%
• GDP per capita	2005	1 083.2	US$/yr
Human Development Index (highest = 1)	2005	0.731	
Access to improved drinking water sources			
Total population	2004	92	%
Urban population	2004	94	%
Rural population	2004	88	%

FIGURE 1
Map of Occupied Palestinian Territory

OCCUPIED PALESTINIAN TERRITORY

FAO - AQUASTAT, 2008

The limestone hills of the West Bank act as a porous sponge which absorbs most of the rainwater falling on it, and much of this emerges as springs in valleys and along the margins of the highlands both east and west. Farming in the Occupied Palestinian Territory is largely determined by a variety of agro-ecologic conditions, influenced by altitude, proximity to sea and soils. Moving from east to west there are five main zones: the Jordan Valley, eastern slopes, central highlands, semi-coastal and coastal regions (FAO, 2001).

In 1998, the total cultivated area amounted to 185 011 ha of which 90 percent lie in the West Bank. Fruit trees occupied 113 840 ha of which 105 483 ha in the West Bank and 8 357 ha in the Gaza Strip (Table 2 and Table 3). With the exception of the Gaza Strip, the Jordan Valley and some parts of Qalqilya, most fruit trees are grown under rainfed conditions. Olives constitute over 70 percent of the area planted with fruit trees, while almonds and grapes occupy 8 and 7 percent respectively. Field crops are planted on 52 011 ha (48 075 ha in the West Bank and 3 936 ha in the Gaza Strip), but only in Jericho are they predominantly under irrigation. Wheat and barley are, with 32 and 28 percent respectively of the area under field crops, the main field crops planted. Field crops can also be found intercropped in orchards, especially while the trees are still young. Vegetables, grown in the open, in low plastic tunnels and in greenhouses, are planted on 19 160 ha (13 144 ha in the West Bank and 6 016 ha in the Gaza Strip).

Tomatoes, squash and potatoes occupy the majority of land under vegetables (between 10 to 15 percent each). The majority of vegetables are grown under irrigation, although watermelon, cucumber and some pulses tend to be grown under rainfed conditions (FAO, 2001).

In 2005, the total cultivated area in the Occupied Palestinian Territory was 222 000 ha, of which 107 000 ha annual crops and 115 000 ha permanent crops (Table 1).

TABLE 2
Basic statistics and population in the West Bank

Physical areas			
Area of the territory	2005	565 500	ha
Cultivated area (arable land and area under permanent crops)	1998	166 702	ha
• as % of the total area of the territory	1998	29.5	%
• arable land (annual crops + temp. fallow + temp. meadows)	1998	61 219	ha
• area under permanent crops	1998	105 483	ha
Population			
Total population	2005	2 302 000	inhabitants
• of which rural	2005	47.0	%
Population density	2005	407.1	inhabitants/km^2
Economically active population	-	-	inhabitants
• as % of total population	-	-	%
• female	-	-	%
• male	-	-	%
Population economically active in agriculture	-	-	inhabitants
• as % of total economically active population	-	-	%
• female	-	-	%
• male	-	-	%
Economy and development			
Gross Domestic Product (GDP) (current US$)	-	-	million US$/yr
• value added in agriculture (% of GDP)	-	-	%
• GDP per capita	-	-	US$/yr
Human Development Index (highest = 1)	-	-	
Access to improved drinking water sources			
Total population	-	-	%
Urban population	-	-	%
Rural population	-	-	%

TABLE 3
Basic statistics and population in the Gaza Strip

Physical areas			
Area of the territory	2005	36 500	ha
Cultivated area (arable land and area under permanent crops)	1998	18 309	ha
• as % of the total area of the territory	1998	50.2	%
• arable land (annual crops + temp fallow + temp. meadows)	1998	9 952	ha
• area under permanent crops	1998	8 357	ha
Population			
Total population	2005	1 400 000	inhabitants
• of which rural	2005	5.4	%
Population density	2005	3836	inhabitants/km^2
Economically active population	-	-	inhabitants
• as % of total population	-	-	%
• female	-	-	%
• male	-	-	%
Population economically active in agriculture	-	-	inhabitants
• as % of total economically active population	-	-	%
• female	-	-	%
• male	-	-	%
Economy and development			
Gross Domestic Product (GDP) (current US$)	-	-	million US$/yr
• value added in agriculture (% of GDP)	-	-	%
• GDP per capita	-	-	US$/yr
Human Development Index (highest = 1)	-	-	
Access to improved drinking water sources			
Total population	-	-	%
Urban population	-	-	%
Rural population	-	-	%

Climate

The climate in Occupied Palestinian Territory is predominantly of the eastern Mediterranean type with cool and rainy winters, hot dry summers and an annual rainfall in the range of 100-700 mm.

The following are the five major zones based on several factors including climate, topography, soil types and farming systems:

- *The Jordan Valley Region* lies 90-375 m above sea level with an annual rainfall of only 100-200 mm. Soil salinization is a major problem. Irrigation is essential for farming operations and winter vegetables and grapes are the main irrigated crops.
- *The Eastern Slopes Region* is a transitional zone between the Mediterranean and Desert climate with rainfall of 150-300 mm/year. The main economic activity is livestock. There is also some spring-irrigated agriculture.
- *The Central Highlands Region* extends the length of the West Bank with mountains ranging from 400-1 000 m. Annual rainfall varies between 300 mm in the south to 600 mm in the north. Agriculture is primarily rainfed and includes olives, stone fruits, field crops, etc.
- *The Semi-Coastal Region* has an elevation of 100-300 m above sea level. Rainfall varies from 400-700 mm/year. It supports the same rainfed crops as the Central Highlands Region but it also has a limited irrigated area under vegetables.
- *The Coastal Plain* is the Gaza Strip. It has a rainfall of 200-400 mm/year. The soils are fertile. Irrigated agriculture is substantially practiced using groundwater. Citrus fruits and vegetables, the latter both in the open and under plastic, are extensively grown. Overexploitation of the aquifer has led to extensive seawater intrusion and salinization of the water.

Population

In 2005, the total population of the Occupied Palestinian Territory reached about 3.7 million (Table 1), of which 62 percent in the West Bank and 38 percent in the Gaza Strip (Table 2 and Table 3). The annual demographic growth rate was estimated at 3.3 percent during the period 2000-2005. About 73 percent of the population had access to improved sanitation in 2004 (78 and 61 percent in urban and rural areas, respectively) and 92 percent had access to improved water sources (94 and 88 percent in urban and rural areas, respectively).

ECONOMY, AGRICULTURE AND FOOD SECURITY

In 1970 agriculture was the dominant sector in the Occupied Palestinian Territory economy, providing employment for a large part of the population and 36 percent of the GDP. Since then, agriculture's role in the economy has declined and the contribution of agriculture to the GDP was 9.5 percent in 2000. The agricultural sector remains, however, the main shock absorber and plays a major role in poverty alleviation and in achieving a certain level of food security for a considerable portion of the population. Most Palestinians benefit from the flexibility and sustainability of the agricultural sector in meeting basic food requirements. Statistical data indicate that this sector plays a crucial role in ensuring job opportunities and employment. In addition, agriculture has provided work for more than 39 percent of those who work in informal sectors and supports a significant proportion of Palestinian families who cultivate their lands for survival. The unemployment rate increased to 35.2 percent in the Gaza Strip and 26.1 percent in the West Bank.

Recent studies carried out in the West Bank revealed several forms of tenancy. Approximately 30 percent of the holdings are owned and farmed by the owners, 36 percent are sharecropped and the third type of tenancy is an outright rental system. Under the sharecropping system the owner usually shares in decision-making regarding agricultural activities and provides water, in the case of irrigated crops, and shares in the cost of purchased inputs. The tenant provides the labour requirements and a part of the inputs. Farm production is usually divided on a fifty-fifty basis.

The role of women in agriculture is not adequately documented but it is estimated that 71 percent of the population economically active in agriculture is female. Moreover their labour in the sector, which is substantial, is considered as family labour. Average wages for working women are lower than those for men, usually amounting to about 80 percent of the latter.

Rainfed farming predominates in the West Bank and covers about 94 percent of the total cultivated area, mostly in the Western Highlands, while in the Gaza Strip more than half of the cultivated land is irrigated. In 2003, the total irrigated land in the Occupied Palestinian Territory amounted to about 24 000 ha. Of this area 11 400 ha are in Gaza Strip, 5 400 ha in the semi-coastal area of the West Bank and about 7 000 ha in the rest of the West Bank, primarily in the Jordan Valley. Irrigated crops include citrus fruits, various kinds of vegetables, including tomatoes, cucumbers, eggplants cauliflower and others. Strawberries and cut flowers are also grown. Rainfed crops include olives (over 80 percent of all perennials), grapes, figs, almonds, plums, cereals and pulses.

An increasing number of Palestinian households are becoming food insecure in the Gaza Strip, following the declining cash income and employment, and because of the declining supply and increasing price of imported food commodities. In general, the nature of the food insecurity problem in the Occupied Palestinian Territory is essentially due to: (i) reliance on imports of basic staples (wheat/rice); (ii) lack of adequate purchasing power of the poor linked to inadequate means of employment, particularly at times of border closures; (iii) inadequate food distribution due primarily to lack of geographical contiguity; (iv) weak and inadequate domestic policies geared to increasing productivity and improving food security (FAO, 2001 and 2006). In March/April 2006, the food security situation further deteriorated with the outbreak of avian influenza.

WATER RESOURCES

The water resources in the Occupied Palestinian Territory include mainly groundwater and a little bit of surface water. The groundwater regime in the five agro-ecological zones of the territory is a multiaquifer and subaquifer system that comprises several rock formations from Cretaceous to Recent age. Most of the formations are composed of carbonate rocks, mainly limestone, dolomite, chalk, marl and clay. The various formations occur in a series of aquifers and aquacultures, in which groundwater is found in shallow, intermediate and deep aquifers. These Rock formations outcrop (i.e., expose at the surface) throughout the West Bank constituting recharge areas for this hydrological system. In addition, there is another local aquifer in the Jordan Valley area, which comprises the alluvial deposits of the Pleistocene age. The main Gaza Aquifer is a continuation of the shallow sandy/sandstone coastal aquifer of Israel (shared aquifer) which is of the Pliocene-Pleistocene geological age. This aquifer is divided into three subaquifers that overlie each other and are separated by impervious and/or semi-impervious silty clayey layers. The base of the aquifer consists of impermeable marly clay (Saqiah formation) of Pliocene age. The thickness of the coastal aquifer varies throughout the region gradually increasing from about 5 to 60 m in the east to about 10 to 160 m in the west along the coast. The aquifer is highly permeable with a transmissivity of about 1 000 m^2/day and an average porosity of 25 percent. The only permanent river which can be used as a source of surface water in the West Bank is the Jordan River, which flows from north to south from an elevation of 2 200 m above mean sea level at Mount Hermon to about 395 m below mean sea level at the Dead Sea. The Jordan River flows along a straight distance of about 140 km with a river length of about 350 km due to its tortuous path. The slope of the land and accordingly that of the river bed is slight and directed toward the south. Much steeper gradients than the Jordan River itself were found in all of its tributaries. The catchment area of the Jordan River and Dead Sea basin comprises some 40 650 km^2 (Isaac, 1999).

The total internal renewable groundwater resources in the Occupied Palestinian Territory are estimated at 740 million m^3/year of which 694 million m^3 is produced in the West Bank and 46 million m^3 in the Gaza Strip. The total internal renewable surface water resources are estimated at 72 million m^3/year in the West Bank whereas it is considered negligible in the Gaza Strip. The overlap between surface water and groundwater is considered to be zero, giving a total of 812 million m^3/year for the total internal renewable water resources (IRWR) in the Occupied Palestinian Territory. As far as external renewable water resources are concerned, the total flow of 1 578 million m^3/year from the Jordan River is unavailable because it involves brackish water and moreover this water is denied to the Palestinians. About 15 million m^3/year of surface water and 10 million m^3/year of groundwater enter from Israel into the Gaza Strip. This makes the total actual renewable water resources in the Occupied Palestinian Territory 837 million m^3/year, of which 766 million m^3/year in the West Bank and 71 million m^3/year in the Gaza Strip (Table 4 and Table 5). Surface water and groundwater outflow from the West Bank to Israel are estimated at 20 and 325 million m^3/year respectively.

TABLE 4
Water resources in the West Bank

Renewable freshwater resources			
Precipitation (long-term average)	-	409	mm/yr
	-	2.313	10^9 m^3/yr
Internal renewable water resources (long-term average)	-	0.766	10^9 m^3/yr
Total actual renewable water resources	-	0.766	10^9 m^3/yr
Dependency ratio	-	0.0	%
Total actual renewable water resources per inhabitant	2005	333	m^3/yr
Total dam capacity	1997	0	10^6 m^3

In the Gaza Strip overexploitation of the aquifer has already resulted in seawater intrusion. In the West Bank both well and spring water are available. The quality of the groundwater, particularly in the Gaza Strip and to a much lesser extent in the West Bank, has drastically deteriorated over the last twenty years due to over-pumping and subsequent salinization.

TABLE 5
Water resources in the Gaza Strip

Renewable freshwater resources			
Precipitation (long-term average)	-	300	mm/yr
	-	0.11	10^9 m^3/yr
Internal renewable water resources (long-term average)	-	0.046	10^9 m^3/yr
Total actual renewable water resources	-	0.071	10^9 m^3/yr
Dependency ratio	-	35.2	%
Total actual renewable water resources per inhabitant	2005	51	m^3/yr
Total dam capacity	1997	0	10^6 m^3

The water conveyance systems from springs to farms (often several kilometres downstream) consist of open earthen or lined canals and earthen buffer pools (usually plastic lined), the bad conditions of which are responsible for substantial losses of water through seepage and evaporation. These losses are estimated at about 15 million m^3/year. On the other hand water conveyance systems from wells to farms are made of closed systems and water losses at farm gate are usually minimal (FAO, 2001).

Due to lack of authority and Israeli restrictions, no dams were built on wadis to collect natural runoff from watersheds including urban runoff. With the increase of urbanization in the Occupied Palestinian Territory, more runoff is observed during winter months. There is a good opportunity to build dams on the major wadis of the West Bank such as El-Faria, El-Auja and Qilt. These wadis drain significant runoff amounts to the Dead Sea basin. Initial investigations showed a possibility of utilizing 13 million m3/year of runoff water by constructing dams on these wadis. Due to their location and to the water quality, these dams could be utilized for agricultural purposes. Another importance for these dams would be to store water from the springs which are located along these wadis during winter months when most of the discharge of these springs is lost due to a lack of storage facilities. Israeli Authorities constructed a storage dam on the El-Faria wadi east of Jiftlik after signing the Oslo Accords. This construction shows the feasibility of dam construction on such wadis. The other option for rainwater harvesting is utilizing small-scale storage facilities such as ponds and cisterns. There are many villages in the West Bank which still utilize cisterns for domestic purposes. Due to lack of quality monitoring for these cisterns, it is recommended that water be supplied through pipe networks for domestic purposes for these villages. Cisterns could be converted for agricultural use through small-scale home gardening. In recent years and due to water restrictions, many farmers have built ponds to collect runoff water from the roofs of greenhouses. This practice has proved to be feasible and economical and helps the sustainability of irrigated agriculture.

There are only a few wastewater treatment plants the West Bank (Al-Bireh, Ramallah, Tulkarm and Hebron), and not a single one is working properly. Thus, those plants are under reconstruction, rehabilitation, and/or expansion. There are three locations with wastewater treatment facilities in the Gaza Strip: Gaza town, Jabalia and Rafah. Reused treated wastewater in the Gaza Strip accounts for 10 million m^3.

Brackish water is available in Gaza Strip due to the low quality of groundwater there and at brackish water springs in the West Bank such as the El-Fashka spring. Brackish water could be utilized to irrigate crops which can tolerate salinity. Desalination and mixing with fresh water are also alternatives for brackish water use. However, desalination costs are still too high for agriculture to pay for them. Currently, some brackish water from irrigation wells in the Ghor area is being mixed with spring water to allow its use in agriculture.

INTERNATIONAL WATER ISSUES

During the Six Day War, in 1967, Israel took control of the Golan Heights, the West Bank, and the Gaza Strip. This gave Israel control of the Jordan River's headwaters and significant groundwater resources.

More than thirty years of Israeli occupation of the West Bank and Gaza Strip have been accompanied by a series of laws and practices targeting land and water resources in the Occupied Palestinian Territory. Water resources were confiscated for the benefit of the Israeli settlements in the Ghor. Palestinian irrigation pumps on the Jordan River were destroyed or confiscated after the 1967 war and Palestinians were not allowed to use water from the Jordan River system. In other zones, the Israeli authorities introduced quotas on existing irrigation wells to restrict the amount of water pumped from these wells. Furthermore, the authorities did not allow any new irrigation wells to be drilled by Palestinian farmers, while it provided fresh water and allowed drilling wells for irrigation purposes in the Jewish settlements in the Occupied Palestinian Territory. In 1993, the "Declaration of Principles on Interim Self-Government Arrangements" was signed between Palestinians and Israelis, which called for Palestinian autonomy and the removal of Israeli military forces from Gaza and Jericho. Among other issues, this bilateral agreement called for the creation of a Palestinian Water Administration Authority and cooperation regarding water, including a Water Development Program prepared by experts from both sides, which would also specify the mode of cooperation in the management of water resources in the Occupied Palestinian Territory. Between 1993 and 1995, Israeli and Palestinian representatives negotiated to broaden the provisional agreement to encompass more the West Bank territory. In September 1995, the "Israeli-Palestinian Interim Agreement on the West Bank and the Gaza Strip", commonly referred to as "Oslo II", was signed. The question of water rights was one of the most difficult to negotiate, with a final agreement postponed to be included in the negotiations for final status arrangements. However a significant compromise was achieved between the two sides: Israel recognized Palestinian water rights (during the interim period a quantity of 70-80 million m3 should be made available to the Palestinians), and a Joint Water Committee was established to cooperatively manage the West Bank water and to develop new supplies. This Committee also supervised joint patrols to investigate illegal water withdrawals. No territory whatsoever was identified as being necessary for Israeli annexation due to access to water resources (Wolf, 1996). In 2003, the Roadmap for Peace, developed by the United States in cooperation with the Russian Federation, the European Union, and the United Nations (the Quartet), was presented to Israel and the Palestinian Authority, with the purpose of achieving a final and comprehensive settlement of the Israeli-Palestinian conflict.

WATER USE

The total water withdrawal in the Occupied Palestinian Territory is estimated at about 418 million m^3/year, of which 189 million m^3 or more than 45 percent for agriculture (2005) (Table 6 and Figure 2). In 2000, agriculture utilized about 174 million m^3/year of which 89 and 85 million m^3 in the West Bank and Gaza Strip respectively (Table 7, Table 8, Figure 3 and Figure 4). Irrigated agriculture plays a significant role in the economy of the Occupied Palestinian Territory. Thus almost 53 percent of the total agricultural production in the West Bank is produced from only 7 percent of the land which is under irrigation. In 2005, domestic and industrial water withdrawal was estimated at 200 and 29 million m^3 respectively (PASSIA, 2003). Water in the West Bank is derived from two sources, wells and springs, while the Gaza Strip is entirely dependent on wells. In 2005, 125 million m^3 of the water withdrawn for irrigation came from wells (40 million m^3 in the West Bank and 85 million m^3 in the Gaza Strip) and the remaining 49 million m^3 came from springs in the West Bank. In 2005, primary groundwater accounted for 408 million m^3 and reused treated wastewater accounted for 10 million m^3 (Figure 5 and Figure 6).

TABLE 6
Water withdrawal in the Occupied Palestinian Territory

Water withdrawal			
Total water withdrawal	2005	418	10^6 m^3/yr
- irrigation + livestock	2005	189	10^6 m^3/yr
- municipalities	2005	200	10^6 m^3/yr
- industry	2005	29	10^6 m^3/yr
• per inhabitant	2005	113	m^3/yr
Surface water and groundwater withdrawal	2005	418	10^6 m^3/yr
• as % of total actual renewable water resources	2005	48.7	%

FIGURE 2
Water withdrawal in the Occupied Palestinian Territory
Total 0.418 km^3 in 2005

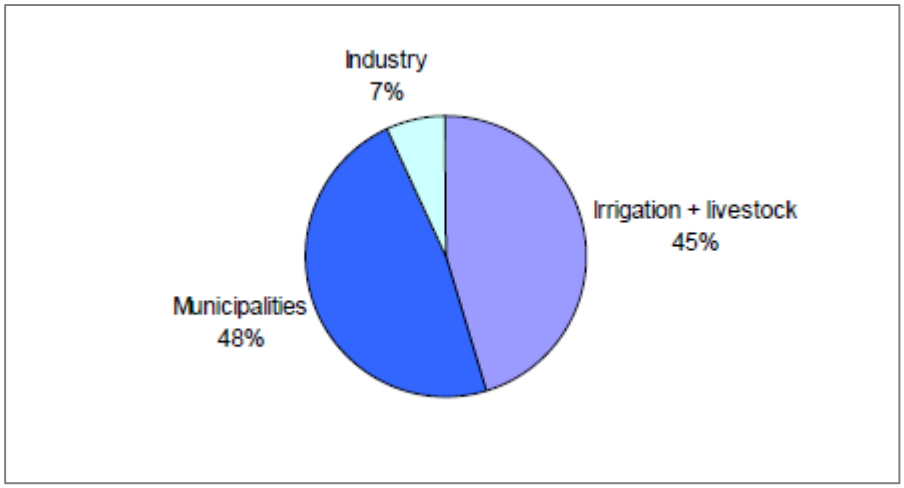


TABLE 7
Water use in the West Bank

Water withdrawal			
Total water withdrawal	2000	157	10^6 m^3/yr
- irrigation + livestock	2000	89	10^6 m^3/yr
- municipalities	2000	59.4	10^6 m^3/yr
- industry	2000	8.6	10^6 m^3/yr
• per inhabitant	2000	91.5	m^3/yr
Surface water and groundwater withdrawal	2000	157	10^6 m^3/yr
• as % of total actual renewable water resources	2000	20.5	%
Non-conventional sources of water			
Produced wastewater	-	-	10^6 m^3/yr
Treated wastewater	-	-	10^6 m^3/yr
Reused treated wastewater	-	-	10^6 m^3/yr
Desalinated water produced	-	-	10^6 m^3/yr
Reused agricultural drainage water	-	-	10^6 m^3/yr

TABLE 8
Water use in the Gaza Strip

Water withdrawal			
Total water withdrawal	2000	133	10^6 m^3/yr
- irrigation + livestock	2000	85	10^6 m^3/yr
- municipalities	2000	42	10^6 m^3/yr
- industry	2000	6	10^6 m^3/yr
• per inhabitant	2000	127.5	m^3/yr
Surface water and groundwater withdrawal	2000	133	10^6 m^3/yr
• as % of total actual renewable water resources	2000	187	%
Non-conventional sources of water			
Produced wastewater	-	-	10^6 m^3/yr
Treated wastewater	1998	10	10^6 m^3/yr
Reused treated wastewater	-	-	10^6 m^3/yr
Desalinated water produced	-	-	10^6 m^3/yr
Reused agricultural drainage water	-	-	10^6 m^3/yr

FIGURE 3
Water withdrawal by sector in the West Bank
Total 0.157 km^3 in 2000

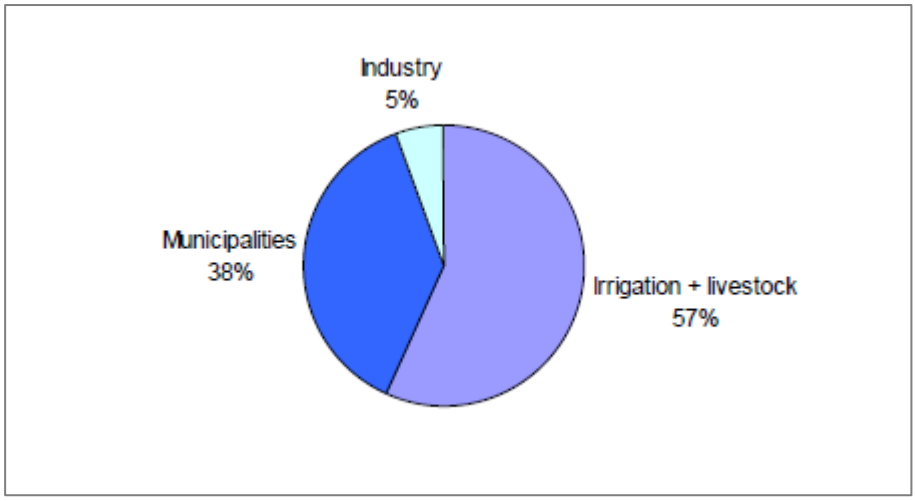


FIGURE 4
Water withdrawal by sector in the Gaza Strip
Total 0.133 km^3 in 2000

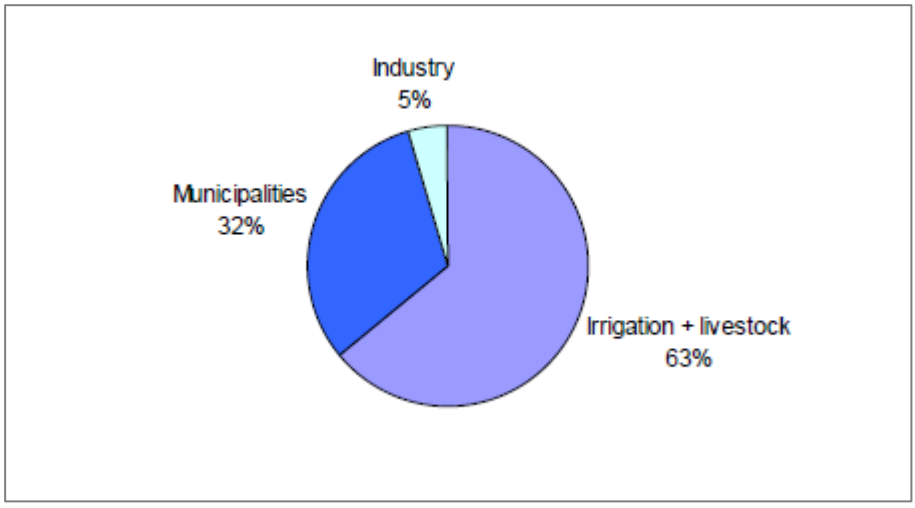


FIGURE 5
Water withdrawal by source in the Occupied Palestinian Territory
Total 0.418 km^3 in 2005

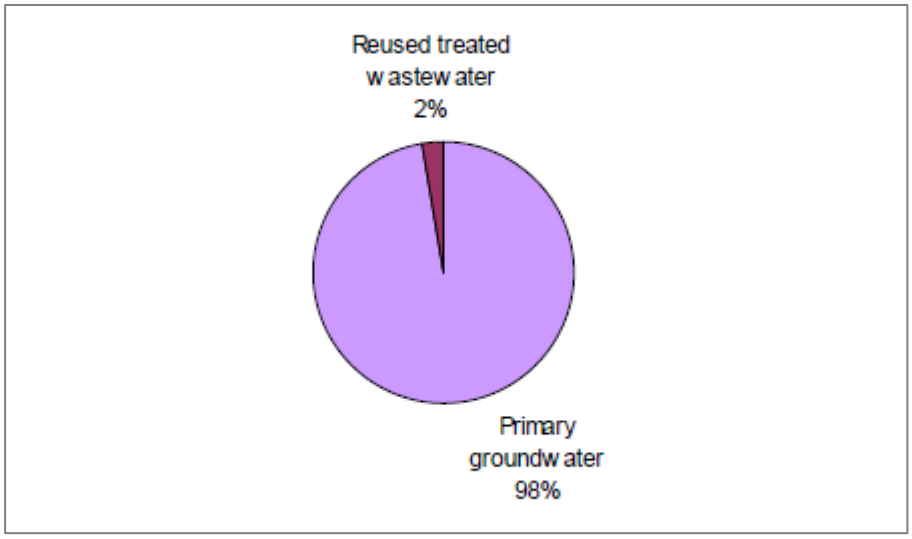
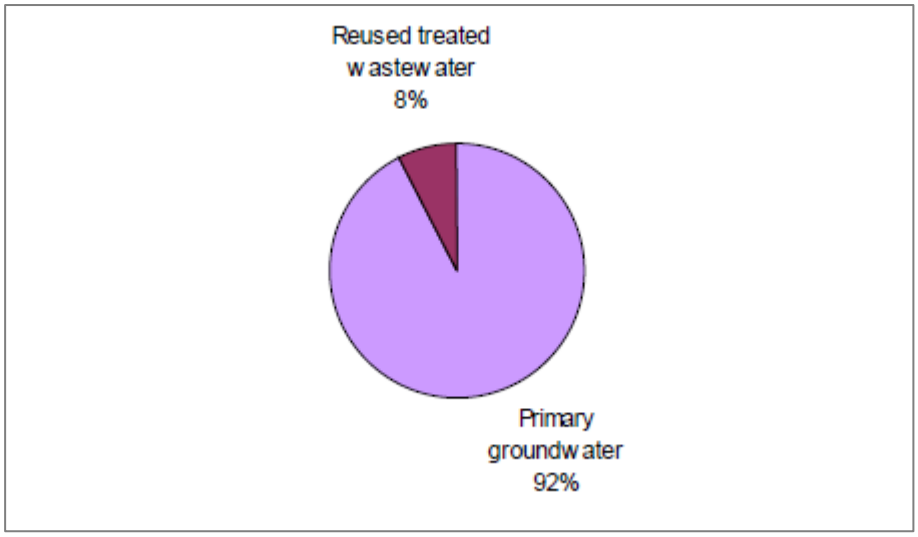


FIGURE 6
Water withdrawal by source in the Gaza Strip
Total 0.133 km^3 in 2000



The Occupied Palestinian Territory wells are 100-150 m deep, have a diameter of about 0.5 m and are iron lined. Every well has been allocated an annual quota, following the Israeli-Palestinian Agreement, and they are monitored by means of flow meters checked jointly and annually. Pumping equipment for Palestinian owned wells and conveyance systems are said to be very old, resulting in low efficiency and high operation costs. On farm irrigation is drip irrigation and in a few cases by sprinklers and flooding. In addition to these wells there are many illegal wells operating, particularly in the Gaza Strip, which are responsible for a substantial extraction of groundwater and a negative effect on the water balance of the aquifer. Salinization of the water from the shallow aquifer irrigation wells is also increasing in the West Bank particularly in the Jordan Valley.

Wells primarily used for irrigation are usually owned by big landowners who sell water to smaller or landless farmers. Those used for domestic water supply are mainly controlled by municipalities, cooperatives or village councils. Springs on the other hand are either jointly or communally owned. Some have no clear ownership rights, which invariably leads to poor maintenance and management. There were 527 springs in the West Bank (1998), but only 114 of these had a minimum discharge of 0.1 litre/second. Most of these springs are used for irrigation only; about 16 however are used for domestic water purposes.

Since the current water extraction from wells cannot be increased in order to maintain a balance between water recharge and extraction, and the spring water flow is basically influenced by the prevailing rainfall, the only way to achieve an early increase in the total water available is through improving the conveyance systems to avoid losses through seepage and evaporation and improving on farm application and water management practices. It is estimated that improvements in water management applications could reduce amount of water needed for irrigation by around 20 million m^3/year. Attention also needs to be focused on crops with a higher return per m^3 of water utilized. Crops such as bananas and citrus fruits among others have a low return per m^3 of water utilized. Greenhouse crops on the other hand, produced during the winter months with lower evapotranspiration requirements, return higher dividends per m^3 of water utilized. Attention also needs to be focused on the potential use of tertiary treated sewage water for agriculture, the potential development of the Eastern Aquifer with a yield of about 80 million m^3/year (as indicated in the Oslo Accords) as well as the possible desalination of brackish water existing in both the Gaza Strip and the West Bank and currently estimated at 90 million m^3/year.

Domestic water, usually piped, is available in all municipalities and larger villages. Metering is widely used. In many cases the distribution system is however antiquated and there is an urgent need for its gradual replacement. Old and leaky pipes are widespread and water losses in the distribution system and

through unregistered connections are estimated to reach some 45 percent. This figure is by far too high for a water deficit region like the Occupied Palestinian Territory. These losses should be gradually reduced to about 20 percent (and probably less) through the replacement of worn out pipes, better connections and certainly by better policing to ensure legal connections to the system by all the users.

IRRIGATION AND DRAINAGE

Evolution of irrigation development

There are 80 000 ha suitable for irrigation in the Occupied Palestinian Territory of which 61 000 ha in the West Bank and 19 000 ha in the Gaza Strip. In 2003, about 24 000 ha of this land were irrigated, of which 12 600 ha in the West Bank and 11 400 ha in the Gaza Strip (Table 9 and Table 10).

TABLE 9
Irrigation and drainage in the West Bank

Irrigation potential		61 000	ha
Irrigation			
1. Full or partial control irrigation: equipped area	2003	12 600	ha
- surface irrigation	-	-	ha
- sprinkler irrigation	-	-	ha
- localized irrigation	-	-	ha
• % of area irrigated from surface water	-	-	%
• % of area irrigated from groundwater	2003	100	%
• % of area irrigated from mixed surface water and groundwater	-	-	%
• % of area irrigated from non-conventional sources of water	-	-	%
• area equipped for full or partial control irrigation actually irrigated	-	-	ha
- as % of full/partial control area equipped	-	-	%
2. Equipped lowlands (wetland, ivb, flood plains, mangroves)	-	-	ha
3. Spate irrigation	-	-	ha
Total area equipped for irrigation (1+2+3)	**2003**	**12 600**	**ha**
• as % of cultivated area	-	-	%
• % of total area equipped for irrigation actually irrigated	-	-	%
• average increase per year over the last ... years	-	-	%
• power irrigated area as % of total area equipped	-	-	%
4. Non-equipped cultivated wetlands and inland valley bottoms	-	-	ha
5. Non-equipped flood recession cropping area	-	-	ha
Total water-managed area (1+2+3+4+5)	**2003**	**12 600**	**ha**
• as % of cultivated area	-	-	%
Full or partial control irrigation schemes **Criteria**			
Small-scale schemes < ha	-	-	ha
Medium-scale schemes	-	-	ha
large-scale schemes > ha	-	-	ha
Total number of households in irrigation	-	-	
Irrigated crops in full or partial control irrigation schemes			
Total irrigated grain production (wheat and barley)	-	-	metric tons
• as % of total grain production	-	-	%
Harvested crops			
Total harvested irrigated cropped area	-	-	ha
• Annual crops: total	-	-	ha
• Permanent crops: total	-	-	ha
Irrigated cropping intensity (on full/partial control irrigation area)	-	-	%
Drainage - Environment			
Total drained area	-	-	ha
- part of the area equipped for irrigation drained	-	-	ha
- other drained area (non-irrigated)	-	-	ha
• drained area as % of cultivated area	-	-	%
Flood-protected areas	-	-	ha
Area salinized by irrigation	-	-	ha
Population affected by water-related diseases	-	-	inhabitants

TABLE 10
Irrigation and drainage in the Gaza Strip

Irrigation potential		19 000	ha
Irrigation:			
1. Full or partial control irrigation: equipped area	2003	11 400	ha
- surface irrigation	-	-	ha
- sprinkler irrigation	-	-	ha
- localized irrigation	-	-	ha
• % of area irrigated from surface water	-	-	%
• % of area irrigated from groundwater	2003	100	%
• % of area irrigated from mixed surface water and groundwater	-	-	%
• % of area irrigated from non-conventional sources of water	-	-	%
• area equipped for full or partial control irrigation actually irrigated		-	ha
- as % of full/partial control area equipped		-	%
2. Equipped lowlands (wetland, ivb, flood plains, mangroves)	-	-	ha
3. Spate irrigation	-	-	ha
Total area equipped for irrigation (1+2+3)	**2003**	**11 400**	**ha**
• as % of cultivated area	-	-	%
• % of total area equipped for irrigation actually irrigated		-	%
• average increase per year over the last ... years		-	%
• power irrigated area as % of total area equipped	-	-	%
4. Non-equipped cultivated wetlands and inland valley bottoms	-	-	ha
5. Non-equipped flood recession cropping area	-	-	ha
Total water-managed area (1+2+3+4+5)	**2003**	**11 400**	**ha**
• as % of cultivated area	-	-	%
Full or partial control irrigation schemes: **Criteria**:			
Small-scale schemes < ha	-	-	ha
Medium-scale schemes	-	-	ha
large-scale schemes > ha	-	-	ha
Total number of households in irrigation	-	-	
Irrigated crops in full or partial control irrigation schemes:			
Total irrigated grain production (wheat and barley)	-	-	metric tons
• as % of total grain production	-	-	%
Harvested crops:			
Total harvested irrigated cropped area	-	-	ha
• Annual crops: total	-	-	ha
• Permanent crops: total	-	-	ha
Irrigated cropping intensity (on full/partial control irrigation area)	-	-	%
Drainage - Environment:			
Total drained area	-	-	ha
- part of the area equipped for irrigation drained	-	-	ha
- other drained area (non-irrigated)	-	-	ha
• drained area as % of cultivated area	-	-	%
Flood-protected areas	-	-	ha
Area salinized by irrigation	-	-	ha
Population affected by water-related diseases	-	-	inhabitants

Table 11 shows the distribution of irrigation technologies in the semi-coastal zone which is typical when irrigation water sources come from irrigation wells. In general drip and trickle irrigation systems are used to irrigate vegetables in the coastal, semi-coastal and the Ghor areas. A small percentage of vegetables are still irrigated by traditional methods as well as most citrus trees.

TABLE 11
Distribution of irrigation methods in the semi-coastal zone (West Bank)(1994/1995)

	Areas (ha)			
	Drip	**Sprinklers**	**Traditional**	**Total**
Vegetables	2 036.8	312.0	18.8	2 367.6
Fruit trees	97.0	514.5	1 095.3	1 706.8
Fodder	-	38.0	-	38.0
Total	**2 133.8**	**864.5**	**1 114.1**	**4 112.4**

There are still a few earth canals used in certain areas of the West Bank, such as the El-Faria and Bethan springs (producing about 10 million m^3/year) and parts of Auja (producing about 12 million m^3/year on average). In these areas, water is distributed with no charge to the farmer and the sizes of farms are usually small which increases the number of farmers sharing such sources. These canals require high maintenance costs due to weed growth and land slides in hilly areas. They also suffer from high deep-percolation and evaporation losses. Concrete canals are also used, especially in the Jericho area and parts of Auja, to convey and distribute water from natural springs to farms. The conveyance efficiency is high in such canals when they are maintained with good linings. Any losses are due to evaporation. Farmers usually use plastic lined pools to store their shares of fresh spring water and mix them with brackish well water. Then water is pumped and applied through trickle irrigation systems. From nearly all wells in the Occupied Palestinian Territory water is pumped into steel pipes which convey the water to the irrigation systems directly in the farms. This includes the coastal, the semi coastal and large parts of the Ghor and semi-Ghor zones. As the pumping costs are high, the cost per unit water is high and thus farmers need to use better distribution and conveyance efficiencies through the use of pipes. Furthermore, most farms irrigated by wells use pressurized irrigation systems, so farmers have to use the pressure head applied by the turbine pumps at the well to supply their irrigation systems with the needed pressure.

Surface irrigation systems are used either in areas irrigated by natural springs (Faria, Bethan, Nassarieh and Aqrabanieh) or for irrigating citrus trees, using basins or furrows. Basin irrigation is used mostly for irrigating trees, mainly citrus. For every tree, a small basin is constructed and water is distributed to the basins through small earth ditches and in some case using polyethylene pipes. Furrows of a helical type to minimize tail water runoff are still used to irrigate vegetables in some areas irrigated by natural springs. Application efficiency of surface irrigation systems rarely reaches 60 percent.

Solid set sprinklers are usually used to irrigate potatoes, onions, carrots, radishes and spinach. These sprinklers are often used to supply the water needed for land preparation in greenhouses and to supply water to cabbages at certain growth stages. The cost of solid set sprinklers is about US$ 4 000/ha including sprinklers, polyethylene pipes, fittings and valves.

Micro sprinklers are also used to irrigate fruit trees, especially citrus trees. Two sprinklers are usually installed per tree. The cost of these systems depends on the density of the sprinklers in the farm and the type of cropping (trees or densely planted vegetables). For trees, the cost of these systems is about US$ 3 500/ha. Application efficiency of sprinkler irrigation systems can reach 85 percent. However, due to poor design and operation of such systems the efficiency is usually less. Due to the inflexibility of water supplies, farmers sometimes tend to operate such systems for several hours. This results in application rates that are higher than the infiltration capacity of soil. Therefore, water is lost in the form of surface runoff which causes soil erosion and loss of nutrients. Most vegetable crops are irrigated using trickle irrigation.

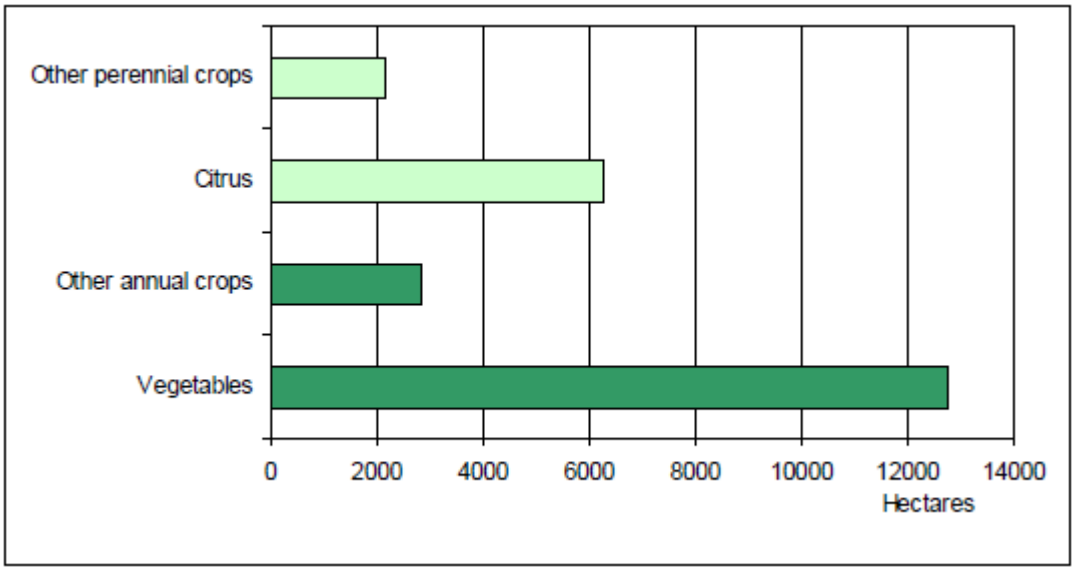
Role of irrigation in agricultural production, the economy and society

Open field vegetables are grown in the five agro-climatic zones. Common crops include tomatoes, cucumbers, eggplants and squashes. The timing for planting each type of vegetables is site dependent. For the Ghor area, they are either planted in late summer/early fall (August-October), or in late winter/early spring (January-February). Vegetables are not usually planted during summer months in the Ghor area due to the high temperatures there. In other climatic zones, most vegetables are usually planted during most of the year except winter. Frost spills are a major concern for farmers growing open field vegetables especially during late fall or early spring. Frost is possible in all climatic zones, although it is rare in the Ghor. Open field vegetables cover more than 8 900 ha or 70 percent of the total area of vegetables in the Occupied Palestinian Territory (Table 12 and Figure 6). The percentage is higher in the Ghor area than other areas due to the lower possibility of frost in that area. Productivity of open field vegetables depends on the type of vegetables and ranges from about 7 tonnes/ha for green beans to about 70 tonnes/ha for tomatoes. On average, productivity is about 25.7 tonnes/ha for open field vegetables.

TABLE 12
Cropping pattern for irrigated agriculture in the Occupied Palestinian Territory (1996/1997)

Areas (ha) and Cropping pattern						
		Coastal	**Semi coastal**	**Mountains**	**Ghor & semi**	**Total**
Fruits	Citrus	4 381.2	1 384.3	10.1	485.5	6 261.1
	Bananas	0	0	0	577.0	577.0
	Other fruits	1 321.5	119.4	1.1	142.5	1 584.5
	Sub sum	5 702.7	1 503.7	11.2	1 205.0	8 422.6
Vegetables	Open field	2 818.0	1 663.6	219.9	4 229.1	8 930.6
	Greenhouses	859.7	891.0	13.2	70.5	1 834.4
	Tunnels	638.7	674.0	0.1	680.8	1 993.6
	Sub sum	4 316.4	3 228.6	233.2	4 980.4	12 758.6
Field crops		1 436.0	397.7	0.7	1 004.4	2 838.8
Total area	**ha**	**11 455.1**	**5 130.0**	**245.1**	**7 189.8**	**24 020.0**
Total water use	million m^3/year	60.0	20.8	1.7	64.3	146.8
Production	Tonnes	341 930	189 713	5 500	199 353	736 496

FIGURE 7
Irrigated crops in the Occupied Palestinian Territory
Total harvested area 24 021 ha in 1997



Low plastic tunnels provide some protection from frost for vegetables. However, they are less efficient than plastic houses. Farmers tend to use these tunnels especially in the Ghor area to provide protection against frost and improve the agricultural microclimate. Productivity in these tunnels is usually higher than that in open field agriculture and less than that in greenhouses. Low plastic tunnels cover about 2 000 ha with a productivity of 28.3 tonnes/ha.

Plastic houses allow good control of the climate, thus allowing vegetables to be planted all year in most areas in the Occupied Palestinian Territory, but they are mostly used in the coastal and semi-coastal zones. This could be attributed to the availability of irrigation water in these zones and to the warm winter climate with low possibility of frost (but not as warm as the Ghor where production is possible in open field conditions during winter). New vegetable varieties have been introduced which are suitable for the area and have high productivity. On average, productivity in plastic houses is about 95 tons/ha, but will be much higher for certain crops such as cucumbers and tomatoes where productivity is 150 tons/ha or more. Plastic houses cover more than 1 800 ha. This area has been continuously increasing over time.

Field crops include potatoes and onions in addition to forages and grain crops. Field crops cover about 2 800 ha with a productivity of 20.7 tonnes/ha. This high average is attributed to the large areas of potatoes and onions and the low areas of forages and grain crops. Grain crops such as wheat and barley

are rarely planted under irrigated agricultural conditions with the exception of the Ghor area, where rainfall is not sufficient for planting grain field crops which are frequently planted as part of crop rotation. In areas irrigated by springs, farmers plant some field crops such as wheat, barley and alfalfa as part of their crop rotation.

Irrigated fruit trees planted in the Occupied Palestinian Territory are mainly citrus trees in the coastal and semi-coastal areas and bananas in the Ghor. In the coastal zone, the area of citrus trees was reduced from about 7 000 ha in the early 1990s to about 4 300 ha in 1996/1997. Many of these citrus trees are in poor condition and lack proper maintenance and enough water due to the low availability of water, the low quality of irrigation water and the possible loss of these lands to urbanization as a result of high land prices there. In the semi-coastal areas, the conditions of citrus farms are better than those in the Gaza Strip due to better water availability and quality. Citrus trees cover about 1 400 ha in this zone with a productivity of about 35 tonnes/ha. There are about 280 ha of citrus trees located within the El-Faria wadi which is located within two agroclimatic zones (Ghor and semi Ghor). Jericho district has about 140 ha of citrus trees which depend mainly on spring water. However, the dominant fruit trees in Jericho are bananas covering 580 ha. Although bananas consume more water than citrus trees, they sell at higher prices in the local markets, making their plantation economically feasible in the Ghor.

WATER MANAGEMENT, POLICIES AND LEGISLATION RELATED TO WATER USE IN AGRICULTURE

Institutions

The Minister of Agriculture assisted by a Deputy Minister heads the Ministry of Agriculture (MOA). It is made up of 13 Directorates covering all aspects of the agricultural sector, such as planning, marketing, soils and irrigation, land development, forests and rangeland, extension, veterinary/animal health, plant protection, fisheries etc. There are 17 Regional Departments of Agriculture, covering the whole of the Occupied Palestinian Territory, which deal with the specific requirements in research/extension at regional level.

An extended system of adaptive research and farmer training/extension was developed during the British Mandate and also under Jordanian authority. After the Israeli occupation in 1967, research and extension services were placed under the supervision of the Israeli Ministry of Agriculture, and benefited from an influx of resources and new technology. In the 1980s, funding gradually decreased, and activities virtually collapsed. Although NGOs have attempted to fill the gap left by public services, their efforts have been scattered and have fallen short of the needs of most farmers.

Institutional development was one of the first priorities of the Palestinian National Authority. At present agricultural research is carried out through the National Agricultural Research Centre (NARC) in eleven research stations in the Occupied Palestinian Territory, although they are operating at a low level.

The Ministry of Agriculture (MOA) also provides formal agricultural extension services from 17 centres throughout the Occupied Palestinian Territory. A total of 220 extension workers provide services free of charge to the farmers. In general the number of staff available is adequate for current needs; however adequate funding and staff mobility is a constraint on the optimum operation of these services, and there is an acute shortage of specialist officers for extension, research, development and planning. As a result of these inadequacies the MOA is not in a position to accept its responsibilities in full. In contrast some of the NGOs have acquired such experience and as a result there is at times some underlying tension between the MOA and NGOs.

The Palestinian Water Authority (PWA) was established by Law 2/1996 and is an institution with an independent status. It is responsible for the development and management of the Occupied Palestinian Territory water resources. It is also charged with implementing all the agreed elements regarding water (Article 40) from the Oslo Accords. In implementing its mandate it issues permits, licenses and concessions for any type of water utilization or wastewater use and has the responsibility of

implementing all policies approved by the National Water Council. The PWA is under the direct authority of the President of the PNA.

The Palestinian Hydrology Group (PHG) is a non-profit, non-governmental organization established in 1987 with the aim of protecting and developing the water resources of the Occupied Palestinian Territory. Its main activities are currently concentrated on the rehabilitation of springs and on promoting the use of cisterns (repair of old or construction of new ones) for collecting and storing rain water for use by families, schools, clinics and so on. The PHG is also involved in small-scale wastewater treatment and reuse for irrigating small home gardens. Another section of the PHG is involved in hydrological/geological studies and in water policy aspects.

Water management

The PWA prepared the National Water Plan of 2000 which is the strategic plan for the water sector until the year 2020. The plan describes the role of the service providers and shifts the functions of the PWA to regional utilities in terms of operations, maintenance, repairs, wastewater collection and treatment, bulk water supply, water reuse and allocation for industrial and agriculture use. The PWA will license and monitor drilling, abstraction and discharge (Husseini, 2004).

High water losses are observed for several reasons:

- Most irrigation wells were drilled in the late 1950s or early 1960s, during which period the irrigation distribution systems were also established. Therefore, most of the irrigation water infrastructure is old and extremely inefficient. Distribution systems at springs are mostly earth or concrete canals with very low conveyance and distribution efficiency.
- In most irrigation wells, water is pumped directly to the farmer without any storage facilities. Therefore, water is managed and scheduled according to supply availability and not according to irrigation demands. This results in a low efficiency of water use at farming level. The problem is more serious at springs where high discharge variability is a major problem in reducing the efficiency of spring water use. Storage structures would reduce the effects of variability in spring discharge and improve the efficiency of water use at the farm level.
- Many practices such as the use of traditional irrigation methods are considered inefficient and result in losses of water at farming level. A lack of water measuring devices and irrigation scheduling tools at the farm level leads to reduced water use efficiency.
- Many irrigation water sources such as wells and springs are shared or owned by groups of farmers with efficient institutional and organizational structures which could introduce or implement policies and strategies to improve the efficiency of water use. The dimensions of land tenure are also usually small for irrigated agriculture which cannot absorb the water shares from irrigation wells or springs which are divided in terms of units of time. This problem arises more in greenhouses where the sizes are small and the water shares from wells cannot be utilized without an efficient organizational structure for distributing water among farmers and allowing them to irrigate several farms at the same time with a fair distribution method.

Policies and legislation

Water-related laws date back to the Ottoman Empire period, followed by the British, Jordanian/Egyptian, Israeli and now the Palestinian Authorities. Each ruling power has enacted new laws and created different water-related institutions.

During the British Mandate Period (1922-1948) the British regulated issues related to sewerage, drainage and water use within municipalities and enacted legislation to control the scarce water resources and ensure an adequate supply for domestic use.

During the Jordanian Period in the West Bank (1948-1967) the policies considered were to:

- introduce water management related laws and concepts
- require registration and licensing of use
- limit quantities used for various uses (agriculture, domestic)
- establish water allocation principles
- empower municipalities to distribute water
- set rules for pollution of springs, canals, pools cisterns and so on
- create the West Bank Water Department to supply water to Jerusalem, Ramallah, Bethlehem and neighbouring towns and villages

Egypt did not extend its laws to Gaza (1948-1967) nor did it create new laws in the water area. The British Mandate laws continued to apply.

During the Israeli Period (1967-1994), Israel controlled the water resources as to use, management, quality, allocation and supply and distribution. Law No. 2 of 1967 declared all water resources to be State Property.

The Palestinian Authority (1994-present) faced a legal challenge in the water sector since administration and regulations were severely underdeveloped. In 1996, Law No. 2 set out the objectives, functions, duties and responsibilities of the Palestinian Water Authority (PWA). In 1997, Presidential decree No. 66 established the regulations of the water sector and its rules and procedures. Law No.3 of 2002 encompasses all water sector issues. It aims to develop and manage the water resources, increase capacity, improve quality and preserve and protect against pollution and depletion. The major departures in this Law from Israeli legislation are that water is deemed a public property (owned by the people) not state property, the state manages water resources and private use is licensed as well as all other uses (Husseini, 2004).

ENVIRONMENT AND HEALTH

In the past few years there has been a lot of urban expansion at the expense of the best agricultural lands and in Jenin, Tulkarm, Qalqilya and Gaza Strip in particular urban expansion is taking a lot of irrigated land. There are many irrigation wells in these areas which are either pumping less than their quotas or not pumping at all as a result of land losses for urban areas. Instead of expanding cities towards lands not suitable for agriculture in the mountains of Tulkarm, Jenin and Qalqilya, municipalities are expanding their boundaries towards the fertile plains which are used for irrigated agriculture.

Improper farming practices such as the excessive use of fertilizers and pesticides are negatively affecting land and water resources. Excessive fertilization in greenhouses with improper and insufficient leaching is increasing soil salinities to levels unsuitable for vegetable production. Leaching of fertilizers and pesticides to groundwater is threatening the water quality for both domestic and agricultural sectors.

Treated wastewater is becoming a highly important source of irrigation water in the Near East region. Utilizing wastewater for reuse in agriculture requires building wastewater collection and treatment systems. Up to now, the collection infrastructure has been under-designed and only a few cities have such an infrastructure. Wastewater treatment plants are not treating wastewater to levels which allow its reuse. Significant investment is needed to construct wastewater collection and treatment systems in the Occupied Palestinian Territory.

PROSPECTS FOR AGRICULTURAL WATER MANAGEMENT

Strategic options for alleviating constraints include:

- Political negotiations with Israel on land and water rights,

- Rehabilitation of the irrigation infrastructure, which should be given the highest priority to develop irrigated agriculture. This includes rehabilitation of irrigation wells, springs and water distribution systems.
- Regulation and monitoring of water, fertilizer and pesticide use.
- Construction of storage reservoirs in irrigated areas to store water from wells when supply exceeds demand. Those reservoirs will supply water when demand increases depending on the time of the day. It is suggested that farmers' water user associations are to be created to manage such reservoirs. Water gauges should be installed at each farm to measure the volume of water consumed by the farmer. A group of wells could use one storage reservoir. Gauges at wells measure the amount of water supplied from each well to estimate the amounts of water shares owned by each individual.
- Improving on-farm water management, which requires adding essential equipment to the farm such as water flow meters, pressure gauges and tensiometers in the field. Training for the use of such equipment will be needed. This is to be accompanied by increasing water supply reliability and flexibility through storage reservoirs to allow the farmer to add water according to crop demands. Other water management practices on the farm level include replacing old surface irrigation systems by new systems especially for citrus trees. Incentives for farmers could include subsidizing irrigation equipment and other equipment needed for improving water use efficiency.
- As the sizes of farms are small, there is a need to form some water user associations to manage water in a collaborative way to achieve an optimal distribution of water. Such associations should include all users in the same area depending on the sources of water. Managing a water storage facility for several wells requires an association for all farmers using these sources to set up schedules for water and to cooperate on maintenance and operation of the system.
- Without solving marketing problems for irrigated agricultural products, this sector will find it very difficult to expand and improve. Farmer unions are a tool to solve the problems farmers are facing, including marketing. Although farmers' cooperatives have not been very successful in solving problems faced by farmers, such cooperatives still are the best tool if farmers understand that cooperative work is a worthwhile commitment.
- Encouraging the private sector to improve the agricultural industry and construct storage, grading and processing facilities. This could be done through incentives such as reducing income taxes on such facilities and allowing importing such technology with tax exemptions.
- Wastewater reuse could be done in stages. The first stage would be to utilize wastewater for restricted crops such as fodder crops and fruit trees. A good example of crops that can utilize wastewater is citrus trees in Gaza, Tulkarm, Qalqilya and Jenin. After gaining experience in wastewater treatment and reuse, a move towards unrestricted crops could be made.

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