Water resources and use
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Definitions

Water resources

Water resource is one of natural resources. The definition of natural resources is natural assets (raw materials) occurring in nature that can be used for economic production or consumption. It includes both renewable natural resources and non-renewable natural resources. The water is the importance one out of all other natural resources due to relation between water and life (no life without water).

The water resources are natural assets. The distinction is made between renewable and non-renewable water resources. Non-renewable water resources are not replenished at all or for a very long time by nature. This includes the so-called fossil waters. Renewable water resources are rechargeable due to the hydrological cycle unless they are overexploited, comprising groundwater aquifers and surface water like rivers and lakes. Internal renewable water resources comprise the average annual flow of rivers and groundwater generated from endogenous precipitation.

The fresh water resources is divided into:

1- conventional water resources

- Ground water

Water that is being held in, and can usually is recovered from, or via, an underground formation. All permanent and temporary deposits of water, both artificially charged and naturally occurring in the subsoil, of sufficient quality for at least seasonal use are included. This category includes phreatic water-bearing strata, as well as deep strata under pressure or not, contained in porous or fractured soils. Ground water includes springs, both concentrated and diffused, which may be subaqueous.

It also includes both renewable and non-renewable water resources. The importance of ground water is: it is safer than surface water (less polluted and cleaner water).

- Surface water

Water which flows over, or rests on the surface of a land mass, natural watercourses such as rivers, streams, brooks, lakes, etc., as well as artificial watercourses such as irrigation, industrial and navigation canals, drainage systems and artificial reservoirs. Water abstracted through bank filtration is included under fresh surface water. Sea-water, and transitional waters, such as brackish swamps, lagoons and estuarine areas are considered non-fresh water and are not included here.

The importance of surface water is due to the low cost of production as well the cost of water use it, and fed the ground water and dams, but it has some disadvantage like high loses by evaporation and it is easily polluted.

It depends directly on the quantity of precipitation on the catchment's area during the same rainfall year.

The table below contains some indicators relates to water resources in Arabic region

Water availability indicators in the Arab region

Country	Water availability worldwide ranking (out of 182)	Water resources:		Population density in 2000 (Inh / km^2)
		Total renewable (Km^3/year)	Total renewable per capita (m^3/capita/year)	
Algeria	163	14.49	478	13
Bahrain	169	0.12	181	928
Comoros	140	1.20	1,700	317
Djibouti	164	0.30	475	27
Egypt	156	58.30	859	68
Emirates	178	0.15	58	31
Gaza	179	0.06	52	2,834
Iraq	108	75.42	3,287	52
Jordan	170	0.88	179	55
Kuwait	180	0.02	10	107
Lebanon	149	4.41	1,261	342
Libya	174	0.60	113	3
Mauritania	95	11.40	4,278	3
Morocco	155	29.00	971	67
Oman	165	0.99	388	12
Saudi Arabia	173	2.40	118	9
Somalia	144	13.50	1,538	14
Sudan	129	64.50	2,074	13
Syria	141	26.26	1,622	88
Tunisia	162	4.56	482	61
West Bank	181	0.75	--	--
Yemen	168	4.10	223	35

Source: al-weshah, UNESCO 2004

2- non conventional water resources:

Desalinated water

it includes desalinated of sea water and brackish water. This resource becomes one of the important sources of water in the poor countries, but still it is expensive and produce salt and other pollutants.

Method of water statistics

The water statistics is related to the sustainable development indicators, so it could be classified into three items: 1- pressure 2- state 3- response.

1- Fresh renewable water resources statistics it includes:

- Internal flow: Total volume of river run-off and groundwater generated, in natural conditions, exclusively by precipitation into a territory. The internal flow is equal to precipitation less actual evapotranspiration and can be calculated or measured. If the river run-off and groundwater generations are measured separately, transfers between surface and groundwater should be netted out to avoid double counting.

The definition of precipitation is a total volume of atmospheric wet precipitation (rain, snow, hail, dew...) falling on the territory of the country over one year, in millions of cubic meters (Mio m3).

This quantity could be calculated by drawing rain map contains the contour lines for rain by using long term average rainfall (average of at least twenty years).

Then calculate the area of each rain zone, after that the meteorological stations will be distributed in each zone to measure the rainfall, the total volume of rain water (precipitation) equal to the rainfall measured in the stations (in mm) times the area (in square km) the result is precipitation in 1000 of cubic meter.

Due to the dry condition in the region a lot of precipitated water was lost by **evapotranspiration** (Total actual volume of evaporation from the ground, wetlands and natural water bodies and transpiration of plants.

The 'actual evapotranspiration' is calculated using different types of mathematical models, ranging from very simple algorithms (Budyko, Turn Pyke, etc) to schemes that represent the hydrological cycle in detail) (above 90% in the ESCWA region), in addition some water lost by flood or during transport.

Outflow of surface and ground waters: Actual outflow of rivers and groundwater into neighboring countries and/or into the sea.

Renewable groundwater available for annual abstraction: it includes the available ground water and could be safely abstracted for different use during one year.

This includes Recharge of water to the aquifer layer less the long term annual average rate of flow required to achieve ecological quality objectives for associated surface water. It takes into account the ecological restrictions imposed to groundwater exploitability; other restrictions based on economic and technical criteria could also be taken into account in terms of accessibility, productivity and maximum production cost deemed acceptable by developers. The theoretical maximum of groundwater available is the recharge.

It could be mentioned that the available ground water for use includes total fresh water could be withdraw from aquifer layers without any side effect like over pumping of water. At calculated as a net value of between inflow and outflow the actual abstraction may be more than or less the safe yield.

Regular freshwater resources 95% of the time Portion of the total freshwater resource that can be depended on for annual water development during 19 out of 20 consecutive years, or at least 95 per cent of the years included in longer consecutive periods. This item yields information about the average annual long-term availability of fresh water for use in human activities.

This item yields information about the average annual long-term availability of fresh water for use in human activities, which is important information for future planning and early warning for any scarcity of water in future. It also helps in taking the proper decision in water management.

Method of filling w1:

Table w1: renewable fresh water resources

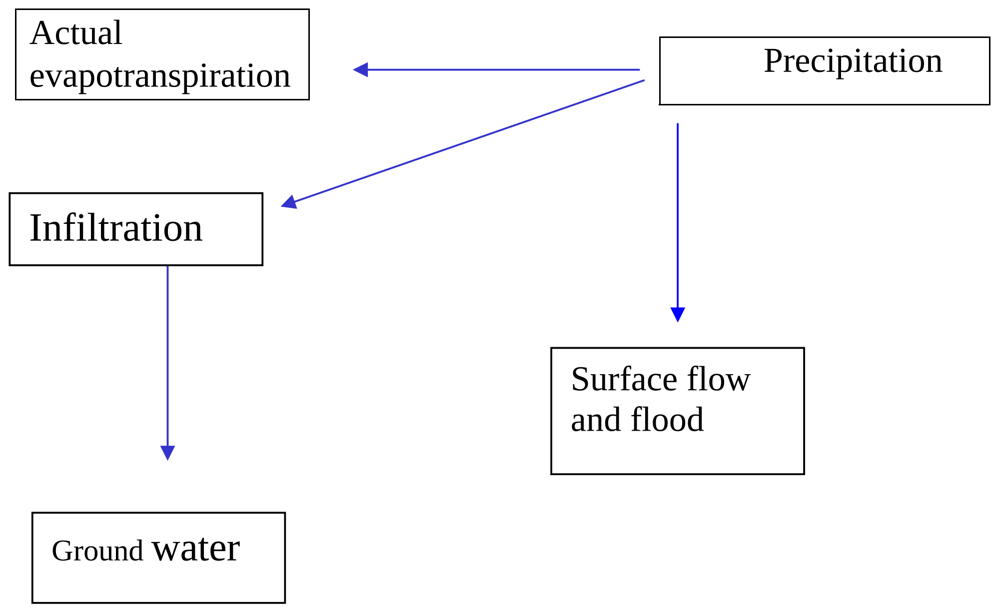
Priority	Category	Unit	Long team Annual average	1990*	1995*	1996	1997	1998	1999	2000	2001	2002
!	Precipitation (1)	Mio m3/y										
!	Actual evapotranspiration (2)	Mio m3/y										
!	Internal flow (3)=(1)-(2)	Mio m3/y										
!	Actual external Inflow of surface and ground waters (4)	Mio m3/y										
!	Total renewable fresh water	Mio m3/y										

	resources (5)=(3+4)												
	Outflow of surface and ground waters	Mio m3/y											
!	Renewable groundwater available for annual abstraction	Mio m3/y											
	Regular freshwater Resource 95% of the time	Mio m3/y											

This table covers the main issues of water resources and its availability in the country. It includes fresh water resources (surface and ground) that's come mainly from precipitation (after exclude the losses) and it fed the aquifer layer and flood in the surfaces water body.

It includes Internal flow from other countries. The climate and other limitations specify the availability of water to use from different resources. And it is included in the table as a regular freshwater resource 95% of the time.

The main source of water is Precipitation (Total volume of atmospheric wet precipitation (rain, snow, hail, dew...) falling on the territory of the country over one year, in millions of cubic meters (Mio m3). This water may be filtrated (absorbed) through soil pores to fed the aquifer layer or run on the surface of the land and surface water body, or lost by evaporation and flood.



Long-term annual average:
The table includes the items below:

1- **precipitation volume**: it measures in million of cubic meter or could be use cubic kilometer (one cubic kilometer equal to one billion of cubic meter). The long-term average is a rithmetic average over at least 20 consecutive years (represent the mean of at series of at least twenty years). The moving average will be used to update the estimation of the long term average (as example of moving average if 2004 the long term was calculated for the period of 1984 – 2004, so the moving average in 2005 represent the period 1985 – 2005). The average over available period is required in this questionnaire, please indicate the length of the time period in the footnotes.

The importance of long term average is give clear idea about the situation in general, regardless the current year if it is dry year or wet. Also the data for series of years is required, it is suggested to fill the table with available data.

2- **Actual evapotranspiration:** as mentioned above in the definition it includes evaporation from the ground, water surface, other water bodies and transpiration from plant The 'actual evapotranspiration' is calculated using different types of mathematical models, ranging from very simple algorithms (Budyko, Turn Pyke, etc) to schemes that represent the hydrological cycle in detail), this volume is varies depending on temperature, sun rise, humidity the type of plant grown and density of green land and other factors.

There is a technical coefficient for each crop grown in each climatic zone.

Agricultural specialist could measure this coefficient. (Above 90% of precipitated water lost by evapotraspiration in the ESCWA region), in addition some water lost by flood or during transport.

3- **internal flow:** as mentioned above it includes the total volume of river run-off and groundwater generated, in natural conditions, exclusively by precipitation into a territory. The internal flow is equal to precipitation less actual evapotranspiration and can be calculated or measured. If the river run-off and groundwater generation is measured separately, transfers between surface and groundwater should be netted out to avoid double counting. This variable specifies the quantity of water flow from other countries and that's in risk (for many reasons like pollution and depletion) more than the available local waters in the country.

4- Actual external Inflow of surface and ground waters: it is equal to total volume of actual flow of rivers and groundwater, coming from neighboring countries.

5- Total renewable fresh water resources: it is equal to Internal flow + Actual external inflow of surface and ground waters.

6- Outflow of surface and ground waters: Actual outflow of rivers and groundwater into neighboring countries and/or into the sea.

7- Renewable groundwater available for annual abstraction: the total volume of water could be abstracted safely from groundwater (safe yield). It equals to recharge of water to the aquifer layer less the long term annual average rate of flow required to achieve ecological quality objectives for associated surface water. It takes into account the ecological restrictions imposed to groundwater exploitability; other restrictions based on economic and technical criteria could also be taken into account in terms of accessibility, productivity and maximum production cost deemed acceptable by developers. The theoretical maximum of groundwater available is the recharge.

8- Regular freshwater resources 95% of the time: Portion of the total freshwater resource that can be depended on for annual water development during 19 out of 20 consecutive years, or at least 95 per cent of the years included in longer consecutive periods. This item yields information about the average annual long-term availability of fresh water for use in human activities.

Water abstraction

Water removed from any source, either permanently or temporarily, during a specified period of time. Mine water and drainage water is included. Water abstractions from ground water resources in any given time period are defined as the difference between the total amount of water withdrawn from aquifers and the total amount charged artificially or injected into aquifers. The amounts of water artificially charged or injected are attributed to abstractions from that water resource from which they were originally withdrawn. Water used for hydroelectricity generation is an in-situ use and should be excluded.

Table w2 water abstraction by source

Priority	Category	Unit	1990*	1995*	1996	1997	1998	1999	2000	2001	2002
!	Total fresh surface water abstracted (1)	Mio m3/y									
!	by: Public supply (ISIC 41)	Mio m3/y									
!	Agriculture, fishing and forestry (ISIC 01-05)	Mio m3/y									
	of which for Irrigation	Mio m3/y									
!	Manufacturing industries (ISIC 15-37)	Mio m3/y									
	Production of electricity (ISIC 40)	Mio m3/y									
	Other economic activities	Mio m3/y									
	Households	Mio m3/y									
!	Total fresh ground water abstracted (2)	Mio m3/y									
!	by: Public supply (ISIC 41)	Mio m3/y									
!	Agriculture, fishing and forestry (ISIC 01-05)	Mio m3/y									
	of which for Irrigation	Mio m3/y									
!	Manufacturing industries (ISIC 15-37)	Mio m3/y									
	Production of electricity (ISIC 40)	Mio m3/y									
	Other economic activities	Mio m3/y									
	Households	Mio m3/y									
!	Total gross fresh water abstraction (3)=(1)+(2)	Mio m3/y									
	Water returned without use (4)	Mio m3/y									
	Imports of water (5)	Mio m3/y									
	Exports of water (6)	Mio m3/y									
	Desalinated water (7)	Mio m3/y									
	Total reuse of	Mio m3/y									

	fresh water (8)										
!	TOTAL fresh water available for use (9)=(3)-(4)+(5)-(6)+(7)+(8)	Mio m3/y									
	Non-fresh water abstraction	Mio m3/y									

This table includes the actual volume of water abstracted from different sources (surface and ground sources), and it includes:

1- Total fresh surface water abstracted

Water which flows over, or rests on the surface of a land mass, natural watercourses uch as rivers, streams, brooks, lakes, etc., as well as artificial watercourses such as irrigation, industrial and navigation canals, drainage systems and artificial eservoirs. Water abstracted through bank filtration is included under fresh surface water. Sea-water, and transitional waters, such as brackish swamps, lagoons and estuarine reas are considered non-fresh water and are not included here.

The table required the volume of surface water abstracted by economic activity that abstract the water as follows:

Public supply (ISIC 41)
Agriculture, fishing and forestry (ISIC 01-05)
of which for Irrigation
Manufacturing industries (ISIC 15-37)
Production of electricity (ISIC 40)
Other economic activities
Households

2- Total fresh ground water abstracted

Occurring in the subsoil, of sufficient quality for at least seasonal use are included. This category includes phreatic water-bearing strata, as well as deep strata under pressure or not, contained in porous or fractured soils. Ground water includes springs; both concentrated and diffused, which may be subaqueous.

Public supply (ISIC 41)
Agriculture, fishing and forestry (ISIC 01-05)
Of which for Irrigation
Irrigation water: Water, which is applied to soils in order to increase their moisture content and to provide for normal plant growth.

Manufacturing industries (ISIC 15-37)
Production of electricity (ISIC 40)
Other economic activities
Households

Total gross fresh water abstraction

Total of fresh surface water and fresh groundwater abstractions over one year within the national territory. And it equals to surface water abstracted and ground water abstracted.

3-Water returned without use:

Water abstracted from any fresh water source and discharged into fresh waters without use, or before use. Occurs primarily during mining and construction activities. Discharges to the sea are excluded.

4- Imports of water

Total volume of bulk fresh water that is imported from other countries as a commodity through pipelines or on ships. Bottled water is excluded.

5- Exports of water

Total volume of bulk fresh water that is exported to other countries as a commodity through pipelines or on ships. Bottled water is excluded.

6- Desalinated water

Total volume of water obtained from desalination processes. (From seawater, brackish water etc)

7- Total reuse of fresh water

Fresh water that has undergone wastewater treatment and is deliverable to a user as reclaimed wastewater. This means the direct supply of treated effluent to the user. Excluded is wastewater discharged into a watercourse and used again downstream. Recycling within industrial sites is excluded.

8-Total reuse of fresh water

9- Total fresh water available for use:

The total volume of freshwater available for use is composed of water abstracted from fresh (surface and ground) water resources of the country, of water originating from other sources, such as imports of bulk water from other countries or desalinated water from non-fresh water resources, and the reuse of treated waste water (reclaimed water). Water that is returned without use (e.g. mine water) and water exported in bulk to another country are not considered to be available for use and are therefore subtracted from the total. Abstraction of freshwater is broken down by main water abstractor sectors/activities, according to the International Standard Industrial Classification of All Economic Activities, Third Revision (ISIC Rev.3). Please note that water abstracted directly from the atmosphere into storage tanks is not accounted for.

10- Non-fresh water abstraction

Includes seawater and transitional water, such as brackish swamps, lagoons and estuarine areas.

Water, which is being held in, and can usually, be recovered from, or via, an underground formation. All permanent and temporary deposits of water, both artificially charged and naturally

Water supply

`Water Supply System: system for the collection, transmission, treatment, storage and distribution of water from source to consumers, for example, homes, commercial establishments, industry, irrigation facilities and public agencies for water-related activities (fire-fighting, street flushing and so forth).

Table w3: water use by supply, category and activity

P	Category	U	1	1	1	1	1	1	2	2	2
!	Total public water supply (ISIC 41) (1)	m									
	of which used by: All economic actitivites	m									
	Agriculture, forestry, fishing (ISIC 01-05)	m									

	of which for irrigation	m										
	Manufacturing industries (ISIC 15-37)	m										
	Production and distribution of electricity (ISIC 40)	m										
	Other economi	m										

	cactivities										
	Households	m									
	Self-supply (2)	m									
	Other supply (3)	m									
	Total water supply	m									

	(4)=(1)+(2)+(3)										
	Water losses during transport	m									
!	Population connected to public water supply	%									

1-Total public water supply (ISIC 41) (1)

Water supplied by economic units engaged in collection, purification and distribution of water (including desalting of sea water to produce water as the principal product of interest, and excluding system operation for agricultural purposes and treatment of waste water solely in order to prevent pollution.) It corresponds to ISIC division 41. Deliveries of water from one pubic supply undertaking to another are excluded.

Of which used by:

All economic activities

Agriculture, forestry, fishing (ISIC 01-05)

Of which for irrigation

Water, which is applied to, soils in order to increase their moisture content and to provide for normal plant growth.

Manufacturing industries (ISIC 15-37)
Production and distribution of electricity (ISIC 40)
Other economic activities
Households

2-Self-supply
Abstraction of water for owns final use. Includes water drawn from village wells.

3-Other supply
Any supply of water not specified elsewhere. In particular, supplies from commercial and industrial establishments, whether marketed or not. Also included is supply of reusable water.
Total water supply (4) = (1)+(2)+(3)
Delivery of water to users and abstraction for own final use. Total water supply excludes water used in hydropower generation. (Total public water supply + Self-supply + Other supply)

4-Total water supply is the volume of water supplied for final use, either as public water supply (by economic units belonging to ISIC 41), as self-supply (where the abstractor is also the end user), or as other supply (where the abstractor supplies the water to a different end user). Public water supply is broken down by main groups of activities to which the water is supplied according to ISIC rev.3.

5-Water losses during transport: is the volume of water lost during transport between a point of abstraction and a point of use, and between points of use and reuse.

6-Population connected to public water supply %:

Water Resources in Jordan*

(prepared by *Emad K. Al-Karablieh)*

This section highlights the scarce resources in Jordan with special attention being paid to the agricultural resources in rained and irrigated areas. It is necessary to understand the economical, ecological, and social constraints that might hinder the adoption of new production practices and delay a technological change.

Water is the most limiting factor for agricultural development in Jordan. It is very scarce, and there is increasing demand for it for non-agricultural purposes. Jordan receives rainfall of about 6,000 million cubic meters (MCM), and the Syrian catchment of the Yarmouk river Basin receives an additional 2,065 MCM. High evaporation and infiltration results in a relatively small annual stream flow, amounting to only about 878 MCM, excluding the Jordan flow. The potential for further development of surface water resources rests principally with the construction of the proposed Al-Wehdeh Dam on the Yarmouk River. This dam would provide an annual safe yield of about 105 MCM, 55 MCM would be needed for manufacturing and industrial uses in Irbid region and the remaining 50 MCM will be used to intensify agricultural production in the Jordan Valley.

In addition to the overall constraints of this resource, there are other problems which limit its large-scale usage for irrigation purposes. One of the most important problems, in addition to the growing costs of water pollution and the excess pumping of groundwater especially in highlands area (Dheleil and Azraq basins), is the exceeding of the safety limits which leads to the depletion of resources and an increased salinity of the water.

In the future, strong competition can be expected between the agricultural sector and the other sectors regarding their shares in water consumption. This will definitely affect the agricultural sector's share of water, due to the priority given to securing water for domestic and industrial purposes. Shatanawi et al. (1987) investigated the water requirements of wheat and barley in the Jordan Valley. The study indicates that the water use efficiency was 0.75 m3/kg and 0.85 m3/kg for wheat and barley respectively. 3/4 cubic meter of water is the mean required to produce one kilogram of wheat. If wheat consumption in 1997 was used to calculate the water requirements for self-sufficiency of wheat, 470 MCM of virtual water and 1,566 irrigable dunums with an average of 400 kg/du should be allocated to wheat production. Therefore, Jordan is considering among the poorest countries in the world in terms of water resources. The climate is generally arid, with more than 90% of Jordan's total area receiving less than 200 millimeters rainfall per year and more than 70% of the country receiving less than 100 millimeters of precipitation on a year. Only around 2% of the land area, located in the northwestern highlands have an annual precipitation exceeding 300 millimeters, though the northern highlands may receive as much as 600 millimeters. About 5.5% of Jordan's area are considered dry land with annual rainfall ranging from 200 to 300 millimeters as shown in Table 2. The pattern of rainfall is characterized by an uneven distribution over the various regions, and strong fluctuation from year to year in terms of quantity and timing.

The available surface water is derived mainly from the Jordan River tributaries, i.e. the Yarmouk River that rises in Syria and the Zarqa River that comes from the East Bank of the Jordan Valley. This valley is a 105-km long and 4 to 16 km wide depressions, with an elevation from 200 m below sea level in the north down to 400 m below sea level at its southern end on the Dead Sea (Jordan Valley Authority, 1997). The average annual temperature is 24° C, with a mean maximum temperature of 36° C in summer and a mean minimum temperature of 14° C in winter. Rainfall occurs from November until mid-April, and decreases from 377 mm/year in the north to 87 mm/year in the south. The average relative humidity is 65% in winter and 45% in summer (Department of Meteorology, 1999).

The Jordan Valley Authority (JVA) established an irrigation network system to serve 31,174 ha in the fertile valley on Jordan's western border, an area that makes a significant contribution to the total tonnage of fruit and vegetables produced in Jordan. The annual supply of water amounts to 252 MCM in total, with the Yarmouk and Zarqa Rivers supplying about 72% and 20%, respectively and the Jordan River East Bank wadis1 providing the remaining 8%; from the overall total, 200.6 MCM are available for agricultural use, while the rest is diverted for municipal uses to Amman. As a result, the average volume of irrigation water available/dunum/year is about 640 m3, which is a very small amount compared with other countries.

Six main dams provide a gross storage capacity for irrigation water of about 173.3 MCM. Two dams are located in the northern part of the valley, two in the middle and two in the southern part. The two dams in the middle of the valley have the highest storage capacity with about 139 MCM, followed by those in the north with about 24.3 million m^3 and the dams in the south with about 10 MCM. The main, concrete-lined conveyor of water, the King Abdullah Canal, starts at the northern end of the valley and serves most of the valley's irrigated land.

Treated wastewater represents another essential element in the Kingdom's water strategy; approximately 95% of the total volume of treated wastewater are utilized for irrigation. The treated effluent of the major urban areas is added to the stock of irrigation water and, in 1999, constituted more than 20% of irrigation water resources in Jordan. Furthermore, treated wastewater compensates for that share of irrigation water that has to be diverted to meet municipal water demands.

Waste stabilization ponds are used extensively in Jordan, and clearly provide the least cost option for the treatment of sewage. At Al-Samra, the quality of the wastewater

1 Wadi is the Arabic term for erosion depressions that run water only after rainfalls

is claimed to be poor, but the low BOD removal efficiency is the consequence of algae in the effluent of such facilities. Waste stabilization ponds appear suitable for use in Jordan, but suffer from evaporation and seepage losses and can be a source of odors if overloaded or poorly designed. Chlorination is relied upon to disinfect wastewater prior to discharge (World Bank, 2001).

The direct use of treated wastewater in Jordan is limited. A small portion is used to irrigate trees in the vicinity of the treatment plants, while the major portion is discharged, after treatment, into wadis and so reaches the reservoirs used for restricted irrigation. The largest wastewater treatment plant (Al-Samra, Amman) contributes approximately 75% of the wastewater generated in Jordan (40 MCM/year). The treated effluent from the Al-Samra plant is discharged into the Wadi Zarqa Basin system and flows into the King Talal Reservoir located about 42 kilometers from the plant. In the reservoir, the treated wastewater is mixed with water from the Zarqa River Basin in a ratio of approximately 1:1. Water from this reservoir is used to irrigate lands within the middle and southern zones of the Jordan Valley (World Bank, 2001).

A program of continuous monitoring of all watercourses carrying wastewater is being carried out by the Department of Environmental Health, which sets the parameters for the wastewater quality and monitors the effluent discharge from wastewater treatment plants by taking random samples up to four times per month for analysis. However, Jordanian standards do not permit the use of treated wastewater for the irrigation of crops that are likely to be eaten raw.

Jordan is characterized by a pronounced scarcity of renewable fresh water resources, which averages at about 680 MCM per year, or approximately 135 m3 per capita for all uses. Thus, Jordan's water resources are, on a per capita basis, among the lowest in the world.

The water resources of Jordan consist of groundwater and fossil water which extends in aquifers in different depths throughout Jordan, of surface water flows from precipitation in the Jordan River Basin, from an increasing amount of treated waste water effluent, and from non-conventional water resources such as brackish water.

As the current use of water already exceeds available renewable supplies, Jordan covers the increasing deficit through over drafting of highland aquifers and exploitation of non-renewable groundwater. In the period 1991-1997, the annual average over drafting of groundwater resources reached more than 230 MCM.

The total water consumption in Jordan increased by more than 28%, from 639 MCM in 1985 to 821 MCM in 1997, with an average amount of 807 MCM over the whole time period. However, strong yearly fluctuations can be observed due to high variation in rainfall.

Water for municipal uses showed the highest increase in average annual water consumption (153 -216 MCM) and with 5% the highest increase in share of total average water consumption between the period 1985-1990 and 1991-1997 as shown in Table 3. The share of total average consumption 1985-1997 amounts to almost 23%. Water use for the industry stagnated at around 33 MCM that compares to a 4% share of the total average water consumption during the entire time period.

Irrigation water for agriculture makes up the largest part of total average water consumption with 72.5% over the time period 1985-1997. The average annual water consumption between 1985-1990 and 1991-1997 has increased by a total of 34 MCM as shown in Table 4. However, the average share of irrigation water in total water use has decreased by 5% between 1985-1990 and 1991-1997.

Water consumption for livestock production has increased slightly but constitutes only 0.9% of the total average water consumption between 1985 and 1997. It has to be noted that annual water uses for the agricultural sector vary considerably due to variation in climate

For the agricultural sector the potential for water saving by increasing the efficiency of water utilization and improving the irrigation management is considerable and should be pursued with high priority.

Water Table: level below which water-saturated soil is encountered. It is also known as groundwater surface.

Water Conservation: preservation, control and development of water resources, both surface and groundwater, and prevention of pollution.

Freshwater: naturally occurring water having a low concentration of salts. It is generally accepted as suitable for abstraction and treatment to produce potable water.
Surface Water: all water naturally open to the atmosphere, including rivers, lakes, reservoirs, streams, impoundments, seas, estuaries and so on. The term also covers springs, wells or other collectors of water that are directly influenced by surface waters.

Groundwater: freshwater beneath the earth's surface (usually in aquifers) supplying wells and springs. Because groundwater is a major source of drinking water, there is a growing concern over leaching of agricultural and industrial pollutants or substances from underground storage tanks.
**source Al-Karablieh 2001*