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Water Statistics and Accounts for Jordan: Part II

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Abstract
Water accounts considered one of the tools that can be used to evaluate the input and output of water in different sectors. The objective of this paper is to highlight some economic aspects of water use in Jordan. The paper was concerned with two parts. The first economics of water use in different sectors while the second concerned with the emissions evolved. The results of this paper showed that the most profit of water use is through the industrial sector.

Introduction

Water accounts considered as one of the important subjects specially for countries with scare sources of water. Comprehensive water accounts analysis will make possible to figure out the distribution of water among the different sectors in the country. Detailed information will help decision maker reallocate the distribution of water uses for sectors with economically higher production. Allocations for domestic uses will increase over time due to population increase but, are the expenses required for these services recovered? Water accounts provide answers for such questions.

This is considered as the first water accounts paper. The paper will deal with some aspects of water accounts according to the available data. The paper will concentrate on the accounts of water uses and distribution as well as water consumption by different economic sectors and the contribution of these sectors to the economy.

The possibility to go further in this paper to include water assets available for water distribution and the other fields that require high details and collection of information will not be included in this report. Collection of data on the available assets for detailed water accounts reports requires a complete staff and complete cooperation of other governmental institutions to make the required information available to complete these parts.

Moreover, the concentration on the fields included in this report is a cause of enough experience to go deeply in water accounts. Overtime, other water account papers may go further to cover other fields and introduce more integrated information.

Physical Supply and Use Tables

In general, different economic activities can abstract water for different uses. In this concern, the breakdown of the economic activities, classified according to ISIC Rev.4, distinguishes the following groups (UNSD, 2007):

- ISIC 1-3 which includes Agriculture, Forestry and Fishing;
- ISIC 5-33, 41-43 which includes: Mining and Quarrying, Manufacturing and Construction;
- ISIC 35 - Electricity, gas, steam and air conditioning supply;
- ISIC 36 - Water collection, treatment and supply;
- ISIC 37 - Sewerage;
- ISIC 38, 39, 45-99, which corresponds to the Service industries.

ISIC 35, 36 and 37 have been separately identified because of their importance in the use and supply of water and water-related services. In particular, ISIC 36 and 37 are separately identified as they are key industries for the distribution of water and wastewater. Cost-recovery policies and policies aiming at improving the access to safe drinking water and sanitation are examples of policies that are involving almost exclusively these two economic activities.

ISIC 35 is a major user of water for hydroelectric power generation and cooling purposes: it abstracts and returns into the environment enormous quantities of water. Aggregating information on water use and supply by ISIC 35 with that of other industries would provide misleading information as the water use (and returns) of ISIC 35 alone may outweigh any other industry's water use (and returns).

Physical supply and use table provides a good image about the major distributions of water and the production of water. In Jordan, some economic activities are concerned regarding water use and supply. The bolded ISICs is the major interest concerning water supply in use. In Jordan, the Ministry of Water and Irrigation (MoW) is considered the main body responsible for water abstraction and supply. Any water abstraction through the private sector for agricultural, industrial and domestic purposes is supervised by MoW. So, ISIC 36 regarding water collection, treatment and supply is represented by MoW. None of the other activities can abstract water without being reported by MoW. This justifies the use of ISIC 36 as major and only contributor to water abstraction in Jordan.

Physical Use

Physical water use table about concerned with water abstraction. The table has divided the abstraction of water through two sources; from the environment and within the economy. The following definitions reflect the exact meaning of terms used in physical water use table (UNSD, 2007):

1. Abstraction: is defined as the amount of water that is removed from any source, either permanently or temporarily, in a given period of time for consumption and production activities. Water used for hydroelectric power generation is also considered as abstraction. The purpose is abstraction for own use and for distribution. Type of source is abstraction from water resources –surface water, groundwater and soil water as in the asset classification- and from other sources which include sea water and precipitation.

a.1 For own use: water is abstracted to be used by the same economic unit which abstracts it.

a.2 For distribution: abstraction to be supplied, possibly after some treatment, to other economic units.

Most of the water is abstracted for distribution by ISIC 36, *Water collection, treatment and supply* -as the case of Jordan- however, there may be other industries which abstract and supply water as a secondary activity.

b.1 Water resources include the abstraction of surface water, groundwater and soil water. Soil water can be defines as (UNSD, 2007): "water use in rainfed agriculture**,** this is computed as the amount of precipitation that falls onto agricultural fields". The excess of water, e.g. the part that is not used by the crop, is recorded as a return flow to the environment from rainfed agriculture. More the 60% of all food production in the world is produced under rainfed conditions.

b.2 Other resources include the abstraction of sea water and the direct collection of precipitation for production and consumption activities, which is not applied in case of Jordan. The abstraction from sea can be defined as: "water is generally abstracted from the sea either for cooling purposes - the corresponding wastewater flow is generally returned to the original source of water (i.e. the sea or ocean)– or for desalination processes. In the latter case, desalinated water could be returned to the inland water resource and constitute a resource. A typical example of collection of precipitation is roof rain harvested by households.

In Jordan both activities are practiced, collection of precipitation and abstraction from the sea, but there is no available records as these two processes are run individually and in minor quantities.

2. Use of water received from other economic units refer to the amount of water that is delivered to an industry, households or the rest of the world by another economic unit. This water is usually delivered through mains (pipes), but other means of transportation are not excluded (such as artificial open channels, etc.). The **use of water received from other economic units** by the rest of the world corresponds to the **exports** of water. It is generally the industry, ISIC 36, which exports water.

3. Total use of water: Total abstraction + Use of water received from other economic units

Table (1) summarizes physical supply of water in 2015. The total water abstracted is carried out through ISIC 36 (MoW). The total volume of water abstracted in 2015 was 857.4 MCM for distribution. Abstracted water was through two resources; surface water which forms 351.4 MCM and groundwater 506.0 MCM. This amount is used within the economy by other activities excluding the amounts of water lost through transmission which is a considerable percentage, in addition to the amounts of treated water. The total amount of reused water within the economy is 730.2 MCM with efficiency reaching 85.16%.

Physical Supply

The supply of water to other economic units refers to the amount of water that is supplied by an economic unit to another. It includes the supply by one establishment to another. The supply of water is recorded net of losses in distribution. The supply to other economic units generally occurs through mains, but can also occur through artificial open channels, trucks and other means. Note that the supply of water by the rest of the world corresponds to the import of water (UNSD, 2007).

Table 1: The standard physical water use in 2015

Physical use table

Physical units MCM

		Industries (by ISIC categories)									
		1 irrig.	1 stock	All except 1,35,36,37	35	36	37	Total	Households	the world	Total
From the environment	**U1 - Total abstraction (= a.1+a.2 = b.1+b.2):**	0.0	0.0	0.0	0.0	857.4	0.0	857.4	0.0		857.4
	a.1- Abstraction for own use	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0
	a.2- Abstraction for distribution	0.0	0.0	0.0	0.0	857.4	0.0	857.4	0.0		857.4
	b.1- From water resources:	0.0	0.0	0.0	0.0	857.4	0.0	857.4	0.0		857.4
	Surface water	0.0	0.0	0.0	0.0	351.4	0.0	351.4	0.0		351.4
	Groundwater	0.0	0.0	0.0	0.0	506.0	0.0	506.0	0.0		506.0
	Soil water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0
	b.2- From other sources	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0
	Collection of precipitation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0
	Abstraction from the sea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0
Within the economy	U2 - Use of water received from other economic units	421.5	5.07	24.96	0	0	89.26	540.8	189.4		730.2
	of which: Reused water	0	0	0	0	0	89.26	89.26	0		89.3
	of which: Wastewater to sewerage										0.0
U=U1+U2 - **Total use of water**		421.5	5.1	25.0	0.0	857.4	89.3	1398.2	189.4		1587.6

4.a Reused water: as wastewater supplied to a user for further use with or without prior treatment, excludes recycling within industrial sites. It is also commonly referred to as *reclaimed wastewater*.

4.b Wastewater to sewerage: water which is of no further immediate value to the purpose for which it was used or in the pursuit of which it was produced because of its quality, quantity or time of occurrence. Wastewater can be discharged directly into the environment (in which case it is recorded as a return flow), supplied to a treatment facility (ISIC 37) (recorded as wastewater to Sewerage) or supplied to another industry for further use (reused water). Total wastewater generated by an economic unit is obtained from Table (1) as the sum of the supply of reused water, wastewater to sewerage and returns into the environment.

5. Total returns include water that is returned to the environment. It is the sum of water returned to water resources (surface water, groundwater, and soil water) and other resources (e.g. sea water, water used for cooling, treated water).

6. Total supply of water is computed as the sum of the amount of water supplied to other economic units and the amount of water returned to the environment.

Table (2) represents water supply table in Jordan in 2015. The total amount of water supply is 10303 MCM.

Table 2: The standard physical water supply in 2015

Physical supply table

Physical units MCM

		Industries (by ISIC categories)									
		1 irrig.	1 stock	All except 1,35,36,37	35	36	37	Total	Households	the world	Total
Within the economy	S1 - Supply of water to other economic units	0.0	0.0	15.4	0.0	557.3	83.6	656.3	73.9		730.2
	of which: Reused water										
	Wastewater to sewerage	0	0	15.4	0	0	0	15.4	73.9		89.3
To the environment	S2 - Total returns (= d.1+d.2)	0	0	0	0	300.1	0	300.1	0		300.1
	d.1- To water resources	0	0	0	0	300.1	0	300.1	0		300.1
	Surface water	0	0	0	0	300.1	0	300.1	0		300.1
	Groundwater	0	0	0	0	0	0	0	0		0.0
	Soil water	0	0	0	0	0	0	0	0		0.0
	d.2- To other sources (e.g. Sea water)	0	0	0	0	0	0	0	0		0.0
S - **Total supply of water** (= S1+S2)		0.0	0.0	15.4	0.0	857.4	83.6	956.4	73.9	0.0	1030.3
Consumption (U - S)		**421.5**	**5.1**	**9.6**	**0.0**	**0.0**	**5.7**	**441.8**	**115.5**	**0.0**	**557.3**

Note: grey cells indicate zero entries by definition.

7. Consumption: Total use of water – Total supply of water

Water Consumption

The concept of water consumption gives an indication of the amount of water that is lost by the economy during use, in the sense that it has entered the economy but has not returned either to water resources or to the sea. This happens because during the used part of the water is incorporated into products, evaporated, transpired by plants or simply consumed by households or livestock. The difference between the water use (row 3 in Table 1) and the water supply (row 6 in Table 2) is referred to as water consumption. It can be computed for each economic unit and for the whole economy. The concept of water consumption used in the SEEAW is consistent with the hydrological concept. It differs, however, from the concept of consumption used in the national accounts which instead refers to water use.

For the whole economy, the balance between water flows can be written as

Total abstraction + Use of water received from other economic units = Supply of water to other economic units + Total returns + Water consumption

Note that since the total water supply to other economic units equals the total water use received from other

economic units, the equation can be rewritten as:

Total abstraction = Total returns + Water consumption

Water consumption can include water that is stored, for example, in water towers, but this quantity is usually very small as water is generally stored only for a short period of time.

When water consumption is computed for each industry, it gives an indication of the industry's water use efficiency. Since water supply does not equal water use by industry, water consumption is computed as a difference between the supply and use by industry:

Water consumption by industry i = Total use of water by industry i – Total supply of water by industry i

The discharges of water into the sea should also be considered as lost water since this water, once in the sea, is not directly available for further use as it would be in the case, for example, of discharges into a river, where discharged water becomes a resource for downstream uses. The concept of inland water consumption is introduced to give an indication of the amount of water that is not returned to the inland water system. Inland water consumption is thus calculated as:

Inland water consumption = Water consumption + Returns to Other sources (e.g. sea water).

In Table 3 abstraction for own use is further disaggregated in the following uses:

Hydroelectric power generation
Irrigation water
Mine water
Urban runoff

Table 3 Abstraction for own use is further disaggregated

	Industries (by ISIC categories)									
	1 irrig.	1 stock	All except 1,35,36,37	35	36	37	Total	Households	the world	Total
1. Net supply of water to other economic units	0.0	0.0	15.4	0.0	557.32	83.6	656.3	73.9		730.2
2. Losses in distrubution	0.0	0.0	0.0	0.0	300.1	0.0	300.1	73.9		
2.a Leakages	0	0	0	0	300.1	0	300.1	73.9		374.0
2.b other (evaporation)	0	0	0	0	0	0	0.0	0		0.0
3. Gross supply within the economy (1+2)	0.0	0.0	15.4	0.0	857.4	83.6	956.4	147.8	0.0	730.2

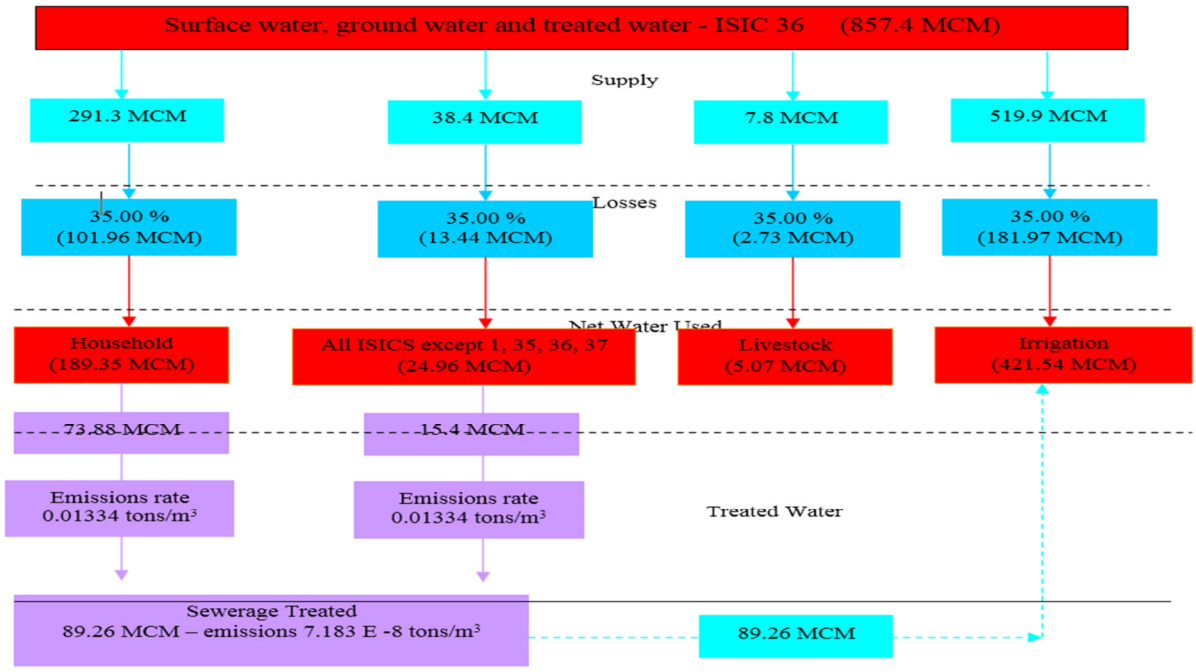

Figure 1: Flow diagram of water flow among the different economic sectors

Emission Accounts

Background

Emissions to water refer to the direct release of pollutants to water as well as the indirect release by transfer to an off-site wastewater treatment plant (European Commission, 2000). The SEEAW, emission accounts focus only on the release of pollutants into water resources through the (direct and indirect through a wastewater treatment plant) discharge of wastewater into water resources.

Emission accounts record the amount of pollutant added to water by an economic activity during a reference period (generally the accounting year) and are expressed in terms of weight (kilograms or tonnes, depending on the pollutant under consideration). Emission accounts cover: (a) pollutants added to wastewater and collected in the sewerage network; (b) pollutants added to wastewater discharged directly to water bodies; and (c) selected non-point sources emissions, namely emissions from urban runoff and from agriculture.

Point source emissions are those emissions for which the geographical location of the discharge of the wastewater is clearly identified. They include, for example, emissions from wastewater treatment plants, power plants and other industrial establishments.

Non-point (or diffuse) sources of pollution are sources without a single point of origin or a specific outlet into a receiving water body. Pollutants are generally carried off the land by storm-water runoff or may be the result of a collection of individual and small scale polluting activities, which for practical reasons, cannot be treated as point sources of pollution. The commonly used categories for non-point sources include agriculture and urban areas.

Scope of Emission Accounts

Include:	Exclude:
Point sources: Pollutants added to wastewater	Point sources: Discharges of heavy metal and hazardous wastes not contained in wastewater (*included in the SEEA waste accounts)* Pollutants resulting from in-situ use (e.g. navigation, fishing, etc.)
Non-point sources: Urban runoff Irrigation water and rainfed agriculture	Non-point sources: All non-point sources except for urban runoff, irrigation water and rain-fed agriculture (*included in the quality accounts)*

The emission accounts record the pollution added to water by an economic unit and not the total pollution discharged with wastewater. This implies that, if an industry abstracts (or receives) 1 cubic meter of water which already contains x kg of a pollutant and returns to a river 1 cubic meter of wastewater containing y kg of the same pollutant, even though the total discharge of the pollutant to the river is y kg, only (y-x) kg is recorded as it represents the pollution generated by the industry. This has several implications for the measurement of emissions: the level of emissions is not given by the pollutants content of outgoing flows of water, but by the difference between the pollutants content of incoming and outgoing flows. While for drinking water, the pollutant content should normally be negligible, for some other uses (e.g. cooling or process water) the pollutant content of the incoming water can be significant.

Pollution is generally measured in terms of quantity of a measured parameter released during a certain period of time. They can be expressed either directly in terms of the quantity of a parameter (for example, kilogram per year), or reported to an arbitrary unit that can represent one or more parameters. For example, population equivalent (population equivalent (p.e.) means the organic biodegradable load having a BOD5 of 60 g of oxygen per day) made of five-day biochemical oxygen demand (BOD5), Nitrogen (N), Phosphorus (P), Suspended solids (SS).

Gross and Net Emissions

1. Gross emission: The total amount of a pollutant generated by an economic unit measured at the point of discharge.

1**.a. Direct emission to water:** The amount of pollutant that is released directly into water (that is, it is contained in the direct discharge of wastewater into the environment).

1.a.1 Without treatment:
1.a.2 After on-site treatment:
1.a.i To water resources
1.a.ii To the sea

1.b. To Sewerage: The amount of pollutant that is released into the sewage system. The pollutant content of the urban runoff collected by ISIC 37 is included.

2. Reallocation of emission by ISIC 37: calculated through ISIC 37 table 2
3. Net emission: the sum of direct and indirect emission.

Table 4. Emission accounts for Jordan in 2015

Emission accounts

Physical units tons

Pollutant	Industries (by ISIC categories)							Households	the world	Total
	1 irrig.	1 stock	All except 1,35,36,37	35	36	37	Total			
Gross emissions (= a + b)	0.0	0.0	205436.0	0.0	0.0	0.0	205,436.0	985,559.2		1,190,995.2
a. Direct emissions to water (= a1 + a2 = b1 + b2)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0
a1. Without treatment	0.00	0.00	0.0	0	0	0.00	0.0	0		0.0
a2. After on-site treatment	0	0	0.0	0	0	0	0.0	0		0.0
b1. To water resources	0.00	0.00	0.0	0	0	0.00	0.0	0		0.0
b2. To the sea	0	0	0.0	0	0	0	0.0	0		0.0
b. To Sewerage (ISIC 37)	0.00	0.00	205436.0	0	0	0.00	205,436.0	985559.2		1,190,995.2
d. Reallocation of emission by ISIC 37	6.0	0.0	0.0	0.0	0.0	0.0	6.0	0.0		6.0
e. Net emissions (= a. + d.)	6.0	0.0	0.0	0.0	0.0	0.0	6.0	0.0		6.0

Emissions to water by ISIC 37

Physical units tons

Pollutant	ISIC 37
c. Emissions to water (=c1 + c2)	**6.0**
c1. After treatment	6.0
To water resources	6.0
To the sea	0.0
c2. Without treatment	0.0
To water resources	0.0
To the sea	0.0

Water Use in Different Economic Sectors

High variations in the amount of water existed among different economic sectors. The services sector is the highest consuming water JD8.71 millions in 2015, followed by wholesaler and retailer with JD4.17 millions (Table 5). The lowest amount of consumed water registered in insurance sector JD0.079 millions. The highest value of water consumed does not reflect necessarily the highest contribution of activity to economy.

The contribution of each sector to gross domestic product can be used as a guide to reallocate the amounts of distributed water in Jordan.

Figure 2 shows variation of contribution of different sectors to GDP and the values of water used in these sectors. Manufacturing sector shows high consumption of water qualities and the highest contribution to the GDP. For the other sectors, the contribution to GDP exceeded the value of the amount of used water. In general, some sectors in Jordan such as mining and querying have effective use of water, because in this sector most of used water is treated and used once more for other purposes.

Table 5: Prices of the total amount of water in specific sectors (000 JD) in 2015

Sector	Stock	Purchase during the year	Change in Stock	Materials sold without processing	Losses	Consumption cost
Industry	0.0	28135.7	0.0	0.2	0.0	28135.4
-electricity generation and distribution	0.0	1198.1	0.0	0.0	0.0	1198.1
Wholesaler and retailer	0.0	4173.6	0.0	0.0	0.0	4173.6
Services	0.0	8710.8	0.9-	0.0	0.0	8711.7
Construction	0.0	2614.8	0.1-	0.0	0.0	2614.9
Transportation and communication	0.0	2790.1	0.0	0.0	0.0	2790.1
Insurance	-	79.0	0.0	0.0	0.0	79.0

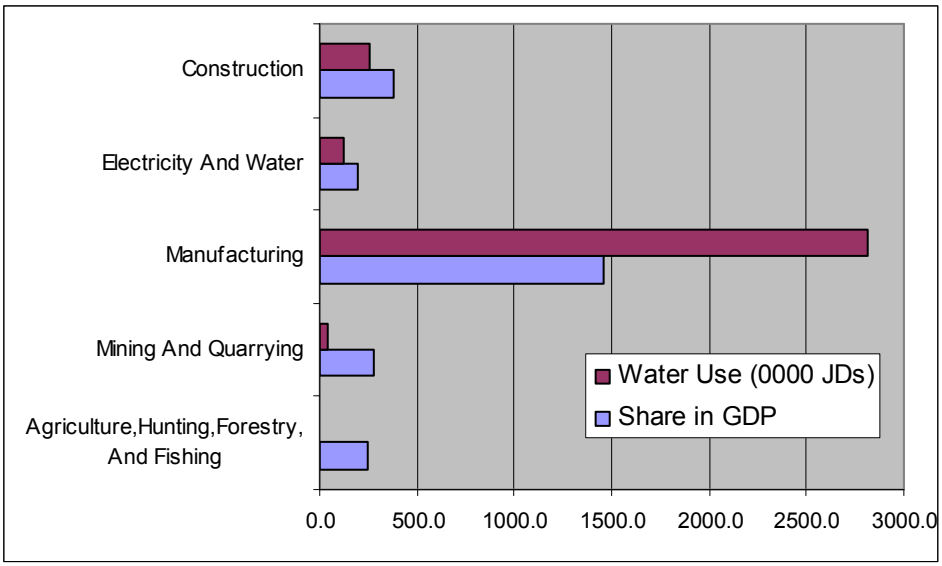

Figure 2: Water use value (JD) and contribution to Gross Domestic Product (GDP) in 2015

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