



Food and Agriculture  
Organization of the  
United Nations

# WATER RESOURCES

*AQUASTAT, FAO's global information system on water and agriculture*

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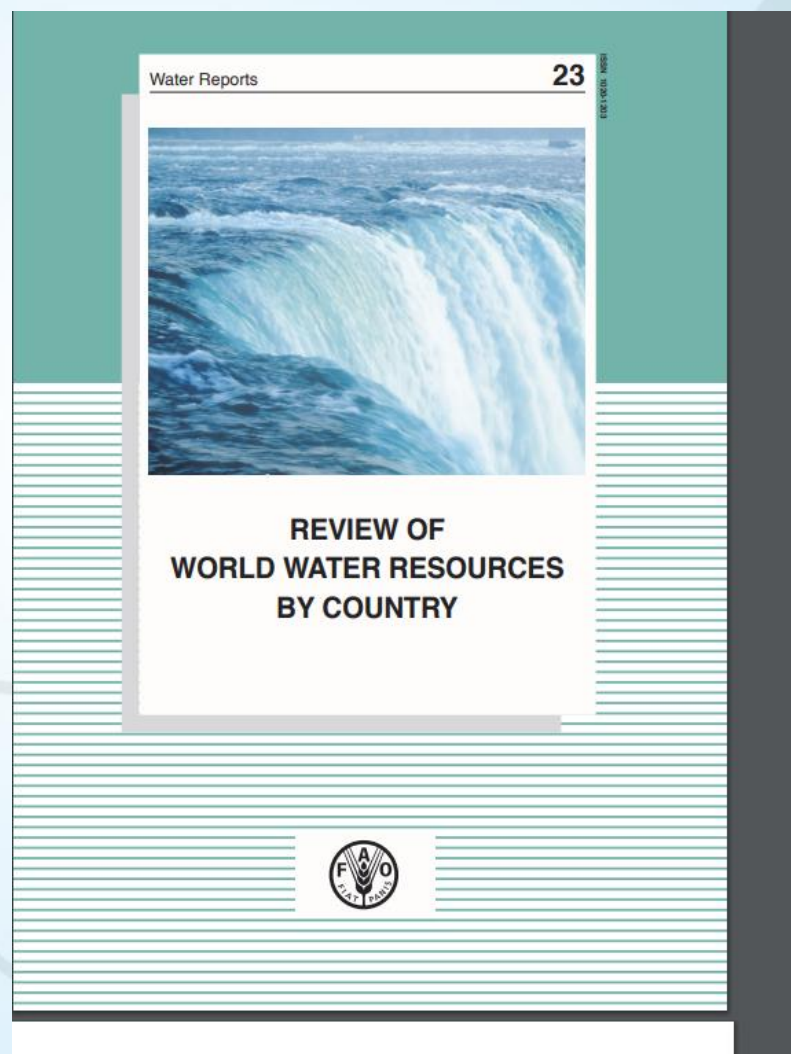


## SDG 6.4.2 – Level of water stress

Total freshwater withdrawn (TFWW) divided by the difference between the **total renewable freshwater resources (TRWR)** and the environmental flow requirements (EFR)

$$\text{Water Stress (\%)} = \frac{TFWW}{TRWR - EFR} * 100$$

# Review of World Water Resources by country

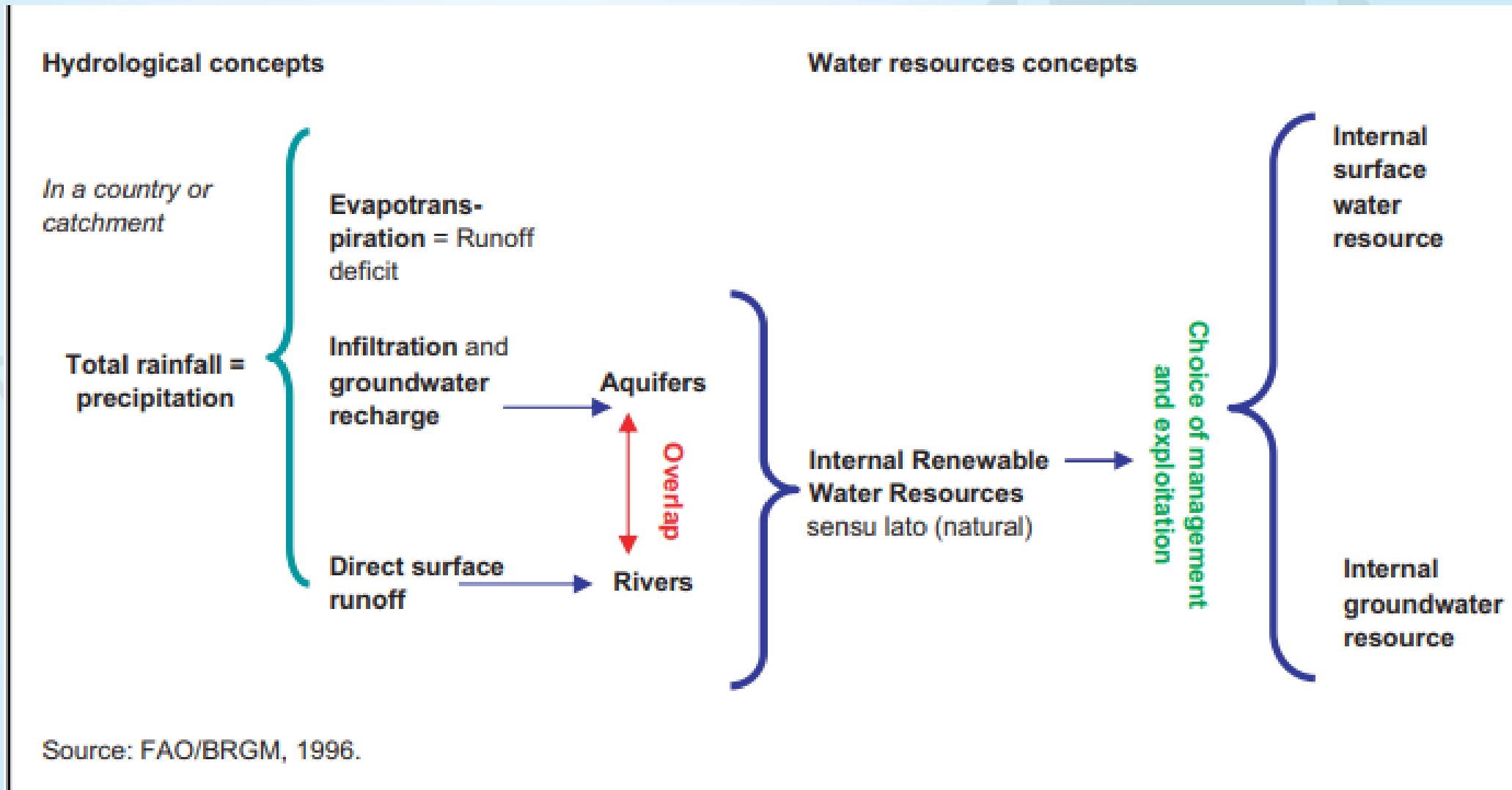


# Definitions

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- **Internal renewable water resources** - long-term average annual flow of rivers and recharge of groundwater for a given country generated from endogenous precipitation.
- **External renewable water resources** - flows of water entering the country, taking into consideration the quantity of flows reserved to upstream and downstream countries through agreements or treaties.
- **Total renewable water resources (TRWR)** - sum of internal and external renewable water resources.

# Internal Renewable Water Resources



# Internal Renewable Water Resources

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$$\text{IRWR} = \text{R} + \text{I} - (\text{Qout} - \text{Qin}) \quad \text{Overlap}$$

**R** = **Surface runoff**, generated from endogenous precipitation

Long-term average annual volume of surface water generated by direct runoff from endogenous precipitation (surface runoff) and groundwater contributions.

**I** = **Groundwater recharge**, generated from endogenous precipitation

Long-term annual average groundwater recharge, generated from precipitation within the boundaries of the country. Renewable groundwater resources of the country are computed either by estimating annual infiltration rate (in arid countries) or by computing river base flow (in humid countries).

**Qout** = groundwater drainage into rivers (typically, base flow of rivers);

**Qin** = seepage from rivers into aquifers.

# External Renewable Water Resources

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$$\text{ERWR} = \text{SW}_1\text{in} + \text{SW}_2\text{in} + \text{SWprl} - \text{SWout} + \text{GWin}$$

**SW<sub>1</sub>in** = Surface water entering the country, which is not submitted to treaties

**SW<sub>2</sub>in** = Surface water entering the country, which is secured through treaties

**SWprl** = Accounted flow of border rivers and/or lakes

**SWout** = Surface water leaving country, reserved by treaties or agreements for downstream countries

**GWin** = Groundwater entering the country

# Total Renewable Water Resources

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$$\text{TRWR} = \text{IRWR} + \text{ERWR}$$

where:

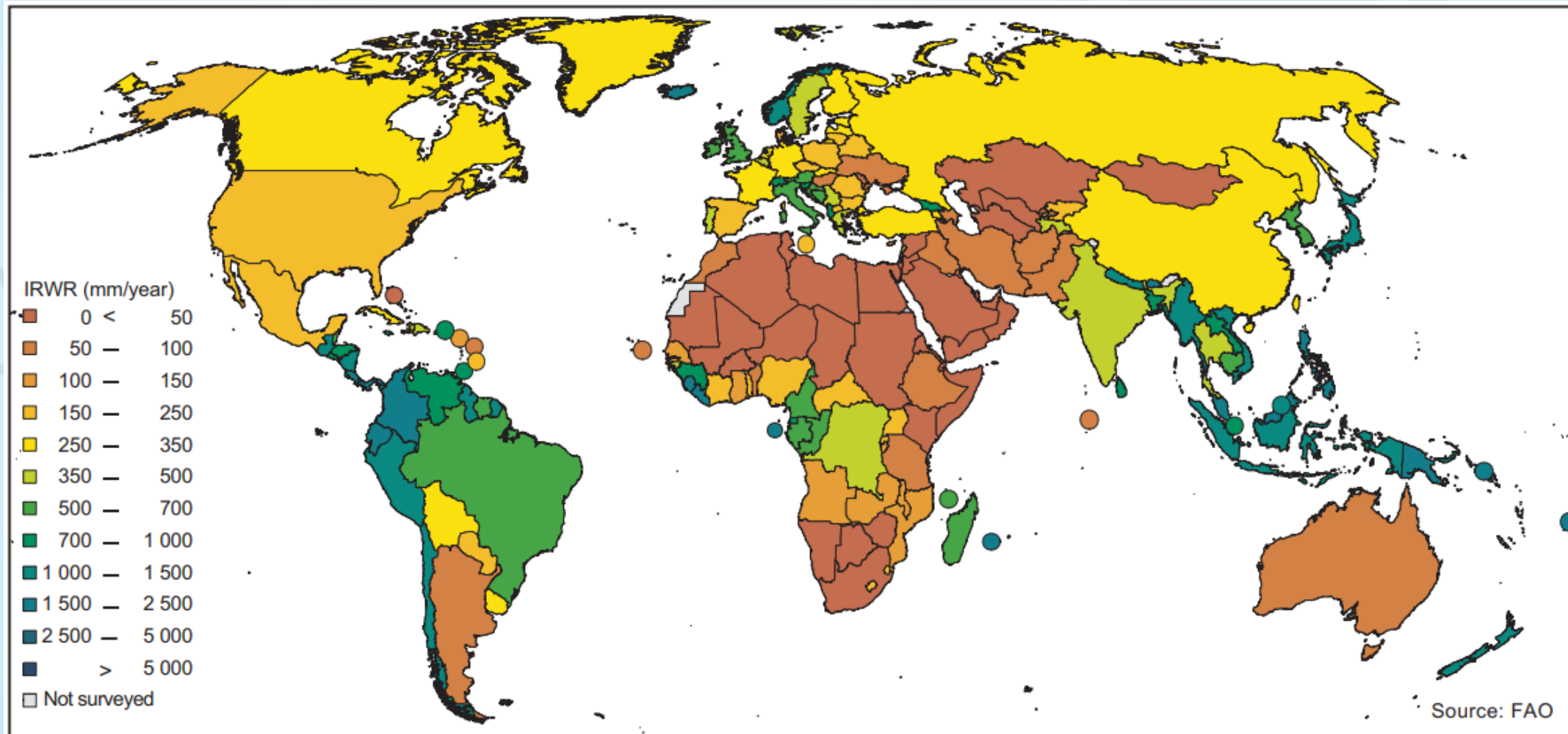
IRWR = internal renewable water resources

ERWR= external renewable water resources

Note: Regional Aggregation of TRWR : while IRWR can be added up TRWR cannot.



# World map of internal renewable water resources (IRWR), per country





Computation of long-term annual renewable water resources (RWR) by country (in km<sup>3</sup>/year, average)

Egypt

Internal RWR		
Precipitation (mm/year)	[1]	18.1
Area of the country (1000 ha)	[2]	100 145
Precipitation (km <sup>3</sup> /year)	[3]	18.13 =([1]*1000000)/([2]*10)
Surface water: produced internally	[4]	0.5
Groundwater: produced internally	[5]	0.5 (a)
Overlap between surface water and groundwater	[6]	0 (b)
<b>Total internal renewable water resources</b>	[7]	1 =([4]+[5]-[6])
External RWR		
	Total	Accounted
<b>Surface water</b>		
Surface water entering the country	84	
Inflow not submitted to treaties		[8] 0
Inflow submitted to treaties		84
Inflow secured through treaties		[9] 55.5 (c)
Flow in border rivers	0	[10] 0
Accounted inflow		[11] 55.5 =([8]+[9]+[10]) (d)
Surface water leaving the country	0	
Outflow not submitted to treaties		0
Outflow submitted to treaties		0
Outflow secured through treaties		[12] 0
Total external renewable surface water		[13] 55.5 =([11]-[12])
<b>Groundwater</b>		
Groundwater entering the country	1 (e)	[14] 1
Groundwater leaving the country	0	0
<b>Total external renewable water resources</b>		[15] 56.5 =([13]+[14])
Total RWR		
Surface water		[16] 56 =([4]+[13]) (f)
Groundwater		[17] 1.5 =([5]+[14])
Overlap between surface water and groundwater		[6] 0 (b)
<b>Total renewable water resources</b>		[18] 57.5 =([16]+[17]-[6])
Dependency ratio (%)		[19] 98.26 =100*([11]+[14])/([11]+[14]+[7])



Computation of long-term annual renewable water resources (RWR) by country (in km<sup>3</sup>/year, average)

**Bahrain**

Internal RWR		
Precipitation (mm/year)	[1] <input type="text" value="83"/>	
Area of the country (1000 ha)	[2] <input type="text" value="77.8"/>	
Precipitation (km <sup>3</sup> /year)	[3] <input type="text" value="0."/>	$=([1]*1000000)*([2]*10)$
Surface water: produced internally	[4] <input type="text" value="0.004"/>	
Groundwater: produced internally	[5] <input type="text" value="0"/>	
Overlap between surface water and groundwater	[6] <input type="text" value="0"/>	<sup>(a)</sup>
<b>Total internal renewable water resources</b>	[7] <input type="text" value="0.004"/>	$=([4]+[5]-[6])$
External RWR		
	Total	Accounted
<b>Surface water</b>		
Surface water entering the country	<input type="text" value="0"/>	
Inflow not submitted to treaties		[8] <input type="text" value="0"/>
Inflow submitted to treaties		<input type="text" value="0"/>
Inflow secured through treaties		[9] <input type="text" value="0"/>
Flow in border rivers	<input type="text" value="0"/>	[10] <input type="text" value="0"/>
Accounted inflow		[11] <input type="text" value="0"/>
		$=([8]+[9]+[10])$
Surface water leaving the country	<input type="text" value="0"/>	
Outflow not submitted to treaties		<input type="text" value="0"/>
Outflow submitted to treaties		<input type="text" value="0"/>
Outflow secured through treaties		[12] <input type="text" value="0"/>
Total external renewable surface water		[13] <input type="text" value="0"/>
		$=([11]-[12])$
<b>Groundwater</b>		
Groundwater entering the country	<input type="text" value="0.112"/>	[14] <input type="text" value="0.112"/>
Groundwater leaving the country	<input type="text" value="0"/>	<input type="text" value="0"/>
<b>Total external renewable water resources</b>		[15] <input type="text" value="0.112"/>
		$=([13]+[14])$
Total RWR		
Surface water		[16] <input type="text" value="0.004"/>
		$=([4]+[13])$
Groundwater		[17] <input type="text" value="0.112"/>
		$=([5]+[14])$
Overlap between surface water and groundwater		[6] <input type="text" value="0"/>
		<sup>(a)</sup>
<b>Total renewable water resources</b>		[18] <input type="text" value="0.116"/>
		$=([16]+[17]-[6])$
Dependency ratio (%)		[19] <input type="text" value="96.55"/>
		$=100*([11]+[14])/([11]+[14]+[7])$

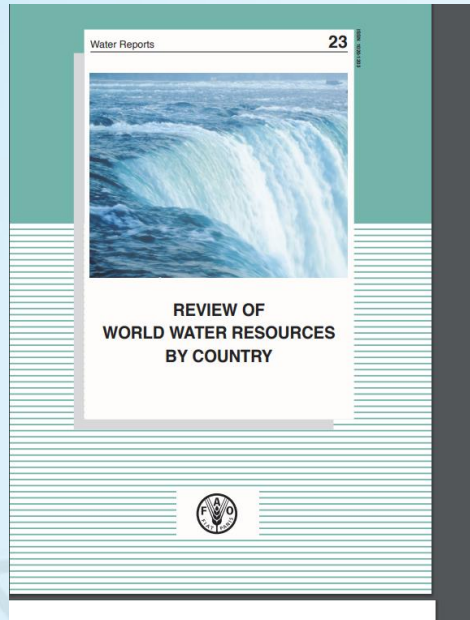
Metadata:  
(a) Overlap between surface water and groundwater is negligible.

# Other sources of water

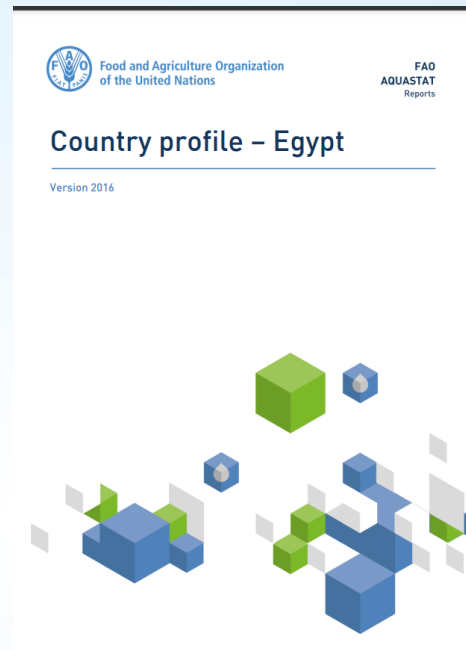
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- **Non-conventional sources of water: These include:**
  - **Direct use of treated wastewater**
  - **Direct use of agricultural drainage water**
  - **Desalinated water: production of freshwater by desalinization of brackish water or saltwater**

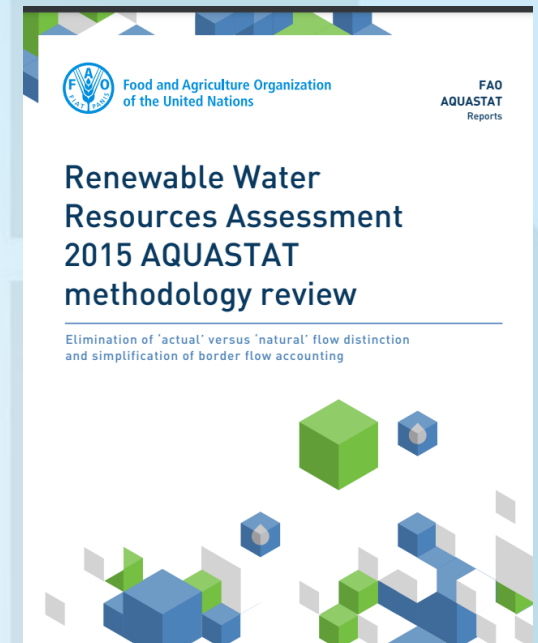
# References



<https://www.fao.org/3/Y4473E/y4473e.pdf>



<https://www.fao.org/3/ca0403en/CA0403EN.pdf>



<https://www.fao.org/3/bc818e/bc818e.pdf>