

The System of Environmental-Economic Accounting for Water SEEAW

Water Asset Accounts

MEDSTAT-ESCWA-UNSD Joint subregional training session on
the System of Environmental-Economic Accounting for Water
(SEEAW)

Amman, March 10-13, 2008

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Water Accounts

- ◆ The development of water accounts, from a national accounting perspective, can be defined as the process of **systematically** measuring the **flow and stock** of **surface and sub-surface** water, in **physical, quality and monetary** terms.

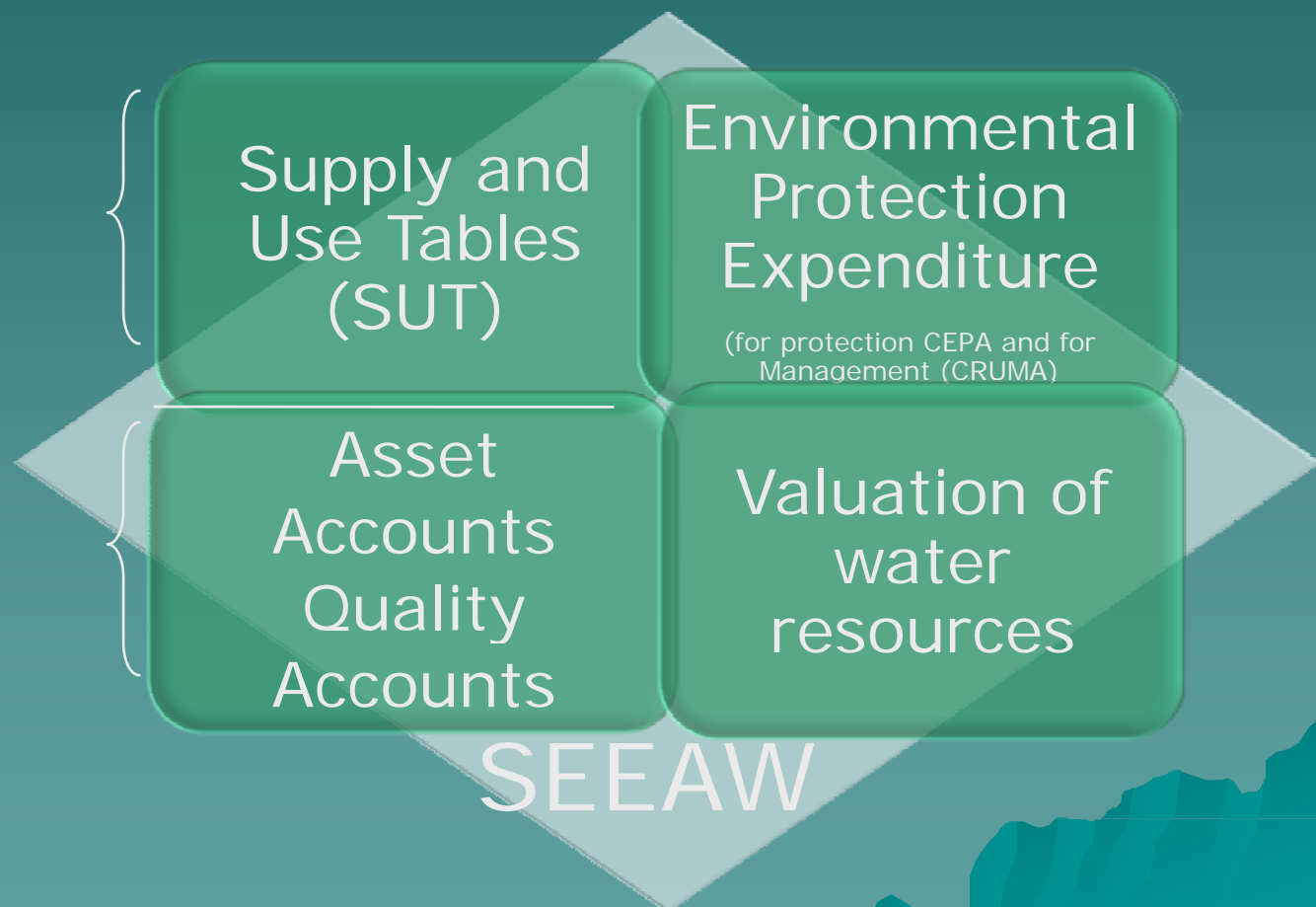
Soulard, F. Statistics Canada. 2003. Water accounting at Statistics Canada: The inland fresh water assets account, London Group of Environmental Accounting Rome, November 2003

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SEEAW: A Statistical Standard?

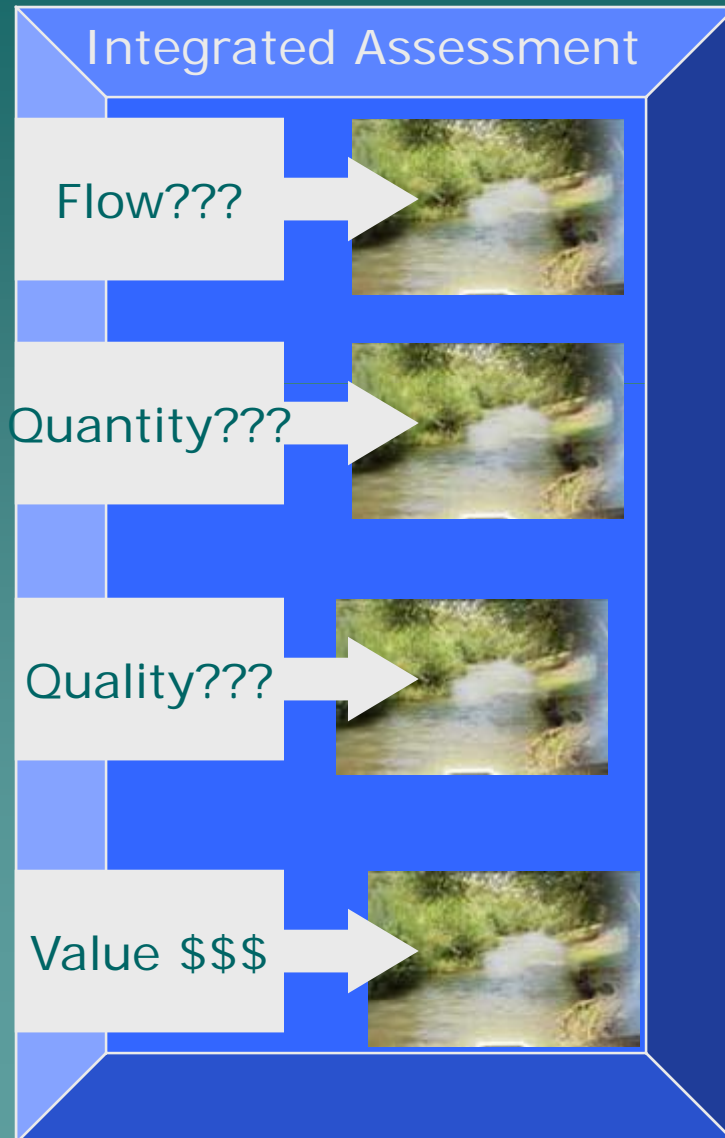
Statistical
Standard
(operational):

Under
development:
Other modules:



Water asset accounts in SEEAW

Chapter 6 and relation to other Chapters



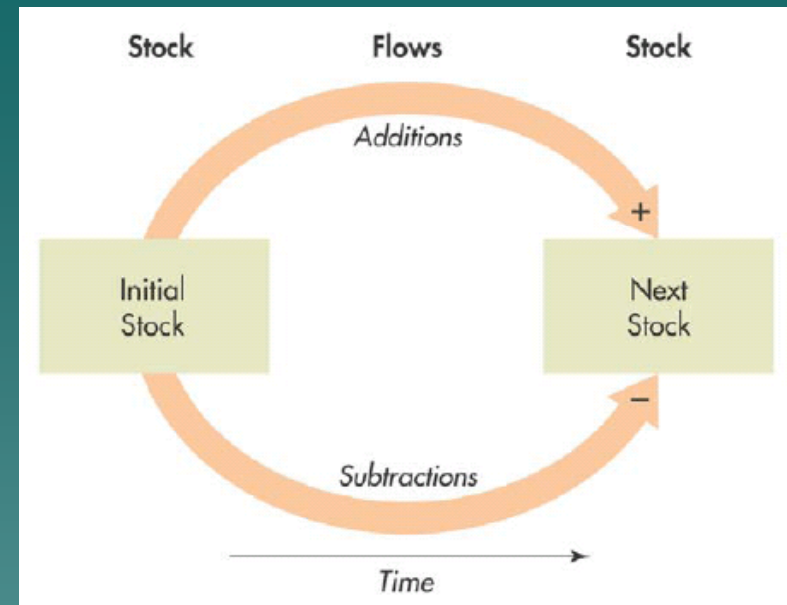
- ◆ The **Flow** is in **chapter 3** in SUT Tables
- ◆ **Chapter 6** focuses on **Assets**: the **quantitative assessment** of the stocks and the changes in stocks which occur during the accounting period.
- ◆ **Qualitative characteristics of the stocks** are dealt with in the **Quality accounts (chapter 7)**.
- ◆ Monetary description of the assets of water resources no standard techniques to assess the economic and non-economic values of water (Chapter 8).

Assets versus Flows

A "stock" exists *at a point* of time, (may have been accumulated in the past)

It would be measured in units (such as dollars or tons).

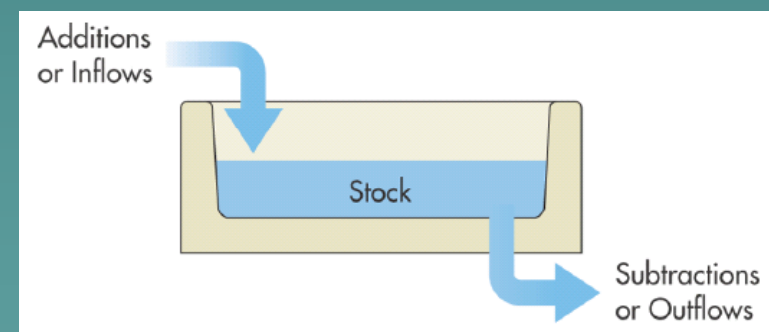
For example, the amount of water in a bathtub.



A "flow" occurs *over time*

It would be measured *per unit of time* (dollars or tons per month, year, ...).

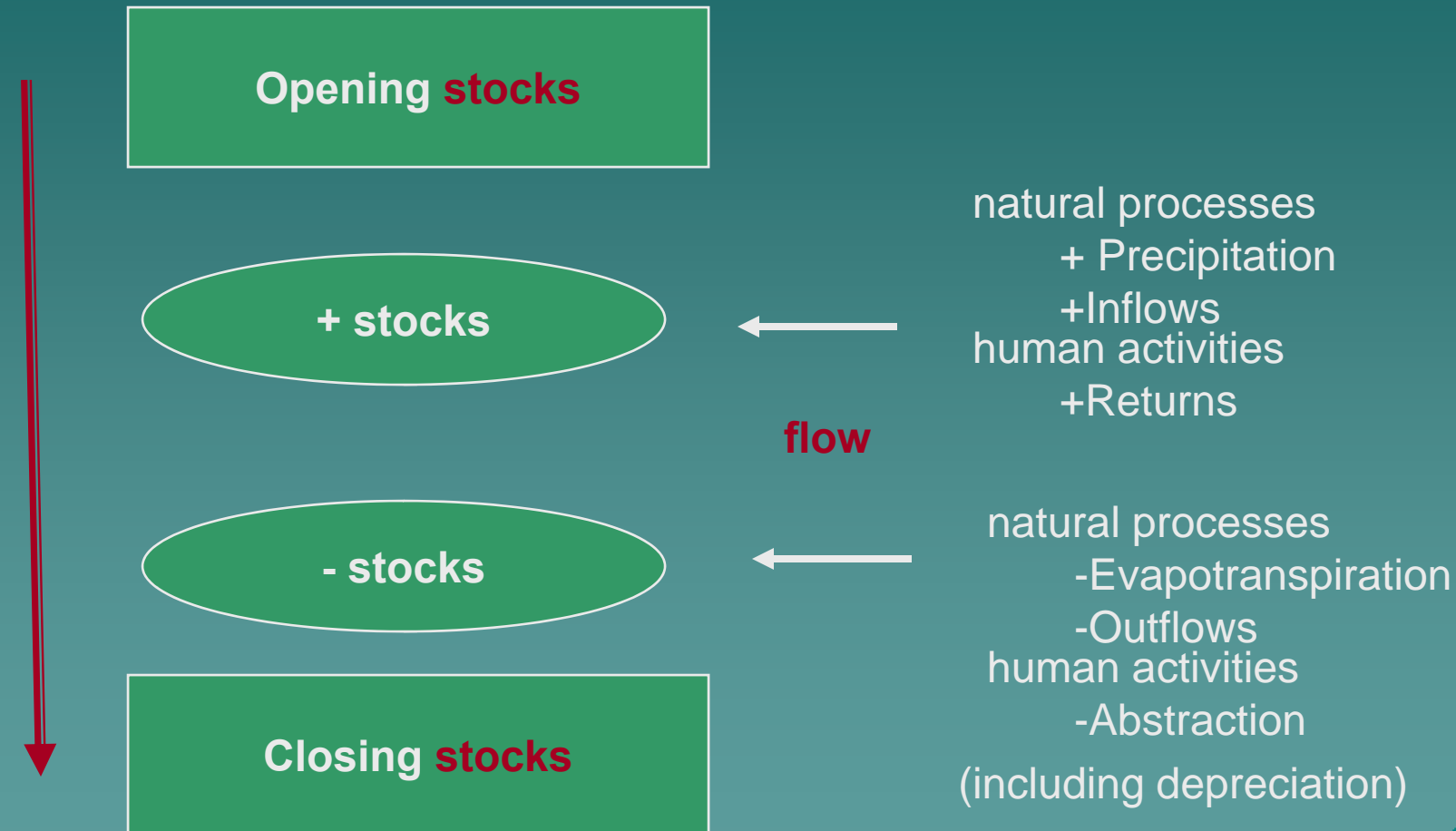
For example, the water that goes into a bathtub from a faucet is a flow;



Ref.: George W. Harrison (1987). "stocks and flows," *The New Palgrave: A Dictionary of Economics*, v. 4, pp. 506-09. Retrieved from http://en.wikipedia.org/wiki/Stock_vs_flow

The Global Development And Environment Institute, Tufts University (GDAE),

Linking flows with stocks



➡ How current levels of abstraction & discharges affect the stocks of water?

Spatial Information System (SIS) for Natural Resources

- ◆ Appropriate support from a geographical information system (GIS), with an adequate digital hydrological framework are essential in developing water assets.
- ◆ SIS maintains accounts with spatial attributes: geographic units, i.e. ecozones and drainage basins, as well as statistical, and administrative boundaries
- ◆ SIS Provides the spatial dimension that is required to model hydrologic attributes.
- ◆ SIS should include a digital drainage area framework of layers of hydrological features, including rivers, lakes and watershed.

Ref: Soulard, F. Water accounting at Statistics Canada: The inland fresh water assets account. London Group Meeting, 2003

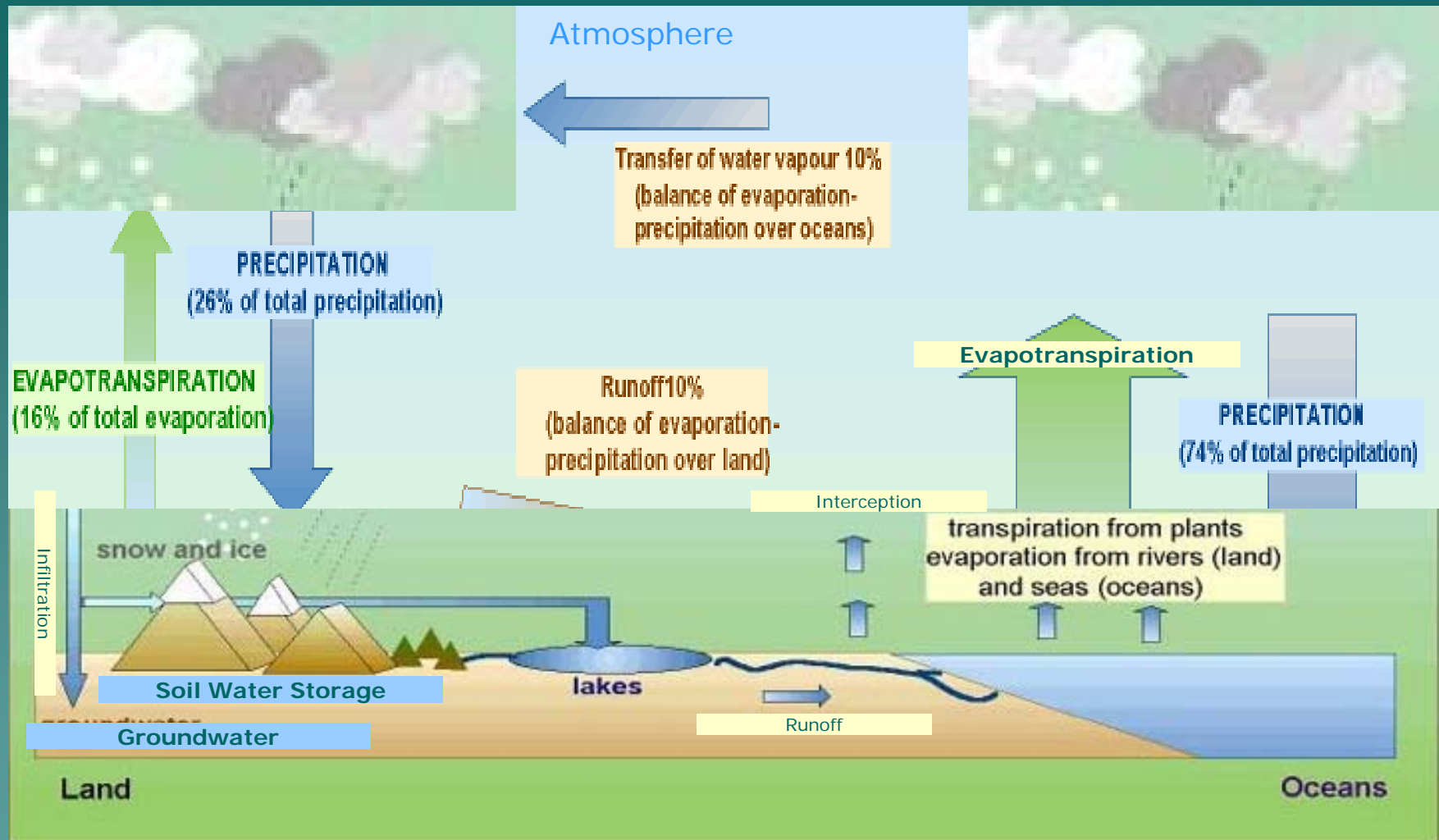
Importance of Water Assets in the SEEAW

- ◆ links the information on the abstraction and discharge of water with information on the stocks of water resources in the environment in order to assess how current levels of abstraction and discharges affect the stocks of water.
- ◆ useful in balancing the use of water and the available resource in its different compartments: aquifers, soil, rivers, canals, lakes, reservoirs,...

What is in Water Asset Accounts Chapter

- ◆ Water asset accounts describe water in the environment
- ◆ The hydrological cycle and how it is represented in the asset accounts
- ◆ The principles behind physical asset accounts; from opening stock levels to closing stock levels
- ◆ The classification of water resources
- ◆ Standard tables for compilation
- ◆ The compilation of asset accounts for transboundary waters.

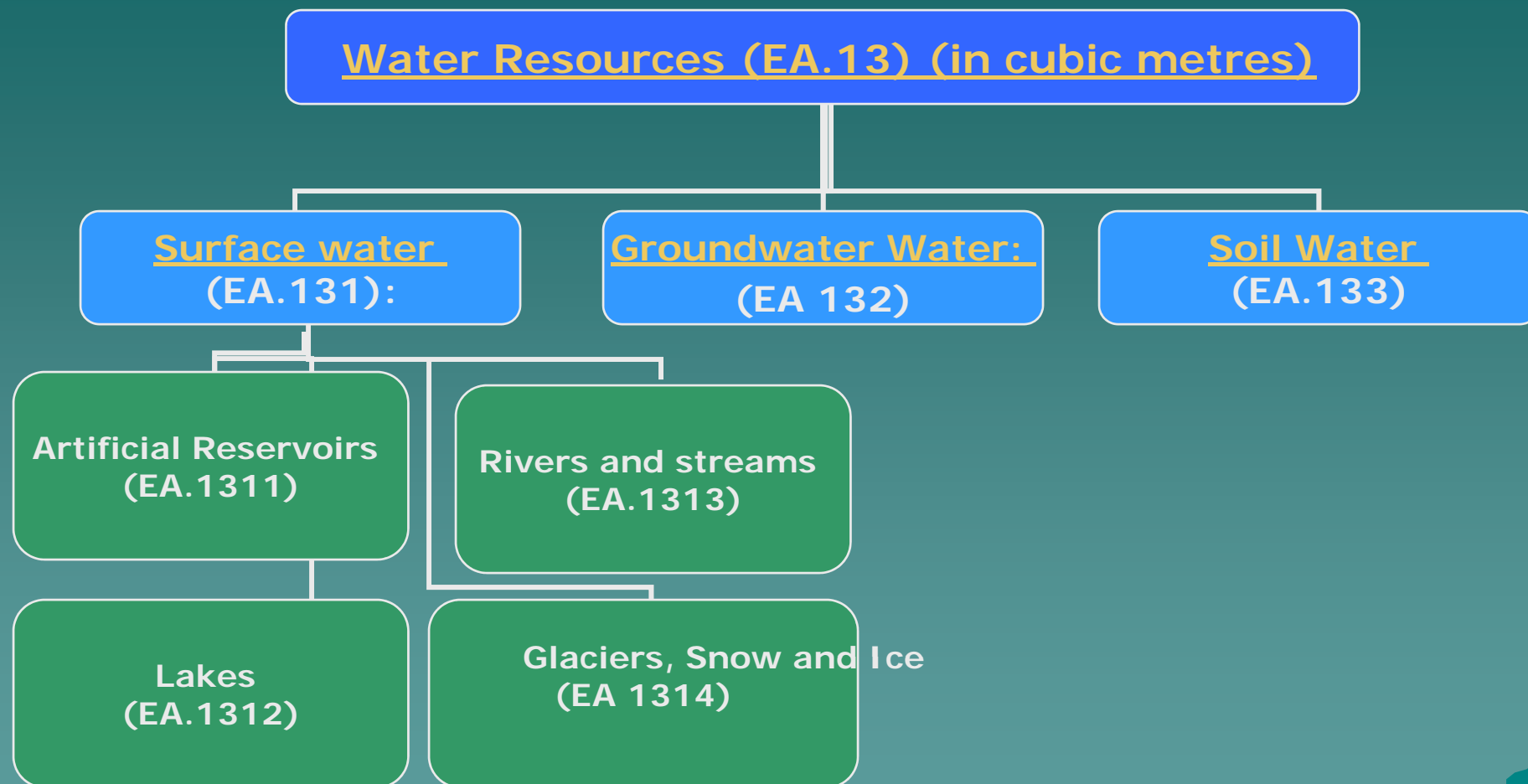
The Water cycle



With permission from The Chemistry Information Centre, CIC , 2007

Precipitation = runoff + evapotranspiration + infiltration + interception +
+/- change in storage (in soil or the bedrock)

Water Assets: Definition and Classification



Water Resource assets: Definition

Water Resources : Water found in fresh and brackish surface and groundwater bodies within the national territory that provide direct use benefits now or in the future (option benefits) through the provision of raw material and may be subject to quantitative depletion through human use.

Surface water (EA.131):

Water which flows over, or is stored on the ground surface

Groundwater Water: (EA 132)

It collects in porous layers of underground formations known as aquifers

Soil Water (EA.133)

Water suspended in the uppermost belt of soil, or in the zone of aeration near the ground surface, that can be discharged in to the atmosphere by evapotranspiration

Special Considerations

- ◆ Spatial Variability (at the river basin or catchment levels)
- ◆ Seasonal Variability
- ◆ The stock of a river:
 - the average volume held in the riverbed.
 - alternative that is proposed in SEEA, i.e. that of the mean annual run-off [SEEA, 2003, 8.112], equivalent to the “accumulated flow” concept proposed by Margat [1986; 1996].
- ◆ Groundwater assets could alternatively be measured as the sustainable yield rather than as the volume in storage

Special Considerations

- ◆ Boundaries between categories may not always be precise
 - ◆ Data availability
 - ◆ Country priorities
- E.g., Disaggregate the classifications:
artificial lakes for household, agricultural,
hydroelectric power generation & mixed use

Type of water resources: Salinity level

◆ Fresh water

- naturally occurring water having a low concentration of salts. It is generally accepted as suitable for abstraction and treatment to produce potable water.
- It is often the major source of water supply.
- It is an important renewable resource.

◆ Brackish water

- water containing salts at a concentration significantly lower than that of sea water. The concentration of total dissolved salts is usually in the range of 1,000-10,000 (mg/l).
- It can be used with or without treatment for some industrial uses or for irrigation purposes for some specific crops or aquaculture.

The salinity level that distinguishes fresh and brackish water varies among countries.

<http://unstats.un.org/unsd/ENVIRONMENTGL/>

Wafa A. Hosn UNESCWA Amman, March 2008

Accounting for transboundary water

- ◆ Quota indicated in the international agreement opening/closing stocks
- ◆ Without agreement equal share
(e.g., if the river borders 2 countries,
amount of inflows: 50/50)

Asset accounts vs physical supply & use tables

	Asset accounts	Physical supply & use tables
Sea	Water flowing into oceans and sea (outflows from rivers)	Water abstracted from & returned into the sea (e.g., cooling, desalination)
Evaporation & evapo-transpiration	Water vaporised and evapo-transpired from water resources	Which occurs within the economic sphere (e.g., part of water consumption)
Precipitation	Precipitation into water resources (flow from atmosphere to inland water resources)	Precipitation directly used by the economy (e.g., rain harvest)

SEEAW

Asset Accounts

Standard Tables and Supplementary Tables

Table 6.1 Asset Accounts

Opening Stocks and Increases in Stocks

Asset accounts								
Physical units (Million Cubic Meters)								
		EA.131 Surface water				EA.132 Groundwater	EA.133 Soil water	Total
		EA.1311 Artificial Reservoirs	EA.1312 Lakes	EA.1313 Rivers	EA.1314 Snow, Ice and Glaciers			
1. Opening Stocks								
Increases in stocks								
	2. Returns from the economy							
	3. Precipitation							
	4. Inflows							
	4.a. from upstream territories							
	4.b. from other resources in the territory							

Table 6.1 Asset Accounts

Decreases in Stocks and Closing Stocks

	EA.131 Surface water				EA.132 Groundwater	EA.133 Soil water	Total
	EA.1311 Artificial Reservoirs	EA.1312 Lakes	EA.1313 Rivers	EA.1314 Snow, Ice and Glaciers			
Decreases in stocks							
5. Abstraction							
6. Evaporation/Actual evapotranspiration							
7. Outflows							
7.a to downstream territories							
7.b to the sea							
7.c to other resources in the territory							
8. Other changes in volume							
9. Closing Stocks							
Note: Grey cells indicate non relevant or zero entries by definition.							

Table 6.2 Matrix of Flows between Water Resources

Supplementary information to the asset accounts (Chapter 6)							
Matrix of flows between water resources							
Physical units (Million Cubic Meters)							
	EA.131 Surface water				EA.132 Groundwater	EA.133 Soil water	Outflows to other resources in the territory
	EA.1311 Artificial Reservoirs	EA.1312 Lakes	EA.1313 Rivers	EA.1314 Snow, Ice and Glaciers			
EA.1311 Artificial Reservoirs							
EA.1312 Lakes							
EA.1313 Rivers							
EA.1314 Snow, Ice and Glaciers							
EA.132 Groundwater							
EA.133 Soil water							
Inflows from other resources in the territory							

Table 6.3 Asset accounts at national level

	Water Resources (classified according to the asset classification)		Total
	Legal quotas established by	of which Transboundary waters	
1. Opening Stocks			
Increases in stocks			
2. Returns ^(a)			
3. Precipitation			
4. Inflows			
4.a from upstream territories ^(a) :			
4.a.1 Country 1			
...			
4.b from other Water Resources in the te	Na		
Decreases in stocks			
5. Abstraction ^(a)			
6. Evaporation/Actual			
7. Outflows			
7.a to other Water Resources in the	Na		
7.b to the sea	Na		
7.c to downstream territories			
7.c.1 Country 2			
...			
Other changes in volume	Na		
Closing Stocks			

Note: (a) Each of these flows may be subject to quotas established in treaties and agreements between riparian countries; Na not applicable

Table 6.4 Asset accounts for a river basin shared by two countries

		Water Resources		Total
		(classified according to the asset classification)		
		Country 1	Country 2	
1. Opening Stocks				
Increases in stocks				
2. Returns ^(a) :				
2.a by Country 1				
2.b by Country 2				
3. P recipitation				
4. Inflows from other resources ^(a) :				
4.a Country 1				
4.b Country 2				
Decreases in stocks				
5. Abstraction ^(a) :				
5.a by Country 1				
5.b by Country 2				
6. Evaporation/Actual evapo transpiration				
7. Outflows to other resources in the country ^(a) :				
7.a Country 1				
7.b Country 2				
8. Outflows to the sea				
9. Other Volume changes				
10. Closing Stocks				

Note: (a) Each of these flows may be subject to quotas established in treaties and agreements between riparian countries. Information on these quotas should be reported in a separate column when available.

Example of Water Assets from Philippine

**APPENDIX TABLE 5. PHYSICAL ACCOUNTS OF GROUNDWATER, BY REGION, 1988-1994
IN MILLION CUBIC METERS**

ACCOUNT	1988	1989	1990	1991	1992	1993	1994
NCR							
Opening Stock	6,185.14	5,871.76	5,499.42	5,154.17	4,721.80	4,283.50	3,838.74
Changes in Quantity (Withdrawal)	(519.54)	(549.71)	(580.73)	(610.04)	(623.05)	(641.08)	(670.69)
Other Accumulation (Recharge)	206.16	177.37	235.48	177.67	184.75	196.32	212.41
Closing Stock	5,871.76	5,499.42	5,154.17	4,721.80	4,283.50	3,838.74	3,380.46
Changes in Quality	103.08	88.69	117.74	88.84	92.38	98.16	106.21
REGION I							
Opening Stock	4,620.00	4,472.31	4,377.64	4,242.93	4,096.09	4,003.73	3,869.82
Changes in Quantity (Withdrawal)	(251.29)	(267.27)	(297.01)	(287.40)	(249.69)	(247.73)	(274.78)
Other Accumulation (Recharge)	103.60	172.60	162.30	140.56	157.33	113.82	103.97
Closing Stock	4,472.31	4,377.64	4,242.93	4,096.09	4,003.73	3,869.82	3,699.01
Changes in Quality	103.60	172.60	162.30	140.56	157.33	113.82	103.97
REGION II							
Opening Stock	11,850.00	11,938.25	12,035.31	12,215.36	12,340.87	12,430.74	12,482.76
Changes in Quantity (Withdrawal)	(91.40)	(92.95)	(95.15)	(97.14)	(98.65)	(100.48)	(102.52)
Other Accumulation (Recharge)	179.65	190.01	275.21	222.65	188.51	152.51	139.94
Closing Stock	11,938.25	12,035.31	12,215.36	12,340.87	12,430.74	12,482.76	12,520.19
Changes in Quality	179.65	190.01	275.21	222.65	188.51	152.51	139.94
REGION III							
Opening Stock	54,700.00	54,618.27	54,499.92	54,421.20	54,280.08	54,157.35	54,061.46
Changes in Quantity (Withdrawal)	(261.38)	(263.42)	(269.04)	(270.01)	(278.00)	(285.82)	(294.45)
Other Accumulation (Recharge)	179.65	145.07	190.32	128.89	155.27	189.93	125.84
Closing Stock	54,618.27	54,499.92	54,421.20	54,280.08	54,157.35	54,061.46	53,892.85
Changes in Quality	179.65	145.07	190.32	128.89	155.27	189.93	125.84
REGION IV							
Opening Stock	37,000.00	35,901.79	34,723.95	33,426.30	32,008.17	30,418.75	28,684.27
Changes in Quantity (Withdrawal)	(1,301.64)	(1,393.00)	(1,533.33)	(1,619.01)	(1,753.11)	(1,953.55)	(2,258.61)
Other Accumulation (Recharge)	203.43	215.16	235.68	200.88	163.69	219.07	170.94
Closing Stock	35,901.79	34,723.95	33,426.30	32,008.17	30,418.75	28,684.27	26,596.61
Changes in Quality	203.43	215.16	235.68	200.88	163.69	219.07	170.94

Example of Water Assets from Philippine

Philippine Asset Accounts National Statistical Coordination Board) ENRA
Report No. 2, May 1998

This report was written for the Integrated Environmental Management for Sustainable Development (IEMSD), a programme of the Department of Environment and Natural Resources (DENR) and the National Economic and Development Authority (NEDA) with funding support from the United Nations Development Programme (UNDP). (National Statistical Coordination Board) ENRA Report No. 2, May 1998

Philippine Water Resources

APPENDIX TABLE 1. WATER DEMAND REQUIREMENTS FROM GROUNDWATER, BY SECTOR AND BY REGION, IN MILLION CUBIC METERS, 1988-1994

SECTOR	1988	1989	1990	1991	1992	1993	1994
Domestic							
NCR	208.64	214.35	220.03	225.66	231.24	236.73	242.16
I	127.94	130.28	132.66	135.04	137.57	139.79	142.28
II	88.88	91.07	93.26	95.45	97.67	99.94	102.16
III	192.6	197.16	201.76	206.36	210.99	215.63	220.22
IV	286.99	294.64	302.4	310.16	317.96	325.8	333.63
V	148.69	152.06	155.42	158.82	162.26	165.69	169.17
VI	179.51	183.37	187.2	191.06	194.89	198.72	202.48
VII	161.81	164.9	167.99	171.09	174.18	177.24	180.29
VIII	30.65	31.2	31.75	32.32	32.9	33.47	34.05
IX	39.34	40.2	41.06	41.92	42.79	43.67	44.54
X	112.41	115.28	118.19	121.17	124.14	127.15	130.16
XI	155.95	159.72	163.57	167.42	171.27	175.16	179.04
XII	105.75	108.39	111.03	113.71	116.43	119.19	121.94
Sub-total	1,839.16	1,882.62	1,926.32	1,970.18	2,014.29	2,058.18	2,102.12

.....Other Sectors

Same Table for Surface Water

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Example of Water Assets from Canada

An asset account for inland fresh water (km³)

Row number	EA.131 Surface Water			EA.132 Groundwater		Total	EA.nc Glaciers	Total
	EA.1311 Reservoirs	EA.1312 Lakes	EA.1313 Rivers	EA.nc Shallow aquifers	EA.nc Deep aquifers			
1	Opening Stock	880	17398	3315	.	21593	35000	56593
2	Abstraction	41	.	1	.	42	.	.
3	Residuals	Return from irrigation	.	.	.	.	.	.
		Wastewater	31	1702	.	1733	.	.
		Lost in transport	...	2	...	2	.	.
		Others	.	.	.	.	.	.
4	net precipitation (1)	3200	.	.	.	3200	.	.
5	Inflows	52	.	.	.	52	.	.
6	Net natural transfers	.	.	.	.	.	.	.
7	Evaporation from water bodies	403	...	...	.	403	.	.
8	Outflows	To other countries	192	.	.	192	.	.
		To the sea	3123	.	.	3123	.	.
9	Other Volume Changes	Due to natural disaster	.	.	.	.	.	.
		Discovery	.	.	.	.	.	.
		Others	.	.	.	.	.	.
10	Closing Stock	.	.	.	.	.	.	.

Notes:

The stock in reservoirs refers to operational capacity of large dams; data excludes dams smaller than 15 meters in height.

The stock of lakes refers to Great Lakes, Canadian portion only.

Stock in rivers refers to annual accumulated flows, based on the long term average.

(1) This row should be replaced by four rows: precipitation, evapotranspiration, evaporation, and their balance, net precipitation

. Not available

... Not applicable

Relation to UNSD Questionnaire

<http://unstats.un.org/unsd/environment/questionnaire2006.htm>



UNSD/UNEP QUESTIONNAIRE 2006 ON ENVIRONMENT STATISTICS

Section: WATER

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Relation to UNSD Questionnaire

Water Questionnaire 2006 is more comprehensive regarding the volume of water abstracted by activity and by source, in addition to that, Information about wastewater treatment facilities are detailed.

However the questionnaire lacks the below parts (Stocks by source as mentioned above, emissions, and economic information).

Policy Relevance

Sustainability Assessment: The volume of water use must be compared to the availability of water in the environment based on the assessment of stocks.

However, few countries compile comprehensive water asset accounts as their water SUT.

Integrated water resource management (IWRM) : Analysis of water allocations, future water demands.