PAWA – Pilot Arno Water Accounts

System of Environmental-Economic Accounting for Water

1st Draft water flow diagrams & SEEA-Water tables

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1st Draft water flow diagrams and SEEA-Water tables

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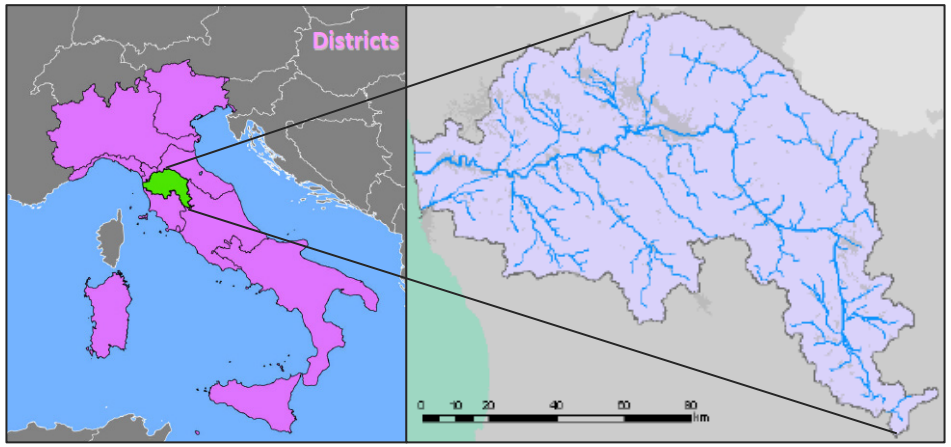
Introduction. Case of study



Arno River Basin:

- Area: 8228 Km^2
- River length: 241 Km
- Altitude: 0 m-1385 m
- Climate: Mediterranean

Chiana: Pollution, high irrigation use

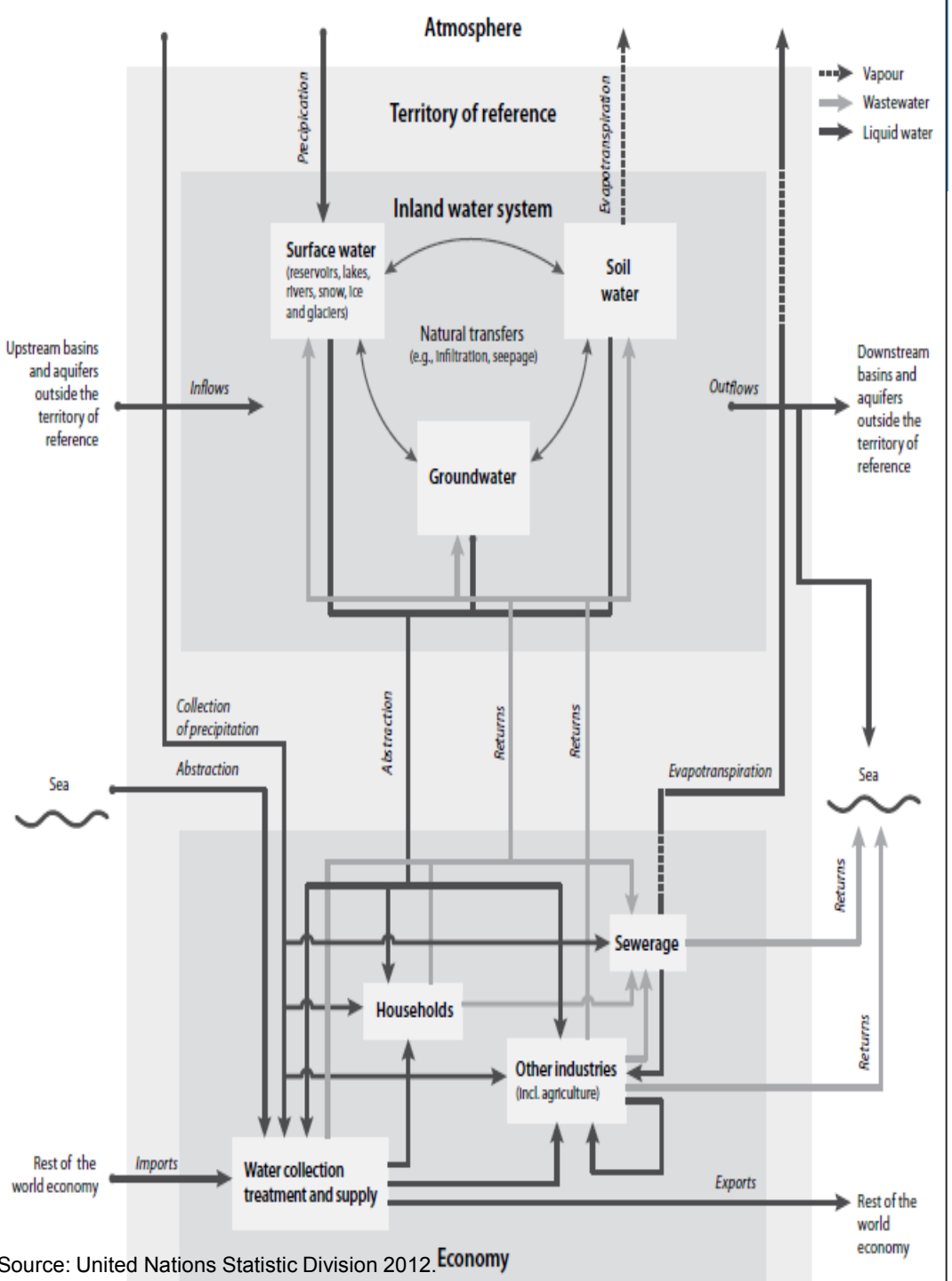
- Area: 1373 km^2
- Precipitation: 774.6 mm/year
- Annual avg. Temperature: 13.8 °C

Bisenzio: Pollution, high industrial use

- Area: 347.5 km^2
- Precipitation: 570.7 mm/year
- Annual avg. Temperature: 13.9 °C

Pisa: Salinity intrusion, aquifer exploitation

- Area: 407 km^2
- Precipitation: 891.2 mm/year
- Annual avg. Temperature: 15.9 °C



Source: United Nations Statistic Division 2012.

The SEEA-Water method:

- Integrates water cycle with economic activities in a standard way.

Standard codes:

- For the economic activities (ISIC Rev. 4)
- For all data items (water flows)

Standard SEEA-Water tables

1) Physical Supply and Use Accounts

- Water supply and its use in the production process and by households
- The reused water within the economy

(2) Emission Accounts

- The pressures imposed by the economy into the environment.

(3) Hybrid and Economic Accounts

- The cost, the financing of these cost, the investments and the payment of permits for access to water.

(4) Water Asset Accounts

- Stocks and flows of water within the environment.

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Introduction. PAWA Objectives

What for	How	Main Actions
• Improve the knowledge on water availability and its use in the economy. • Support for decision making. • Have been we able to collect all data necessary? • What are the main difficulties faced?	Creating a tool: • Set of SEEA-Water tables • Water-related indicators.	• Create data inventory table; • Match data sets with SEEA-Water structure; • Build water accounts from 1999 to 2013; • Compute water efficiency indicators; • Pre-define water saving measures; • Create scenarios.

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Data characterization

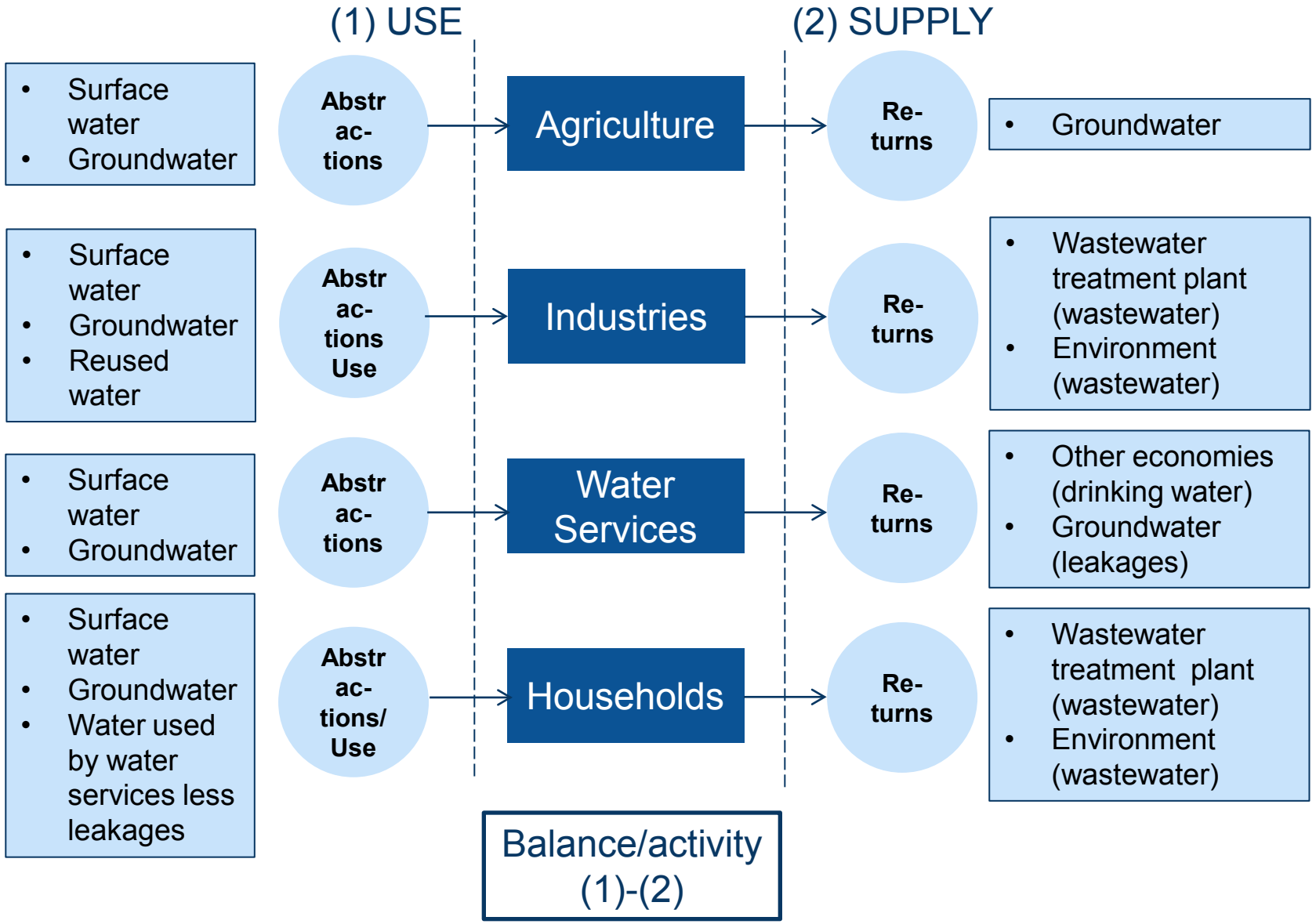
SEEA-W 2012	Type	Parameter		Data source	Location (web-site)	Temporal scale (monthly)	Temporal extend	Physical scale	Comments (Ex. Modelled data or real data, access rights)
Water use table (A Table III.3)	Water use	Abstraction from inland water resources: surface water (Specify which purpose: distribution or own use)	Agriculture, farming. If it's for own use: which use? Irrigation, etc..						
			mining quarrying, manufacturing and construction If it's for own use: which use?						
			Electricity, Gas, steam, air conditioning. If it's for own use: which use? Ex:						

Data sets used:

- Direct measurements,
- Data from model: i.e. ground water balance, i.e. GIS layers,
- Data from water rights and wastewater discharge permits,
- Estimates and
- Statistical results.

1st Draft water flow diagrams and SEEA-Water tables

Water Flow Diagrams for Water Supply and Use Accounts Table I



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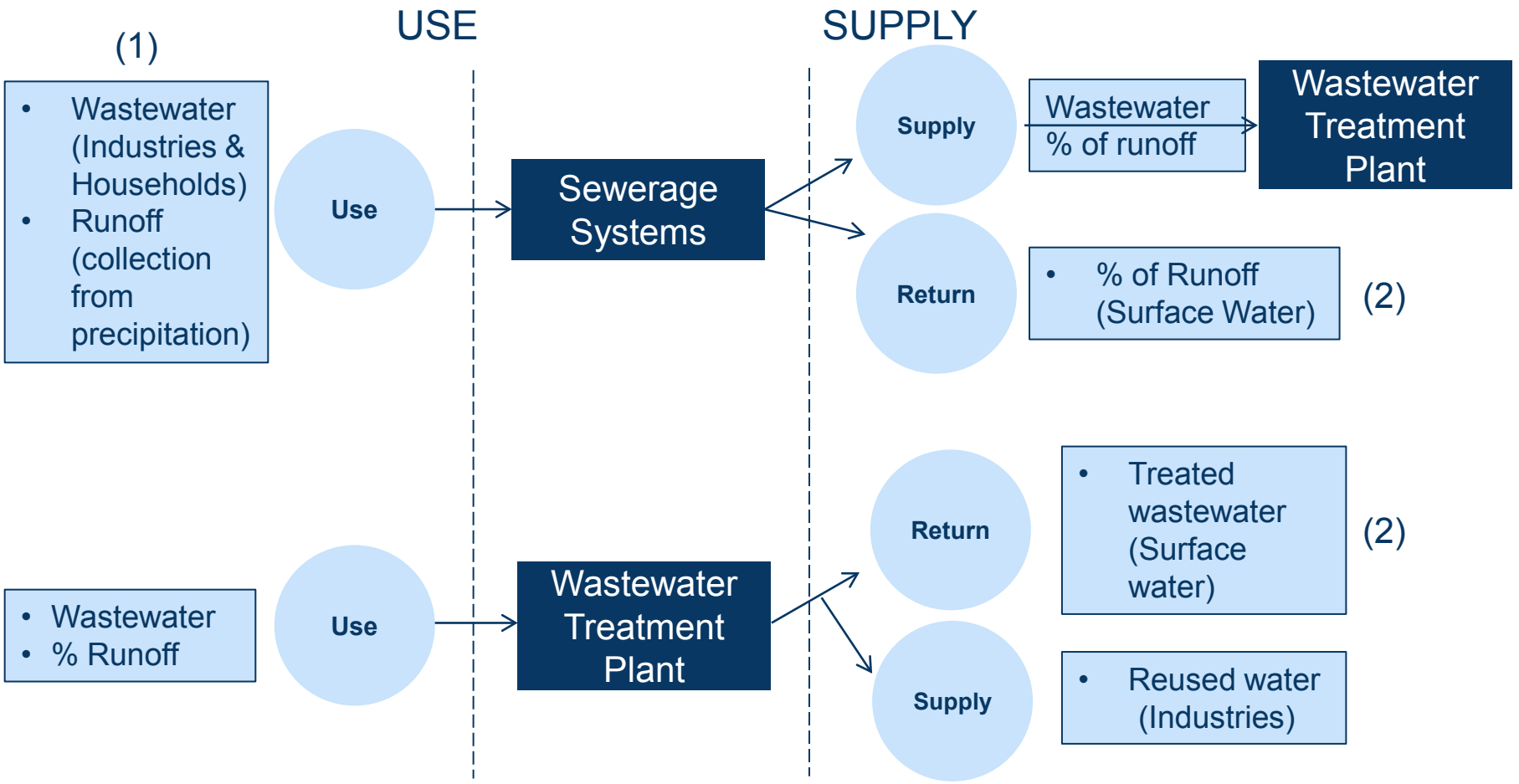
Water Flow Diagrams for Water Supply and Use Accounts Table II



Balance: Sewerage Systems + WasteWater Treatment Plant: (1)-(2)

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Water Flow Diagrams for Water Asset Accounts I

OPENING STOCKS

The amount of available water at the beginning of the account period

Useful to know how much has the stock fluctuated

Surface Water

Addition of Reservoirs, Lakes & Rivers

Artificial Reservoirs

Not taken into account

Lakes

Only one in Chiana

Rivers

Not easy to estimate in the accounts

Groundwater

Known & use

Soil Water

Not easy to use in the accounts

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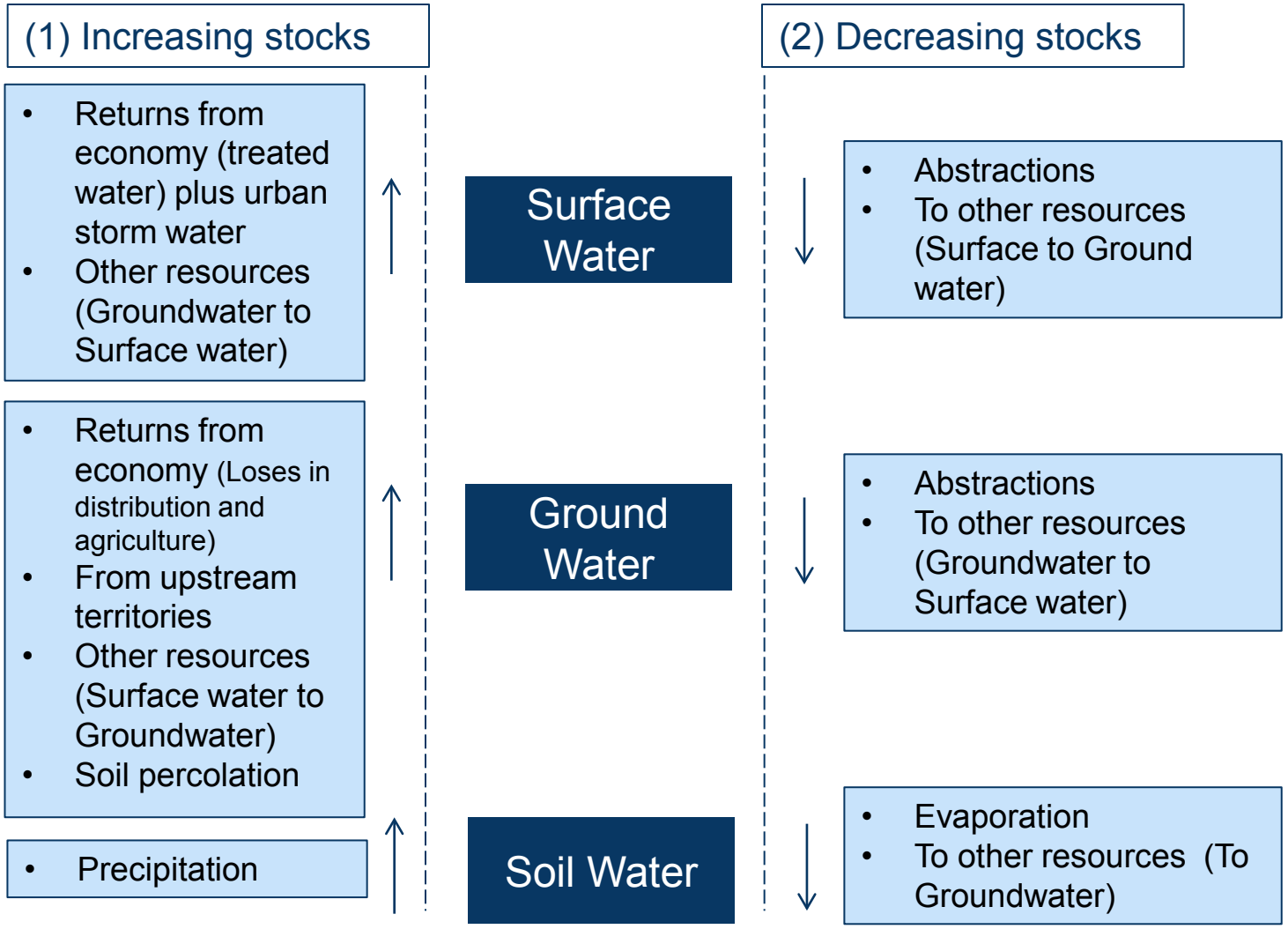
Water Flow Diagrams for Water Asset Accounts II



Closing stocks=Opening stocks + (1)-(2)

Balance: Closing stocks-Opening stocks

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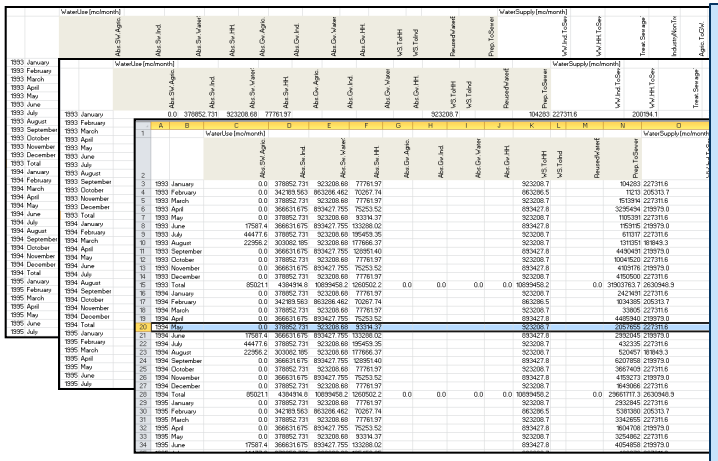
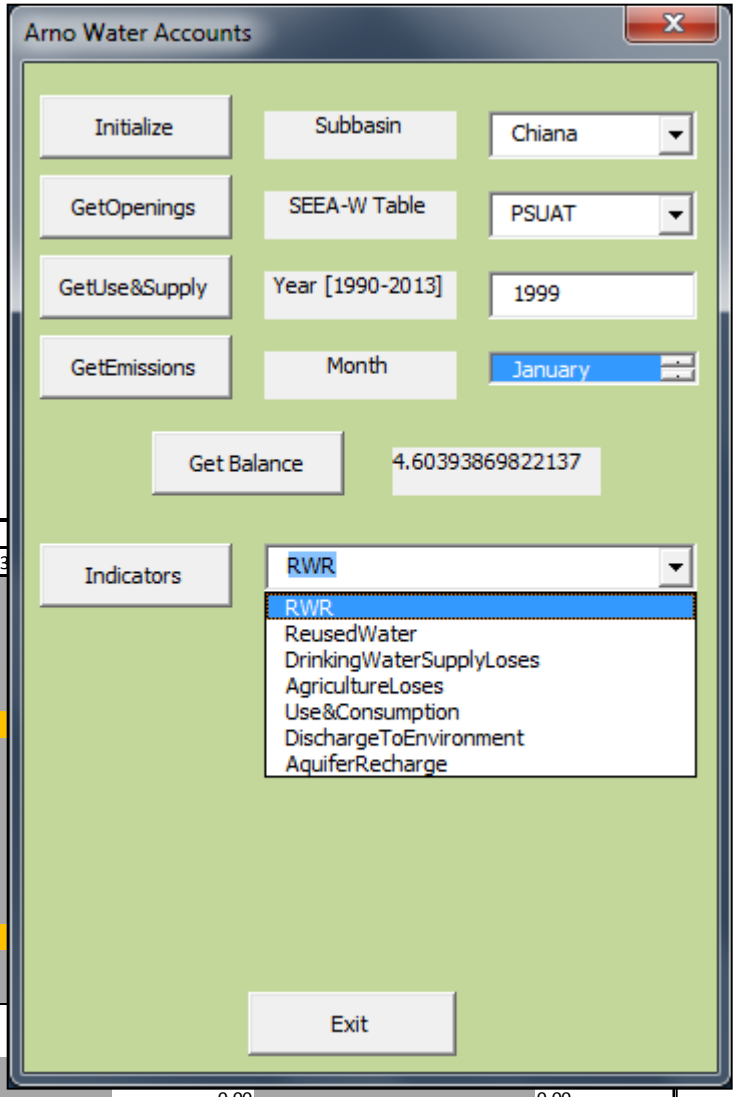
Method to fill SEEA-Water tables. VBA graphical user interface

SEMIDE EMWIS



Initialize: Clear table
GetOpenings: Store Opening and Closing stocks
GetUse&Supply: Store use and supply items and balance.
GetBalance: Computes balance



A. Physical water use table (Table III.3) [m3]		Activities 1-3							
From the environment	1.a Abstraction for own use	14571235.2							
	(Type of use) Hydroelectric power generation								
	Irrigation water	14571235.2							
	Mine water								
	Urban run-off (urban storm water)								
	Cooling water								
	Other								
	1.b Abstraction for distribution			5165184.84					
	1.i From inland water resources	14571235.27	2050027.69	5165184.84					
	Surface water	901235.27	50027.69	1895184.84					
	Groundwater	13670000.00	2000000.00	3270000.00					
	Soil water								
	1.ii Collection of precipitation								
	1.iii Abstraction from the sea								
	1. Total abstraction (1.a+1.b(=1.i+1.ii+1.iii))	14571235.27	2050027.69	5165184.84					
Within the economy	2. From other economic units		0.00						
	Water services								
	Reused water					0.00			0.00
	Wastewater to sewerage				2718050.88				2718050.88
	Desalinated water								
	3. TotalA (1+2)	14571235.27	2050027.69	5165184.839	11662219.23	33448667.03	8465185.16		41913852.18

1st Draft water flow diagrams and SEEA-Water tables

The Water Use & Supply Accounts table. CHIANA 2007 WATER USE

A. Physical water use table (Table III.3) [m3]		Activities						Households	Rest of the world (exports water)	Total
		Agric	Industry	35	Water Servics	Sew. & WWTP	Total			
From the environment	1.a Abstraction for own use	18,539,762	3,728,788				22,268,550	4,229,734		26,498,284
	(Type of use) Hydroelectric power generation									
	Irrigation water	18,539,762					18,539,762			18,539,762
	Mine water									
	Urban run-off (urban storm water)					17,888,337	17,888,337			17,888,337
	Cooling water									
	Other									
	1.b Abstraction for distribution				5,165,185		5,165,185			5,165,185
	1.i From inland water resources	18,539,762	3,728,788		5,165,185		27,433,735	4,229,734		31,663,468
	Surface water	4,869,762	1,728,788		1,895,185		8,493,735	309,734		8,803,468
	Groundwater	13,670,000	2,000,000		3,270,000		18,940,000	3,920,000		22,860,000
	Soil water									
	1.ii Collection of precipitation					17,888,337	17,888,337			17,888,337
	1.iii Abstraction from the sea									
	1. Total abstraction (1.a+1.b(=1.i+1.ii+1.iii))	18,539,762	3,728,788		5,165,185		27,433,735	4,229,734		31,663,468
Within the economy	2. From other economic units		-			6,945,792	6,945,792	4,235,452		11,181,244
	Water services							4,235,452		4,235,452
	Reused water						-			-
	Wastewater to sewerage					6,945,792	6,945,792			6,945,792
	Desalinated water									
	3. TotalA (1+2)	18,539,762	3,728,788		5,165,185	24,834,129	47,102,679	8,465,185		55,567,864

Water abstractions Hm3		[%]
Agriculture	18.54	58.55
Industries	3.73	11.78
WaterServices	5.17	16.31
Sewerage&Treatment	0.00	0.00
HouseHolds	4.23	13.36

Hm3	Water abstr	[%]
Surface water	8.80	27.80
Groundwater	22.86	72.20
TotalAbs.	31.66	

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The Water Use & Supply Accounts table. CHIANA 2007 WATER SUPPLY

B. Physical supply table (Table III.3) [m3]		Activities					Households	Rest of the world (Imports water)	Total
		Agric	Industry	35	Water Servics	Sew. & WWTP	Total			
Within the economy	4. To other economic units		1,864,394		4,235,452	-	6,099,846	5,081,398		11,181,244
	4.a Reused water						-			-
	4.b Wasterwater to sewerage		1,864,394				1,864,394	5,081,398		6,945,792
	4.c Desalinated water									
Into the environment	5. Total returns (=5a+5b)	3,707,952	745,758		929,733	24,834,129	30,217,572	3,172,300		33,389,872
	Hydroloelectric power generation									
	Irrigation water	7,415,905					7,415,905			7,415,905
	Mine water									
	Urban run-off (storm water)					17,888,337	17,888,337			17,888,337
	Cooling water									
	Loses in distribution because of leakages				929,733		929,733			929,733
	Non treated wastewater		745,758			12,521,836	13,267,593	3,172,300		16,439,893
	Treated wastewater					12,312,293	12,312,293			12,312,293
	Other									
	5.a To inland water resources (=5a.1+5a.2+5a.3)	3,707,952	745,758		929,733	24,834,129	29,471,815	3,172,300		32,644,115
	5a.1 Surface water					24,834,129	24,834,129			24,834,129
	5a.2 Groundwater	3,707,952			929,733		4,637,686			4,637,686
	5a.3 Soil water									
	5b To other resources	12,050,845					12,050,845			12,050,845
	6. TotalB (4+5)	3,707,952	2,610,152		5,165,185	24,834,129	36,317,418	8,253,698		44,571,116
	7. Consumption	14,831,810	1,118,636		-	-	15,950,446	211,487		10,996,748

	Water Use Hm3	[%]	Water Returns Hm3	[%]	Water Consumed Hm3	[%]
Agriculture	18.5	33.4	3.7	20.0	14.8	80.0
Industries	3.7	6.7	2.6	70.0	1.1	30.0
WaterServices	5.2	9.3	5.2	100.0	0.0	0.0
Sewerage&Treatment	24.8	44.7	24.8	100.0	0.0	0.0
HouseHolds	8.5	15.2	8.3	97.5	0.2	2.5
Total	55.6	100.0	44.6	80.2	11.0	19.8
Rused	0	0				

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The Asset Accounts table. CHIANA JULY 2007

Asset accounts (Table VI.1) [m3]	EA.131.Surface water			EA.131 SurfaceWater	EA.132 Groundwater	EA.133 Soil water	Total
	EA.1311 Artificial reservoir	EA.1312 Lakes	EA.1313 Rivers				
1. Opening stocks	-	5,880,000.0	-	-	535,005,589,907.3	-	535,011,469,907.3
Increases in stocks			-	589,670.2	3,034,711.6	177,433.5	3,801,815.3
2. Returns				589,670.2	564,711.6		1,154,381.8
3. Precipitation						177,433.5	177,433.5
4. Inflows			-	-	2,470,000.0		2,470,000.0
4.a From upstream territories					1,235,000.0		1,235,000.0
4.b From other resources in the territory					1,235,000.0		1,235,000.0
Decreases in stocks		90,140.4	791,942.4	1,641,867.1	1,905,000.0	27,807,276.0	30,594,358.8
5. Abstraction		90,140.4		1,641,867.1	1,905,000.0		3,637,007.5
6.Evaporation/actual evapotranspiration						27,807,276.0	27,807,276.0
7. Outflows			791,942.4		-	-	791,942.4
7.a To dowsntream territories			791,942.4				791,942.4
7.b To the sea							-
7.c To other resources in the territory						-	-
8. Other changes in volume							336,178.3
9. Closing stocks		5,789,859.6			535,006,719,618.9		534,958,220,998.6
10.Balance	-	5,789,859.6	- 791,942.4	- 1,052,196.8	1,129,711.6	- 27,629,842.5	- 53,248,908.7

(1) Incrs. Groundwater [m3]		[%]	(2) Decrs. Groundwater [m3]		Balance (1)-(2) [m3]
Economy	564,711.6	31.4	**Economy**	1,905,000.0	- 1,340,288.4
UpstreamTerritories	1,235,000.0	68.6		-	1,235,000.0
SurfaceWater	-	-	**Other Resources in**		
Percolation	-	-	**the territory**		
Total	1,799,711.6	100		1,905,000.0	- 105,288.4

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The Asset Accounts table. CHIANA DECEMBER 2007

Asset accounts (Table VI.1) [m3]	EA.131.Surface water			EA.131 SurfaceWater	EA.132 Groundwater	EA.133 Soil water	Total
	EA.1311 Artificial reservoir	EA.1312 Lakes	EA.1313 Rivers				
1. Opening stocks	-	5,880,000.0	-	-	535,010,490,889.1	-	535,016,370,889.1
Increases in stocks			-	1,346,158.7	2,831,796.6	36,727,458.0	40,905,413.3
2. Returns				1,346,158.7	361,796.6		1,707,955.3
3. Precipitation						36,727,458.0	36,727,458.0
4. Inflows			-	-	2,470,000.0		2,470,000.0
4.a From upstream territories					1,235,000.0		1,235,000.0
4.b From other resources in the territory					1,235,000.0		1,235,000.0
Decreases in stocks		90,140.4	987,552.0	612,998.9	1,905,000.0	16,819,933.0	19,802,625.4
5. Abstraction		90,140.4		612,998.9	1,905,000.0		2,608,139.3
6.Evaporation/actual evapotranspiration						15,340,977.0	15,340,977.0
7. Outflows			987,552.0		-	1,478,956.0	2,466,508.0
7.a To dowsntream territories			987,552.0				987,552.0
7.b To the sea							-
7.c To other resources in the territory						1,478,956.0	1,478,956.0
8. Other changes in volume							325,458.4
9. Closing stocks		5,789,859.6			535,011,417,685.7		535,058,901,923.3
10.Balance	-	5,789,859.6	- 987,552.0	733,159.8	926,796.6	19,907,525.0	42,531,034.3

(1) Incrs. Groundwater [m3]		[%]	(2) Decrs. Groundwater [m3]		Balance (1)-(2) [m3]	
Economy	361,796.6	11.8	**Economy**	1,905,000.0	- 1,543,203.4	
UpstreamTerritories	1,235,000.0	40.2		-	2,713,956.0	
SurfaceWater	-	-	**Other Resources in**			
Percolation	1,478,956.0	48.1	**the territory**			
Total	3,075,752.6	100		1,905,000.0	1,170,752.6	Recharge

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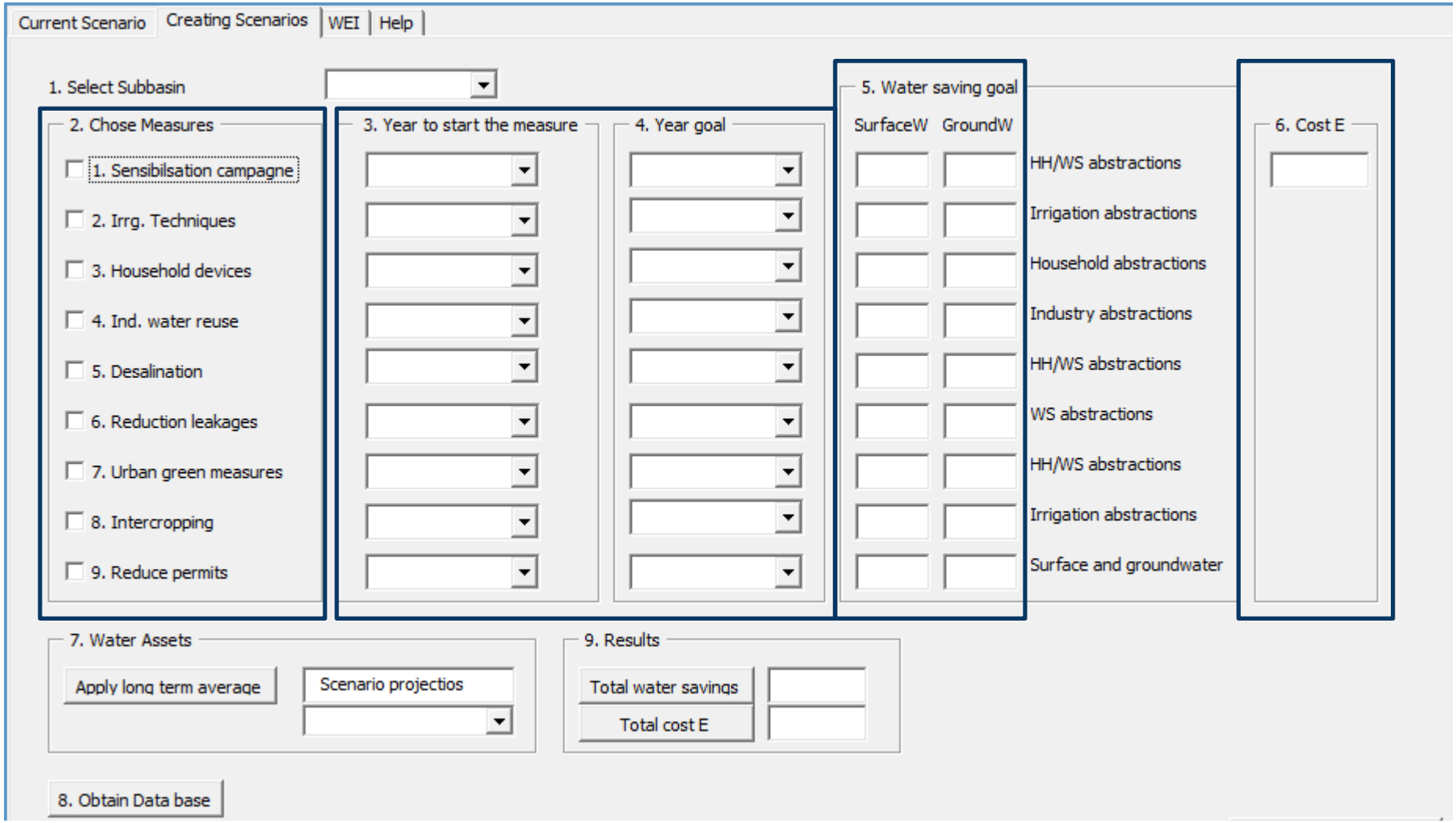
OPTIMIZATION OF MEASURES II: Tool in development.



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Conclusions and Recommendations

PAWA project	SEEA-Water	Recommendations

Objectives fulfilment:
• Water accounts from 1999 to 2013,
• Annual incremental trend groundwater stocks,
• Inf. on surface water: stocks not easy access, WEI high summer periods;
• Visual Basic tool as support decision making in water saving measures.
	• Identify dry years,
	• Easy comparison between territories,
	• Strong points:
	  • Compact system of information,
	  • WA link hydrological information (assets) directly to economic accounts (supply and use,
	  • WA at sub-basin level.
	• Weak points:
	  • It requires a great sum of data series,
	  • Some of data series high level of uncertainty.
		• Improve knowledge on:
		  • water abstractions,
		  • surface water availability at sub-catchment level.
		• Would it be possible to rearrange the surface water returns upstream?
		• Further steps beyond PAWA: Link the existing tables with:
		  • Pollutant emissions,
		  • cost and revenues.

Thank you for your kind attention!

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http://pawa.emwis.net/