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Pilot Arno Water Accounts

Deliverable: D5.1 Final water account tables

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1 Introduction

The PAWA project is composed of four successive technical activities and two horizontal activities, as presented in **Figure 1**.

During the Activity 1, three sub-basins were identified over the Arno River basin as priority areas to prepare water accounts on a monthly basis (see **D1.2 Prioritisation list of sub-basins**). These sub-basins are:

- Chiana valley (1373 sq. km);
- Bisenzio valley and Prato plain (hydr. basin of 320 sq. km + groundwater of 90 sq. km);
- Pisa area (407 sq. km).

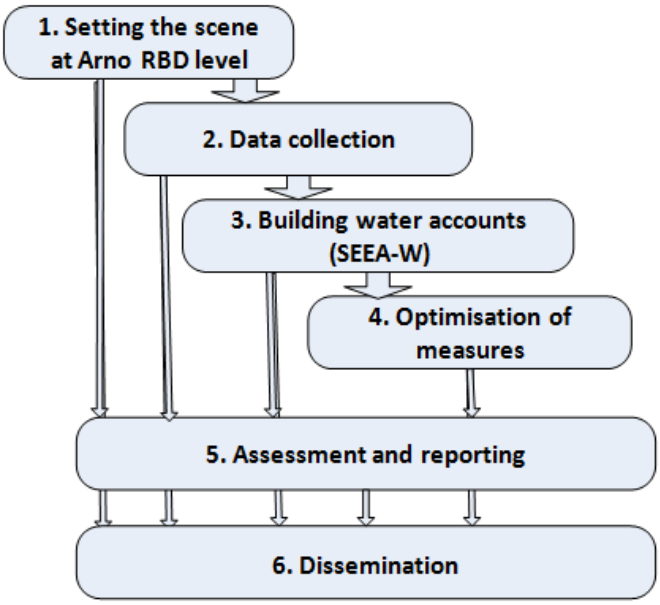


Figure 1 – PAWA project activity chart.

During Activities 2 ("Data collection") and 3 ("Building water accounts"), water flows occurring on the sub-basins were identified, validated with local stakeholders and interpreted to calculate preliminary water balances and to produce the SEEA-Water tables (see **D3.1 1st Draft water flow diagrams and associated SEEA-Water tables**). At a later stage, the Water Accounts (WA) tables so obtained have been revised thanks to the availability of new datasets and the improvement of some data estimates. In particular, a transfer of wastewater to other territories has been added into the PAWA database. The structure of the "Physical Supply and Use Accounts" Table (PSUAT) has been modified in accordance. These revisions are described in **D4.1 Water efficient targets for future revisions Arno RBMP**.

The current deliverable presents:

- a reminder on the water flow diagrams;
- the final SEEA-WATER PSUAT and "Asset" Tables for the three pilot sub-basins and for some specific years;
- the tool that allows to generate PSUAT and "Asset" Tables for a specific sub-basin and for a particular month or year within the period covered by the project, that is, from 1993 to 2013. The tool (updated version) itself is available on the **PAWA FTP public repository** (directory: PAWA VBA), but it is reminded that the most realistic datasets are those available for the period 2006–2013.

Limitations, recommendations for further improvement and lessons learnt are presented in the deliverable **D6.2 Compendium of lessons learnt**.

2 Water flow diagrams

The diagram of water flows for the "Water Supply and Use Accounts" in the Arno River Basin is presented in **Figure 2**. The SEEA-Water tables for the Chiana, Bisenzio and Pisa territories are set up on the basis of these flows.

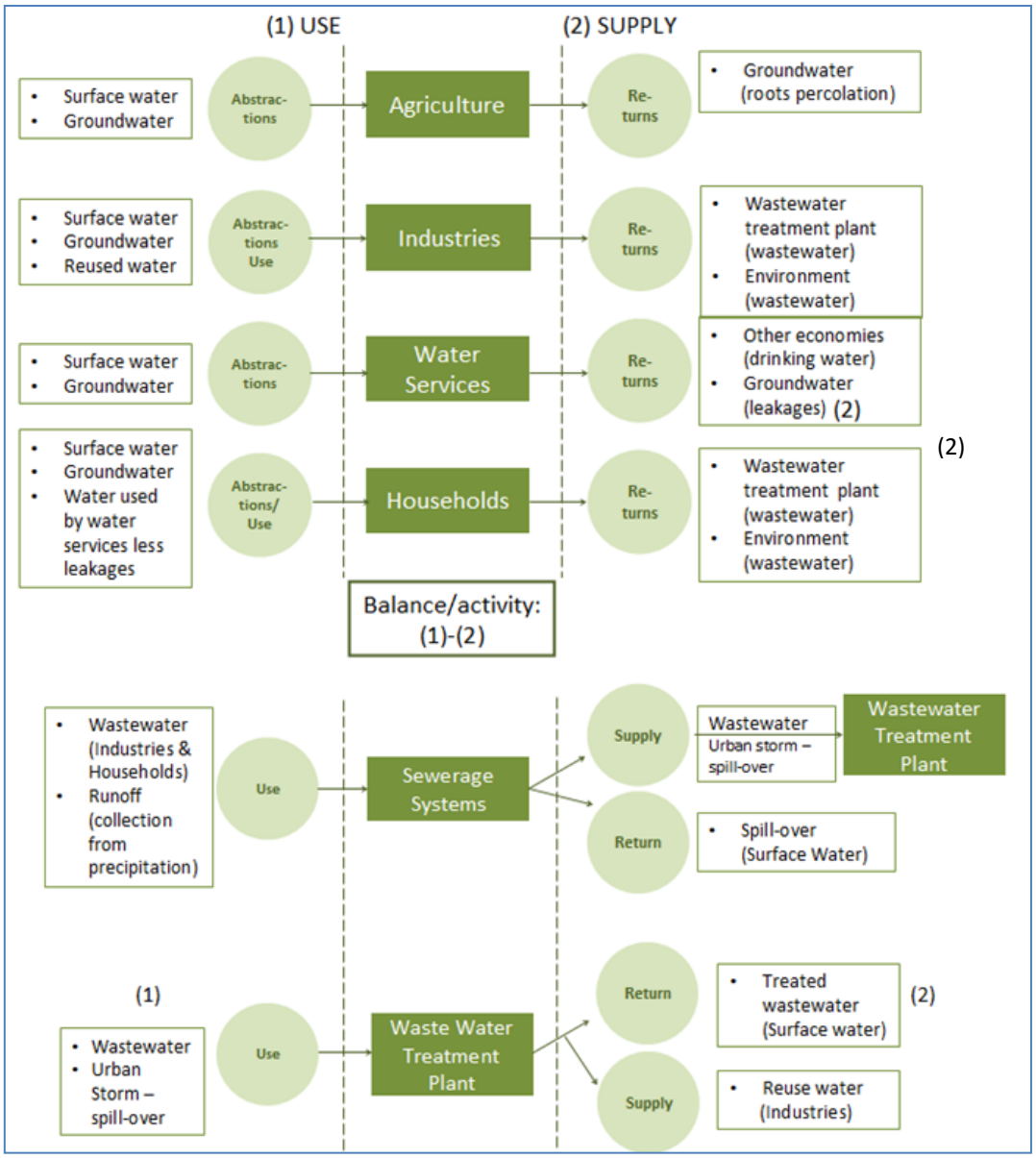


Figure 2 – The diagram representing the "Water Supply and Use Accounts" in the Arno River Basin.

All water flows represented in **Figure 2** are transferred into cells of the PSUAT. The water balance for each economic activity is computed as the difference between boxes 1 and 2. Sewerage systems and wastewater treatment plant (WWTP) represent two economic activities. The balance is computed as the difference between sewerage system water use less 50% of urban storm water returned from the sewerage system and the treated wastewater returned from the wastewater treatment plant. This percentage has been estimated in agreement with local experts.

The method reveals that the 50% of the urban storm water collected is not treated and released directly to surface water. Besides, it can be deducted from the diagram in **Figure 2** that the total treated water is the water released after the treatment plant, the total untreated water includes direct wastewater discharge from industries and households and the 50% of urban storm collected that is not going to the treatment plant. Wastewater released by the sewerage systems is returned to surface water (treated and not treated). However, wastewater, released by the economy and not going to the sewerage, goes to the environment, but there is no possible way to differentiate if it goes to surface or groundwater.

The total water return to inland water resources (surface and groundwater) is computed as the sum of total water return to surface water (treated wastewater and 50% of storm urban water) plus direct wastewater discharged from industries and households and the agriculture losses to groundwater. For the Bisenzio area, a part of the treated wastewater is transferred to another territory, so the total water return to inland water resources is decreased of this amount.

Water balance is the difference between water use and supply to other economies and returns to the environment.

Water use by economy = Agriculture (surface and groundwater abstractions) + Industry (surface and groundwater abstractions + reuse water from the WWTP) + Water services (surface and groundwater abstractions) + Sewerage systems (wastewater from industries and households + total urban runoff collected) + WWTP (wastewater from industries and households + total urban runoff collected less spillover) + Households (surface and groundwater abstractions + water services to households).

Total use = Agriculture use + Industry use + Water Services use + Sewerage Systems use + Households use – Water Services to households.

Supply by economy = Agriculture (return to groundwater) + Industry (supply to WWTP and return directly to the environment) + Water Services (supply to household and return to groundwater) + Sewerage Systems (supply to WWTP and return to surface water) + WWTP (return to surface water less the treated water transferred to other territories) + Households (return to WWTP and directly to the environment).

Total supply = Agriculture supply + Industry supply + Water Services supply + WWTP supply + Household supply.

Water balance/Consumption = Total supply – Total use.

Besides, in the latest version of the SEEA-Water tables of the PAWA project, it is possible to track the volumes of non-conventional water uses, namely irrigation recycle, industrial reuse, and desalination, to which water saving measures can be applied.

The diagram in **Figure 3** represents the "Water Assets". The "snow and glaciers" asset is not present in the Arno River Basin and the "surface water asset" has been added to group reservoirs, lakes and rivers (returns from the economy are not disaggregated by rivers, reservoirs or lakes).

The opening stock of the lake in the Chiana area will appear on the "Water Asset Accounts". The water volume abstracted and returned is known and it is considered to be the same over the

period. This means that the opening stock of the lake is the same no matter which month is taken into consideration.

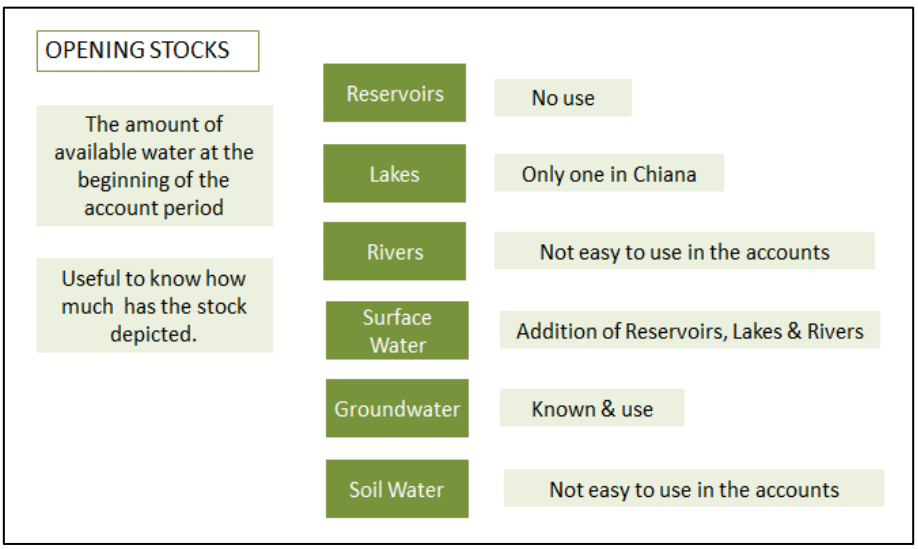


Figure 3 – The water assets representing the environment: opening stock definitions.

The groundwater opening stock is known for the three territories. For the rest of the assets (reservoirs, rivers and soil water), information about opening stocks is not available. Opening stocks refer to the amount of available water at the beginning of the accounting period. Hence, for groundwater assets and for the lake used in Chiana, it is possible to know the increase or decrease of the stock. For the rest of the assets, only fluctuations are possible to assess.

Figure 4 represents the increasing and decreasing stocks of "Water Assets". The "Water Asset Accounts" tables are filled in with the water flows represented in the diagrams.

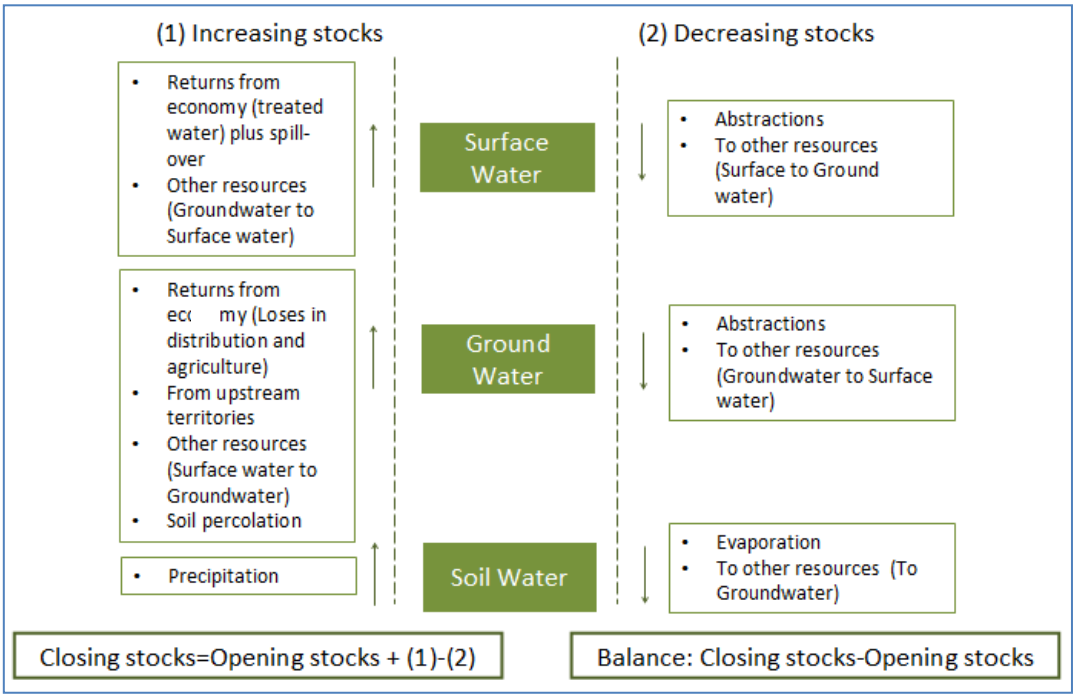


Figure 4 – Increasing and decreasing stocks in the Arno River Basin.

It must be noted that:

- Surface water and groundwater balance cannot be computed separately because the quantity of direct wastewater from the economic activities discharged into surface water cannot be distinguished from discharges into groundwater.
- Returns to the environment do not appear on the opening stocks diagram (**Figure 4**).
- Other changes in volume are computed as the addition of untreated water coming from economical activities (households and industries) and evapotranspiration from agriculture. Other changes in volume are added to the global balance.

3 SEEA-Water tables

Making use of the "*Arno Water Accounts*" tool (MS-Excel Visual Basic application), the next nine SEEA-Water tables (**Table 1**–**Table 9**) have been compiled to illustrate the results on specific years. These specific years have been selected because they are the most complete in terms of data availability and include water scarcity periods:

- PSUAT for *i*) Chiana in 2012, *ii*) Bizensio in 2007, and *iii*) Pisa in December 2011;
- "Water Assets" tables for *i*) Chiana in December 2012, *ii*) Bizensio in December 2007, and *iii*) Pisa in December 2011.

Numbers are measured in m^3. Economic activity headings correspond to Revision 4 of the International Standard Industrial Classification of All Economic Activities (**ISIC, Rev. 4**), developed by the Department of Economic and Social Affairs of United Nations, where:

- ISIC divisions 1–3 include agriculture, forestry, and fishing;
- ISIC divisions 5–33 and 41–43 include mining and quarrying, manufacturing, and construction;
- ISIC division 35 corresponds to electricity, gas, steam, and air-conditioning supply;
- ISIC division 36 includes water collection, treatment, and supply;
- ISIC divisions 37–39 include sewerage, and wastewater treatment plant systems; and
- ISIC divisions 45–99 correspond to the service industries.

The cell colours[1] defined in **D2.2 Assessment of data availability** are used for the WA tables:

- **grey** cells for not applicable items;
- **red** for missing existing items (data not available);
- **orange** for estimations;
- **green** for real measurements;
- **pink** for data items generated as a result scenario processing; and
- cells with no colour for data obtained by combining values from other cells.

[1] Some coloured cells appear empty, because the corresponding data series does not exist for that specific territory; though it exists for other areas (e.g., the reuse water data available only for the Bisenzio area).

3.1 Physical Supply and Use Accounts table

Table 1 – Chiana 2012 Physical Supply and Use Table: Use.

A. Physical water use table (Table III.3) [m3]		Activities						Households	Rest of the world (exports water)	Total
		Agriculture	Industry	35	Water Services	Sewerage	WWTP	Total			
From the environment	1.a Abstraction for own use	18 539 762	3 728 788			25 278 831		47 547 381	4 229 734		51 777 114
	(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)					25 278 831	*15 167 299*	25 278 831			25 278 831
	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					25 278 831	*15 167 299*	25 278 831			25 278 831
	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	25 278 831		52 712 566	4 229 734		56 942 299
Within the economy	2. From other economic units	-	-		-	6 310 475	21 477 773	27 788 248	4 235 452		32 023 699
	Water services		-						4 235 452		4 235 452
	Recycle/Reused water		-					-			-
	Wastewater to sewerage					6 310 475	6 310 475	6 310 475			6 310 475
	Desalinated water							-			-
	3. TotalA (1+2)	18 539 762	3 728 788		5 165 185	31 589 305.4	21 477 773.1	80 500 813	8 465 185		88 965 998

In 2012, the total water abstraction amounted to 56.94 Hm³ (including urban stormwater). If we consider only abstractions from surface/ground waters, the total abstracted amount is 31.66 Hm³ (line 1.i), of which the 27% from surface water and 73% from groundwater.

The breakdown of total abstractions is the following: *i*) agricultural abstractions 59%; *ii*) industrial abstractions 12%; *iii*) drinking water supply system abstractions 16%; and *iv*) households' abstractions 13%. The "Water Use" table should be read taking into consideration the "Water Supply Accounts" table (**Table 1** vs. **Table 2**; see comments on water use on the following page).

Table 2 – Chiana 2012 Physical Supply and Use Table: Supply.

B. Physical supply table (Table III.3) [m3]		Activities						Households	Rest of the world (Imports water)	Total
		Agriculture	Industry	Water Services	Sewerage	WWTP	Total			
Within the economy	4. To other economic units		1 864 394	4 235 452	21 477 773	-	6 099 846	4 446 081		10 545 926
	4.a Reused water					-	-			-
	4.b Wasterwater to sewerage		1 864 394		21 477 773		1 864 394	4 446 081		6 310 475
	4.c Desalinated water									
Into the environment	5. Total returns (=5a+5b)	3 707 952	745 758	929 733	10 111 532	21 477 773	36 972 749	3 172 300		40 145 049
	Hydroloelectric power generation									
	Irrigation water	3 707 952					3 707 952			3 707 952
	Mine water				Spillover					
	Urban run-off (storm water)				10 111 532	*15 167 299*	25 278 831			25 278 831
	Cooling water									
	Loses in distribution because of leakages			929 733			929 733			929 733
	Non treated wastewater		745 758		*10 111 532*		10 857 290	3 172 300		14 029 590
	Treated wastewater					21 477 773	21 477 773		-	21 477 773
	Other									
	5.a To inland water resources (=5a.1+5a.2+5a.3)	3 707 952	745 758	929 733	10 111 532	21 477 773	36 972 749	3 172 300		40 145 049
	5a.1 Surface water				10 111 532	21 477 773	31 589 305			31 589 305
	5a.2 Groundwater	3 707 952		929 733			4 637 686			4 637 686
	5a.3 Soil water									
	5b To other resources									
	6. TotalB (4+5)	3 707 952	2 610 152	5 165 185	31 589 305	21 477 773	64 550 367	7 618 381	-	72 168 748
	7. Consumption	14 831 810	1 118 636	-	-	-	15 950 446	846 804	-	16 797 250
	7a Loses in distribution (evap. Or malfunctioning meters)	12 050 845								12 050 845

The following figures result from **Table 1** (Use) and **Table 2** (Supply). In 2012, in the Chiana sub-basin, agriculture used around 18.54 Hm^3 (**Table 1**, line "3. TotalA") and consumed the 80% of this amount (**Table 2**, line "7. Consumption"). Industries and services used 3.73 Hm^3 (**Table 1**) and consumed the 30% (**Table 2**). Water services used 5.17 Hm^3 (**Table 1**) and there is no consumption (water is distributed to other economies and losses are retuned to the environement). Sewerage systems and the wastewater treatment plants did not consume water. Households used 8.47 Hm^3 (**Table 1**, line "3. TotalA") and returned the 90% (**Table 2**, line "6. TotalB"). In 2012, the Chiana sub-basin used a total of 88.97 Hm^3, returned or supplied to other economic activities 72.17 Hm^3 and consumed 16.80 Hm^3, which amounted to 19% of the total water used and 53% of abstracted surface water and groundwater.

The graphs in **Figure 5** and **Figure 6** illustrate the above described figures.

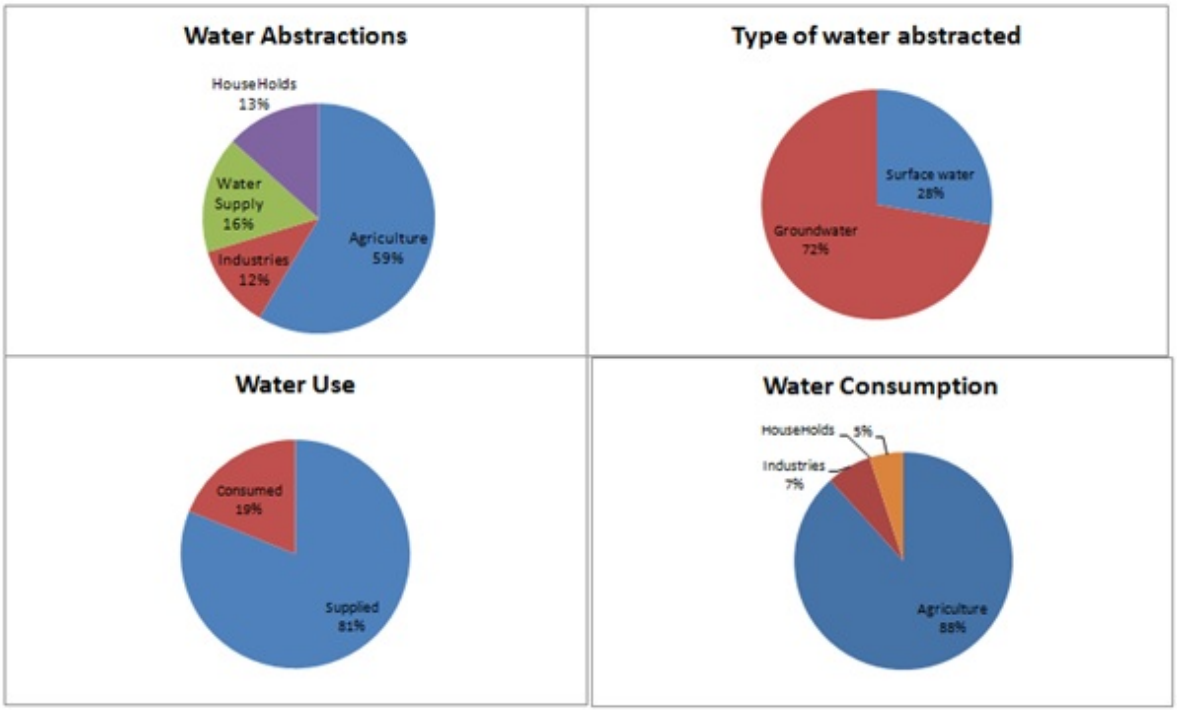


Figure 5 – Chiana 2012: Physical Supply and Use Accounts (56.94 Hm³ abstracted).

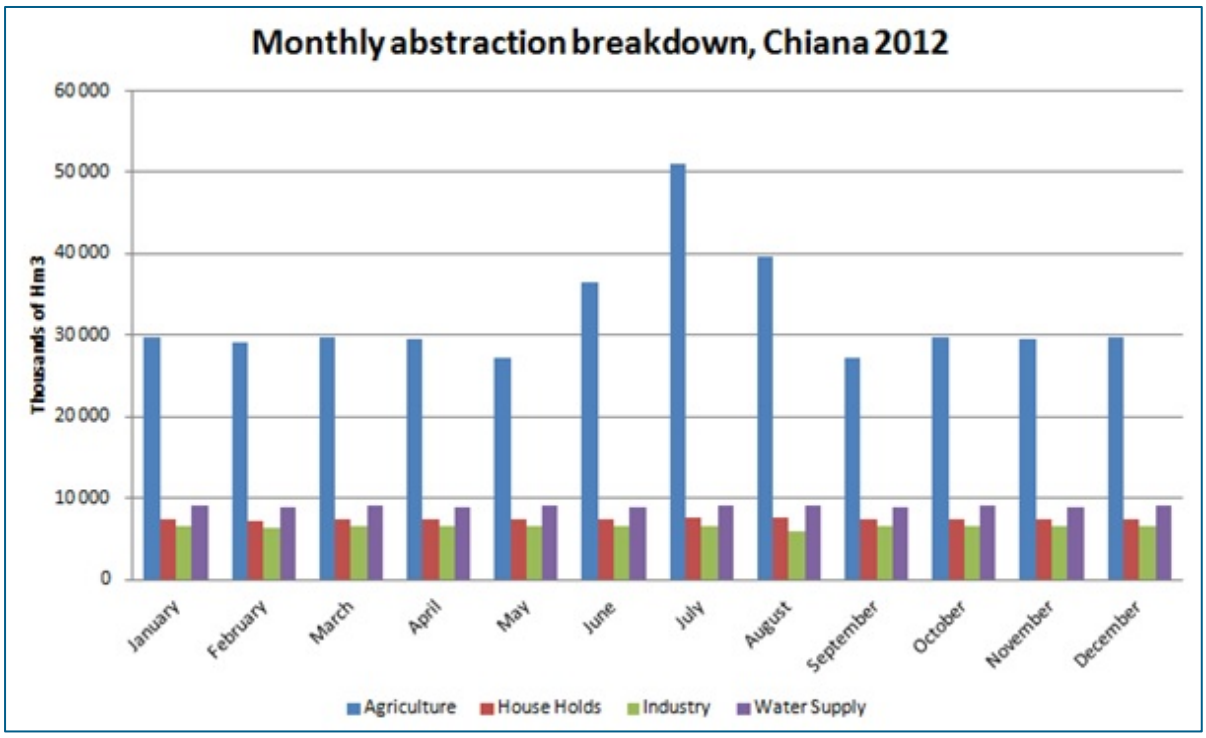


Figure 6 – Chiana 2012: Monthly water abstraction by sector.

A monthly analysis is also interesting as it shows the period where shortages may occur due to a high level of abstraction if a drought happens.

Table 3 – Bisenzio 2007 Physical Supply and Use Accounts Table: Use.

A. Physical water use table (Table III.3) [m3]			Activities						Households	Rest of the world (exports water)	Total
			Agriculture	Industry	35 Water Services	Sewerage	WWTP	Total			
From the environment	1.a Abstraction for own use		330 193	9 678 181				10 008 374	1 451 735		11 460 109
	(Type of use)	Hydroelectric power generation									
		Irrigation water	330 193					330 193			330 193
		Mine water									
		Urban run-off (urban storm water)				30 364 158	3 036 416	30 364 158			30 364 158
		Cooling water									
		Other									
	1.b Abstraction for distribution				25 445 211			25 445 211			25 445 211
	1.i From inland water resources		330 193	9 678 181	25 445 211			35 453 585	1 451 735		36 905 320
		Surface water	85 021	2 936 100	10 899 458			13 920 579	1 260 502		15 181 081
		Groundwater	245 172	6 742 081	14 545 753			21 533 006	191 233		21 724 239
		Soil water									
	1.ii Collection of precipitation					30 364 158	3 036 416	30 364 158			30 364 158
	1.iii Abstraction from the sea										
	1. Total abstraction (1.a+1.b(=1.i+1.ii+1.iii))		330 193	9 678 181	25 445 211			35 453 585	1 451 735		36 905 320
Within the economy	2. From other economic units		-	1 030 146	-	22 720 381	22 720 381	46 470 908	16 005 038		62 475 946
		Water services		-					16 005 038		16 005 038
		Recycle/Reused water		1 030 146				1 030 146			1 030 146
		Wastewater to sewerage				22 720 381	22 720 381	22 720 381			22 720 381
		Desalinated water						-			-
	3. TotalA (1+2)		330 193	10 708 327	25 445 211	53 084 539.2	25 756 796.7	62 240 528	17 456 773		63 692 263

As shown in **Table 3**, water abstracted in the Bisenzio area in 2007 amounted to 36.90 Hm^3 (line "1. Total abstraction"), of which the 41% was taken from surface water and the remaning 59% from groundwater. In addition, agricultural abstraction represented the 1% (line "1.a Abstraction for own use/Irrigation water", column "Agriculture"), industries the 26% (column "Industry"), water drinking supply systems the 69% (column "Water Servicies"), and households the 4% (column "Households") of the total abstractions.

Table 4 – Bisenzio 2007 Physical Supply and Use Accounts Table: Supply.

B. Physical supply table (Table III.3) [m3]		Activities						Households	Rest of the world	Total
		Agriculture	Industry	35	Water Services	Sewerage	WWTP	Total		(Imports water)	
Within the economy	4. To other economic units		6 424 996		16 005 038	25 756 797	1 030 146	23 460 180	16 295 385		39 755 565
	4.a Reused water						1 030 146	1 030 146			1 030 146
	4.b Wasterwater to sewerage		6 424 996			25 756 797		6 424 996	16 295 385		22 720 381
	4.c Desalinated water										
Into the environment	5. Total returns (=5a+5b)	66 039	1 070 833		9 440 173	27 327 742	25 756 797	63 661 584	1 088 801		64 750 385
	Hydroloelectric power generation										
	Irrigation water	66 039						66 039			66 039
	Mine water					Spillover					
	Urban run-off (storm water)					27 327 742	*3 036 416*	30 364 158			30 364 158
	Cooling water										
	Loses in distribution because of leakages				9 440 173			9 440 173			9 440 173
	Non treated wastewater		1 070 833			*27 327 742*		28 398 575	1 088 801		29 487 376
	Treated wastewater						25 756 797	25 756 797		19 833	25 756 797
	Other										
	5.a To inland water resources (=5a.1+5a.2+5a.3)	66 039	1 070 833		9 440 173	27 327 742	25 756 797	63 661 584	1 088 801		64 750 385
	5a.1 Surface water					27 327 742	25 756 797	53 084 539			53 084 539
	5a.2 Groundwater	66 039			9 440 173			9 506 212			9 506 212
	5a.3 Soil water										
	5b To other resources										
	6. TotalB (4+5)	66 039	7 495 829		25 445 211	53 084 539	25 756 797	111 848 414	17 384 186	19 833	129 212 767
	7. Consumption	264 155	3 212 498		-	-	-	3 476 653	72 587	- 19 833	3 569 072
	7a Loses in distribution (evap. Or malfunctioning meters)	198 116									198 116

The following figures are deducted from **Table 3** (Use) and **Table 4** (Supply). During the year 2007, in the Bisenzio area, agriculture used around 0.33 Hm^3 (**Table 3**, line "3. TotalA") and consumed the 80% (**Table 4**, line "7. Consumption"). Industries and services used 10.7 Hm^3 (**Table 3**) and consumed the 30% (**Table 4**). Water services used 25.4 Hm^3 (**Table 3**) and there is no consumption (water is distributed to other economies and losses are retuned to the environment). Sewerage systems and wastewater treatment plants did not consume water. Households used 17.46 Hm^3 (**Table 3**, line "3. TotalA") and returned the 99.6% (**Table 4**, line "6. TotalB"). In 2007, the Bisenzio area used a total of 132.8 Hm^3, returned or supplied to other economic activities 129.2 Hm^3 and consumed 3.57 Hm^3, including 0.2 Hm^3 (about 6%) which were transfered to another territory.

The graphs in **Figure 7** illustrate the above described figures.

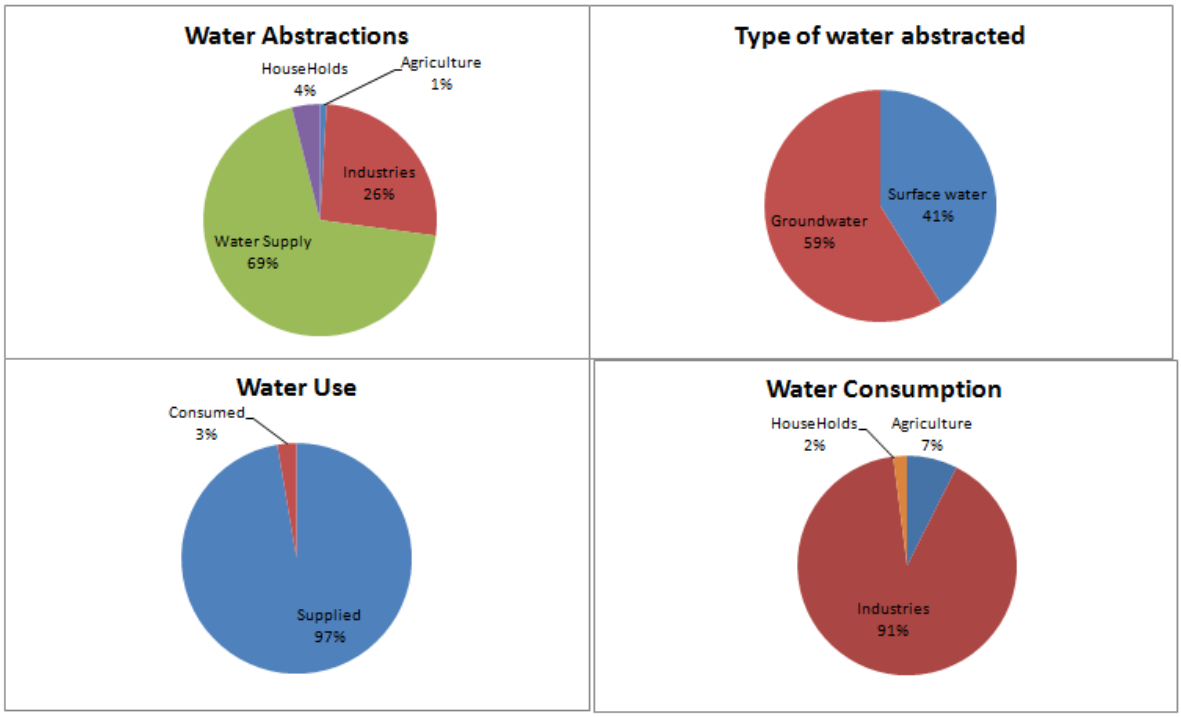


Figure 7 – Bisenzio 2007: Physical Supply and Use Accounts (36.90 Hm^3 abstracted).

Table 5 – Water Use Accounts for the Pisa sub-basin in December 2011.

A. Physical water use table (Table III.3) [m3]			Activities						Households	Rest of the world (exports water)	Total
			Agriculture	Industry	35	Water Services	Sewerage	WWTP	Total			
From the environment	1.a Abstraction for own use		11 462	319 241			-		330 703	116 947		447 651
	(Type of use)	Hydroelectric power generation										
		Irrigation water	11 462						11 462			11 462
		Mine water										
		Urban run-off (urban storm water)						-	-			-
		Cooling water										
		Other										
	1.b Abstraction for distribution					1 015 000			1 015 000			1 015 000
	1.i From inland water resources		11 462	319 241		1 015 000			1 345 703	116 947		1 462 651
		Surface water	3 454	4 241					7 696	281		7 976
		Groundwater	8 008	315 000		1 015 000			1 338 008	116 667		1 454 674
		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))		11 462	319 241		1 015 000	-		1 345 703	116 947		1 462 651
Within the economy	2. From other economic units		-	-		-	838 700	838 700	1 677 400	771 400		2 448 800
		Water services		-						771 400		771 400
		Recycle/Reused water							-			-
		Wastewater to sewerage					838 700	838 700	838 700			838 700
		Desalinated water							-			-
	3. TotalA (1+2)		11 462	319 241		1 015 000	838 700.1	838 700.1	3 023 103	888 347		3 911 451

In the Pisa sub-basin, the total water abstracted in December 2011 amounted to 1.46 Hm^3, and it was mainly (99%) taken from groundwater (see line "1.i From inland water resources" in **Table 5**). Total abstraction breakdown per sector: *i*) agriculture 0.8%; *ii*) industry 21.8%; *iii*) water drinking supply systems 69.4%; and *iv*) households 8%.

Table 6 – Water Supply Accounts for the Pisa sub-basin in December 2011.

B. Physical supply table (Table III.3) [m3]		Activities						Households	Rest of the world (Imports water)	Total
		Agriculture	Industry	35	Water Services	Sewerage	WWTP	Total			
Within the economy	4. To other economic units		159 621		771 400	838 700	-	931 021	679 079		1 610 100
	4.a Reused water							-			-
	4.b Wasterwater to sewerage		159 621			838 700		159 621	679 079		838 700
	4.c Desalinated water										
Into the environment	5. Total returns (=5a+5b)	2 292	31 924		243 600	-	838 700	1 116 517	87 711		1 204 227
	Hydroloelectric power generation										
	Irrigation water	2 292						2 292			2 292
	Mine water					Spillover					
	Urban run-off (storm water)						-	-			-
	Cooling water										
	Loses in distribution because of leakages				243 600			243 600			243 600
	Non treated wastewater		31 924					31 924	87 711		119 635
	Treated wastewater						838 700	838 700		-	838 700
	Other										
	5.a To inland water resources (=5a.1+5a.2+5a.3)	2 292	31 924		243 600	-	838 700	1 116 517	87 711		1 204 227
	5a.1 Surface water						838 700	838 700			838 700
	5a.2 Groundwater	2 292			243 600			245 892			245 892
	5a.3 Soil water										
	5b To other resources										
	6. TotalB (4+5)	2 292	191 545		1 015 000	838 700	838 700	2 886 237	766 790	-	3 653 027
	7. Consumption	9 169	127 697		-	-	-	136 866	121 557	-	258 423
	7a Loses in distribution (evap. Or malfunctioning meters)	7 450									7 450

Figures in **Table 5** and **Table 6** provide the following information. In December 2011, agriculture in the Pisa sub-basin used around 0.011 Hm^3 and consumed the 80%. Industries used 0.32 Hm^3 and consumed the 40%. Water services consumed 1.02 Hm^3 and did not consume water (losses due to leakages returns to the environment). They returned 100% (losses go to the environment and the rest is supplied to households). Sewerage systems and wastewater treatment plants did not consume water. Households used 0.89 Hm^3 (**Table 5**, line "3. TotalA") and returned the 99.9% (**Table 6**, line "6. TotalB").

Total water uses in the Pisa area amounted to 3.9 Hm^3 of which 3.65 Hm^3 were returned, and 0.25 Hm^3 consumed.

These figures are illustrated in the graphs in **Figure 8**.

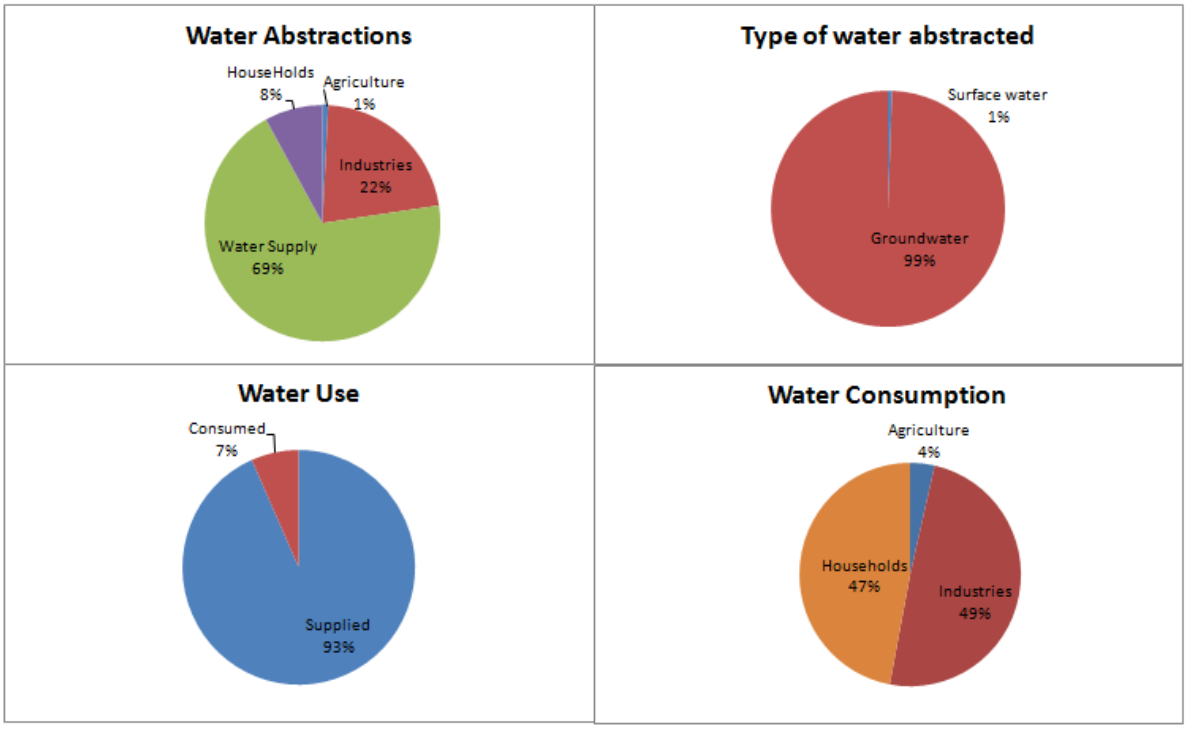


Figure 8 – Pisa December 2011: Physical Supply and Use Accounts.

3.2 Water Asset Accounts table

Table 7 – Chiana December 2012 Water Asset Accounts Table.

Chiana	EA.131.Surface water						
Asset accounts (Table VI.1) [m3]	EA.1311 Artificial reservoir	EA.1312 Lakes	EA.1313 Rivers	EA.131 SurfaceWater	EA.132 Groundwater	EA.133 Soil water	Total
1. Opening stocks	-	5 880 000.0	-	-	535 026 564 743.3	-	535 032 444 743.3
Increases in stocks			-	2 368 911.5	4 970 605.8	83 781 801.0	91 121 318.3
2. Returns				2 368 911.5	361 796.6		2 730 708.1
3. Precipitation						83 781 801.0	83 781 801.0
4. Inflows			-	-	4 608 809.2		4 608 809.2
4.a From upstream territories					1 235 000.0		1 235 000.0
4.b From other resources in the territory					3 373 809.2		3 373 809.2
Decreases in stocks		90 140.4	41 980 516.1	42 070 656.5	2 517 998.9	9 571 216.7	54 159 872.2
5. Abstraction		90 140.4	522 858.5	612 998.9	1 905 000.0		2 517 998.9
6.Evaporation/actual evapotranspiration						6 197 407.5	6 197 407.5
7. Outflows			41 457 657.6	41 457 657.6	612 998.9	3 373 809.2	45 444 465.8
7.a To dowsntream territories			41 457 657.6	41 457 657.6			41 457 657.6
7.b To the sea							-
7.c To other resources in the territory					612 998.9	3 373 809.2	3 986 808.2
8. Other changes in volume							325 458.4
9. Closing stocks		5 789 859.6			535 029 017 350.2		535 106 693 094.0
10.Balance	-	- 90 140.4	- 41 980 516.1	- 39 701 745.1	2 452 606.9	74 210 584.3	74 248 350.7

In December 2012, surface water abstractions in the Chiana sub-basin amounted to 24.5% (0.613 Hm^3) and groundwater abstractions amounted to 75.5% (1.91 Hm^3) of the total water abstracted from inland water resources (2.52 Hm^3; **Table 7**). The groundwater opening stocks in December 2012 reached an amount of 535 Mm^3. The groundwater balance was positive, meaning that, closing stocks overpassed opening stocks during this month and the surplus was equal to 2.45 Hm^3. Returns from the economy (0.3 Hm^3), upstream territories (1.23 Hm^3), and soil percolation (3.3 Hm^3) represented the 7.3%, 24.8%, and 7.9%, respectively.

Table 8 – Bisenzio December 2007 Water Asset Accounts Table.

Bisenzio / Asset accounts (Table VI.1) [m3]	EA.131.Surface water						
	EA.1311 Artificial reservoir	EA.1312 Lakes	EA.1313 Rivers	EA.131 SurfaceWater	EA.132 Groundwater	EA.133 Soil water	Total
1. Opening stocks	-	-	-	-	107 986 428 513.6	-	107 986 428 513.6
Increases in stocks			-	3 090 249.3	1 795 533.1	30 117 477.5	35 003 260.0
2. Returns				3 030 453.0	795 912.8		3 826 365.8
3. Precipitation						30 117 477.5	30 117 477.5
4. Inflows			-	59 796.3	999 620.3		1 059 416.6
4.a From upstream territories					147 639.6		147 639.6
4.b From other resources in the territory				59 796.3	851 980.7		911 777.0
Decreases in stocks		-	4 654 108.8	1 254 647.0	3 052 775.5	4 885 386.9	12 592 271.2
5. Abstraction				1 254 647.0	1 798 128.5		3 052 775.5
6.Evaporation/actual evapotranspiration						4 093 202.5	4 093 202.5
7. Outflows			4 654 108.8	-	1 254 647.0	792 184.4	6 700 940.2
7.a To dowsntream territories			4 654 108.8				4 654 108.8
7.b To the sea							-
7.c To other resources in the territory				59 796.3	1 254 647.0	792 184.4	2 046 831.4
8. Other changes in volume					12 326.7		152 147.4
9. Closing stocks		-			107 985 171 271.2		108 031 402 638.6
10.Balance	-	-	- 4 654 108.8	1 835 602.3	- 1 257 242.4	25 232 090.6	44 974 124.9

In December 2007, for the Bisenzio territory, surface water abstractions represented the 41% (1.25 Hm^3) and groundwater abstractions represented the 59% (1.8 Hm^3) of the total water abstracted from inland water resources that amounted to 3.05 Hm^3 (compare figures in line "5. Abstraction" in **Table 8**). The groundwater opening stocks in December 2007 reached an amount of 107.97 Mm^3. The groundwater balance was negative and the difference was 1.2 Hm^3 (see column "EA. 132 Groundwater" in **Table 8**). Returns from the economy (0.79 Hm^3), upstream territories (0.15 Hm^3), surface water (0.06 Hm^3), and soil percolation (0.79 Hm^3) represented the 44.3%, 8.2%, 3.3%, and 44.1%, respectively.

Table 9 – Water Asset Accounts for the Pisa sub-basin in December 2011.

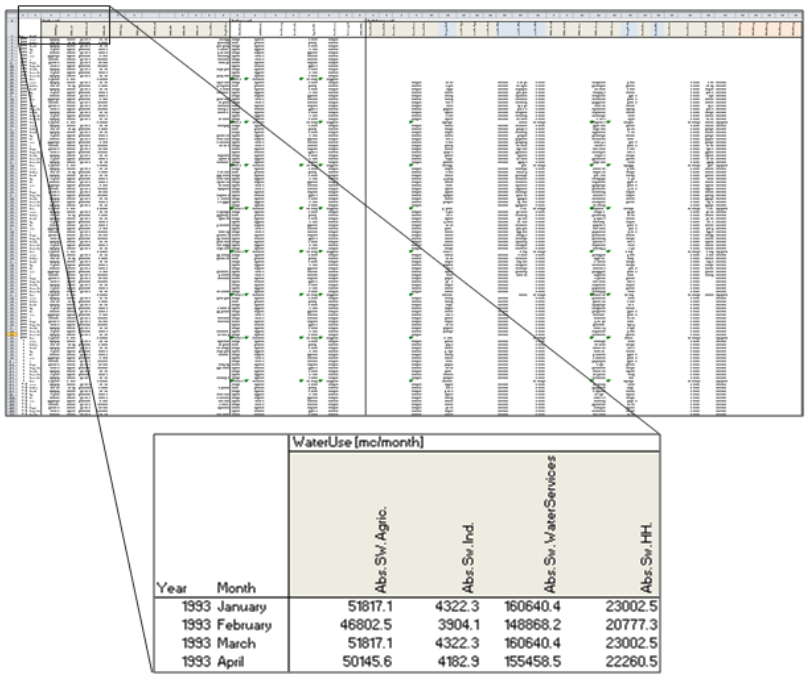
Pisa	EA.131.Surface water						
Asset accounts (Table VI.1) [m3]	EA.1311 Artificial reservoir	EA.1312 Lakes	EA.1313 Rivers	EA.131 SurfaceWater	EA.132 Groundwater	EA.133 Soil water	Total
1. Opening stocks	-	-	-	-	250,082,454,227.9	-	250,082,454,227.9
Increases in stocks			104,264,761.6	752,961.3	5,341,199.9	7,773,003.0	118,131,925.7
2. Returns				752,961.3	245,892.4		998,853.6
3. Precipitation						7,773,003.0	7,773,003.0
4. Inflows			104,264,761.6	-	5,095,307.5		109,360,069.1
4.a From upstream territories			104,264,761.6		1,069,416.7		105,334,178.2
4.b From other resources in the territory					4,025,890.8		4,025,890.8
Decreases in stocks		-	154,975,728.0	-	1,454,674.3	4,792,381.2	161,222,783.5
5. Abstraction					1,454,674.3		1,454,674.3
6.Evaporation/actual evapotranspiration						766,490.4	766,490.4
7. Outflows			154,975,728.0		-	4,025,890.8	159,001,618.8
7.a To dowsntream territories							-
7.b To the sea			154,975,728.0				154,975,728.0
7.c To other resources in the territory						4,025,890.8	4,025,890.8
8. Other changes in volume							119,634.6
9. Closing stocks		-			250,086,340,753.5		249,996,392,146.9
10.Balance	-	-	- 50,710,966.4	752,961.3	3,886,525.6	2,980,621.8	- 86,062,080.9

In December 2011, groundwater abstractions (1.45 Hm^3) represented for Pisa the 100% of the total water abstracted from inland water resources (see **Table 9**). The groundwater opening stocks reached an amount of 250.07 Mm^3. The groundwater balance was positive meaning that, for this month, closing stocks overcame opening stocks and the surplus was 3.88 Hm^3. Returns to groundwater from the economy (0.24 Hm^3), upstream territories (1.07 Hm^3), and soil percolation (4.025 Hm^3) represented the 4.6%, 20%, and 75.4%, respectively.

4 SEEA-Water computing tool

One of the objectives of the PAWA project is to compile monthly WA from 1993 to 2013 for the three pilot territories, namely Chiana, Bisenzio and Pisa. For the aims of the project, WA tables considered are "Water Use and Supply" and "Water Assets". Hence, there are two SEEA-Water tables to compile for each pilot territory and for each month during the selected 20-year time period, making up a total of 480 tables. To process these tables, a Visual Basic Application (VBA) called "*Arno Water Accounts*", has been created. This tool was described into details in **D3.1 1st Draft water flow diagrams and associated SEEA-Water tables**.

The VBA tool selects the right values from the corresponding database and fills in the selected table at sub-basin and monthly scale. One database is defined for each pilot territory (**Figure 9**). These databases are stored in MS-Excel worksheets called Chiana, Bisenzio and Pisa, respectively. First, the application recognizes which database has to be considered. Then, it searches the year and month, later that it transfers the information stored into the corresponding table.



		WaterUse [mc/month]			
Year	Month	Abs.SW.Agric.	Abs.Sw.Ind.	Abs.Sw.WaterServices	Abs.Sw.HH.
1993	January	51817.1	4322.3	160640.4	23002.5
1993	February	46802.5	3904.1	148868.2	20777.3
1993	March	51817.1	4322.3	160640.4	23002.5
1993	April	50145.6	4182.9	155458.5	22260.5

Figure 9 – Database for the Arno Water Accounts.

A new tool version, called "*PAWA Scenarios Tool V.1*", has been developed to generate different PAWA tables under possible scenarios. Scenarios are dynamic datasets based on climate change data series coexisting with the water saving measures impacts (less water abstractions volumes, increasing water demand due to population increase, etc.) – see **D4.1 Water efficient targets for future revisions Arno RBMP** for more details. This new version allows computing the same WA tables from the new Graphical User Interface (GUI; see **Figure 10**).

The benefit of this tool is that by clicking on the button "Get started Scenarios" from the "Start" Worksheet, the GUI pops up and guides the user on how to compile the tables which is achieved fairly quick and automatically. Moreover, the application can save the new generated database

of the respective scenarios created, indicators calculated and visualised as graphs (e.g. WEI+). Saving the outputs of the created scenarios allows an easier comparison of unmet demand and WEI+ resulting from the different simulations. Hence, it is possible to foresee the best scenario.

Figure 10 – Access to the new Graphical User Interface.

Then, the same functionalities are available as in the previous version by using only the right side of the interface called "Water Accounts Table without measures" (see **Figure 11**). Users only need to select the name of the sub-basin, the climate change scenario (the item with the name of the sub-basin is without scenario), the name of the SEEA-Water table ("PSUAT" or "Asset"), the year, and the month under investigation. The application also gives the option to compute the table on a yearly basis. In this case the user should select "Total" instead of selecting, for instance, "January".

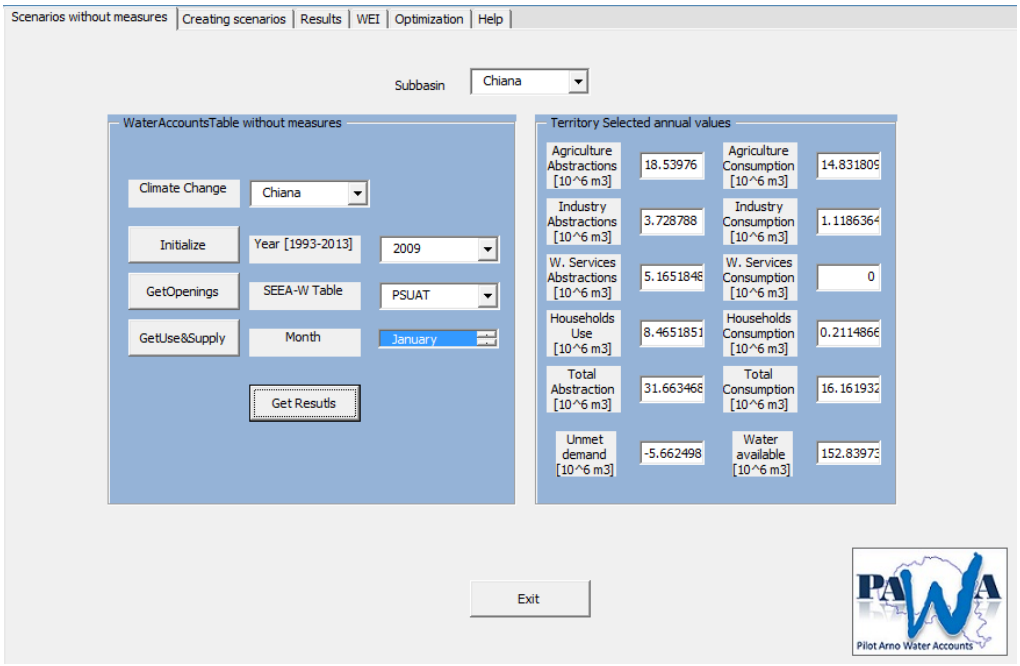


Figure 11 – Computing WA without scenario.