Integrating ecosystem service concept into spatial planning - for sustainable land-use in grasslands and beyond

16-18 May 2018, Sigulda, Latvia

LIFE SAM4CP

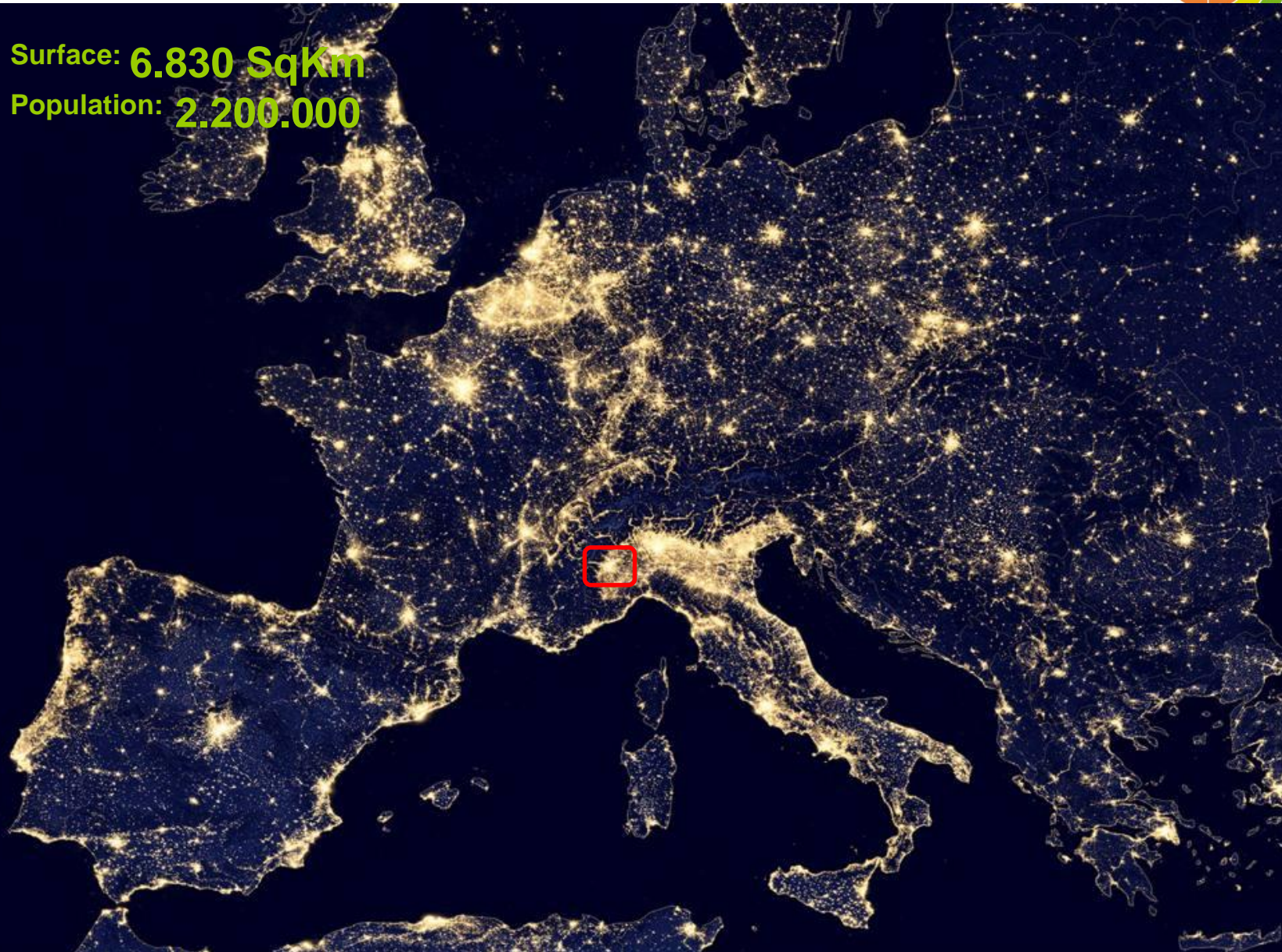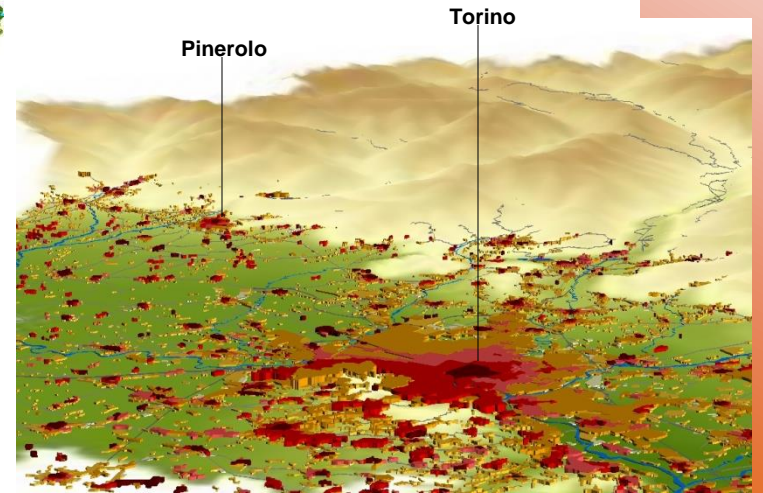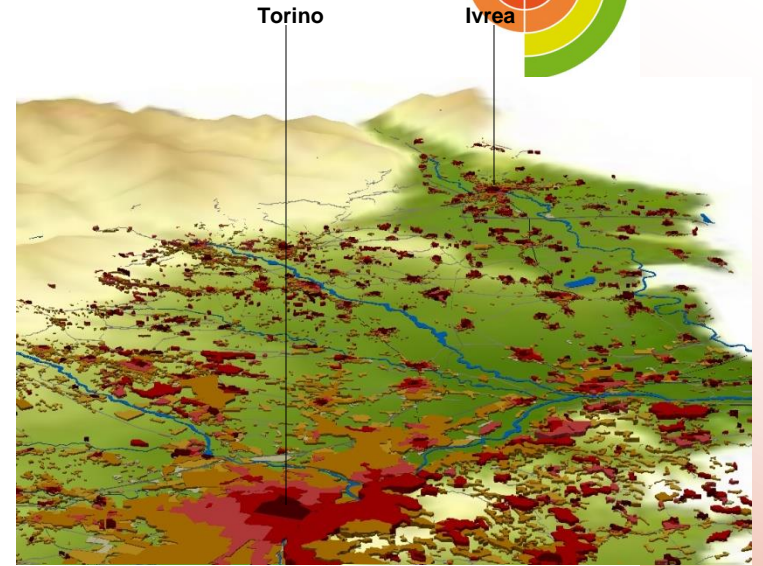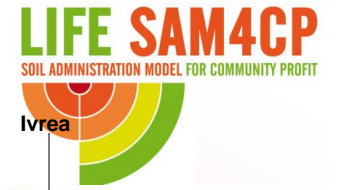# *Tools to support local planning*

Simonetta Alberico, Andrea Ballocca

Surface: **6.830 SqKm**
Population: **2.200.000**

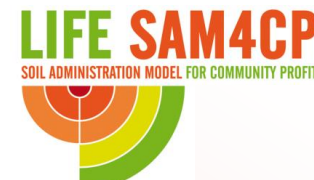**2000**
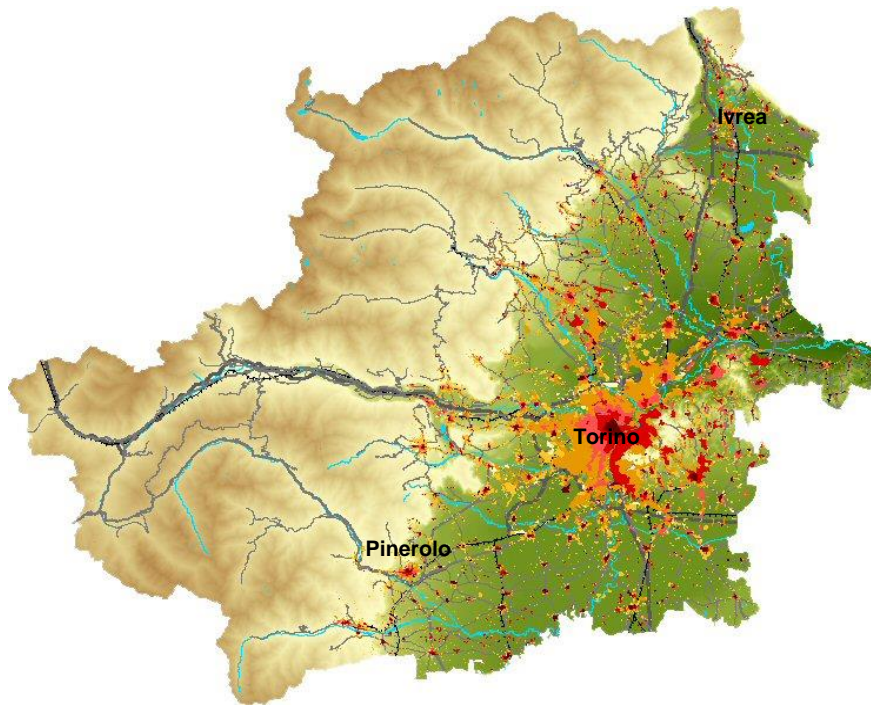
Land use trend between 1990-2016

Legend:
- Consumo suolo [RP-CMTO]
- Trend popolazione [ISTAT]
- Trend famiglie [ISTAT]
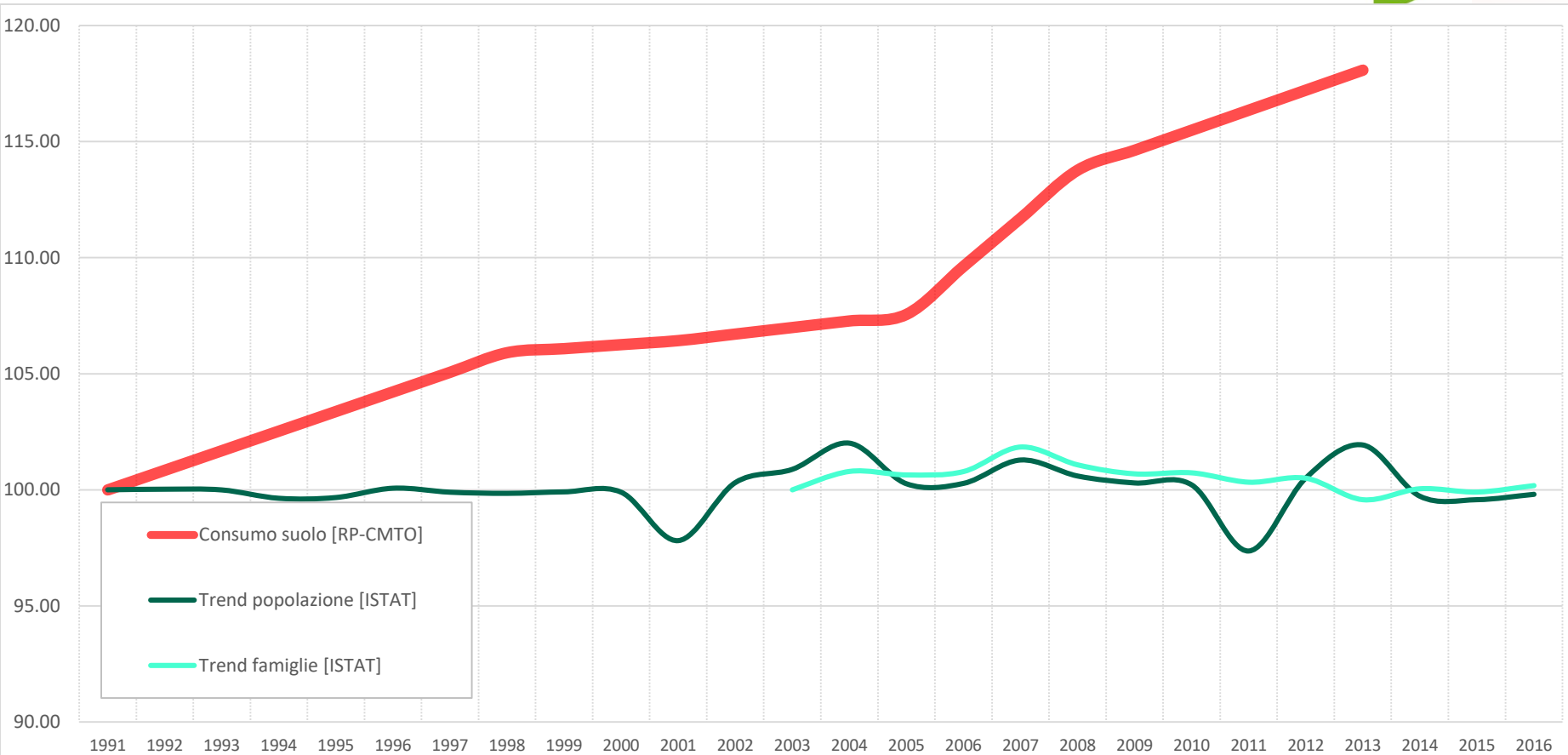
annual growth rate [1,01%]

hypothetical increase at 2050 = +20.171 ha [+37%]
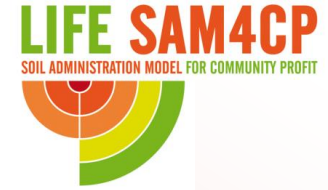
Actual land use data

	ha	%
Surface MCT [ha] 682.699		
	ha	%
Soil consumption	**62.242**	**9,12**
Infrastructure	*7.900*	*1,16*
Urban use	*53.421*	*7,82*
Reversible use	*921*	*0,14*
Agricoltural use	46.905	6,87
Effect size of Urban sprawl	29.261	4,7

Actual land use data

Soil consumption (2015) 62.242ha [9,12%]

Sheds and manifactury plant:

for sale: 828

for rent: 712

Unoccupied flats: 186.964 [15,78%]

Unused real estate stock: 4,2%

Ecosystem services: what nature provide us for free

The **Millennium Ecosystem Assessment** (2000) grouped E.S. into four broad categories:
provisioning, such as the production of food and water;
regulating, such as the control of climate and disease;
supporting, such as nutrient cycles and crop pollination;
cultural, such as spiritual and recreational benefits.

Ecosystem services diagram, source: metrovancouver.org
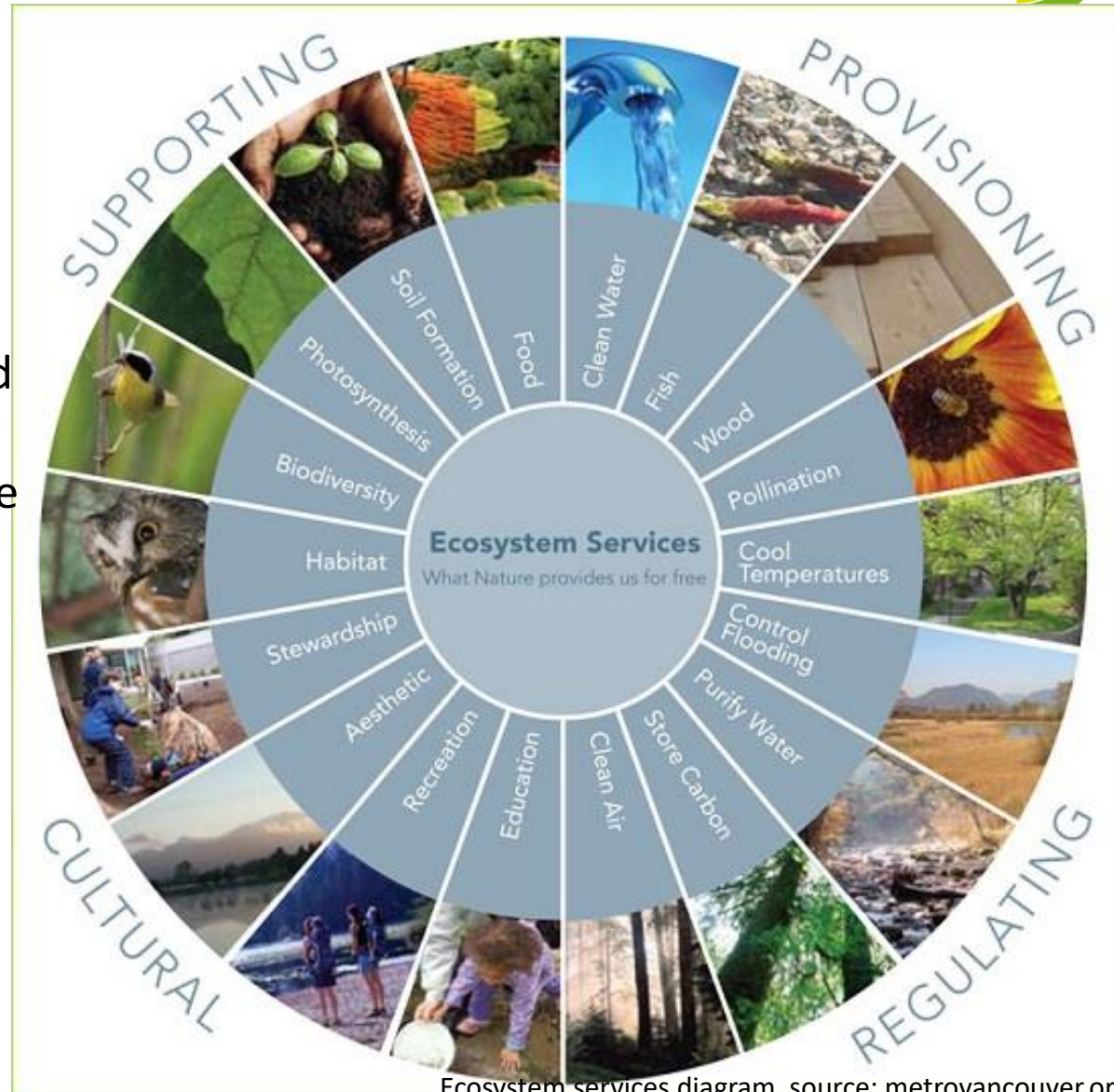
LIFE SAM4CP –
Soil administration Models 4 Community Profit
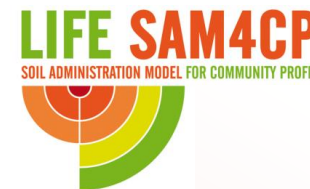
SAM4CP project aims at contributing to the Specific objective "SOIL" of LIFE+ 2013 Program, Axe 2 "Policy and Environmental Governance"

- **Budget:** 1.425.350 (700.474 EU contribution)

- **Period**: June 2014 – June 2018

- **Partnership:**
  - **Città Metropolitana di Torino** – Department of land use and spatial planning – Leadpartner
  - **ISPRA** – National Institute of eEnvironmental Research
  - **POLITECNICO DI TORINO** – DIST – Department of Science, Projects and Policies on land planning
  - **CREA** – National Institute of Agricoltural Research
  - **CSI Piemonte**: Information System Consortium of Piedmont

1° step: evaluation and quantification of ecosystem services provided by soil.
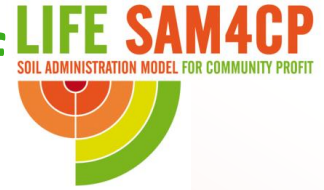
- This first step was **to quantify**, using the software InVEST, produced by the Stanford University inside the *Natural Capital Project,* **biophysical benefits** produced by a range of seven primary ecosystem services provided by soil:

1. Habitat quality
2. Carbon storage and sequestration
3. Nutrient retention
4. Sediment retention
5. Pollinator abundance
6. Managed timber production
7. Crop production

1. Characterization, biophysic quantification and mapping at national level of the seven E. S.
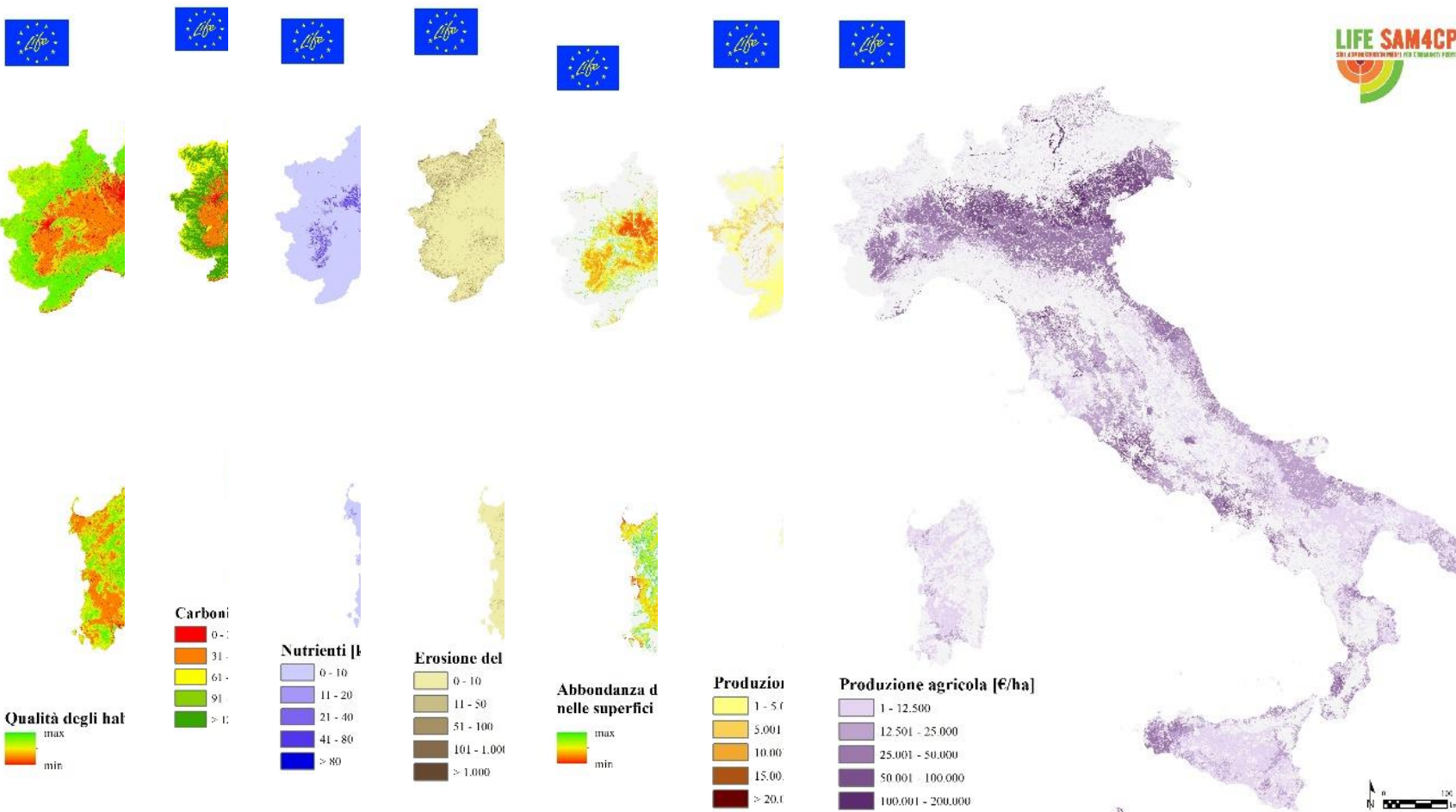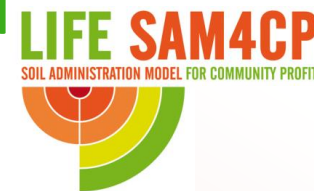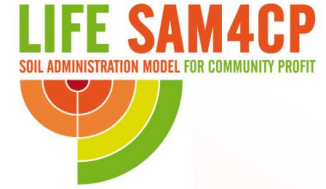
LIFE SAM4CP
SOIL ADMINISTRATION MODEL FOR COMMUNITY PROFIT

Fig. 1:   Fig. 2:   Fig. 3:   Fig. 4:   Fig. 5:   Fig. 6:   Fig. 7: Crop production

2° Step: Biophysical and economic evaluation of ecosystem services given by soil at the local scale

We improved the analysis deepening it at local scale:

- To achieve the necessary precision required we adopted the mapping chart Land Cover Piedmont (scale 1:10.000) merged with other local land use maps (scale 1:2.000, 98 types of land use)
- The output grid is a geotiff (pixel 5x5 meters)

To have the economic estimation of ecosystem functions InVest was integrated with the economic value of the E.S. in an exchange system offer/demand and with other prices and costs indicators of natural services

Biophysical and economic evaluation of ecosystem services at the local scale

| Ecosystem Services	Output	Distribution	Indicator	Biophysic Value	Economic Value
Habitat Quality	Raster file with biophysic values distributed to the context of study. LULC map with precision of 1:2.000 scale and thematic accuracy at 4 level CLC has been use for input distribution in the municipalities of Bruino, Settimo Torinese, Chieri, None. Output is of 5 per 5 pixel meters cell	Entire territory	index 0 to 1	Weighted average of values for each LULC class Formula: ∑ val bio * mq / mq tot (LULC class)	Stated preferences contingent value using questionnaires to evaluate the willingness to pay for conserve/improve natural areas in the context of study. [20€/px]
Carbon Sequestration		Entire territory	stocked ton per pixel	Sum of values for each LULC class Formula: ∑ val bio * mq (LULC class) / 25 (mq pixel)	Market value for each tons of carbon sequestered it is associated the value of fiscal fees to compensate for CO_2 emissions (LIFE VIMINE - LIFE12 NAT/IT/001122). [100 €/t]
Water Yield		Entire territory	evapotrenspired mm per pixel	Sum of values for each LULC class Formula: ∑ val bio * mq (LULC class) / 25 (mq pixel)	Sostitution cost artificial water control system of floodings (Piedmont price list) [12,6 €/mc]
Water Purification		Entire territory	Kg of Nitrogen per pixel	Sum of values for each LULC class Formula: ∑ val bio * mq (LULC class) / 25 (mq pixel)	Sostitution cost system of natural purification (LIFE VIMINE - LIFE12 NAT/IT/001122) [64 €/kg]
Sediment Retention		Entire territory	ton of erosion per pixel	Sum of values for each LULC class Formula: ∑ val biofisico * mq (classe d'uso) / 25 (mq pixel)	Avoided cost Soil fertility restoration costs (MGN – Making Good Natura) [150€/t]
Crop Pollination		Only agricultural areas	n. of pollinator species per pixel	Sum of values for each LULC class Formula: ∑ val biofisico * mq (classe d'uso) / 25 (mq pixel)	Market price: application of vulnerability index for agricultural productions (Gallai, Salles J.M., Settele J., Vaissière B.E., 2009) and estimation of economic value of pollinator dependent prod. [226€/ha]
Crop Production		Only agricultural areas	€	Weighted average of values for each LULC class Formula: ∑ val bio * mq / mq tot (LULC class)	Market price: standard production of each agricultural land use. [€]

3° Step: the simulator
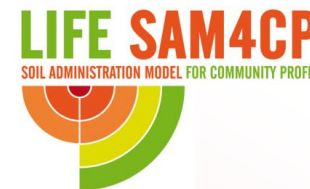
The SAM4CP project developed an open source software - a "*simulator*" – that allows the assessment of lost or gain of ES related to different territorial transformation scenarios in order to support the decision-making process.

We developed 2 kind of tool:

- PlaySoil, an educational simplified tool available on the project web-site

- SimulSoil, a tool (provided by QGIS plugin) for professional use [local administrators, technicians, etc]

4° Step: quantification of the environmental and economic effects of the soil exploitation within MCT
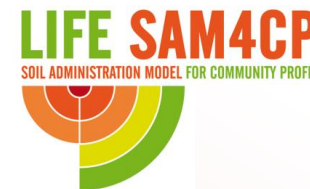
By overlapping forecasted urban changes we made a direct comparison between the value of existing ES and the forecasted future scenarios within all metropolitan city of Turin urban plans.

Over 1.780 hectares of «**booked**» land use

CS_€	TP_€	CPR_€	HQ_€	CPO_€	WY_€	SDR_€	NR_€
12.042.240	3.752	16.746	9.467.332	3.433.562	924	4.606.432	697.446

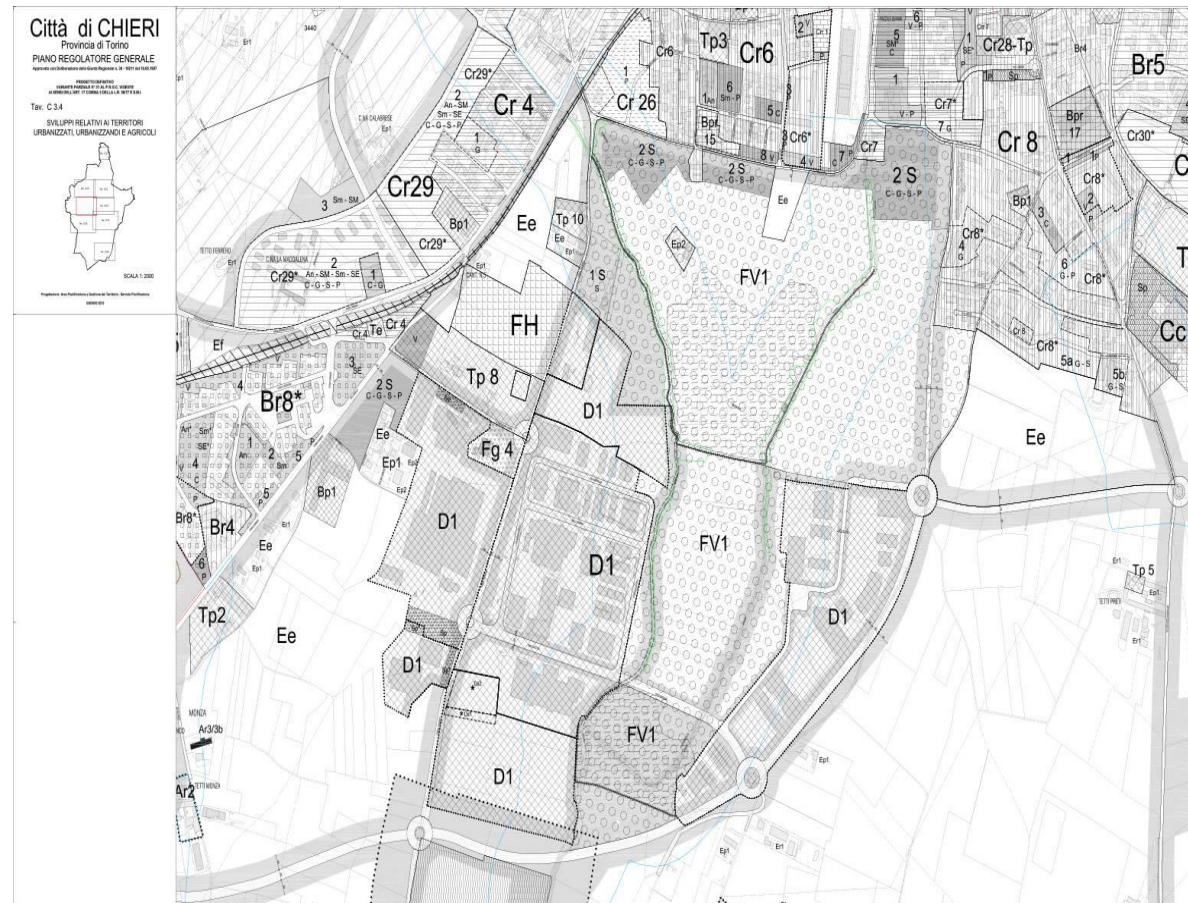## Corresponding to an economic value of € 30.268.433

17.000€/ha

We tested the tool during the decisional process of four new urban plans.

The example of the Chieri Municipality urban plan…

Trend of ES value at:
- **present situation [T0]**
- **previous urban plan prevision [T1]**
- **new urban plan [T2]**

	bio			eco		
	T0	T1	T2	T0	T1	T2
CS [t]	8.320	10.703	7.578	906.917	1.166.645	826.052
CPO	0,224	0,248	0,230	10.767	12.567	11.459
HQ	1,321	0,542	1,237	977.533	634.521	873.299
NR [kg]	331,2	44,5	184,7	2.583	347	1.441
SDR [t]	210,0	203,6	225,0	31.506	30.544	33.757
WY [l]	15.134	15.646	17.465	190.688	197.138	220.059
CPR [€]	3.147.591	506.216	2.614.035	3.147.591	506.216	2.614.035
TP [€]	x	x	x	x	x	x
				5.267.586	**2.547.978**	**4.580.102**
superficie [ha]	131,95					
n. pixel	52.779					
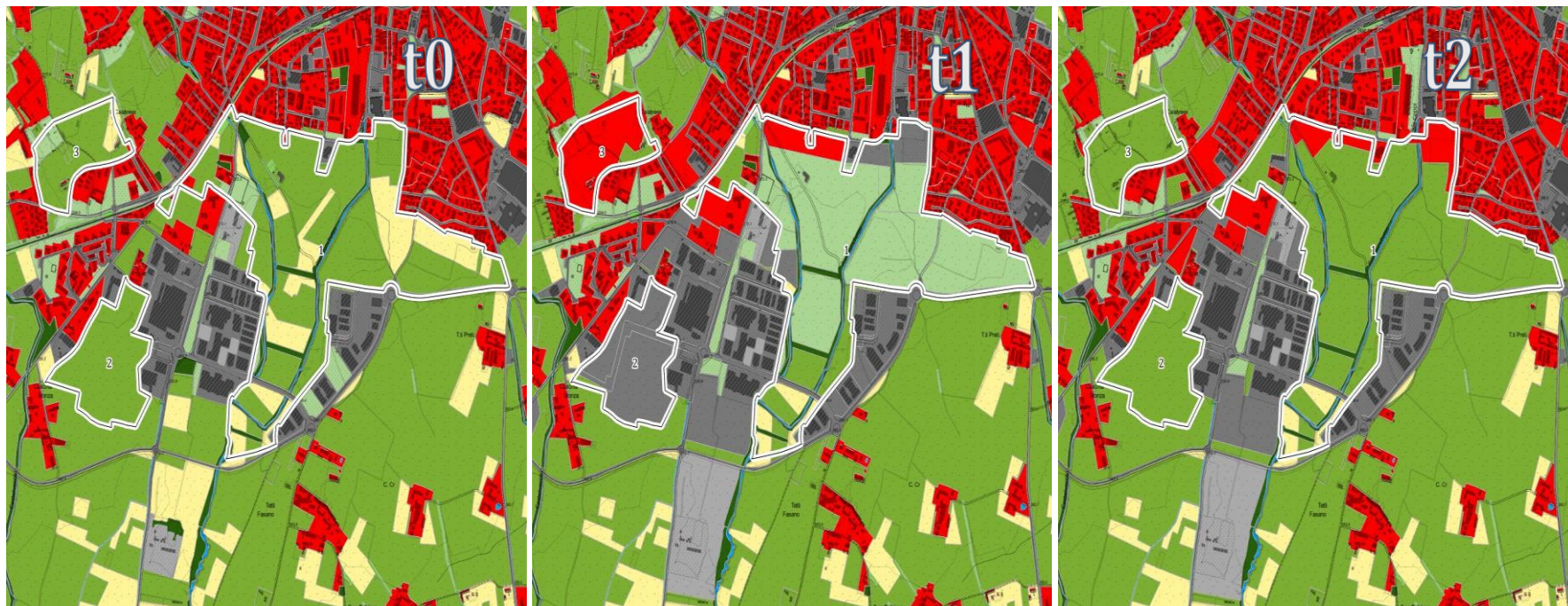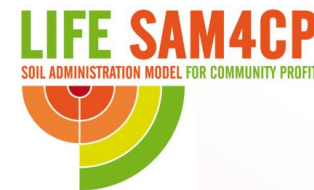
The new urban plan saves ES for over 2 millions€
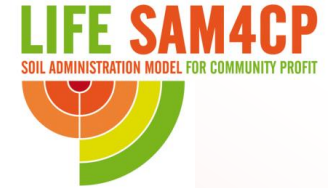
Operational tools [informative and professional version]

- Support Local Administrations in planning and implementation of territorial policies

- Evaluate the biophysical effects on ecosystem services and the social (non-commercial!) cost induced by the soil transformations
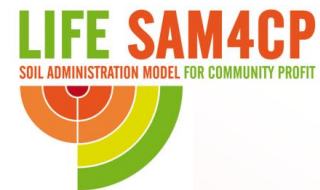
PlaySoil

Thank you