

# SOIL ORGANIC CARBON BALANCE AND CO<sub>2</sub> EMISSION FROM AGRICULTURAL ITALIAN LAND MODELLING WITH CENTURY



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## Introduction

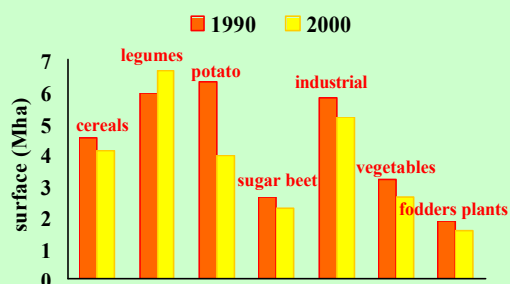
Italian emission of greenhouse gas (GHG) originate from agricultural practices is 46-49%, 17% of this emission come from soil organic matter degradation. Agricultural practices also affects soil organic carbon (SOC) stock and consequently soil CO<sub>2</sub> emission, but presently in Italy official assessment are not available (Benedetti et al., 2001). Italy, ratifying Kyoto protocol, agreed to reduce 6.5% of GHG (N<sub>2</sub>O, CH<sub>4</sub>) emission at 2012 compared with 1990 emission values (deliberation CIPE 137/98). Official statistic showed an increase of CO<sub>2</sub> emission from 1990 to 2000 (from 416 to 447 Mtons). Italian agricultural landscape decreased from 15 million of ha (1990) to 13.2 million of ha (2000) (ISTAT, 2000) (fig.1a); 2 million of hectare were transformed from conventional to organic management and the remainder was intensified (fig.1b). In this study the SOC balance and CO<sub>2</sub> emission from agricultural Italian lands in the years 1990 and 2000 were investigated using CENTURY ecosystem model v.5. The objective of this work were to assess agricultural Italian soils contribution to atmospheric CO<sub>2</sub> enrichment, to determine soil organic carbon balance and to estimate if the agricultural system can utilized to acquire carbon "credits", according to Kyoto provisions.

## Material and methods

This study consist of two phases: 1) data base creation containing climatic data, management and agricultural soils characteristics located in North, Center and South Italy. Those informations are main parameters witch affect SOC; 2) data base use as input data to run CENTURY model version 5. CENTURY model (Parton et al, 1987) describe soil nutrients trend (C, N, S, e P) for different soil-plant system (Pennock, 2001) developed to analyse agricultural, grassland, forest and savannah ecosystems. SOC annual balance and CO<sub>2</sub> emission (for province in tons/ha), obtained from CENTURY, were compared with a CO<sub>2</sub> emission inventory from IPCC (Intergovernmental Panel of Climate Change) published in 2004 by APAT (Environment and Territory Protection Agency).

## Results and discussion

The results, obtained by 40 CENTURY simulations, showed significant higher values of CO<sub>2</sub> emission in South in comparison to Center and North Italy in 2000 (respectively 1.87, 0.66 and 1.26 tons/ha/year on average, tab.1); organic management had emission values not significantly different in comparison to conventional management for 2000, while the comparison is not possible for 1990, as organic agriculture in Italy was still at the start. SOC annual balance decreased with significant differences for three geographic areas (-10.5% South, -1.3% Center, and -2.7% North Italy on average, tab.1) and for management (- 4.9% conventional and -0.6% organic). A comparison of three provinces of Center and South Italy simulation results with CO<sub>2</sub> emission values from IPCC showed a overestimate of CENTURY (+ 20% on average, tab.2).



Italian geographic areas	TOC annual decrease (%) simulated	CO <sub>2</sub> emission annual increase (%) simulated
North	2,70 (± 0,38)	1,26 (± 0,08)
Center	1,32 (± 0,48)	0,65 (± 0,03)
South	10,51 (± 2,94)	1,87 (± 0,04)

Tab. 1 Average of Total Organic Carbon (TOC) decrease and CO<sub>2</sub> emission from agricultural Italian lands simulated with CENTURY model, year 2000.

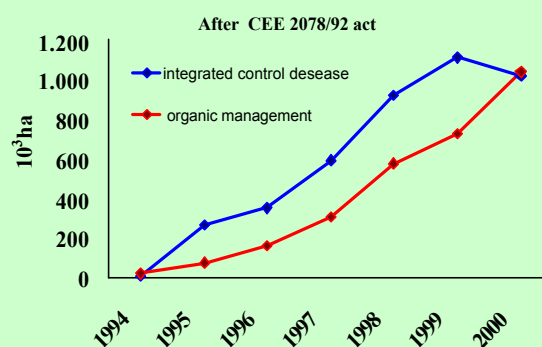


Fig. 1 a) Land use change from 1990 to 2000 (ISTAT, 2000); b) change from conventional to organic farming after CEE 20/78 act.

	Frosinone		Latina		Cattara	
	IPCC	CENTURY	IPCC	CENTURY	IPCC	CENTURY
Original content of TOC (tha year)(a)	21,4	21,4	22,4	22,4	11,8	11,8
Final content of TOC (tha years)(b)	20,7	20,5	21,7	21,9	11,4	11,3
TOC balance (ab)	0,7	0,9	0,7	0,5	0,4	0,5
TOC decrease (%)	3,3	4,2	3,1	2,2	3,4	4,2
CO <sub>2</sub> emission increase (%)	0,44	0,68	0,47	0,59	0,51	0,47

Tab.2 Comparison of three provinces of Center and South Italy simulation results with TOC annual change and CO<sub>2</sub> annual emission values from IPCC, year 2000.

## References

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## Conclusions

The first results related a general trend of SOC decrease and CO<sub>2</sub> emission increase; organic management seem to be a conservative agricultural system. The future development of large scale studies about SOC trend and CO<sub>2</sub> emission requires a field study and a model application. CENTURY is an excellent model to simulate soil organic carbon trend, while for CO<sub>2</sub> emission the model tend to overestimate values in comparison to IPCC results. For the future of this research we will need a comparison between the field studies and CENTURY simulations to validate the model for the Italian agroecosystem.