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THE IMPORTANCE OF CONSERVATION TILLAGE WITH REGARD TO THE KYOTO PROTOCOL

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BACKGROUND

Although still a controversial issue, the main contributors to the global climate change both in terms of substances (greenhouse gases - GHG's) and emitters have been clearly identified. Agriculture is accused to contribute with up to 20% to the total emission of GHG's with methane playing the major role amongst them (Cole, 1996). Fuel burning through agricultural machinery is often regarded as the main source of CO_2 emission of the primary sector, neglecting the CO_2 fluxes deriving from agricultural land caused by the "burning" of organic litter left after harvest and soil organic carbon (SOC) through the more or less intensive soil tillage, which is still considered the normal and "good agricultural practice".
According estimations and measurements over decades soil organic matter (SOM) decreased considerably due to agricultural land use (Reicosky, 2001). Regarding a 1% reduction of SOC in the 30 cm topsoil layer an amount of around 45 tons of carbon or 166 tons of CO_2 per one hectare of land is lost to the atmosphere. This calculation clearly illustrates the impact that agriculture had and may have on the release of CO_2 to the atmosphere, where land use led and leads to a depletion of SOC.
On the other hand, it also reveals the potential of CO_2 sequestration, which a change of the agricultural practice could have, if it succeeded in restoring at least some of the SOC lost over decades of traditional land use, thus increasing not only the levels of SOM but also soil fertility and long-term sustainability of agriculture and food production.

Potential of Conservation Tillage to reduce CO_2 emissions and increase CO_2 sequestration

In this context, conservation tillage, defined, in general terms, as the reduction of soil tillage intensity, in combination with the maintenance of the crop residues on the soil surface, could play a decisive role, once this practice reduces biological oxidation and thus the mineralisation rate of organic matter and soil carbon. A great number of studies shows that conservation tillage, and especially no-tillage, are able to increase the levels of SOC, turning the soil into a sink for atmospheric carbon and a pool for the storage of tremendous amounts of carbon.
Estimates based on the assumptions that 30% and 40% of the arable land in Europe (EU-15) could be cultivated using no-tillage (NT) and reduced tillage (RT), respectively, and NT would increase SOC in 0.77 t ha^{-1} a^{-1} and RT in 0.5 t ha^{-1} a^{-1}, a total yearly CO_2 sequestration of 130 Mt could be achieved. Compared to this amount, the saving of around 5.3 Mt CO_2 a^{-1} through less fuel consumption due to the

reduction of tillage operations is rather small. Together, this emission reduction would account for almost 40% of the 346 Mt CO_2 a^{-1}, which the EU-15 member states agreed to reduce until 2012 (Tebrügge, 2001). Similar figures are provided for the USA, reporting a potential carbon sequestration of 0.45 to 1.0 t ha^{-1} a^{-1} summing up to an average annual agricultural soil sink of 180 Mt C a^{-1}. Thus, soils sinks could offset about 30% of the CO_2 emission reduction target of the USA (Lal et al., 1988).

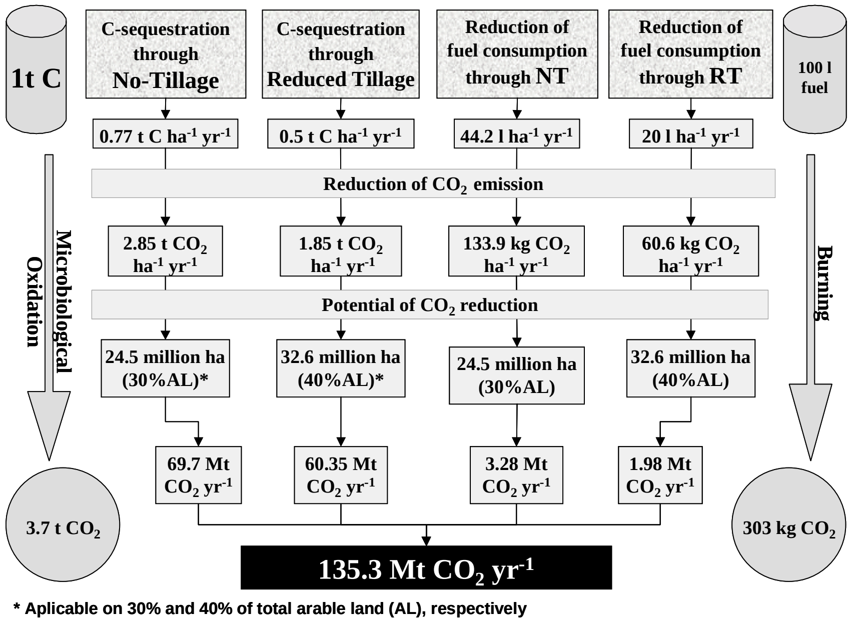

Figure 1. Estimation of the potential reduction CO_2 emissions through the application of reduced and no- tillage in Europe (EU-15)

CONCLUSIONS

The agronomical, environmental and economic feasibility of conservation tillage systems has been proven under many soil and climatic conditions. Its possible adoption on a substantial part of the arable land could invert the continuous decline of soil organic matter and soil fertility and contribute decisively to the necessary decrease of CO_2 emissions and CO_2 levels in the atmosphere as agreed in the Kyoto Protocol.

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