

Conservation tillage- Protection of soil, water and climate and influence on management and farm income

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Abstract

With the background of political concerns, land utilisation is confronted with the serious need for the protection of soil, fauna, landscape, climate and water quality more strongly now than ever before. Besides the visible signs of soil fertility loss, e.g. soil erosion by water and wind, soil sealing and crusting of the soil surface, there are other problems, including deep soil compaction, less trafficability, reduced water infiltration and deep root penetration, reduced organic matter content of the soil, high emission rates of CO₂ through fast biological oxidation of organic matter and through high fuel consumption as well as water pollution by leaching and run-off of nitrate, water soluble phosphate and other xenobiotica that contribute to overall environmental quality. It can be recognised that the high intensity of soil tillage in Europe (mouldboard ploughing and pto. driven rotary for seedbed preparation) has been accompanied by damaging effects to soil structure, to soil quality, to soil fauna and at least to the environment. The question about the necessity of intensive soil tillage, relates to both ecological and environmental concerns of the general public and economic interests of the farmers.

This paper reviews the interdisciplinary research performed since 1979 at the Justus-Liebig-University of Giessen, Germany with emphasis on the interactions of different soil tillage intensities on ecosystem soil properties that have demonstrated ecological, economic and environmental benefits of less tillage. On the basis of 21 years of research on 5 on-farm trials with 5 different soils (e.g. Eutric Cambisol, Eutric Fluvisol) and with different crop rotations in this study, and extending the results to an international level, it can be concluded that non-inversion no-tillage systems improve and maintain numerous soil functions and cross-linkages in the ecosystem. If crop rotation, machinery, especially seed placement, and plant protection are well adapted for introduction of conservation tillage and particularly of no-tillage, these systems can replace inversion tillage in many cases and can have a positive effect on the farm income. The no-tillage system, therefore, offers the possibility of soil ecosystem, water and climate protection, and takes into account the economic interests of the farmer. These interrelations are more valid as the selling prices tend in the direction of the world market prices and as agricultural land becomes more highly valued for sustainable production and future environmental quality. Soil tillage systems have a direct and indirect influence on soil structure and soil quality and are very closely linked to environmental quality.